US Army Corps of Engineers
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study
FINAL Limited Reevaluation Report

Appendix C: FINAL Supplemental Environmental Impact Statement

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Acronyms and Abbreviations

µPa	micro-Pascal
APE	Area of Potential Effects
BE	Biological Evaluation
BNSF	Burlington Northern & Santa Fe
CAA	Clean Air Act
CEQ	Council for Environmental Quality
CFR	Code of Federal Regulations
CH4	methane
CO2	carbon dioxide
CO2e	carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dBRMS	root mean square decibels
DIM	Dredge Impact Model
DMMP	Dredged Material Management Program
DMMU	dredged material management unit
DNR	Washington State Department of Natural Resources
DO	dissolved oxygen
DPS	distinct population segment
EAs	environmental assessments
Ecology	Washington State Department of Ecology
EFH	Essential Fish Habitat
EISS	Environmental Impact Statement Supplement
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionary significant unit
FR	Federal Register
FTE	full-time equivalent employee
FWCA	Fish and Wildlife Coordination Act

GHG	greenhouse gases
GHNIP	Grays Harbor Navigation Improvement Project
GIS	geographic information system
HBC	Hudson's Bay Company
HFC	Hydrofluorocarbon
I	Interstate
ILWU	International Longshoremen's Union provides
Imperium	Imperium Renewables
Ldn	decibels day-night average sound level
LiIDAR	Light Detection and Ranging
LTMS	Long Term Management Strategy
MBTA	Migratory Bird Treaty Act
MDNS	Mitigated Determination of Non-Significance
MHHW	mean higher high water
MLLW	mean lower low water
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSA	Magnuson-Stevens Act
N2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
ODFW	Oregon Department of Fish and Wildlife
PBE	programmatic biological evaluation
PFC	Perfluorocarbon
PM10	particulate matter less than 10 micrometers in size
PM2.5	particulate matter less than 2.5 micrometers in size
Port	Port of Grays Harbor
PSAP	Puget Sound and Pacific
RCMSA	Revised Crab Mitigation Strategy Agreement
RCW	Revised Code of Washington
ROD	Record of Decision
RORO	Roll-on/Roll-off

RTIA	Rail Transportation Impact Analysis
SEIS	supplemental environmental impact statement
SF6	sulfur hexafluoride
SHPO	Washington State Historic Preservation Officer
SMP	Shoreline Master Program
SMS	Sediment Management Standards
TCDD	2,3,7,8- Tetrachlorodibenzo-p-dioxin
TEQ	toxin equivalents
TSS	total suspended solids
UP	Union Pacific
USC	United States Code
Users' Manual	The Dredged Material Evaluation and Disposal Procedures
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VTIA	Vessel Traffic Impact Analysis
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	water resource inventory area

Executive Summary

Introduction

This second supplemental environmental impact statement (SEIS) addresses design changes to the Grays Harbor and Chehalis River Navigation Project (proposed action) developed since the U.S. Army Corps of Engineers (Corps) promulgated a General Design Memorandum that articulated the present orientation and dimensions of the Federal navigation channel. This SEIS provides a second supplement to and incorporates by reference the *Grays Harbor, Chehalis and Hoquiam Rivers, Washington Channel Improvements for Navigation Interim Feasibility Report and Final Environmental Impact Statement* (U.S. Army Corps of Engineers 1982) and its first supplement (U.S. Army Corps of Engineers 1989a) by assessing the effects of executing those design changes, and it modifies and updates the description of effects that are expected to result from implementing maintenance of the channel, as modified through the changes in design. The *Fiscal Years 2012 through 2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Environmental Assessment* (U.S. Army Corps of Engineers 2011) is presently tiered off the 1982 EIS and 1989 SEIS, as well as a Supplemental Environmental Assessment (EA) promulgated in November, 2013 evaluating a change to dredging equipment in one of the channel reaches. Once promulgated, this second supplemental EIS would provide the updated basis from which that Fiscal Year 2012-18 maintenance dredging EA is tiered.

Proposed Action

The proposed action is located in Grays Harbor, approximately 50 miles west of the city of Olympia on the central coast of Washington State. The navigation channel traverses the harbor, providing shipping access between the Pacific Ocean and the lower reaches of the Chehalis River where the cities of Aberdeen, Hoquiam, and Cosmopolis are located.

The proposed action is to deepen the federal deep-draft navigation channel in Grays Harbor (navigation channel) from its currently maintained depth of −36 feet mean lower low water (MLLW) to its legislatively authorized depth of −38 feet MLLW, including placement of the dredged material at existing authorized dredged material placement sites (including upland placement for sediments not meeting open-water placement criteria). The proposed action also includes a one-time 1,000 foot north-northwestern shift in the Point Chehalis material placement site, and subsequent maintenance of the channel over the next 50 years.

The navigation channel is used by deep-draft ocean-going vessels to safely reach and leave the Port of Grays Harbor (Port). Currently, the inner harbor reaches of the navigation channel are limited by depth and are inadequate to accommodate large vessels with drafts exceeding −36 feet MLLW. To better accommodate the current vessel traffic and alleviate large-vessel restrictions imposed by insufficient channel depths, the Corps proposes to deepen approximately 14.5 miles of the 27.5-mile navigation channel. The specific planning objective of the evaluation for which this SEIS was prepared is to reduce navigation transportation costs, and improve efficiency and reliability of navigation to and from Grays Harbor over the 50-year period of analysis as feasible and economically justified.

Purpose and Need

The navigation channel is used by deep-draft ocean-going vessels to safely reach and leave the Port of Grays Harbor. Currently, the inner harbor reaches of the navigation channel are limited by depth and are inadequate to accommodate large vessels with drafts exceeding −36 feet MLLW at all stages of the tidal cycle. The need for improvement to navigation stems from the following problem: as a result of the current channel depth of -36 feet MLLW and the narrow tidal windows, deep draft vessels calling at Grays Harbor have to be partially loaded or experience tidal delays due to insufficient channel depth. The Port has requested deepening the channel up to the authorized depth to better accommodate current vessel traffic for existing port tenants and commodities.

The purpose of the proposed action to deepen the navigation channel is to reduce navigation transportation costs for the existing and projected future traffic of deep-draft vessels, and improve efficiency and reliability of navigation to and from Grays Harbor over the 50-year period of analysis as feasible and economically justified, within the parameters of the navigation channel as legislatively authorized.

Alternatives

This SEIS evaluates three proposed alternatives, including two action alternatives that would deepen and subsequently maintain over the next 50 years the existing Grays Harbor navigation channel at -37 feet MLLW (alternative 2) and at its legislatively authorized depth of −38 feet MLLW (Alternative3), and the No Action Alternative (Alternative 1) that would continue to dredge the navigation channel to its currently maintained depth of −36 feet MLLW (i.e., the continuation of existing activities). The alternatives are described briefly below and presented in detail in Chapter 2, *Alternatives*.

Alternative 1 (No Action): Continue Channel Maintenance of −36 Feet MLLW: The No Action Alternative provides the baseline conditions for comparing the potential effects of the two action alternatives. Under Alternative 1, the Corps would continue the current practice of maintenance dredging of the navigation channel to a depth of −36 feet MLLW within the South, Outer Cross-over, Inner Cross-over, North Channel, Hoquiam, and Cow Point Reaches and the Cow Point turning basin, and placement of the dredged materials at a variety of open-water placement, beneficial beach nourishment sites, and the Point Chehalis Revetment Extension mitigation site (when feasible). Although Alternative 1 does not meet the proposed action's purpose and need, it is carried forward in this analysis to provide a comparison for the evaluation of effects against the action alternatives.

Alternative 2: Deepen Channel to −37 Feet MLLW: Alternative 2 would implement the proposed action by deepening the navigation channel an additional one foot to a depth of -37 feet MLLW, and require the removal of an additional 1,031,000 cubic yards of sediment to construct. Annual maintenance dredging requirements would increase by an estimated 50,000 cubic yards. The methods for dredged material placement and placement sites would be modified to address placement of material determined unsuitable for open water placement and would shift the Point Chehalis placement site to better accommodate the volumes that would be placed for regular maintenance dredging and the deepening all occurring in the same year. Construction dredging of Alternative 2 would occur over a duration of approximately six months for the inner harbor reaches, approximately 1.5 months longer than typical maintenance dredging under Alternative 1, and would occur within the same seven month dredge window as under Alternative 1. The duration of dredging for the outer harbor reaches would be

approximately 1 month, the same as under Alternative 1. Annual maintenance dredging would be required to be performed in the same year as the deepening construction dredging. Annual maintenance dredging volumes in the deepening reaches, as evaluated in the 2011 EA, are estimated at 2,090,000 cubic yards based on a 10-year average of historic dredging volumes, plus one standard deviation. Thus, conducting both maintenance and deepening to -37 feet MLLW in the construction year would require dredging of a total estimated volume of 3,121,000 cubic yards (volume from Alternative 1 plus the additional incremental volume for Alternative 2). Impacts are addressed for the total volume dredged in the construction year and for the incremental depth of an additional one foot. However, analysis for this document is primarily focused on the deepening volumes and subsequent maintenance attributable to the one foot of deepening.

While the vast majority of the sediments from the inner harbor reaches (over 98%) are suitable for open-water placement, approximately 13,500 cubic yards of sediment that would be dredged during construction of Alternative 2 from the Cow Point 32a subunit are unsuitable for open-water disposal due to toxicity expressed in the sediment larval bioassay. This material would require appropriate upland disposal (slated for the former Hoquiam wastewater treatment lagoon). Prior to subsequent maintenance dredging cycles, the Corps would contact the DMMP agencies to determine whether additional sediment testing in Cow Point Reach subunit 32a is required. Further explanation of channel sediment suitability is provided in Sections 3.7 and 4.7, *Water Quality and Sediment Characterization*, as related to the affected environment and environmental consequences, respectively.

Alternative 3: Deepen Channel to –38 Feet MLLW: Alternative 3 would implement the proposed action by deepening the navigation channel two feet to a depth of -38 feet MLLW, and require the removal of an additional 1,972,000 cubic yards of sediment to construct. Annual maintenance dredging requirements would increase by an estimated 107,000 cubic yards. Construction dredging of Alternative 3 would occur over approximately six months for the inner harbor reaches (the same as Alternative 2), approximately 1.5 months longer than maintenance dredging under baseline conditions (Alternative 1), and would occur within the same seven-month dredge window as under Alternative 1. The duration of dredging for the outer harbor reaches would be approximately 1 month, the same as under Alternatives 1 and 2. Conducting both annual maintenance and deepening to -38 feet MLLW in the construction year would require dredging of a total estimated volume of 4,062,000 cubic yards (volume from Alternative 1, plus additional volume for Alternative 3). Impacts are addressed for the total dredged volume in the construction year and for the incremental depth of an additional two feet. However, the environmental impacts analysis for this document is primarily focused on the deepening volume (1,972,000 cubic yards) and subsequent maintenance attributable to the two feet of deepening over the next 50 years.

Approximately 22,400 cubic yards of sediment that would be dredged during construction of Alternative 3 from the Cow Point 32a subunit are unsuitable for open-water disposal due to toxicity expressed in the sediment larval bioassay. This material would require appropriate upland disposal (slated for the former Hoquiam waste water treatment lagoon). Prior to subsequent maintenance dredging cycles, the Corps would contact the DMMP agencies to determine whether additional sediment testing in Cow Point Reach subunit 32a is required. Further explanation of channel sediment suitability is provided in Sections 3.7 and 4.7, *Water Quality and Sediment Characterization*, as related to the affected environment and environmental consequences, respectively.

Under both Alternatives 2 and 3, project construction (i.e., the dredging process), including scheduled work periods, types of equipment, and methods for dredged material placement, would be implemented similar to maintenance dredging under Alternative 1. Equipment would be the same except that a long reach excavator may be used in hardpack to break up material for removal by a clamshell dredge in areas of Cow Point and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible) for both Alternatives 2 and 3. Dredged materials would be deposited at the existing Half Moon Bay, South Jetty, South Beach, and upland at Point Chehalis Revetment Extension mitigation placement sites used during maintenance dredging. The Point Chehalis aquatic placement site would be shifted approximately 1,000 feet to the north north-west to take advantage of deeper water and more favorable hydrodynamics, and material unsuitable for open water disposal would be placed at an appropriate upland site under both Alternatives 2 and 3. The estimated volume of material dredged from the inner and outer harbor reaches of the navigation channel associated with each alternative are provided below in Table ES-1. The volumes listed include 2 feet of advance maintenance and 2 feet of allowable overdepth in each alternative.

Table ES-1. Estimated Dredged Material Volumes (cubic yards) for the affected Reaches (South, Outer Crossover, Inner Crossover, North Channel, Hoquiam, Cow Point Reach and turning basin) by Alternative

		Alternative 2		Alternative 3	
	Alternative 1)	Construction	Operation	Construction	Operation
Navigation Channel Reach	*Annual average dredging to maintain channel at -36 feet MLLW*	*Estimated additional volumes attributable to Channel Deepening to -37 feet MLLW*	*Estimated Additional Annual Maintenance attributable to deepening to -37 feet MLLW*	*Estimated additional volumes attributable to Channel Deepening to -38 feet MLLW*	*Estimated Additional Annual Maintenance attributable to deepening to -38 feet MLLW*
Inner Harbor Reaches	1,665,000	954,000	37,000	1,601,000	76,000
Outer Harbor Reaches	425,000	77,000	13,000	371,000	31,000
Total	2,090,000	1,031,000	50,000	1,972,000	107,000

Affected Environment Summary

The Corps described the affected environment pertinent to each resource area to inform the consideration of environmental consequences and the potential impacts of the proposed action on these resources. Table ES-2 summarizes the affected environment for each resource area. Each resource area is described in detail in Chapter 3, *Affected Environment*, and impacts associated with each resource area are analyzed in Chapter 4, *Environmental Consequences*.

Table ES-2. Affected Environment for Resource Areas Included in the SEIS

Resource	Characteristics of the Affected Environment
Marine Transportation	A variety of commercial, recreational, and Tribal vessels use the navigation channel to transit through the area, including the use of four terminals at the Port of Grays Harbor adjacent to the Hoquiam and Cow Point reaches.
Geomorphology	The morphology of the harbor is determined by differences in the capacity of harbor inflows (flood currents) and waves to transport sediment into the harbor and outflows (ebb currents) to transport sediment out of the harbor. Grays Harbor is generally dominated by tidal currents, but high flows on the Chehalis River can control currents in the upper estuary, and the locations of shoals continually shift. Sediment transport is influenced by the complex dynamics of fluvial sediment and water inputs from tributaries entering the harbor and mixing with marine sediment and water inputs from the Pacific Ocean. Historic changes to the estuary, as a result of many factors including but not limited to the presence of the navigation channel, jetties, and the Point Chehalis Revetment, have altered the natural geomorphology of Grays Harbor.
Aquatic and Terrestrial Vegetation	With the exception of the inner harbor shoreline near the Port terminals, Grays Harbor is relatively undeveloped and contains many intertidal mudflats, eelgrass meadows, large areas of intertidal salt marsh, and sand dunes stabilized by dunegrass. However, the water depths, currents, and shifting sediments within the navigation channel and placement sites do not support these types of habitats.
Invertebrates, Fish, and Wildlife	Numerous economically, culturally, and ecologically important invertebrate, fish, and wildlife species rear, migrate, and/or reproduce in Grays Harbor and adjacent nearshore marine areas. Dungeness crab, numerous clam species, oysters, and a diverse epibenthic community provide forage for the fish, birds, and other wildlife. A variety of groundfish, forage fish, and other fish species can be found there, including six species of salmon, green sturgeon, and white sturgeon. The Grays Harbor National Wildlife Refuge and the expansive mud and sand tidal flats of Grays Harbor provide habitat to as many as 278 species of birds, while the Harbor waters are known to support a variety of marine mammals, such as harbor porpoises and harbor seals. Larger marine mammals such as killer whales and several species of sea turtle are known to occur in Washington waters outside of the harbor.
Threatened and Endangered Species	Twenty-two species of federally listed threatened and endangered species may potentially occur in the vicinity of Grays Harbor and its surrounding shoreline and nearshore area. These species include 4 birds, 6 fish, 6 marine mammals, 4 sea turtles, and one terrestrial butterfly. Most of these species are not known to occur in the navigation channel or near the dredged material placement sites. The species most likely to occur within the vicinity of the proposed action are the Pacific salmon species (Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon and Columbia River chum salmon), bull trout, eulachon, green sturgeon, marbled murrelet, western snowy plover, streaked horned lark, and killer whale.
Historic and Cultural Resources	There are no cultural or historic resources in the area of potential effect of the proposed action. There are two known cultural resources sites located in Grays Harbor, neither of which is located in the navigation channel. Six archaeological sites have been identified either within 1 mile of the area of potential effect or during previous Corps cultural investigations for other elements of the Grays Harbor and Chehalis River Navigation Project, but none are within the navigation channel or dredged material placement sites.

Resource	Characteristics of the Affected Environment
Water Quality and Sediment Characterization	The history of industrial uses in and around Grays Harbor, its shoreline, and nearshore environment have led to significant past water quality problems for the Chehalis River and inner harbor near Hoquiam and Aberdeen and create the potential for contaminated sediments in the navigation channel. Sediment testing is conducted prior to dredging and the Dredged Material Management Program (DMMP) agencies review dredging and placement of material to ensure appropriate methods of sediment removal and placement (or disposal if warranted) are followed based on the composition of the sediments and their potential for impacts on aquatic organisms. Three out of four of the South Reach dredged material management units (DMMUs) did not meet the exclusionary criteria and required contaminant testing. None of the DMMUs exceeded the dioxin limits for disposal in Grays Harbor. Cow Point 32a DMMU was found to be unsuitable for open-water disposal due to toxicity expressed in sediment larval bioassay. The waters of Grays Harbor generally meet state water quality standards with the exception of one testing site near the harbor entrance that has in the past (2008) been identified as having intermittently low dissolved oxygen levels. Past issues (1999) with fecal coliform bacteria pollution in the inner and outer harbor have been resolved and fecal coliform bacteria pollution is no longer a problem.
Air Quality, Noise, and Artificial Lighting	The ambient air quality in Grays Harbor is generally good; potential sources of particulates include local automobiles, local fishing vessels, a local pulp mill, and ocean-going commercial cargo vessels. Noise and sources of artificial lighting in Grays Harbor are minimal and are primarily associated with the populated cities of Westport, Aberdeen, Hoquiam, and Cosmopolis. Sources of noise on the water include vessel traffic, and small private and port-related operations on the shoreline in the eastern portion of Grays Harbor. Sources of artificial lighting in the vicinity of the navigation channel and the placement sites include vessel traffic in the navigation channel, private homes, small private marinas and docks along the shoreline (particularly along Point Chehalis) and port-related operations along the eastern shoreline of the Cow Point and Hoquiam reaches of the navigation channel.
Land Use and Aesthetics	Development including commercial, residential, transportation, and communications/utilities land uses are more concentrated on the eastern and western sides of the harbor in the cities of Westport, Aberdeen, Hoquiam, and Cosmopolis. Undeveloped land and resource production land uses are prevalent along the northern and southern margins. Grays Harbor also encompasses many recreational areas, including several state and local parks and designated wildlife areas. The viewshed for Grays Harbor is quite large, extending more than 10 miles from east to west. The harbor is a wide, long estuary with low, forested hills around the bay on the north, east, and south sides. Views around this area are panoramic, extending across the estuary to the horizon. Only distant landforms and color contrasts are visible across the long distances of the Grays Harbor viewshed.
Recreation	Grays Harbor hosts a large array of recreational opportunities including fishing, clamming, crabbing, birding, wildlife viewing, surfing, hunting, hiking, picnicking, and recreational boating.
Global Climate Change	Statewide emissions in 2008 were 101.1 million metric tons of carbon dioxide equivalent (CO_2e) (approximately 2% of nationwide emissions). The following changes are expected to occur along the Washington coast as a result of climate change: inundation, flooding, erosion and landslides, saltwater intrusion, and increased ocean surface temperature and acidity. Sea level rise and changes in sediment transport into Grays Harbor may alter the need for maintenance dredging in the future, but the complexities of sediment transport make the degree and nature of such changes unknown at this time.

Resource	Characteristics of the Affected Environment
Local Economy / Socioeconomics	The economies of the cities immediately surrounding Grays Harbor are linked to the import and export of goods through the Port of Grays Harbor and recreational, Tribal, and commercial use of the harbor's aquatic resources. The economy of the larger Grays Harbor County centers on natural resources, including the timber industry (particularly silviculture, logging and forest product manufacturing) and fisheries (commercial and recreational fishing, shellfish and fish processing). The recent recession impacted Grays Harbor County in terms of loss of employment and wage income. The unemployment rate in Grays Harbor County remains significantly higher than the statewide average.
Environmental Justice Communities	Grays Harbor County had a population of 76,797 (2010 census data). The populations of surrounding towns (Westport, Cosmopolis, Hoquiam, and Aberdeen) range from a high of 16,986 in Aberdeen to 1,649 in Cosmopolis. The county (88.3%) and the communities near the proposed action are predominantly white (80% of residents). The largest numbers of residents identify themselves as American Indian/Alaska Native or Hispanic or Latino reside in Hoquiam and Aberdeen. Unemployment is considered high in Grays Harbor County (11.6%), as well as in the surrounding towns of Westport (14%), Hoquiam (12.3%), Cosmopolis (4.1%) and Aberdeen (10.1%). Unemployment rates also vary between ethnicities in each town, with Hispanic or Latino residents of Hoquiam having the highest unemployment rate of 27.6%.
Indian Treaty Rights	Native American tribes that may be affected by the proposed action include the Quinault Indian Nation, the Chehalis Indian Tribe, and the Shoalwater Bay Indians. Only the Quinault Indian Nation has a reservation and federally adjudicated off-reservation hunting and gathering rights to locations within Grays Harbor. Grays Harbor is within the federally adjudicated usual and accustomed fishing area of the Quinault Indian Nation.
Placement Site Environment	Dredged material placement would occur at the designated placement sites that have been regularly used for material placement during the annual maintenance dredging of the navigation channel, and at the shifted Point Chehalis site. Unsuitable material would be placed upland. The South Jetty and Point Chehalis placement sites are public, multi-user, unconfined, open-water dredged material placement sites managed by Washington State Department of Natural Resources (DNR). Material dredged from the sandy outer reaches of the navigation channel is periodically used for nearshore nourishment at Half Moon Bay and at South Beach, when those areas require material placement to offset erosion. The Point Chehalis Revetment Extension mitigation site is maintained in accordance with the October 1998 *Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement* (see SEIS Appendix I).

Environmental Consequences Summary

The Corps analyzed the potential environmental consequences of each alternative on each resource area. The environmental consequences of each of the three alternatives and the resulting determination for each resource area for the action alternatives are summarized in Table ES-3 by resource area.

Table ES-3. Environmental Consequences and impact Determinations for Resource Areas Included in the SEIS

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Marine Transportation	Navigation channel would be maintained in its existing condition; tidal delays for vessels exceeding 36 feet of draft and light loading of such vessels would continue due to channel depth. No change in marine transportation conditions; vessel operation constraints would continue.	Under keel vessel clearance would increase and thus lengthen tidal windows for loaded vessels to utilize the navigation channel. Additional 1 foot of depth would improve window of availability for vessel transits[1] to a greater proportion of the tidal cycle compared to Alternative 1. A beneficial effect on marine transportation; vessel operations would be improved, allowing fuller loads per vessel and reducing ocean transportation costs.	Underkeel vessel clearance would further increase and thus further lengthen tidal windows for loaded vessels to utilize navigation channel. Additional 2 feet of depth would improve the window of availability for vessel transits to a greater proportion of the tidal cycle than deepening by 1 foot under Alternative 2. Beneficial effect on marine transportation anticipated, with a channel depth that best meets project's purpose and need; vessel operations would be improved, allowing fuller loads per vessel and reducing ocean transportation costs.
Geomorphology	Geomorphic attributes of navigation channel and estuary would be maintained in existing condition. Sediment transport dynamics, including the dynamics of the flood and ebb currents, and patterns of shoaling and erosion, would be expected to continue as currently occur. Placement of approximately 2 million cubic yards of dredged material at existing placement sites would continue.	Navigation channel depth would increase by 2.5%, with limited influence on the estuary's larger morphological processes. Slight increase in salinity concentration in deeper channel, but with negligible effect on the pressure gradients controlling saltwater intrusion. One-time placement of an additional 1,031,000 cubic yards of material, and the additional 50,000 cubic yards of annual maintenance is not expected to alter sediment transport dynamics. Potential for alterations in salt wedge dynamics, ship-wake erosion, erosion of navigation channel side slopes, Whitcomb Flats morphology, and sediment transport dynamics are expected to be minor.	Navigation channel depth would increase by 5%, with limited influence on the estuary's larger morphological processes. Slight increase in salinity concentration in deeper channel, but with negligible effect on the pressure gradients controlling saltwater intrusion. One-time placement of an additional 1,972,000 cubic yards of material, and the additional 107,000 cubic yards of maintenance dredging are not expected to alter sediment transport dynamics. Potential for alterations in salt wedge dynamics, ship-wake erosion, erosion of navigation channel side slopes, Whitcomb Flats morphology, and sediment transport dynamics are expected to be minor.

[1] The terms 'vessel transit' and 'vessel call' appear throughout the tables and the text of the entire report. For purposes of this report a transit can be interpreted as an individual arrival or departure, and a call can be interpreted as a cycle (arrival and departure).

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Aquatic and Terrestrial Vegetation	No direct impacts on eelgrass beds would occur. Eelgrass is not found in the navigation channel or at the placement sites because of low light levels/water depth, shifting substrate, and high tidal current. Short-term increases in turbidity during dredging and material placement could result in settlement of suspended sediments on eelgrass near the navigation channel, but effect expected to be rare and of short duration, with waves and tidal action quickly washing sediment from eelgrass fronds within 1 to 2 days.	The potential for alterations to eelgrass, macroalgae, saltmarsh, dunegrass, or sweet grass by deepening the channel 1 foot is expected to be negligible for the same reasons as noted for Alternative 1.	The potential for alterations to eelgrass, macroalgae, saltmarsh, dunegrass, or sweet grass by deepening the channel 2 feet is expected to be negligible for the same reasons as noted for Alternative 1.
Invertebrates, Fish, and Wildlife	Entrainment of aquatic invertebrates such as crabs, and a variety of epibenthic-associated fish such as flatfish, lingcod, and forage fish would occur at rates commensurate with the volume of material dredged via clamshell and hydraulic dredge to maintain the channel at -36 MLLW. Impacts are limited due to limited habitat in navigation channel (lingcod); high numbers of flatfish and forage fish in Grays Harbor, large spatial extent of foraging habitat (sturgeon), and per Dredge Impact Model (DIM) results for entrainment of Dungeness crab. Temporary displacement of seabirds, waterfowl and marine mammals may occur, but effect would be limited due to slow movement of dredges and confined footprint of noise and disturbance. Abundance of salmon, forage fish, groundfish, and benthic invertebrates are not measurably affected by maintenance dredging.	Deepening the inner harbor reaches would require an additional 45 days relative to Alternative 1, but would occur within the same in-water work window and at discrete locations in the channel at any one time. Hydraulic dredging to deepen the outer harbor reaches to -37 feet MLLW would entrain an additional estimated 77 to 2,156 flatfish, 77 to 154 lingcod, and 77 to 1,386 forage fish over Alternative 1 conditions if both south and outer crossover reaches are hopper dredged. Subsequent maintenance dredging would represent an approximate entrainment increase of 2.5% over Alternative 1. DIM results indicate that predicted Dungeness crab losses as a result of Alternative 2 are minimal and show little impact to harvestable size crabs (age 2+). The effects of Alternative 2 on invertebrates, fish, and wildlife are thus anticipated to be minor, and similar in nature and magnitude to those identified for Alternative 1.	One additional clamshell dredge, tug, and bottom dump barge would be employed during dredging of the inner harbor reaches compared to Alternatives 1 and 2. Deepening the inner harbor reaches would require an additional 45 days relative to Alternative 1, but would occur within the same in-water work window and at discrete locations in the channel at any one time. Hydraulic dredging to deepen the outer harbor reaches (both South Reach and potentially Outer Crossover Reach) to −38 feet MLLW would entrain an additional estimated 371 to 10,388 flatfish, 371 to 742 lingcod, and 371 to 6,678 forage fish, and subsequent maintenance dredging would represent an increase of 5% over Alternative 1 conditions. DIM results indicate that predicted Dungeness crab losses as a result of Alternative 3 are minimal and show little impact to harvestable size crabs (age 2+). The effects of Alternative 3 on invertebrates, fish, and wildlife are thus anticipated to be

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
			minor and similar in nature and magnitude to those identified for Alternative 1.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Threatened and Endangered Species	Alternative 1 would not adversely affect threatened or endangered species. National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) concurred in 2011 that continuation of the maintenance dredging from 2012 through 2026 would not result in likely adverse effects on any listed threatened or endangered species or designated critical habitat.	Dredging would require an additional 45 days for the inner harbor reaches, compared to Alternative 1, but the effect mechanisms of Alternative 1 would largely be the same. Alternative 2 would employ the same schedule, and would be conducted with the same number of dredging vessels and work hours per day as under Alternative 1, with the following exceptions: dredged material for upland mitigation site replenishment would be pumped ashore via submerged/floating hydraulic pipeline moored in Half Moon Bay, a long-reach excavator would be used to break up some material from the Cow Point Reach for removal by clamshell dredge, material determined to be unsuitable for unconfined aquatic disposal would be transferred and disposed upland, and dredged material would be placed in a shifted Point Chehalis aquatic site during construction of the deepened channel. Placement sites would include South Jetty, Half Moon Bay, South Beach and the Point Chehalis Revetment Extension mitigation site as in Alternative 1, and would add the shifted Point Chehalis site and the upland placement of unsuitable material. Listed species, including juveniles, are not likely to experience water quality or disturbance effects in the navigation channel or burial effects at the dredged material placement sites, because they are unlikely to use the affected habitats, and/or their vulnerable life-history stages are not likely to be present at these sites during the timing of dredging and material placement. The effects of Alternative 2 on threatened and endangered species are thus anticipated to be minor and similar in nature and magnitude to those identified for Alternative 1.	One additional clamshell dredge, tug, and bottom dump barge would be employed during dredging of the inner harbor reaches compared to Alternative 2. Deepening the inner harbor reaches would require an additional 45 days relative to Alternative 1, but would occur within the same in-water work window and at discrete locations in the channel at any one time. Both dredges do not typically work in the same portion of the channel at the same time. The duration and area of disturbance associated with dredging activities under Alternative 3 would not differ significantly from levels that occur under Alternatives 1 and 2. Listed species are not likely to experience water quality or disturbance effects in the navigation channel or burial effects at the dredged material placement sites for the same reasons as noted for Alternative 2. The effects of Alternative 3 on threatened and endangered species are thus anticipated to be minor and similar in nature and magnitude to those identified for Alternatives 1 and 2.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Historic and Cultural Resources	No historic or cultural resources are known to occur in the navigation channel or at the dredged material placement sites.	Negligible effects are expected because no historic or cultural resources are known to occur in the navigation channel or at the dredged material placement sites.	Negligible effects are expected because no historic or cultural resources are known to occur in the navigation channel or at the dredged material placement sites.
Water Quality and Sediment Characterization	Based on the results of the February 2012 determination, all of the sediment that would be maintenance dredged under Alternative 1 is suitable for open-water placement. Dredging and placement of dredge materials have only short-duration, localized impacts on water quality. The turbidity and low-DO plume associated with the dredging and placement of dredged materials typically dissipates quickly due to the strong tidal currents and wave exposure, particularly at the open-water placement sites.	All sediment that would be dredged under Alternative 2 is suitable for open-water placement, with the exception of 13,500 cubic yards of material from the Cow Point 32a subunit. This material would be dredged and then removed to an appropriate upland placement site. Prior to subsequent maintenance dredging cycles, the Corps would contact the DMMP agencies to determine whether additional sediment testing in Cow Point Reach DMMU subunit 32a is required. The duration of dredging activities under Alternative 2 would be extended by 45 days compared to Alternative 1. Best management practices (BMPs) would ensure that water quality impacts remain localized and overall impacts remain negligible. The Corps will seek a CWA Section 401 water quality certification from Ecology and would abide by any requirements included therein for the protection of water quality, associated with the discharge of dredged material into waters of the United States. Minor effects are, therefore, expected.	All sediment that would be dredged under Alternative 3 is suitable for open-water placement, with the exception of 22,400 cubic yards of material from the Cow Point 32a subunit. This material would be dredged and then removed to an appropriate upland placement site (former Hoquiam waste water treatment lagoon). Prior to subsequent maintenance dredging cycles, the Corps would contact the DMMP agencies to determine whether additional sediment testing in Cow Point Reach DMMU subunit 32a is required. The duration of dredging activities under Alternative 3 would be extended by 45 days compared to Alternative 1. BMPs would ensure that water quality impacts remain localized and overall impacts remain negligible. The Corps will seek a CWA Section 401 water quality certification from Ecology and would abide by any requirements included therein for the protection of water quality, associated with the discharge of dredged material into waters of the United States. Minor effects are, therefore, expected.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Air Quality, Noise, and Artificial Lighting	Alternative 1 constitutes a routine facility repair activity generating an increase in emissions that is clearly *de minimis* under 40 CFR 93.153(c)(1)(ix), and represents no changes in emission or air quality effects from the baseline conditions. The volume of emissions and related air quality and lighting effects that occur during maintenance dredging would continue.	Emissions of nitrogen oxides associated with deepening of the navigation channel under Alternative 2 (76 tons) in the construction year are below the General Conformity thresholds for non-attainment or maintenance areas (Grays Harbor is neither a non-attainment area nor a maintenance area).Air quality impacts are considered minor because of their relatively short duration (i.e., 6 months of inner harbor activity and 1 month for the outer harbor) and the low potential for pollutant concentrations to reach sensitive receptor locations.	Deepening of the inner harbor reaches would use more dredging machinery than under Alternative 2, resulting in greater air pollutant emissions. Emissions of nitrogen oxides associated with deepening of the navigation channel under Alternative 3 (84 tons) in the construction year are below the General Conformity thresholds for non-attainment or maintenance areas (Grays Harbor is neither). Total emissions for Alternative 3 are greater than those of Alternatives 1 and 2, but still relatively minor. As is the case with Alternative 2 dredging activities associated with deepening the navigation channel under Alternative 3 would have a relatively short duration (i.e., 6 months for the inner harbor reaches and 1 month for the outer harbor reaches), and low potential for pollutant concentrations to reach sensitive receptor locations.
Land Use and Aesthetics	Maintenance dredging activities do not conflict with current uses in Grays Harbor (e.g., shipping, recreational boating, fishing) or involve any elements that conflict with local plans or development regulations. The Grays Harbor viewshed includes the annual occurrence of dredge equipment, visible to observers from the shore and from the water. The visual appearance of these features is compatible with the existing large ships and commercial and recreational vessel traffic throughout Grays Harbor and particularly within the navigation channel.	No new features or elements would be introduced that would potentially conflict with or affect current land uses, land use planning, or aesthetic resources. Minor effects are anticipated because the dredging process, work periods, equipment, and the material placement methods and locations are the same as occur under Alternative 1 conditions, with the exception of the Point Chehalis placement site, possible use of a long reach excavator, pump ashore for upland placement at the Point Chehalis upland site, and the upland disposal of unsuitable material.	Negligible effects are anticipated for the same reasons as noted for Alternative 2.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Recreation	Recreational boaters (as well as commercial and tribal fishing vessels) are required to avoid the immediate area of dredging and placement for safety. The U.S. Coast Guard issues a *Notice to Mariners* announcing the locations and duration of dredging. The extent of dredging and placement of material is small and highly localized at any one time and can be easily be avoided. Dredging and dredge material placement does not conflict with recreational use of parks or wildlife viewing areas; placement of dredged materials helps slow erosion and maintain recreational activities along the South Jetty and Half Moon Bay area.	The dredging process, work periods, equipment, and the material placement methods and locations are the same as occur under Alternative 1 conditions, with the exception of the Point Chehalis site shift, possible use of a long reach excavator, pump ashore for upland placement at the Point Chehalis upland site and the upland disposal of unsuitable material. Placement of dredged material from the channel deepening under Alternative 2 at the Half Moon Bay and South Jetty sites would moderate erosion and help maintain these areas for recreational uses, potentially resulting in a beneficial effect on recreational resources.	Minor effects anticipated for the same reasons as noted for Alternative 2.
Global Climate Change	Maintenance dredging emissions would continue to contribute to the total greenhouse gas (GHG) atmospheric burden, but the quantity of emissions is a tiny fraction of all anthropogenic sources of GHGs. However, because global climate change is recognized to be an evolving cumulative effect, this relatively small amount of GHG emitted from maintenance dredging activities is acknowledged to be a contributor (albeit minor) to cumulative global emissions of GHGs.	Approximately 821 metric tons CO_2e would be emitted over Alternative 1 conditions due to the additional 45 days of dredging of the inner harbor reaches. Emissions would fall below the NEPA guidance recommended threshold of 25,000 metric tons for conducting a quantitative effects assessment, and the effects are considered to be minor.	Approximately 1,375 metric tons CO_2e would be emitted over Alternative 1 conditions due to the additional clamshell dredge and tugboat and the additional 45 days of dredging needed to deepen the inner harbor reaches. Emissions would fall below the NEPA guidance recommended threshold of 25,000 metric tons for conducting a quantitative effects assessment, and the effects are considered to be minor.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Local Economy / Socioeconomics	The -36 feet MLLW depth of the navigation channel constrains the operations of the existing fleet of vessels utilizing the harbor for water-oriented business, resulting in delays to arrivals and departures as well as light loading.	The additional 1 foot of channel depth would improve the window of availability for vessel transits, which would provide increased socioeconomic support to the region. While entrainment of fish and crabs would occur during the deepening, such impacts are expected to be minor. Alternative 2 would have a beneficial effect on the local economy and socioeconomics of the area because vessel operations would be improved, allowing fuller loads per vessel and reducing ocean transportation costs.	The additional 2 feet of channel depth would further improve the window of availability for vessel transits, which would provide increased socioeconomic support to the region. While more entrainment of fish and crabs would occur during the deepening, such impacts to commercial species are expected to be minor. Alternative 3 would have a beneficial effect on the local economy and socioeconomics of the area because vessel operations would be more fully improved, allowing fuller loads per vessel and reducing ocean transportation costs. These beneficial effects would be higher than those under Alternative 2 because of the increased clearance and longer window of availability for vessel transits into and out of the Port.
Environmental Justice Communities	Maintenance dredging of the navigation channel and placement of dredged materials provides economic support to the area by maintaining a navigable channel to the Port of Grays Harbor and related manufacturing facilities. This supports the low-income communities located along the shoreline of Grays Harbor. However, the extent of that support would continue to be limited due to the shoaling, tidal delays, and related constraints on vessels use of the navigation channel when maintained at −36 feet MLLW.	Alternative 2 would not result in disproportionately high or adverse human health or environmental effects on minority and low-income communities, because the channel deepening would not result in any direct impacts on such communities. By deepening the channel 1 foot, Alternative 2 would better support jobs related to the Port facilities, manufacturing and commercial businesses, and recreation that depend on reliable navigation through the harbor.	Alternative 3 would not result in disproportionately high or adverse human health or environmental effects on minority and low-income communities, because the channel deepening would not result in any direct impacts on such communities. By deepening the channel 2 feet, Alternative 3 would better support jobs related to the Port facilities, manufacturing and commercial businesses, and recreation that depend on reliable navigation through the harbor. These beneficial effects would be higher than those under Alternative 2 because of the increased clearance and longer window of availability for vessel transits into and out of the Port.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Indian Treaty Rights	Maintenance dredging overlaps with the latter portion of the tribal gillnetting season (late January to mid-April). Gillnetters may be displaced by the location of the dredging barge in the navigation channel, but would be able to deploy their nets upstream or downstream of the barge and continue fishing. Because gillnets can be deployed to avoid the dredging barge, and the dredging operations are pre-coordinated with the fishers only very minor reductions in fishing efficiency would be experienced under Alternative 1. Vessel traffic during dredging and placement of dredged materials, particularly at open-water sites, has the potential to temporarily affect the activities of Quinault Indian Nation Dungeness crab fishers. Under Alternative 1, the degree and nature of such temporary effects would continue per baseline conditions.	Dredging would require an additional 45 days for the inner harbor reaches, compared to Alternative 1, but the effect mechanisms of Alternative 1 would be the same. Alternative 2 would employ the same methods, dredging equipment, placement sites (with the following exceptions: dredged material for upland mitigation site replenishment would be pumped ashore via submerged/floating hydraulic pipeline moored in Half Moon Bay, a long-reach excavator would be used to break up some material from the Cow Point Reach for removal by a clamshell dredge, material determined to be unsuitable for unconfined aquatic disposal would be transferred and disposed upland, and dredged material would be placed in a shifted Point Chehalis aquatic site during construction of the deepened channel), and schedule, and would be conducted with the same number of dredging vessels and work hours per day as under Alternative 1. Although the duration of disruption to the Quinault Indian Nation fisheries crab fisheries would increase under this alternative and there would be more trips to the placement sites by the barges, the nature of the disruption would not change and the disruptions would remain temporary. Therefore, the potential for impacts on Indian Treaty Rights for these fisheries is expected to be minor.	Dredging would require two clamshell dredges under this alternative, however the potential for impacts on Indian Treaty Rights for gillnet and Dungeness crab fisheries is expected to be minor for the same reasons as noted for Alternative 2.

Resource	Alternative 1 (No Action) Continue Channel Maint. of -36 Feet MLLW	Alternative 2 (Deepen Channel to −37 Feet MLLW)	Alternative 3 (Deepen Channel to −38 Feet MLLW)
Placement Site Environment	The Corps selects among the designated placement sites for any particular volume of sediment based on the source of the dredged material, the depth and capacity of each placement site, the amount of material already present at the placement sites, the capabilities of the contractor's equipment, and weather/wave conditions at the time of placement. Typically, material from the inner harbor reaches is deposited at the South Jetty site, unless there are adverse weather/wave conditions or the South Jetty site is full, in which case placement occurs at the Point Chehalis site. For the outer harbor reaches, some sediment may be deposited at the Half Moon Bay beneficial use site, the Point Chehalis Revetment Extension mitigation site, and the South Beach nearshore nourishment site, with the remainder of the sediment placed in the South Jetty or Point Chehalis sites. The presence of commercial crab pots in a placement site and/or access lane (South Beach), and the amount of material present (Half Moon Bay) are also factors considered for outer harbor reach sediments.	Approximately 1,031,000 cubic yards of additional material would be placed during the construction year. The Half Moon Bay, South Beach, Point Chehalis Revetment Extension mitigation and South Jetty placement sites would be expected to continue to receive material, as needed, to maintain beach nourishment activities, but could receive a larger volume of material if such a need were present during the implementation of Alternative 2. The South Jetty and shifted Point Chehalis site would receive material, and 13,500 cubic yards would be placed upland. The placement of the dredged material is not expected to alter sediment transport dynamics, including the dynamics of the flood and ebb currents and patterns of shoaling and erosion compared to placement under Alternative 1. Therefore, the effects of this alternative on the placement sites are expected to be minor.	Approximately 1.972 million cubic yards of material would be placed during the construction year. The dredged material would be placed at the same placement sites as under Alternative 2, and 22,400 cy of unsuitable material would be placed upland. The placement of the dredged material is not expected to alter sediment transport dynamics, including the dynamics of the flood and ebb currents and patterns of shoaling and erosion compared to placement under Alternative 1. Therefore, the effects of this alternative on the placement sites are expected to be minor.

Mitigation Measures

The environmental consequences analysis conducted for this reevaluation (and documented in Chapter 4 of this SEIS) shows the potential impact on resources of the recommended plan (i.e. the increment to dredge from -36 feet MLLW to -38 feet MLLW, and subsequent maintenance requirements) would be minor or negligible. Based on this analysis, no new compensatory mitigation measures are proposed specifically for the construction or maintenance of the recommended plan. The potential impact of dredging would be minor to the overall Dungeness crab population based on modeling that was conducted as part of the environmental analysis.

The Corps currently implements the following avoidance and minimization measures in the study area as part of regular maintenance dredging. These same avoidance and minimization measures would be implemented for maintenance of the recommended plan after construction.

- To avoid impacts on bull trout and out-migrating juvenile salmon, the Corps would not dredge the Cow Point Reach, Hoquiam Reach, and turning basins between February 15 and July 15.
- Use a clamshell dredge to reduce entrainment of fish and crabs in the inner harbor reaches.
- Dredge the outer harbor during periods to avoid peak crab abundance.
- Coordinate with local fishers to reduce the potential to damage crab pots.
- Coordinate the timing of dredging to minimize impacts on target species important to Native Americans.
- Place dredged material at Half Moon Bay Nearshore and Upland Placement sites to facilitate a stable beach profile.
- Implement ballast water exchange protocols to avoid and minimize the potential for dredging activities to facilitate the transfer of nonnative and potentially invasive organisms from different estuaries along the Pacific Coast.

The Corps also implements the following avoidance and minimization measures specifically to protect Grays Harbor as an important nursery for juvenile Dungeness crab.

- Schedule dredging to the extent practicable to avoid times and areas of high crab densities.
- Locate offshore placement sites to avoid high concentrations of crabs and interference with the crab fishery.
- Use clamshell dredges instead of hopper dredges wherever possible in order to avoid entraining crabs.
- Continue to implement the 1998 *Revised Crab Mitigation Strategy Agreement* (RCMSA) (Appendix E).

Cumulative Impacts

The cumulative effects analysis describes baseline conditions; identifies past, present, and reasonably foreseeable future actions; and analyzes incremental effects of the proposed action on cumulative impacts. Past, present, and reasonably foreseeable future actions described in this analysis include the Port of Grays Harbor maintenance dredging, proposed Port of Grays Harbor terminal expansions, Point Chehalis revetment maintenance project, Grays Harbor long-term management strategy, Washington State Department of Transportation (WSDOT) SR 520 Pontoon Casting Basin dredging, and other in-water work and over-water structures which are proposed in Grays Harbor. Collectively, these actions could have cumulative effects on several resource areas, including, but not limited to, marine transportation, benthic invertebrates, fish and wildlife, water quality, noise, air pollution, and GHG emissions.

The proposed action's contribution to these cumulative effects is expected to be minor because effects associated with the proposed action would occur in the same physical and spatial context as during annual maintenance dredging under baseline conditions. Additionally, the intensity of the anticipated effects would be of similar magnitude as the effects that currently occur under baseline.

Agency Coordination and Public Outreach

Throughout the development of this SEIS, the Corps has coordinated with federal, state, and local agencies, as well as reaching out to the general public. Specifically, the Corps has been coordinating with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington State Department of Ecology (Ecology), Washington Department of Natural Resources (DNR), the Dungeness Crab Work Group, the Washington State Department of Archeology and Historic Preservation (DAHP), and local Native American tribes including Confederated Tribes of the Chehalis Reservation, Hoh Indian Tribe, Quinault Indian Nation, and Shoalwater Bay Tribe. The Corps also presented a public information meeting at the beginning of the development of this SEIS, and accepted public comments on the circulated Draft SEIS. Chapter 8, *Agency Coordination and Public Outreach*, presents a detailed discussion of these efforts. Additional coordination documentation is in SEIS Appendix H.

As part of the public review process for the Draft SEIS, the Corps conducted a Community Workshop three weeks after releasing the Draft SEIS for public review (February 2014). The purposes for holding the Community Workshops were to inform the public regarding the scope, analysis, and proposed conclusions of the Draft SEIS during the public comment review period, and to solicit and collect written and verbal comment.

Environmental Compliance

The Corps' proposed action must comply with several Federal and state environmental regulations. The following is a list of the regulations with which the Corps has demonstrated its compliance in this SEIS (see Chapter 9, *Environmental Compliance,* for a detailed discussion of the proposed action's compliance with each regulation).

- National Environmental Policy Act
- Tribal Treaty obligations

- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- Fish and Wildlife Coordination Act
- Coastal Zone Management Act
- Marine Protection, Research, and Sanctuaries Act
- Marine Mammal Protection Act
- Federal Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- National Historic Preservation Act
- Clean Air Act
- Clean Water Act
- Executive Order 11988, Floodplain Management
- Executive Order 11990, Protection of Wetlands
- Executive Order 12898, Environmental Justice

Preferred Alternative

Based on the information presented in this SEIS, the Corps has identified Alternative 3 (deepening the navigation channel from −36 feet MLLW to −38 feet MLLW) as the preferred alternative because under Alternative 1 (No Action) the purpose and need of reducing costs and improving efficiency and reliability of navigation would not be met, as the navigation channel would be maintained in its existing condition, and tidal delays and light loading of ships would continue. Under Alternative 2 under keel clearance would increase and thus lengthen tidal windows and partially ameliorate light loading of vessels, thus improving the efficiency of the navigation channel as a marine transportation route in Grays Harbor, but not to the extent of Alternative 3.

Although Alternative 3 would have a greater effect on the natural environment compared to Alternatives 1 and 2 due to a higher volume of material to be dredged and placed during the initial deepening, and subsequent maintenance, Alternative 3 is identified as the preferred alternative. Alternative 3 would best meet the project purpose and need and the planning study objective to reduce navigation transportation costs, and improve efficiency and reliability of navigation to and from Grays Harbor to the extent possible over the next 50 years. Additionally, although Alternative 3 would have a greater effect on the natural environment, vessel operations would be improved, allowing fuller loading per vessel transit, thus increasing efficiency and reducing ocean transportation costs. The environmental consequences analysis presented in this SEIS determined that the environmental effects would be minor.

Chapter 1
Purpose and Need of the Proposed Action

1.1 Introduction

This second supplemental environmental impact statement (SEIS) addresses design changes to the Grays Harbor and Chehalis River Navigation Improvement Project (proposed action) developed since the U.S. Army Corps of Engineers (Corps) promulgated a General Design Memorandum that articulated the present orientation and dimensions of the Federal navigation channel. This SEIS provides a second supplement to and incorporates by reference the *Grays Harbor, Chehalis and Hoquiam Rivers, Washington Channel Improvements for Navigation Interim Feasibility Report and Final Environmental Impact Statement* (Corps 1982) and its first supplement (Corps 1989a) by assessing the effects of executing those design changes, and it modifies and updates the description of effects that are expected to result from implementing maintenance of the channel, as modified through the changes in design. The *Fiscal Years 2012 through 2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Environmental Assessment* (Corps 2011), and its 2013 supplemental EA pertaining to clamshell dredging in the Outer Crossover Reach (Corps 2013), are presently tiered off the 1982 EIS and 1989 SEIS. Once promulgated, this second supplemental EIS would provide the updated basis from which that 2012-18 maintenance dredging EA is tiered.

This chapter describes the proposed action and its purpose and need. It also includes a list of previously completed environmental studies that are relevant to the proposed action which are hereby incorporated by reference.

1.2 Proposal for Federal Action

The proposed action is to deepen approximately 14.5 miles of the 27.5-mile the Federal deep-draft navigation channel in Grays Harbor (Grays Harbor navigation channel) from its currently maintained depth of −36 feet mean lower low water (MLLW) down to its legislatively authorized depth of −38 feet MLLW. The action includes placement of the dredged material at three existing, authorized open-water dredged material placement sites (Half Moon Bay, South Jetty, and South Beach sites) and an upland beneficial use placement site at the Point Chehalis revetment extension. An additional upland site will be utilized for material dredged that is determined unsuitable (DMMU sub-unit 32a) for open-water placement (slated for the former Hoquiam waste water treatment lagoon). DMMU sub-unit 32a will be physically surveyed after construction, and a determination will be made at that time whether an additional round of testing is required of that sub-unit prior to any subsequent maintenance dredging episode in that sub-unit's footprint. In order to take advantage of deeper water and more dispersive hydrodynamics the action includes a one-time 1,000 foot north-northwestern shift in the Point Chehalis open-water placement site.

Deepening the navigation channel would require dredging 1 to 2 feet of sediment (depending on the alternative selected) from the bottom of the navigation channel and placing that material at dredged material placement sites in Grays Harbor and vicinity. Deepening the navigation channel from a depth of −36 feet MLLW to a depth of −37 feet MLLW is estimated to require the removal of an additional

1,031,00 cubic yards of material, and increase subsequent annual maintenance dredging requirements by an estimated 50,000 cubic yards. Deepening the navigation channel from a depth of −36 feet MLLW to the authorized depth of −38 feet MLLW is estimated to require the removal of an additional 1,972,000 million cubic yards of material, and increase annual maintenance dredging by an estimated 107,000 cubic yards (see Chapter 2, *Alternatives*, for complete descriptions of these alternatives). The Corps would continue to annually dredge the deeper channel commensurate with funding allocated by Congress in order to maintain efficient and reliable navigation to and from the Port of Grays Harbor. Beneficial reuse of material from both construction and maintenance dredging would be considered and pursued when feasible based on several factors, including funding and opportunities for habitat enhancement.

1.2.1 Location

The proposed action is located in Grays Harbor, approximately 50 miles west of the city of Olympia on the central coast of Washington State (T17N, R10W, Sections 9 through 13 and T17N, R9W, Sections 8 through 10) (Figure 1). The navigation channel traverses the harbor, providing shipping access between the Pacific Ocean and the lower reaches of the Chehalis River where the cities of Aberdeen, Hoquiam, and Cosmopolis are located. As shown in Chapter 1, Figure 2 and Figure 3, the channel is divided into nine distinct reaches and deepening would occur in the six reaches (South, Outer Cross-over, Inner Cross-over, North Channel, Hoquiam and Cow Point Reaches, and the Cow Point Turning Basin) from the South Reach upstream to Cow Point Reach adjacent to the Port of Grays Harbor Terminal 4.

1.2.2 Authorization

The background and authorization of the proposed action originate over a century ago. Congress initially authorized construction and maintenance of the navigation channel principally through the River and Harbor Act of June 3, 1896 (29 Stat. 202, Ch. 314) and through the River and Harbor Act of August 30, 1935 (49 Stat. 409, Ch. 831); as subsequently amended, among others, by the River and Harbor Act of March 2, 1945 (Public Law 79-14) and the River and Harbor Act of September 3, 1954 (Public Law 83-780).

Dredging of the navigation channel to a depth of −38 feet MLLW was originally authorized as the Navigation Improvement Project by Congress in Section 202 of the Water Resources Development Act of 1986 (Public Law 99-662) in November 1986. The Corps' *General Design Memorandum for the Grays Harbor Navigation Improvement Project* (U.S. Army Corps of Engineers 1989b) documented detailed post-authorization engineering, environmental, and economic studies, which found justification for dredging to a depth of −36 feet MLLW at that time. The economic analysis in the 1989 General Design Memorandum was based on the timber industry and log vessels that, at that time, did not need depths of −38 feet MLLW.

In 1990, the Corps completed the deepening of 3.8 miles of upstream channel (Aberdeen Reach), and the widening of the Cow Point Turning Basin to 950 feet. In 1991, the Corps completed the deepening of 19.7 miles of downstream channel (Bar Channel to Cow Point Reach).

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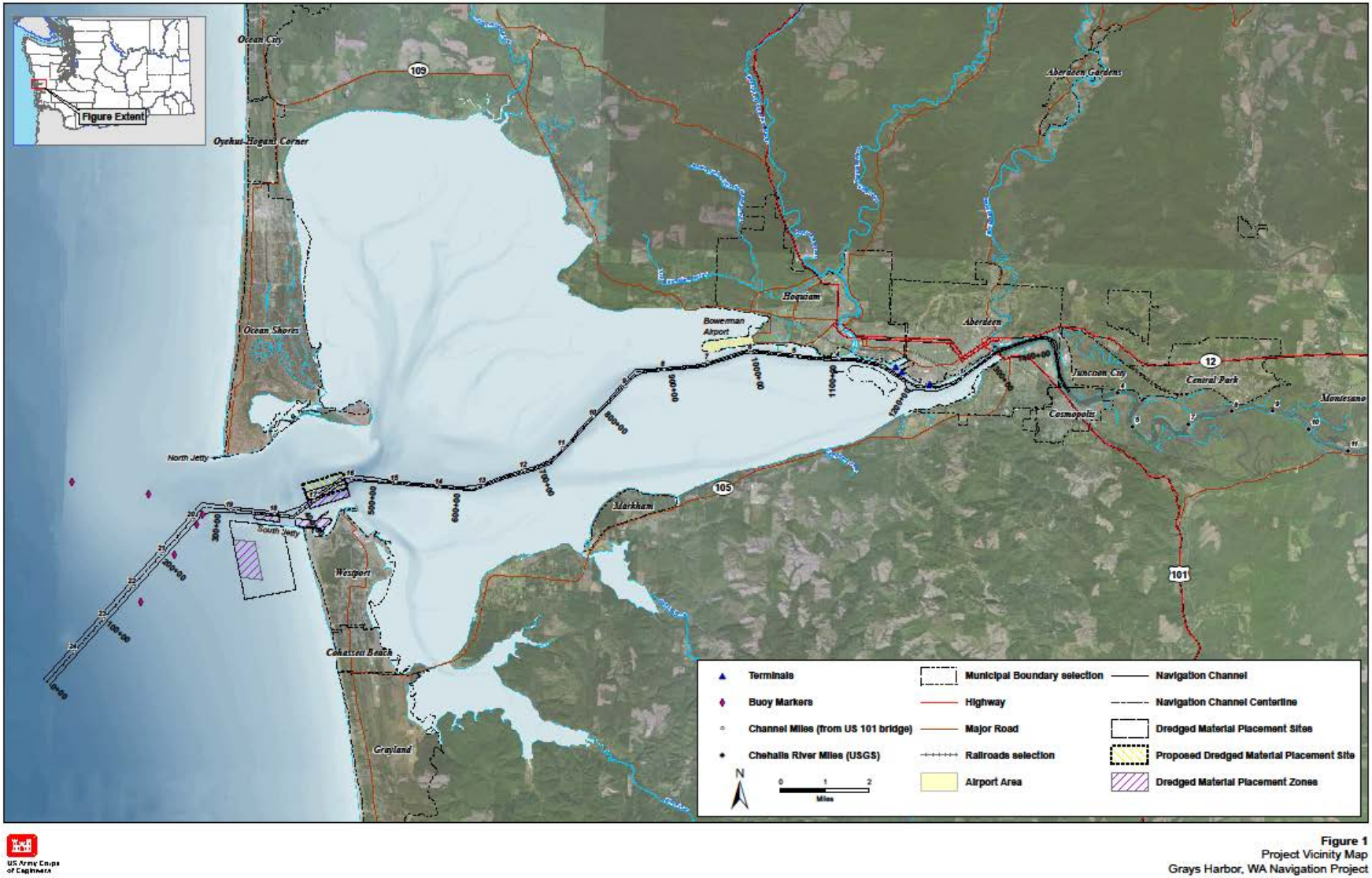

Figure 1. Project Vicinity Map

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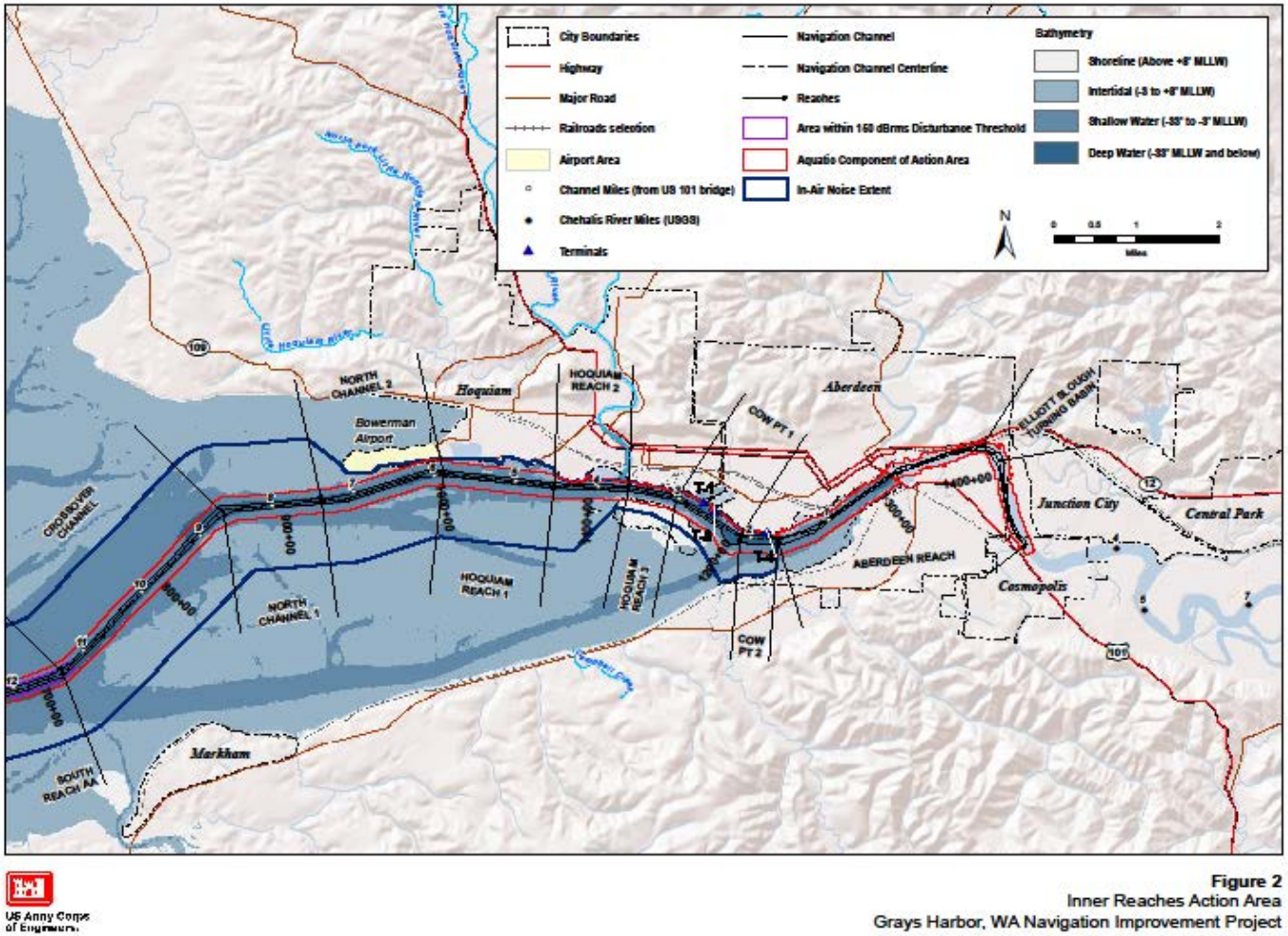

Figure 2. Proposed Action—Inner Harbor Reaches

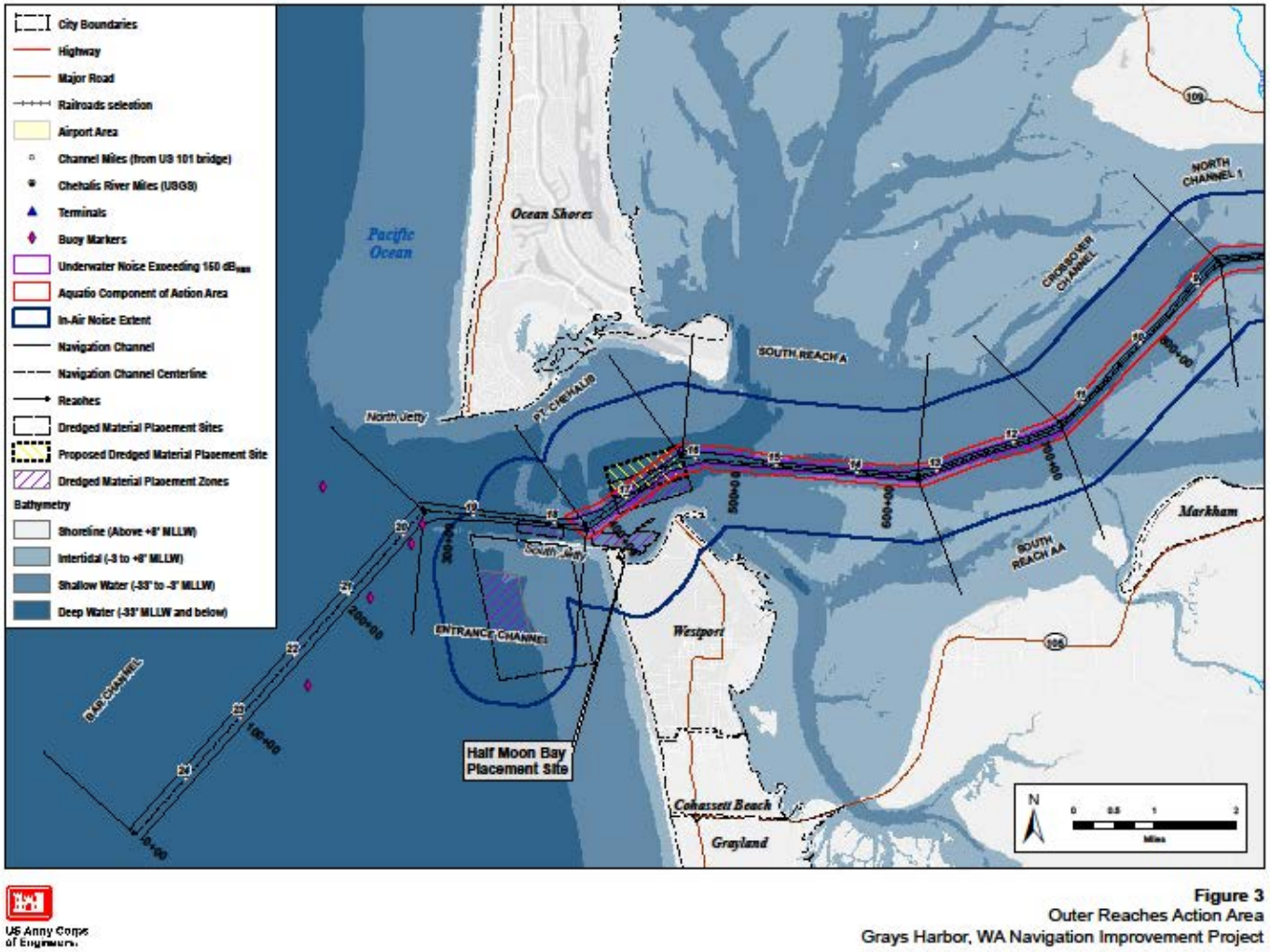

Figure 3. Proposed Action—Outer Harbor Reaches

1.3 Purpose and Need

The navigation channel is used by deep-draft ocean-going vessels to safely reach and leave the Port of Grays Harbor (Port). Currently, the inner harbor reaches of the navigation channel are limited by depth and are inadequate to accommodate the largest deep draft vessels for a sufficient period of the tide cycle. The need for improvement to the navigation channel stems from the following problem: as a result of the current channel depth of -36 feet MLLW and the narrow tidal windows, deep draft vessels calling at Grays Harbor have to be partially loaded or experience tidal delays due to insufficient channel depth. The Port of Grays Harbor has requested deepening the channel up to the legislatively authorized depth to better accommodate current vessel traffic for existing port tenants and commodities.

The purpose of the proposed action to deepen the navigation channel is to reduce navigation transportation costs for the existing and projected future traffic of deep-draft vessels, and improve efficiency and reliability of navigation to and from Grays Harbor over the 50-year period of analysis as feasible and economically justified, within the parameters of the navigation channel as legislatively authorized.

1.4 Project Background

Navigation improvements as initially authorized in 1896 were intended to prevent the continuous shifting of the entrance channel across the bar which deterred regular entry of ships into Grays Harbor. The entrance bar and channel were stabilized in the early 1900's by the construction of a jetty system and dredged channels. Subsequent reconstructions, improvements, and expansions culminated in the extensive jetty, revetment, groin, and dredged channel system present today. While the Entrance Reach and bar were largely self-maintaining as a result of the jetty system, the rest of the navigation channel was maintained at -30 ft MLLW by annual dredging in various areas from Cosmopolis through South Reach until the 1990 deepening. Planning studies for the Navigation Improvement Project to deepen the channel began in 1957. A Feasibility Report/Environmental Impact Statement (FR/EIS) was completed in September 1982 and approved in May 1985. During the interim, additional biological assessments and impact mitigation studies were developed focusing on salmon and Dungeness crab. The 1982 FR/EIS evaluated deepening and widening the channel to a depth of -38 ft MLLW in most reaches. In 1989 a separate Environmental Assessment (EA) was developed to specifically address concerns over potentially harmful contaminants in Grays Harbor sediments. The EA included additional environmental investigations on sediment contaminants, primarily polychlorinated dibenzodioxins (PCDD), polychlorinated dibenzofurans (PCDF) and resin acids (guaicols). In addition to determining suitability of material for unconfined, open water disposal, the EA evaluated the effects of disposal on the human environment. Information and insights gained from these analyses were compiled into the 1989 Environmental Impact Statement Supplement (EISS) which supplanted the 1982 FR/EIS. The EISS evaluated the impacts of deepening the channel to -36 MLLW, and addressed design refinements to the project, the additional environmental studies, and the impacts of dredging and disposal of dredged materials on biological communities in terrestrial, intertidal and subtidal habitats, on water quality, sediment contamination, and on commercially important fish and shellfish resources (specifically Dungeness crab and salmon). Environmental Assessments tiered from the 1989 EIS supplement were completed in April 2001, December 2005, October 2006, and September 2011 with the latter EA accounting for impacts through FY 2018. These documents addressed impacts due to annual dredging

required to maintain the channel at -36 ft MLLW in terms of an updated agreement on Corps treatment of Dungeness crab impacts, additional species listings and updated studies, and more current information. The maintenance dredging EA from September 2011 has been supplemented to address utilization of clamshell dredging in the outer Cross-Over Reach (previously exclusively hopper dredged) to reduce entrainment and mortality of Dungeness crab and other species. Sediment sampling and evaluation for open water disposal under the guidelines of the Dredged Material Management Program (DMMP) administered by the Corps, Environmental Protection Agency (EPA), Washington Department of Ecology (Ecology), and Washington Department of Natural Resources (DNR) has continued throughout this process. Additional sediment sampling and analysis will occur on a regular basis as specified in the *Dredged Material Evaluation Procedures and Site Disposal Manual*.

In accordance with 40 Code of Federal Regulations (CFR) 1502.20, this second SEIS supplements previous National Environmental Policy Act (NEPA) documents—the 1982 environmental impact statement (EIS) and its 1989 supplemental EIS—prepared in relation to the proposed action. This second SEIS does not repeat evaluations presented in these NEPA documents, but incorporates discussions by reference and concentrates on new issues specific to the proposed action. The FY 2012-18 maintenance dredging EA is tiered from the 1989 EIS Supplement, as stated previously. Upon conclusion of this SEIS process with a Record of Decision, the FY 2012-18 maintenance dredging EA and its accompanying FONSI will remain in full force and effect. To the extent that the incremental effects on the quality of the human environment of post-deepening maintenance dredging, when considered in conjunction with those addressed in the FY 2012-18 EA and FONSI, trigger the requirements of 40 CFR 1502.9(c), that EA would be formally supplemented and the significance of effects evaluated, prior to implementation of any maintenance dredging episode in the years following the initial construction year.

The entire Grays Harbor and Chehalis River Navigation Project consists of maintaining the federal navigation channel, as well as work related to features including the North Jetty, South Jetty, and Point Chehalis revetment. Historical information on the navigation channel and these structures, as well as descriptions of related modifications and maintenance work, has been described in several Corps documents. The proposed action encompasses only the proposed modifications to the depth of the navigation channel. The following documents are incorporated here by reference.

- *Grays Harbor and Chehalis River Navigation Project, Operation and Maintenance Environmental Impact Statement*, dated June 1975.
- *Long Range Maintenance Dredging Program for the Grays Harbor and Chehalis River Navigation Project, Operation and Maintenance Environmental Impact Statement Supplement (EISS) No. 2*, dated October 1980.
- *Grays Harbor, Chehalis and Hoquiam Rivers, Washington Channel Improvements for Navigation Interim Feasibility Report and Final EIS*, dated September 1982.
- *Grays Harbor, Washington, Navigation Improvement Project Final EIS Supplement*, dated February 1989.
- *Grays Harbor, Washington, Navigation Improvement Project Operations and Maintenance Final Environmental Assessment, 1989 Sediment Collection and Testing Program*, dated February 1990.
- *Dredged Material Evaluation Procedures and Disposal Site Manual*, dated June 1995.
- *Revised Crab Mitigation Strategy Agreement Evaluation Report and Environmental Assessment*, dated September 1998.

- *Point Chehalis Revetment Extension and Half Moon Bay Inter-Agency Mitigation Agreement*, dated October 1998.
- *Juvenile Salmonid Use of Half Moon Bay, Grays Harbor, Washington* (prepared by R2 Resource Consultants for the U.S. Army Corps of Engineers), dated 1999.
- *Fiscal Years 2001-2006 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Final Environmental Assessment*, dated April 2001.
- *South Jetty Breach Fill Final Environmental Assessment*, dated April 2002.
- *South Jetty Breach Fill Maintenance Final Environmental Assessment*, dated February 2004.
- *South Jetty Breach Fill Maintenance Final Supplemental Environmental Assessment*, dated December 2004.
- *South Jetty Breach Fill Maintenance Final Supplement to the Final Supplemental Environmental Assessment*, dated November 2005.
- *Fiscal Year 2006 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Final Supplemental Environmental Assessment*, dated December 2005.
- *Grays Harbor Crab Mitigation Program Oyster Spat Placement Environmental Assessment and Biological Evaluation*, dated March 2006.
- *Fiscal Years 2007-2011 Maintenance Dredging and Disposal, Grays Harbor and Chehalis*, dated October 2006.
- *Fiscal Years 2012 through 2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Environmental Assessment*, dated September 2011.
- *Biological Evaluation Fiscal Year 2011 and Future Years Maintenance Dredging and Disposal Grays Harbor and Chehalis River Navigation Project*, dated March 2011.
- *Determination Regarding the Suitability of Dredged Material From the Grays Harbor Navigation Improvement Project, Evaluated Under Section 404 of the Clean Water Act, for Open-water Disposal at the South Jetty or Point Chehalis Dispersive Sites, or for Beneficial Use, dated 5 February 2013.*
- *Determination on the Suitability of Proposed Federal Operation and Maintenance Dredged Material From Grays Harbor, Washington, Evaluated Under Section 404 of the Clean Water Act, for Open-water Disposal at the South Jetty or Point Chehalis Dispersive Sites, and at the South Beach and Half Moon Bay Beneficial Use Sites, dated 9 February 2012*.
- *Applicability of the DMMP Suitability Determination For The Grays Harbor Navigation Improvement Project, Dated February 5, 2013, to The Realigned Federal Navigation Channel, dated 2 May 2013.*
- *Applicability of the DMMP Suitability Determination For The Grays Harbor Navigation Channel Operation And Maintenance Project, Dated February 9, 2012, to The Realigned Federal Navigation Channel And Post-Deepening Conditions, dated 3 January 2014.*
- *Supplemental Environmental Assessment Fiscal Years 2012-2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Environmental Assessment*. (documenting channel realignment)
- *Supplemental Information Report to the 2013 Supplemental Environmental Assessment FY 2011-2018 Maintenance Dredging Grays Harbor and Chehalis River Federal Navigation Channel.*

1.5 Scope of Analysis

This SEIS supplements the previously promulgated NEPA documentation and the associated environmental effects analyses, by evaluating the following consequences of agency action:

- The incremental effects of initial construction of the action alternatives (Alternatives 2 and 3, further described in Chapter 2), during the initial construction year and within the channel reaches affected by the proposed action to the dimensions of the respective channel prisms, over and above the effects of annual maintenance dredging and disposal as described in the 1989 EISS and the FY 2012-18 maintenance dredging EA; and
- The incremental effects of maintenance dredging and disposal, in years subsequent to the construction year, within the segments of the navigation channel deepened under Alternative 2 or Alternative 3, over and above the effects of annual maintenance dredging evaluated in the 1989 EISS and the FY 2012-18 maintenance dredging EA, in light of both the characteristics and volumes of that material.

Chapter 2
Alternatives

2.1 Introduction

This chapter describes the three proposed alternatives evaluated in this second SEIS. The two action alternatives describe deepening, and subsequently maintaining, the existing Grays Harbor navigation channel to -37 feet MLLW (Alternative 2), and to its legislatively authorized depth of −38 feet MLLW (Alternative 3). The no-action alternative describes continued dredging of the navigation channel to its currently maintained depth of −36 feet MLLW (i.e., the continuation of existing activities). This chapter also provides a summary of the alternatives eliminated from further consideration.

2.2 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Section 1502.14 of the Council on Environmental Quality regulations implementing NEPA (42 United States Code [USC] 4371, et seq.) requires that the environmental review sharply define the issues and provide a clear basis for choice among options by the decision makers and the public. To comply with this requirement, NEPA regulations require that the review include a no-action alternative to ensure that impacts associated with taking no action are compared to the effects associated with a reasonable range of alternative ways of accomplishing a project's purpose and need.

Where ongoing programs initiated under existing legislation and regulations would continue, 'no action' may be defined as no change from current management direction or level of management intensity (Council on Environmental Quality 1981). Therefore, the No Action Alternative may be thought of in terms of continuing with the current course of action until that action is changed. Accordingly, projected effects of the alternatives would be compared to those effects projected for current practices.

The No Action Alternative provides the baseline conditions for comparing the potential effects of the two action alternatives. Under Alternative 1, the No Action Alternative, the Corps would continue the current practice of maintenance dredging of the navigation channel to a depth of −36 feet MLLW and placement of the dredged materials at a variety of open-water placement, beach nourishment, and upland beneficial use sites, as described below. It is important to note that under Alternative 1 the navigation channel would be maintained in its existing condition, and tidal delays and light loading of ships would continue. Alternative 1 does not meet the proposed action's purpose and need, but is carried forward in this analysis for the purpose of comparing the relative merits and disadvantages of the action alternatives.

The No Action Alternative in this analysis is continued Operations and Maintenance dredging to -36 feet MLLW for the reaches addressed in this SEIS (South Reach, Outer Cross-over, Inner Cross-over, North Channel, Hoquiam, Cow Point and Cow Point turning basin). The full analysis of the No Action Alternative is described as part of the *Fiscal Years 2012 through 2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project Environmental Assessment*, dated September 2011 (Corps 2011) as supplemented in 2013 (Corps 2013;2013a). The 2011 maintenance

dredging EA evaluated the impacts of dredging the maximum expected volume in any given year to meet the -36 ft MLLW depth (see table 2-1 for volume estimates) for the full channel (Entrance to Aberdeen reaches). However, the deepening reaches (South Reach to Cow Point) are the only pertinent areas for purposes of this SEIS. The actual volume dredged for any reach is dependent on sedimentation rates and available funding during that maintenance dredging year, and would likely be less than the volumes estimated in the 2011 maintenance dredging EA in most years. Since promulgation of the 2011 EA, the Corps has implemented a minor realignment of the navigation channel in discrete locations. This modification is intended to take advantage of greater scour from river and tidal currents, which is expected to reduce the volume of material accumulating in these portions of the navigation channel. This modification is also projected to significantly reduce future dredging in this portion of the navigation channel, which would, in turn, avoid and reduce impacts of dredging and disposal. This channel realignment was evaluated in a 2014 Supplemental Information Report to the 2011 maintenance dredging EA, and the Corps concluded that formal supplementation of the EA was not necessary in that context . The estimated dredge volumes presented here and environmental evaluation of potential effects of channel deepening in this SEIS take into account this implementation of the minor channel alignment modification, that is part of the continuing maintenance to -36 feet MLLW (Alternative 1).

2.2.1 Maintenance Dredging Process

The Grays Harbor navigation channel is divided into discrete reaches, which are based on physical characteristics and dredging requirements. These include five “inner harbor” reaches (Aberdeen, Cow Point, Hoquiam, North Channel, and Inner Crossover) (Figure 2) and five “outer harbor” reaches (Outer Crossover, South, Point Chehalis, Entrance Channel, and Bar Channel) (Figure 3). Under Alternative 1 the reaches under evaluation in this SEIS, those segments from South Reach to Cow Point, would continue to be dredged in order to maintain a depth of −36 feet MLLW.

Figure 2-1 shows typical cross sections of two representative reaches of the navigation channel: Cow Point (an inner harbor reach) and Crossover Channel (the transition between the inner and outer harbor reaches). As shown in Figure 2-1 and presented in Table 2-1, the side slopes of the navigation channel vary by reach because finer substrates are more cohesive and therefore are able to maintain a steeper slope. Representative side slopes range from 1 foot of vertical rise for every 3 feet of horizontal distance, presented as 1V:3H, in the Cow Point, and Hoquiam reaches, to a shallower slope of 1V:5H in the North Channel, Crossover Channel, and the inner portion of the South reaches, to a very shallow slope of 1V:10H in the outer portion of South Reach.

2.2.1.1 Advance Maintenance and Allowable Overdepth

The typical channel cross sections in Figure 4 illustrate the total dredging prism, which includes the currently maintained dredging depth (−36 feet MLLW), advance maintenance depth, and allowable overdepth[2]. These additional dredging depth allowances are explained below.

[2] “Advance Maintenance” and “Allowable Overdepth” are defined in the Corps’ Engineering Regulation (ER) 1130-2-520 (U.S. Army Corps of Engineers 1996).http://publications.usace.army.mil/publications/eng-regs/ER_1130-2-520/c-8.pdf

Advance Maintenance

Advance maintenance is dredging to a specified depth and/or width beyond the authorized channel dimensions (Figure 4) in critical and fast-shoaling areas. Where justified, advance maintenance typically occurs during each periodic episode of maintenance dredging. Advance maintenance allows the Corps to avoid frequent re-dredging, and ensures the reliability and least overall cost of maintaining channels to authorized and implemented dimensions (U.S. Army Corps of Engineers 2006). To assure channel operational reliability and least overall cost, the Corps allows an additional 2 feet of depth in the applicable reaches of the Grays Harbor navigation channel prism.

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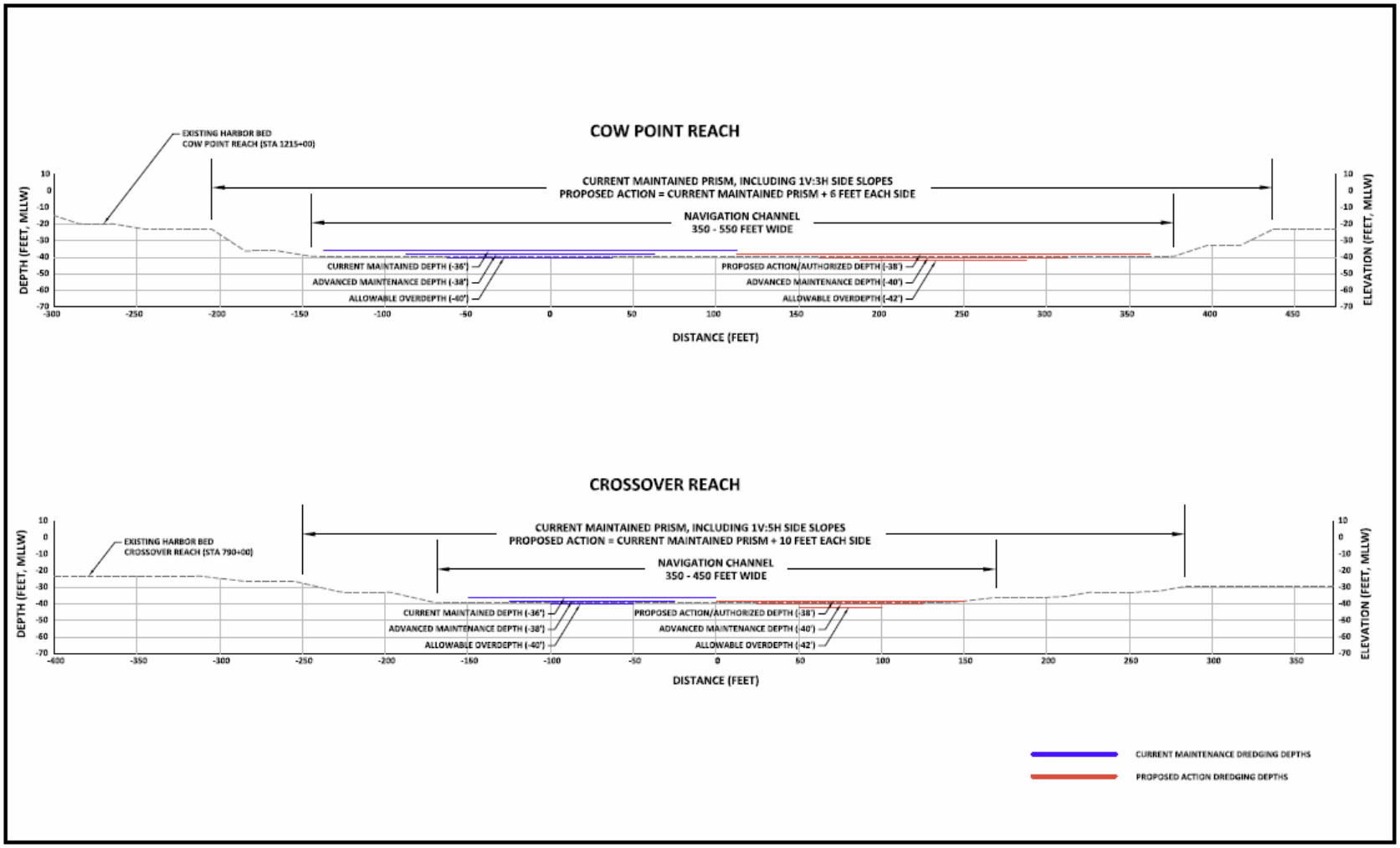

Figure 4. Current and Proposed Channel Excavation Depths

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Allowable Overdepth

Allowable overdepth is dredging to a permitted depth and/or width outside the required channel prism to allow for the inherent inaccuracies in the dredging process. During typical dredging activities, precision varies with physical conditions, dredged material characteristics, channel design, and type of dredging equipment used. Due to these variables and the resulting imprecision associated with the dredging, the Corps recognizes that dredging below the authorized dimensions occurs. To compensate for these inevitable inaccuracies, the Corps allows for a maximum overdepth tolerance of 2 feet beyond the advance maintenance depth (U.S. Army Corps of Engineers 1996) (Figure 4).

2.2.1.2 Dredging Schedule

The dredging schedule varies by reach (Table 2-1). Dredging occurs between July 16 and February 14 in the Cow Point turning basin, Cow Point, and Hoquiam Reaches, and from 1 August to 14 February in the North Channel and Inner Crossover Reaches. Dredging is scheduled to allow removal of shoals resulting from high river flows in the spring and to avoid salmonid migrations in the spring and early summer. Typically, this dredging operation lasts approximately 4.5 months but could be up to an allowed window of 6 months, depending largely on weather conditions. For the outer harbor reaches, dredging occurs between April 1 and June 30 in South Reach, and the Outer Crossover is dredged 1 April to 31 May if a hopper dredge is utilized or 1 August to 14 February if a clamshell dredge is used. The duration of maintenance dredging can vary year to year, but is typically about 1 month. Dredging is scheduled for this time to coincide with favorable weather/wave conditions and to reduce impacts on the Dungeness crab fishery. Therefore, throughout the year dredging and placement of dredged materials are not occurring during two periods: February 15 through March 31 and July 1 through July 15.

2.2.1.3 Dredging Methods and Equipment

The Corps uses two methods to dredge the navigation channel. The first method is a mechanical or "clamshell" dredge (Figure 5), which is used to dredge the inner harbor reaches (including the entire Crossover reach, however, a hopper dredge may still be used in the Outer Crossover reach when necessary). Clamshell dredges include use of a tugboat and two barges, one to support the clamshell derrick and the other a bottom-dump barge for storage and transport of the dredged material to the placement site. Under baseline conditions (Alternative 1), one tugboat is used to position one clamshell dredge (on a barge) and one bottom-dump barge is used to transport material in order to complete the inner harbor dredging.

Use of a clamshell dredge has been well documented to greatly reduce both entrainment and mortality of crab and other aquatic species when compared to a hopper dredge (Armstrong et al 1987, Dumbauld et. al. 1988). Clamshell dredging is used exclusively in the Inner reaches (inner Cross-Over Reach and inward) to reduce entrainment of fish, shrimp, and crabs in the inner harbor reaches. For the outer half of the Cross-over Reach clamshell use is emphasized and preferred, however this reach can be dredged with either hopper dredge or clamshell. The clamshell bucket proceeds from the outer edges of the navigation channel, across the channel to the other bank and then back, dredging progressively until the desired depth is achieved. This method of dredging, along with the mild angle of the channel's side slopes (e.g., 1V:5H in South Reach, steepening to 1V:3H beginning at the North Channel), leaves the channel width substantially unchanged and minimizes the potential for sloughing/avalanching of sediment from the channel's side slopes after dredging is completed.

Figure 5. Clamshell Dredge

The other method uses a hydraulic hopper dredge (Figure 6) for the reaches in the outer harbor. The hopper dredge is able to dredge material, store it onboard, transport it to a placement area, and deposit it. Two government hopper dredges "*Essaysons*" and "*Yaquina*" have annual assignments in Grays Harbor to perform outer harbor maintenance dredging. Hopper dredges are better suited for use in the more exposed outer harbor reaches, because clamshell dredges must be rafted together with a scow barge, which can be hazardous in choppy seas. Sediments removed from the outer harbor reaches are primarily sands of marine origin that are extracted using a hopper dredge. These heavy particles settle out of suspension rapidly and generally do not disperse to adjacent areas (U.S. Army Corps of Engineers 2011). Use of a hopper dredge also reduces suspension of these heavier sediments.

The hydraulic hopper dredge typically cuts from the toe of the sideslope outward, maximizing the bank height to achieve greater production rates. The mild angle of the channel's side slopes minimizes the potential for sloughing/avalanching of sediment from the side slopes after dredging is completed.

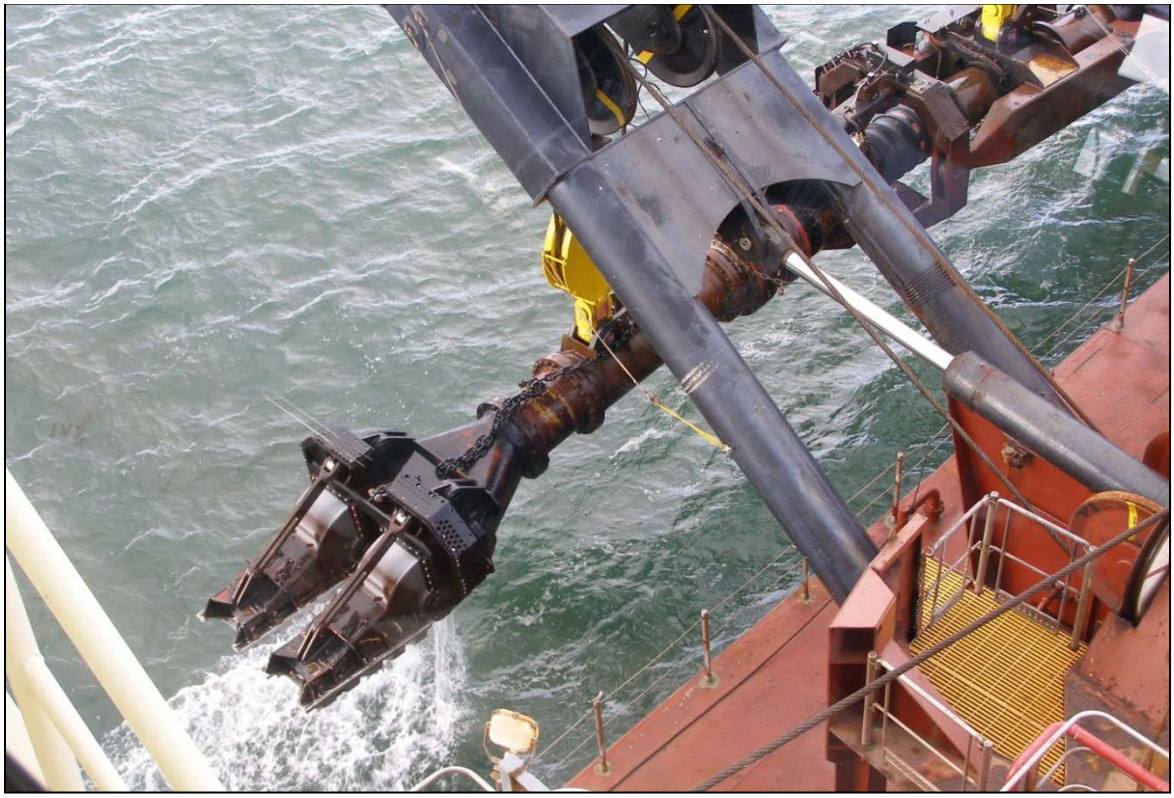


Figure 6. Hopper Dredge Drag Arm

2.2.1.4 Annual Maximum Volume of Dredged Material

The 2011 maintenance dredging EA evaluated the impacts of dredging the maximum expected volume in any given year to meet the -36 ft MLLW depth. Currently, the Corps removes an annual maximum volume of approximately 2.09 million cubic yards in the six reaches targeted for deepening (South, Outer Cross-over, Inner Cross-over, North Channel, Hoquiam, and Cow Point Reaches, including the Cow Point Turning Basin) annually to maintain the channel depth at -36 feet MLLW in these reaches. An annual maximum volume of approximately 1.66 million cubic yards is removed from the inner harbor reaches (Inner Cross-over, North Channel, Hoquiam, Cow Point Reaches and Cow Point turning basin) and an annual maximum volume of approximately 425,000 cubic yards is removed from the outer harbor reaches (South and Outer Cross-over Reaches).

Table 2-1 lists the annual maximum volume of material dredged from each reach of the navigation channel under baseline conditions (Alternative 1) to maintain the channel at a depth of −36 feet MLLW, the characteristics of the reaches, and the typically allowed timing of dredging activities for each reach. The volumes in Table 2-1 include one standard deviation and include both Advance Maintenance and Allowable Overdepth quantities (described above), and have been computed by the Corps based on 10 years of Grays Harbor dredging records from 2000 to 2010. The actual volume dredged in any one year varies from these averages based on volume deposited, location and extent of targeted shoals, and Congressional funding, which dictates the duration/amount of dredging that can be executed in a particular year.

Table 2-1 also includes the dredged material placement sites that are typically used for material from each reach. The actual placement site utilized during dredging is determined as described in Section 2.2.2. The dredged material is deposited at approved designated areas, including the Point Chehalis and South Jetty open-water placement sites. Dredged material is also deposited at nearshore locations—Half Moon Bay and South Beach—where the material provides a beneficial use (i.e., beach replenishment). Details regarding the dredged material placement sites are presented below in Section 2.2.2.1, *Dredged Material Placement Sites*.

Table 2-1. Reach Characteristics of the Grays Harbor Navigation Channel at –36 Feet MLLW

Reach	Approximate Average Volume (cubic yards)[a]	Sediment Type	Dredge Type	Channel Dimension[b] (feet) (MLLW/ wide)	Placement Site	Work Closure	Work Schedule
Cow Point	750,000 annually	Sandy silt	Clamshell	–36/350–550	South Jetty or Point Chehalis[c]	Feb 15–July 15	July 16–Feb 14
Cow Point Turning Basin	215,000 annually	Sandy silt	Clamshell	–36/350–950	South Jetty or Point Chehalis[c]	Feb 15–July 15	July 16–Feb 14
Hoquiam	150,000 annually	Sandy silt	Clamshell	–36/350	South Jetty or Point Chehalis[c]	Feb 15–July 15	July 16–Feb 14
North Channel	175,000 annually	Silty sand	Clamshell	–36/350	Point Chehalis	Feb 15–July 31	August 1–Feb 14
Inner Crossover	375,000 annually	Silty sand	Clamshell	–36/350–450	Point Chehalis	Feb 15–July 31	August 1–Feb 14
Outer Crossover	235,000 annually	Silty sand	Hopper or Clamshell[d]	–36/350	Point Chehalis	June 1–March 31 Feb 15-July 31	April 1 – May 31 August 1-Feb 14
South Reach	190,000 annually	Sand	Hopper	–36/350–450	Point Chehalis or Half Moon Bay	July 1–March 31	April 1–June 30
Total	2,090,000 annually						

Source: U.S. Army Corps of Engineers 2011.

[a] Volumes are averages, plus one standard deviation, computed based on the last 10 years of dredging records, from 2000 to 2010 and include both allowable overdepth and advance maintenance. Thus, the actual volumes dredged in the past may be more or less than those shown in the table. These volumes are more representative of funding received rather than the volume available for dredging in the channel.

[b] Depths shown are authorized depths and do not include the 2-foot advance maintenance or 2-foot overdepth tolerance. Exceptions: Aberdeen Reach has 0-foot advance maintenance and 1-foot overdepth tolerance. Elliott Slough Turning Basin has a 3-foot advance maintenance for half of the channel (inside bend). Widths shown are those of the channel bottom, and do not include extra width at channel bends.

[c] Adverse weather/wave relief site.

[d] The Outer half of the Cross-Over Reach may be dredged with either hopper with work closure of June 1 –March 31: and corresponding work schedule April 1- May 30 or clamshell with closure of February 15 –July 15: corresponding work schedule of August 1 – February 14.

2.2.2 Dredged Material Placement

2.2.2.1 Dredged Material Placement Sites

Placement of the material dredged from the navigation channel occurs only at designated placement sites. Figure 7 illustrates the location of all dredged material placement sites. Two Washington State Department of Natural Resources (DNR) public, multi-user, unconfined open-water dredged material placement sites are located directly adjacent to the navigation channel: the South Jetty and the Point Chehalis placement sites. Both sites are located on state-owned aquatic lands and managed by Washington DNR. In addition, material dredged from the sandy outer harbor reaches of the channel is periodically used for both direct upland placement at the Point Chehalis Revetment Extension mitigation site (when feasible) and nearshore nourishment at the Half Moon Bay beneficial use site and nearshore nourishment at the South Beach beneficial use site. Material placed above MHHW in the Point Chehalis Revetment Extension mitigation site is expected to subsequently erode through natural processes, with portions of the material entering the intertidal zone and thus the littoral system. The Point Chehalis site overlaps the navigation channel however, the dispersive nature of this site effectively transports material out of the site boundaries and has historically provided sufficient capacity for annual O&M dredged material. The Southwest (also known as 3.9 mile) site is not used.

The determination of which placement site is used during the course of maintenance dredging is based on a variety of factors. For both the inner and outer harbor reaches, placement is determined based on the source of the dredged material, the depth of each aquatic placement site, the amount of material already present at the placement sites, and weather/wave conditions at the time of placement. For the inner harbor reaches, material is typically deposited at the South Jetty site, unless there are adverse weather/wave conditions or the South Jetty site is full, in which case placement typically occurs at the Point Chehalis open water placement site. For the outer harbor reaches, some of the dredged materials may be deposited at three beneficial use sites: Half Moon Bay dredged material nearshore nourishment site , Point Chehalis Revetment Extension Mitigation site, and South Beach nearshore nourishment site. Remaining material is typically placed in the South Jetty or Point Chehalis sites. Factors that determine which placement sites are used for the outer harbor reaches include the presence of commercial crab pots in a placement site and/or access lane (for South Beach), the amount of material present (for Half Moon Bay), as surveyed annually, and results of pre-disposal Dungeness crab surveys (for both Half Moon Bay and South Beach) as required.

The volumes of dredged material placed at each placement site over the last 12 years are summarized in Table 2-2. Dredged activities from 2012 through 2013 have not significantly differed from those conducted 2000-2012.

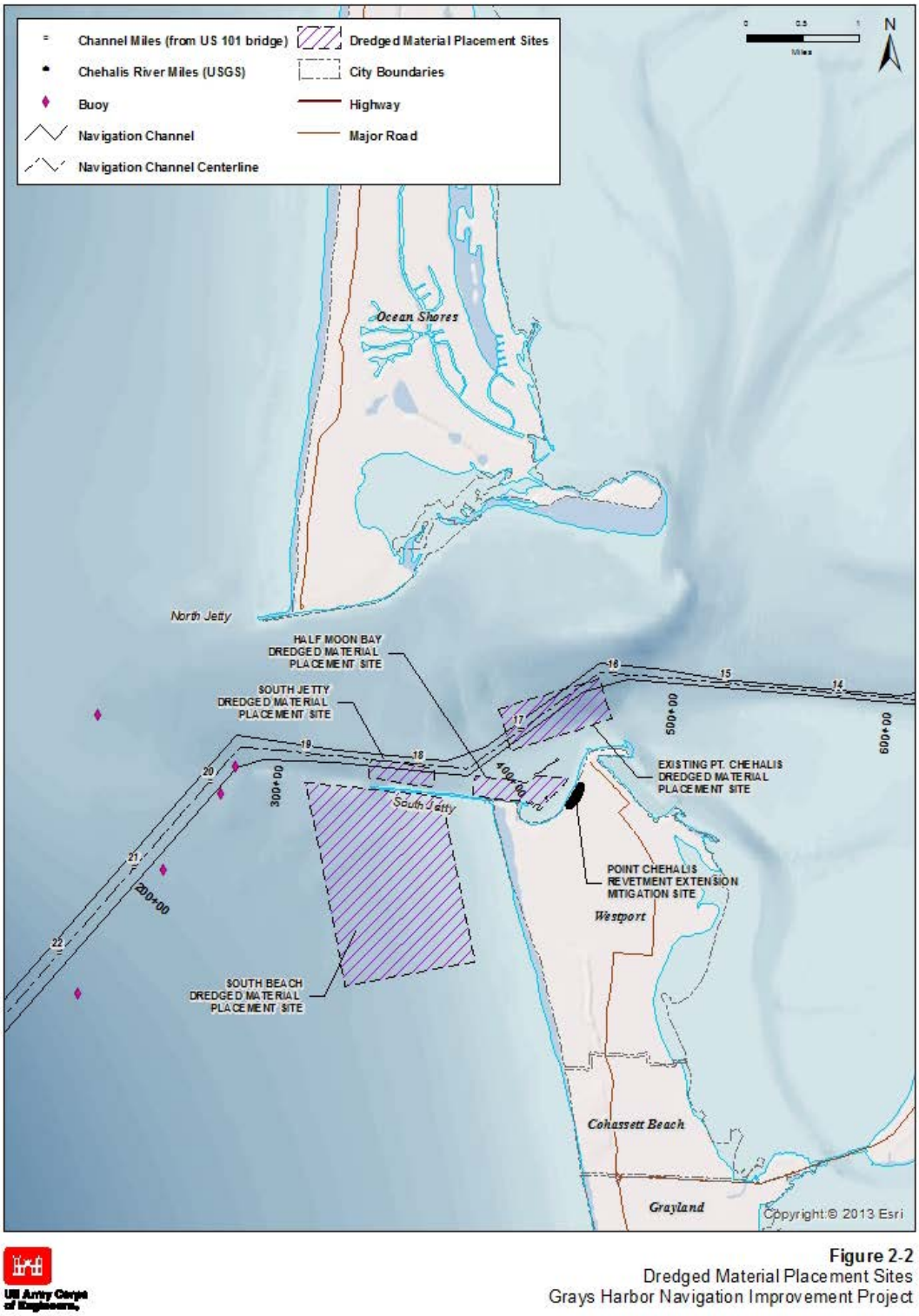


Figure 7. Dredged Material Placement Sites for Alternative 1

Table 2-2. Reported Dredged Material Deposit Volumes (cubic yards) by Placement Site for Grays Harbor at −36 Feet MLLW

Year	Point Chehalis (Open-Water)	South Jetty (Open-Water)	Half Moon Bay (Nearshore)	South Beach (Nearshore)	Point Chehalis Revetment Extension Mitigation site	Total
2000	956,700	1,200,248	0	0	0	2,156,948
2001	667,943	358,873	0	0	0	1,026,816
2002	942,310	475,199	378,441	75,219	135,705	2,006,874
2003	355,139	824,694	329,107	125,388	0	1,634,328
2004	957,186	1,166,089	289,652	262,176	0	2,675,103
2005	1,054,086	740,970	102,194	217,909	0	2,115,159
2006	1,277,837	196,833	126,892	55,170	0	1,656,732
2007	599,254	389,127	140,406	0	0	1,128,787
2008	1,288,726	707,080	171,352	0	0	2,167,158
2009	1,223,159	21,088	144,975	214,502	0	1,603,724
2010	977,282	91,720	91,720	118,182	0	1,278,904
2011	702,650	1,000,925	177,150	298,251	0	2,178,976
2012	1,481,714	320,985	111,205	142,313	0	2,056,217
Total Volume	12,483,986	7,493,831	2,063,094	1,509,110	135,705	23,685,726
Average Annual Volume (2000–2012)	960,307	576,449	158,700	116, 085	10,439	1,821,979

Source: Corps 2011 and updated for years 2011 and 2012

2.2.2.2 Dredged Material Characterization and Suitability

The types of sediment in the outer and inner harbor reaches vary, and thus their suitability for deposit at certain placement sites also varies. Materials dredged from the outer harbor reaches consist primarily of course-grained marine sands deposited by tidal action and silty sand/sandy silt redistributed in the estuary by wind and wave action. For instance, dredged material from the Bar and Entrance Channels has been found to meet the exclusionary criteria specified in the Clean Water Act (40 CFR 230.60), and thus does not require contaminant testing. This determination is based on the physical characteristics of the materials, location in a high-energy environment, and geographic separation from sources of contamination. Dredged material from these reaches is suitable for beneficial use at designated placement sites. Materials that accumulate in the inner harbor reaches originate from tributary streams and rivers. Compared to the materials in the outer harbor reaches, the inner harbor reaches contain larger fractions of fine-grained suspended/bedload sediment, and are closer to historical sources of contamination. Because of these factors, contamination testing is required prior to in-water or unconfined beneficial use placement, and subsequent testing occurs on a regular basis.

The suitability determination, prepared under the Dredged Material Management Program for maintenance dredging to −36 feet MLLW (i.e., Alternative 1), showed that all sediments are suitable for open-water placement. Further explanation of channel sediment suitability is provided in Sections 3.7 and 4.7, *Water Quality and Sediment Characterization*, as related to the affected environment and environmental consequences, respectively.

2.2.2.3 Dredged Material Placement Method and Equipment

Dredged material is transported to open water placement sites by either a bottom-dump hopper dredge (defined above) or by a tugboat and bottom-dump (or split-hull) barge. These vessels generally have the ability to transport between 800 and 6,000 cubic yards of material each trip. The number of barge discharges per day is typically three to five, but this number varies depending on the extent of the dredging activity occurring at the time. A tug tows the barge to the open water placement site and releases the dredged material near the updrift boundary of the open water site. This allows the material to be fully released within the site boundary as currents typically result in the drift of the barge during placement. Target zones are specified annually within each open water placement site and are dependent on site capacity at the start of the dredge year. Strategic placement of dredged materials is necessary to ensure long-term site capacity and to minimize the potential for sediments to re-enter the navigation channel. Pre and post placement monitoring surveys are performed before and after placement of maintenance dredged material from the outer and inner harbor navigation channel. Some outer harbor material is typically placed at three beneficial use sites, including the South Beach nourishment site, the Half Moon Bay nearshore nourishment site, and the upland Point Chehalis Revetment Extension mitigation site. The purpose of the latter two placement sites is to maintain a stable beach profile west of the Point Chehalis revetment and to ensure that the armor stone toe of the revetment is not exposed. Sandy material is placed as close to shore as possible (nearshore nourishment), in accordance with the 1998 Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement. Half Moon Bay is a high energy environment, subject to erosion. The nearshore nourishment site is used for material placement as bathymetric conditions permit (i.e., when the bay is deep enough for the bottom dump barge or hopper dredge to navigate). Typically the Corps uses its shallowest draft hopper dredge (MV *Yaquina*) to place material at the Half Moon Bay site. Dredged

material is placed so that material will be transported, via natural processes, to the nearshore and intertidal areas to assist in maintaining existing stable beach profile.

The upland Point Chehalis Revetment Extension mitigation site was filled in 2002 with sand from the navigation channel described in the 2011 EA (Corps 2011). A hydraulic pipeline has typically been used when placing outer harbor materials at the upland Point Chehalis Revetment Extension mitigation site. A hopper dredge full of a sand and water slurry docked at the existing rock dock at Firecracker Point and pumped the slurry through a pipeline to the mitigation site. Firecracker Point is a jetty extension located on the southeastern side of the southeastern entrance to the Westport Marina. Booster pumps are required to pump the slurry 1.7 miles across-town. The temporary pipeline was installed in 1994, and is buried along the road that generally crosses the Westport peninsula from Firecracker Point to Half Moon Bay. The slurry of sand and water was discharged to the area in front of the buried revetment. A sand berm/perimeter dike separates the discharge area from Half Moon Bay. The slurry of water and sand temporarily ponds in the placement site, and water is conveyed via effluent pipe into Grays Harbor at the exposed rock revetment near Groin A. A water quality monitoring plan was implemented in accordance with an approved Water Quality Certification issued by Ecology. The sandy dredged material would quickly dewater and a bulldozer was used to grade the sand uniformly over the placement area (Figure 8). Material placed above MHHW in the Point Chehalis Revetment Extension mitigation site is expected to subsequently erode through natural processes, with portions of the material entering the intertidal zone and thus the littoral system.

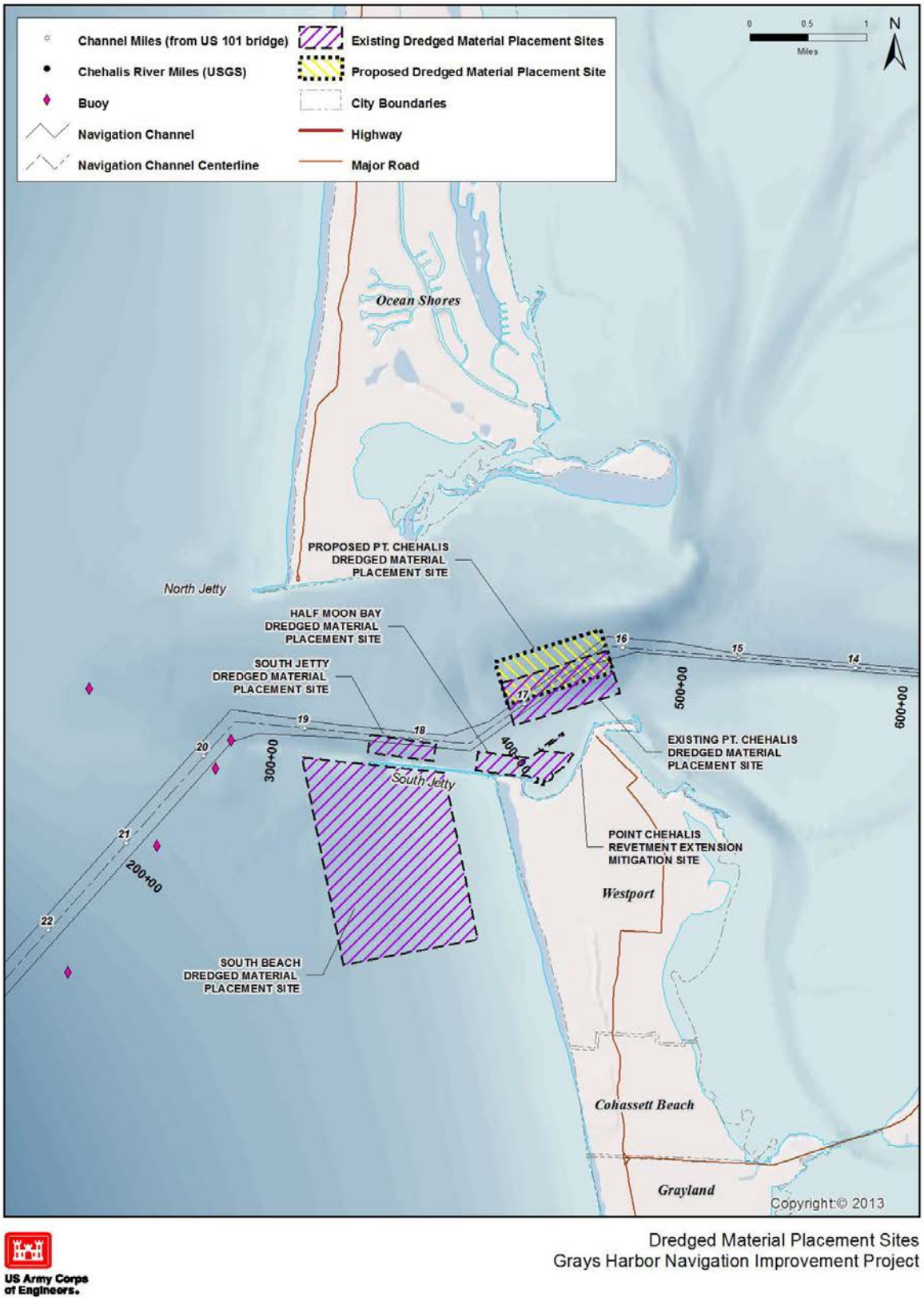
Figure 8. Direct beach pump ashore from a hopper dredge via a floating pipeline (over North Jetty of Columbia River onto Benson Beach, 2008). Note sand berms to contain material.

2.3 Alternative 2—Deepen Channel to −37 Feet MLLW

Alternative 2 would implement the proposed action by deepening the navigation channel an additional one foot, compared to baseline conditions (Alternative 1), to a depth of −37 feet MLLW. Following deepening, the channel would thereafter be maintained at the new design depth of -37 feet MLLW for a period of 50 years, through annual maintenance dredging in a manner identical to Alternative 1 with the exception of a minor increase in dredged material volumes. Under this alternative the nature of the dredging would be similar to Alternative 1 with some minor modifications as further detailed in this section. Construction dredging of Alternative 2 would occur within the same dredge work window as under Alternative 1. Dredging duration would be approximately 6 months for the inner harbor reaches, or 1.5 months longer than under Alternative 1. The dredging of the outer harbor reaches would occur in the April to June work window for hopper dredging and 1 August to 14 February in Outer Cross Over Reach if a clamshell dredge is used, the same as under Alternative 1. In Cow Point Reach, dredging may require use of a barge-mounted long reach excavator to rip hard substrate in the channel prior to dredging to achieve full channel depth. Previous subsurface explorations have determined sandstone exists near the upstream portion of the channel reach adjacent to Port Terminal 4. This methodology has been shown to be successful for dredging sandstone in New York Harbor. Dredged materials would

be deposited at the placement sites used during maintenance dredging under baseline conditions (Half Moon Bay, South Jetty, and South Beach), and would include a shift to the Point Chehalis site and upland placement of unsuitable material.

The Corps recently completed a dredged material placement site capacity analysis for the Point Chehalis placement site to estimate short-term and long-term fate of channel deepening sediments and subsequent annual maintenance sediments that could be deposited at this site (Hayter et al. 2012). Based on sediment transport modeling and Sedflume analysis conducted (Demirbilek et al. 2010; Hayter et al. 2012) it was determined placing all dredged material within the current PCS boundaries may pose an adverse risk to navigation and O&M dredging costs. The unique grain size and other characteristics of dredged material derived from channel deepening make those sediments likely to accumulate within the placement sites at a faster rate than recently accrued material derived from maintenance dredging, based on historical trends of O&M material (Hayter et al. 2012). The Federal navigation channel passes through the site and mounding of material can result in loss of channel depth and width without proper site management. The site capacity analysis recommended a 1,000-foot north-northwestern shift in the placement site and placement of dredged materials over the entire placement site (Figure 9). This shift produces less sedimentation in the navigation channel and less accumulation above authorized channel depths over the course of dredged material placement (Hayter et al. 2012). As a result of the site capacity analysis, the Corps would place dredged material at the Point Chehalis placement site under Alternative 2 as per this recommended shift (as described in Appendix G). This placement site shift would not increase the size of the Point Chehalis Site and would be a temporary one time shift to accommodate the volumes of material to be placed during the construction year by taking advantage of deeper water and more dispersive hydrodynamics. The site would be shifted back after the construction year's activities of deepening are completed.



US Army Corps of Engineers.

Dredged Material Placement Sites
Grays Harbor Navigation Improvement Project

Figure 9. Point Chehalis Placement Site Shift for Alternatives 2 and 3.

The latest suitability determination, prepared under the Dredged Material Management Program (Appendix A), showed that a vast majority (more than 98%) of the sediments from the inner harbor reaches are suitable for open-water placement. Approximately 13,500 cubic yards of sediment that would be dredged during construction of Alternative 2 from the Cow Point 32a subunit are unsuitable for open-water disposal because of toxicity expressed in the sediment larval bioassay. This material would require appropriate upland disposal. Further explanation of channel sediment suitability is provided in Sections 3.7 and 4.7, *Water Quality and Sediment Characterization*, as related to the affected environment and environmental consequences, respectively.

The approximately 13,500 cubic yards of material determined to be unsuitable for open water disposal underwent extensive testing, consisting of three rounds of chemical analysis and bioassays (Appendix A). In the first round of chemical testing, the material exceeded the DMMP screening level for benzyl alcohol, but in subsequent rounds this chemical was either below the screening level or undetected. Bioassay testing results were equivocal, with the same species of amphipod exhibiting toxicity in one test but not another; and with the larval bioassay results ranging from no toxicity to significant toxicity depending on the testing round and termination protocol used. The uncertainty surrounding bioassay results for this material and adjacent material was compounded by elevated levels of ammonia. The ammonia results were unequivocal for the final round of amphipod testing and the amphipod results were rejected as a result. However, an analysis of the sediment larval data relative to ammonia did not provide unequivocal evidence that ammonia was responsible for the toxicity exhibited in the larval test. Therefore, the DMMP agencies made an environmentally conservative call and found the material in subunit CP32a unsuitable for open-water disposal. However, the material is not a Resource Conservation and Recovery Act regulated material (not a hazardous waste) and does not pose a human health risk. Risk to human health and higher-order ecological receptors are assessed by exceedances of the DMMP bioaccumulation triggers (and bioaccumulation testing in the event that bioaccumulation triggers are exceeded). Benzyl alcohol is not a bioaccumulative chemical of concern and, therefore, does not have a bioaccumulation trigger. There were no bioaccumulation trigger exceedances for any of the chemicals of concern tested for this project.

The unsuitable material will be clamshell dredged. Implementation of best management practices – such as control of the speed of the dredging bucket during descent and ascent – and compliance with the water quality monitoring plan will ensure that turbidity is reduced to the maximum extent possible during dredging. Dredged material will be placed in a fully fenced haul barge where it will be dewatered through filtered scuppers to control turbidity in water returning to Grays Harbor. Contaminants are generally associated with the sediment itself and with suspended sediment particles in the water column. By minimizing the loss of suspended particles during dewatering, loss of any chemical contaminants associated with the sediment will also be minimized. The dredged material would be dewatered and taken by barge to be offloaded at nearby Port of Grays Harbor Terminal 3 (a distance of less than 4 miles) and is slated to be trucked the short distance to the former Hoquiam city wastewater treatment lagoon for offload (less than half-a-mile), and dumped from the transport trucks directly into the offload site. The dewatered dredged material would be mechanically transferred from the barge to trucks using an excavator or front load excavator. The lagoon is a former wastewater treatment pond formerly utilized by the city of Hoquiam for treatment of municipal sewage. Approval for usage will require acquisition of real estate interests and any applicable State permits which will be obtained by the Port of Grays Harbor. The methodology for placing the material is expected to consist of dredging via clamshell dredge and barge with mechanical rehandling of material on land. During dredging the barge would be lined with geotextile fabric to prevent leakage. The barge would be transported to Port of Grays

Harbor Terminal 3 and dewatered through a sump pump with a geofabric bag surrounding the discharge pipe to contain sediments. Land-based equipment would be used to transfer and transport the dewatered dredged material from the barge to the placement area. The site is bermed with containment dikes on the southern and eastern sides so minimal earthwork would be required to contain the dredged material within the former lagoon footprint. Upon placement along the southern edge of the former waste water treatment lagoon, which would be staked in the field in the location depicted in Figure 10, the deposited material would be backgraded to stabilize the positioning of the material within the designated footprint. The Corps expects the Port of Grays Harbor to acquire and thereafter own the parcel on which the former wastewater treatment lagoon is located. The Port is expected to further develop the property following placement of dredged material, and thus will assume responsibility for any monitoring, maintenance, and adaptive management of that material following placement.

Other upland sites were considered for disposal of unsuitable dredged material during the construction year, if the necessary real estate interests in the former wastewater treatment plant cannot be acquired. Alternative sites considered were the Terminal 3 Uplands, Industrial Development District #1, and Slip One. The effects of disposal at any of these alternative sites are anticipated to be closely similar to the effects of placement at the former Hoquiam wastewater treatment plant. Currently, the Hoquiam Waste Water Treatment Lagoon area represents the most feasible and least costly (particularly in terms of transportation costs) area for the placement of unsuitable material. Land use for the former waste water treatment lagoon upland disposal site includes foreseeable future development regardless of whether it is used for the placement of the modest volume of unsuitable material derived from the deepening or not. Any alternative location chosen for this material would go through the appropriate disclosure and permitting as applicable.

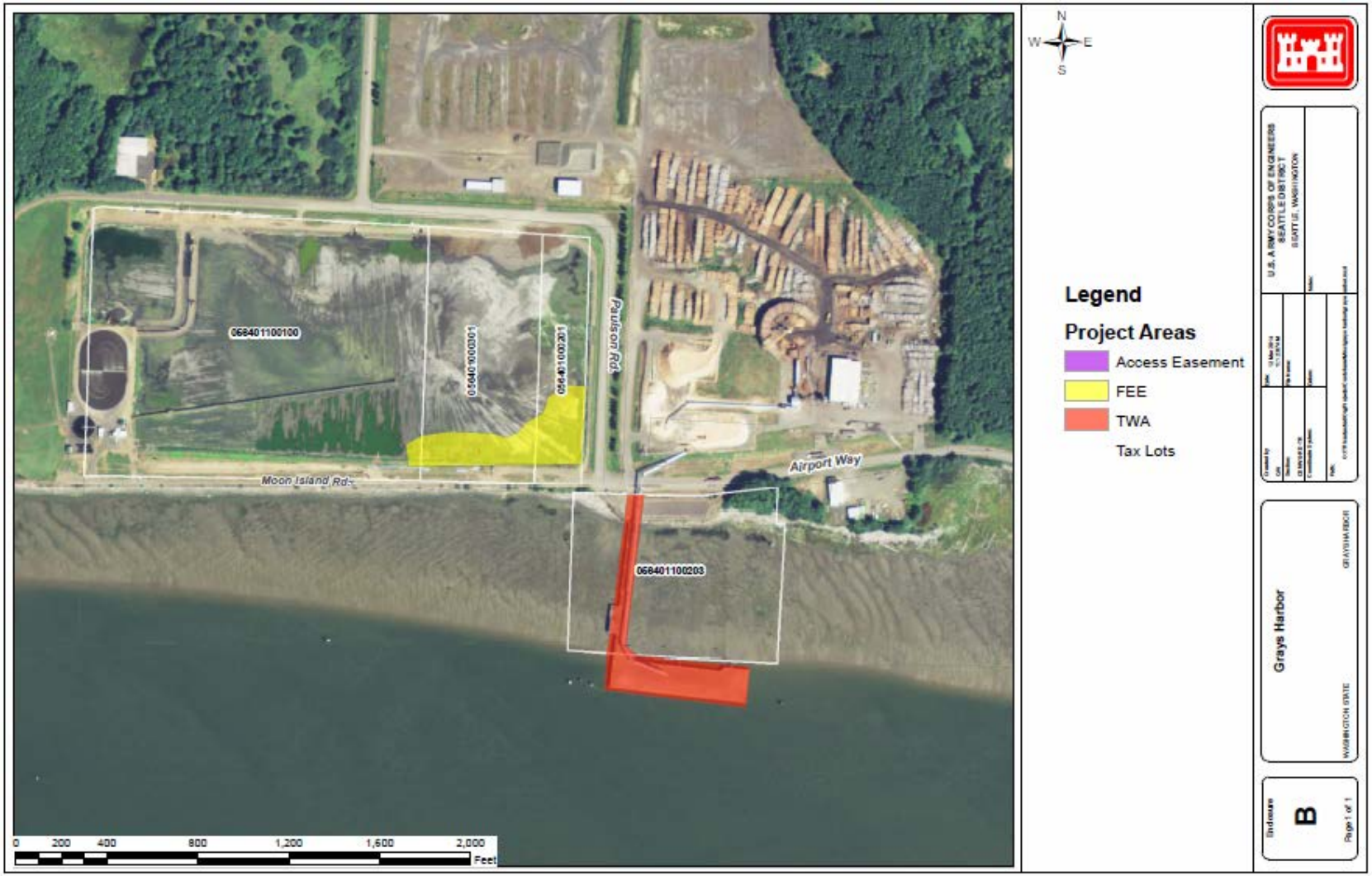


Figure 10. The City of Hoquiam Wastewater treatment lagoon, located near Terminal 3 at the Port of Grays Harbor, for Alternatives 2 and Alternative 3.

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The upland Point Chehalis Revetment Extension mitigation site would be recharged when feasible with dredged material from a hopper dredge with hydraulic pump-ashore capability. The hopper would dredge sand from the navigation channel and transit to a mooring dolphin within Half Moon Bay and hydraulically pump dredged material via a floating or submerged pipeline into the mitigation site. Water discharged from the dredge slurry would be contained by dikes around the perimeter of the mitigation site. The sandy dredged material would quickly dewater and a bulldozer would grade the sand uniformly over the placement area. The slurry of water and sand would temporarily pond in the placement site as the dredged sediments settle out of suspension, and decant water would be conveyed via effluent pipe into Grays Harbor at the exposed rock revetment near Groin A. A water quality monitoring plan would be implemented in accordance with an approved Water Quality Certification issued by Ecology. As with Alternative 1, material placed above MHHW in the Point Chehalis Revetment Extension mitigation site is expected to subsequently erode through natural processes, with portions of the material entering the intertidal zone and thus the littoral system.

The volumes estimated to dredge to -36 feet MLLW prior to any deepening (Table 2-1) are from the 2011 EA (Corps 2011) and are based on the average amount dredged from 2000 to 2010 plus one standard deviation. Actual volumes in the deepening construction year would be determined based on bathymetric surveys of the channel just prior to deepening.

Annual maintenance dredging to -36 feet MLLW would be required to be performed in the same year as the deepening construction dredging. The estimated volume of material to be removed during dredging from the maintained depth of -36 feet MLLW to the deepened depth of -37 feet MLLW and the anticipated volume removed annually during maintenance dredging attributable to the deepening are shown in Table 2-3. The volumes listed include 2 feet of advance maintenance and 2 feet of allowable overdepth. Maintenance dredging to reach -36 feet MLLW in the deepening reaches is estimated at 2,090,000 cubic yards. Thus total volumes dredged for both maintenance to -36 feet and deepening from -36 feet to -37 feet MLLW in the construction year requires an estimated 3,121,000 cubic yards (Table 2-3, column 3). However, the environmental impacts analysis for this document is focused on the deepening volumes (above 2,090,000cubic yards) and subsequent increased maintenance attributable to that deepening (50,000 cubic yards annually).

Initial deepening of the channel by 1 foot would require excavation (and placement) of an additional 1,031,000 cubic yards of sediment. Subsequent annual maintenance volumes for project operation are estimated to increase by approximately 50,000 cubic yards annually over the 50 year project span. This represents an increase in annual maintenance dredging of 2% to maintain the channel at -37 feet MLLW.

All volume estimates take into account the reduced amounts attributable to the minor channel re-alignment that has previously been evaluated and will have been undertaken prior to the execution of this proposed action. The estimated dredge volumes presented here and environmental evaluation of potential effects of channel deepening in this SEIS are assessed in light of prior implementation of the minor channel alignment modification.

Table 2-3. Estimated Dredged Material Volumes (cubic yards) by Reach to Deepen Navigation Channel from −36 Feet MLLW to −37 Feet MLLW under Alternative 2.

Navigation Channel Reach	Average annual dredging to maintain channel at – 36 feet MLLW (Alternative 1)	Channel Deepening[a] from average annual maintenance volume to −37 feet MLLW[a] (Alternative 2)	Total dredged in Construction year	Annual increase in Maintenance Dredging attributable to deepening to -37 feet MLLW[c]
Inner Harbor Reaches				
Cow Point[b]	965,000	16,000	981,000	10,000
Hoquiam	150,000	521,000	671,000	11,000
North Channel	175,000	196,000	371,000	8,000
Inner Crossover	375,000	221,000	596,000	8,000
Outer Harbor Reaches				
Outer Crossover	235,000	95,000	330,000	7,000
South	190,000	-18,000[d]	172,000	6,000
Total	2,090,000	1,031,000	3,121,000	50,000

[a] Includes advance maintenance and allowable overdepth dredging volumes; initial channel deepening volumes obtained from the August 2013 condition survey by the Corps vessel *Shoalhunter*.

[b] Volumes include the Cow Point Turning Basin.

[c] Increased annual maintenance attributable to the 1 foot incremental deepening from -36 ft to -37 ft MLLW (Rosati 2004)

[d] Negative number is due to the volume required to dredge to -37 feet is less than the historical average baseline volume dredged in South Reach, due to channel realignment resulting in reduced dredging volume .

2.4 Alternative 3—Deepen Channel to −38 Feet MLLW

Alternative 3 would implement the purpose and need by deepening the navigation channel an additional two feet, compared to baseline conditions (Alternative 1), to a depth of −38 feet MLLW. Following deepening, the channel would thereafter be maintained at the new design depth of -38 feet MLLW for a period of 50 years, through annual maintenance dredging in a manner identical to Alternative 1 with the exception of a minor increase in dredged material volumes. Under this alternative, project construction (i.e., initial dredging), including scheduled work periods, types of equipment, and methods for dredged material placement, would be implemented as described for construction dredging under Alternative 2. Construction dredging of Alternative 3 would occur over approximately six months for the inner harbor reaches (the same as Alternative 2), and would occur within the same seven month dredge window as under Alternatives 1 and 2. The duration of dredging for the outer harbor reaches would be approximately 1 month, the same as under Alternatives 1 and 2. Dredged materials would be deposited at the placement sites as identified in Alternative 2, using the same prioritization methodology. An additional clamshell dredge and barge would be needed under this alternative.

Approximately 22,400 cubic yards of sediment that would be dredged during construction of Alternative 3 from the Cow Point 32a subunit are unsuitable for open-water disposal because of toxicity expressed in the sediment larval bioassay. This material would be handled and placed as described in Section 2.3 for Alternative 2 and shown in Figure 10 above.

Initial deepening of the channel by 2 feet would require excavation (and placement) of an additional 1.972 million cubic yards of sediment beyond that volume of dredging estimated in the 2011 EA (Corps 2011) to a depth of -36 feet MLLW. Subsequent annual maintenance volumes are estimated to increase by 107,000 cubic yards. This represents an increase in annual maintenance dredging of 5% to maintain the channel at -38 feet MLLW.

The estimated volume of material to be dredged during project construction and the anticipated volume removed annually during maintenance dredging are shown in Table 2-4. As is the case with Alternative 2, annual maintenance dredging to -36 feet MLLW would be required to be performed in the same year as the deepening construction dredging. Maintenance dredging to reach -36 feet MLLW in the deepening reaches is estimated at 2,090,000 cubic yards. Thus total volumes dredged for both maintenance to -36 feet and deepening from -36 feet to -38 feet MLLW in the same year requires an estimated 4,062,000 cubic yards (Table 2-4, column 3). However, the environmental impacts analysis for this document is focused on the deepening volumes (above 2,090,000 cubic yards) and subsequent increased maintenance attributable to that deepening (107,000 cubic yards annually). The volumes listed include 2 feet of advance maintenance and 2 feet of allowable overdepth.

Table 2-4. Estimated Dredged Material Volumes (cubic yards) by Reach to Deepen Navigation Channel From –36 Feet MLLW to –38 Feet MLLW under Alternative 3

Navigation Channel Reach	Average annual dredging to maintain channel at – 36 feet MLLW (Alternative 1)	Channel Deepening[a] from average annual maintenance volume to –38 feet MLLW (Alternative 3)	Total dredged in Construction year	Annual increase in Maintenance Dredging attributable to deepening to -38 feet MLLW[c]
		Inner Harbor Reaches		
Cow Point[b]	965,000	193,000	1,158,000	21,000
Hoquiam	150,000	708,000	858,000	22,000
North Channel	175,000	344,000	519,000	17,000
Inner Crossover	375,000	356,000	731,000	16,000
		Outer Harbor Reaches		
Outer Crossover	235,000	231,000	466,000	16,000
South	190,000	140,000	330,000	15,000
Total	2,090,000	1,972,000	4,062,000	107,000

a Includes advance maintenance and allowable overdepth dredging volumes; initial channel deepening volumes obtained from the August 2013 condition survey by the Corps vessel *Shoalhunter*.
b Volumes include the Cow Point Turning Basin.
c Increased annual maintenance attributable to the 2 foot incremental deepening from -36 ft to -38 ft MLLW (Rosati 2004)

2.5 Comparison of Alternatives

Due to the dynamic nature of the project area annual maintenance dredging would be accomplished in the same dredge year (same dredge windows; see table 2-1 for description of dredge windows by reach) with the same equipment (Clamshell for Crossover Reach inward and hopper dredge for outer reaches). Placement sites would include South Jetty, Half Moon Bay, and the shifted Point Chehalis site, as well as beneficial use sites at South Beach, Half Moon Bay, and the Point Chehalis Revetment Extension mitigation site. Upland disposal would be utilized for the volumes (13,500 cubic yards for Alternative 2 and 22,400 cubic yards for Alternative 3) determined unsuitable for open water disposal. The volumes estimated to dredge to -36 feet MLLW prior to any deepening (Tables 2-1; 2-3; 2-4; and 2-6) are from the 2011 EA (Corps 2011) and are based on the average amount dredged from the reaches to be deepened from 2000 to 2010 plus one standard deviation. Actual volumes in the deepening construction year would be determined based on bathymetric surveys of the channel. Table 2-5 summarizes the assumptions for the three alternatives that were taken into consideration for the environmental consequences discussion in Chapter 4. Additionally, this section presents a comparison of the volumes dredged under each alternative (Table 2-6), which is also included in the environmental consequences analyses in Chapter 4.

Table 2-5 presents a summary of the assumptions for each alternative, including basic information assumed for all three alternatives; information related to maintenance dredging, following initial

deepening during the construction year, of the inner and outer reaches of Grays Harbor under Alternatives 1, 2, and 3; as well as information related to the deepening of the inner and outer reaches of Grays Harbor under Alternatives 2 and 3. The main differences between the alternatives are the duration of dredging, the number of dredges and barges needed, and the volume of material dredged and placed at the dredged material placement sites.

Table 2-5. Summary of Assumptions

Basic Information Assumed for All Alternatives
Minor channel alignment modification has been previously implemented
Offroad diesel fuel burned in all dredging equipment
Tier 0 engines used on all equipment except hydraulic (hopper) dredges (*Essayons* and *Yaquina*)
Tier 2 engines for hydraulic dredges[1]
Equipment is not operating at full power the entire time of operation (typically a clamshell dredge, while operating 24 hours will be dredging up to 18 hours/day)
22 hours of operation per day for hopper dredges
7 days of operation per week for all dredging equipment
Maintenance—Inner Harbor Reaches, All Alternatives
1 Clamshell Dredge (total horsepower for main and auxiliary engines = 2,340 hp)[2]
1 Tugboat (total horsepower for main and auxiliary engines = 1,534 hp)[3]
4.5 months of activity
Dredging period: July 16 to February 14 (Cow Point and Hoquiam reaches) August 1 to February 14 (North Channel and Inner Crossover reaches)
Maintenance—Outer Harbor Reaches
2 Hydraulic (hopper) Dredges (one with pump ashore capability may be required)
MV Essayons total horsepower for main and auxiliary engines = 31,481 hp[1]
MV Yaquina total horsepower for main and auxiliary engines = 5,500 hp[1]
A hopper dredge with pump ashore capability may replace one of the two Corps owned vessels above (it is assumed that this dredge would have similar characteristics to *Essayons*)
Up to 1 month of activity
Dredging period: South reach (April 1 to June 30)

Alternative 1[4]	Alternative 2 Deepening	Alternative 3 Deepening
Deepening—Inner Harbor Reaches		
1 clamshell dredge	1 clamshell dredge	2 clamshell dredges
1 tugboat	1 tugboat	1 tugboat
4.5 months of activity	6 months of activity	6 months of activity
Dredging period: July 16 to February 14 (Cow Point and Hoquiam reaches) August 1 to February 14 (North Channel and Inner Crossover reaches)	Dredging period: July 16 to February 14 (Cow Point and Hoquiam reaches) August 1 to February 14 (North Channel and Inner Crossover reaches)	Dredging period: July 16 to February 14 (Cow Point and Hoquiam reaches) August 1 to February 14 (North Channel and Inner Crossover reaches)

Alternative 1[4]	Alternative 2 Deepening	Alternative 3 Deepening
Deepening—Inner Harbor Reaches		
Use of existing placement sites	Minor shift in Point Chehalis Open Water Placement Site for dredged material placement	Minor shift in Point Chehalis Open Water Placement Site for dredged material placement
No unsuitable material	Upland disposal of 13,500 cubic yards of unsuitable material	Upland disposal of 22,400 cubic yards of unsuitable material
Deepening—Outer Harbor Reaches		
2 hydraulic (hopper)dredges (*Essayons and Yaquina*); operation of both vessels may occur simultaneously	2 hydraulic (hopper)dredges (one may have pump ashore capability); operation of both vessels may occur simultaneously	2 hydraulic (hopper) dredges (one may have pump ashore capability); operation of both vessels may occur simultaneously
1 month of activity	1 month of activity	1 month of activity
Dredging period: Outer Cross-over April 1 to 31 May (for hopper dredging) or August 1 to February 14 (for clamshell dredging) to South Reach (April 1 to June 30	Dredging period: Outer Cross-over April 1 to 31 May (for hopper dredging) or August 1 to February 14 (for clamshell dredging) to South Reach (April 1 to June 30	Dredging period: Outer Cross-over April 1 to 31 May (for hopper dredging) or August 1 to February 14 (for clamshell dredging) to South Reach (April 1 to June 30
Use of existing placement sites	Minor shift in Point Chehalis Open Water Placement Site for dredged material placement	Minor shift in Point Chehalis Open Water Placement Site for dredged material placement

1 http://www.nwp.usace.army.mil/Missions/Navigation/Vessels.aspx
2 U.S. Army Corps of Engineers 2009.
3 ICF International 2009.
4 No channel deepening would be conducted under Alternative 1 (maintenance dredging would be conducted per the 2011 Environmental Analysis)).
5 Engine 'tier' based on engine displacement, power, speed, and model year, which create exhaust emissions standards (http://www.epa.gov/otaq/standards/nonroad/marineci.htm).

Table 2-6 presents a comparison of the volumes dredged under each alternative.

Deepening the navigation channel from −36 feet MLLW to −37 feet MLLW under Alternative 2 would require removal of an additional 1,031,000 cubic yards of material above the amount estimated in the 2011 EA (Corps 2011). Approximately 954,000 cubic yards would be removed from the inner harbor reaches and turning basin to deepen the channel over a dredging duration of approximately 6 months via one clamshell dredge and one tug and barge. Approximately 77,000 cubic yards would be removed from the outer harbor reaches under this alternative via two hydraulic dredges, over a dredging duration of approximately one month. Additional annual maintenance dredging attributable to Alternative 2 deepening is estimated at 50,000 cubic yards annually over the 50 year project span.

Deepening the navigation channel from −36 feet MLLW to −38 feet MLLW under Alternative 3 would require removal of an additional 1,972,000 cubic yards of material, as compared to Alternative 1. Approximately 1,601,000 cubic yards would be removed from the inner harbor reaches and turning basin. Dredging of the inner reaches would be accomplished with two clamshell dredges and two tugs removing approximately 371,000 cubic yards over approximately 6 months under Alternative 3. Dredging of the outer harbor reaches would be accomplished with two hydraulic dredges over approximately one month under Alternative 3. Additional annual maintenance dredging

attributable to Alternative 3 deepening is estimated at 107,000 cubic yards annually over the 50 year project span.

Table 2-6. Estimated Dredged Material Volumes (cubic yards) by Reach under Each Alternative for the construction year and future operation (maintenance)

Navigation Channel Reach	Alternative 1	Alternative 2			Alternative 3		
		Construction Year	Operation & Maintenance		Construction Year	Operation & Maintenance	
	Average Annual Maintenance Volume[a] (2011 EA volumes)	Channel Deepening to -37 ft MLLW (2013 Estimate)	Increase in Maintenance Dredging Volume from average annual dredging to -37 ft MLLW (Rosati 2004)	Average Annual Maintenance Volume to -37 ft MLLW	Channel Deepening to -38 ft MLLW (2013 Estimate)	Increase in Maintenance Dredging Volume from average annual dredging to -38 ft MLLW (Rosati 2004)	Approximate Average Annual Maintenance Volume to -38 ft MLLW
Inner Harbor Reaches							
Cow Point[b]	965,000	981,000	10,000	975,000	1,158,000	21,000	986,000
Hoquiam	150,000	671,000	11,000	161,000	858,000	22,000	172,000
North Channel	175,000	371,000	8,000	183,000	519,000	17,000	192,000
Inner Crossover	375,000	596,000	8,000	383,000	731,000	16,000	391,000
Subtotal	1,665,000	2,619,000	37,000	1,702,000	3,266,000	76,000	1,741,000
Outer Harbor Reaches							
Outer Crossover	235,000	330,000	7,000	242,000	466,000	16,000	251,000
South Reach	190,000	172,000	6,000	196,000	330,000	15,000	205,000
Subtotal	425,000	502,000	13,000	438,000	796,000	31,000	456,000
TOTAL	2,090,000	3,121,000	50,000	2,140,000	4,062,000	107,000	2,197,000

[a] Volumes are averages, plus one standard deviation, computed based on the last 10 years of dredging records, from 2000 to 2010. Thus, the actual volumes dredged in the past may be more or less than those shown in the table (USACE 2011). This represents the annual O&M dredging expected over the project life cycle following Construction.

[b] The Cow Point Reach volumes include the Cow Point Turning Basin.

2.6 Alternatives Considered but Eliminated from Detailed Analysis

The following sections describe three additional alternatives that were considered for this SEIS, but ultimately eliminated from detailed analysis because they did not meet the purpose and need or are not technically feasible.

2.6.1 Discontinue Maintenance Dredging

Under this alternative, maintenance dredging of the Grays Harbor navigation channel would cease. Natural shoaling would occur and shoaled sediments would not be removed by the Corps.

This alternative would result in minimal or no effects on the aquatic environment as a result of dredging and placement of dredged materials because no dredging would take place; however, the problems for marine traffic caused by present shoaling would worsen as sediments accumulate. The navigation channel would continue to accumulate sediments, which would reduce the depths of the channel to less than the currently maintained depth, greatly restricting use by large ocean-going vessels. This would likely have a negative effect on the local economy by limiting reliable transportation to and from the Port of Grays Harbor. This alternative does not meet the purpose and need for the proposed action because it does not alleviate present restrictions on large-vessel traffic, and would require congressional authorization.

2.6.2 Dredging Beyond −38 Feet MLLW

Under this alternative, the navigation channel would be deepened beyond −38 feet MLLW to provide a deeper channel that would allow passage for larger ships. This alternative does not meet the purpose and need for the project, as it is not within the parameters of the navigation channel as legislatively authorized. Furthermore, based on the Categorical Exemption of ER 1105-2-100, the Corps is not required to analyze project plans greater (deeper) than the plan desired by the sponsor (U.S. Army Corps of Engineers 2000). In accordance with the Categorical Exemption, the scope for the action alternatives was limited to deepening the navigation channel to −38 feet MLLW. Because dredging beyond this depth is outside the scope of this analysis and would require congressional authorization, it was eliminated from further analysis.

2.6.3 Major Realignment of the Navigation Channel

This alternative would involve a large-scale realignment of the Grays Harbor navigation channel to potentially reduce shoaling and the consequent need for annual maintenance dredging and/or deepening the channel. In accordance with the Categorical Exemption of ER 1105-2-100, described above, the scope for the action alternatives in this SEIS was limited to deepening the existing navigation channel to −38 feet MLLW. A large-scale realignment of the navigation channel was eliminated from further analysis because it would not meet the purpose and need because it is not within the parameters of the navigation channel as legislatively authorized and would require congressional authorization and is, therefore, outside the scope of this of this analysis.

Chapter 3
Affected Environment

Introduction

This chapter provides the environmental and regulatory setting for each of the resources that could be affected by implementing any of the alternatives as defined in Chapter 2, *Alternatives*. The environmental setting describes the study area and existing conditions of each resource and the depth of discussion for each resource is based on the potential degree of impact to that resource. Within the regulatory setting, applicable laws, regulations, permits, and policies associated with the resource are identified.

The following resources areas are analyzed in this SEIS:

- Marine transportation
- Geomorphology
- Aquatic and terrestrial vegetation
- Invertebrates, fish, and wildlife
- Threatened and endangered species
- Historic and cultural resources
- Water quality and sediment characterization
- Air quality, noise, and artificial lighting
- Land use and aesthetics
- Recreation
- Global climate change
- Local economy/socioeconomics
- Environmental justice communities
- Indian treaty rights
- Placement site environment

Most of the resource areas listed above were also addressed in the Grays Harbor, Chehalis and Hoquiam Rivers, Washington Channel Improvements for Navigation Interim Feasibility Report and Final Environmental Impact Statement (1982 EIS) and its supplement (1989 SEIS) and have been incorporated by reference into this SEIS. The following resource areas have been added to this SEIS for consistency with the resources typically analyzed by the Corps in maintenance dredging NEPA documents (U.S. Army Corps of Engineers 2001): marine transportation, aquatic and terrestrial vegetation, land use and aesthetics, recreation, global climate change, and environmental justice communities.

3.1 Marine Transportation

This chapter summarizes the marine vessel activities in the navigation channel in Grays Harbor and describes the channel's importance to those vessels.

3.1.1 Marine Terminal Activity

This section reviews the trends of cargo activity and vessel calls at Port marine terminals and describes the changing characteristics of the commercial vessel fleet serving the terminals.

3.1.1.1 Description of Terminals

The Port has four marine terminals. The terminals are supported by large, paved, secured cargo yards, the Port's on-dock rail system, and more than 104,000 square feet of covered storage. In addition, the Port has a rail loop that goes through the entire facility. The Port is positioned centrally between the Pacific Northwest markets of Seattle, Washington, and Portland, Oregon. The Port of Grays Harbor is connected to its hinterlands by rail and U.S. Highway 101[3]. Figure 11, below, displays the terminals and their locations.

[3] The inland trade region served by a port is called its hinterland. That hinterland usually consists of a number of cargo hinterlands defined by the inland origins or destinations of specific commodities. Collectively, the cargo hinterlands of actual and potential commerce of the project port define the economic study area. (U.S. Army Corps of Engineers, Institute for Water Resources 2010)

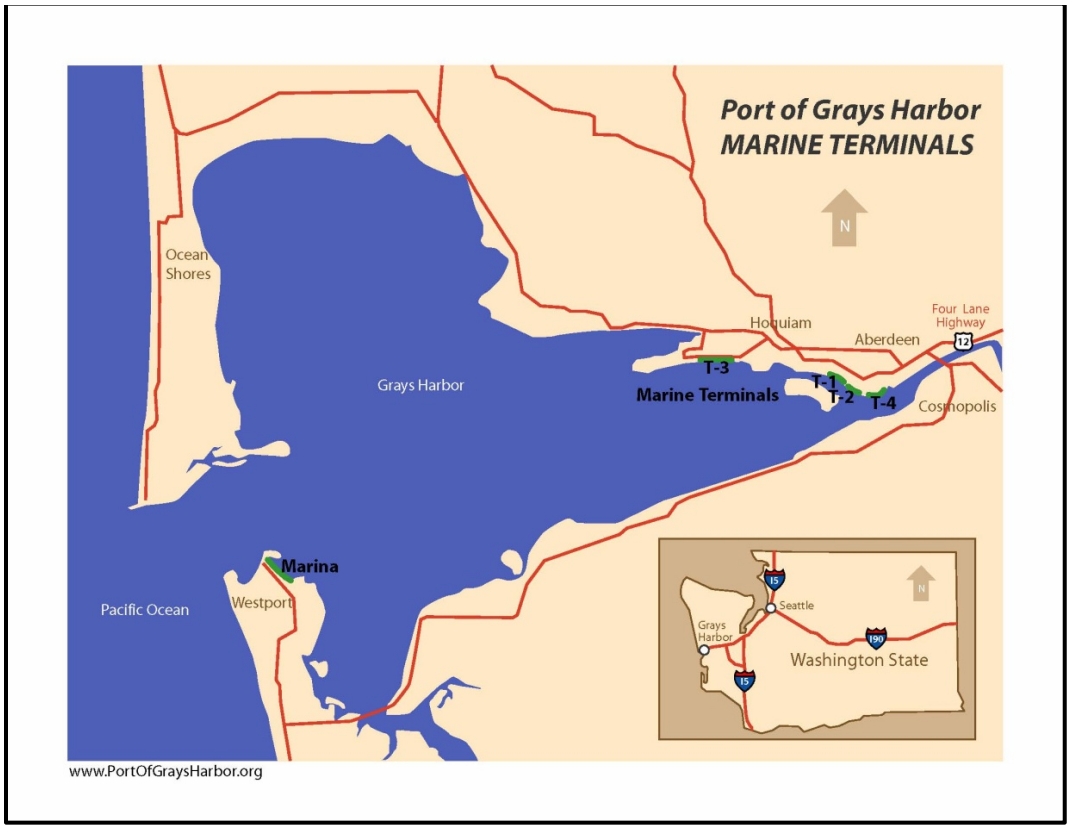


Figure 11. Terminals Vicinity Map

Table 3.1-1 provides a summary of the terminals; additional information on each terminal is provided in the following text.

Table 3.1-1. Summary of Existing Shipping and Receiving Facilities at Port of Grays Harbor

Terminal	Length (feet)	Depth (feet)	Use(s)
Terminal 1 Liquid Bulk	480	−41 MLLW	Bulk liquid
Terminal 2 Liquid Bulk	600	−41 MLLW	Liquid bulk
Terminal 2 AGP Facility	600	−41 MLLW	Agricultural products
Terminal 3	600	−41 MLLW	N/A
Terminal 4	1,400	−41 MLLW	Logs – break bulk - auto and Ro/Ro[a]

[a] Roll-on/roll-off vehicle-based shipping.
N/A = not available.

Terminal 1

Terminal 1 operates as a bulk liquid loading facility with adjacent upland storage area (Figure 12). It provides liquid bulk commodity shipping access to Port customers Imperium Renewables (Imperium) and Westway Terminal Company. It has a berthing depth of −41 feet MLLW, length of 480 feet, width of 50 feet, and is served, as are the other terminals, by an on-site rail loop (Port of Grays Harbor 2013).

Figure 12. Terminal 1

Imperium is planning for the construction of new storage tanks, rail infrastructure, and office space. Permits for these facilities will provide Imperium with the opportunity to develop an additional 10.7 acres within the Port and adjacent to the existing Imperium biodiesel plant. Imperium anticipates that the products stored on site will vary over the life of the facility, and may include biodiesel, ethanol, U.S. crude oil, jet fuel, gasoline, diesel, vegetable oil, and feed stock (Imperium Renewables 2013).

Terminal 2

Terminal 2 serves as a multi-type bulk loading facility. It has a berthing depth of −41 feet MLLW, a length of 600 feet, and a width of 100 feet (Figure 13). It includes 75 paved acres, secured cargo yard, and near-dock warehousing. The facility also includes enclosed conveyers that transport product from the silos, and the receiving building through a sampler and inline scales into the vessel. The Port, in conjunction with Ag Processing, Inc., a grower-owned cooperative in the Midwest, developed the state-of-the-art terminal (Port of Grays Harbor 2013).

Figure 13. Terminal 2

Terminal 3

Terminal 3 is an over 150-acre site with a deep-water marine terminal. It has a berthing depth of -41 feet MLLW, length of 600 feet, and width of 120 feet. The Port has installed on-site rail access, which is served by the Burlington Northern & Santa Fe (BNSF) and Union Pacific (UP) railroads (Figure 14). It is less than a mile from Bowerman Airport and linked to I-5 by a four-lane state highway (Port of Grays Harbor 2013). Grays Harbor Rail Terminal, LLC, is proposing a bulk liquids rail logistics facility at Terminal 3. The facility would be designed to handle liquid bulk, primarily crude oil or light oil. Grays Harbor Rail Terminal is conducting a feasibility study and is expected to be completed by year end 2014.

Figure 14. Terminal 3

Terminal 4

Terminal 4 is the Port's main general cargo terminal. It features over 100,000 square feet of dry, covered warehouse space, a rail loop with on-dock rail access to BNSF and UP railroads, a connection to I-5 via a four-lane state highway, 120 acres of paved cargo yard, and twin self-scouring deep-water berths (Figure 15). It has a berthing depth of −41 feet MLLW, length of 1,400 feet, and width of 100 feet. (Port of Grays Harbor 2013)

Figure 15. Terminal 4

3.1.1.2 Existing Infrastructure

Rail

Main line rail service to the industrial properties and marine terminals provides direct access to both Class 1 BNSF and UP railroads, via G&W's Puget Sound and Pacific short-line railroad. A rail loop runs through the marine terminal complex providing a continuous rail loop to all three main cargo terminals. Unit trains can be continuously loaded and unloaded using this infrastructure for movement through the Port's facilities. Auto tracks provide the auto-handling capacity at Terminal 4. A second rail loop was completed in 2012, providing all shippers with additional import and export handling capacity. An intermodal 2,800-lineal-foot on-dock rail system with direct discharge options and four parallel spurs is also available on Terminal 4 (Port of Grays Harbor 2013).

Figure 16 and Figure 17 provide maps of the rail system linking the Port of Grays Harbor with the regional and national rail system.

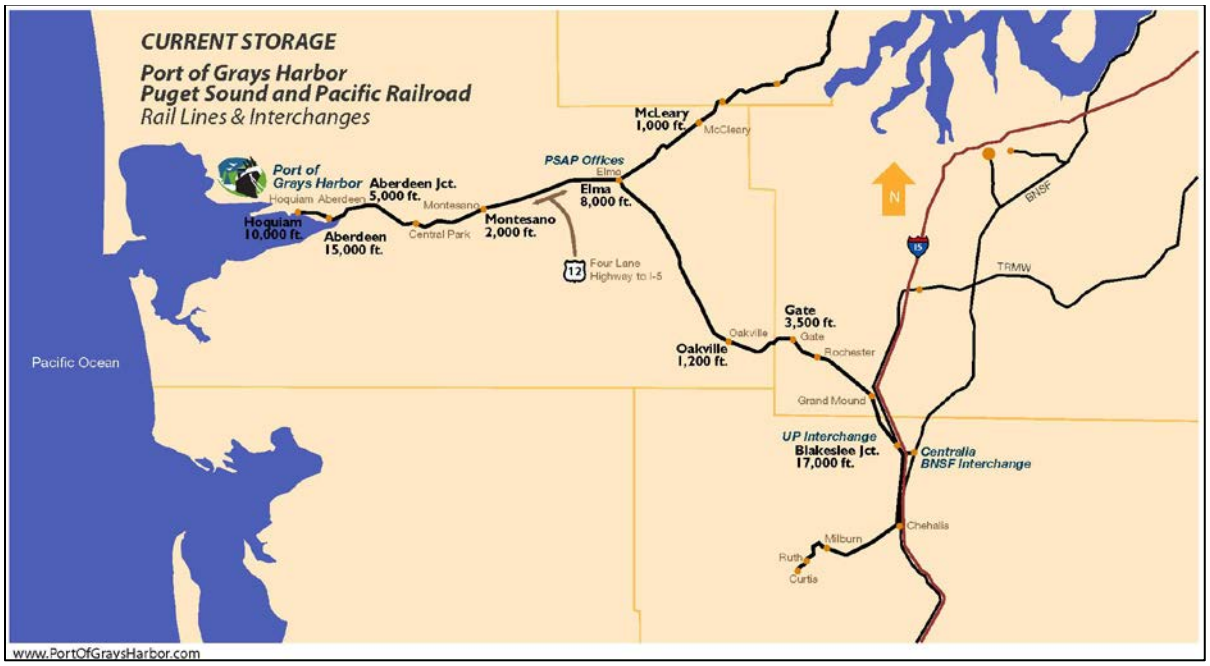


Figure 16. Puget Sound and Pacific Railroad Connections to Grays Harbor

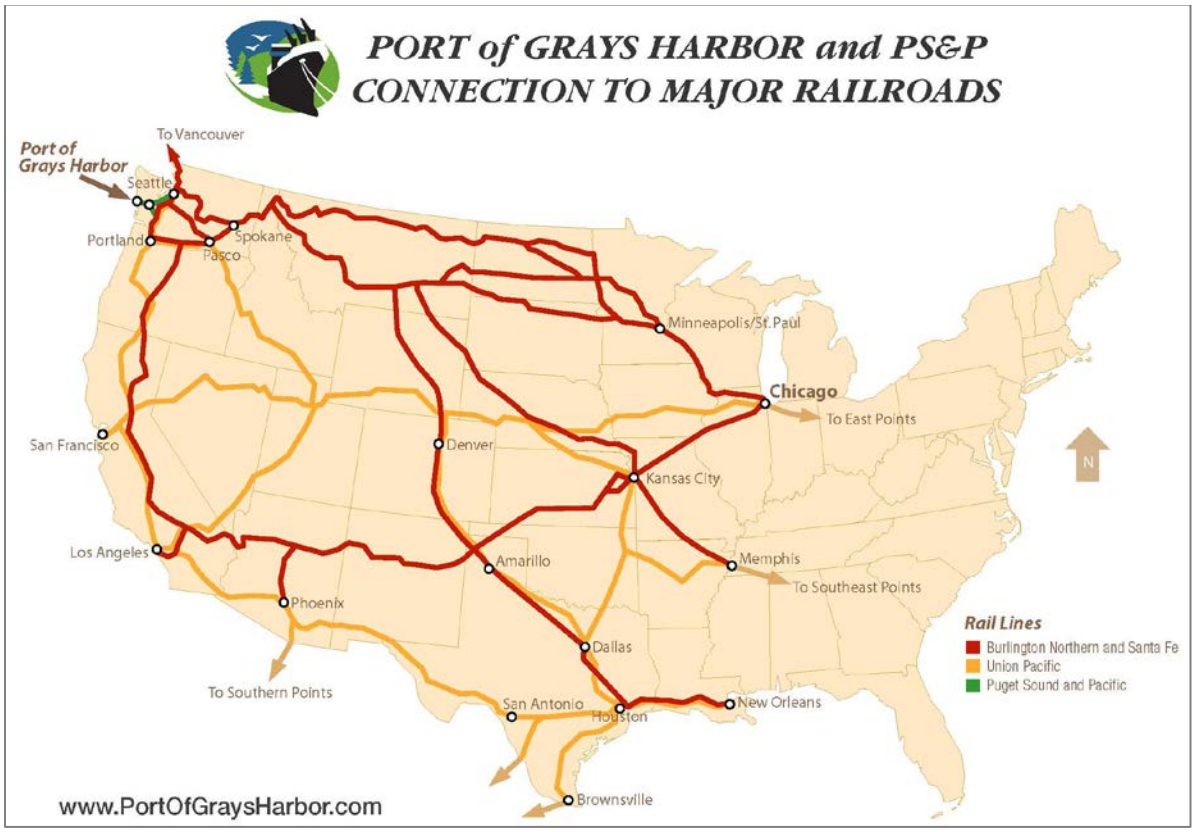


Figure 17. Puget Sound and Pacific Railroad Connections to Grays Harbor

Highway Corridor

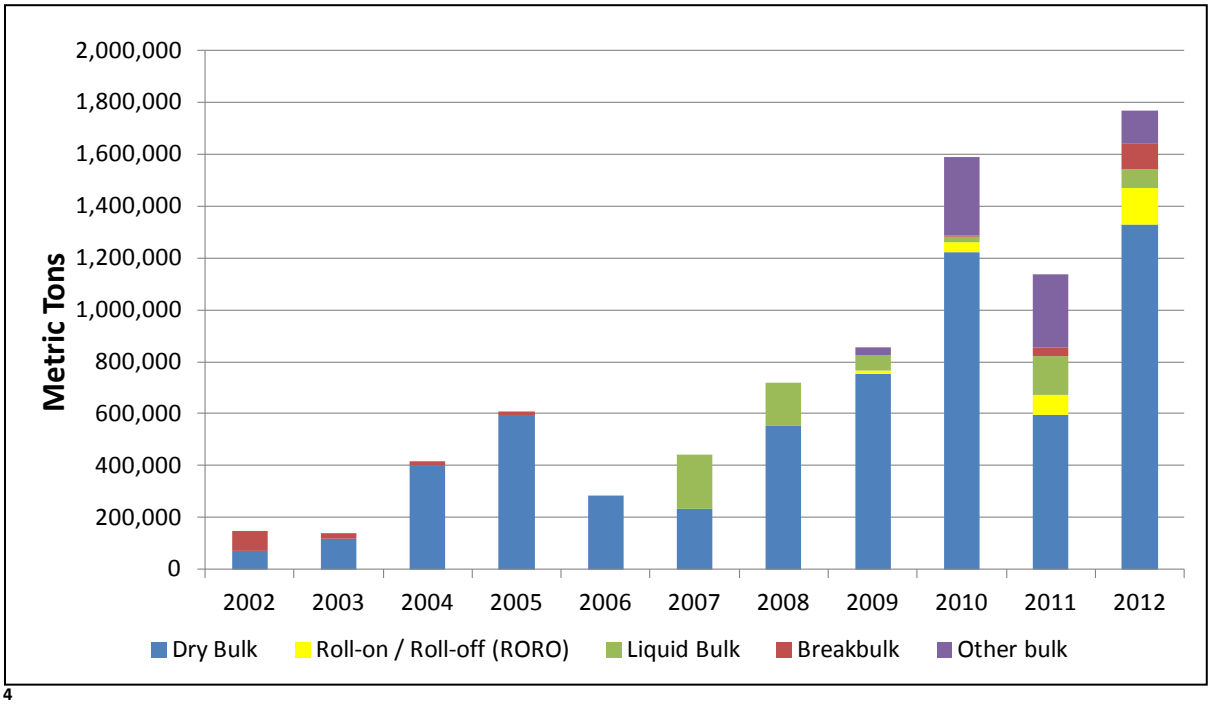
A four-lane state highway connects Grays Harbor to I-5, a trip of approximately 1 hour. I-5 connects to I-90, which provides access to the midwestern (a major supplier of food and farm product exports) and central United States (Figure 18).

Figure 18. Major Highway Corridor

3.1.1.3 Cargo Tonnage

The Grays Harbor area had been reliant on log traffic (consisting primarily of exports but also including imports and coastwise shipments), which accounted for 70% or more of all marine cargo between 1990 and 1997. Log volumes declined steadily from 1 million or more tons per year to approximately 87,000 tons in 2009.

As a result of these trends, the Port developed a strategy to diversify its marine cargo into alternative cargos such as agricultural bulks (Grain), liquid bulks (Bio-diesel), equipment, and automobiles. This strategy has resulted in cargo volumes increasing from 158,000 tons in 2002 to 1.8 million tons in 2012 (Figure 19).



[4]

Figure 19.Port of Grays Harbor Marine Cargo Trends

Agri-Bulks

AG Processing Inc., which is the largest soybean meal cooperative in the United States, began shipping its products (soybean meal, DDGS, and other processed grains and whole grains) through the Port in late 2003. Volumes increased from approximately 23,000 tons in 2003 to more than 1.2 million tons in 2012.

Liquid Bulks

Imperium opened the Imperium Grays Harbor in August 2007. This plant has a 100-million-gallon-per-year nameplate capacity (maximum capacity) and is the nation's largest BQ-9000® certified biodiesel plant. Imperium produces pure, unblended B100 biodiesel refined from a variety of oils: canola grown in the Pacific Northwest and Canada, soy, and many other crops. Westway Terminal Company completed its $20 million liquid bulk storage facility at Terminal 1 in early 2010 adjacent to Imperium Grays Harbor. Westway Group is a leading global provider of bulk liquid storage, including agricultural products, oils, and chemicals. Liquid bulk flowing through these two facilities at the Port ranged from 22,000 tons to 207,000 tons between 2007 and 2012 (Table 3.1-2).

Equipment and Autos

The Pasha Group, a diversified global transportation services and logistics company, announced in December 2008 that the Chrysler Group LLC had selected their automotive facilities at the Port in Aberdeen, Washington, to support their export vehicle requirements from the Pacific Northwest to selected destinations in Asia. In addition, Pasha is transporting large volumes of construction and other equipment through the Port.

[4] Figure 19 excludes wood products, such as logs and pulp, and is used to convey the Port's strategy of diversification away from said commodities.

Roll-on/roll-off traffic has increased from approximately 14,000 tons in 2009 to more than 141,000 tons in 2012 (Table 3.1-2).

Roll-on/roll-off traffic refers to vessels that are designed to carry wheeled cargo that can be driven directly onto the vessel. Examples of the types of goods loaded on said vessels are automobiles and tractors.

Table 3.1-2. Port of Grays Harbor Marine Terminal Activity—Summary

Cargo volume by Commodity	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Dry Bulk	69,540	118,581	398,641	592,564	283,595	232,874	551,601	753,350	1,221,356	594,365	1,326,839
Roll-on/Roll-off (RORO)	-	-	-	-	-	-	-	13,961	39,889	76,289	141,259
Liquid Bulk	-	-	-	-	-	206,954	168,565	59,004	21,903	152,402	73,140
Breakbulk	77,236	21,939	16,375	16,655	-	-	-	-	4,758	32,671	97,449
Other bulk	-	-	-	-	-	-	-	27,561	302,978	282,928	130,993
Total Cargo Volume	158,529	140,706	415,016	611,228	283,595	442,393	720,166	853,876	1,590,884	1,138,655	1,769,680
Deepwater Vessels	22	8	26	41	19	37	36	45	65	70	82
Barges	32	50	42	21	-	-	-	20	41	16	15
Total Vessels and Barges	54	58	68	62	19	37	36	65	106	86	97

Source: Port of Grays Harbor

Forest Products

After a slight hiatus, the Port began exporting logs again in 2009, with volumes increasing from 27,600 tons in 2009 to a peak of 303,000 tons in 2010. Volumes remained high at 282,000 tons in 2011 but fell to 131,000 tons in 2012. The Port began shipping packaged pulp for export in 2010. Volumes have increased from 4,700 tons in 2010 to 97,000 tons in 2012. The pulp is produced at the Cosmo Specialty Fibers in nearby Cosmopolis.

The Port has experienced intermittent shipment of wood chips throughout the past. Within the past 5 years, woodchip shipments by barge have ranged from 48,000 tons to 145,000 tons. Willis Enterprises, a forest products company specializing in barge shipments of wood chips, became fully operational at Terminal 3 in 2010.

3.1.1.4 Vessel Calls

Vessels enter the Port, either loaded with cargo or empty, and transit through the navigation channel to the terminal docks where they offload cargo and/or take on new cargo and then depart again through the navigation channel to the ocean. Because the existing channel is limited to 36 feet of water depth at MLLW, vessels may arrive or leave with a partial load (see Chapter 4.1 for additional details on vessel loading patterns). Each round trip through the navigation channel to a terminal is a vessel call. Vessel calls at the Port have increased significantly in recent years, from 22 calls in 2002 to more than 80 calls in 2012. This represents an increase of more than 300% (Figure 20). Barge traffic ranged from 21 to 50 calls between 2002 and 2005, and then experienced a hiatus from 2006 to 2008. From 2007 to 2012, barge calls resumed, ranging from 15 to 41 calls (Figure 20). Barge cargoes are dominated by shipments of logs and wood chips.

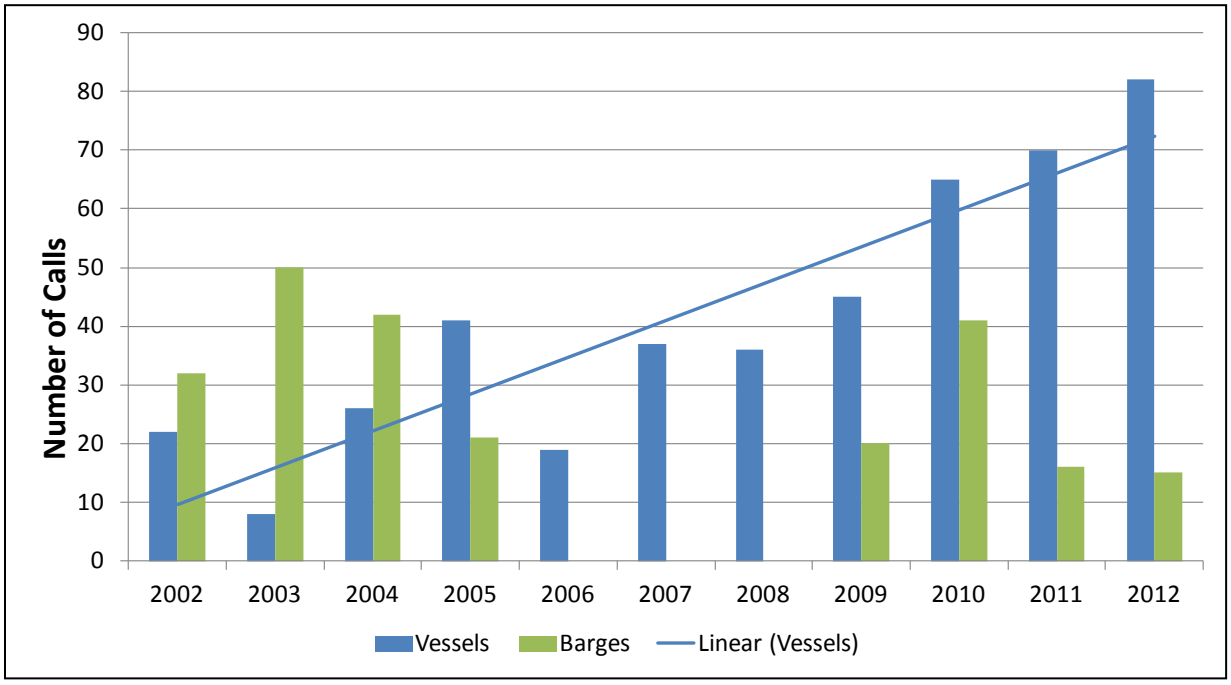


Figure 20. Port of Grays Harbor Marine Vessel and Barge Call Trends

3.2 Geomorphology

This section discusses the general geomorphology of Grays Harbor and the associated project elements relative to the navigation channel and the dredged material placement sites.

3.2.1 Regulatory Setting

Geomorphology, the study of landforms and the processes that shape them, is not directly regulated. Thus, the regulatory setting relevant to geomorphology is described in the following sections pertaining to specific resource areas that are affected by the geomorphology of Grays Harbor.

- Section 3.3, *Aquatic and Terrestrial Vegetation*
- Section 3.4, *Invertebrates, Fish, and Wildlife*
- Section 3.5, *Threatened and Endangered Species*
- Section 3.6, *Historic and Cultural Resources*
- Section 3.7, *Water Quality*

3.2.2 Environmental Setting

Grays Harbor is approximately 15 miles long and 12 miles wide at its widest section. The harbor has relatively large semi-diurnal tides. At mean higher high water (MHHW), the tide level of 9.16 feet covers 94 square miles in Grays Harbor, while at mean lower low water (MLLW) the tide (0 feet) covers 38 square miles and about 63% of the harbor's surface area is mudflats (U.S. Army Corps of Engineers 2012). In addition, mudflats, sandbars, and low islands are interspersed with a dendritic pattern of channels formed in the estuary (U.S. Army Corps of Engineers 1989). The majority (over 80%) of Grays Harbor is less than 20 feet deep MLLW. The navigation channel is the deepest portion of Grays Harbor east of the entrance from the Pacific Ocean (U.S. Army Corps of Engineers 2011). In excess of 50% of Grays Harbor has a depth of about 0 feet MLLW (U.S. Army Corps of Engineers 2011).

Major water and sediment inputs to Grays Harbor include the Chehalis, Elk, Humptulips, Hoquiam, Johns, and Wishkah Rivers (U.S. Army Corps of Engineers 2012). The Chehalis River is the largest tributary to Grays Harbor, accounting for over 80% of the total fresh water in the estuary (U.S. Army Corps of Engineers 1989). The Chehalis River originates in the Willapa Hills, the Black Hills, and lowlands east of I-5 near Centralia and does not have a glacial source of water. It generally flows westerly through conifer forests and open farmlands and is the major contributor of fluvial sediment to the inner portions of Grays Harbor.

Sea level rise following the Pleistocene glaciation drowned the river valley that formed in the current Grays Harbor. Submergence of the former river valley led to partial infilling of the estuary during the Holocene period with coarse-grained sediment of fluvial and marine origin (Osborne 2003). The Holocene sediment deposition resulted in three distinct zones of sediment origins: marine sediment in the outer estuary, mixed sediment in the middle estuary, and river-derived sediment in the inner estuary.

Sediment transport in Grays Harbor is controlled by the complex dynamics of fluvial sediment and water inputs from tributaries entering the harbor and mixing with marine sediment and water inputs from the Pacific Ocean. The morphology of the harbor is determined by differences in the capacity of harbor

inflows (flood currents) and waves to transport sediment into the harbor and outflows (ebb currents) to transport sediment out of the harbor. In general, Grays Harbor is dominated by tidal currents; however, high flows on the Chehalis River can control currents in the upper estuary, and the locations of shoals are continually shifting in the estuary (U.S. Army Corps of Engineers 2012). Sediment carried out of the harbor can be transported back into the harbor by wave-driven transport. Sediment accumulation in the seaward portion of the estuary is controlled primarily by redistribution of estuary silt by wind and waves and deposition of ocean sands by tidal action (U.S. Army Corps of Engineers 2012). Sediment accumulations in the interior estuary are controlled by river inputs.

The current authorized navigation channel is 27.5 miles long, beginning in the Aberdeen reach at the lower end of the Chehalis River and extending out across the ebb shoal in the Bar Channel reach in the Pacific Ocean. The navigation channel is a prominent morphological feature in the estuary. Sections of the channel are dredged annually to maintain sufficient widths and depths for navigation of deep-draft vessels. The channel is 32 feet deep and between 200 and 300 feet wide in the inner Aberdeen reach and deepens to 36 feet and widens to over 350 feet beginning in the Cow Point reach where the estuary begins to widen appreciably. Out in the Bar Channel reach, the navigation channel is 46 feet deep and up to 1,000 feet wide. When accounting for 2 additional feet for advanced maintenance dredging and 2 feet for allowable overdepth, the channel depth can vary from these typical depths, as much as 4 feet. For example, the depths in the Cow Point reach can be up to 40 feet deep.

The side slopes of the navigation channel vary throughout the harbor, becoming progressively steeper toward the mouth of the Chehalis River due to the presence of finer textured, more cohesive substrates that allow maintenance of steeper slopes. In the Aberdeen, Cow Point, and Hoquiam reaches, representative slopes are typically around 1V:3H; in the North, Crossover, and South (inner portion) reaches slopes are typically 1V:5H; and in the outer portion of the South, Entrance Channel, and Bar Channel reaches, the side slopes are their mildest at 1V:10H (U.S. Army Corps of Engineers 2011).

Since original construction, the most active morphology near the navigation channel has been in the inlet throat which extends from the Entrance Reach to the South Reach. Prior to jetty construction, a deep natural channel (-65 feet MLLW) existed near the location of the present navigation channel, north of which was dominated by shallow sand flats. After construction of the jetties, the channel scoured to a depth of about -95 feet MLLW in 1921. Between 1921 and 1940, the thalweg of the channel migrated north and shoaled to a depth of about -85 feet MLLW. Following reconstruction of the north jetty in 1942 sediments which historically fed the shoals north of the channel were cut off and these shoals began to erode until the north jetty began to deteriorate and again allow sediments to reenter the harbor over the north jetty. From 1954 to 1987, Damon Point accreted substantially from south-directed littoral transport over and around the north jetty. Waves and flood-tidal currents transported sand toward a small sand spit east of the north jetty. During this period, the subaerial extent of Damon Point expanded significantly, creating a large peninsula and shoal feature that began encroaching on the navigation channel. This encroachment on the channel led the Corps to realign the former Sand Island Reach in 1976 approximately 1 mile south to the present day location in the South Reach. The constriction of the channel between Damon Point and Point Chehalis has continued to present day and has scoured this portion of the navigation channel over 10 feet since 1987 (Kraus and Arden 2003).

The 1990 Navigation Channel Improvement Project deepened the navigation channel to −36 feet MLLW and widened the Bar and Entrance Channel Reaches. Osborne (2003) found that there is no significant variation in the wave height time series that correlates with either the channel realignment in 1976 or the early 1990s Navigation Channel Improvement Project. Rather, Osborne (2003) shows a steady

increase in wave height over time that correlates with the larger scale morphological changes of inlet deepening and throat migration southward.

Over the past decade, the estimated annual volume dredged from the five inner harbor reaches has been 1.7 million cubic yards, compared to an annual estimated volume dredged from the outer harbor reaches of 425,000 cubic yards (U.S. Army Corps of Engineers 2011). The dredged material is placed at one of five locations, typically providing nourishment at beach and nearshore environments. These include the Point Chehalis open water site, South Jetty Open water placement site, Half Moon Bay Nearshore Beneficial Use Site, South Beach Beneficial Use Site, and the Point Chehalis Revetment Extension mitigation site.

Dredged material placed at the Point Chehalis and South Jetty open water placement sites have a net seaward transport (Demirbilek et al. 2010; Hayter et al. 2012). The South Jetty Site has historically been utilized to mitigate scour along the channel side toe of the south jetty. Material placed at the Point Chehalis open water site has historically been utilized to mitigate scour at the Point Chehalis Revetment and erosion within Half Moon Bay. Sediments placed in the Half Moon Bay and South Beach Beneficial Use Sites mitigate erosion to the nearshore areas which have been eroding and steepening since 1954.
Historical Perspective

The evolution of Grays Harbor since the late 1800s can be divided into six epochs as described in Kraus and Arden (2003):

1. Epoch I is before the navigation shipping channel and jetties were built during the period between 1862 and 1898.
2. Epoch II is after the establishment of the navigation channel and construction of the jetties at the harbor entrance between 1898 and 1916.
3. Epoch III is the period between 1916 and 1942 during which the jetties deteriorated to approximately MLLW and were subsequently rehabilitated to 20 feet above MLLW.
4. Epoch IV is the period between 1942 and 1965 during which the Pt. Chehalis Revetment was constructed and the jetties were rehabilitated and maintained at approximately half of their original length.
5. Epoch V is 1965 to 1987 which included the second rehabilitation to the jetties. During this time, Damon Point began to accrete rapidly southeasterly into the harbor.
6. Epoch VI is 1987 to present. This period includes the third rehabilitation to the jetties and the recession of the beaches on South Beach and Damon Point.

Prior to construction of the jetties and the dredging of the shipping channel (Epoch I), the shorelines at the entrance to Grays Harbor were naturally occurring sandy spits (a type of shoal) located more than 2,000 feet east of the current coastline, and Damon Point (also known as Protection Island) did not exist. Sediment was transported into the estuary via marginal flood channels that formed flood shoal deposits as part of a flood tidal shoal complex. A main ebb channel maintained by the ebb current transported sediment back out of the estuary throat until its energy diminished enough for sediment to deposit and form an ebb shoal in the ocean outside the entrance to the estuary.

Initial construction of the north and south jetties (Epoch II) altered the patterns of flood and ebb currents, longshore drift, and wave action in Grays Harbor. By design, the jetties alter the volume of water flowing into and out of the estuary as the tide rises and falls (i.e., the tidal prism) by constricting

the inlet and concentrating the ebb tidal current in the inlet throat for the purpose of deepening the seabed and scouring the navigation channel. The increased velocity of the concentrated ebb flow also resulted in movement of the ebb shoal further out into the ocean where it would be less obtrusive to navigation (Osborne 2003). The jetties also reduce storm surge flooding and substantially reduce the amount of shoaling in the navigation channel due to waves and longshore drift, particularly the southward movement of littoral drift, by blocking the flood currents that deliver the sediment. Blockage of the longshore drift results in substantial sediment accretion on beaches north and south of the jetties. The position of the shoreline along the beaches accreted or eroded depending on the condition of the jetties and their ability to block longshore drift (U.S. Army Corps of Engineers 2012). Seasonal variability in wave height and direction typically results in southerly onshore transport in the summer (beach accretion) and northerly offshore sediment transport in the winter (beach erosion) (U.S. Army Corps of Engineers 2012).

Between 1920 and 1940, the jetties settled and deteriorated due to erosion from waves and tidal currents (Epoch III). They became low enough and porous enough to be overtopped and allow sand to pass over and through them, leading to the initial creation of Damon Point and the creation of Point Chehalis. The net sediment accretion southeast of Damon Point has increased hydraulic resistance in the ebb channel in that location and led to a deepening and shift of the channel to the south (Osborne 2003). Bathymetry analysis (U.S. Army Corps of Engineers 2012: Figures 11 and 12) of the period from 1955 to 2010 shows that flood currents and net accretion prevail, under existing conditions, on the north side of the channel (formerly Sand Island reach), whereas ebb currents and erosion prevail on the south side of the channel (South reach) (U.S. Army Corps of Engineers 2012). The area offshore of South Beach (U.S. Army Corps of Engineers 2012: Figure 12 [area boundaries]) has lost about 31 million cubic yards of sediment since 1955, and the nearshore area off of North Beach has lost about 5 million cubic yards (U.S. Army Corps of Engineers 2012). The area offshore of the entrance and North Beach areas, has lost about 33 million cubic yards. Bathymetric elevations in the north jetty area have remained largely unchanged since 1955, while about 30 million cubic yards have been lost in the entrance (U.S. Army Corps of Engineers 2012). The navigation channel was relocated from the Sand Island reach to the South reach in 1978, because persistent north side accretion had caused dredging volumes in the former location to become unsustainable (Osborne 2003).

Epoch IV began after the rehabilitation of the jetties, which included raising their crest elevations and increasing their masses by replacing deteriorated armor rock with large armor rock. At this time, the Westport Marina was created by private interests as the community of Westport was developed. Rehabilitating the jetties stopped sand from passing over the jetties and reduced or eliminated sand passing through the jetties resulting in the erosion and eastward migration of both Point Chehalis and Damon Point prompting the construction of the Point Chehalis Revetment to stabilize the shoreline and prevent damage to the marina. Toward the end of Epoch IV the outer portions of both jetties had deteriorated significantly and only the inner portions of the jetties were maintained. The reduction in length of the North Jetty allowed some sediment to bypass and continue providing sediment to Damon Point during this phase.

Epoch V began after the rehabilitation of the inner portions of the jetties resulting in the structure configuration that has been maintained up to the present. Epoch VI included two major rehabilitations to the north and south jetties in the early 2000s to maintain this configuration. This did not have the same effects as previous rehabilitation efforts partly due to the fact that the jetties were not restored to their original length, resulting in subsequent changes in coastal sediment transport and related morphological adjustment of the channel and adjacent nearshore areas. Maintenance of the structures in

their current configuration has resulted in the eastward migration of Damon Point and the Whitcomb Flats sand island, and the creation of Half Moon Bay. Point Chehalis has stabilized at its current location as a result of the combined effects of the revetment and groin system and placement of dredge material in the Half Moon Bay Nearshore Nourishment Site.

The presence of the jetties and related structures has likely resulted in increased sand accumulation on the offshore bar than would have otherwise occurred, and likely reduced the amount of sand moving into Grays Harbor from the outer coast. Sand accretion and migration at Damon Point and Point Chehalis has enlarged and altered the configuration of these coastal features, most notably including the eastward migration of Damon Point. The increased export of sand from Grays Harbor has also increased the rate of accretion on the beaches to the north (Ocean Shores) and south (Westport area) of the harbor entrance, extending these beaches westward from the historic shoreline. In contrast, the exposed portions of the Whitcomb Flats sand island and the Half Moon Bay and Point Chehalis beaches on either side of the revetment are receding in conjunction with the ongoing morphological adjustment of nearshore bathymetry to these structures.

The outer harbor sediments consist primarily of sand transported north as a part of the Columbia River Littoral Cell. Buijsman et al. (2003) found that the decrease of sand supply rather than the condition of the jetties has been the dominant factor influencing local shoreline changes within Grays Harbor since the 1960s. Gelfenbaum and Kaminsky (2010) found that the construction of dams on the Columbia River reducing peak discharge has reduced the sediment transport down the river by a factor of three; however, the impact of this reduction on sediment entering the littoral cell is unknown. The reduction in sediment supply moving into the system combined with the deepening of the inlet and offshore migration of the ebb tide delta as a result of constructing and maintaining the jetties has resulted in a net export of sand from Grays Harbor. The amount of sand entering outer Grays Harbor is dependent on the influence of the jetties and the amount of sand available to enter Grays Harbor from the Pacific Ocean, which in turn, is dependent on coastal erosion south of Grays Harbor (e.g., at Washaway Beach) and the amount of sand recruitment to coastal littoral drift from the Columbia River. The Corps anticipates that the navigation channel thalweg will continue to scour and deepen to convey the flows out of Grays Harbor on the ebb tide.

Another important morphological feature in the estuary is Whitcomb Flats, a sand flat about 1 mile east of the entrance to Westport Marina and south of the navigation channel (Figure 1). Most of Whitcomb Flats is submerged at high tide. Reconstruction of the South Jetty to +20 feet MLLW in 1939 substantially reduced sediment supply to Whitcomb Flats (Osborne 2003). From 1967 to 2001, Whitcomb Flats has been migrating east at about 100 feet per year, on average (Osborne 2003). The prevailing mechanisms attributed to the migration are ocean waves, tidal currents, and possibly eolian (wind) transport (Osborne 2003). As described above, the long-term trend of accretion along Damon Point and the associated migration of the ebb channel south into deeper water enabled larger waves to reach Whitcomb Flats and lead to the eastward migration (Osborne 2003).

The Corps estimates that over 1 million cubic yards of material has eroded from the base of Damon Point and been transported to the southeastern tip of the spit in the past 5 years. Based on these data, the Corps predicts that Damon Point will continue to elongate until it encounters the confluence of the navigation channel and the channel draining the North Bay area. Additionally it is expected to periodically breach in the narrow portion near the Ocean Shores Marina. At some point, Damon Point may be disconnected from the Ocean Shores spit and any sand added to Damon Point will likely settle in the shallow area west of Damon Point. Whitcomb Flats is expected to continue its eastward migration.

Repairing and maintaining the revetment at Point Chehalis prevents the navigation channel from migrating to the south, keeping the channel in its approximate current location.

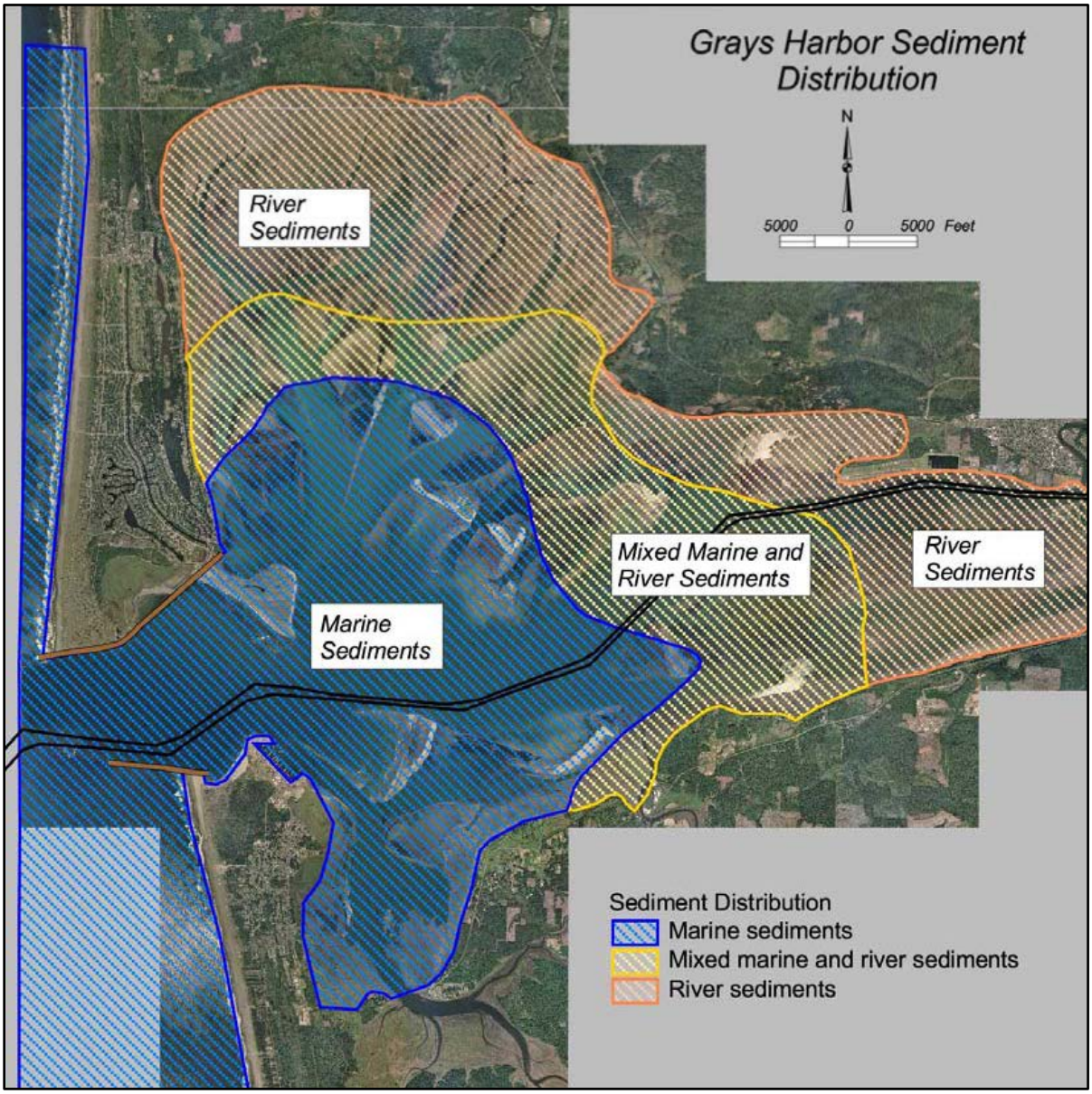


Figure 21. Inlet and Nearshore Morphodynamics—Provinces of Sand Deposition in Grays Harbor

3.3 Aquatic and Terrestrial Vegetation

This section discusses eelgrass, macroalgae, and salt marsh habitats found within Grays Harbor and associated dunegrass habitats near the Point Chehalis Revetment Extension Mitigation site. Applicable regulations that pertain to vegetation are also provided below.

3.3.1 Regulatory Setting

Coastal and inland waters, lakes, rivers, and streams that are navigable waters of the United States, including their adjacent wetlands, are regulated at the federal level under Section 404 of the Clean Water Act, which is implemented by the Corps with oversight by the U.S Environmental Protection Agency. Special aquatic sites such as vegetated shallows, wetlands, and mudflats are also waters of the United States. The Corps issues Section 404 permits to outside applicants for discharges of fill or dredged material that may have impacts on waters of the United States, including wetlands. The Corps does not issue a permit to itself, but does substantively comply with the CWA through a Section 404(b)(1) evaluation process. Vegetation communities in the Grays Harbor area that reside within these regulated waters include salt marsh, eelgrass and macroalgae, and coastal wetlands. The Section 404 compliance process also triggers a requirement of a Section 401 water quality certification, issued by the Washington State Department of Ecology. Section 401 certification concludes that the project will comply with state water quality standards.

Wetlands are also regulated by Executive Order 11990, which requires federal agencies to minimize the loss or degradation of wetlands and enhance their natural state when possible.

3.3.2 Environmental Setting

Grays Harbor is the fourth-largest estuary on the West Coast (Seiler 1989) and is the larger of two major estuaries along the Washington coast (the other being Willapa Bay). The inner harbor is heavily industrialized, and the shoreline has been greatly altered by diking, armoring, and the construction of docking terminals. With the exception of the inner harbor shoreline near the Port terminals, Grays Harbor is relatively undeveloped and contains many intertidal mudflats, eelgrass meadows, and large areas of intertidal salt marsh.

In the Pacific Northwest, eelgrass and benthic macroalgae represent the majority of aquatic vegetation (Borde et al. 2003). Eelgrass and benthic macroalgae frequently occur in close proximity to steep tidal channels of Pacific Northwest estuaries, where they constitute distinct patches of transitional intertidal habitat that is important to a variety of species, including juvenile salmonids, Dungeness crabs, and migratory shorebirds.

Salt marshes are highly productive intertidal wetlands that contain key components of the benthic foodweb in estuaries. Salt marshes represent an important intertidal component of the aquatic vegetation community in the Grays Harbor estuary.

Native dunegrass (*Elymus mollis*) and the introduced European beachgrass (*Ammophila arenaria*) occur on sand dunes along the upland edges of Grays Harbor, where they stabilize the ever-shifting sands of

the dunes and provide nesting habitat for some species of shorebirds, and foraging habitat and shelter for a variety of wildlife.

3.3.2.1 Eelgrass

Eelgrass meadows and macroalgae beds provide habitat that is important to the ecology of estuarine systems in Washington State. These habitats are known to support many lifestages of fish, crab, and other aquatic organisms by providing direct and indirect food sources as well as refuge from predation.

Approximately 8,000 to 11,000 acres of Grays Harbor's 25,000 total acres support eelgrass meadows (Borde et al. 2003). Eelgrass flourishes in shallow environments with unconsolidated substrate that are protected from strong currents and heavy, repeated wave action. Analysis of the bathymetry indicates that nearly 60% of the harbor is between −6 feet and +3 feet, elevations that are known to support abundant eelgrass growth in Grays Harbor (Figure 22). Eelgrass prefers currents less than 3.5 knots, depths less than 22 feet, and salinity greater than or equal to 20 parts per thousand (Phillips and Watson 1984). These environmental parameters are not found in the navigation channel, but are all found in abundance in Grays Harbor leading to a proliferation of eelgrass meadows in the estuary but not in the navigation channel, or the dredge material placement sites.

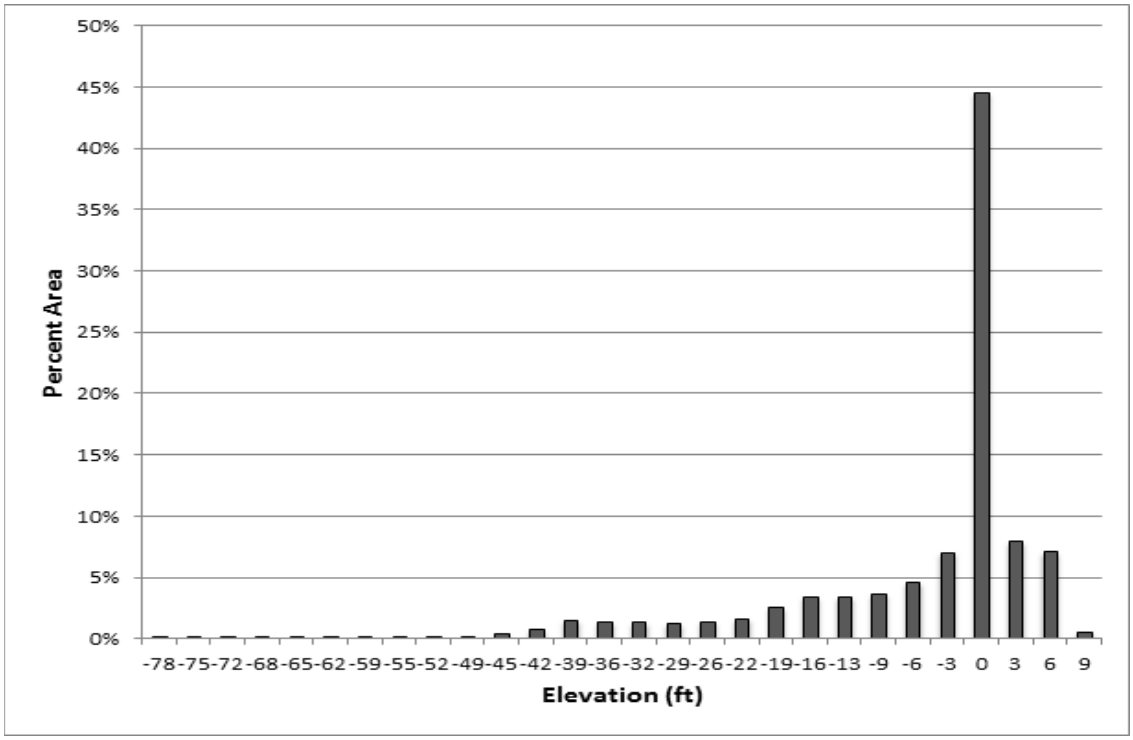


Figure 22. Percentage of the Grays Harbor Estuary by Elevation

Turbidity is the single most important water quality parameter affecting eelgrass growth and success (Oregon State University 1977). As a photosynthetic plant, eelgrass depends on sunlight to support growth. As turbidity increases, light penetration is reduced, eventually to the point that light levels are not high enough to support growth. The Chehalis River drains a geography that is high in clay content and, as such, is highly turbid with suspended sediments. The inner harbor reaches near the Chehalis River are highly turbid (U.S. Army Corps of Engineers 2008; ICF Jones & Stokes 2009) and do not

support growth of eelgrass in subtidal areas. As the turbid waters of the Chehalis are diluted farther from the river mouth, the increased water clarity allows for the growth of substantial eelgrass beds.

3.3.2.2 Macroalgae

Macroalgae beds are not prevalent in Grays Harbor. Most macroalgaes require hard substrate to attach to. Because most of Grays Harbor is unconsolidated sand and mud, macroalgae cannot find attachment points. Underwater video recorded in 2009 showed low densities of leafy green sea lettuce (*Ulva lactuca*), rockweed (*Fucus distichus*), and green gut weed (*Enteromorpha intestinalis*) in the inner margins of the harbor near Cow Point (ICF Jones & Stokes 2009). Most macroalgae observed during the surveys were detached from the substrate and adrift. These detached algae were found sparsely distributed on the substrate throughout the inner harbor. Small amounts of sea lettuce and rockweed were also found attached to derelict pilings and on boulder riprap armoring the shoreline.

Further underwater video surveys recorded immediately adjacent to the South Reach indicated a fine sand substrate that was unable to support the attachment and successful growth of macroalgaes (ICF Jones & Stokes 2009). With the exception of boulder armoring along the diked margins of the harbor, and occasional boulders and large pieces of woody debris, the substrate found in Grays Harbor does not support the attachment and growth of macroalgae beds.

3.3.2.3 Salt Marsh and Dunegrass

Salt marsh (sometimes more generally referred to as tidal marsh) most commonly occurs fringing the borders of rivers as they connect within the Pacific Ocean or Puget Sound and on the leeward side of bay-mouth bars that enclose broad river valleys, such as in Grays Harbor (Seliskar and Gallagher 1983). Historically, this type of marsh extended many miles upstream of the estuary, becoming progressively dominated by freshwater species at the upper extent of tidal influence. Salt marshes are generally regarded as essential elements of the estuarine landscape. They provide habitat for a variety of species and are sources of primary production for the general estuarine system (Seliskar and Gallagher 1983; Thom 1987).

Salt-tolerant plants, such as tufted hairgrass (*Descampsia cespitosa*), Lyngby's sedge (*Carex lyngbyei*), Baltic rush (*Juncus balticus*), and pickleweed (*Salicornia virginica*), provide important resting and foraging habitat for migrating birds and rearing juvenile fishes. They also contribute to the benthic productivity of the system by seasonally contributing organic material such as leaves and stems.

Salt marshes line portions of the estuary; however, diking of intertidal areas has transformed much of the historical marshes into wet pasturelands that are removed from tidal influence. The total areal extent of salt marsh in Grays Harbor is not well documented, but at least 1,500 acres of salt marsh remain in the Grays Harbor National Wildlife refuge.

Native dunegrass (*Elymus mollis*) occurs above MHHW on the upland sand dunes along the shorelines of Grays Harbor, including on the sand dunes upslope of the South Jetty and Half Moon Bay (U.S. Army Corps of Engineers 2005, 2006) and along the north shore of Damon Point (nearly 2 miles north of the navigation channel). Dunegrass in the Damon Point area provides critical nesting habitat for the snowy plover (*Charadrius alexandrius nivosus)*, a federally listed shorebird. No plovers are known to exist in the dunes along the south shores of Grays Harbor (Section 3.5, *Threatened and Endangered Species*).

3.3.2.4 Sweet Grass

Sweet grass, also known as American or common three-square or chair-maker's rush (*Schoenoplectus pungens [formerly classified as Scirpus americanus]),* is a common, relatively tall sedge that is an important plant resource in Grays Harbor where it is used by basket makers from the Chehalis and Quinault Tribes. Sweet grass grows in either freshwater or brackish marshes on the flats of the intertidal zone and exists in the area along the shoreline of Bowerman Basin within the Grays Harbor National Wildlife Refuge.

While sweet grass is an important plant resource, as an emergent intertidal plant, it does not occur within the deeper waters of the navigation channel or dredged material placement sites.

3.4 Invertebrates, Fish, and Wildlife

This section discusses invertebrates, fish, and wildlife found within Grays Harbor. Regulations related to invertebrates, fish, and wildlife that are applicable to the proposed action are also provided below.

3.4.1 Regulatory Setting

Grays Harbor and the surrounding shoreline and coastal habitats support a diverse community of fish, wildlife, and invertebrate species. These species and their habitats are protected and managed under a number of complementary federal, state, and local regulations.

Fish and wildlife species are managed by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS)). These agencies each have regulatory jurisdiction over fish and wildlife resources in the vicinity of Grays Harbor. NMFS and USFWS regulate fish and wildlife species and critical habitats listed for protection under the federal Endangered Species Act (ESA) (16 USC 1531–1544, as amended). Section 3.5, *Threatened and Endangered Species*, addressed these species and habitats specifically.

Several marine mammal species and bird species that are known to occur or may potentially occur in the Grays Harbor vicinity are protected under the additional federal regulations described below.

3.4.1.1 Aquatic Invertebrates and Fish

Several fish species are protected under the ESA and other federal regulations. NMFS has regulatory jurisdiction over ESA-listed marine fish as well as anadromous salmon and steelhead and designated critical habitats. USFWS has regulatory authority over other ESA-listed fish species that occur in Grays Harbor, specifically bull trout. Federally managed commercial fisheries are managed under the authority of the Magnuson-Stevens Fishery Conservation and Management Act of 1990, as amended, also referred to as the Magnuson-Stevens Act (MSA). The federal management plans have been developed by the Pacific Fishery Management Council and are implemented and enforced under the jurisdiction of NMFS.

The management plans cover fish species that are known to occur or are likely to occur in Grays Harbor and adjacent nearshore coastal habitats. Habitats used by these federally managed species are protected by NMFS under the Essential Fish Habitat (EFH) provisions of Section 305 of the MSA. The MSA authorizes the federal government to regulate fishing from 3 to 200 miles offshore. In 1996, the MSA was amended to include the Sustainable Fisheries Act, which makes substantive changes regarding bycatch and the conservation of fish habitat. Per U.S. Public Law 109-479, federal agencies must consult

with NMFS when conducting actions that might adversely affect EFH. While the fishery management jurisdiction of the MSA applies to federal waters, the EFH provisions of the act apply throughout the range of the managed species and commonly extend into state-managed estuarine and riverine habitats. The MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" for species protected under the act. Federal agencies must consult with NMFS on adverse effects of federal projects.

3.4.1.2 Wildlife

Wildlife includes terrestrial and aquatic birds, reptiles, and marine mammal species, as well as terrestrial invertebrates not addressed above. This group includes several species and associated habitats that are currently protected or proposed for protection under the ESA and one or more additional federal regulations. USFWS and NMFS have jurisdiction over federally protected wildlife and their habitats in Washington State. USFWS is responsible for enforcing the Migratory Bird Treaty Act (16 USC 703–713) and the Bald and Golden Eagle Protection Act (16 USC 668–668c), and NMFS implements the Marine Mammal Protection Act (50 CFR 216). Both agencies have responsibilities for species protected under the ESA (16 USC 1536 (a)–(d)). NMFS has regulatory authority over marine mammals; USFWS has regulatory authority over marine and terrestrial birds and terrestrial mammals.

3.4.2 Environmental Setting

The environmental setting for invertebrates, fish, and wildlife includes all aquatic and terrestrial habitats that may be directly or indirectly affected by the proposed action and the species that use those habitats for rearing, migration, and reproduction.

Grays Harbor and the surrounding watershed have been affected by anthropogenic activities since the late 1800s when the Port was developed to become a major exporter of wood products and center of fisheries harvest. Construction and maintenance of the navigation channel was integral to supporting a local economy built on logging and shipping. Logging of the surrounding forests; filling, diking, and dredging of aquatic habitat; habitat fragmentation; increased impervious surface due to development; commercial, tribal, and sport harvest of fish and crab; and water quality impacts have all led to stress on the invertebrate, fish, and wildlife populations in Grays Harbor. While development has changed the condition of the nearshore areas from presettlement, much of the intertidal and open-water areas in the central portion of the estuary have remained relatively untouched and provide pristine habitat to a variety of species.

3.4.2.1 Invertebrates

A wide variety of invertebrates use Grays Harbor. Dungeness crab, numerous clam species, oysters, and a diverse epibenthic community provide forage for the fish, birds, and other wildlife in Grays Harbor. Commercial harvest of Dungeness crab and farming of oysters provide substantial inputs to the local economy of the communities surrounding Grays Harbor.

Dungeness Crab

Population

Dungeness crab are found in nearshore and estuarine environments from California to Alaska. Adult females mate in the early spring and carry the sperm received from males through to the following fall

when they extrude an egg mass that is carried on the abdomen until the planktonic larvae are released to drift with ocean currents 3 months later. This drifting planktonic stage has resulted in a population that is genetically homogeneous, meaning that the west coast Dungeness crab population appears to be one large population rather than several smaller, distinct populations.

The first five larval stages are referred to as zooea and are completely dependent on currents for transport. After 3 to 8 months the zooea molt and transform into a megalopae stage that begins to move shoreward by swimming and preferentially selecting shoreward moving flood tide currents. The megalopae then settle in intertidal areas during late spring and early summer where they metamorphose from their larval life stages into juvenile Dungeness crab. In Grays Harbor, juveniles at this stage are often found in densities as high as 100 crabs per square meter (Visser and Armstrong 1998). Early juvenile phases are heavily preyed on by a large number of fish and bird species.

Both male and female Dungeness crabs reach sexual maturity at about 2 years of age; although males may not breed until 3 years or older. A large portion of the nearshore 1+ (i.e., ages 1 to 2 years) crab population migrates into the estuary in early summer, joining the resident 1+ population, and returns offshore in late summer or early fall.

Dungeness crab populations in and near Grays Harbor were estimated from trawling surveys conducted from 1980 through 1981(Stevens and Armstrong 1984), and 1983 through 1986 (Armstrong et al. 1987) and again in 1996 through 1999 (Striplin Environmental 2000). Armstrong et al. (1987) noted four features of crab population abundance in Grays Harbor:

- highest abundance in mid spring through early summer,
- a high initial recruitment of young of year crab with very high natural mortality rates and related population declines,
- population decline toward the end of the summer through fall, and
- evidence of movements of age 1+ and older crab to and from estuarine and nearshore areas (off shore of South Beach and North Beach).

Armstrong et al. (1981) found that crab abundances in Grays Harbor ranged from about 3 to 28 million crabs, depending on the season. Age 1+ population estimates for Grays Harbor ranged between 8 and 13 million crabs in 1983 and estimates were typically about 5 million between 1984 and 1985 as shown in Table 3.4-1. More recently, it has been suggested that age 1+ populations are in the 10 million range (Armstrong 2013).

Trawl surveys in the Grays Harbor navigation channel by Armstrong et al. (1991) reported an average Dungeness crab density (all reaches combined) of 678 crab per hectare with a range of 0 to 9,796 crabs per hectare for individual trawl tows. Average crab density for each reach ranged from a low of 26 crabs per hectare in the North Channel reach in December to a high of 4,106 crabs per hectare in the North Channel reach in October. Smaller, juvenile crabs tend to be found in higher densities in the North Channel and Crossover reaches; while larger, mature crabs are found in higher densities in the South reach nearer the harbor entrance (Armstrong et al. 1991).

Sex ratios of the population shift from a 1:1 male-to-female ratio in the inner harbor reaches to nearly 4:1 ratio in the outer harbor reaches near the mouth of Grays Harbor (Armstrong et al. 1991).

Habitat

The expansive mudflats and dendritic tidal channels of Grays Harbor provide highly productive habitat for juvenile Dungeness crabs (Armstrong et al. 2003). Eelgrass beds and mudflats of Grays Harbor benefit the population by providing cover and rearing/foraging habitat to all life stages. The inner harbor reaches contain more mud and silt and, as such, are not as suitable to rearing crabs as the sandier outer harbor reaches. While structured habitats of eelgrass and oyster cultures have been shown as critical for age 0+ Dungeness crabs (Dumbauld et al. 2000), Holsman et al. (2006) highlighted the significance of unstructured littoral habitats importance as foraging areas for juvenile and subadult (1+ and >1+ yr classes) Dungeness crabs. Holsman et al. (2006) also suggests that these unstructured habitats, including mud and sandflats, in the intertidal areas may be the primary foraging areas and are, therefore, critical to crab production.

Table 3.4-1. Grays Harbor Dungeness crab Population Estimates (Millions)

By age for sub and intertidal, nearshore (South and North Beach), and all of Grays Harbor (four year mean estimate 1983–1986)			
0+ Crab	Subtidal and Intertidal	Nearshore	All Grays Harbor
April–May	209.4	13.4	222.8
June–Sept	22.6	172.7	195.3
Oct–Dec	12.1	72.5	84.6
Jan–Mar	6.9	34.3	41.2
1+ Crab	Subtidal and Intertidal	Nearshore	All Grays Harbor
April–May	3.2	4.4	7.6
June–Sept	6.9	10.5	17.4
Oct–Dec	3.6	6	9.6
Jan–Mar	0.7	3.8	4.5
>1+ Crab	Subtidal and Intertidal	Nearshore	All Grays Harbor
April–May	1.4	1.4	2.8
June–Sept	1.3	2	3.3
Oct–Dec	1.2	1.3	2.5
Jan–Mar	0.3	1	1.3
Total all Ages	Subtidal and Intertidal	Nearshore	All Grays Harbor
April–May	214	19	233
June–Sept	31	185	216
Oct–Dec	17	80	97
Jan–Mar	8	39	47
Crab Population Estimates 1980–1981			
0+ Crab	All Grays Harbor		
Summer	28,942,000		
Winter	753,000		
Spring	931,000		
1+ Crab	All GH		
Summer	7,922,000		
Winter	2,311,000		
Spring	2,965,000		

>1+ Crab	All Grays Harbor
Summer	2,160,000
Winter	207,000
Spring	3,904,000
Total all Ages	
	All Grays Harbor
Summer	39,024,000
Winter	3,271,000
Spring	7,800,000

1983-1986 Average (4 year mean) Crab Density (Crab/ha) in Outer and Inner Grays Harbor

0+ Crab	Outer Harbor Bar to South Reach	Inner Harbor Cross Over to Aberdeen Reach	All Reaches
April–May	463	2,900	3,363
June–Sept	288	353	641
Oct–Dec	262	319	581
Jan–Mar	203	248	451
1+ Crab	**Outer Harbor Bar to South Reach**	**Inner Harbor Cross Over to Aberdeen Reach**	**All Reaches**
April–May	159	157	316
June–Sept	531	176	707
Oct–Dec	277	91	368
Jan–Mar	74	24	98
>1+ Crab	**Outer Harbor Bar to South Reach**	**Inner Harbor Cross Over to Aberdeen Reach**	**All Reaches**
April–May	189	62	251
June–Sept	197	38	235
Oct–Dec	173	33	206
Jan–Mar	47	10	57
Total All Ages	**Outer Harbor Bar to South Reach**	**Inner Harbor Cross Over to Aberdeen Reach**	**All Reaches**
April-May	811	3,119	3,930
June-Sept	1,016	567	1,583
Oct-Dec	712	443	1,155
Jan-Mar	324	282	606

1996–99 Average (4 year mean) Density (Crab/ha) using 3M beam trawl

0+ Crab	Outer Harbor Bar Reach	Entrance Reach	South Reach	All Outer Reaches
April–May	4	212	160	376
June–Sept	825	10,680	6,283	17,788
Oct–Dec	450	860	480	1,790
Feb–Mar	8	196	113	317
1+ Crab				
April–May	24	908	2,508	3,440
June–Sept	257	1,112	1,402	2,771

Oct–Dec	239	702	1,175	2,116
Feb–Mar	11	294	613	918
>1+ Crab				
April–May	93	442	1,241	1,776
June–Sept	794	594	633	2,021
Oct–Dec	198	158	388	744
Feb–Mar	47	143	372	562
Total All Ages				
April–May	121	1,562	3,909	5,592
June–Sept	1,876	12,386	8,318	22,580
Oct–Dec	887	1,720	2,043	4,650
Feb–Mar	66	633	1,098	1,797

Sources: Armstrong et al. 1987; Stevens and Armstrong 1984; Striplin Environmental 2000.

Harvest

Commercial

The commercial Dungeness crab fishery is one of the most economically important fisheries in Washington State, valued at nearly $20 million annually (Washington Department of Fish and Wildlife 2013a). If WDFW determines that the males have recovered from the fall molt then the season begins on December 1 (or when WDFW determines from shell-condition testing that the population is ready for harvest) and continues through September 15. Washington coastal Dungeness crab landing data back to 1950 shows a large fluctuation in harvest, ranging from a low of 2.5 million pounds in 1981 to a high of 25 million pounds in 2004-05, and averaging at 9.5 million pounds. It is believed that this large fluctuation in landings is not a result of harvest patterns, but likely due to varying ocean conditions including, water temperature, food availability, and ocean currents (Washington Department of Fish and Wildlife 2013a).

The fishery employs baited traps deployed and retrieved from fishing vessels manned by two to five crew members. The bulk of the fishery is located nearshore (Figure 23, areas 60A-1 and 60A-2) in relatively shallow water less than 50 meters deep. Together, these two areas accounted for on average 8.4 million pounds annually versus 100,000 pounds for Grays Harbor (area 60B). The coastal fisheries generally opens in December and most of the annual landings occur by March. Apparent cycles of abundance of about 9 to 10 years were noted by Armstrong et al. 1987. Crab are of legal size for commercial harvest when their carapace width is 6.25 inches or greater, which generally equates to a crab that is about 3 years of age. Only male crabs are harvested in the fishery; all females are to be returned to the water unharmed. In 2012, 228 vessels were commercially licensed to fish crab on the Washington coast, with an estimated 200 actively participating in the fishery (Washington Department of Fish and Wildlife 2013a). The fishery is co-managed by WDFW and local tribes who have partitioned the Washington coast into eight distinct catch reporting areas (Table 3.4-2). Grays Harbor encompasses WDFW catch reporting area 60B (Figure 23). The 15-year average catch for the 1997/1998 through 2011/2012 seasons in 60B was 99,281 pounds (low of 46,000, high of 220,000) (Table 3.4-2); this represents nearly $300,000, as paid to the vessel, assuming an average $3.00 per pound

The main ports of landing for Dungeness crab in Washington State are Ilwaco, Chinook, Westport, Tokeland, and La Push.

Table 3.4-2. WDFW-Reported Non-Treaty Crab Landings (in pounds) by Season and Catch Reporting Area

		Catch Reporting Area							
Season	Non-Treaty Total	59A1	59A2	60A1	60B	60A2	61	60C	60D
1997/1998	7,550,760	848,630	1,051,965	1,351,568	57,811	3,276,150	688,027	275,590	1,019
1998/1999	8,967,145	1,091,884	1,464,311	1,855,975	83,838	3,879,415	354,907	228,029	8,786
1999/2000	16,022,288	2,555,395	2,306,756	3,485,396	95,793	6,185,140	948,006	445,802	–
2000/2001	8,104,328	552,974	210,346	2,540,438	177,831	3,470,457	499,838	643,744	8,700
2001/2002	11,345,321	251,059	927,742	2,697,177	65,639	5,512,243	1,194,271	696,415	775
2002/2003	20,347,949	1,439,123	2,582,791	6,834,150	141,383	6,997,527	1,317,504	1,035,471	–
2003/2004	17,374,210	426,677	3,073,340	3,297,819	125,743	8,269,734	1,304,188	875,165	1,544
2004/2005	20,427,669	1,167,167	5,329,217	5,250,676	219,697	6,588,471	955,326	917,115	–
2005/2006	14,342,919	2,146,815	3,052,461	2,349,790	65,232	5,051,349	1,157,451	519,564	257
2006/2007	11,606,166	1,215,429	1,760,968	2,453,677	46,537	4,610,994	861,628	653,934	2,999
2007/2008	12,204,682	941,052	2,032,167	2,612,727	45,758	4,868,019	1,214,040	490,919	–
2008/2009	8,298,331	144,824	518,945	1,692,974	64,834	4,181,107	1,202,195	479,539	13,913
2009/2010	12,989,135	290,551	1,005,927	2,690,311	79,621	6,246,590	2,097,873	578,262	–
2010/2011	16,731,998	791,740	871,003	3,851,300	132,546	8,216,717	1,654,693	1,189,981	24,018
2011/2012	8,617,136	82,185	433,223	1,682,851	86,946	4,491,443	1,215,446	625,042	–
Average	13,308,064	929,700	1,774,744	2,976,455	99,281	5,456,357	1,103,568	643,638	4,134

Blank cells (–) denote no landings reported for that season.
Source: Washington Department of Fish and Wildlife 2013a

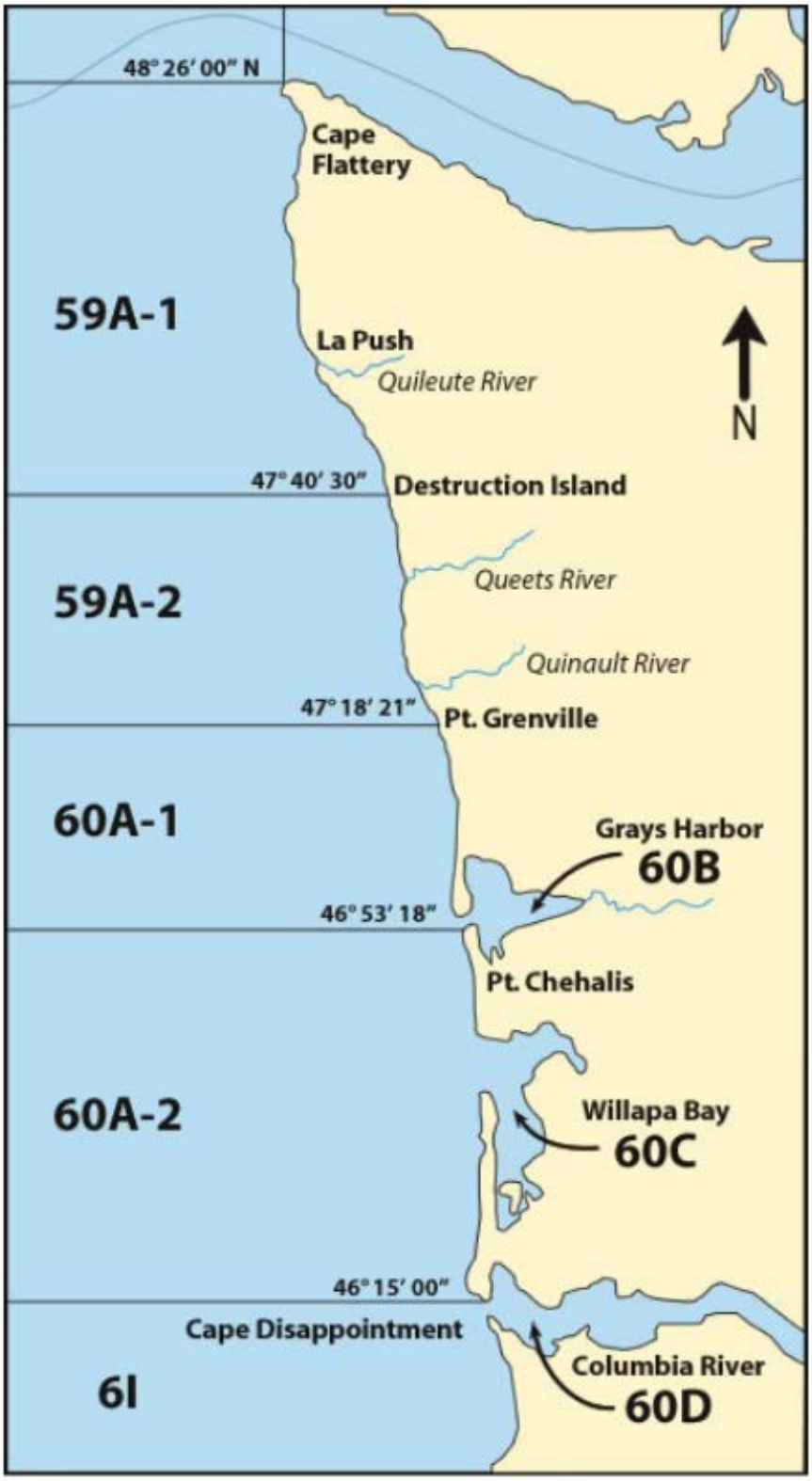


Figure 23. Commercial Crab Fishing WDFW Catch Reporting Areas

Source: Washington Department of Fish and Wildlife 2013b.

Tribal

The Dungeness crab fishery is comanaged with WDFW by four coastal treaty tribes; the Quinault Tribe, Hoh Tribe, Makah Tribe, and Quileute Tribe. Tribal fishers can harvest up to 50% of the harvestable shellfish in their usual and accustomed fishing grounds in Grays Harbor. The Quinault tribe is the only treaty tribe with usual and accustomed fishing grounds in Grays Harbor. During the 2010/2011 season, 30 tribal vessels landed 4.1 million pounds of crab from Grays Harbor and the catch reporting areas immediately adjacent to Grays Harbor. A 15-year average of 1.8 million pounds of crab were landed by the Quinault Tribe for the 1997/1998 through 2011/2012 seasons (Table 3.4-3); this represents approximately $5.4 million dollars in ex-vessel value assuming $3.00 per pound.

Table 3.4-3. Quinault-Reported Treaty Crab Landings (in pounds) by Season and Catch Reporting Area

		Catch Reporting Area		
Season	Quinault Treaty Total	59A2	60A1	60B
1997/1998	393,240	11,378	350,184	31,678
1998/1999	412,065	648	400,718	10,699
1999/2000	725,309	–	713,597	11,712
2000/2001	679,842	5,066	665,714	9,062
2001/2002	580,567	33,954	536,878	9,735
2002/2003	1,734,324	–	1,717,481	16,843
2003/2004	1,430,762	–	1,430,762	–
2004/2005	2,809,978	587,957	2,217,863	4,158
2005/2006	2,596,958	638,530	1,957,165	1,263
2006/2007	2,126,599	1,263,622	860,357	2,620
2007/2008	2,608,757	1,112,058	1,485,613	11,086
2008/2009	1,813,522	466,500	1,347,022	–
2009/2010	3,246,471	961,705	2,277,292	7,474
2010/2011	4,142,919	1,439,325	2,703,594	–
2011/2012	1,978,001	428,786	1,549,215	–
Average	1,807,237	463,302	1,347,564	7,755

Blank cells (–) denote no landings reported for that season.
Washington Department of Fish and Wildlife 2013a

Sport

WDFW does not require sport fishermen to report landings of sport-caught Dungeness crab in Washington coastal waters; therefore, total landings of Dungeness crab caught in the Grays Harbor sport fishery are unknown.

Stressors

Harvest is the largest anthropogenic stressor on crab populations in Grays Harbor. Direct impacts due to dredging are also known to cause mortality in crab and vary by the type of equipment used. Clamshell dredges result in much lower mortality than suction dredges (Reine and Clark 1998). Dredging impacts in Grays Harbor evaluated by Stevens (1981) found that the numbers of crabs entrained depended on dredge type; hopper and pipeline entrained approximately 0.2. to 0.25 crab per cubic yard dredged,

while clamshell dredge entrained 95% less. A crab entrained by a dredge is not necessarily killed, and mortality rates depend on dredge type, disposal methodology, crab size, and softness of crab shell as related to molting (Armstrong et al. 1987; Stevens (1981). Estimated immediate and delayed mortality for hopper dredges were 56 to 73%, and 10% for clamshell, while mortality for pipeline was 100%. Dredging entrainment and associated mortalities were also evaluated by Dinnel et al. (1986), Dumbauld et al. (1988), Wainwright et al. (1990), and Armstrong et al. (1991). This work included side-by-side assessments of the number of crabs entrained by a Corps hopper dredge and the number of crabs caught during trawling alongside the hopper dredge. These direct comparisons eventually led to a substantial number of entrainment estimates that could be expressed as percentages of crabs present in the dredged channels (McGraw et al. 1988). A key element in the process to estimate loss of Dungeness crabs caused by dredging was the development of the University of Washington Dredge Impact Model (DIM) (Armstrong et al. 1987). This model attempted to integrate relevant crab population data (age, season, location) with dredging gear type (hopper, clamshell, pipeline), volume dredged (cubic yards), dredging season (spring, summer, or fall), and location (channel reach). An entrainment function was calculated from data on dredge-specific crab entrainment and resulting mortality. Projected crab losses of all ages were then adjusted for natural mortality to yield an equivalent adult loss (normalized at age 2+ crabs) to the fishery (unfished females were set equal to males). The Corps used this model to select dredge gear type, location, and season in such a way as to minimize crab losses.

Predation of juvenile life stages by fish and shore birds is extremely high and is a limiting factor to the production of Dungeness crab (Fernandez et al. 1993). Diking has made over 30% of the historical intertidal habitat in Grays Harbor inaccessible to rearing juvenile crab. Reduced availability of habitat limits the productivity and capacity of crab populations (Holsman et al. 2006).

Other Invertebrates

Oysters are farmed on approximately 900 acres in Grays Harbor (Green et al. 2009). In Washington State, 55 million pounds of oysters are farmed annually, leading all other Pacific coast states combined (Pauley et al. 1988).

Pacific oysters are bivalve mollusk in the same family as clams, abalone, and octopus. They are generally found in the intertidal or shallow subtidal zone attached to hard substrate. Oysters feed on planktonic organisms that they filter from the water column. Spawning occurs annually in July or August when water temperatures rise above 19.5 degrees Celsius. Fertilization of eggs is achieved by the simultaneous release of eggs and sperm into the water column. Fertilized eggs hatch and develop into pelagic, planktonic stage within 48 hours. Water temperature greatly influences development rates, but typically young oysters attach to hard substrate approximately 2 weeks after fertilization. Once attached, oysters are sessile and remain at the attachment location for the remainder of their lives.

Ocean acidification has led to problems attaining successful cohorts of juvenile oysters in recent years (Miller et al. 2009). Acidification affects the calcium carbonate shell of the larvae, dramatically reducing survival and settlement rates. This has necessitated the shipment of young oysters from nursery habitats outside of Washington State to maintain successful farming operations.

A variety of worms, nematodes, copepods, amphipods, mollusks, and crustaceans inhabit the upper-most benthic layers throughout Grays Harbor and provide forage for numerous species of fish and birds. Benthic invertebrates adapted to high-energy, volatile environments like the ever-shifting substrates of Grays Harbor, are able to quickly repopulate areas of disturbance, and the benthic community has the ability to rebound quickly (SAIC et al. 2005).

3.4.2.2 Fish and Wildlife

Numerous economically, culturally, and ecologically important fish and wildlife species rear, migrate, and/or reproduce in Grays Harbor. Table 3.4-4 lists fish and wildlife species that occur in Grays Harbor and their federal and state status.

Table 3.4-4. Washington State Fish and Wildlife with Special Status Found in Grays Harbor

Common name	Scientific Name	Animal Type	State Status[a]	Federal Status[b]
Western grebe	*Aechmophorus occidentalis*	Bird	SC	none
Marbled murrelet	*Brachyramphus marmoratus*	Bird	ST	FT
Vaux's swift	*Chaetura vauxi*	Bird	SC	none
Snowy Plover	*Charadrius nivosus*	Bird	SE	FT
Yellow-billed cuckoo	*Coccyzus americanus*	Bird	SC	FC
Short-tailed albatross	*Diomedea albatrus*	Bird	SC	FE
Streaked horned lark	*Eremophila alpestris strigata*	Bird	SE	FT
Peregrine falcon	*Falco peregrinus*	Bird	SS	FCo
Tufted puffin	*Fratercula cirrhata*	Bird	SC	FCo
Common loon	*Gavia immer*	Bird	SS	none
Sandhill crane	*Grus Canadensis*	Bird	SE	none
Bald eagle	*Haliaeetus leucocephalus*	Bird	SS	FCo
Loggerhead shrike	*Lanius ludovicianus*	Bird	SC	FCo
American white pelican	*Pelecanus erythrorhynchos*	Bird	SE	none
Brown pelican	*Pelecanus occidentalis*	Bird	SE	FCo
Brandt's cormorant	*Phalacrocorax penicillatus*	Bird	SC	none
Black-backed woodpecker	*Picoides arcticus*	Bird	SC	none
Purple martin	*Progne subis*	Bird	SC	none
Cassin's auklet	*Ptychoramphus aleuticus*	Bird	SC	FCo
Common murre	*Uria aalge*	Bird	SC	none
Valley silverspot	*Speyeria zerene bremnerii*	Butterfly or Moth	SC	FCo
Green sturgeon	*Acipenser medirostris*	Fish	none	FT
Pacific herring	*Clupea pallasi*	Fish	SC	FCo
River lamprey	*Lampetra ayresi*	Fish	SC	FCo
Chum salmon (Lower Columbia)	*Oncorhynchus keta*	Fish	SC	FT
Coho salmon (Lower Columbia/SW WA)	*Oncorhynchus kisutch*	Fish	none	FT
Chinook salmon (Lower Columbia)	*Oncorhynchus tshawytscha*	Fish	SC	FT
Bull trout	*Salvelinus confluentus*	Fish	SC	FT
Brown rockfish	*Sebastes auriculatus*	Fish	SC	FCo
Copper rockfish	*Sebastes caurinus*	Fish	SC	FCo

Common name	Scientific Name	Animal Type	State Status[a]	Federal Status[b]
Black rockfish	*Sebastes melanops*	Fish	SC	none
Redstripe rockfish	*Sebastes proriger*	Fish	SC	none
Eulachon	*Thaleichthys pacificus*	Fish	SC	FT
Townsend's big-eared bat	*Corynorhinus townsendii*	Mammal	SC	FCo
Keen's myotis	*Myotis keenii*	Mammal	SC	none
Sei whale	*Baleonoptera borealis*	Marine mammal	SE	FE
Blue whale	*Baleonoptera musculus*	Marine mammal	SE	FE
Fin whale	*Baleonoptera physalus*	Marine mammal	SE	FE
Sea otter	*Enhydra lutris*	Marine mammal	SE	FCo
Gray whale	*Eschrichtius robustus*	Marine mammal	SS	none
Steller sea lion	*Eumetopias jubatus*	Marine mammal	ST	FCo
Humpback whale	*Megaptera novaeangliae*	Marine mammal	SE	FE
Killer Whale	*Orcinus orca*	Marine mammal	SE	FE
Pacific harbor porpoise	*Phocoena phocoena*	Marine mammal	SC	none
Sperm whale	*Physeter macrocephalus*	Marine mammal	SE	FE
Loggerhead sea turtle	*Caretta caretta*	Reptile	ST	FE
Green sea turtle	*Chelonia mydas*	Reptile	ST	FT
Leatherback sea turtle	*Dermochelys coriacea*	Reptile	SE	FE

[a] State status codes: SE = endangered; ST = threatened; SC = candidate; SS = sensitive; SM = monitored.
[b] FE = endangered; FT = threatened; FP = proposed; FC = candidate; FCo = species of concern.

Fish

Salmonids

Six species of salmonids are known to migrate and rear in portions of Grays Harbor. The salmon and trout of the Grays Harbor basin spawn in freshwater rivers and streams, rear for a portion of their life in their natal streams, emigrate to the marine environment where they rear for months or years depending upon the species, and then return to their natal stream to spawn. Table 3.4-5 presents the salmonid species that occur in Grays Harbor and its tributary streams that could occur within the navigation channel and at the placement sites.

Table 3.4-5. Salmonid Species in Grays Harbor and Tributary Streams

Salmonid Species	Scientific Name	ESU or DPS	Listing Under the Endangered Species Act	Life Stage Likely Found in Grays Harbor
Chum	*Oncorhyncus keta*	Pacific Coast Chum ESU	Not warranted	Outmigrating juveniles, returning adults
		Columbia River Chum ESU	Threatened	Outmigrating juveniles, returning adults
Coho	*Oncorhyncus kisutch*	Southwest Washington Coho ESU	Not warranted	Outmigrating juveniles, returning adults
Chinook	*Oncorhyncus tshawytscha*	Lower Columbia River Chinook ESU	Threatened	Outmigrating juveniles, rearing juveniles, returning adults
		Washington Coast Chinook ESU	Not warranted	Outmigrating juveniles, rearing juveniles, returning adults
		Upper Willamette River Chinook ESU	Threatened	Outmigrating juveniles, rearing juveniles, returning adults
Steelhead trout	*Oncorhyncus mykiss*	Washington Coast DPS	Not warranted	Outmigrating juveniles, returning adults
Bull trout	*Salvelinus confluentus*	Coastal/Puget Sound DPS	Threatened	Rearing juveniles, foraging adults
Coastal cutthroat trout	*Oncorhyncus clarkia*	Southwestern Washington/Lower Columbia River DPS	Threatened	Outmigrating juveniles, rearing juveniles, foraging adults, returning adults

ESU = evolutionary significant unit; DPS = distinct population segment.
Source: Washington State Dept of Transportation SR 520 Pontoon Construction EIS December 2010.

Chum Salmon

Most chum salmon found in Grays Harbor belong to the Pacific Coast Chum evolutionary significant unit (ESU), but NMFS also believes that juvenile chum from the Lower Columbia River Chum ESU may use nearshore areas of Grays Harbor for rearing (National Marine Fisheries Service 2009).

Adult chum salmon of the Pacific Coast ESU migrate into rivers in the fall after the onset of heavy rains. They do not generally travel long distances to spawn and select reaches immediately upstream of tidal influence to build a nest in gravelly substrate and lay their eggs. Immediately after hatching in the spring, the juveniles move downstream into the estuary to rear in the nearshore environment. Their early outmigration to the estuary and the lengthy juvenile rearing that takes place there make chum salmon heavily reliant upon beneficial estuarine conditions.

Coho Salmon

According to surveys, catches of juvenile coho salmon of the Southwest Washington Coast Coho ESU peak in mid-April to late May in the upper estuary near Cow Point and peak in the lower estuary 1 to 2

months later in mid- to late June (Moser et al. 1991). This indicates that coho spend at least a portion of their juvenile rearing stage in the Grays Harbor estuary (Moser et al. 1991).

Adults returning to spawn pass through Grays Harbor from August to October with the peak river entry typically occurring in September.

Chinook Salmon

Chinook salmon of the Washington Coast Chinook ESU in the Chehalis River comprise two runs, spring and fall, referring to the timing the adults return to the rivers to spawn. The juveniles of the fall run are typically ocean-type, meaning the juveniles emigrate to marine waters as subyearlings. Stream-type juveniles of the spring run rear for a longer time in fresh water and emigrate the following year as yearlings. There are very few reports of yearlings being captured in the estuary (Sandell et al. 2011), indicating that they move quickly through the system to reach the marine waters outside of Grays Harbor. Juvenile Chinook salmon have been captured in the estuary from January through November (Tokar et al. 1970; Simenstad and Eggers 1981) with peak catches occurring from May to June. Although there is evidence of Chinook juveniles residing in the estuary nearly year round, numbers decline rapidly after June (Simenstad and Eggers 1981).

Fall-run adults return to the freshwater rivers and streams to spawn in the fall and pass through Grays Harbor in September. Spring-run adults are likely to be transiting the estuary during April on their return trip to spawn in upper tributaries.

NMFS believes that Lower Columbia River Chinook ESU juveniles and Upper Willamette River Chinook ESU juveniles may be present in Grays Harbor at various times of the year depending on prevailing ocean currents (National Marine Fisheries Service 2009).

Steelhead Trout

Steelhead trout exhibit a very diverse range of life histories. Juveniles leave the freshwater system anywhere from 1 to 5 years after hatching. While some steelhead exhibit an anadromous life history, rearing for a portion of their life in marine waters prior to returning to spawn in their natal river, fish of the same population may choose to rear for the entirety of their lives in fresh water.

Anadromous steelhead of the Washington Coast distinct population segment (DPS) in Grays Harbor are winter-run, meaning they return to rivers to spawn between November and April typically peaking in December. Winter-run steelhead spawn shortly after reaching their spawning grounds, usually between January and March in the Chehalis River.

Resident steelhead trout may be found in the freshwater tributaries to Grays Harbor but would not be found in the marine or estuarine waters.

Bull Trout

No bull trout populations have been documented in the tributaries to Grays Harbor (U.S. Fish and Wildlife Service 2004). Nearby Olympic Peninsula rivers support healthy populations of bull trout that are known to use Grays Harbor for foraging and rearing as adults. Adult bull trout have been found in Grays Harbor and the lower Chehalis River, but no spawning has been documented.

Coastal Cutthroat Trout

Like steelhead, cutthroat trout have both anadromous and resident life-history forms. Anadromous forms migrate from freshwater areas in the late winter and spring to feed in the highly productive nearshore coastal and estuarine environments. In the winter they re-enter fresh waters to feed and spawn. Cutthroat trout may repeat this spawning/rearing cycle multiple times.

Resident cutthroat trout may be found in the freshwater tributaries to Grays Harbor but would not be found in the marine or estuarine waters.

Sturgeon

Green Sturgeon

Two populations of green sturgeon, northern and southern, are known to occur in Grays Harbor. Both populations originate from large coastal river systems including the Sacramento, Klamath, and Rogue Rivers. They do not spawn in Grays Harbor tributaries and only occur as foraging adults and subadults (National Marine Fisheries Service 2005). Southern green sturgeon are currently listed as threatened under the ESA. Northern and southern green sturgeon occurrence and habitat preferences in Grays Harbor, described in Section 3.5.2.2, *Southern Green Sturgeon*, are essentially identical.

White Sturgeon

White sturgeon, the largest North American sturgeon and a species of interest for the local tribes, is found along the west coast from Alaska to north-central California, including in Grays Harbor (Scott and Crossman 1973). White sturgeon is a slow-growing anadromous fish with reported estimated ages of up to 100 years (Environmental Protection Information Center et al. 2001). White sturgeon are known to occur in Willapa Bay (located just south of Grays Harbor on the Pacific coast of Washington) (Emmett et al. 1991). Quinault tribal members harvested 3,111 white sturgeon in Grays Harbor in 2008 and 1,107 in 2009 (Jorgensen pers. comm.).

Forage Fish, Groundfish, and Other Fish Species

Grays Harbor and adjacent nearshore marine areas provide habitat for a variety of groundfish, forage fish, and other fish species during part or all of their life cycles (Emmett et al. 1991; Monaco et al. 1990). Groundfish species include rockfish, flatfish, and other bottom-dwelling species; forage fish include herring, smelt, eulachon, sardine, and other small pelagic fish species.

The majority of the groundfish and forage fish species are protected under the EFH provisions of the MSA (Pacific Fishery Management Council 2011a, 2011b). Southern eulachon, a forage fish species, is not protected under the MSA but is listed as threatened under the ESA (see Section 3.5.2.3, *Southern Eulachon*). Other forage fish species, specifically herring, surf smelt, and sand lance, are also not listed under the ESA or directly protected under the MSA, but are considered to be components of EFH and designated critical habitat for other federally protected species and are therefore considered in related regulatory consultations.

A summary of groundfish and forage fish species and associated life-history stages likely to occur in Grays Harbor or adjacent nearshore coastal habitats is provided in Table 3.4-6. The species identified in Table 3.4-6 collectively occupy a broad range of habitat types known to occur in these areas, including eelgrass meadows, estuarine mudflats, and shallow-water areas, shorelines, and other estuarine and nearshore marine features (Emmett et al. 1991). Only those species and habitat types likely to be affected by the proposed action are considered in this analysis.

Forage Fish Species

Grays Harbor is habitat for several fish species that provide a prey base (forage) for numerous fish, birds, and marine mammals. Simenstad and Eggers (1981) identified seven species of forage fish in Grays Harbor: Pacific herring (*Clupea harengus pallasi*), Pacific sand lance (*Ammodytes exapterus*), northern anchovy (*Engraulis mordax*), surf smelt (*Hypomesus pretiosus*), longfin smelt (*Spirinchus thaleichthys*), whitebait smelt (*Allosmerus elongatus*), and American shad (*Alosa sapidissima*).

Smith and Eggers (1981) found northern anchovy in higher abundance than other forage fish species in Grays Harbor. All life stages from juvenile to mature adult were captured in surveys. While herring were also abundant, a disproportionate number of juvenile herring in the catch indicate that the harbor is used heavily as juvenile rearing habitat. Abundance and residence time of forage fish in Grays Harbor fluctuates widely due to a variety of physical processes such as winds, currents, and weather patterns that influence distribution of the planktonic foods that forage fish prey upon. American shad are an introduced anadromous species that has been present in Grays Harbor for nearly a century (Chapman 1942). This species still occurs in Grays Harbor in low abundance and is most commonly associated with habitats at the head (i.e., upstream portion) of the estuary (Sandell et al. 2011).

Pacific herring, surf smelt, and sand lance are known to spawn in Grays Harbor (Washington Department of Fish and Wildlife 2013c). Spawning by other forage fish species is uncertain but larval anchovy are found in Grays Harbor (Monaco et al. 1990; Simenstad and Eggers 1981). These species form an important component of the forage base for a number of other species, including marine mammals, marine birds, salmon and steelhead, and bull trout. These species are not directly protected under the ESA or MSA, but are often considered to be important components of EFH and/or designated critical habitat for species that are protected under these statutes.

Table 3.4-6. Forage Fish, Groundfish, and other Fish Species Likely to Occur in Grays Harbor and Adjacent Coastal Nearshore Habitats

		Life Stage				Federal Regulatory Protection	
Scientific Name	Common Name	Adult/ Subadult	Juvenile	Larvae	Egg	Endangered Species Act	Magnuson-Stevens Act
Forage Fish Species (Including MSA Coastal-Pelagics)							
Ammodytes hexapterus	Pacific sand lance	X	X	X		X[b]	
Clupea pallasi	Pacific herring	X	X	X	X	X[b]	
Engaulis mordax	Northern anchovy	X	X[a]	X[a]	X[a]		X
Hypomesus pretiosus	Surf Smelt	X	X	X		X[b]	
Loligo opalescens	Market Squid	X	X[a]	X[a]	X[a]		X
Sardinops sagax	Pacific sardine	X	X[a]	X[a]	X[a]		X
Scomber japonicas	Pacific mackerel	X	X[a]	X[a]	X[a]		X
Thaleichthys pacificus	Eulachon	X	X	X		X	
Groundfish Species							
Atheresthes stomias	Arrowtooth flounder		X	X			X
Citharichthys sordidus	Pacific sanddab			X			X
Eopsetta jordani	Petrale sole			X	X		X
Gadus macrocephalus	Pacific cod			X			X
Galeorhinus galeus	Soupfin shark	X	X				X
Hippoglossoides elassodon	Flathead sole		X	X	X		X
Hydrolagus colliei	Spotted ratfish	X	X				X
Lepidopsetta bilineata	Rock sole			X	X		X
Leptocottus armatus	Pacific staghorn sculpin	X	X	X	X		
Microstomus pacificus	Dover sole				X		X
Microgadus proximus	Pacific tomcod	X		X			
Ophiodon elongatus	Lingcod		X	X			X
Parophrys vetulus	English sole	X	X		X		X
Platichthys stellatus	Starry flounder	X	X	X	X		X
Psettichthys melanostictus	Sand sole				X		X

		Life Stage				Federal Regulatory Protection	
Scientific Name	Common Name	Adult/ Subadult	Juvenile	Larvae	Egg	Endangered Species Act	Magnuson-Stevens Act
Raja inornata	California skate	X			X		X
Sebastes auriculatus	Brown rockfish			X			X
Sebastes caurinus	Copper rockfish			X			X
Sebastes melanops	Black rockfish		X				X
Sebastes proriger	Redstripe rockfish			X			X
Squalus acanthias	Spiny dogfish	X	X				X
Other Fish Species							
Alosa spadisima	American Shad	X	X				
Clevelandia ios	Arrow goby	X	X	X	X		
Cymatogaster aggregate	Shiner perch	X	X	X			
Gasterosteus aculeatus	Three-spine stickleback	X	X	X	X		
Amphisticus spp	Surfperch	X	X	X	X		

[a] The Fishery Management Plan groups juveniles/larvae/eggs together, any of which could be present in estuarine or coastal nearshore habitats in Washington State Also all life history stages of these species may be found in waters off of coastal Washington when surface water temperatures exceed 10 degrees Celsius.

[b] Species is not listed under the ESA but is considered a component of designated critical habitat for an ESA-listed species.

Groundfish Species

Rockfishes

Brown, copper, black, and redstripe rockfish are identified as part of the Washington State coastal estuarine composite of groundfish species included in the federal fishery management plan for this species complex (Pacific Fishery Management Council 2011b). These species are likely to occur in Grays Harbor as larvae and juveniles and may occur in the deeper water portions of the harbor at varying frequency by species (Pacific Fishery Management Council 2005).

Each species is known to preferentially select estuarine habitats during the larval and juvenile life stages, with larvae showing strong directional movement into estuarine habitats where they settle and rear as juveniles. The duration and extent of estuarine rearing varies by species.

Black rockfish larvae typically settle in June and demonstrate pronounced directional movement into estuaries (Pacific Fishery Management Council 2005). They are commonly associated with eelgrass but also found in sandy-bottomed habitats protected from strong current. Juveniles remain in these habitats through October and then move offshore into deeper habitats, including sandy bottom and sand-rock interface. Adult habitats include surface and midwater areas over shallow high-relief substrates like rocky reefs and pinnacles. They can be found in shallow nearshore waters out to depths exceeding 300 feet, but are most commonly found where water depths are less than 200 feet (Pacific Fishery Management Council 2005). Juvenile rockfish preferentially select protected locations with low tidal current. Tidal exchange in the estuary leads to fast, strong tidal currents in the navigational channel, making it unlikely that black rockfish would be found in high concentrations near locations of proposed activities.

Copper rockfish are similar to black rockfish in terms of life history and habitat selection, except that they are typically associated with the bottom rather than midwater habitats (Pacific Fishery Management Council 2005). Juvenile rockfish preferentially select protected locations with low tidal current. Tidal exchange in the estuary leads to fast, strong tidal currents in the navigational channel, making it unlikely that copper rockfish will be found in high concentrations in the locations of proposed activities.

Brown rockfish are habitat generalists. They are tolerant of a wide range of temperature and salinity conditions and are frequently found in shallow-water bays near estuaries. They are most frequently found at depths less than 160 feet and can be found at depths as shallow as 20 feet (Pacific Fishery Management Council 2005). Larval brown rockfish seek out and settle in shallow vegetated areas including kelp beds and eelgrass in shallow bays and estuaries. Juveniles use the same habitat types but are also commonly found in sandy bottomed areas. Adults preferentially select low-profile, hard-bottomed habitats as they mature and are commonly found near a sand-rock interface. They also use rockpiles and other high-relief areas near estuaries and coastal habitats. Adult brown rockfish are sedentary with small home ranges (Pacific Fishery Management Council 2005). The scarcity of macro algae and eelgrass beds in close proximity to locations of proposed activities suggests that few brown rockfish would be found in these areas.

Redstripe rockfish inhabit deep-water habitats on the outer continental shelf and upper continental slope as adults, and are most commonly at depths between 500 and 900 feet (Pacific Fishery Management Council 2005). Larvae and juveniles are commonly found in estuaries, but are less common than the other coastal estuarine complex rockfish. Larvae are typically released between April and July,

with settlement from early to late summer (Pacific Fishery Management Council 2005). Larvae and juveniles are not as closely associated with the bottom as the other estuarine rockfish species. Based on release larvae release times, larvae and juveniles are likely to be present in the Grays Harbor estuary during the in-water work window for dredging and dredged materials placement.

Lingcod

Lingcod is a large, bottom-dwelling fish species found in nearshore coastal waters. Lingcod are predatory, feeding primarily on other fish as adults. Adult lingcod can be found at depths ranging from 30 to 500 feet, with the presence of rocky reefs or other hard substrates with overhangs and crevices being a key factor in habitat selection. They spawn on rock or other hard substrates with overhangs and crevices, between November and April, usually at depths from 10 to 100 feet. Females may produce from 60,000 to 500,000 eggs, depending on individual body size. Incubation of eggs is generally 6 weeks (Emmett et al. 1991). After hatching, free-swimming larvae spend up to 2 months in the nearshore environment, generally in the upper 3 meters of lower-salinity runoff plumes. Larvae then swim against the current to seek out shallow estuarine habitats where they settle on the bottom and transform into juveniles, typically in May and June. Post-settlement larvae and juveniles are commonly found in areas of high productivity, like eelgrass beds or shallow flats with cobble/shell hash substrate (Emmett et al. 1991). In the fall, juveniles move off shore into deeper water, and by 1 year of age begin to associate with rocky substrates. They typically reach sexual maturity in 2 to 3 years (Emmett et al. 1991).

Lingcod is an important commercially fished species in Washington and a highly valued sport fish. Recent studies of lingcod habitat use and density in Grays Harbor are lacking. Taggart and Short (1987) recorded no lingcod in their 5-month trawl survey. It is possible that, because lingcod are fast swimmers when startled, they avoided capture by fleeing from the trawl. It is also possible that the density of juvenile lingcod is low in most of Grays Harbor. Underwater video of the benthos immediately to the south of the South reach revealed a uniform, fine sandy bottom that was not deemed appropriate habitat for juvenile or adult lingcod (ICF Jones & Stokes 2009).

Armstrong et al. (1982) estimated entrainment rates due to dredging activities for lingcod of 0.002 fish per cubic yard of sediment at the South reach and 0 fish per cubic yard for the Crossover, North Channel, and Cow Point reaches indicating that few lingcod are present in the navigation channel. Larvae and juveniles are likely to be associated with eelgrass and shallow-water habitats fringing the estuary, however, the rock jetties at the harbor mouth provide habitat with hard rocky substrate with crevices and overhangs that is likely to be used by adults.

Various Flatfishes

Several flatfish species are known or are likely to occur in Grays Harbor (Table 3.4-6), with sanddab, petrale sole, English sole, and starry flounder being relatively common (Emmett et al. 1991). As a group, flatfish species are known for their specialized body form and close association with the sea bed. These species may be present at any life stage, but are most likely to occur as free-swimming larvae and as juveniles closely associated with bottom substrates (Emmett et al. 1991; Pacific Fishery Management Council 2005). Juveniles are likely to be present in and around the navigation channel and the dredged material placement sites in the estuary during dredging activities. Armstrong et al. (1982) recorded entrainment rates of flatfish and other fish species during hopper dredging in Grays Harbor. They observed entrainment of starry flounder, English sole, sand sole, slender sole, Pacific sanddab, speckled sanddab, and other flatfish species at rates ranging from 0.001 to 0.076 fish per cubic yard of dredged material, depending on the species.

Lamprey

Pacific and river lamprey are both known to occur in the Chehalis River basin. Larval lamprey juveniles (ammocoetes) rear in sandy/silty substrates of low-velocity habitats in freshwater river systems for 3 to 7 years. During this time, they are sedentary filter feeders. Filter-feeding larval stages metamorphose into their adult life stage, during which time they transition to a parasitic stage and leave the freshwater system in search of host fish upon which to feed in the ocean. This emigration happens gradually any time between fall and spring. Adult lamprey return to rivers and migrate upstream to spawn February to June where they die after spawning.

Historically, lamprey were important for food and medicinal purposes to Native American tribes and they remain important for traditional tribal cultural practices. Tribal peoples generally harvest lamprey at falls or in fast-water areas where the fish tend to congregate. The fish were caught by hand, dip net, or by jigging. Lamprey were prepared for eating by drying or roasting. The medicinal oil collected from drying lamprey was applied to skin or an ailing part of the body during a purifying sweat bath.

Wildlife

Birds

The expansive mud and sand tidal flats of Grays Harbor make up one of four major staging areas in the Pacific Flyway extending along the west coast from Alaska to Central and South America. Up to 1 million shorebirds feed and rest in Grays Harbor during their spring and fall migrations. Grays Harbor has accordingly been recognized as important shorebird habitat, with the Grays Harbor National Wildlife Refuge established in 1988 to protect 1,500 acres of intertidal mudflats, saltmarsh, and uplands. Although the refuge occupies only 2% of the intertidal area of Grays Harbor, up to 50% of the shorebirds forage and rest in the refuge (U.S. Fish and Wildlife Service 2013).

As many as 278 species of birds use the Grays Harbor National Wildlife Refuge (Appendix B). The most abundant shorebird species are typically western sandpiper and dunlin. Semi-palmated plover, least sandpiper, red knot, and black-bellied plover are also common during migration. American widgeons are the most common waterfowl species making up nearly 60% of the waterfowl population during spring and fall migrations. Mallards, green-winged teal, and northern pintail are also common during migration time (U.S. Fish and Wildlife Service 1990).

Snowy plover is a rare shorebird species that forages for invertebrates and other prey species in shallow intertidal mudflats. A snowy plover breeding site is located approximately 2 miles northeast of the entrance to Grays Harbor at Damon Point in Grays Harbor (Washington Department of Fish and Wildlife 2013c). The proximity of this active breeding site to suitable foraging habitats in Grays Harbor indicates that this species is likely to be present in the vicinity, and may be using other suitable nesting habitats in the vicinity. The snowy plover is federally listed as threatened, and is discussed in more detail in Section 3.5.2.4, *Birds*.

Bald eagles are known to feed and nest in and around Grays Harbor. Several bald eagle nesting areas have been recorded by WDFW along the shorelines of Grays Harbor since 1997, and some of these are recorded as active. Marbled murrelets are seabirds that feed on forage fish in open marine waters. This species is assumed to be present in offshore marine habitats near the mouth of Grays Harbor throughout the year, with the greatest likelihood of occurrence during the fall, winter, and spring. Murrelet sightings inside Grays Harbor are extremely rare. Marbled murrelets nest in mature upland forests, which do not

occur along the margins of Grays Harbor. The marbled murrelet is federally listed as threatened, and is discussed in more detail in Section 3.5.2.4, *Birds*.

WDFW has identified five nesting bird colonies in Grays Harbor (Table 3.4-7), the closest to the navigation channel being a small colony of pigeon guillemot on the Point Chehalis jetty.

Table 3.4-7. Nesting Colonies of Birds Recorded in Grays Harbor

Species	Approximate Number of Birds	Location	Nearest Navigation Channel Reach	Distance of Colony to Navigation Channel Reach (miles)
Double-crested cormorant	916	Goose Island	South	127
Least tern	5,216	Sand Island	South	88
Glaucous-winged gull	28	Whitcomb Island	South	22
Pigeon guillemot	23	North Jetty	Entrance Channel	35
Pigeon guillemot	4	South Jetty	Entrance Channel	6

Source: Washington Department of Fish and Wildlife 2013c.

Several state-listed species of concern are listed by WDFW as likely to be found in Grays Harbor. Western grebe, tufted puffin, common loon, American white pelican, brown pelican, Cassin's auklet, Brandt's cormorant, and common murre, as well as the marbled murrelet, are open-water species that may be found resting or foraging in or near the navigation channel. Snowy plover and streaked horned lark are shorebirds that would be found along the shorelines of Grays Harbor. Both species are discussed in more detail in Section 3.5.2.4, *Birds*, as federally listed species.

Purple martin nesting was identified by WDFW in 1988 (Washington Department of Fish and Wildlife 2013c) on pilings near Hoquiam, but nesting has not subsequently been identified. Purple martins were sighted foraging over the navigation channel near the mouth of the Hoquiam River during wildlife surveys that took place in 2008 (Washington State Department of Transportation 2011).

Marine Mammals

Blue (*Balaenoptera musculus)*, fin (*B. physalus),* sei *(B. borealis*), sperm (*Physeter macrocephalus*), pygmy sperm (*Kogia breviceps*), humpback (*Megaptera novaengliae*), common minke (*Balaenoptera acutorostrata*), and gray whales (*Eschrichtius robustus*) all occur in the waters off of Grays Harbor. Blue, fin, sei, sperm, and pygmy sperm whales are periodic visitors to Washington waters and their movements are typically restricted to offshore areas near the continental shelf. Humpbacks are primarily found in the warm waters of Mexico or Hawaii in the winter and in Alaska in the summer, but they can also be seen off the Washington coast where they sometimes spend their summer feeding. The occurrence of these species in coastal waters ranges from exceptionally rare (blue whales) to relatively common (humpback whales) (Carretta et al. 2011).

The balaenoptera and sperm whales are nearly always closely associated with the continental shelf (Calambokidis et al. 2004; Carretta et al. 2011; Schorr et al. 2010), which extends approximately 30 miles off shore from the mouth of Grays Harbor. Humpback whales range closer to shore (Calambokidis et al. 2004; Carretta et al. 2011) and may occur in proximity to the navigation channel and dredged material placement areas. The Orca Network (2013) reports many sightings of humpback whales travelling along the coast near the mouth to Grays Harbor, and rarely reports humpbacks entering the

bay itself, indicating that they infrequently use Grays Harbor. Section 3.5.2.5, *Marine Mammals*, describes the occurrence of this species in Grays Harbor in more detail.

Little is known about the movements of common minke whales but they are believed to be migratory, heading to southern waters in the winter. They feed primarily on small schooling fish such as herring, sardines, and anchovies. These fish are abundant in Grays Harbor, likely drawing minke whales to these Washington waters. Gray whales pass through Washington waters twice annually migrating between feeding grounds in Baja California and breeding grounds in Alaska. This migration peaks during March, April, and May in Washington when gray whales swim in large numbers close enough to the Washington coastline to be seen from shore. Primary habitat for gray whales in Washington is the outer coast open waters, including Grays Harbor. Gray whales are bottom feeders, digging up large quantities of sediment laden with worms, crustaceans, and other organisms. The probability of the other whale species listed above occurring in proximity to dredging activities or dredged material placement sites is remote, because these species are rarely seen within 10 miles of shore (Calambokidis et al. 2004; Carretta et al. 2011).

Killer whales (*Orcinus orca*) are also known to occur in offshore waters of coastal Washington in the vicinity of Grays Harbor. Killer whales have three distinct behavioral types—resident, transient, and oceanic—all of which travel in pods ranging from 3 to 50 individuals. Oceanic and transient killer whales range much more broadly than residents, travelling long distances hunting for fish, seals, sea lions, and other whales for food. They are considered only occasional visitors to the waters around Grays Harbor (Orca Network 2013). The resident form of killer whales in the vicinity of Grays Harbor belongs to the Southern Resident Killer Whale DPS, which is known to range in winter as far north as the Queen Charlotte Islands of British Columbia, Canada, and as far south as central California. During the spring, summer, and fall, southern residents spend most of their time hunting returning adult salmon (their primary food source) in and around Puget Sound, the Strait of Juan de Fuca, and Georgia Strait. The ESA-listed southern resident killer whale is described in more detail in Section 3.5.2.5, *Marine Mammals*.

Harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), and Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) are common year-round inhabitants of Grays Harbor and the surrounding coastline, likely feeding upon the numerous forage fishes in and around the bay. The Orca Network (2013) reports many sightings of these species in and around Grays Harbor annually. Common dolphin (*Delphinus delphinus*) are occasionally sighted around Grays Harbor but typically frequent warmer waters to the south.

Harbor seals (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*), California sea lion (*Zalophus californianus*), Steller sea lion (*Eumetopias jubatus*), and eastern Steller sea lion (*Eumetopias jubatus*) are known to or may potentially occur in Grays Harbor. Harbor seals and California sea lions are usual and common inhabitants of Grays Harbor and can be found at a number of haulout sites within the estuary in any month of the year (Jeffries et al. 2000). Eastern Steller sea lions are regular visitors to the Washington coast, but they are not typically observed in Grays Harbor and have not been recorded using haulout areas regularly occupied by seals and California sea lions (Jeffries et al. 2000). A population of sea otters (*Enhydra lutris*) was transplanted to the Washington coast in 1969–1970. In recent years the population measured between 600 and 750 individuals. This population is generally centered on the northern portions of the outer Olympic Peninsula coast north of Destruction Island (50 miles north of Grays Harbor) (Lance 2004), so occurrences of sea otters in the confines of Grays Harbor would be very rare.

Four marine reptile species are known to at least occasionally occur in Washington coastal waters. These include the leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and olive ridley (*Lepidochelys olivacea*) sea turtles. All of these species are protected under the ESA; additional information about their likelihood of occurrence and habitat use are provided in Section 3.5.2.6, *Sea Turtles*.

3.5 Threatened and Endangered Species

This section discusses threatened and endangered species, as well as designated critical habitat, that are known to occur or potentially occur in Grays Harbor or the vicinity. This section also describes the applicable regulations to protect these species and critical habitats.

3.5.1 Regulatory Setting

In accordance with Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts on federally listed and proposed threatened or endangered species and designated or proposed critical habitat. Several ESA-protected species and critical habitats are known to occur or may occur in Grays Harbor or the general vicinity (Table 3.5-1). This section focuses specifically on ESA-protected species and habitat.

The Corps has conducted ESA Section 7 consultations with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) (referred to collectively as the Services) for the maintenance dredging program in 2006 (NMFS Reference NWR-2006-03926 and USFWS Reference 1-3-06-I-0469), and in 2011 (NMFS Reference NWR-2011-2093 and USFWS Reference 13410-2011-0274). The Services concurred with the Corps' determinations of "may affect, not likely to adversely affect" for all listed species and critical habitat covered by this consultation. The 2011 consultation covered maintenance dredging of the GHNIP from 2011 through 2026. The environmental effects associated with the maintenance dredging program to a depth of -36 feet MLLW are therefore part of the environmental baseline in the project action area. The direct and indirect effects of the proposed action are considered relative to this environmental baseline. In 2012 the Corps proposed to make alternative use of clamshell dredging in the Outer Crossover Reach, an area previously hopper dredged, and in late 2012 the Services again concurred with the Corps determinations of "may affect, not likely to adversely affect" for designated critical habitat and all the listed species covered by the previous consultation (NMFS Reference 2011/02093 of November 26, 2012 and USFWS Reference 13410-2011-1-0274-R001).

In 2013 the Corps reinitiated consultation on the above maintenance dredging actions for a minor realignment of the navigation channel intended to follow natural changes in the channel thalweg. The channel realignment represents less substrate disturbance, less dredging, and less sediment disposal. This minor channel realignment is also expected to continue to significantly reduce dredging needs at these locations. Once complete, the deepened channel will be maintained in a manner consistent with the existing annual dredging program, which includes the channel realignment. The Services concurred with the Corps determination of "may affect, not likely to adversely affect" for all of the species in the previous consultations as well as for the recently listed streaked horned lark (NMFS ref: WCR-2013-68; USFWS ref: 13410-2011-I-0274-R002). The recent change to elective use of a clamshell dredge in the formerly hopper-only dredged outer Cross-over

Reach represents greatly reduced entrainment and mortality of aquatic organisms in that area. The effects of these two actions, analyzed separately, along with the current channel maintenance at -36 feet MLLW form part of the baseline for this deepening project. New ESA species listings and critical habitat designations have been proposed since the 2011 programmatic ESA consultation was completed. A new Supplemental BE is being prepared for the proposed action (Chapter 9, *Environmental Compliance*), which will address all changes in species and habitat status since the 2013 SBE that last triggered reinitiated consultation. The findings of the SBE are addressed in this SEIS at Chapter 4. USACE is currently consulting with the Services on this SBE and the results of the consultation process will be incorporated into the Final SEIS.

3.5.2 Environmental Setting

Table 3.5-1 summarizes ESA-listed species and designated critical habitats that are known to occur or could potentially occur in the action area defined for the BE as within 0.11 mile of the navigation channel and the dredged material placement sites below the water surface and within 0.76 mile above the water surface, based on the maximum potential extent of dredging-related underwater and in-air noise and water quality effects.

Table 3.5-1. Species Listed and Proposed for Listing under the Endangered Species Act and Designated Critical Habitat Known to Occur or Potentially Occurring in the Action Area

Species	Listing Status	Critical Habitat Status	Critical Habitat Present	Species Occurrence in Grays Harbor/Vicinity
Coastal/Puget Sound bull trout *Salvelinus confluentus*	Threatened	Designated	Yes	Documented (R2 Resource Consultants 2006)
Columbia River chum salmon *Onchorhynchus keta*	Threatened	Designated	No	Assumed present (National Marine Fisheries Service 2009)
Lower Columbia River Chinook salmon *Onchorhynchus tshawytscha*	Threatened	Designated	No	Assumed present (National Marine Fisheries Service 2009)
Upper Willamette River Chinook salmon *Onchorhynchus tshawytscha*	Threatened	Designated	No	Assumed present (National Marine Fisheries Service 2009)
Southern green sturgeon *Acipenser medirostris*	Threatened	Designated	Yes	Documented (Lindley et al. 2011; Moser and Lindley 2007)
Southern eulachon *Thaleichthys pacificus*	Threatened	Designated	No	Historical rare occurrence documented
Marbled murrelet *Brachyramphus marmoratus*	Threatened	Designated	No	Documented uncommon (Carlson et al. n.d.)
Western snowy plover *Charadrius alexandrius nivosus*	Threatened	Designated	Yes	Documented (77 FR 36727)
Short-tailed albatross *Phoebastria albatrus*	Endangered	None	—	Documented rare (Carlson et al. n.d.)
Streaked horned lark *Eremophila alpestris strigata*	Threatened Threatened	Designated	No	Documented (77 FR 61938)

Species	Listing Status	Critical Habitat Status	Critical Habitat Present	Species Occurrence in Grays Harbor/Vicinity
Southern resident killer whale *Orcinus orca*	Endangered	Designated	No	Not likely to occur (National Marine Fisheries Service 2013b; Orca Network 2013)
Blue whale *Balaenoptera musculus*	Endangered	None	–	Not likely to occur (Carretta et al. 2011)
Fin whale *Balaenoptera physalus*	Endangered	None	–	Not likely to occur (Calambokidis et al. 2004; Carretta et al. 2011; Schorr et al. 2010)
Sei whale *Balaenoptera borealis*	Endangered	None	–	Not likely to occur (Carretta et al. 2011)
Sperm whale *Physeter macrocephalus*	Endangered	None	–	Not likely to occur (Carretta et al. 2011)
Humpback whale *Megaptera novaeangliae*	Endangered	None	–	Not likely to occur (Carretta et al. 2011)
Loggerhead sea turtle *Carretta caretta*	Endangered	Designated	No	Not likely to occur (Conant et al. 2009; Washington Department of Fish and Wildlife 2012)
Leatherback sea turtle *Dermochelys coriacea*	Endangered	Designated	No	Not likely to occur (Conant et al. 2009)
Green sea turtle *Chelonia mydas*	Threatened	Designated	No	Not likely to occur (Conant et al. 2009)
Nesting olive ridley sea turtle *Lepidochelys olivacea*	Endangered	None	—	Not likely to occur (Conant et al. 2009)
Oregon silverspot *Speyeria zerene Hippolyta*	Threatened	Designated	No	None (extirpated) (U.S. Fish and Wildlife Service 2001)

FR = Federal Register
NMFS (2013a) and USFWS (2012).

3.5.2.1 Bull Trout and Salmon

Bull trout are known to use Grays Harbor and its tributaries as adult and subadult foraging habitat and, along with green sturgeon, are the most likely listed species to occur in the vicinity of the proposed action. No established bull trout populations occur in the Chehalis River or any other tributaries to Grays Harbor, so these individuals must be migrating into the estuary from other river systems (R2 Resource Consultants 2006). Strong bull trout populations in the Hoh, Queets, and Quinault Rivers on the western Olympic Peninsula to the north are the likely source of Grays Harbor bull trout. They are known to be anadromous, spending extended periods of time foraging in nearshore coastal waters as adults and subadults (Brenkman and Corbett 2005). Bull trout migrate into Grays Harbor in late winter and forage in estuarine and tributary habitats through mid-summer. Subadults and nonspawning adults may also overwinter in Grays Harbor tributaries.

Surveys of bull trout occurrence indicate that the period of peak abundance extends from March through mid-July (R2 Resource Consultants 2006), which is consistent with the in-water work closure period to protect listed species.

Acoustic-tagging data indicate that the mainstem reach of the Chehalis River between the Elliott Slough Turning Basin and Cow Point Reach is a preferred habitat area (R2 Resource Consultants 2006). However, bull trout are unlikely to be present during the period from mid-July through February when dredging would occur. This is the period when bull trout return to spawning habitats in the headwater mainstem and tributaries of their home river systems. Designated critical habitat for bull trout includes river systems used for spawning and rearing, migration corridors, estuarine habitats extending upstream to the uppermost reach of the tidally influenced saltwater wedge, and nearshore marine habitats extending to −33 feet MLLW (75 *Federal Register* [FR] 63898). This designation effectively includes all of Grays Harbor extending upstream into the mouth of the Chehalis River, with the exception of the navigation channel itself that is currently maintained at -36 feet MLLW, and the dispersive aquatic dredged material placement sites which are predominately deeper than -33 feet MLLW.

Prior to the 2011 ESA consultation on the annual maintenance dredging, NMFS obtained new information indicating that three listed salmonid species not thought to occur in Grays Harbor were, in fact, likely to be present (National Marine Fisheries Service 2009). Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon, and Columbia River chum salmon, all listed as threatened, may use the shallow nearshore areas of Grays Harbor as juvenile foraging habitat before they migrate to the open ocean (National Marine Fisheries Service 2009). These juvenile salmonids can be transported north into Grays Harbor when the Columbia River plume front is pushed northward along the Washington coast by prevailing wind and current conditions in mid- and late winter (DeRobertis and Morgan 2005; Horner-Devine et al. 2009; Thomas and Weatherbee 2006). These species, therefore, are considered likely to occur within their respective juvenile rearing windows, which extend from late winter through summer. Critical habitat has been designated for all three species, but the designation is restricted to the Columbia River mainstem below Bonneville Dam, the estuary, and selected tributaries. It does not extend into Grays Harbor or adjacent marine habitats (70 FR 52630).

3.5.2.2 Southern Green Sturgeon

Subadult and adult southern distinct population segment (DPS) green sturgeon are known to use the shallow estuarine waters of Grays Harbor as summer foraging habitat (Lindley et al. 2011; Moser and Lindley 2007). They enter the harbor as early as April and exit as late as October, but are present in greatest abundance from mid- to late summer (Moser and Lindley 2007). Grays Harbor appears to provide abundant food resources and temperature conditions for optimal growth and is important over-summering habitat for subadult and adults (Moser and Lindley 2007). Tagging studies have confirmed the occurrence of southern DPS green sturgeon in Grays Harbor (Israel and May 2007; Lindley et al. 2011). Israel and May (2007) reported that approximately half of the individuals they sampled in Grays Harbor (35 of 69) were from the southern DPS. Lindley et al. (2011) found that almost half of the green sturgeon they tagged in the Sacramento River system were subsequently detected in Grays Harbor, indicating a high fidelity for this habitat.

Lindley et al. (2011) observed that green sturgeon typically appear in peak abundance in Washington estuaries during mid- to late summer when salinity levels and water temperatures are relatively high (Moser and Lindley 2007). In Grays Harbor, green sturgeon are most commonly

found within and on the seawater side of the estuarine mixing zone, and are present at highest abundances from July through early October (Monaco et al. 1990; Adams et al. 2002). Lindley et al. (2011) found the highest number of tagged fish occurred in September and October. They generally remain in these higher-salinity areas and are rarely found in the lower Chehalis River (Deschamps et al. 1970; Lindley et al. 2011).

The preferred prey species of subadult and adult green sturgeon include crangonid and burrowing thalassinidean shrimp, amphipods, clams, juvenile Dungeness crab (*Cancer magister*), anchovies, sand lances (*Ammodytes hexapterus*), lingcod (*Ophiodon elongatus*), and other fish species (Moyle et al. 1992; Moser and Lindley 2007; Dumbauld et al. 2008). Burrowing ghost shrimp (*Neotrypaea californiensis*), which are abundant on estuarine tidal flats, comprised approximately 50% of the stomach contents of green sturgeon in Willapa Bay (Dumbauld et al. 2008). Kelly et al. (2007) found that foraging adult and subadult sturgeon in San Francisco and San Pablo Bays remained primarily in waters less than 33 feet in depth, moving on and off of shallow flats with the tidal fluctuations. In contrast, actively migrating sturgeon were typically found in deep-water habitats and exhibited rapid directional movement. The majority of Grays Harbor, specifically the areas outside the navigation channel, consists of shallow-water tidal flats with abundant green sturgeon prey resources. The strong preference for this habitat type during estuarine foraging suggests that green sturgeon in Grays Harbor will most commonly be found outside of the navigation channel, but could be found in the vicinity of some of the nearshore placement sites.

Eggs, larvae, and juvenile green sturgeon do not occur in Grays Harbor, because spawning habitat for this species is restricted to the Sacramento River basin in California. The critical habitat designation for southern green sturgeon includes the entirety of Grays Harbor to the upstream limit of the estuarine salt wedge in tributary river systems (74 FR 52300).

3.5.2.3 Southern Eulachon

Eulachon are a type of smelt that spawn in fresh water, are transported by river currents to estuarine and marine habitats as larvae, and live the remainder of their life in the ocean before returning to spawn as adults. The primary spawning habitats for southern eulachon are in the lower Columbia River and its tributaries. Eulachon spawning occurs occasionally in river systems to the north of Grays Harbor on the Olympic Peninsula (Gustafson et al. 2010). Evidence of eulachon occurrence in Grays Harbor is fragmented and contradictory. Literature sources dating prior to 1990 suggest that eulachon were common in Grays Harbor tributaries (Deschamps et al. 1970; Emmett et al. 1991; Monaco et al. 1990). Eulachon have periodically been observed spawning in the Wynoochie River over the past few decades, with the last observed spawning run of significance occurring in 1993. Their occurrence in Grays Harbor in recent years has been classified as rare (Gustafson et al. 2010). The critical habitat designation for this species does not include Grays Harbor or its tributaries (76 FR 65324).

Eulachon commonly return to spawn in late winter and early spring well before the spring freshet, near the seasonal flow minimum, especially on the mainland coast of British Columbia (Lewis et al. 2002). In many rivers, eulachon spawning appears to be timed so that egg hatching will coincide with peak spring river discharge (Flory 2008). The juveniles are flushed rapidly downstream into the river estuary where they rear for weeks to months prior to entering the Pacific Ocean (Hay and McCarter 2000). Adult eulachon typically reside in the upper third of the water column, whereas juveniles are found in higher densities near the bottom (Spangler 2002). McCarter and Hay (2003) note that larval eulachon are typically abundant at depths ranging from 0 to 15 meters (0 to 49 feet)

below the surface, which indicates they would likely be found at all depths in the Grays Harbor navigation channel when present.

The primary spawning habitats for southern eulachon are in the lower Columbia River and its tributaries including the Cowlitz, Lewis, Kalama, and Sandy Rivers (Gustafson et al. 2010). Historically, eulachon were described as "common" in Grays Harbor and Willapa Bay (Monaco et al. 1990; Emmett et al. 1991). However, little data are available regarding eulachon occurrence in Grays Harbor beyond sparse harvest data and anecdotal observations (Gustafson et al. 2010).

Deschamps et al. (1970) reported the capture of a single adult eulachon in a seine catch in March 1966 and stated that "It is unlikely that the Chehalis system [which drains into Grays Harbor] has a run of any consequence, although strays or feeding fish from other areas probably visit the upper harbor at times." However, Willson et al. (2006) identified several Grays Harbor tributaries (Humptulips, Chehalis, Aberdeen and Wynoochee Rivers) as supporting eulachon spawning runs. Eulachon have been reported sporadically in the tributary rivers to Grays Harbor, specifically the Wynoochee River (Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife 2001; Willson et al. 2006). The Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW) (2001:12) noted "in 1993, when the eulachon run into the Columbia River was delayed (presumably due to cold water conditions), they were noted in large abundance in the Quinault and Wynoochee rivers, outside the Columbia Basin." WDFW and ODFW (2001:12) also reported that eulachon "were noted in large abundance in the Wynoochee" River in 1993. Simenstad et al. (2001) recorded eulachon as a "rare" occurrence in sloughs of the Chehalis River estuary in 1990 and 1995. Based on these studies, eulachon appear to be sporadic visitors to Grays Harbor and to occasionally spawn in the rivers that are tributary to Grays Harbor.

3.5.2.4 Birds

Snowy plover is a shorebird that forages for invertebrates and other prey species in shallow intertidal mudflats. This habitat type is abundant in Grays Harbor. A snowy plover breeding site located on the north shore of Damon Point, approximately 9,000 feet north of the Entrance Channel reach, is designated as critical habitat (77 FR 36727). The proximity of this active breeding site to suitable foraging habitats (77 FR 36727) in Grays Harbor indicates that this species could occur in shoreline habitats within the action area. Specifically, plovers may use the Half Moon Bay shoreline as foraging habitat. This could place actively feeding plovers anywhere from the immediate proximity (50 feet) of the upland/shoreline beneficial use placement sites and 300 to 1,200 feet from the in-water placement site at Half Moon Bay.

Marbled murrelet is a seabird that feeds on forage fish in open marine waters. While extensive survey data of marbled murrelets in and around Grays Harbor are lacking, murrelets likely occur in low numbers in the Grays Harbor area throughout the year, particularly during the fall, winter, and spring (Pearson et al. 2011; Speich and Wahl 1995). However, sightings are rare during the nesting season (May through September). Sightings of marbled murrelets inside the harbor are rare (Carlson et al. n.d.; U.S. Fish and Wildlife Service 2011). This species forages in nearshore marine habitats. It has been observed diving in waters ranging from 1 to 100 meters (3 to 330 feet) in depth, but favors habitats ranging from 20 to 80 meters (65 to 265 feet) deep (Strachan et al. 1995). This habitat preference and timing of occurrence indicate the potential for murrelets to occur within the action area. Designated critical habitat for this species is restricted to nesting habitats in mature

upland forests, which do not occur in or around Grays Harbor. The closest critical habitat is located over 20 miles to the northeast in the Olympic Mountains foothills (76 FR 61599).

Short-tailed albatross (*Phoebastria albatrus*) are pelagic sea birds that spend the majority of their lives soaring over the open sea, only coming to shore to nest (65 FR 46643). This species is rarely seen from land and has been recorded fewer than five times in coastal waters offshore from Grays Harbor (Carlson et al. n.d.). It is not likely to occur in the action area.

Since the 2011 BE, the streaked horned lark (*Eremophila alpestris strigata*) was listed as threatened and critical habitat designated. This ground-dwelling songbird species depends on flat, open meadows with sparse, low vegetation. A breeding population of streaked horned lark is present on Damon Point on the north shoreline of the entrance to Grays Harbor approximately 1 mile north of the navigation channel. This area is included in the proposed habitat designation for this species (77 FR 61938). The streak horned lark was included in the effects analysis of the 2013 channel realignment SBE.

3.5.2.5 Marine Mammals

The southern resident killer whale is known to occur in Washington coastal waters in the vicinity of Grays Harbor. Until recently little was known about marine habitat use and movements of southern resident killer whale, beyond the fact that they were known to occur regularly in Washington coastal waters between January and March. Recent research and anecdotal observation records provide useful information about this behavior in the vicinity of Grays Harbor. Satellite tagging studies of winter habitat use have confirmed that this species migrates between the coastal waters of northern California and Puget Sound during winter and periodically approaches coastal waters (National Marine Fisheries Service 2013b). They leave Puget Sound in December and migrate south along the Pacific coast throughout January to foraging areas off the California coast. They begin their return migration to Washington coastal waters in early March and travel rapidly, spending little time in any given area. Pod migrations have been observed within 2 miles of the entrance to Grays Harbor on their northward migration towards Puget Sound, which is consistent with recorded observations. The tagged whales spend limited time in the area, moving rapidly towards the Strait of Juan de Fuca (National Marine Fisheries Service 2013b).

Southern resident killer whales have been sighted and tracked in Washington coastal waters in the vicinity of Grays Harbor during March and April (Krahn et al. 2004; National Marine Fisheries Service 2008), but have not been observed inside Grays Harbor or within the action area. This is consistent with documented whale sightings in the Orca Network (2013) database, which includes several records of killer whales observed within 5 miles offshore from Grays Harbor but none within the harbor itself. Critical habitat has been designated for southern resident killer whale, but it is restricted to the U.S. waters of Puget Sound and the Strait of Juan de Fuca.

Additional ESA-listed marine mammal species may occur off the Washington coast in the general vicinity of Grays Harbor. These include blue, fin, and sei whales (*Balaenoptera musculus, B. physalus, and B. borealis,* respectively), sperm whale (*Physeter macrocephalus*), and humpback whale (*Megaptera novaengliae*), all of which are listed as endangered. The occurrence of these species in coastal waters ranges from exceptionally rare (blue whales) to relatively common (humpback whales) (Carretta et al. 2011). The Balaenoptera and sperm whales are nearly always closely associated with the continental shelf (Calambokidis et al. 2004; Carretta et al. 2011; Schorr et al. 2010), which extends approximately 30 miles offshore from the mouth of Grays Harbor. Humpback

whales range closer to shore (Calambokidis et al. 2004; Carretta et al. 2011) and may occur in closer proximity to the action area than the other whales. For example, Orca Network (2007) documented a humpback whale "just inside the jetties" at the mouth of Grays Harbor in 2007. This suggests that humpback whales may periodically occur at the mouth of Grays Harbor and adjacent nearshore areas, including near the open-water dredged material placement sites (Figure 7), but the frequency of occurrence is likely to be rare. The probability of the other whale species occurring in the action area is remote, because these species are rarely seen within 10 miles of shore (Calambokidis et al. 2004; Carretta et al. 2011). Critical habitat has not been designated for any of these species.

The eastern Steller sea lion (*Eumetopias jubatus*) is currently listed as threatened. The species is a regular visitor to the Washington coast; however, despite the presence of suitable haulout areas, it has not been regularly observed in Grays Harbor or documented in numerous aerial surveys of the haulout sites (Jeffries et al. 2000). Active haulout sites are present several miles to the north in the vicinity of Kalaloch and at Destruction Island approximately 50 miles to the north of Grays Harbor. Based on this information, this species is considered unlikely to occur in Grays Harbor or the project vicinity. Designated critical habitat for this species does not occur in Washington State. NMFS proposed delisting of eastern Steller sea lion in April 2012; the final decision is currently pending.

3.5.2.6 Sea Turtles

Marine reptile species that occur in Washington coastal waters include the leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and olive ridley (*Lepidochelys olivacea*) sea turtles. The green sea turtle is listed as threatened; the remaining species are listed as endangered. All four turtle species occur in Washington state waters at varying frequency, but only as adults. Juveniles of each species are generally found in relatively close proximity to nesting areas in tropical and subtropical latitudes (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998a, 1998b, 1998c, 1998d).

Loggerhead and leatherback sea turtles are both large, highly migratory species that have been documented in the eastern Pacific Ocean from the coast of Chile to Alaska (Conant et al. 2009; National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998a, 1998b). They are primarily found in the open ocean, frequenting current boundaries and upwelling areas associated with aggregations of specific species of jellyfish. They regularly occur off of the Washington coast, in late spring through early fall, pursuing large aggregations of jellyfish that form along the continental shelf. They are typically observed from 6 to 90 miles offshore (Bowlby et al. 1994; Conant et al. 2009). They are occasionally observed in productive coastal waters, but nearshore sightings are rare in Washington State (Washington Department of Fish and Wildlife 2012; Conant et al. 2009). Adult loggerheads and leatherbacks have occasionally been found stranded on the Washington coast (Bowlby et al. 1994), but none have been recorded in the past decade (Washington Department of Fish and Wildlife 2012). Critical habitat has been designated for leatherback turtles in Washington State (77 FR 4170). It includes all U.S. waters off of the Washington coast, with emphasis on areas where large aggregations of specific jellyfish species occur.

Green and olive ridley sea turtles are rare visitors to Washington waters, typically associated with northerly extensions of warm eddy currents during El Niño events (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998c, 1998d). These species are warm-water dependent and cannot survive extended exposure to the typical water temperatures off of coastal Washington (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998c, 1998d). These species are occasionally found stranded on the Washington coast or tangled in nearshore gillnets. These are

typically individuals that have been isolated from warm eddy currents and are dead or near death from exposure (Washington Department of Fish and Wildlife 2012). The likelihood of these species occurring in Grays Harbor or adjacent nearshore areas is considered remote. Critical habitat has been designated for each species, and is specific to nesting habitats that do not occur in Washington State.

3.5.2.7 Terrestrial Invertebrates

Oregon silverspot butterfly (*Speyeria zerene hippolyta*) likely occurred historically in the vicinity of Grays Harbor and similar coastal habitats. The last recorded colony in coastal Washington was located at Long Beach (Willapa Bay). It is believed to have been extirpated from the area by 1991 (U.S. Fish and Wildlife Service 2001). The caterpillars are dependent on early blue violets (*Viola adunca*) for food, and the adults most frequently feed on nectar from plants in the sunflower family (*Asteraceae*) such as thistles (*Cirsium* spp); gumplant (*Grindelia stricta*); goldenrods (*Solidago* spp); tansy ragwort (*Senecio jacobaea*), California aster (*Aster chilensis*), pearly everlasting (*Anaphalis margaritacea*), seaside daisy (*Erigeron glaucus*), and yarrow (*Achillea millefolium*); nectar species from other plant families include sea-pink (*Armeria maritima*) (U.S. Fish and Wildlife Service 2001). Caterpillar habitat in proximity to adult nectar sources does not occur within the action area.

3.6 Historic and Cultural Resources

This section describes those features that may have historic or cultural importance in the Grays Harbor area.

3.6.1 Regulatory Setting

Federal historic preservation laws provide a legal environment for documentation, evaluation, and protection of cultural resources that may be affected by federal undertakings such as the proposed action. The National Historic Preservation Act of 1966, as amended, mandates that federal agencies consider an undertaking's effects on cultural resources. Section 106 of the act requires that Federal agencies identify and assess the effects of Federal undertakings on historic properties and consult with the State Historic Preservation Officer (SHPO), affected Tribes and other interested parties to find acceptable ways to resolve adverse effects. Regulations implementing Section 106 (36 CFR Part 800) encourage maximum coordination with the environmental review process required by NEPA and other statues.

Properties protected under Section 106 are those that are listed or eligible for listing in the National Register of Historic Places. Eligible properties must generally be at least 50 years old and possess integrity of physical characteristics, meaning it must "possess integrity of location, design, setting, materials, workmanship, feeling and association" (36 CFR 60.4). Finally, a historic property must be significant under one or more of the following criteria.

- Criterion A. Be associated with events that have made a significant contribution to broad patterns of our history.
- Criterion B. Be associated with the lives of persons significant to our history.

- Criterion C. Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D. Have yielded, or may be likely to yield, information important in prehistory or history.

3.6.2 Environmental Setting

The abundant natural resources of Grays Harbor have led to human occupation of the harbor by Coast Salish Tribes and later European-American settlers. Human occupation of the Pacific Northwest coast dates to approximately 12,000 years ago; however, within Grays Harbor excavated prehistoric sites date to the past 1,000 years. The oldest site on the Olympic Peninsula is the Manis Mastodon and dates to the 13,800 BC (Ames and Maschner 1999; Matson and Coupland 1995; Waters et. al. 2011). Closer to Grays Harbor, the Minard site was excavated in 1969 and 1970. The Minard site is a shell midden located on the dunes between Grays Harbor and the Pacific Ocean and was first recorded in 1947 (Roll 1974). Excavation of the Minard site consists of artifacts made from stone, bone, antler and shell. Hearth features, post molds and faunal remains were uncovered and human burials identified. Radio Carbon dating has dated the site to the past 1,000 years (Roll 1974; Schneyder et al. 2010). The lack of older sites in the Grays Harbor area is likely due to environmental reasons such as erosion or subsidence, and cultural reasons such as the development of Grays Harbor (i.e., fill associated with construction activities, farming activities) or a shift in settlement patterns of the Tribes (Ames and Maschner1999; Carlson 1990; Matson and Coupland 1995; Schneyder et al. 2010).

Grays Harbor lies within the traditional territory of the Humptulips and Quinault Tribes. The Humptulips territory included the north shore of Grays Harbor to North bay as far east as Junction City plus Hoquiam Creek and the Humptulips and Whiskah Rivers (Ruby and Brown 1992). Quinault territory includes the Quinault drainage from the Pacific Ocean to Raft River and Joe Creek to Lake Quinault. In addition, the Quinault has seasonal fishing locations at the north shore of Grays Harbor (Ruby and Brown 1992; Swanton 1952). In 1855, the Quinault's signed the Quinault River treaty with the Hoh, Queets and Quileute Tribes. In 1856, the treaty was formalized with Washington Territorial Governor Isaac Stevens. The Humptulips did not sign a treaty with the United States government and resisted efforts to move them to a reservation (Hajda 1990; Ruby and Brown 1992).

Explorations of Grays Harbor began in 1792 by fur trader Robert Gray, followed by explorations by John Work of the Hudson's Bay Company (HBC) in 1824 and the Wilkes exploration in 1841. Permanent European-American settlement began in 1848. Hoquiam was named in 1859 and in 1883 the town of Aberdeen was platted on the west side of the Wishkah River (Schneyder et al. 2010).

The Area of Potential Effects (APE) was established by the Corps, to include all areas that may be directly or indirectly affected by the proposed action. The APE for the proposed action has been defined as the vertical and horizontal limits of the project. The vertical extent of the APE is approximately −42 feet MLLW, which encompasses the maximum depth under the deepest alternative (Alternative 3) and includes 4 additional feet associated with advance maintenance and allowable overdepth dredging. The horizontal APE ranges in width from 350 feet to 950 feet for the

reaches in the navigation channel to be dredged. The dredged material placement sites were addressed during previous studies prepared for various aspects of the Grays Harbor and Chehalis River Navigation Project, as described in the following section.

3.6.2.1 Cultural Resource Investigations

A total of 13 cultural resource inventories have been conducted within 1 mile of the navigation channel. Eight of the thirteen inventories have been conducted for the Grays Harbor and Chehalis River Navigation project. Table 3.6-1 lists all of the cultural resource investigations that have been conducted within 1-mile of the project.

Beginning in 1976, the Corps conducted an environmental review, including cultural resources investigation of Grays Harbor navigation channel and dredged material placement sites in support of the 1982 Grays Harbor Navigation Improvement Project EIS (Mass 1980; Munsell 1976,1980). The Corps also conducted an overview of Native American use of Grays Harbor during this period (James and Martino 1986). The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and the 1989 supplemental to the 1982 EIS, including a literature search for underwater shipwrecks in the navigation channel (Kranz 1986; Munsell 1988). In 1988, a side-scan sonar investigation was conducted in the navigation channel; no shipwrecks or other underwater cultural resources were identified (Cox 1989; Larson et. al. 1989).

Other cultural resource investigations that were conducted within 1 mile of the navigation channel include a reconnaissance survey for a Corps gravel and cobble placement project at Half Moon Bay (Kent 2003), an assessment for a proposed resort (Thompson 2000), an investigation for the City of Westport's wastewater treatment facility (Freed 2009), a reanalysis of the Newskah Creek Fish Trap (Schalk and Burtchard 2001), an assessment of the Port of Grays Harbor Industrial Road Improvement Project (Shaw et. al. 2009), and an investigation for the Washington State Department of Transportation State Route 520 Pontoon Construction Project (Schneyder et.al. 2010).

Table 3.6-1. Cultural Resources Inventories Conducted within 1 Mile of the Navigation Channel

Author(s)/Year	Title	Within Area of Potential Effects?	Identified Cultural Resources	Conducted for Previous Elements of the Grays Harbor Navigation Improvement Project?
Munsell 1976	*Cultural Resources Survey Three Sites on Grays Harbor, Grays Harbor County, Washington*	No	No	Yes
Munsell 1980	*Grays Harbor FY 1980 Channel Widening, Cultural Resources Reconnaissance and Testing of Dredge Disposal Area A*	No	No	Yes
Mass 1980	*Cultural Resources Reconnaissance of Three Dredge Materials Disposal Sites (16,17 and 18), Grays Harbor and Chehalis River Navigation- Improvement Project, Grays Harbor County, Washington*	No	No	Yes

Author(s)/Year	Title	Within Area of Potential Effects?	Identified Cultural Resources	Conducted for Previous Elements of the Grays Harbor Navigation Improvement Project?
Kranz 1986	*Historic Sunken Vessels in the Vicinity of Grays Harbor, Washington*	Yes	No	Yes
James and Martino 1986	*Grays Harbor and Native Americans*	No	No	Yes
Cox 1988	*Potential Historical Properties in the Grays Harbor, Washington Navigation Improvement Project Interim Report*	Yes	No*	Yes
Larson et. al. 1989	*The Identification and Evaluation of Potential Historic Properties in the Garys Harbor Navigation Improvement Project (Final Report)*	Yes	No*	Yes
Munsell 1988	*Cultural Resources Investigations Grays Harbor Navigation Improvement Project, Washington*	Yes	No	Yes
Thompson 2000	*Letter to Robert W. Bergquist Regarding Cultural Resource Assessment for the Proposed Westport Golf/Hotel Resort Complex "Linds at Half Moon Bay" Westport, Parcel 6161120143001*	No	No	No
Schalk and Burtchard 2001	*The Newskah Creek Fish Trap Complex Grays Harbor, WA*	No	Yes*	Yes
Kent 2003	*Cultural Resource Reconnaissance Survey for the Half Moon Bay Transition Gravel and Cobble Placement Project Westport, Grays Harbor County, Washington*	No	No	No
Freed 2009	*Archaeological Investigations for the City of Westport's Wastewater Treatment Facility Improvements in Westport*	No	No	No
Shaw et al. 2009	*Cultural Resources Assessment for Port of Grays Harbor Port Industrial Road Improvement Project, Aberdeen and Hoquiam, Washington*	No	No	No
Schneyder et al. 2010	*SR 520 Pontoon Construction Project Draft EIS Cultural Resources Discipline Report*	No	Yes	No

* Not in navigation channel.

3.6.2.2 Archaeological Sites

Six archaeological sites have been identified either within 1 mile of the APE or during previous Corps cultural resources investigations for other elements of the Grays Harbor and Chehalis River Navigation Project (See Table 3.6-2). The Newakah fish weir (45GH73) was identified during Corps investigations in 1981 for proposed dredged material placement areas (Munsell 1981). Fifty wood stakes and piling alignments were observed in a 5-acre area of the intertidal area near Newakah Creek. In addition to the fish weir, a stone maul, a clay pipe, and bottle fragments were collected. In 1999, additional investigation of the Newakah site occurred revealing that site was much bigger than originally thought. The 1999 investigations revealed 170 wood stake alignment features over 80 acres. Radiocarbon dates indicate an age range of 900 to 500 years before present (Schalk and Burtchard 2001). A second fish weir (45GH179) was found during investigations for State Route 520 Pontoon Construction Project (Schneyder et al. 2010). The fish weir was discovered near the confluence with the Hoquiam River and depths between 17 to 25 feet below ground surface. Investigators collected 486 cedar stakes; 102 of the stakes exhibited cultural modification. Radiocarbon dates range from 220 to 1,220 years before present (Schneyder et. al. 2010).

The remains of three lumber mills have been recorded in the APE—Northwestern Lumber Company (45GH58), Blagen Mill (45GH179), and Hulbert Mill (45GH180)—show that lumber was an economic driver of the Grays Harbor economy. The remains of the 1930s Hooverville community (45GH130) were recorded in the intertidal area.

The closest shipwreck to the APE is the *S.S. Catala*, (45GH127) which is the remains of a steamer passenger vessel that was built in 1925. In 1963, the *S.S. Catala* became a hotel barge and commercial facility (McCroskey 2006). In 1965, a winter storm carried the *S.S. Catala* to its current location along north shore of Damon Point (McCroskey 2006). The wreck of the *S.S. Catala* is now located approximately 1.84 miles north of the navigation channel.

Table 3.6-2. Cultural Resources Located along the Shoreline of Grays Harbor

Site Number	Description	Within the APE?	Eligible for Inclusion in the National Register of Historic Places?
45GH73[a]	Newskah Creek Fish Weir	No	Yes
45GH58	Northwestern Lumber Company	No	Unevaluated
45GH127	*S.S. Catala* shipwreck	No	No
45GH130	Hoquiam Hooverville and industrial tideland	No	Unevaluated
45GH179	Blagen Mill/precontact fish weir	No	Yes
45GH180	Hulbert Mill	No	Unevaluated

[a] Discovered during previous cultural resource investigations for the Grays Harbor Navigation Improvement Project.

3.6.2.3 Traditional Plants

Sweet grass (*Schoenoplectus pungens),* a tall sedge, is an important plant resource in Grays Harbor and is used by basket makers from the Chehalis and Quinault Tribes. Sweet grass grows on the flats of the intertidal zone and exists in the area along the shoreline of Bowerman Basin within the Grays

Harbor National Wildlife Refuge (see Section 3.3 *Aquatic and Terrestrial Vegetation*). While sweet grass is an important plant resource, it is not located within the APE of the project.

3.7 Sediment Characterization and Water Quality

This section describes current water quality and the nature of the sediment in Grays Harbor and more specifically within the navigation channel.

3.7.1 Sediment Characterization

3.7.1.1 Regulatory Setting

Federal, state, and local agencies define and regulate hazardous materials in Washington. At the Federal level they are identified and regulated by the U.S. Environmental Protection Agency (EPA). EPA has delegated authority for implementing hazardous materials regulation in Washington to the Washington State Department of Ecology (Ecology) but retains final authority.

Sediment Management Standards (SMS) for the state of Washington (Chapter 173-204 Washington Administrative Code [WAC]) are enforced by Ecology in order to avoid, reduce, and/or eliminate degraded environmental conditions that may affect biological resources because of sediment contamination. These standards provide metrics to measure sediment quality, reduce pollutant discharge, and outline decision processes for cleanup of contaminated sediment sites.

Placement of dredged materials is managed and regulated by the multiagency Dredged Material Management Program (DMMP). The Corps, EPA, DNR and Ecology work collaboratively to manage material dredged to maintain navigational waterways and berth depths. The DMMP agencies evaluate the suitability of what material can be placed and where. The DMMP does not manage contaminated sediment cleanups.

Federal laws and regulations pertaining to hazardous materials and wastes include the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (known as Superfund); All Appropriate Inquiries; Resource Conservation and Recovery Act; Occupational Safety and Health Act; Clean Water Act (CWA), ESA, and NEPA.

3.7.1.2 Environmental Setting

The proposed action would remove sediments from specified reaches via clamshell and hydraulic dredging and would place dredged sediments at open-water dispersive[5], beach nourishment, and upland beneficial use sites, as described in Section 2.2.2.1, *Dredged Material Placement Sites*.

The history of industrial uses in and around Grays Harbor, its shoreline, and its nearshore environment create the potential for contaminated sediments to be found in the estuary and potentially in the navigation channel that could be harmful to biological organisms. Consequently, sediment testing is conducted prior to dredging to ensure appropriate methods of sediment removal and placement or disposal are followed based on the composition of the sediments and their potential for impacts on aquatic organisms.

[5] Dispersive refers to the fact that the sediments placed in these sites disperse with the current/tides.

Because benthic sediments may be contaminated, dredging and placement of dredged materials are evaluated by the Dredged Material Management Program (DMMP) agencies—the Corps, Ecology, DNR, and the EPA. The *Dredged Material Evaluation and Disposal Procedures Users Manual* (Dredged Material Management Program 2013) outlines the requirements for determining the suitability of dredged material for open-water disposal. This manual is reviewed annually and updated as needed. The most recent update to the manual was released in July 2013 after the analyses were already completed for this project using the 2008 manual.

Dredged material evaluation procedures require that material be tested for chemical contaminants prior to any dredging activities, except for areas in exclusion zones. The navigation channel reaches are divided by the DMMP agencies into agreed-upon dredged material management units (DMMUs) for testing. Representative samples from each unit are taken for composite analysis to determine the suitability of the sediments for dredging and for placement at open-water, dispersive sites. The size of the DMMUs is based on the rank of a particular project, with the rank determined by the potential to encounter sediment contamination as determined by the DMMP agencies.

The outer harbor reaches (with the exception of Outer Crossover) have been found to meet exclusionary criteria for maintenance dredging due to their coarse-grained material in a high-energy environment geographically removed from historical sources of contamination (Appendix A). Periodic testing of grain size and total organic carbon is, however, required to verify that the exclusionary status of these reaches is still appropriate. All dredged materials originating from the inner harbor reaches (plus Outer Crossover) require contaminant testing because of their historically fine-grained character and relative proximity to sources of contamination. For annual maintenance dredging, materials in the navigation channel are ranked as having low potential for contamination (Dredged Material Management Program 2008). Because the channel deepening would require dredging of materials below those typically dredged during annual maintenance, the DMMP agencies expressed increased concern for the deepening material in Hoquiam Channel and Cow Point Reach (based on higher potential risk from historical contamination in these areas) and classified the dredged material in these reaches as having low-moderate potential for contamination (Appendix A).

General sampling requirements are outlined in DMMP 2013. The DMMP suitability determination and subsequent explanatory memoranda for the proposed action provide a complete description of sediment testing and results within each of the DMMUs (Appendix A); the results are summarized below.

- The channel deepening area was divided into 36 DMMUs for sampling and testing (Figure 24 through Figure 32). Two of the DMMUs – Crossover 7 and Cow Point 32 – were subsequently split into two subunits each for additional testing.
- Physical and chemical testing results are summarized in Table 3.7-1.
- Contrary to expectations, three out of four of the South Reach DMMUs did not meet the exclusionary criteria and required chemical testing.
- Most DMMUs did not exceed any chemical screening levels and did not require biological testing. Therefore, the majority of DMMUs are suitable for open-water disposal on the basis of chemistry alone.
- Benzyl alcohol was the only chemical of concern detected above the DMMP screening level, with concentrations of 100 and 110 ug/kg respectively in DMMUs Cow Point 32 and 33. The

screening level for this chemical is 57 ug/kg. The screening level exceedances triggered biological testing of these two DMMUs.

- Dioxin concentrations were similar to those found historically in the navigation channel. None of the DMMUs exceeded the dioxin limits for disposal in Grays Harbor—5 parts per trillion for 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD) and 15 parts per trillion for toxic equivalents (TEQ) (Dredged Material Management Program 2013). Therefore, with regard to dioxin, all the DMMUs are suitable for open-water disposal.
- The DMMP agencies agreed that should revised dioxin guidelines be adopted for Grays Harbor prior to dredging, the suitability determination may need be revisited and revised accordingly.
- Dredging of the Cow Point 32 DMMU would expose sediments with concentrations of ammonia that could be toxic to some benthic organisms. The DMMP agencies agreed that because ammonia would be likely to dissipate quickly when exposed to more oxygenated conditions after dredging, any detrimental effects from exposure of sediment underlying the Cow Point 32 DMMU would be short-lived.
- The DMMP agencies found the Cow Point subunit 32a DMMU unsuitable for open-water disposal due to toxicity expressed in the sediment larval bioassay, but agreed to allow the Corps to conduct additional sampling and testing of the unit prior to dredging (Appendix A).

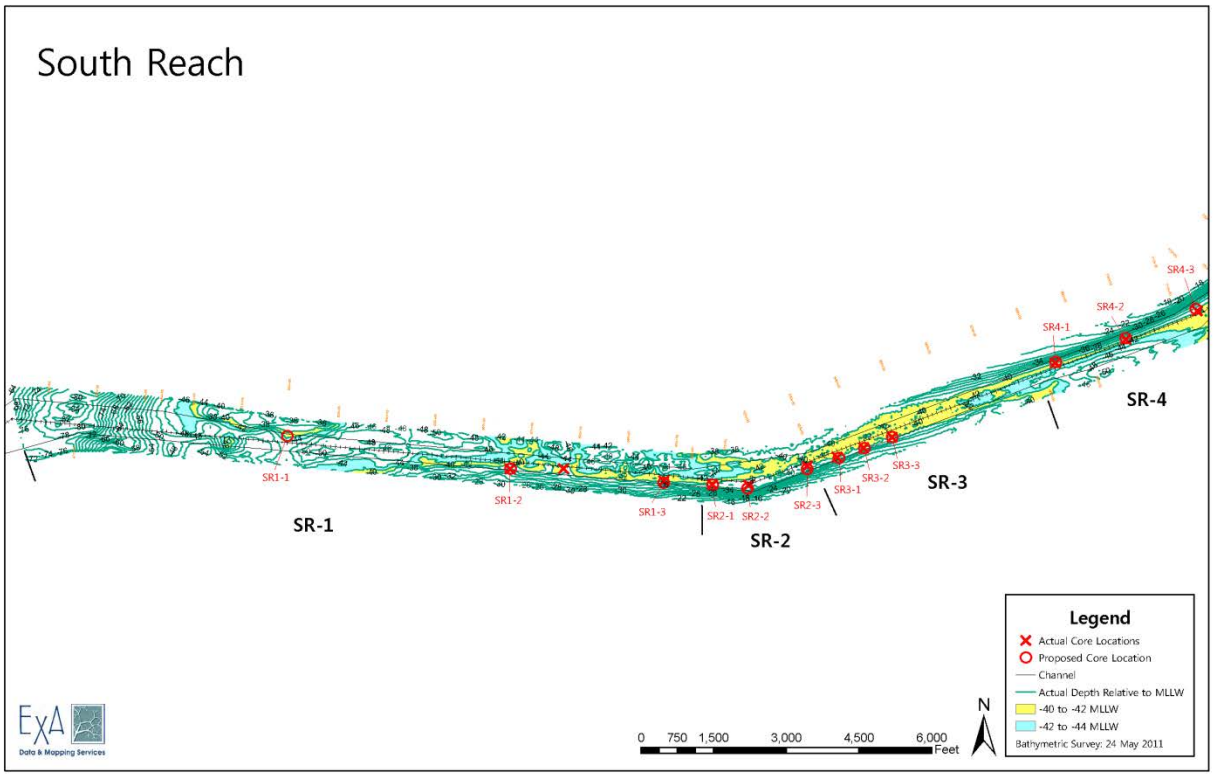


Figure 24. DMMUs in South Reach

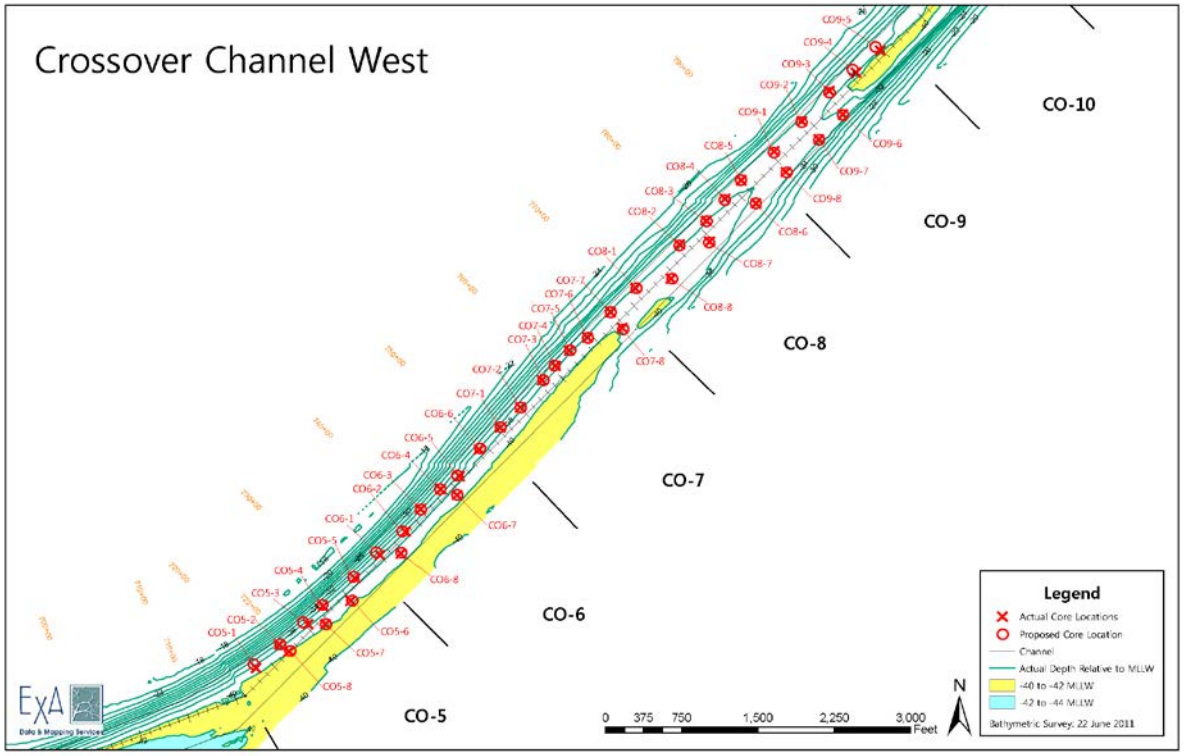


Figure 25. DMMUs in Crossover Channel West

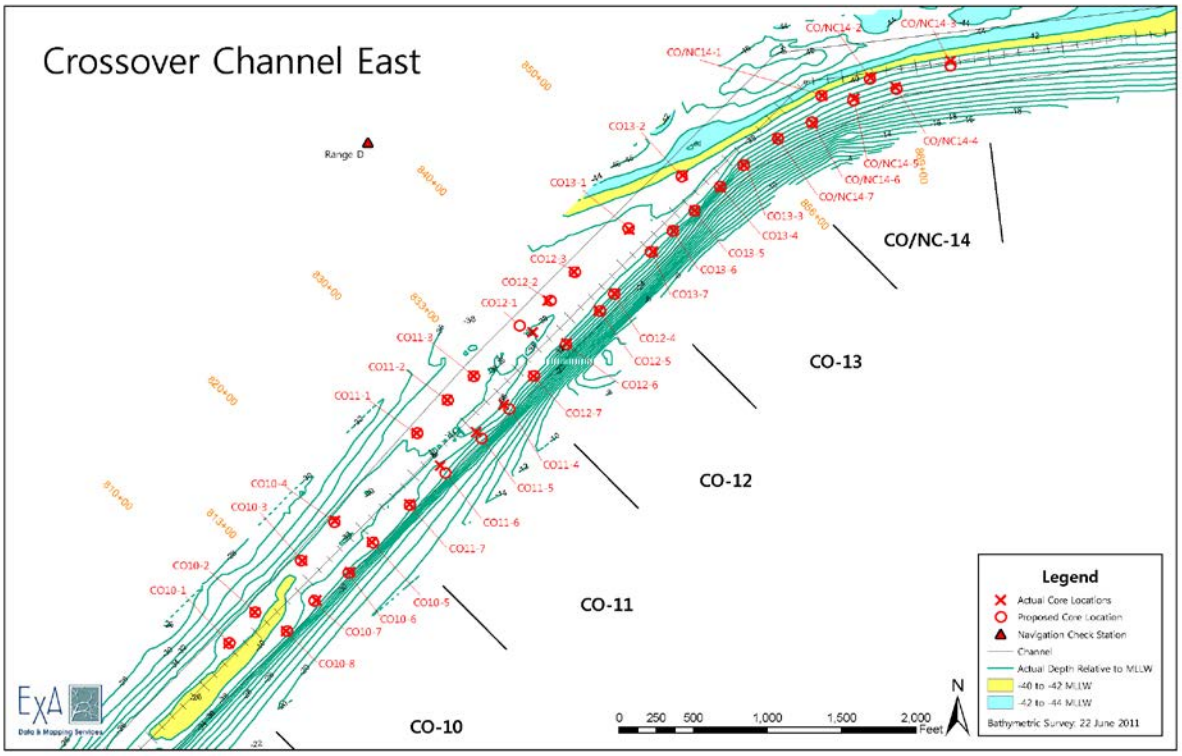


Figure 26. DMMUs in Crossover Channel East

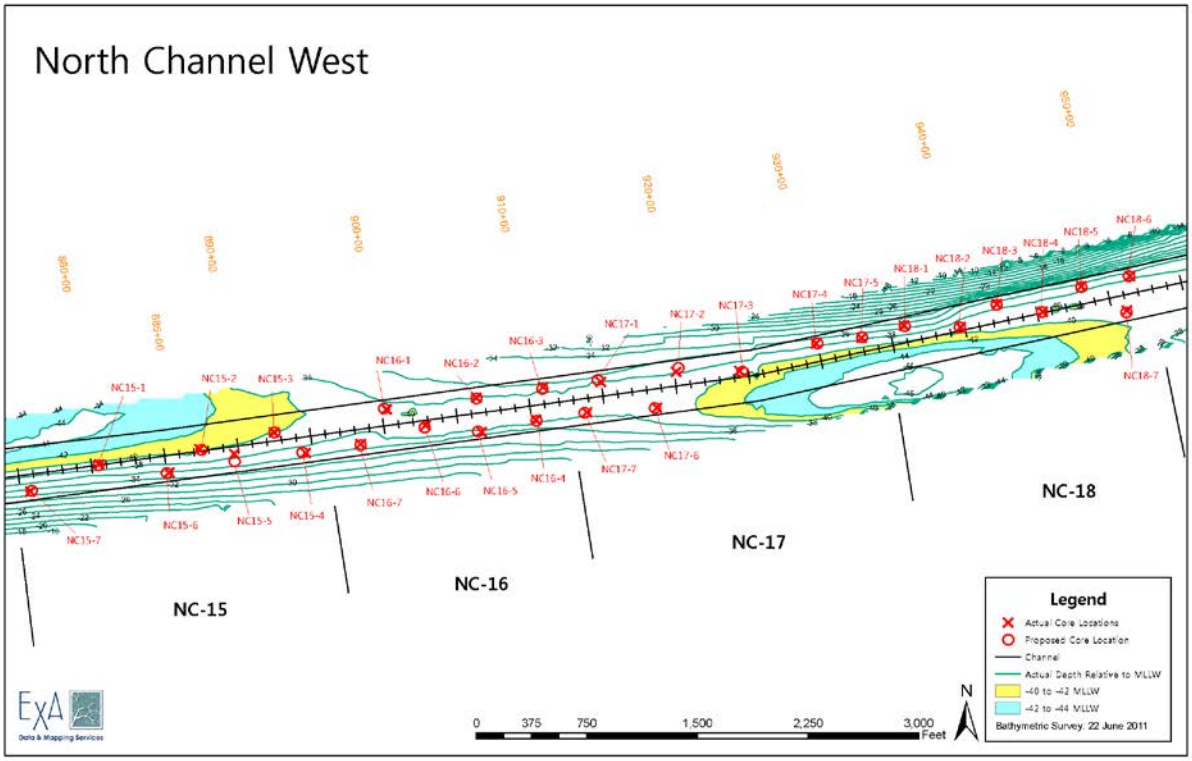


Figure 27. DMMUs in North Channel West

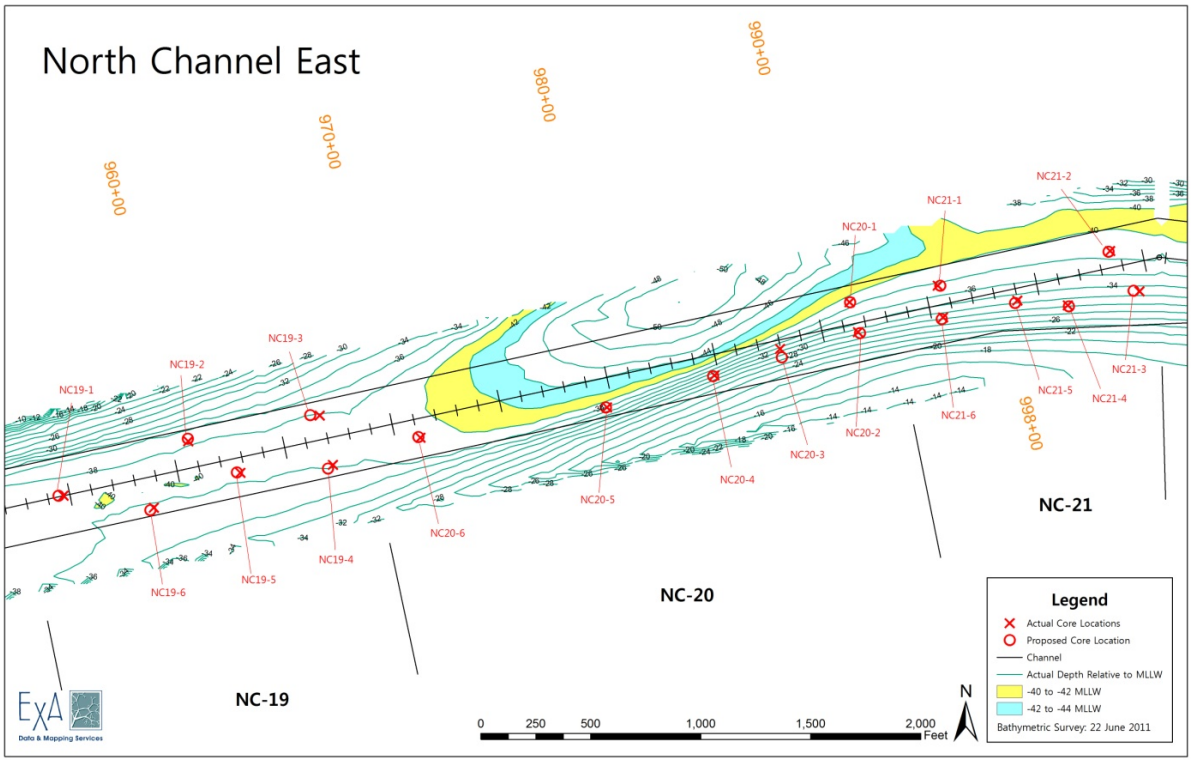


Figure 28. DMMUs in North Channel East

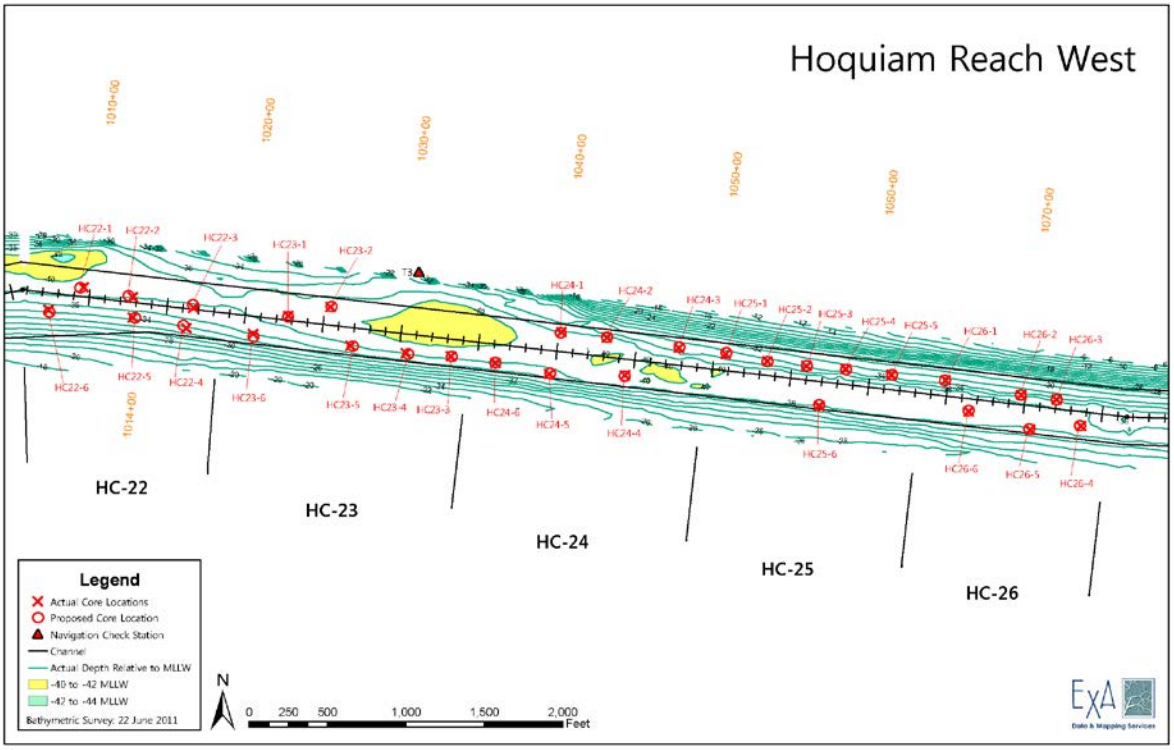


Figure 29. DMMUs in Hoquiam Channel West

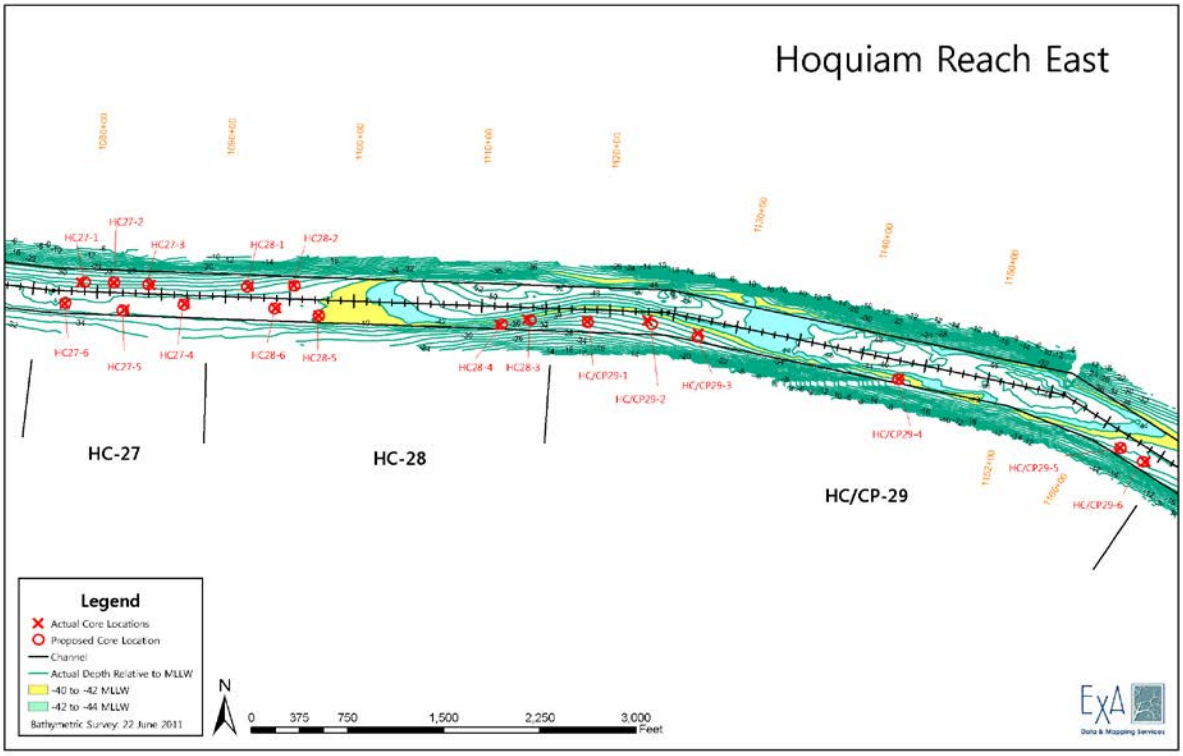


Figure 30. DMMUs in Hoquiam Channel East

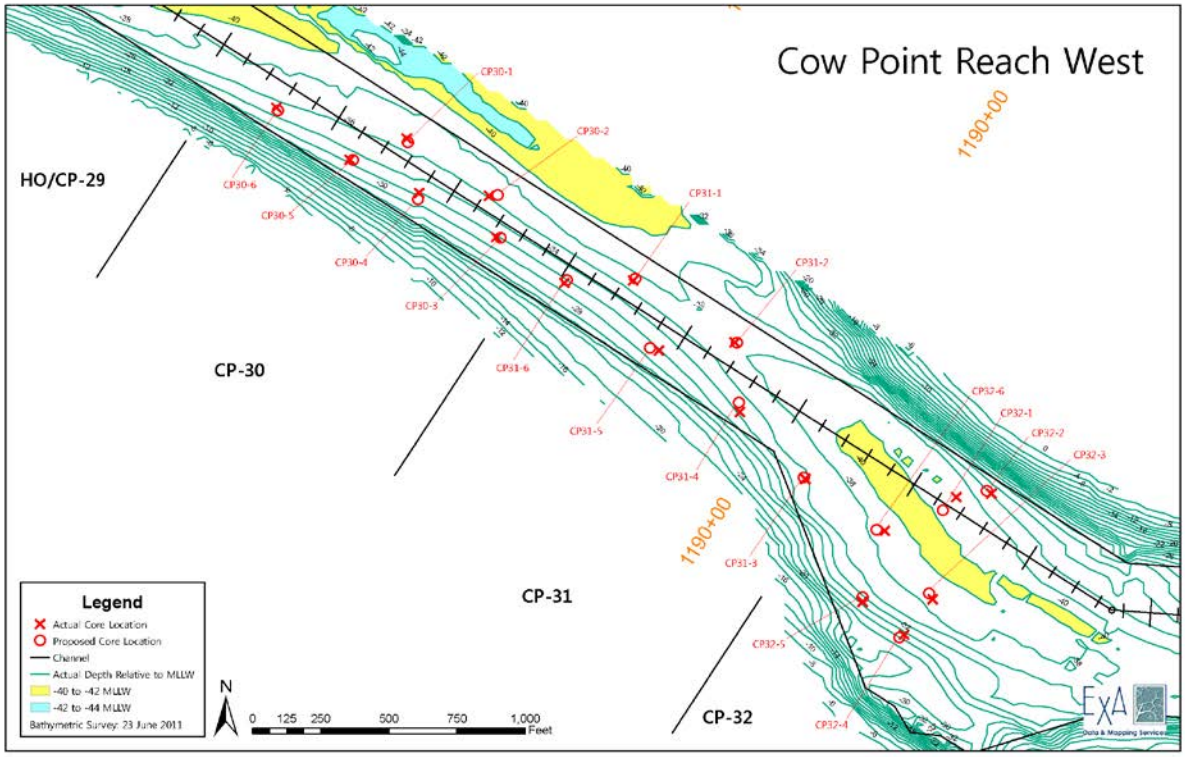


Figure 31. DMMUs in Cow Point Reach West

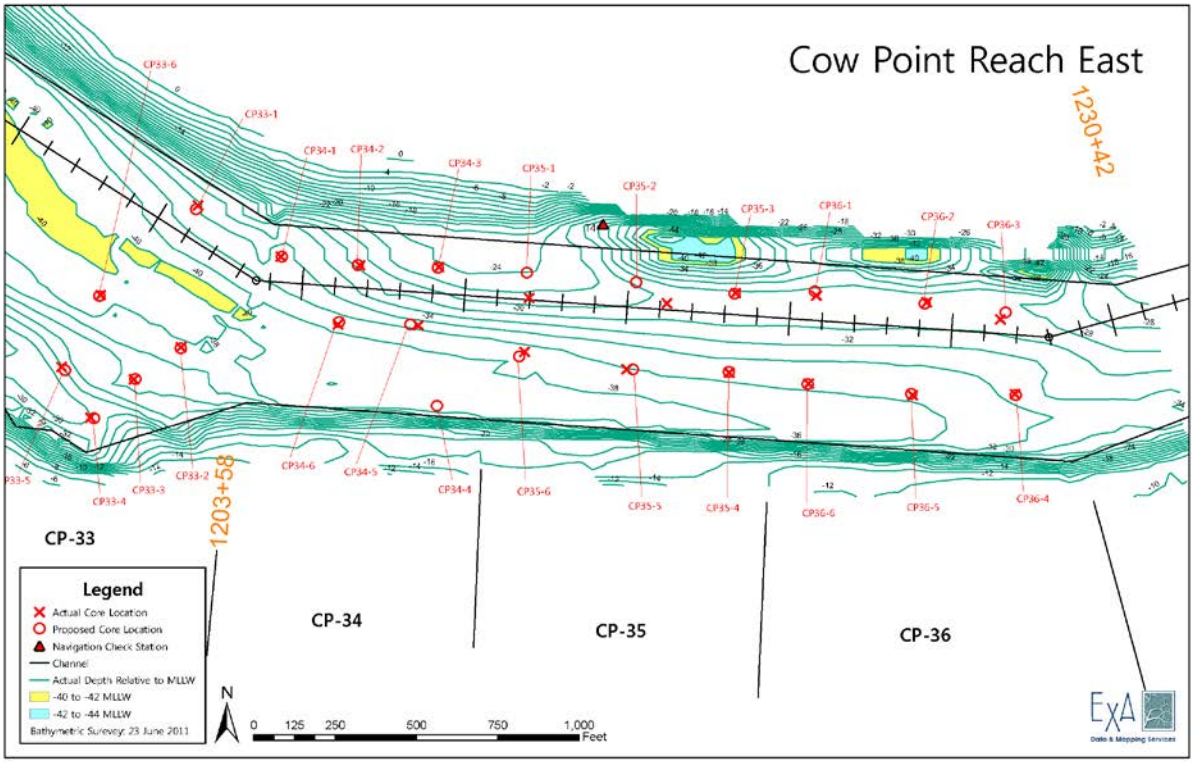


Figure 32. DMMUs in Cow Point Reach East

Table 3.7-1 Physical and Chemical Characteristics of DMMUs by Reach

Compound	DMMP Guidelines			South Reach	Crossover Reach	North Channel	Hoquiam Channel	Cow Point Reach
	SL	BT	ML					
Conventionals								
Total Solids (%)	—	—	—	75-90	65-72	57-70	57-70	48-58
Total Organic Carbon (%)	—	—	—	0.3-2.7	0.6-1.6	0.8-2.2	1.1-1.8	1.5-2.4
Gravel (%)	—	—	—	0-1	0-5	0-1	0-1	0-43
Sand (%)	—	—	—	85-100	63-79	36-73	43-74	15-32
Silt (%)	—	—	—	0-10	14-25	19-46	18-43	27-57
Clay (%)	—	—	—	0-5	6-12	8-18	7-16	14-31
Metals (mg/kg dw)								
Antimony	150	—	200	5U-7U	6U-7U	7U-8U	7U-20U	8U-20U
Arsenic	57	507.1	700	5U-7U	6-8	7U-8U	7U-20U	8U-20U
Cadmium	5.1	11.3	14	0.2U-0.3U	0.3U	0.3U	0.3U-0.8U	0.3U-0.9U
Chromium	260	260	—	17-24	24-30	27-37	33-40	38-48
Copper	390	1,027	1,300	7-16	21-30	27-50	38-57	62-83
Lead	450	975	1,200	2U-3	3-4	3-5	4-8U	6-9U
Mercury	0.41	1.5	2.3	0.02U-.03U	0.03-0.04	0.03-0.05	0.03-0.05	0.05-0.06
Selenium	—	3	—	0.5U-0.6U	0.6U-0.8U	0.6U-0.9U	0.7U-0.8U	0.8U-1.0U
Silver	6.1	6.1	8.4	0.3U-0.4U	0.4U	0.4U-0.5U	0.4U-1.0U	0.5U-1.0U
Zinc	410	2,783	3,800	33-46	46-60	54-74	63-79	77-93
PAHs (µg/kg dw)								
Naphthalene	2,100	—	2,400	18U-20U	11J-27	12J-70	15J-33	17J-49
2-Methylnaphthalene [1]	670	—	1,900	18U-20U	11J-24	10J-20U	19U	10J-19U
Acenaphthylene	560	—	1,300	18U-20U	18U-20U	18U-20U	19U	18U-19U
Acenaphthene	500	—	2,000	18U-20U	18U-20U	18U-20U	12J-19U	18U-19U
Fluorene	540	—	3,600	18U-20U	18U-20U	18U-20U	9.4J-19U	9.4J-19U
Phenanthrene	1,500	—	21,000	18U-20U	10J-20	12J-28	12J-49	22-50
Anthracene	960	—	13,000	18U-20U	18U-20U	18U-20U	13J-19U	9.6J-19U
Total LPAH	5,200	—	29,000	18U-20U	10-47	19U-98	19U-79	39-80
Fluoranthene	1,700	4,600	30,000	18U-20U	10J-18J	10J-33	11J-76J	30-58
Pyrene	2,600	11,980	16,000	18U-20U	10J-19	10J-30	11J-63J	26-63
Benzo(a)anthracene	1,300	—	5,100	18U-20U	18U-20U	18U-20U	19U-41J	10J-24
Chrysene	1,400	—	21,000	18U-20U	18U-20U	18U-20U	10J-41J	12J-24
Benzo(a)pyrene	1,600	—	3,600	18U-20U	18U-20U	18U-20U	19U-34	18U-23
Indeno(1,2,3-cd)pyrene	600	—	4,400	18U-20U	18U-20U	18U-20U	16J-19U	9.6J-19U
Dibenz(a,h)anthracene	230	—	1,900	18U-20U	18U-20U	18U-20U	19U	19U
Benzo(g,h,i)perylene	670	—	3,200	18U-20U	18U-20U	18U-20U	16J-19U	11J-19U
Total Benzofluoranthenes	3,200	—	9,900	18U-20U	11J-20U	18U-20U	12J-72J	13J-30
Total HPAH	12,000	—	69,000	18U-20U	10U-48	19U-75	19U-359	69-245
Chlorinated Hydrocarbons (µg/kg dw)								
1,4-Dichlorobenzene	110	—	120	18U-20U	18U-20U	18U-20U	19U	16J-19U
1,2-Dichlorobenzene	35	—	110	18U-20U	18U-20U	18U-20U	19U	18U-19U
1,2,4-Trichlorobenzene	31	—	64	18U-20U	18U-20U	18U-20U	19U	18U-19U
Hexachlorobenzene	22	168	230	18U-20U	18U-20U	18U-20U	19U	18U-19U
Phthalates (µg/kg dw)								
Dimethylphthalate	71	—	1,400	18U-20U	18U-20U	18U-20U	19U	18U-19U

Compound	DMMP Guidelines			South Reach	Crossover Reach	North Channel	Hoquiam Channel	Cow Point Reach
	SL	BT	ML					
Diethylphthalate	200	—	1,200	46U-49U	46U-49U	46U-50U	47U-48U	46U-48U
Di-n-Butylphthalate	1,400	—	5,100	18U-20U	18U-20U	18U-20U	19U	18U-19U
Butylbenzylphthalate	63	—	970	18U-20U	18U-20U	18U-20U	19U	10J-19U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	23U-25U	15J-24U	23U-25U	15J-24U	16J-24U
Di-n-Octyl phthalate	6,200	—	6,200	18U-20U	18U-20U	18U-20U	19U	18U-19U
Phenols (µg/kg dw)								
Phenol	420	—	1,200	18U-41	16J-47	19-80	13J-52	22-130
2-Methylphenol	63	—	77	18U-20U	18U-20U	18U-20U	19U	11J-19U
4-Methylphenol	670	—	3,600	37U-39U	18J-88	13J-79	13J-67	20J-110
2,4-Dimethylphenol	29	—	210	17U-20U	18U-20U	18U-20U	19U	18U-19U
Pentachlorophenol	400	504	690	180U-200U	180U-200U	180U-200U	190U	180U-190U
Miscellaneous Extractables (µg/kg dw)								
Benzyl Alcohol	57	—	870	18U-20U	18U-20U	15U-20U	11J-24	24-110
Benzoic Acid	650	—	760	370U-390U	370U-390U	110J-400U	370U-390U	110J-380
Dibenzofuran	540	—	1,700	18U-20U	18U-20U	9.2J-20U	19U	18U-19U
N-Nitrosodiphenylamine	28	—	130	18U-20U	18U-20U	18U-20U	19U	18U-19U
Heptachlor	1.5	—	—	0.5U-1.8U	0.47U-.50U	0.46U-.49U	0.46U-0.5U	0.47U-3.8U
Hexachlorobutadiene	11	—	270	0.5U	0.47U-.50U	0.46U-.49U	0.46U-0.5U	0.47U-.49U
Pesticides and PCBs (µg/kg dw)								
Aldrin	9.5	—	—	0.5U-3.1U	0.47U-.50U	0.46U-.49U	0.46U-.50U	0.47U-.49U
Dieldrin	1.9	—	—	0.9U-1.0U	0.93U-1.0U	0.93U-.99U	0.92U-.99U	0.93U-.98U
4,4 -DDE	16	—	—	0.9U-1.0U	0.93U-1.0U	0.93U-.99U	0.92U-.99U	0.93U-1.4U
4,4 -DDD	9	—	—	0.9U-1.0U	0.93U-1.0U	0.93U-.99U	0.92U-.99U	0.93U-.98U
4,4 -DDT	12	—	—	0.9U-1.0U	0.93U-7.4J	0.93U-.99U	0.92U-.99U	0.93U-.98U
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.9U-1.0U	0.93U-7.4J	0.99U	0.92U-1.5U	0.93U-.98U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	2.0U-3.0U	1.8U-3.4U	1.8U-2.0U	1.8U-2.0U	1.9U-2.0U
Total PCBs	130	— [2]	3,100	9.0U	9.3U-9.7U	9.2U-9.8U	9.5U-9.9U	9.3U-9.9U
Dioxins and Furans (ng/kg)								
TEQ (U = 1/2 EDL)	—	15	—	0.3-1.0	1.0-2.9	0.6-5.0	2.8-10.1	0.6-8.7

SL - screening level

BT - bioaccumulation trigger

ML - maximum level

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

EDL - estimated detection limit

TEQ - toxic equivalents

Detected value exceeds the DMMP screening level

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. The bioaccumulation trigger for PCBs is 38 mg/kg carbon-normalized.

3.7.2 Water Quality

3.7.2.1 Regulatory Setting

Water quality is protected by various Federal, state, and local regulations. The EPA is responsible for enforcing the CWA (33 USC 1251 et seq.), enacted in 1972 to restore all waters to "fishable and swimmable." The EPA has delegated authority under the CWA to Ecology to evaluate compliance with State Water Quality Standards of any discharges into waters of the state. Ecology thus evaluates water quality through this delegated authority under Section 401 of the CWA to ensure state water quality standards are met in conjunction with a discharge of dredged or fill material into the water of the United States. Under this delegated authority, Ecology issues a project-specific Section 401 Water Quality Certification in conjunction with the 404(b)(1) evaluation for a project undertaken by the Corps).

Ecology monitors water quality in Washington by assigning water quality criteria for water bodies under the Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201a). Section 303(d) of the CWA requires that Ecology identify and categorize the water quality of these water bodies to determine future regulatory action. Section 305(b) requires categorization and reporting of marine water quality for inclusion on the 303(d) list. The federal Clean Water Act, adopted in 1972, requires that all states restore their waters to be "fishable and swimmable." Washington's Water Quality Assessment lists the water quality status for water bodies in the state. The 303(d) list comprises those waters that are in the polluted water category, for which beneficial uses– such as drinking, recreation, aquatic habitat, and industrial use – are impaired by pollution.

Impacts on water quality by surface sediments are regulated by Ecology under the authority of WAC 173-204 (i.e., the sediment management standards). Sediment standards are enforced to ensure the reduction of pollutant discharges to waters of the state. See Section 3.7.1.1, *Regulatory Setting*, for a more complete description of sediment standards.

3.7.2.2 Environmental Setting

The industrial use of the shoreline and waterways of Grays Harbor has led to significant past water quality problems for the Chehalis River and inner harbor near Hoquiam and Aberdeen. Two pulp mills historically released substances that are toxic to fish and shellfish (Wendler and Deschamps 1955; Hiss and Knudsen 1992; Schroder and Fresh 1992), but these mills have either ceased operations or altered operations dramatically to reduce their discharge of chemicals into the harbor. Ecology (2000) reported that "no chronic toxicity was detected" in mill effluents. Subsequent reports have shown that the waters of Grays Harbor generally meet state water quality standards with the exception of one testing site near the harbor entrance that has in the past (2008) been identified as having intermittently low dissolved oxygen levels (Washington State Department of Ecology 2012).Dioxin has been found in the sediments immediately downstream of the outfalls to the pulp mills, presumably originating from the pulp mills (Schroder and Fresh 1992), which could be released from sediments during dredging activities. Testing of the sediments prior to dredging indicates dioxin concentrations below the current guidelines for Grays Harbor (Appendix A).

The 2012 Ecology 303(d) list of polluted waters in Washington State identifies 12 locations within Water Resource Inventory Area 22 (Lower Chehalis and Grays Harbor) as polluted (Washington State Department of Ecology 2012). One location is within Grays Harbor proper and within the project area. The only location in the marine environs of Grays Harbor that did not meet water

quality standards was a point in the outer harbor within the navigation channel immediately adjacent to the Pt. Chehalis open-water placement site that failed water quality standards due to dieldrin levels in a composite tissue sample of mussel (*Mytilus* sp.). Dieldrin is a persistent insecticide originally developed as an alternative to DDT, but which also biomagnifies in the foodweb, and, thus, has now been banned (https://fortress.wa.gov/ecy/wqamapviewer/default.aspx?res=1280x1024). Reaches of the Humptulips River failed water quality standards based on pH and dissolved oxygen levels; reaches of the lower Chehalis River failed due to PCB and mercury levels; Black Creek failed water quality standards due to temperature levels; and Grays Harbor County Drainage Ditch No. 1 failed water quality standards due to diazinon, DDE, DDD, chlopyrifos, and water level bioassays. Water quality in the inner and outer harbors was rated by the Ecology 303(d) list as polluted due to fecal coliform bacteria in 1999; however, water quality has subsequently improved and fecal coliform bacteria are no longer a problem (Washington State Department of Ecology 2012).

3.8 Air Quality, Noise, and Artificial Lighting

This section describes existing conditions relative to air quality and potential sources of air pollutants, sources of noise, and artificial lighting within Grays Harbor and its immediate vicinity, generally defined as within a quarter mile of its shoreline.

3.8.1 Air Quality

3.8.1.1 Regulatory Setting

EPA regulates the nation's air emissions through the Clean Air Act, as amended in 1990. The agency has divided the country into 10 regions and has established standards, the National Ambient Air Quality Standards (NAAQS), regarding the amount of criteria pollutants that can be emitted into the air by stationary sources. The criteria pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter (particulate matter with a diameter of 10 micrometers or less [PM10] and particulate matter with a diameter of 2.5 micrometers or less [PM2.5]), and sulfur dioxide. These standards form a baseline from which to gauge air pollutant emissions across the country in order to gain an understanding of current air quality and improve on it.

The Washington State Clean Air Act (RCW 70.94) also regulates air quality. The act is administered by Ecology at the state level and by local clean air agencies at the regional level. The Olympic Region Clean Air Agency has local jurisdiction along with Ecology's Southwest Regional Office for Grays Harbor County.

Ambient Air Quality Standards

EPA and Ecology have established regulations designed to limit emissions from air pollution sources and to minimize concentrations of pollutants in the outdoor ambient air. Although their regulations are similar in stringency, each agency has established its own standards. Unless the state or local jurisdiction has adopted more stringent standards, EPA standards apply.

Table 3.8-1 lists both the national and Washington State ambient air quality standards for six criteria pollutants—carbon monoxide, ozone, particulate matter, lead, sulfur dioxide, and nitrogen dioxide—and total suspended solids. Annual standards are never to be exceeded. Short-term

standards are not to be exceeded more than once per year unless noted. The NAAQS consist of primary standards designed to protect public health and secondary standards designed to protect public welfare (e.g., preventing air pollution damage to vegetation). Ecology has established additional ambient standards for total suspended particulates and sulfur dioxide, which are more 0stringent than the federal requirements.

Table 3.8-1. National and Washington State Ambient Air Quality Standards

	Federal		
Pollutant	Primary	Secondary	State
Carbon monoxide			
8-hour average[a]	9 ppm	No standard	9 ppm
1-hour average[a]	35 ppm	No standard	35 ppm
Ozone			
8-hour average[b,c]	0.075 ppm	0.075 ppm	0.075 ppm
Total suspended particles			
Annual average	No standard	No standard	60 μg/m^3
24-hour average[a]	No standard	No standard	150 μg/m^3
PM10			
24-hour average[a]	150 μg/m^3	150 μg/m^3	150 μg/m^3
PM2.5			
Annual average	15 μg/m^3	15 μg/m^3	15 μg/m^3
24-hour average[a]	35 μg/m^3	35 μg/m^3	35 μg/m^3
Lead			
Quarterly average	1.5 μg/m^3	1.5 μg/m^3	1.5 μg/m^3
Rolling 3-month average	0.15 μg/m^3	0.15 μg/m^3	No standard
Sulfur dioxide			
Annual average	0.030 ppm	No standard	0.02 ppm
24-hour average[a]	0.14 ppm	No standard	0.10 ppm
3-hour average[a]	No standard	0.50 ppm	No standard
1-hour average[d]	0.75 ppm	No standard	0.40 ppm
Nitrogen dioxide			
1-hour average	0.01 ppm	No standard	No standard
Annual average	0.053 ppm	0.053 ppm	0.05 ppm

Source: 173 WAC 470–475; U.S Environmental Protection Agency 2012.

[a] Not to be exceeded on more than 1 day per calendar year as determined under the conditions indicated in 173 WAC 475.

[b] In March 2008, EPA lowered the federal standard for 8-hour ozone from 0.08 ppm to 0.075 ppm to better protect public health.

[c] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

[d] The 0.25 ppm standard is not to be exceeded more than two times in 7 consecutive days.

ppm = parts per million; PM10 = particulate matter with a diameter of 10 micrometers or less; PM2.5 = particulate matter with a diameter of 2.5 micrometers or less; μg/m3 = micrograms per cubic meter.

Attainment Status Designation

Ecology maintains a network of air quality monitoring stations throughout the state. These stations are placed in areas where air quality problems are most likely to occur, usually in or near urban areas or close to large air pollution sources. A limited number of additional stations are located in remote areas to provide an indication of regional background air pollution levels.

Based on monitoring information collected over a period of years, EPA and Ecology designate regions as being attainment or nonattainment areas for regulated air pollutants. Attainment status indicates that air quality in an area meets the federal, health-based ambient air quality standards; nonattainment status indicates that air quality in an area does not meet those standards. If the measured concentrations in a nonattainment area improve to levels consistently below the Federal standards, Ecology and EPA can reclassify the nonattainment area to a maintenance area. In that case, Ecology and the local clean air agency are required to implement maintenance plans to ensure ongoing emission reductions and continuous compliance with the federal standards.

Grays Harbor County meets all NAAQS and the more stringent state standards set for total suspended solids and sulfur dioxide. The EPA has established *de minimis* threshold levels, which represent a screening level for which a conformity analysis must be prepared if various criteria pollutants emissions exceed the thresholds. The region is in attainment for all NAAQS.

3.8.1.2 Environmental Setting

The ambient air quality in Grays Harbor is generally good with few sources that introduce particulates into the air (Washington Dept of Transportation 2010). Those sources are primarily local automobiles, local fishing vessels, a local pulp mill, and ocean-going commercial cargo vessels. These sources of air pollution are minor compared to the size of the entire area. To the north and east are logging and lumber mill operations that are sources of air particulates, but these and other air particulates generated in the area are moved out of the area by the prevailing winds from the southwest.

A sensitive receptor is generally defined as a facility or land use that houses or attracts members of the population who are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of sensitive receptors include schools, hospitals, convalescent facilities, and residential areas. The nearest sensitive receptors to the navigation channel and dredged material placement sites are residential uses located approximately 0.2 mile (1,000 feet) from the navigation channel in Aberdeen and Cosmopolis. The nearest hospital is the Grays Harbor Wound Healing Center located 0.36 mile from the channel, and the nearest convalescent facility is the Pacific Care center located 0.75 mile from the channel. There is a recreational area in Westport (Westhaven State Park) approximately 0.25 mile from the outer harbor reaches, and no recreational areas within 0.75 mile of the inner harbor reaches. The majority of land uses along the coastline of the channel are commercial/industrial, which do not constitute sensitive receptors.

3.8.2 Noise

3.8.2.1 Regulatory Setting

Federal, state, and local governments provide guidance on acceptable noise levels to ensure the public's health and well-being, both now and in the future. The Noise Control Act of 1972 (Public Law 92-574) directs federal agencies to comply with applicable federal, state, interstate, and local noise control regulations. As part of its responsibility to provide information to the public regarding identifiable effects of noise on public health and welfare, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This report identifies sound levels less than or equal to 55 decibels day-night average sound level (L_{dn}) as being appropriate outdoors for residential areas and other places in which quiet is a basis for uses to avoid annoyance and interference with outdoor activity (U.S. Environmental Protection Agency 1974).

Federal Regulations

Guidance for evaluating long-term noise increases in NEPA documents was published by the EPA in 1980. The guidance specific to noise increases in residential areas caused by industrial or transportation projects suggests that a long-term noise increase of 5 to 10 dBA[6] above background noise should be considered noticeable (U.S. Environmental Protection Agency 1980).

State Regulations

The primary regulations governing noise levels in Washington are contained in WAC 173-60, Maximum Environmental Noise Levels, and are cited in order to provide a frame of reference for analysis of noise effects.

Ecology implements these regulations. Allowable noise limits depend on the land use classification for the source and the receiver. Dredging operations are classified as industrial noise, or "Class C" noise sources, and areas where people normally sleep (i.e., homes and campsites that are considered noise-sensitive land uses) are classified as "Class A" receivers. The allowable noise limits at a Class A receiver for noise emitted from a Class C source are listed in Table 3.8-2.

Table 3.8-2. Allowable Noise Limits for Class A Receiver and Class C Noise Source

Time Period	Noise Limit (1-hour L_{eq}, dBA)
Daytime (7:00 a.m. to 10:00 p.m.)	60[a]
Nighttime (10:00 p.m. to 7:00 a.m.)	50

Source: Washington Administrative Code 173-60.
Leq = Equivalent noise level; dBA = A-weighted decibel.
[a] Temporary construction or dredging operations are exempt from daytime noise limits.

The following noise sources and activities are specified in WAC 173-60-050 as exempt from daytime noise limits.

[6] A-weighted decibels: an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, compared with unweighted decibels, in which no correction is made for audio frequency. This correction is made because the human ear is less sensitive at low audio frequencies, especially below 1000 Hz, than at high audio frequencies.

- Noise from motor vehicles operating on public roads.
- Sounds originating from temporary construction sites as a result of construction activity.
- Sounds created by the installation or repair of essential utility services.
- Warning devices not operating continuously for more than 5 minutes, such as backup alarms.

For this evaluation, equipment operations associated with dredging would be considered a temporary construction activity, and therefore would be exempt from state daytime noise regulations (WAC 173-60-050). The nighttime noise limits in Table 3.8-2 apply to construction or dredging activities conducted between 10:00 p.m. and 7:00 a.m.

3.8.2.2 Environmental Setting

Noise in Grays Harbor is minimal and is associated primarily with the populated cities of Westport, Aberdeen, Hoquiam, and Cosmopolis. Other sources of noise are vessel traffic, private homes, and small private and port-related operations on the shoreline in the eastern portion of Grays Harbor.

Noise-sensitive land uses include residences, outdoor recreation areas (e.g., parks and campgrounds), and other areas where noise can adversely affect how a land is used or enjoyed. Noise-sensitive land uses would generally include residences and recreational areas. Locations of public areas and residentially zoned land within Grays Harbor and within a quarter mile of its shoreline are shown on Figure 33.

3.8.3 Artificial Lighting

3.8.3.1 Regulatory Setting

Artificial lighting is not regulated by the federal, state, or county governments. The City of Westport Municipal Code Chapter 17.32, Section 17.32.060 (Shoreline Development Guidelines), 5.C.xxi, cited as a frame of reference, states, “Special attention should be given to designs and methods that prevent, avoid, and minimize adverse impacts such as noise, light, temperature changes, turbidity, water pollution, and contaminated sediments on the marine, estuarine, or upland environment. Such attention should be given particularly during critical migration periods and life stages of marine species and critical oceanographic processes.”

The municipal codes of Aberdeen, Cosmopolis, and Hoquiam do not regulate artificial lighting.

3.8.3.2 Environmental Setting

Artificial lighting in Grays Harbor is minimal and is associated primarily with the populated cities of Westport, Aberdeen, Hoquiam, and Cosmopolis. Sources of artificial lighting in the vicinity of the navigation channel and the dredged material placement sites include vessel traffic in the navigation channel and private homes and small private marinas and docks along the shoreline (particularly along Point Chehalis) and port-related operations along the eastern shoreline of the Cow Point and Hoquiam reaches of the navigation channel. The rest of the shoreline of Grays Harbor within the vicinity of the navigation channel and dredged material placement sites is not developed and thus not lighted.

Under baseline conditions, maintenance dredging sometimes occurs at night to enable the desired volume of sediment to be removed within the designated in-water work window. Lights on the dredges and tugs are used to enable this work. Lights are oriented down toward the water and thus do not illuminate areas outside of the immediate vicinity of the dredge and barge.

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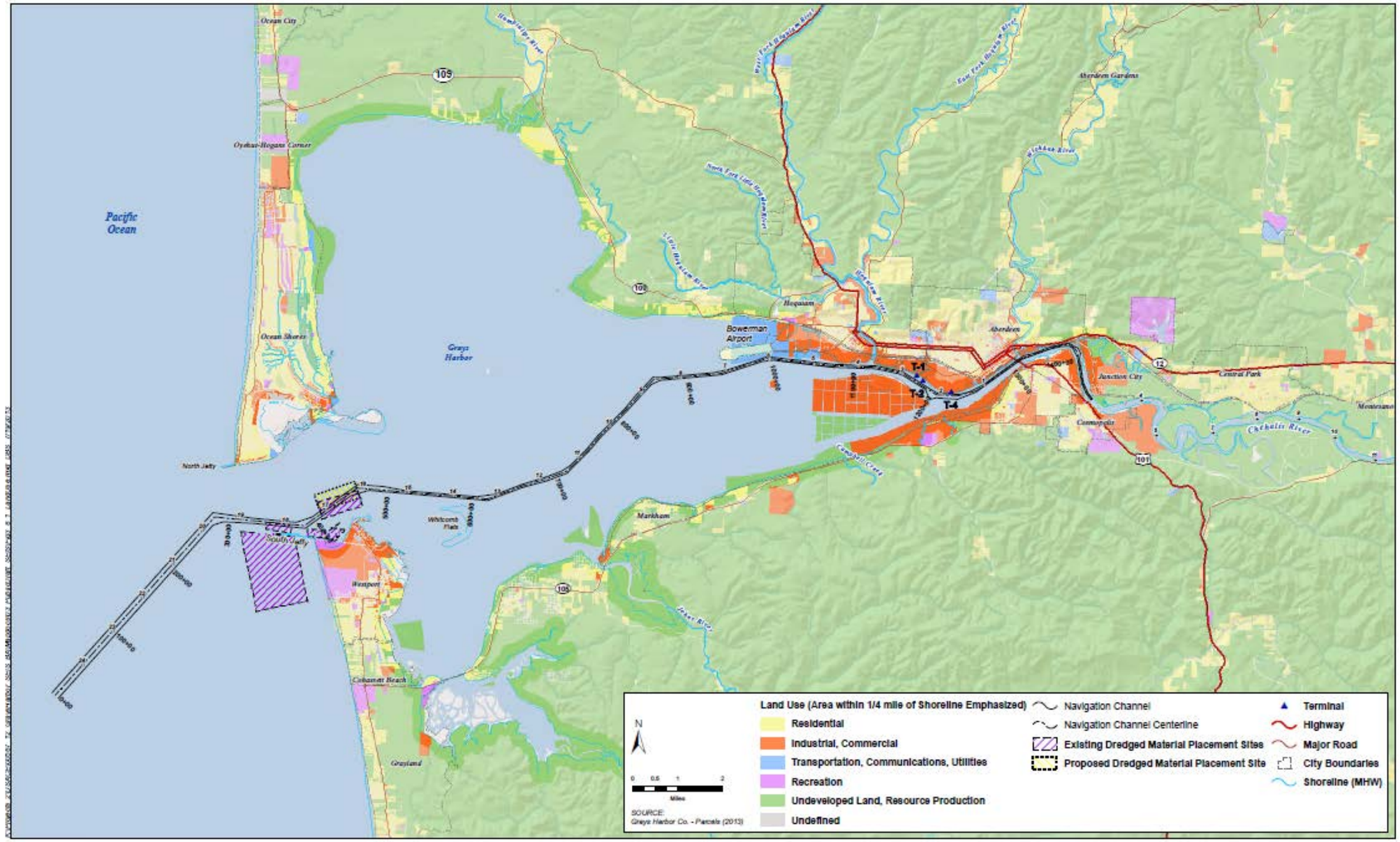

Figure 33. Shoreline Land Use

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3.9 Land Use and Aesthetics

This section discusses the existing conditions of land use and aesthetic resources surrounding Grays Harbor. The study areas for both resources are defined below followed by a description of their environmental setting, as well as their applicable regulations.

3.9.1 Land Use

The proposed action occurs within Grays Harbor County near the cities of Aberdeen, Hoquiam, Cosmopolis, and Westport. The study area used to analyze the consistency between the proposed action and existing land uses encompasses land within 0.25 mile of the Grays Harbor shoreline. Thus, the city of Ocean Shores, located along the northwestern extent of the harbor, was also included in the study area. However, the navigation channel and dredged material placement sites are located predominantly in the southwestern portion of the harbor, and thus do not occur along the shoreline near Ocean Shores.

3.9.1.1 Regulatory Setting

Land use in the study area is managed through a number of local land use plans and development regulations for implementing the local plans. These plans and regulations are reviewed in context of project impacts to area land and land use as evaluated under NEPA.

Comprehensive Plans

Over the past 50 years, the Grays Harbor County Planning Commission and staff have compiled a comprehensive plan establishing a long-range planning policy for the unincorporated portion of Grays Harbor County. The comprehensive plan, as adopted by the Board of County Commissioners, comprises five planning elements (Critical Areas Protection, Land Use and Rural Lands, Agriculture, Transportation, and Comprehensive Flood Hazard Management), which form the backbone of designated land use throughout the county (Grays Harbor County 2013).

Comprehensive plans are also required for each code city in the state of Washington per RCW 35A.63.060. These plans are prepared to anticipate and influence the orderly and coordinated development of land and building uses of the city and its environs. Within the study area, comprehensive plans have been assembled for the cities of Aberdeen, Hoquiam, Ocean Shores, Cosmopolis, and Westport to identify where and how growth needs will be met.

State-Owned Aquatic Lands

The Washington State Department of Natural Resources (DNR) (2013) manages approximately 2.6 million acres of state-owned aquatic lands. Aquatic, or submerged, lands include both marine (salt) waters and fresh waters, and are categorized by DNR (2013) as one of the following.

- Bedlands—Those aquatic lands that are submerged at all times, and include navigable salt waters and fresh waters of the state.
- Tidelands—Submerged lands and beaches that are exposed and submerged with the ebb and flow of the tides.

- Shorelands—Submerged lands lying along the edge of a river or lake.

State-owned aquatic lands occur in the study area at the dredged material placement sites. The Point Chehalis and South Jetty open–water placement and nearshore beneficial use sites are located on DNR aquatic bedlands.

Coastal Zone Management Act

The Coastal Zone Management Act gives states the primary role in managing coastal and shoreline resources. The state prepares a Coastal Zone Management Program document that describes the state's coastal resources and how these resources are managed, and the delegated primary role is assumed upon NOAA approval of the State's program. Ecology's Shorelines and Environmental Assistance Program is responsible for implementing Washington's program.

Under Washington's program, federal activities that affect land use, water use, or natural resource of the coastal zone must comply with the enforceable policies within the following six laws identified in the program document.

- Shoreline Management Act (including local government SMPs)
- SEPA
- Clean Water Act
- Clean Air Act
- Energy Facility Site Evaluation Council
- Ocean Resource Management Act

The Corps has prepared a Coastal Zone Management Consistency Determination (Appendix C).

Shoreline Master Programs

Grays Harbor County prepared a Shoreline Master Program (SMP) to assist the management of shorelines within the parameters of the Washington State Shoreline Management Act of 1971 and the guidelines developed by Ecology (Grays Harbor County 2002). The program applies to the proposed action's dredging activity and dredged material placement sites per the "Shoreline Management Policies" of the SMP. Under the "Activities" category, policies for dredging are included as follows (Grays Harbor County 2002).

- Dredging should minimize damage to existing ecological values, natural resources, and the river system of both the area to be dredged and the area for deposit of dredged materials and shall also minimize water quality degradation.
- Spoil deposit sites in water areas should be identified in cooperation with the State Departments of Natural Resources and Fish and Wildlife. Depositing of dredged material in water areas should be allowed only for habitat improvements, to correct problems of material distribution adversely affecting fish and shellfish resources, or where the alternatives of depositing material on land are more detrimental to shorelines resources than depositing it in water areas.
- Dredging of bottom materials for the single purpose of obtaining fill material should be discouraged.

- Ship channels, turning and moorage basins should be identified and no new such areas should be prepared or used without sufficient evidence that existing channels and basins are inadequate.
- The use of dredge spoils for purpose other than landfill is encouraged.

The cities of Aberdeen, Hoquiam, Ocean Shores, and Westport also each have an SMP in compliance with the Shoreline Management Act (City of Aberdeen 1989; City of Hoquiam 1989; City of Ocean Shores 1998; City of Westport 1998). The City of Westport is beginning the process of updating its 1998 SMP. In conformance with state requirements, the regulations of these programs are embodied in their municipal codes to identify their intent and provide the cities with clear direction in applying the regulations. The policies that pertain to dredging in these programs are similar to the policies listed above for Grays Harbor, with the added policy from the Westport SMP (City of Westport 1998) as follows.

- Dredging should focus on public access, transportation, and shoreline industry in identified industrial areas.

Grays Harbor Estuary Management Plan

The *Grays Harbor Estuary Management Plan* provides jurisdictional and regional linkage between the Shoreline Management Act and the SMPs of the cities of Aberdeen, Hoquiam, Ocean Shores, and Westport. The management plan is multijurisdictional, covering the entire Grays Harbor estuary, including all associated shorelands of Aberdeen, Hoquiam, Ocean Shores, and Westport. Where inconsistencies exist between state and local jurisdictions, such as shoreline of statewide significance designation, they are resolved through permits issued by the participating agencies, including stipulations and mitigation measures.

Elements of the proposed action are included in the *Grays Harbor Estuary Management Plan*. The Point Chehalis Revetment Extension Mitigation site is located in Planning Area VIII, Management Unit 40, which is intended for public recreational uses. An allowable use in Management Unit 40 is bankline erosion control, defined as a type of fill designed to preserve the existing bankline or to protect the bankline from erosion (Grays Harbor County 1986). The following general policies for bankline erosion control are applicable to the proposed action (Grays Harbor County 1986).

- Materials to be used shall be of non-erodable quality that will allow long-term stability and minimize maintenance. Some erodable materials may be used when it can be demonstrated that fish and wildlife uses will be enhanced.
- Riprap/bank stabilization procedures shall be confined to those areas where active erosion is occurring or new development or redevelopment requires protection intended to maintain the integrity of upland structures or facilities.
- Only clean materials may be used. Materials which could create water quality problems or which will rapidly deteriorate are not permitted.
- Minor modifications of the bankline may be allowed on a case-by-case basis. These alterations shall be for the purpose of stabilizing the bankline, not for the purpose of developing new upland areas.
- Under no circumstances shall bankline erosion control be initiated for the purpose of gaining developable uplands from existing water areas.

- All projects shall be constructed in a manner to minimize turbidity in adjacent waters.
- The outer slope of the bankline after completion of the erosion control will not exceed a slope of 2:1.
- Use of vegetation for bankline stability is required where technically applicable and should be in conjunction with structural forms of erosion control. Vegetation shall be self-sustaining, soil stabilizing, and compatible with natural shoreline vegetation.

The navigation channel, open-water dredged material placement sites, the South Beach, and the Half Moon Bay nearshore placement sites are located in Management Unit 44, a special unit that includes all water area not included within any other designated management unit. The objective for this unit is to protect areas for purposes that directly use or depend on natural systems. The activities that occur in these areas should be compatible with natural systems to maintain the carrying capacity and biological productivity of the bay.

Special conditions are imposed on Management Unit 44 to ensure that activities are carried out in a manner that does not reduce or degrade these estuarine resources. The following special conditions are applicable to the proposed action (Grays Harbor County 1986).

- Activities in Unit 44 will be compatible with the natural system.
- EPA-authorized in-water dredged material placement sites are allowable in this management unit consistent with meeting all designation criteria.

3.9.1.2 Environmental Setting

Land surrounding the harbor to the north, east, and south, and two peninsulas (north and south) lie on the west coast between the harbor and the Pacific Ocean. A majority of the surrounding area is forested in native vegetation that has undergone repeated and extensive timber harvest in the past 150 years. The land surrounding the harbor is sparsely populated with the exception of the cities of Aberdeen, Hoquiam, Cosmopolis, Ocean Shores, and Westport; however, these areas are small compared to most of the cities in the Puget Sound Basin.

Figure 33 depicts the current general land uses in the study area including residential, industrial/commercial, transportation/communications/utilities, recreation, and undeveloped land/resource production. As shown, development within the study area is more concentrated on the eastern and western sides of the harbor and a majority of undeveloped land/resource production is located along the northern and southern margins. Industrial/commercial use is prevalent on the eastern side along the shoreline in the cities of Aberdeen, Hoquiam, and Cosmopolis. Notwithstanding recent diversification of the local economy, the timber and fishing industries are large components of the local economy. Industrial/commercial use can also be found along the western side of the harbor, particularly in the city of Westport. Businesses here include fishing, shellfish harvesting, seafood processing, and tourism. Ship and boat building have more recently also become important parts of Westport's economic base (City of Westport 2013).

Figure 33 also illustrates some industrial/commercial and resource production land uses waterward of the shoreline and within the harbor. This is due to zoning of intertidal areas; a majority of the uses in these areas include shellfish/oyster farming, and cranberry harvesting on lands along the southern shoreline of the harbor.

Residential use occurs along all sides of the harbor, particularly concentrated in and around city and industrial areas. In some locations, industrial land use exists directly adjacent to residential use. This was caused by early shoreline development of the harbor for commerce, resulting in manufacturing and housing being developed concurrently. Residential use is also clustered within the western peninsulas of the harbor in and around the cities of Westport and Ocean Shores. The communities here are primarily on flat shorelines and promontories with ocean and harbor views and are popular vacation and retirement areas.

The study area also encompasses many recreational areas, including several state and local parks and designated wildlife areas. Most of these areas occur on the western half of the harbor within and near the north and south peninsulas. Recreational activities that mainly occur here include fishing, birding, wildlife viewing, hiking, and boating. Details on specific recreational parks and wildlife areas are included in Section 3.10, *Recreation*.

Transportation/communications/utilities land use occurs in a few areas around the harbor. Most notably, the Bowerman Airport, also known as Bowerman Field, is a public-use airport owned by the Port, located along the northern edge of the harbor about 2 miles west of the city of Hoquiam and near the northern edge of the Hoquiam Reach of the navigation channel. Two smaller public-use airports are also located along the harbor near the cities of Westport and Ocean Shores. The marinas in these areas are also included in the transportation/communications/utilities land use category along with the Ocean Shores Sewage Treatment Plant, a utility service located in the city of Ocean Shores near the end of the northern peninsula.

3.9.2 Aesthetics

The study area to assess the visual quality and aesthetic characteristics of the proposed action encompasses the entire Grays Harbor viewshed. A viewshed is the landscape or topography and features visible from a geographic viewing point. It is important for understanding the overall landscape character and for identifying important visual resources and views of those resources. Because this viewshed is so large, the study area is broken up into two distinct landscape units to depict the harbor's eastern and western sides. A landscape unit is a visually distinct area within a study area, which allows a closer look at an area's details and character. These landscape units were chosen to correspond with the inner harbor reaches in the eastern portion of the harbor and the outer harbor reaches and dredged material placement sites in the western portion of the harbor. The discussion below describes the Grays Harbor viewshed and landscape units, and provides a summary of the relevant regulations for aesthetic resources in the study area.

3.9.2.1 Regulatory Setting

Federal regulations require that the Corps consider the visual and aesthetic effects of the proposed action on nearby communities and resources. Understanding how a proposed action would affect visual quality helps planners and engineers design and build project facilities that fit their settings and are beneficial to communities.

3.9.2.2 Environmental Setting

The viewshed for Grays Harbor is quite large, because it extends more than 10 miles from east to west. The harbor is a wide, long estuary with low, forested hills around the bay on the north, east, and south sides. Views around this area are panoramic, extending across the estuary to the horizon. Only distant landforms and color contrasts are visible across the long distances of the Grays Harbor viewshed. Also, with the presence of the existing navigation channel, both large and small vessels are often included in the viewshed, along with ships that moor in the harbor. Remnants of wooden piles from former docks and piers protrude from the water just offshore in some locations. Otherwise, the harbor is free of structures other than navigation buoys (Figure 34 and Figure 35).

To break up the long expanse of Grays Harbor, the viewshed is broken up into eastern and western landscape units. On the eastern side, where the inner harbor reaches of the navigation channel occur, the shoreline consists of development including industrial uses and Port terminals and facilities (Figure 36). As discussed above, early development of the shoreline for commerce led to industrial use and housing being built concurrently over the last century. Today, the shoreline includes zoning for industrial uses; therefore, the trend of predominately industrial buildings occurring along the shoreline in this area is anticipated to continue.

In contrast, the western side of the harbor has little development. People in this area include the residents with homes on the western peninsulas and harbor-facing hillsides and shorelines and visitors that engage in the recreational activities offered in the area. Residents and visitors are likely to be sensitive to the quality of views in this landscape unit because of its natural setting.

Currently, annual maintenance dredging of the outer harbor reaches and the open-water and nearshore placement sites and beneficial use of dredged materials occur in this area (Figure 37).

Figure 34. Navigation Buoys in the Grays Harbor Viewshed

Figure 35. Distant Landforms and Color Contrasts visible across the Grays Harbor Viewshed

Figure 36. Industrial Uses and Port Terminals and Facilities in the Grays Harbor Viewshed

Figure 37. View Overlooking Half Moon Bay (left) and the Navigation Channel near the Point Chehalis Open-Water Placement Site (far right)

3.10 Recreation

This section discusses the existing recreational uses of Grays Harbor. Applicable plans and regulations that pertain to these recreational activities are described below as they relate to the proposed action.

3.10.1 Environmental Setting

3.10.1.1 Recreational Activities

Grays Harbor hosts a large array of recreational opportunities. The city of Westport, located at the southern mouth of the harbor, is advertised as "the salmon fishing capital of the world" (Grays Harbor County 1989). Chartered salmon fishing is available to locals and visitors from the Westport Marina, Washington's largest fish landing port. Although small in comparison to Westport, Ocean Shores Marina (located near the northern mouth of the harbor) also provides fishing boats, and during the salmon fishing season approximately 30 to 40 additional boats operate out of the marina. Fishers can also fish off the nearby jetties and piers for a variety of deep-sea saltwater fish including rockfish, lingcod, and surf perch.

Recreational clam digging and crabbing are also popular activities at the harbor. Razor clams can be found near the north and south jetty at the mouth of Grays Harbor; razor clam seasons are limited and tightly regulated. Crabbing in the harbor commonly consists of the use of crab pots to catch Dungeness and red rock crabs; however, crabs are also caught using ring nets and dip nets and by wading in shallow water during spring and early summer. The season for crabbing by use of crab pots is limited (December 1 through September 15), whereas fishing with other crab gear is open all year (Washington Department of Fish and Wildlife 2009). These water-related activities typically occur within Grays Harbor away from the navigation channel to avoid interaction with marine traffic.

Other popular recreational activities offered in the harbor include a variety of wildlife viewing and bird watching. The Bowerman Basin, an arm of Grays Harbor, is a world renowned bird-watching area, particularly during the spring and fall shore bird migration. The Oyhut Wildlife Recreation Area, a 682-acre area of protected land located just west of Damon Point State Park on the north shore of the harbor, is another area to view birds including blue herons, brown pelicans, pheasants, and federally listed (threatened) snowy plovers. Also, during the early months of spring, Pacific gray whales can be spotted approximately 2 miles beyond the entrance to Grays Harbor. To better see whales, Westport provides many chartered trips and whale-watching tours.

Wave riding/surfing is a popular activity at several locations in the Grays Harbor vicinity. The three primary surfing locations are South Beach near the South Jetty, Half Moon Bay, and the groin areas of the Point Chehalis revetment. Other general types of recreational activities that occur in Grays Harbor include hiking, picnicking, horseback riding, boating, beachcombing, and hunting. Surrounding the harbor are several state and local parks and designated wildlife areas (discussed in the following section) where these types of activities occur.

3.10.1.2 Recreational Parks and Wildlife-Viewing Areas

Surrounding Grays Harbor are several state and local parks and designated wildlife areas (Figure 38). The larger state and local parks are listed in Table 3.10-1 along with a general description of

their facilities and recreational opportunities offered. Several smaller city or neighborhood parks (1 to 3 acres) are also spread throughout the areas surrounding the harbor, and these mainly include landscaped/manicured areas, athletic fields/courts, and picnicking-based facilities.

Table 3.10-1. Greater Recreational Parks of Grays Harbor

Park	Description
Damon Point State Park	61-acre day-use park located at the southeastern tip of the Ocean Shores Peninsula. The park includes a 1-mile walkable strip of land within a 1-mile-long, 0.5-mile-wide stretch of land jutting out to the ocean. Activities include bird watching, wildlife viewing, hiking, picnicking, fishing, clamming, crabbing, rock collecting, and beachcombing.
Westhaven State Park	79-acre day-use park located near the city of Westport, on the Pacific Ocean and Half Moon Bay. Activities include picnicking, fishing, clamming, horseback riding, kite flying, crabbing, surfing, scuba diving, and beachcombing.
Westport Light State Park	212-acre park located on the Pacific Ocean adjacent to the historic Westport Lighthouse. Activities include hiking, fishing, beachcombing, and bird watching.
Westport City Park	7-acre park located just east of Westport Light State Park. Facilities include covered picnic shelter, children's play area, tennis court, softball field, hiking trails, BMX track, and community house.
Bottle Beach State Park	75-acre day-use park with 6,000 feet of shoreline on Grays Harbor located in the community of Ocosta. Activities include bird/wildlife viewing, and a walking trail is provided.
North Bay Park	7-acre city park located in the city of Ocean Shores between the Ocean Shores Wildlife Area and Duck Lake. Facilities include a boat launch, fishing dock, athletic fields/courts, playground, and picnic shelter.
Ocean City State Park	170-acre camping park located in the community of Ocean City. Activities include camping, hiking, beachcombing, and bird watching.
Twin Harbors Beach State Park	172-acre camping park located along the Pacific coast, approximately 4 miles south of the community of Westhaven. Activities include camping, hiking, beachcombing, and wildlife viewing.
Morrison Riverfront Park	11-acre park located on the Chehalis River at the east entrance to the city of Aberdeen, providing 4,650 feet of waterfront access. Facilities include picnic tables, fishing/viewing dock, and a 1.35-mile landscaped trail.

Several designated wildlife areas also occur along Grays Harbor offering a variety of recreational opportunities. The Oyhut Wildlife Recreation Area, located in the southern end of the peninsula of the city of Ocean Shores, features 682 acres of wetlands and tidal flats that shelter coastal birds including blue herons, brown pelicans, pheasants, and federally listed (threatened) snowy plovers. This area serves as a popular migrant stop for these coastal birds, and as such is ideal for bird watching. The Ocean Shores Bay Wildlife Area is also located in the city of Ocean Shores and adjacent to the harbor. This area offers excellent year-round birding opportunities and is also popular for waterfowl hunting.

The Grays Harbor National Wildlife Refuge, located within the Grays Harbor estuary at the mouth of the Chehalis River, is visited by over a million travelers each year (U.S. Fish and Wildlife Service 2012). It encompasses 1,500 acres of intertidal mudflats, salt marsh, and uplands including the

Bowerman Basin. Although limited, recreational activities allowed on refuge lands include wildlife viewing, photography, and nature study. No fishing or hunting is allowed on the refuge.

Grays Harbor also includes the Johns River Unit, a 1,500-acre wildlife area located 10 miles south of the city of Aberdeen. Found here are extensive mudflats and swamps that have formed behind old dikes that create prime habitat for numerous types of wildlife and waterfowl. A boat launch and trails are offered to visitors for easy access to explore the area. Along with hiking and wildlife viewing, fishing and hunting are also popular activities within the wildlife area.

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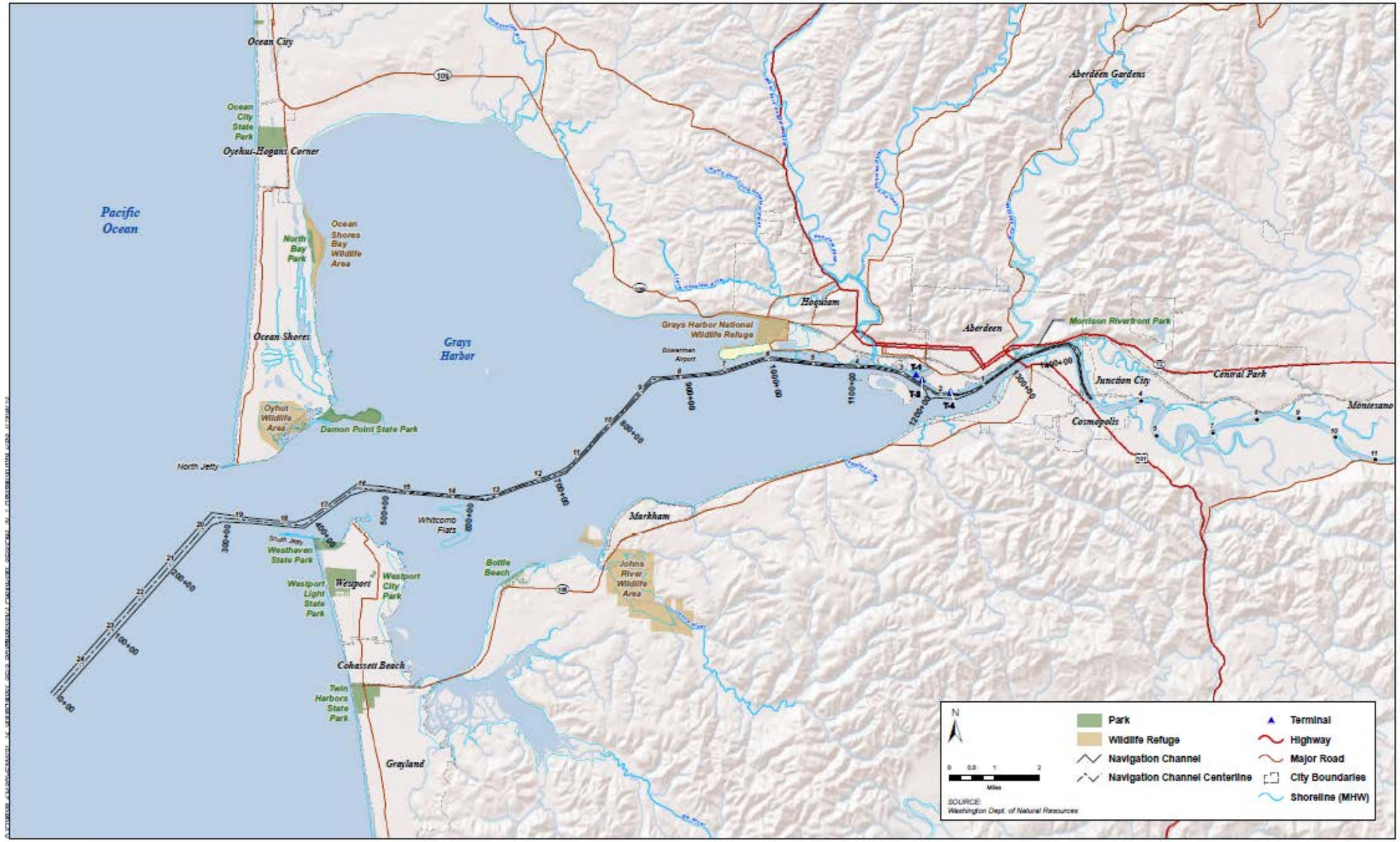

Figure 38. Public Recreation Area

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3.11 Global Climate Change

This section describes existing conditions relative to the regulation of greenhouse gases and global climate change and potential sources of greenhouse gases (GHGs) as a result of activities within Grays Harbor and its immediate vicinity.

Climate change is a global problem and certain GHGs are considered global pollutants directly contributing to climate change. The primary GHGs in the atmosphere are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Of these six primary GHGs, CO_2, CH_4, and N_2O would likely be emitted by activities under the proposed action. Consequently, this analysis focuses on emissions of these three GHGs. The characteristic these GHGs have in common is their absorption of radiation within the thermal infrared range. Absorption of radiation within this range is the fundamental cause of the "greenhouse effect," which traps heat in the troposphere. Anthropogenic sources of GHGs have been increasing over the past 150 years, and have reached a rate of contribution that is causing global climate change.

3.11.1 Regulatory Setting

The Council for Environmental Quality (CEQ) issued draft guidance requiring all NEPA documents to evaluate the impacts from a project's GHG emissions if a proposed action would cause annual direct and indirect emissions of 25,000 metric tons or more of CO_2-equivalent (CO_2e) GHG emissions for land management agencies actions. The CEQ does not propose 25,000 metric tons CO_2e as a specific significance threshold, but rather suggests that agencies should consider this an indicator that a quantitative and qualitative assessment of GHG emissions is important to decision makers and the public in the NEPA process (Council for Environmental Quality 2010).

The CEQ also advises assessment of the relationship of climate change effects to a proposed action or alternatives. Federal agencies should consider the ways in which climate change is affecting or could affect environmental effects of a proposed action.

The EPA administrator signed the following two distinct findings regarding GHGs under the Clean Air Act on December 7, 2009 (74 FR 66496).

- Endangerment Finding:

  > The Administrator finds that the current and projected concentrations of the six key well-mixed greenhouse gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—in the atmosphere threaten the public health and welfare of current and future generations. (The Clean Air Act now classifies these six GHG as pollutants under the Clean Air Act.)

- Cause or Contribute Finding:

  > The Administrator finds that the combined emissions of these well-mixed greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution which threatens public health and welfare.

These findings do not in themselves impose any requirements on industry or other entities. However, this is a prerequisite to finalizing the EPA's proposed GHG emission standards for light-

duty vehicles, which were jointly proposed by EPA and the Department of Transportation's National Highway Safety Administration on September 15, 2009 (74 FR 49454).

3.11.2 Environmental Setting

Concern regarding the implications of global climate change is increasing across both the public and private sectors and within Federal, state, and local governments. The concern for Federal projects is the contribution of GHGs to the atmosphere in such large quantities as to outweigh the benefit of executing the proposed action. The most common source of anthropogenic GHG emissions is the burning of fossil fuels either by vehicles/equipment (e.g., vessels used to accomplish dredging and placement of dredged material) or to generate heat and power for buildings.

Ecology has completed a GHG inventory to estimate statewide anthropogenic GHG emissions for the period from 1990 to 2008 (Washington State Department of Ecology 2010). Statewide emissions in 2008 were 101.1 million metric tons of CO_2e (approximately 2% of nationwide emissions). Annual updating and reporting are intended to help Ecology develop a comprehensive inventory of emissions from all significant sectors of the Washington economy.

Marine vessels are captured in the state's inventory. Dredging activities likely represent a very small component of the marine vessel subcategory within the transportation sector. The Corps has not completed a GHG inventory of its own operations.

3.12 Local Economy/Socioeconomics

The economy of Grays Harbor County has been and continues to be dependent on natural resources, including the timber industry (particularly silviculture, logging and forest product manufacturing) as well as fisheries (commercial and recreational fishing, shellfish and fish processing), and the port activities. The recent recession had a negative impact on Grays Harbor County, in terms of loss of employment and wage income. Recovery has been delayed at Grays Harbor County and the unemployment rate is significantly higher than the statewide average (Washington State Employment Security Department 2013).

The activities of the Port have helped to address these difficult economic conditions. In particular, within the context of the existing navigation channel conditions and authorized use and current zoning allowances, the Port has worked with its public and private partners to upgrade rail transportation and marine terminals, which provides for the current status of employment for terminal operators and wage income.

3.12.1 Population and Demographics

This section reviews recent trends in population in Grays Harbor County.

3.12.1.1 Population Trends

Table 3.12-1 presents population trends in Grays Harbor County based on U.S. census data from 1990 to 2010 (U.S. Census Bureau 2013). The population of Grays Harbor County increased from 64,175 persons in 1990 to 67,194 persons in 2000, an average annual growth rate of 0.5%. This was

much slower than Washington State as a whole, which grew at 1.9% annually during the same period.

From 2000 to 2010, the population of Grays Harbor County also grew more slowly than the state population, increasing from 67,194 persons in 2000 to 72,797 persons in 2010, an average growth rate of 0.8%. The statewide population grew at 1.3% annually during the same period.

As a result, Grays Harbor County has experienced a slight decline as a percentage of state population: from 1.32% in 1990 to 1.14% in 2000 and 1.08% in 2010.

Within Grays Harbor County, the percentage of the population in incorporated and unincorporated areas has remained relatively stable. In 1990, incorporated areas accounted for 61.0% of the county population with 39.0% in unincorporated areas. In 2000, the population in incorporated areas increased to 62.0%, with 38.0% in unincorporated areas. In 2010, the population in incorporated areas dropped to 60.9%, with 39.1% in unincorporated areas (Washington State Employment Security Department 2012.

The largest cities in Grays Harbor County are Aberdeen and Hoquiam, which accounted for 23.2% and 12.0%, respectively, of the county population in 2010. During the period from 1990 to 2010, Aberdeen experienced a very slight growth in population, increasing from 16,565 in 1990 to 16,896 in 2010 (gain of 331 persons), while Hoquiam's population decreased from 8,972 in 1990 to 8,725 in 2010 (loss of 246 persons). Most of the population growth in the incorporated areas during this period occurred in Ocean Shores and Montesano, with the Ocean Shores population increasing from 2,301 persons in 1990 to 5,569 persons in 2010 (gain of 3,268 persons) and the Montesano population increasing from 3,060 persons in 1990 to 3,976 persons in 2010 (a gain of 916 persons) (Washington State Office of Financial Management 2012).

Table 3.12-1. Population Trends

				Average Annual Growth Rates	
Area	1990	2000	2010	1990–2000	2000–2010
United States	250,132,000	282,385,000	308,745,538	1.2%	0.9%
Washington State	4,866,659	5,894,143	6,733,250	1.9%	1.3%
Grays Harbor County	64,175	67,194	72,797	0.5%	0.8%
Unincorporated County	25,000	25,548	28,438	0.2%	1.1%
Incorporated County	39,175	41,646	44,359	0.6%	0.6%
Aberdeen	16,565	16,461	16,896	-0.1%	0.3%
Cosmopolis	1,372	1,595	1,649	1.5%	0.3%
Elma	3,011	3,049	3,107	0.1%	0.2%
Hoquiam	8,972	9,097	8,726	0.1%	-0.4%
McCleary	1,473	1,484	1,653	0.1%	1.1%
Montesano	3,060	3,312	3,976	0.8%	1.8%
Oakville	529	675	684	2.5%	0.1%
Ocean Shores	2,301	3,836	5,569	5.2%	3.8%
Westport	1,892	2,137	2,099	1.2%	-0.2%

Sources: U.S. Census Bureau 2013; Washington State Office of Financial Management 2012.

3.12.2 Economic Trends

This section reviews recent trends in employment, unemployment, and wages in Grays Harbor County based on data from the Washington State Employment Security Department (2012).

3.12.2.1 Employment

The number of employed persons covered by unemployment insurance[7] declined from 23,113 persons in 2002 to 22,371 persons in 2011, an annual loss of 0.4% in employment (Washington State Employment Security Department 2012).

Growth occurred in wholesale trade, information, administrative and waste services, and health care and social assistance. All other sectors lost employment. Within the government sector, losses in local government outweighed slight gains in state and federal government employment.

Government is the largest employment sector in Grays Harbor County, with covered employment accounting for approximately 25 to 27% of employment between 2002 and 2011 (Washington State Employment Security Department 2012). Manufacturing is the next largest sector, but its share of overall covered employment dropped from a peak of 16% in 2005–2006 to 13% in 2010–2011. Retail trade is the third largest sector, but retail employment also declined from 13% of total covered employment in 2002–2003 to 11% in 2011. Health care and social assistance is the fourth largest sector, accounting for 11% of covered employment in 2011, up from 8% in 2002.

Employment and Median Income in the Study Area

Table 3.12-2 provides estimates of civilian employment and median household income for Westport, Cosmopolis, Hoquiam, and Aberdeen in 2010 (U.S. Census Bureau 2013).

All communities in the study area have a relatively high proportion of manufacturing jobs, ranging from 11% in Cosmopolis and Aberdeen to 19% in Westport. Retail trade only accounted for 4% of the employment in Westport but 15% in Cosmopolis. Employment in arts, entertainment, recreation, accommodation and food services accounted for 21% of income in Westport but only 4% in Cosmopolis. Transportation, warehousing, and utilities represented 5 to 6% of the employment base in Cosmopolis, Aberdeen, and Hoquiam but 0% in Westport.

Median annual household income ranged from a low of $30,525 in Westport to a high of $45,720 in Cosmopolis, with Aberdeen and Hoquiam at $41,956 and $39,008, respectively (U.S. Census Bureau 2013). The income difference reflects the seasonal pattern of employment in Westport, especially in the fishing and tourist sectors.

[7] Covered employment represents the largest share of employment in an area. However, covered employment does not include self-employed persons or industries that are self-insured including employees of railroads, among other industries.

Table 3.12-2. Civilian Employment in Westport, Cosmopolis, Hoquiam, and Aberdeen, Washington

	Number of Persons Employed			
Employment Sector	Westport	Cosmopolis	Hoquiam	Aberdeen
Civilian employed population 16 years and over	839	898	4,832	8,931
Agriculture, forestry, fishing and hunting, and mining	77	71	195	538
Construction	6	49	301	659
Manufacturing	161	98	641	1,010
Wholesale trade	8	16	136	213
Retail trade	36	132	590	1,241
Transportation and warehousing, and utilities	0	52	240	416
Information	36	7	117	167
Finance and insurance, and real estate and rental and leasing	58	33	210	306
Professional, scientific, and management, and administrative and waste management services	0	79	342	382
Educational services, and health care and social assistance	133	174	994	1,710
Arts, entertainment, and recreation, and accommodation and food services	172	35	539	1,203
Other services, except public administration	43	51	221	373
Public administration	109	101	306	713
Median household income (dollars)	$30,525	$45,720	$39,008	$41,956

Source: U.S. Census Bureau 2013

3.12.2.2 Wages

Wages in Grays Harbor County increased from $656.7 million in 2002 to $782.9 million in 2011, an average annual rate of 2.0%, unadjusted for inflation (Washington State Employment Security Department 2012). Considering the 2.3% rate of inflation during this period, real wages (adjusted for inflation) in Grays Harbor County declined slightly during this period (-0.3% per year).

The average covered wage in Grays Harbor County in 2011 was $34,998 (Washington State Employment Security Department 2012).

Wages in the following sectors were above average in Grays Harbor County in 2011:

- Professional, Scientific, and Technical Services ($71,844)
- Management of Companies and Enterprises ($51,801)
- Manufacturing ($46,251)
- State government ($46,007)
- Wholesale trade ($45,571)
- Federal government ($45,147)
- Construction ($43,408)

- Government ($40,842)
- Agriculture, forestry, fishing and hunting ($40,540)
- Local government ($39,328)
- Finance and insurance ($38,854)
- Transportation and warehousing ($37,905)
- Information ($37,287)
- Health care and social assistance ($35,312)

Wages in the following sectors were below average in Grays Harbor County in 2011:

- Administrative and waste services ($32,742)
- Retail trade ($25,621)
- Real estate and rental and leasing ($19,659)
- Other services, except public administration ($15,045)
- Accommodation and food services ($13,983)
- Arts, entertainment, and recreation ($12,365)

Wages in the sectors related to marine development (wholesale trade, manufacturing, transportation, and warehousing) were above average in 2011. Table 3.12-3 presents the number of persons employed in Grays Harbor by industry from 2002 through 2011. Table 3.12-4 presents total wages from covered employment in Grays Harbor by industry for the same period.

Table 3.12-3. Covered Employment by Industry in Grays Harbor County, 2002–2011

NAICS Code	Industry	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR 2002–2011
	Total	23,113	23,393	24,124	24,711	24,907	24,769	24,810	22,933	22,526	22,371	-0.4%
11	Agriculture, forestry, fishing and hunting	1,043	1,042	1,064	1,108	1,074	953	882	796	731	689	-4.5%
23	Construction	1,097	1,051	1,035	1,205	1,365	1,406	1,431	948	877	871	-2.5%
31-33	Manufacturing	3,242	3,369	3,544	3,920	3,864	3,782	4,064	3,151	2,959	2,907	-1.2%
42	Wholesale trade	469	478	690	543	794	716	705	646	636	644	3.6%
44-45	Retail trade	2,984	2,938	3,016	2,863	2,795	2,862	2,776	2,654	2,616	2,560	-1.7%
48-49	Transportation and warehousing	573	624	615	614	597	587	588	536	587	553	-0.4%
51	Information	180	174	242	261	230	223	224	223	210	206	1.5%
52	Finance and insurance	643	658	615	588	609	632	635	610	601	570	-1.3%
53	Real estate and rental and leasing	236	260	297	293	284	238	239	233	202	187	-2.6%
54	Professional, Scientific, and Technical Services	514	496	514	513	473	433	378	369	332	430	-2.0%
55	Management of Companies and Enterprises	–	–	150	163	91	42	42	41	48	92	–
56	Administrative and waste services	283	290	317	334	360	490	493	422	457	509	6.7%
62	Health care and social assistance	1,909	1,981	2,027	2,112	2,154	2,245	2,245	2,268	2,288	2,388	2.5%
71	Arts, entertainment, and recreation	249	244	281	274	264	245	224	220	191	179	-3.6%
72	Accommodation and food services	2,083	2,073	2,102	2,218	2,224	2,232	2,170	2,030	1,993	2,001	-0.4%

NAICS Code	Industry	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR 2002–2011
81	Other services, except public administration	1,337	1,424	1,387	1,386	1,385	1,384	1,365	1,452	1,560	1,426	0.7%
	Government	6,157	6,168	6,126	6,242	6,284	6,201	6,261	6,259	6,168	6,097	-0.1%
	Federal Government	215	208	200	234	241	237	232	243	262	218	0.2%
	State Government	1,153	1,196	1,197	1,207	1,190	1,198	1,249	1,236	1,205	1,186	0.3%
	Local Government	4,790	4,765	4,729	4,802	4,854	4,766	4,780	4,780	4,700	4,694	-0.2%

Source: Washington State Employment Security Department 2012.
CAGR = compound annual growth rate.

Table 3.12-4. Wages from Covered Employment by Industry in Grays Harbor County, 2002–2011 ($1,000s)

NAICS Code	Industry	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR 2002–2011
	Total	656,745	681,032	719,757	756,720	788,744	805,312	825,549	762,681	755,300	782,936	2.0%
11	Agriculture, forestry, fishing and hunting	36,401	37,360	35,652	35,902	34,884	32,832	29,773	27,220	26,556	27,932	-2.9%
23	Construction	36,844	35,420	34,381	43,750	50,298	55,413	59,386	38,135	36,982	37,808	0.3%
31-33	Manufacturing	133,466	142,979	149,750	170,053	170,909	164,927	170,427	137,078	129,589	134,451	0.1%
42	Wholesale trade	15,468	16,411	27,269	18,778	32,223	29,855	29,548	27,953	27,762	29,347	7.4%
44-45	Retail trade	61,728	63,072	66,725	65,343	65,679	69,892	68,834	66,686	66,190	65,591	0.7%
48-49	Transportation and warehousing	18,014	18,220	19,442	20,561	19,671	19,300	19,804	16,798	21,085	20,962	1.7%
51	Information	4,419	4,722	7,193	8,586	7,931	7,760	7,973	7,987	7,415	7,681	6.3%
52	Finance and insurance	20,571	21,545	21,145	21,251	21,963	23,231	23,655	23,660	22,537	22,147	0.8%
53	Real estate and rental and leasing	3,659	3,846	4,284	4,949	5,051	4,341	4,563	4,109	3,615	3,676	0.1%
54	Professional and technical services	20,734	19,850	20,829	20,397	19,701	17,263	15,246	14,585	13,371	22,274	0.8%
55	Professional and technical services	–	–	6,612	6,787	3,298	2,549	2,592	2,302	2,716	6,610	–
56	Administrative and waste services	5,765	5,919	6,465	6,883	7,582	10,995	14,290	12,297	13,929	16,666	12.5%
62	Healthcare and social assistance	53,773	57,474	61,565	66,074	69,337	76,643	78,396	81,414	80,883	84,326	5.1%
71	Arts, entertainment, and recreation	2,928	3,141	3,171	3,652	3,455	3,475	3,128	2,861	2,381	2,213	-3.1%
72	Accommodation and food services	24,457	24,430	25,276	27,282	28,305	28,804	28,675	27,759	27,307	27,979	1.5%

NAICS Code	Industry	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR 2002–2011
81	Other services, except public administration	16,695	17,588	18,338	18,315	18,959	20,595	22,083	22,216	24,645	21,454	2.8%
	Government	197,019	204,247	208,352	215,433	226,972	233,698	243,840	246,813	245,703	249,011	2.6%
	Federal Government	8,328	8,435	8,565	8,837	9,544	9,147	9,398	9,880	10,318	9,842	1.9%
	State Government	41,804	43,874	44,829	45,445	48,069	52,727	55,918	56,054	55,581	54,565	3.0%
	Local Government	146,887	151,937	154,958	161,151	169,359	171,824	178,524	180,879	179,804	184,604	2.6%

Source: Washington State Employment Security Department 2012.
CAGR = compound annual growth rate.

3.12.2.3 Unemployment

The effects of the recent recession are still very strong in several counties, including Grays Harbor County.

The unemployment rate in Grays Harbor County was 13.1% in March 2013 (Washington State Employment Security Department 2013). As a result, Grays Harbor County joined a number of other counties with unemployment rates higher than 11.1% (Figure 39). As a comparison, the statewide unemployment rate was 7.5%. The statewide unemployment rate is buoyed by relatively low rates in its largest counties (5.1% in King County and 5.7% in Snohomish County).

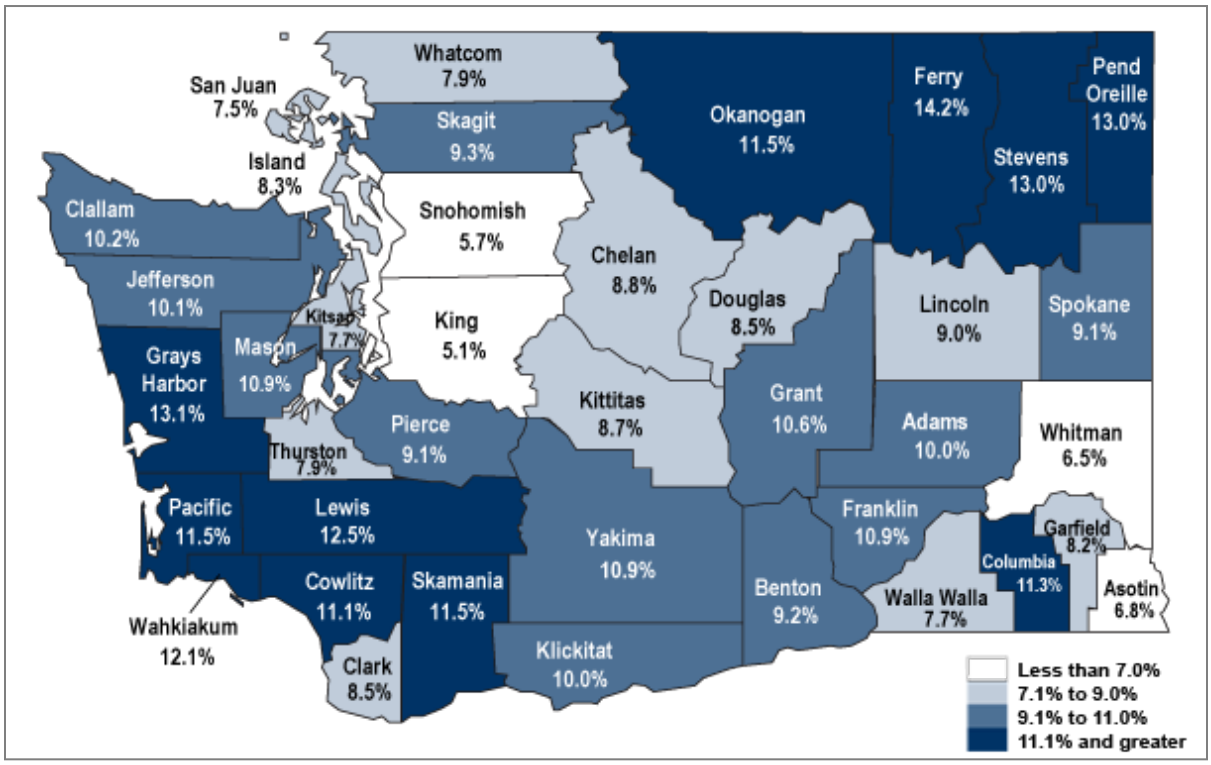

Figure 39. March 2013 Unemployment Rate

Source: Washington State Employment Security Department 2013.

3.12.3 Marine-Related Industries

Marine-related industries primarily include firms engaged in terminal services, fishing and fish processing, and ship/boat building and repair.

3.12.3.1 Terminal Services

Terminal services include terminal operators, transportation providers, and other similar industries that engage in or support terminal operations. The marine terminals are described in Section 3.1, *Marine Transportation*.

The Port estimates that approximately 290 jobs are associated with marine terminal activity (Figure 40).

Figure 40. Port of Grays Harbor Terminal Employment Estimate (July 2012)
Source: Port of Grays Harbor 2012.

The following firms directly manage terminal operations in the Port of Grays Harbor.

- Pasha Automotive has 105 employees in Aberdeen (Greater Grays Harbor 2013).
- Westway Terminal Company LLC has 50 employees in Hoquiam (Dun & Bradstreet 2013).
- Imperium Renewables Inc has 23 employees in Hoquiam (Dun & Bradstreet 2013).

In addition, the Port has 45.9 full-time equivalent employees (FTEs) in 2013, including 4.5 FTEs involved in the management of terminal operations and 3.5 FTEs involved in pilot operations (Port of Grays Harbor 2013:7).

The following transportation providers serve the Port terminals.

- Puget Sound & Pacific Railroad has 33 employees in Elma (Dun & Bradstreet 2013).
- Stevedores operating at the Port include SSA Marine and Jones Stevedoring Company, each of which have three to four employees at Grays Harbor.

The International Longshoremen's Union provides (ILWU) cargo handling services at Port terminals. ILWU hours and wages have grown rapidly in recent years in relation to additional cargo throughput at the Port terminals (Table 3.12-5). The ILWU hours increased from 38,765 hours in

2007 to 158,528 hours in 2012, an increase of over 300%. The number of full time equivalent jobs[8] increased from 19.4 in 2007 to 79.3 in 2012. Likewise, the wages paid to ILWU members increased from $1.6 million in 2007 to $7.6 million in 2012, an increase of 367%. The average wage per FTE increased from $84,045 in 2007 to $95,920 in 2012. This compensation only includes direct wages and does not include benefits and employer-paid taxes.

Table 3.12-5. International Longshoremen's Union Employment and Wages

Year	Hours	Estimated FTEs	Total Wages Paid ($1,000s)	Estimated Annual Wage per FTE
2007	38,765	19.4	$1,629	$84,045
2008	62,878	31.4	$2,725	$86,676
2009	49,376	24.7	$2,203	$89,234
2010	123,086	61.5	$5,640	$91,643
2011	100,373	50.2	$4,410	$87,872
2012	158,528	79.3	$7,603	$95,920

Source: Pacific Maritime Association 2013:74.
FTE = full-time equivalent.

Purchases by the Port also provide a substantial benefit to the local community. In 2011, Port purchases totaled $34.9 million, as presented below by vendor location.

- Grays Harbor–based vendors: $24.8 million[9].
- Other Washington vendors: $5.6 million.
- Outside Washington Vendors: $1.2 million.

The shipment of local products also helps retain local employment. Examples of these related jobs include log exports[10] and pulp shipments from Cosmo Specialty Fibers in Cosmopolis, which has approximately 200 employees (Washington State Department of Natural Resources 2010, 2012).

The increased marine terminal activity at the Port terminals has created substantial increases in employment and wages in Grays Harbor County.

3.12.3.2 Fisheries and Fish Processing

According to the Port (Smith 2013), "Westport Marina serves as homeport for approximately 285 annual boaters, two-thirds of which are the commercial fleet, including several tribal commercial fishing vessels. During the fishing seasons, transient commercial fishing boats arrive from California, Oregon, Alaska, other Washington ports and Canada, with a modest-sized charter fishing fleet still operating out of the marina."

The Port estimates that there are approximately 1,000 employees in Westport during the peak season (Figure 41).

[8] Estimated based on 2,000 hours per year.

[9] Includes companies based in Grays Harbor that may use home offices outside of the area.

[10] A majority of the log exports through the Port originate in Grays Harbor County (Washington State Department of Natural Resources 2010).

Figure 41. Port of Grays Westport Employment Estimate (July 2012)
Source: Port of Grays Harbor 2012.

In addition to permanent moorage tenants, Westport Marina is also used by transient boats. In 2012, there were approximately 2,300 boat days of use by recreational boats and more than 6,000 boat days of use by visiting commercial boats (Port of Grays Harbor 2012).

The following firms are engaged in fisheries and fish processing in Grays Harbor.

- Ocean Gold seafood processing has 280 to 500 seasonal employees in Westport (Greater Grays Harbor 2013).
- Washington Crab Producers has 120 employees in Westport (Greater Grays Harbor 2013).
- Ocean Protein LLC has 35 employees in Hoquiam (Dun & Bradstreet 2013).
- Westport Seafood Inc has 30 employees in Westport (Dun & Bradstreet 2013).
- Quinault Pride Seafoods has 25 employees in Taholah (Dun & Bradstreet 2013).
- Brady's Oysters Inc. has 15 employees in Aberdeen (Dun & Bradstreet 2013).
- Coast Seafoods Company has 10 employees in Aberdeen (Dun & Bradstreet 2013).

3.12.3.3 Ship/Boat Building and Repair

The following firms are engaged in boat/ship building and repair in Grays Harbor.

- Westport Shipyard has 400 employees (Greater Grays Harbor 2013).

- Moe Howard Enterprises Inc. (formerly called the Little Hoquiam Shipyard) has 29 employees in Hoquiam (Dun & Bradstreet 2013).

3.12.3.4 Other

In addition to the above sectors, other businesses are engaged in water-related activities, including the following.

- Kiewit Construction has 370 employees (Greater Grays Harbor 2013) engaged in construction of bridge pontoons for the State Route 520 bridge project. The pontoons are manufactured in a graving dock located in Aberdeen and then floated out for delivery by tugboat to the bridge. This project is scheduled to continue through the end of 2014. After 2014, the site could continue to be used for other construction projects.

3.13 Environmental Justice Communities

This section describes minority and low-income communities in the study area, composed of the cities of Aberdeen, Hoquiam, and Cosmopolis which are closest to the navigation channel and dredged material placement sites. This section also describes related regulations as they pertain to the potential for a disproportionately high and adverse human health impacts of the proposed action on these communities relative to other communities.

3.13.1 Regulatory Setting

3.13.1.1 Executive Order 12898

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, directs federal agencies to:

> Promote nondiscrimination in Federal programs substantially affecting human health and the environment, and provide minority and low-income communities access to public information on, and an opportunity for public participation in, matters relating to human health or the environment.

Executive Order 12898 also directs agencies to identify and consider "disproportionately high and adverse" human health or environmental effects of their actions on minority and low-income communities, and provide opportunities for community input in the NEPA process, including input on potential effects. Low-income status is defined based on the Department of Health and Human Services poverty guidelines. For 2011, this was $22,250 for a family of four.

3.13.1.2 Environmental Justice Guidance under the National Environmental Policy Act

After the issuance of Executive Order 12898, CEQ prepared a guidance document entitled *Environmental Justice Guidance under the National Environmental Policy Act* to assist federal agencies in meeting their environmental justice commitments under NEPA (Council on Environmental Quality 1997). This guidance provides the following definitions of the terms "minority" and "low-income community" in the context of environmental justice analysis. Minority individuals are members of the following population groups: American Indian or Alaska Native, Asian or Pacific Islander, African-American, and Hispanic. A low-income community is one found to

be below the poverty thresholds from the U.S. Census Bureau. CEQ has oversight for the federal government's compliance with Executive Order 12898 and NEPA process, with the EPA serving as the lead agency responsible for implementation of the executive order.

3.13.1.3 Title VI of the Civil Rights Act

Title VI of the Civil Rights Act of 1964, and related statutes, requires federally assisted programs not to discriminate on the basis of race, color, national origin, age, sex, or disability[11].

3.13.2 Environmental Setting

The federal navigation channel is located in open water in Grays Harbor County, Washington. Cities located near the inner harbor reaches include Aberdeen, Hoquiam, and Cosmopolis. Westport is located near the outer harbor reaches and the open-water placement sites, with the Half Moon Bay beneficial use placement site located just offshore of Westport. Demographic information for these nearby communities, as well as for Grays Harbor County, was used to determine the existence of potential environmental justice communities.

According to the 2010 census (U.S. Census Bureau 2010a), Grays Harbor County has a population of 76,797. The county is predominantly white (representing 88.3% of the population). In comparison, the populations of surrounding towns (Westport, Cosmopolis, Hoquiam, and Aberdeen) range from a high of 16,986 in Aberdeen to 1,649 in Cosmopolis (Table 3.13-1). As with the state and county demographics, these communities are predominantly white, with over 80% of residents identifying with that ethnicity. The largest number of residents identifying themselves as American Indian/Alaska Native or Hispanic or Latino reside in Hoquiam and Aberdeen.

The structure of age groups across the surrounding towns is similar to those of the county and state (Table 3.13-2). Westport, a community with a large tourist and retirement component, has the highest percentage of persons 64 years and older (21.3%), while Aberdeen has the lowest (13%). Hoquiam has the highest percentage of people under the age of 25, while Westport has the lowest at 26%.

[11] Religion is a protected category under the Fair Housing Act of 1968.

Table 3.13-1. Race/Ethnicity in the Study Area Compared to Grays Harbor County and Washington State

Population Group	Westport[a]	Cosmopolis[b]	Hoquiam[c]	Aberdeen[d]	Grays Harbor County[e]	Washington State[e]
Total Population	2,099[h]	1,649[h]	9,188[g]	16,896[f]	76,797[e]	6,724,540[e]
Percentage of total population						
White	87%	88.5%	85.5%	80.4%	88.3%	82%
Black	0.9%	0.1%	0.8%	0.8%	1.3%	3.8%
American Indian/ Alaska Native	2.9%	1.6%	3.9%	3.7%	5.1%	1.8%
Asian	1.1%	3.0%	1.1%	1.9%	1.5%	7.5%
Native Hawaiian/ Pacific Islander	NA	0.3%	0.2%	0.3%	0.3%	0.7%
Two or More Races	3.6%	2.9%	4.2%	4.9%	3.5%	4.3%
Hispanic or Latino	7.3%	6.1%	9.5%	15.8%	8.9%	11.6%

[a] UsaCityFacts.com 2012a
[b] UsaCityFacts.com 2012b
[c] UsaCityFacts.com 2012c
[d] UsaCityFacts.com 2012d
[e] U.S. Census Bureau 2010a
[f] U.S. Census Bureau 2010b
[g] U.S. Census Bureau 2010c
[h] U.S. Census Bureau 2010d
NA= Designated as not applicable in original data source.

Table 3.13-2. Age Structure in the Study Area

Age Range	Westport[a]	Cosmopolis[b]	Hoquiam[c]	Aberdeen[d]	Grays Harbor County[e]	Washington State[a]
Less than 25	26%	30.1%	34.3%	35.3%	30.2%	33.2%
25–44	23.1%	28.7%	28.1%	29%	27%	31.1%
45–64	32.9%	28.9%	26.1%	26%	30%	27.1%
64 and over	21.3%	16.3%	15%	13%	16.3%	12.3%

[a] UsaCityFacts.com 2012a
[b] UsaCityFacts.com 2012b
[c] UsaCityFacts.com 2012c
[d] UsaCityFacts.com 2012d
[e] U.S. Census Bureau 2010a

Table 3.13-3 provides unemployment percentages and median incomes by ethnicity for each town, the county, and the state. Median annual income ranges from $0 to $55,500, with most ethnicities in most communities reporting below the state average.

Table 3.13-3. Unemployment and Median Annual Income by Population Group in the Study Area

	Westport[a]	Cosmopolis[b]	Hoquiam[c]	Aberdeen[d]	Grays Harbor County[e]	Washington State[a]
Total Population	2,0998	1,6498	9,1887	16,8966	76,7975	6,724,5405
Total	14.8% –	4.1% –	12.3% –	10.1% –	11.6% –	7.6% –
White	16.8% $17,891	3.9% $30,691	11.8% $23,436	9.8% $25,720	11.5% $26,003	7.0% $33,399
Black	NA NA	NA NA	0% $50,759	30% $51,346	7.4% $22,024	13% $26,886
American Indian/ Alaska Native	0% $2,499	0% $0	0% $8,750	10.9% $18,867	16.3% $17,970	16.4% $24,196
Asian	0% $0	20% $55,500	0% $45,313	20% $35,539	13.2% $33,250	5.7% $33,223
Native Hawaiian/ Pacific Islander	NA NA	NA NA	100% $0	0% NA	52.3% $4,891	14.2% $25,695
Two or More Races	0% $2,499	0% $3,553	8.1% $28,616	11.8% $24,063	8.9% $23,074	12.5%
Hispanic or Latino	0% $6,486	0% $21,250	27.6% $16,250	12.9% $15,128	13.6% $15,876	9.9% $20,741

[a] UsaCityFacts.com 2012a
[b] UsaCityFacts.com 2012b
[c] UsaCityFacts.com 2012c
[d] UsaCityFacts.com 2012d
[e] U.S. Census Bureau 2013a
NA= Designated as not available in original data source.

Unemployment is considered high in Grays Harbor County, as well as in the surrounding towns of Westport, Hoquiam, and Aberdeen. Of these cities, Cosmopolis has the lowest unemployment rate at 4.1%, and is considered to have a low unemployment rate relative to the state. Unemployment rates also vary between ethnicities in each town.

The Port runs four marine terminals directly served by the navigation channel and associated rail lines. Principal employers in these communities include a number of manufacturing businesses such as those listed below.

- The Westport Shipyard has 400 employees, and Ocean Gold seafood processing has 280 to 500 seasonal employees. Both are businesses are located in Westport (Greater Grays Harbor 2013).
- Cosmo Specialty Fibers, which operates the former Weyerhaeuser Specialty Cellulose Mill in Cosmopolis, has approximately 150 employees.
- Ocean Spray Cranberries in Aberdeen employs approximately 125 people.
- Harbor Paper and Hoquiam Plywood, both located in Hoquiam, together employ 163 people.

The activities associated with the proposed action—dredging and placement of dredged material—do not occur disproportionally in or near one type of community. Communities and businesses around the shoreline or perimeter of Grays Harbor are equally associated with the proposed action, and would stand to equally benefit.

3.14 Indian Treaty Rights

Federally recognized American tribes that may have interest in the proposed action relative to existing fish and hunting or traditional use treaty rights are presented in this section. This section also describes the agreements related to Indian treaty rights that are relevant to the proposed action.

3.14.1 Regulatory Setting

Native American tribes and the federal government have entered into contractual agreements concerning tribal hunting and fishing rights. In 1856, the Qui-nai-elt (Quinault) tribe entered into the Treaty of Olympia, which secured rights to its “usual and accustomed” fishing and hunting areas. Hunting and fishing within Quinault usual and accustomed hunting and fishing areas are co-managed by the tribe and the Washington Department of Fish and Wildlife (WDFW).

By signing the treaty the tribes retain the “right” to fish and the “privilege” to hunt within the boundaries of their usual and accustomed hunting and fishing areas. Treaty rights also include access to plant materials used in the making of traditional crafts, preservation of sacred sites important in the practice of traditional Indian religion, and the preservation of fish habitat.

Treaty rights may be exercised by tribal members only and must be exercised in accordance with tribal regulations.

Negotiations between WDFW and the Northwest Indian Fisheries Commission result in the agreed upon fishing arrangements for treaty and non-treaty fisheries within Grays Harbor.

3.14.2 Environmental Setting

Native American tribes that may be affected by the proposed action include the Quinault Indian Nation, based in Taholah, Washington, the Chehalis Indian Tribe, located in Oakville, Washington, and the Shoalwater Bay Indians, in Tokeland, Washington.

Of these three tribes, only the Quinault Indian Nation has a reservation and federally adjudicated off-reservation hunting and gathering rights to locations within Grays Harbor. The other groups have reservations established by executive order, but they do not have the same off-reservation treaty rights to take fish at usual and accustomed locations within Grays Harbor. Grays Harbor is thus within the federally adjudicated usual and accustomed fishing area of the Quinault Indian Nation. Fisheries biologists employed by the Quinault Indian Nation actively work with WDFW to responsibly manage salmon and shellfish within their usual and accustomed fishing and hunting areas. The success of the fishery stocks, upon which the Quinault Indian Nation relies, depends on both fishery stock management and habitat protection and restoration.

Currently, the Quinault Indian Nation fishes for coho, chum, and Chinook salmon, steelhead, and sturgeon. They also harvest Dungeness crab in a pot fishery and are allotted a 50% fair share of the harvestable fish and crab in common with the other citizens within their usual and accustomed fishing areas under treaty agreement. The Dungeness crab fishery is one of the economic pillars for coastal tribal fishermen as well as one of the most dangerous. Most of the catch is made in November and December when weather conditions can be at their worst. Two major fishing areas for the Quinault are the Humptulips and Chehalis Rivers. The main fishing methods employed by the Quinault are drift-net fishing near the mouth of the Chehalis River and the harvest of Dungeness crab using crab pots throughout Grays Harbor. Tribal fishers are active much of the year, because the harvest seasons of the different fishery resources are spread throughout the year.

In 1986, when the Grays Harbor Navigation Improvement Project was initially approved, consultation with the Quinault and Chehalis tribes was initiated through written notification. The Corps met with tribal leaders to describe the project and its potential impacts. The main concern expressed by the tribes was the potential for negative impacts on their fisheries and disruption of fishing activities due to increased deep-draft vessel traffic. The Corps determined in 1986 that there would be no impact on Quinault tribal fisheries, because at that time the project was not expected to increase vessel traffic. The tribes also expressed concern that tie-off points for shore-stationed gill nets would be lost due to channel dredging that resulted in widening of the channel. The Corps subsequently altered project plans for the channel widening to prevent losses at individual fishing grounds.

3.15 Placement Site Environment

This section describes the regulatory context and current condition of the placement sites where material dredged as part of the proposed action would be placed.

3.15.1 Regulatory Context

Placement of dredged materials is managed and evaluated by the multiagency Dredged Material Management Program (DMMP). The Corps, EPA, DNR, and Ecology work collaboratively to manage material dredged to maintain navigational waterways and berth depths. The DMMP agencies evaluate

the suitability of what material can be placed and where. The DMMP does not manage contaminated sediment cleanups. The upland disposal site for unsuitable material is slated to be the former Hoquiam waste water treatment lagoon.

3.15.2 Environmental Setting

Dredged material placement would occur at the placement sites described below. All of these placement sites have been regularly used for material placement during the annual maintenance dredging (U.S. Army Corps of Engineers 2011), except for the shifted Point Chehalis site. The South Jetty and Point Chehalis placement sites, located directly adjacent to the navigation channel on state-owned aquatic lands managed by DNR, are public, multi-user, unconfined, open-water dredged material placement sites; use of the shifted portion of the Point Chehalis site would be a single-user, one-time placement episode. In addition, material dredged from the sandy outer harbor reaches of the navigation channel would be periodically used for both direct upland beach and nearshore nourishment at Half Moon Bay and nearshore nourishment at South Beach, when those areas require material placement to offset erosion. See Figure 7 for the location of in water placement sites. Material determined unsuitable for open water placement would be placed upland at the former Hoquiam waste water treatment lagoon as discussed in Section 2.3.

The volumes of dredged material placed at each site since the year 2000 are summarized in Table 2-2.

3.15.2.1 Point Chehalis Open-Water Placement Site

The depth of this site varies between –40 to –80 feet MLLW. It is a dispersive site subject to high wave energy and strong, predominantly westward currents. The irregular bottom consists of fine to medium-sized sand grains of marine origin. Historically, this site has been extremely deep. Charts that predate jetty construction show depths of –100 feet MLLW in this area. Over 40 million cubic yards of dredged material have been placed in this area since 1977, at an average rate of about 960,000 cubic yards per year since 2000. Annual surveys and sediment transport modeling indicate that up to 75% of material placed at this site is transported out of the site in suspension during placement, and 6 to 53% percent of the material reaching the seabed erodes during the following winter (Demirbilek et al. 2010; Hayter et al. 2012). Bathymetric surveys indicate that most of this eroded material moves seaward. Placement of material at this location reduces erosion near the Point Chehalis revetment and groins and delivers sediment to the harbor mouth. The Point Chehalis site is the most heavily used dredged material placement site in Grays Harbor.

As described in Chapter 2, *Alternatives*, the Corps recently completed a dredged material placement site capacity analysis as part of the proposed action to estimate short-term and long-term fate of channel-deepening sediments and subsequent annual maintenance sediments that could be deposited at this placement site (Hayter et al. 2012). The analysis recommended a 1,000-foot north-northwestern shift in the placement site and allowing placement of dredged materials over the entire placement site (Figure 7). Presently O&M dredged material is placed only in the northern half of the Point Chehalis Site to minimize sediments from re-entering the navigation channel. However with the increase in volume associated with the construction of the channel improvement project, the existing capacity is not sufficient in the northern half of the site. The 1,000-foot shift allows placement over a larger area which results in less mounding within the open water placement site and sediment transport pathways oriented away from the navigation channel, thereby best minimizing impacts to the navigation channel (Hayter et al. 2012).

3.15.2.2 South Jetty Open-Water Placement Site

The depth of this site varies between –40 to –50 feet MLLW. This area is subject to fast tidal currents, predominantly westward, that sweep along the jetty toe. Historically, placement of dredged material at this site was necessary to prevent scour and undermining of the South Jetty's foundation. The site is considered dispersive, with seaward transport of placed material generally occurring rapidly; however, in the last decade material within the eastern portion of the site has accumulated faster than it has been dispersed. Site capacity is closely monitored and strict placement restrictions have been implemented to ensure that placement activities do not have adverse impacts on navigation. The irregular bottom consists of fine to medium-sized sand grains of marine origin. This site is the preferred placement area for inner harbor materials, because these materials are dispersed more effectively than coarser grained materials; however, when the South Jetty site is full or weather/wave conditions are hazardous, inner harbor materials are placed at the Point Chehalis site. Dredged materials have been placed at this site at an average of 576,000 cubic yards per year since 2000.

3.15.2.3 Half Moon Bay Nearshore Nourishment and Point Chehalis Revetment Extension Mitigation Sites

The purpose of these two placement sites is to maintain a sustainable beach profile of a slope of 1V:60H west of the Point Chehalis revetment extension constructed in 1998–1999, and to ensure that the armor stone toe of the revetment extension is not exposed. Sandy material from the outer harbor is placed on the Point Chehalis revetment extension (direct upland nourishment) and in the bay as close to shore as possible (nearshore nourishment), in accordance with the October 1998 *Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement* (U.S. Army Corps of Engineers 1998) (see Chapter 5, *Mitigation,* for additional explanation). Obtaining suitable sand through the annual maintenance dredging process and placing this material through the direct beach and nearshore placement processes are essential to compliance with the stable beach slope and revetment toe burial requirements of the mitigation agreement.

The direct upland beach nourishment site is used to help ensure compliance with the beach profile and revetment toe burial obligations of the revetment extension. Material placed in the Point Chehalis Revetment Extension mitigation site serves as a sand cover to ensure the continued burial of the revetment toe required under the mitigation agreement associated with the Point Chehalis revetment extension project. The Point Chehalis Revetment Extension Mitigation site is located above the mean higher high water (MHHW) elevation (+9 feet at this location), but sand from the site erodes into Half Moon Bay during storm events. Approximately 135,000 cubic yards of material were placed at this site in 2000; excavations from the site have been performed to renourish the dune on the western Half Moon Bay and South Beach shorelines to minimize the risk of a breach at the South Jetty. A hydraulic pipeline has typically been used when placing outer harbor materials at the upland Point Chehalis Revetment Extension mitigation site. A hopper dredge full of a sand and water slurry docked at the existing rock dock at Firecracker Point and pumped the slurry through a pipeline to the mitigation site. Firecracker Point is a jetty extension located on the southeastern side of the southeastern entrance to the Westport Marina. Booster pumps are required to pump the slurry 1.7 miles across-town. The temporary pipeline was installed in 1994, and is buried along the road that generally crosses the Westport peninsula from Firecracker Point to Half Moon Bay. The slurry of sand and water was discharged to the area in front of the buried revetment. A sand berm/perimeter dike separates the discharge area from Half Moon Bay.

Half Moon Bay is a high-energy environment subject to erosion. The nearshore nourishment site is used for placement for dredged material that will be transported to the nearshore and intertidal areas off Half

Moon Bay to assist in maintaining the existing beach profile waterward of the Point Chehalis revetment extension. The nearshore nourishment site is used for placement as bathymetric conditions permit (i.e., when the bay is deep enough for the bottom dump barge to navigate). Since spring 2002, Half Moon Bay has been deep enough to allow dredge access for placement. Approximately 2 million cubic yards of material has been placed in this site since spring 2002. An average of 158,700 cubic yards of material have been placed at the Half Moon Bay nearshore nourishment site annually since 2000.

3.15.2.4 South Beach Nourishment Site

The purpose of placement at this site is to slow erosion in the nearshore region on the south side of the South Jetty. Sandy material from the Bar Channel is placed as close to shore as possible, generally between –35 to –45 feet MLLW. This location extends the residence time of dredged material in the littoral system while avoiding productive crabbing areas. Over 1.5 million cubic yards of material have been placed in this site since 2000, with an annual placement rate of 116,100 cubic yards per year since 2000.

3.15.2.5 Former Hoquiam Waste Water Treatment Pond Upland Site

The site is slated to be the wastewater treatment ponds located near Port Terminal 3 that were previously utilized by the city of Hoquiam for treatment of municipal sewage. The lagoon provided off-line storage during times of high influent wastewater flows. The wastewater treatment plant is being upgraded and the lagoon site has been partitioned and partially decommissioned. The site is approximately 18 acres and was identified by the Port of Grays Harbor as a location with sufficient capacity to accept the material determined unsuitable for open water disposal.

Environmental Consequences

4.0 Introduction

This chapter assesses the environmental consequences of implementing the proposed action for each resource area evaluated in this SEIS. The resources that could be affected by implementation of any of the action alternatives are listed in the introduction to Chapter 3, *Affected Environment*, and at the end of this introduction. The environmental consequences associated with each resource area are discussed in the sections that follow this introduction to Chapter 4, and describe the effects of each alternative considered in this SEIS, including the No Action Alternative (i.e., Alternative 1).

The following sections describe the environmental baseline that was considered when developing the environmental consequences discussions, as well as the impact terminology, assessment areas, and general impact assumptions and mechanisms that were taken into consideration when analyzing the effects of the proposed action on each resource area.

4.0.1 Environmental Baseline

The effects of the current practice of maintenance dredging of the navigation channel to −36 feet MLLW and associated placement of dredged materials form the baseline for determining the environmental impacts of the proposed action. In this SEIS, the current environmental setting reflects the effects caused by implementation of Alternative 1, the No Action Alternative (Chapter 2, *Alternatives*). This suite of effects has been the subject of NEPA evaluation, in the multi-year assessment promulgated in the FY 2012-18 EA, as supplemented in November 2013, which concluded with a Finding of No Significant Impact; this conclusion of non-significance is not disturbed by the analysis of the proposed action in this SEIS. According to the CEQ memorandum, *Forty Most Asked Questions Concerning CEQ's NEPA Regulations* (46 FR 18026 (March 23, 1981), as amended, Question #3), the analysis of the No Action Alternative "provides a benchmark, enabling decision makers to compare the magnitude of environmental effects of the action alternatives." Therefore, the impacts of each action alternative are determined by comparing conditions under the alternative with baseline conditions (i.e., conditions under Alternative 1, the No Action Alternative). The environmental impacts assessment of this SEIS evaluates exclusively the incremental impacts of implementing and thereafter maintaining the proposed action, over and above the NEPA environmental baseline.

Under baseline conditions (the No Action Alternative), the Corps would continue the current practice of maintenance dredging of the navigation channel to a depth of −36 feet MLLW and placement of the dredged materials at a variety of open water dispersive sites, beach nourishment sites, and upland beneficial use sites (when feasible); deepening of the navigation channel would not occur.

Increases to maintenance dredging attributable solely to the deepening (either to -37 feet MLLW or -38 feet MLLW) although relatively small are not part of the baseline. Estimated increases in annual maintenance dredging attributable to deepening the channel in the affected reaches (Cow Point to South Reach) to -37 feet MLLW are approximately 50,000 cubic yards, and 107,000 cubic yards for deepening to -38 feet MLLW. The placement sites also represent a small change from the baseline

condition. The upland disposal of material from DMMU sub-unit 32a that was determined unsuitable for open water placement (13,500 cubic yards for deepening to -37 feet MLLW; 22,400 cubic yards for deepening to -38 feet MLLW) and the temporary one-time Point Chehalis placement site shift (1,000 feet to the north, northwest) are not part of the baseline condition and are included in the analysis. The primary difference between the action alternatives and baseline conditions (Alternative 1) is the increased volume of material associated with the initial deepening of the channel, which will be dredged contemporaneously with an annual episode of maintenance dredging. Other differences between baseline and action alternatives are duration of dredging operations in the deepening year, possible use of a long-reach excavator in the Cow Point Reach, possible use of a hopper dredge with pump ashore capability to transport dredged material upland from Half Moon Bay, the planned shift of the Point Chehalis aquatic placement site, upland disposal of unsuitable material, and the use of an additional dredge for Alternative 3.

The analyses in this document focus on the effects associated with the initial deepening of the navigation channel under Alternative 2 and Alternative 3 and the placement of material generated by that deepening, to include future maintenance dredging attributable exclusively to subsequent annual dredging at a depth greater than -36 feet MLLW for the 50 year project horizon. DMMU sub-unit 32a will be physically surveyed after construction, and a determination will be made at that time based on the post-construction bathymetry whether an additional round of testing is required of that sub-unit prior to any subsequent maintenance dredging episode in that sub-unit's footprint. Depending on the results of any sampling and analysis conducted, this SEIS may be supplemented at that time.

4.0.2 Environmental Consequences

NEPA requires federal agencies to prepare an EIS for major federal actions that significantly affect the quality of the human environment. *Significantly* as used in NEPA, requires the federal agency to consider both the context and intensity of the action and its effects. Although CEQ's NEPA regulations (40 CFR 1508.27) direct lead Federal agencies to consider certain factors when determining context and intensity, there are no specific significance criteria provided under NEPA. Determination of significance is left to the discretion of the lead Federal agency.

Impacts associated with each action alternative are related to the incremental effect of the initial dredging of the navigation channel to a greater depth than it is currently dredged under baseline conditions, plus the effects of maintenance attributable to the deepening: Alternative 2 would dredge the navigation channel to a depth of −37 feet MLLW, and Alternative 3 would dredge the navigation channel to a depth of −38 feet MLLW. Deepening of the navigation channel under either action alternative would be of a similar scope and nature (similar methods, equipment, and geographic extent) as used for annual maintenance dredging under baseline conditions with the exceptions noted above in Section 4.0.1. In order to deepen the channel beyond -36 feet MLLW annual maintenance dredging would need to be accomplished first. This would mean that annual maintenance dredging to -36 feet MLLW would be necessary in the same dredging year as the construction (deepening) dredging. Therefore total volumes removed from the channel would be equal to the annual maintenance dredging plus the deepening quantities (Table 2-6) in the construction year. The volumes estimated to get to -36 feet MLLW prior to any deepening (Table 2-1) are from the 2011 EA (Corps 2011) and are based on the average amount dredged from 2000 to 2010 plus one standard deviation. Actual volumes in the deepening construction year would be determined based on bathymetric surveys of the channel just prior to deepening. Impacts are addressed in terms of total volumes dredged (Alternative 1 plus either Alternative 2 or 3) and each

deepening scenario (Alternative 2 or 3) separately. Impacts due to maintenance dredging to -36 feet MLLW were evaluated previously (Corps 2011) and impacts attributable to deepening the channel (Alternatives 2 and 3) and subsequent maintenance attributable to maintaining at depths below -36 feet MLLW are analyzed in this document.

For either action alternative, resources could be directly and indirectly affected during construction and future operation and maintenance activities. Construction- and operation-related impacts could result in temporary, short-term, or long-term negative and/or beneficial outcome for the resources. These impacts are discussed in detail in the sections that follow this introduction.

4.0.3 Indirect Effects

Under 40 CFR 1502.16(b) and 1508.8(b), indirect environmental effects include those impacts caused by an action and which are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects include the effects of any economic growth induced by the project.

4.0.3.1 Induced economic growth

As reflected in section 3.12, it is anticipated that the Port will experience future economic growth in the absence of implementation of the proposed action. In light of the absence of tailored data applicable to the unique circumstances of the POGH, it is not certain that the project itself would proximately cause any growth, over and above that manifested under the without-project conditions of Alternative 1. It is reasonably foreseeable that the deepening of the navigation channel to -38 feet MLLW and subsequent maintenance at that depth may possibly induce economic expansion at the Port of Grays Harbor and in the region, generally. It is foreseeable that the improved channel dimensions may generate an incremental increase in terms of cargo moved through the Port, independent of growth that would be anticipated under Alternative 1; a similar growth, also independent of Alternative 1 growth conditions, is a reasonably foreseeable possibility in the number of deep-draft vessel calls. However, the extent of any such proximately caused economic growth is uncertain.

Generating economic growth is not a purpose of the project; the purpose is to increase the cost-efficiency and reliability of navigation for the present deep draft vessel traffic, as well as the vessels that are projected to utilize the Port under Alternative 1. The project is therefore being proposed to fulfill a presently existing need for more efficient transit of cargo-carrying vessels, by alleviating the problem of tidal delays and light-loading caused by insufficient channel depths. The purpose of the project is not to satisfy a future expected need, nor to generate any such incremental future need. The computation of expected project benefits in the accompanying Limited Reevaluation Report does not rely on any projection of project-induced growth in order to economically justify project approval.

It is a reasonably foreseeable possibility that the enhanced channel dimensions may proximately induce shippers to increase the cargo throughput of the Port, over and above the levels of economic expansion anticipated under Alternative 1.

No numerical model or other source of projection exists, that could effectively distinguish between the without-project and the with-project future condition and reveal the increment of economic growth proximately caused by implementation of the proposed action, taking into consideration the unique economic factors affecting the Port of Grays Harbor and the surrounding region. The Corps has used the WSDOT Marine Cargo Forecast (BST Associates; IHS Global Insight; Mainline

Management Inc., 2011) as a source of projections of cargo movements broken down by commodity for the State and for the Puget Sound region, which is the most closely applicable geographic area addressed by the forecast. The Corps has projected, based on the rationale explained in more detail in the LRR and its Economic Appendix, that the volume of cargo throughput would remain essentially equal in each year of the 50-year period of analysis, between the future without-project condition and the future with-project condition.[12] Use in this SEIS of a more optimistic economic projection for the preferred alternative results in a larger differential of economic growth when comparing Alternative 3 to Alternative 1, and thus a larger increment of anticipated environmental effects of implementing Alternative 3; these effects are evaluated in this chapter. [13] For purposes of assessing future conditions under Alternative 1, the Corps has applied the "moderate" growth projection from that forecast report. As a surrogate indicator of cargo movement projections for the Puget Sound region under with-project conditions for Alternative 3, in the absence of more closely tailored and specifically pertinent projection data, the Corps has adopted the WSDOT Marine Cargo Forecast's "high" estimate of future cargo movement. As a surrogate indicator of cargo movement projections for the Grays Harbor region under with-project conditions for Alternative 2, again in the absence of more specific projection data, the Corps has applied a median estimate between the WSDOT forecast's "moderate" and "high" growth projections. Applying the "high" growth and median high/moderate growth projections, the change in cargo tonnage moved through the Port over time is depicted in the following table 4-1[14].

[12] Growth in cargo tonnage at the Port, for purposes of this 50-year analysis, is expected to be similar between the future with-project and future without-project conditions. This projected parity in cargo growth curves is primarily due to the extrinsic limitations on Port of Grays Harbor capacity that restrict the opportunity for cargo throughput. Given the existing facilities at the Port, predicted future growth under a future with- or without-project scenario will reach maximum capacity at an estimated 469 vessel calls/year based on a calculation of an average vessel moving a set average tonnage. Vessel calls and, therefore, cargo capacity are limited by a number of terminal capacity factors including berthing space (number of berths at the Port), berthing depth (-42' MLLW), terminal space for cargo storage and re-handling, and intermodal capacity for delivery by rail of cargo for export, and are further limited by channel width under current channel maintenance conditions limiting concurrent two-way transit in the inner harbor.

[13] The most likely growth rate from the aforementioned report were used to develop the economic modeling (Economic Appendix) so as to be conservative in the commodity forecast for the Port of Grays Harbor. This is why the reader will note a difference in the number of vessels expected to traverse the channel in the Economic Appendix versus the SEIS. Optimistic growth rates, although highly unlikely, in commodities from said report were applied to the environmental and socioeconomic impacts associated with this analysis so as to be conservative with respect to the environmental impacts.

[14] In an attempt to put a conservative growth estimate (with respect to the environment) on the effect of deepening the Port of Grays Harbor, and what is considered a highly optimistic growth rate from an economic standpoint, two growth percentages were used to put together an approximate tonnage and vessel call list.

Tonnage Without Project Conditions, With Project Conditions -38ft (High), and With Project Conditions -37ft (Median)			
	W/Out Project Condition	With Project -37 MLLW (Median Growth)	With Project -38 MLLW (Optimistic Growth)
2017	10504	10578	10654
2027	11024	11303	11609
2037	11715	12315	13046
2047	11715	12315	13046
2057	11715	12315	13046
2067	11715	12315	13046

It is not reasonably foreseeable that the mix of commodities in which the Port of Grays Harbor has found a specialty niche would change as a result of deepening the Federal navigation channel by two feet to -38 feet MLLW. A substantial change to the mix of commodities already present at the Port would require a modification or improvement to existing infrastructure which is currently not planned or budgeted for by the Port. Likewise, a two foot deepening of the navigational channel from -36' to -38' MLLW is not anticipated to allow for larger bulk or tanker vessel classes to call at the Port as doing so would reintroduce the inefficiencies (light loading and tide riding) that the deepening is intended to alleviate.[15]

Therefore, the most reasonably foreseeable consequence of any increase in cargo volumes handled through the Port, attributable exclusively to the deepening of the channel, would be an increase in deep-draft vessel calls. Implementation of the channel deepening project would generate transportation efficiencies, so there is not a direct correlation between an increase in cargo throughput tonnage and number of vessel calls. The Corps applied the Bulk Loader Tool[16] in order to calculate the number of annual vessel calls that would be required in order to accommodate the projected cargo volumes over time, broken down by commodity categories, for each of the three alternatives. Applying the "high" growth and median high/moderate growth cargo movement projections, the change in terms of deep draft vessel calls at the Port over time is depicted in the following table. [17]

[15] Currently, a mix of break bulk, dry bulk, roll-on/roll-off (Ro-Ro), barge, and tanker vessels call at the Port, the largest of which are Panamax vessels (50,001 – 80,000 dwt), which have a maximum length overall of 965 ft , 106 ft beam, and 39.5 ft draft in order to fit through the Panama Canal. Although Panamax vessels currently call at the Port, they cannot fully load and/or must wait for high tides to transit due to insufficient channel depth. Deepening the navigational channel from -36' to -38' MLLW will allow for more efficient operation of Panamax vessels. However, because the industry does not operate a discrete size category of vessels within the band between a 36-foot draft and a 39.5-foot draft, deepening is not anticipated to allow for larger bulk or tanker vessel classes to call at the Port as doing so would reintroduce the inefficiencies (light loading and tide riding) that the deepening is intended to alleviate. Ro-Ro vessels, with a draft of no more than 32 feet, are not generally depth limited at the Port, dependent on underkeel clearance requirements. Larger bulk classes such as Capesize (typically 175,000 dwt, but up to 400,000 dwt), with a draft of 60 feet and deeper, or larger tankers, such as Aframax (80,000 – 119,000 dwt), with a typical 60-foot draft, would not be expected to call at the Port at a -38-foot MLLW depth. Larger containerized vessels, such as Post-Panamax vessels, requiring 45 feet of depth, are not expected to call at the Port due to lack of container terminals, cranes, and other specialized facilities necessary to accommodate said cargo.

16 The Bulk Loader Tool is an integrated module within HarborSym designed to generate synthetic vessel call lists based upon user provided calling statistics. These statistics include information on tonnage, commodity type, and vessel characteristics.

[17] From the perspective of evaluation of potentially adverse effects, utilizing an optimistic economic growth projection in light of uncertainties reflects a conservative approach to NEPA evaluation. The accompanying Limited Reevaluation Report, on the other hand, has adopted a different approach that also reflects a conservative approach, albeit from a water resources project planning perspective: the LRR has refrained from incorporating the same optimistic projections of with-project economic growth in its calculation of benefits expected to be derived from project implementation to reduce the likelihood of overstating the benefits of implementation of Alternative 3.

Estimated Vessel Calls Induced Growth Scenario (Entire Forecasted Commodity Tonnage)					
Alternative 1		Alternative 2		Alternative 3	
2017 Without Project		2017 With Project -37MLLW (High/Moderate Growth)		2017 With Project -38MLLW (High Growth)	
VesselClass	Calls	VesselClass	Calls	VesselClass	Calls
ATB 30k	122	ATB 30k	122	ATB 30k	122
Bulker 30k	4	Bulker 30k	4	Bulker 30k	4
Bulker 40k	5	Bulker 40k	6	Bulker 40k	6
Bulker 50k	15	Bulker 50k	15	Bulker 50k	12
Bulker 60k	22	Bulker 60k	22	Bulker 60k	22
Bulker 80k	3	Bulker 80k	3	Bulker 80k	3
Ro-Ro 10k	22	Ro-Ro 10k	23	Ro-Ro 10k	24
Ro-Ro 20k	8	Ro-Ro 20k	8	Ro-Ro 20k	8
Tanker-Medium	130	Tanker-Medium	126	Tanker-Medium	123
Tanker-Small	7	Tanker-Small	8	Tanker-Small	9
Total	**338**		**337**		**333**
2027 Without Project		2027 With Project- 37MLLW (High/Moderate Growth)		2027 With Project -38MLLW (High Growth)	
VesselClass	Calls	VesselClass	Calls	VesselClass	Calls
ATB 30k	134	ATB 30k	134	ATB 30k	134
Bulker 30k	6	Bulker 30k	6	Bulker 30k	6
Bulker 40k	7	Bulker 40k	7	Bulker 40k	7
Bulker 50k	9	Bulker 50k	13	Bulker 50k	7
Bulker 60k	25	Bulker 60k	25	Bulker 60k	25
Bulker 80k	5	Bulker 80k	5	Bulker 80k	5
Ro-Ro 10k	19	Ro-Ro 10k	24	Ro-Ro 10k	24
Ro-Ro 20k	17	Ro-Ro 20k	17	Ro-Ro 20k	17
Tanker-Medium	132	Tanker-Medium	128	Tanker-Medium	126
Tanker-Small	13	Tanker-Small	16	Tanker-Small	16
Total	**367**		**375**		**367**
2037 Without Project		2037 With Project -37MLLW (High/Moderate Growth)		2037 With Project -38MLLW (High Growth)	
VesselClass	Calls	VesselClass	Calls	VesselClass	Calls
ATB 30k	149	ATB 30k	149	ATB 30k	149
Bulker 30k	6	Bulker 30k	6	Bulker 30k	7
Bulker 40k	9	Bulker 40k	9	Bulker 40k	11
Bulker 50k	6	Bulker 50k	15	Bulker 50k	18
Bulker 60k	25	Bulker 60k	25	Bulker 60k	26
Bulker 80k	8	Bulker 80k	8	Bulker 80k	8
Ro-Ro 10k	20	Ro-Ro 10k	30	Ro-Ro 10k	26
Ro-Ro 20k	28	Ro-Ro 20k	28	Ro-Ro 20k	35
Tanker-Medium	134	Tanker-Medium	130	Tanker-Medium	127
Tanker-Small	15	Tanker-Small	33	Tanker-Small	44
Total	**400**		**433**		**451**

[18]

Table 4-1 Estimated Vessel Calls (Moderate /HIgh Growth)

An analysis of Table 4-1 shows that at first implementation the anticipated vessel transit efficiencies would take effect and generate a decrease in vessel movements under Alternative 3 as compared

[18] From the perspective of evaluation of potentially adverse effects, utilizing an optimistic economic growth projection in light of uncertainties reflects a conservative approach to NEPA evaluation. The accompanying Limited Reevaluation Report, on the other hand, has adopted a different approach that also reflects a conservative approach, albeit from a water resources project planning perspective: the LRR has refrained from incorporating the same optimistic projections of with-project economic growth in its calculation of benefits expected to be derived from project implementation to reduce the likelihood of overstating the benefits of implementation of Alternative 3.

with Alternative 1. In subsequent years, growth in cargo tonnage moved through the Port would generate an increase in deep-draft vessel calls, with 51 more annual vessel calls projected in 2037.

The indirect effects of increased numbers of deep-draft vessel transits are evaluated in the specific impact assessment sections of this Chapter 4. The socioeconomic effects attributable to an increase in cargo movement caused by implementation of the proposed action are primarily expected to take the form of increased employment and wages, discussed further in this Chapter 4. Any additional human development that may occur in the Grays Harbor port region, attributable exclusively to the proposed action, would occur in previously developed areas and would be addressed in the application of the local master plan for that locality and controlled via zoning and approval requirements as implemented under local regulations. The indirect effects of any increased employment and wages on community development would be speculative, likely minor in intensity from a regional perspective, and remotely attenuated in that it would be impossible to identify and articulate the nature and degree of regional economic development attributable exclusively to deepening the navigation channel to -38 feet MLLW.

4.0.3.2 Uncertainty of indirect effects:

Information on the environmental effects of any economic growth that would be proximately caused by deepening the navigation channel from -36 feet MLLW to -38 feet MLLW is incomplete, because no information has been developed depicting the increment of economic effects between the future without-project and the future with-project conditions, specifically tailored to the Grays Harbor economic region and taking into account the unique mix of cargo commodities handled by the Port.

The information is unavailable at reasonable cost in money and time. The data that would be needed to develop and analyze the effects on economic growth of channel deepening by two feet are non-existent. Also, many variables influenced by factors far outside the scope of this proposed action could be correlated to an increase in growth at or around the project location. In lieu of the Port-specific economic modeling information that is unavailable, this SEIS has applied existing economic projections of regional economic growth as a surrogate measure. Application of the “high” growth projections reflects greater economic activity and commensurately more intense environmental effects in most impact categories, as compared with the “moderate” growth forecast incorporated into the No Action Alternative; thus, the “high” economic growth projections reflect a more conservative perspective in assessment of environmental effects.

The unavailable information detailing the environmental effects of economic growth would not be essential to a reasoned choice among the available alternative proposed actions to meet the project purpose and need. Alternatives 2 and 3 are variations in the degree of activities addressing the project purpose: deepening to -37 feet MLLW, and to -38 feet MLLW, respectively. A comparison of the environmental effects of the two alternatives reveals distinctions in intensities of impacts in each of the evaluated effects categories. Even when applying an environmentally conservative projection of growth in cargo volumes, the adverse environmental effects of Alternative 2 are generally the lesser of the two alternatives in most impact categories; however, the impacts under the preferred alternative, Alternative 3, in each case are no more than minor. Thus, having more precise or refined data on the environmental effects of any economic growth proximately caused by deepening the channel to -38 feet MLLW would not further inform the decision maker’s election among two action alternatives.

4.0.3 Terminology

The environmental consequences sections identify five types of effects: minimal or negligible, minor, moderate, adverse, and beneficial.

- A minimal or negligible impact would cause a very small or negligible change in the environment. Mitigation is not warranted.
- A minor impact would not cause a substantial change in the environment. Mitigation is generally not warranted.
- A moderate impact would cause an adverse, but not a substantially adverse, change in the environment.
- An adverse impact would cause a substantial adverse change in the environment. Compensatory mitigation may be planned for an adverse effect.
- A beneficial effect would cause an improvement in the environment.

4.0.4 Assessment Areas

The following areas associated with the alternatives were analyzed in the environmental consequences assessment of effects.

- Affected reaches of the navigation channel: Cow Point (including turning basin), Hoquiam, North Channel, and Inner Crossover, Outer Crossover, and South reaches (Figure 2).
- Dredged material placement sites: the shifted Point Chehalis and South Jetty open-water placement sites, Half Moon Bay and South Beach nearshore sites, Point Chehalis Revetment Extension mitigation site, and the former Hoquiam wastewater treatment pond.

Each area is described under Alternatives 2 and 3 in Chapter 2, *Alternatives*. The overall project vicinity is presented on Figure 1.

4.0.5 Assumptions

Assumptions regarding dredging machinery, duration, and time periods for the inner and outer harbor reaches are described in detail under the descriptions of each alternative in Chapter 2, *Alternatives*, and are summarized in Table 2-5. Assumptions specific to a resource area are described in the methods for that resource in the following sections.

4.0.6 Mechanisms

The following activities associated with the alternatives were considered in assessing the environmental consequences on each resource.

- Movement of dredging vessels from one dredging location to another (e.g., moving the dredging vessels from one location to the next could disrupt marine traffic; disturb sensitive habitats; and affect noise, water, and air quality).
- Operations associated with dredging the navigation channel (e.g., dredging operations could affect water and air quality and sensitive habitats during the movement of sediment from the bottom of the harbor, up through the water column, and into storage containers on the dredging vessels).

- Placement of the dredged material in open-water and on-land placement sites (e.g., placing dredged material at the open-water placement sites could affect water quality).

These activities could affect the resources discussed in the following sections. Additional resource-specific mechanisms are described in the methodology presented for the applicable resource areas.

4.1 Marine Transportation

4.1.1 Overview

This section reviews the potential changes in transportation patterns associated with deepening the navigation channel under the two action alternatives.

Prior studies have indicated that the navigation channel is insufficiently sized and places constraints on deep-draft vessels (U.S. Army Corps of Engineers 2009). Vessels have to be partially loaded due to insufficient channel depth at some tidal elevations, and experience tidal delays due to insufficient channel depth.

The more cargo that can be loaded into a vessel, the lower the transportation cost. If the depth of the navigation channel is insufficient to allow a vessel to be fully loaded, transportation costs are higher compared to a fully loaded or more fully loaded vessel. These problems are occurring at Grays Harbor and result in an inefficient movement of cargo which, in turn, results in higher transportation costs compared to movement in a deeper channel. Additionally, vessels that have to delay their departure (or arrival) waiting for tides to provide sufficient underkeel clearance also incur added transportation costs. These tidal delay costs will be reduced or eliminated for the current size and type of marine traffic with a deeper channel (U.S. Army Corps of Engineers in 2009:6–7).

4.1.2 Methods

Review of recent trends reveals that the size of deep-draft vessels calling at the Port is increasing as is the actual arrival and departure draft (Port of Grays Harbor 2013) under present conditions independent of project implementation. These trends are documented below[19].

4.1.2.1 Increasing Vessel Sizes

The average size of deep-draft vessels calling at the Port is increasing in all dimensions (Table 4.1-1).

- The number of departures increased from 59 calls in 2005 to approximately 85 calls in 2012, an increase of 43%.

[19] The existing, without-project trend of increasing vessel sizes was not carried forward into the economic analysis due to the fact that the level of detail in the analysis should be commensurate with the level of report, and the trend is not expected to change the outcome of the recommended alternative due to the fact that generally as vessel sizes increase along with increases in the volume of commodites carried, so too do the economies of scale. It is reasonable to assume that with larger vessels the analysis would lead to a better case of transportation cost efficiencies and higher justification for a deeper channel.

- Deadweight tons, the carrying capacity of the vessel including cargo weight fuel and stores has increased from 28,300 tons in 2005 to 35,300 tons in 2012, an increase of 25%.
- Vessel length has increased from 547 feet in 2005 to 619 feet in 2012, a 13% increase.
- Vessel beam (breadth or width) has increased from 87.6 feet in 2005 to 101.8 feet in 2012, an increase of 16%.
- Design draft (the distance from the design waterline to the bottom of the keel, which is the maximum depth that the vessel may be loaded to) has increased from 32.5 feet in 2005 to 35.9 feet in 2012, an increase of 11%.
- Arrival draft (the actual draft of the vessel given the amount of cargo it carries when arriving at port) has increased from 22.4 feet in 2005 to 25.0 feet in 2012, an increase of 12%.
- Departure drafts (i.e. the actual draft of the vessel given the amount of cargo it carries when departing from port), which have a greater impact on Port operations than arrival or design draft because most of the cargo consists of outbound exports and is composed of heavier products, have increased from 30.3 feet in 2005 to 31.9 feet in 2012, a 5% increase.

Table 4.1-1. Vessel Size Trends[20]

	Average Vessel Dimensions at Port of Grays Harbor					
Year	Number of Calls	Deadweight Tons	Length	Breadth	Design Draft	Arrival/ Departure Draft
Arrivals						
2005	58	28,275	547.4	87.6	32.5	22.4
2006	33	29,561	571.1	89.5	32.8	22.5
2007	45	22,764	500.6	78.7	29.5	21.5
2008	48	31,710	557.1	90.1	34.0	23.0
2009	47	29,153	582.8	94.6	34.0	24.0
2010	66	32,980	603.0	98.8	34.3	23.0
2011	72	28,084	574.9	94.3	32.6	24.4
2012	82	35,259	618.9	101.8	35.9	25.0
Increase 2005–2012	41%	25%	13%	16%	11%	12%
Departures						
2005	58	28,767	547.0	87.3	32.3	30.3
2006	34	30,365	572.6	90.0	33.1	31.6
2007	44	22,551	498.8	78.3	29.5	26.4
2008	47	31,065	555.7	107.2	33.8	31.6
2009	48	30,554	584.0	94.9	34.2	30.9
2010	65	32,528	602.7	98.7	34.0	31.4
2011	71	27,811	582.9	95.7	33.0	30.0
2012	83	35,376	618.8	101.7	35.8	31.9
Increase 2005–2012	43%	23%	13%	16%	11%	5%

Source: Port of Grays Harbor 2013.

[20] Table 4.1-1 displays a very small percentage of departures occur deeper than -36 feet. Of note is that the vessels in question have a design draft much deeper than the departure draft. This would indicate that if the channel were deeper then the vessels that have a design draft higher than -36 ft (more than 40 vessels in 2012) could more fully load. One would expect to see more vessels departing at a higher draft thus reducing cost and providing NED benefits (Reference Appendix A Economic Analysis). A figure of greater than 40 vessels is a conservative number (i.e., one which understates the number of vessel calls restricted by channel depths) due to the fact that this simplistic observation does not account for the underkeel clearance requirement of the vessels. Accounting for the underkeel clearance would increase the number of vessels that may potentially gain from a deeper channel.

Impact of Tide Height on Marine Operations

The constraints of the existing channel are affecting vessel loads and operations. This trend is further explored in the Table 4.1-2, which documents the number of calls during which the actual draft was 32 feet or more. The existing channel depth is 36 feet. Without accounting for tidal fluctuation and assuming an underkeel clearance requirement of 3.5 feet, vessel drafts are limited to 32 feet. Arrivals and departures that exceed 32 feet require timing of the tides to utilize greater depths of water.

As discussed above, the depth of the navigation channel mainly affects departures. There were 20 calls in 2005, representing 34% of all calls, with a vessel draft of 32 or more. By 2012, the number of calls in this category (actual departing vessel draft of 32 feet or more) had reached 34 calls, accounting for 41% of all calls. In addition, vessel departures frequently exceeded 36 feet, with some departing at a draft of 40 feet.

Table 4.1-2. Number of Departures 32 Feet Deep and Over

	Depth (feet)									Subtotal	Total	% Over 32
Year	32	33	34	35	36	37	38	39	40	32 feet +	Calls	feet
2005	10	2	1	2	3	-	1	1	-	20	58	34%
2006	8	5	1	-	1	1	-	-	-	16	34	47%
2007	5	2	1	3	-	-	-	-	-	11	44	25%
2008	9	8	1	3	1	1	-	-	-	23	47	49%
2009	5	3	2	2	4	5	-	-	-	21	48	44%
2010	9	7	5	3	4	2	2	-	-	32	65	49%
2011	1	5	7	2	6	7	-	-	-	28	71	39%
2012	-	4	4	1	11	4	4	6	2	34	83	41%
Increase 2005–2012										70%	43%	

Source: Port of Grays Harbor 2013.

As shown in Table 4.1-3, departing vessels are maximizing the use of tides. During the past 3 years, more than 90% of vessel departures have “utilized” a tide of more than 5 feet. In recent years, an increasing number of vessels have “left” at tides from +6 to +10 MLLW.

Table 4.1-3. Departures by Height of Controlling Tide

	Controlling Tide (feet)							
Departures	5	6	7	8	9	10	Over 5 feet	% of Total Departures
2005	8	9	15	7	3	1	43	74%
2006	6	11	8	4	1	-	30	88%
2007	9	7	7	6	3	1	33	75%
2008	10	7	14	7	3	-	41	87%
2009	8	16	10	7	1	-	42	88%
2010	9	19	14	11	5	1	59	91%
2011	13	24	16	10	3	1	67	94%
2012	8	26	25	9	8	-	76	92%

Source: Port of Grays Harbor 2013.

A typical daily tidal cycle in Grays Harbor is shown in Figure 42. The typical window of availability (defined as the number of hours during which the height of the tide exceeds the required height) is approximately 14 hours for a ship requiring a minimum of a 5-foot tide (above MLLW), decreasing to 2 hours at a 9-foot tide (above MLLW). As a result, the probability of the tide meeting vessel requirements is approximately 56% for a 5-foot tide (above MLLW) but only approximately 8% for a 9-foot tide (above MLLW).[21]

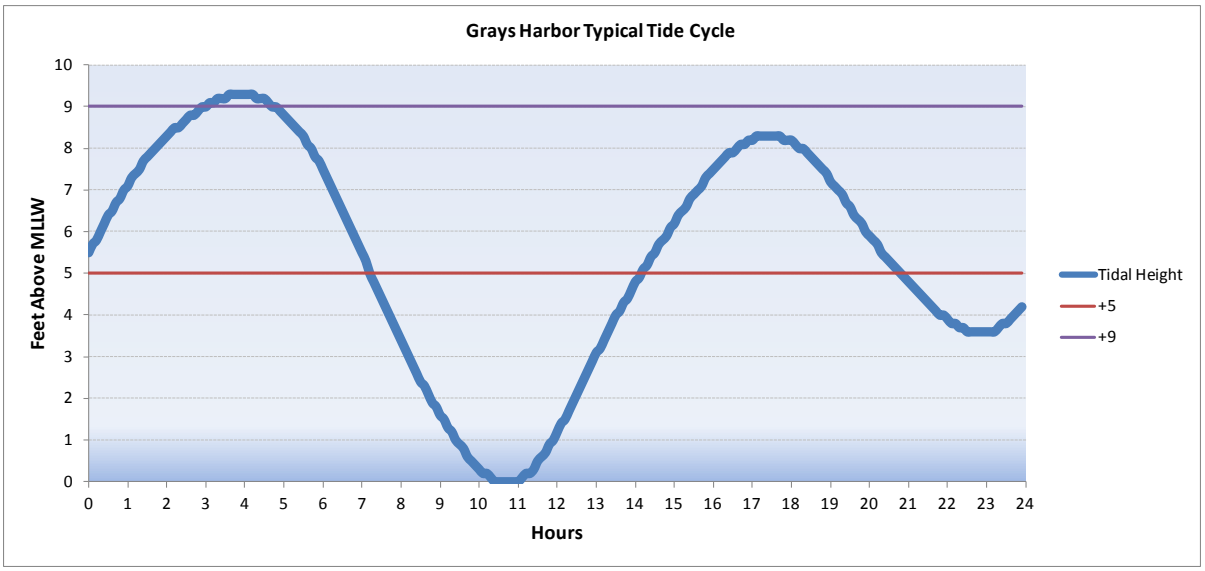

Figure 42. Grays Harbor Typical Daily Tidal Cycle

Source: Nautical Software, Inc. 2006
Note: Tidal cycle for May 14, 2013.

[21] Percentages represent the tidal cycle for May 14, 2013, the day of the charted data, and only apply to this date. However, these percentages represent approximately the amount of time the tide is sufficient to meet vessel requirements for navigation in the channel.

4.1.3 Alternative 1—No Action (Continue Channel Maintenance of −36 Feet MLLW)

Alternative 1 would not improve the capability of load factor of vessel operations in Grays Harbor, because the depth of the current channel constrains the existing fleet (as described in further detail in Section 4.12, *Local Economy/Socioeconomics*). Commercial vessels calling at the Port have increased in size during the past 6 years and now provide greater cargo-loading capability requiring deeper channel depths than are typically available under baseline conditions. Vessel operators have relied on tides of 5 and more feet to maximize loads, with an increasing share of transits at a tide of 9 or more feet. However, the number of transits under these conditions is limited by the tidal window of availability.

Under Alternative 1, the future fleet is expected to be similar to the existing fleet. The existing trend of fewer small vessels and more large vessels up to the practical maximum vessel size is expected to continue. The current channel depth of −36 feet MLLW will accommodate fully loaded vessels with a draft up to 36 feet less that vessel's required underkeel clearance. Vessels exceeding 36 feet of draft are typically light loaded. Thus, the depth of the navigation channel under Alternative 1 would continue to constrain maritime operations, resulting in delays to arrivals and departures, as well as light loading.

4.1.4 Alternative 2—Deepen Channel −37 Feet MLLW

Deepening the channel to −37 feet MLLW under Alternative 2 would improve vessel loading capability in Grays Harbor over baseline conditions. Deepening the navigation channel to −37 feet MLLW would increase the underkeel clearance for vessels and thus lengthen the available tidal windows of opportunity for loaded vessels to utilize the navigation channel. Deepening the channel would improve the tidal delay and light loading conditions that currently increase transportation costs and affect the economic vitality of the Port and its tenants.

The additional 1 foot of channel depth would improve the window of availability for vessel transits. A 9-foot tide under Alternative 2 would be comparable to a 8-foot tide under Alternative 1, because of the 1-foot increase in channel depth. For example, on a typical tidal cycle such as May 14, 2013, this improvement would increase the window of availability for a vessel requiring a 9-foot tide under baseline conditions from 2 hours under Alternative 1 to 5 hours under Alternative 2, an increase from 8% (Alternative 1) to 20% (Alternative 2) of the tidal cycle[22].

Section 4.0.3.1 shows that, under median "high/moderate" projection of growth in cargo tonnage moved through the Port of Grays Harbor, an initial drop in deep draft vessel transits would be experienced in the first year of deepening implementation, followed by a gradually increasing increment of vessel calls. By 2037, there would be 51 additional annual deep draft vessel transits under Alternative 2, as compared with Alternative 1.

Alternative 2 would have a beneficial effect on marine transportation; vessel operations would be improved, allowing fuller loads per vessel and reducing ocean transportation costs.

[22] Percentages represent the tidal cycle for May 14, 2013, the day of the charted data, and only apply to this date. However, these percentages represent approximately the amount of time the tide is sufficient to meet vessel requirements for navigation in the channel.

4.1.5 Alternative 3—Deepen Channel to −38 Feet MLLW

Deepening the channel to −38 feet MLLW under Alternative 3 would improve the loading capability of vessel operations in Grays Harbor over baseline conditions (Alternative 1) and Alternative 2 conditions.

Deepening the navigation channel to −38 feet MLLW would further increase the underkeel clearance for vessels and thus further lengthen the available tidal windows of opportunity for loaded vessels to utilize the navigation channel. Deepening the channel would further decrease the tidal delay and light loading conditions that currently increase transportation costs and affect the economic vitality of the Port and its tenants.

The additional 2 feet of channel depth would improve the window of availability for vessel transits. Under Alternative 3, a 9-foot tide would be comparable with a 7-foot tide under Alternative 1 due to the 2-foot increase in channel depth. For example, on a typical tidal cycle such as May 14, 2013, this improvement would increase the window of availability for a vessel requiring a 9-foot tide under baseline conditions from 2 hours under Alternative 1 and 5 hours under Alternative 2 to 10 hours under Alternative 3, which is an increase from 8% (Alternative 1) and 20% (Alternative 2) to 38% (Alternative 3) of the tidal cycle.[23]

Section 4.0.3.1 shows that, under "high" projection of growth in cargo tonnage moved through the Port of Grays Harbor, an initial drop in deep draft vessel transits would be experienced in the first year of deepening implementation, followed by a gradually increasing increment. By 2037, there would be 51 additional annual deep draft vessel transits under Alternative 3, as compared with Alternative 1.

Alternative 3 would have a more beneficial effect on marine transportation than Alternative 2; vessel operations would be further improved, allowing fuller loads per vessel and reducing ocean transportation costs.

4.2 Geomorphology

4.2.1 Overview

This section addresses how the proposed action would potentially affect geomorphic processes in Grays Harbor, which could have subsequent effects on other resources, such as ecosystem function, shoreline stability, and water quality. This section analyzes the extent to which the proposed action would affect sediment transport dynamics by altering the placement location and/or magnitude of dredged material, affect Whitcomb Flats morphology, alter the processes of side-slope erosion of the navigation channel, enhance ship-wake erosion, and change salt wedge dynamics.

4.2.2 Methods

This analysis is based on review of existing studies of physical processes in Grays Harbor (Osborne 2003; U.S. Army Corps of Engineers 2012) and a qualitative analysis of how each of the action

[23] Percentages represent the tidal cycle for May 14, 2013, the day of the charted data, and only apply to this date. However, these percentages represent approximately the amount of time the tide is sufficient to meet vessel requirements for navigation in the channel.

alternatives could alter geomorphic processes. No new studies were performed as part of the analysis. Sediment transport dynamics, Whitcomb Flats morphology, side-slope erosion potential, ship-wake erosion potential, and alteration of salt wedge dynamics are evaluated, because they are morphological process issues commonly evaluated in analysis of navigation channel dredging for deep-draft vessels.

Dredging the navigation channel and subsequent placement of material are activities that have historically altered the morphology of the estuary (Osborne 2003; U.S. Army Corps of Engineers 2012). Such activities have the potential to alter sediment dynamics in a manner that could appreciably alter physical processes and lead to further morphological change, such as changes to flood and ebb currents and side-slope erosion (Eriksen and Grey 1991; Osborne 2003). Ship-wake erosion is evaluated, because deepening of waterways has the potential to increase ship wakes from deep-draft vessels that can cause shoreline erosion (Maynord 2004). Channel deepening also has the potential to alter the freshwater and saltwater dynamics (Lautier 1998; Louisiana Department of Natural Resources 1995), and is therefore evaluated to determine if the scale of proposed action could influence the salt wedge in Grays Harbor. Finally, the migration of Whitcomb Flats is a specific concern that has been identified and studied in Grays Harbor (Osborne 2003) and is analyzed to determine if the proposed action would affect this particular landform.

4.2.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Under Alternative 1 (baseline conditions), no deepening of the navigation channel would occur. The Corps would continue annual channel maintenance to a depth of −36 feet MLLW, allowing for 2 feet of advanced maintenance and 2 feet of allowable overdepth.

4.2.3.1 Potential to Alter Sediment Transport Dynamics

Sediment transport in Grays Harbor is controlled by the complex dynamics of fluvial sediment and water inputs from tributaries entering the harbor and mixing with marine sediment and water inputs from the Pacific Ocean. The morphology of the harbor is determined by differences in the capacity of harbor inflows (flood currents) and waves to transport sediment into the harbor and outflows (ebb currents) to transport sediment out of the harbor. In general, Grays Harbor is dominated by tidal currents; however, high flows on the Chehalis River can control currents in the upper estuary, and the locations of shoals are continually shifting in the estuary (U.S. Army Corps of Engineers 2012). Sediment carried out to the Pacific Ocean by fresh water can be transported back into the harbor by incoming denser salt water that can form a salt wedge under the freshwater currents. Sediment accumulation in the seaward portion of the estuary is controlled primarily by redistribution of estuary silt by wind and waves and deposition of ocean sands by tidal action (U.S. Army Corps of Engineers 2012). Sediment accumulations in the interior estuary are controlled largely by river inputs.

Sediment transport dynamics, including the dynamics of the flood and ebb currents, and patterns of shoaling and erosion, would continue as they are described in Section 3.2.

4.2.3.2 Potential to Alter Whitcomb Flats Morphology

Whitcomb Flats is a sand flat about 1 mile east of the entrance to Westport Marina and south of the navigation channel. From 1967 to 2001, Whitcomb Flats migrated east at an average of about 100

feet per year (Osborne 2003). The prevailing mechanisms attributed to the migration are ocean waves, tidal currents, and possibly eolian (wind) transport (Osborne 2003). The long-term trend of accretion along Damon Point and the associated migration of the ebb channel south into deeper water enabled larger waves to reach Whitcomb Flats and led to the eastward migration (Osborne 2003). Waves entering Grays Harbor also result in episodes of accretion and erosion, and have the potential to erode Whitcomb Flats. Osborne (2003) found no significant variation in the wave height time series that correlates with either the navigation channel realignment in the late 1970s or the early 1990s deepening of the South Reach to −36 feet MLLW and the maintenance dredging of the Outer Bar, Entrance, and Point Chehalis reaches. Rather, Osborne's study showed a steady increase in wave height (and erosion potential) over time that correlates with the larger scale morphological changes, described above, of inlet deepening and throat migration southward, and did not find a correlation related to the work completed in the early 1990s (Osborne 2003). Additionally, Osborne (2003) reports that the position of the navigation channel has been relatively stable at depths between −20 and −40 feet MLLW since the late 1980s.

While the navigation project existing features such as the jetties and revetment likely contribute to the eastward migration of Whitcomb Flats this is considered part of the baseline condition with continued maintenance dredging to −36 feet MLLW (Alternative 1).

4.2.3.3 Potential for Erosion of Navigation Channel Side Slopes

Side-slope erosion of the navigation channel has the potential to overwiden the channel, undermine infrastructure and shorelines, and affect aquatic habitat. The side slopes of the navigation channel vary throughout the navigation channel, becoming progressively steeper upstream toward the mouth of the Chehalis River due to the presence of finer textured more cohesive substrates that allow maintenance of steeper slopes. In the Aberdeen, Cow Point, and Hoquiam reaches, representative slopes range from 1V:3H. In the North, Crossover, and inner portion of the South reaches, channel slopes are typically 1V:5H, while in the outer portion of the South, Entrance Channel, and Bar Channel reaches, the side slopes are their mildest at 1V:10H (U.S. Army Corps of Engineers 2011). The position of the navigation channel has been relatively stable at depths between −20 and −40 feet MLLW since the late 1980s, indicating minimal widening of the channel due to side-slope erosion and retreat.

In the inner harbor reaches, a clamshell bucket proceeds from the outer edges of the navigation channel, across the channel to the other bank, and then back, dredging progressively until the desired depth is achieved. Due to the mild angle of the channel's side slopes and this method of dredging, the channel width remains substantially unchanged as material removal occurs and the potential for sloughing/avalanching of sediment from the channel's side slopes after dredging is completed is minimized. In the outer harbor reaches, a hydraulic hopper dredge typically proceeds to cut from the outer edge of the channel at an angle toward the center, thus directing sediment toward the channel center as dredging progressively proceeds until the desired depth is achieved. As with clamshell dredging, the mild angle of the channel's side slopes and this angled cut during dredging minimizes the potential for sloughing/avalanching of sediment from the channel's side slopes after dredging is completed and maintains the existing width of the channel.

Under Alternative 1, dredging of the navigation channel would continue in the same manner as currently conducted, which does not result in side-slope erosion of the navigation channel.

4.2.3.4 Potential to Alter Ship-Wake Erosion

Ship-wake waves are primarily dependent upon vessel speed and the ratio of the vessel's cross-section and the waterway's cross-section, which is measured across the estuary from shoreline to shoreline. Under Alternative 1, the size, number, and speed of vessels navigating the harbor would remain unchanged, and no changes would be made to the waterways' cross-sectional area due to the navigation channel.

4.2.3.5 Potential to Alter Salt Wedge Dynamics

The freshwater–saltwater interface in the estuary is dynamic and controlled by many factors, including flood and ebb currents, freshwater inputs from tributary rivers, bathymetry, and groundwater elevations. Salinity concentrations in the harbor are well mixed, particularly during low flows in the Chehalis River, thus limiting the formation of a classic salt wedge of more dense sea water flowing on the bottom of the estuary, with a less dense layer of fresh water on top (Beverage and Swecker 1969). Changes to one or more of the variables controlling the freshwater–saltwater interface can lead to saltwater intrusion, in which higher pressure and denser saltwater (sometimes referred to as a salt wedge) underlying the freshwater reaches further inland, potentially leading to saltwater intrusion into freshwater supplies. The inland extent of the salt wedge is typically limited to a location where the fresh water table rises far enough above sea level to increase the hydraulic head of the fresh groundwater to a point where the fresh water pressure exceeds the saltwater pressure. Saltwater intrusion is most commonly related to fresh groundwater extraction that lowers the water table, thereby reducing the pressure of the fresh water and its ability to counteract the salt wedge. Groundwater extraction can also cause upwelling of saltwater into wells.

Under Alternative 1, annual maintenance dredging of the navigation channel would not alter groundwater pumping rates or the inflow of fresh water from the Chehalis River or other tributaries or involve changes that would affect the salt wedge dynamics in the estuary.

4.2.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Alternative 2 would deepen the navigation channel 1 foot, to a depth of −37 feet MLLW, allowing for 2 feet of advanced maintenance and 2 feet of allowable overdepth as under baseline conditions (a 2.5% increase beyond baseline conditions in the affected reaches). As described in Chapter 2, *Alternatives*, deepening the channel an additional foot would require an additional 1,031,000 cubic yards of dredging during the initial deepening (approximately 954,00 cubic yards total for the inner harbor reaches and 77,000 cubic yards total for the outer harbor reaches). Subsequent maximum annual maintenance dredging volumes are estimated to increase by a relatively small amount (50,000 cubic yards) compared to baseline conditions.

4.2.4.1 Potential to Alter Sediment Transport Dynamics

The deepening of the channel would require additional dredged material to be placed at the placement sites, including 13,500 cubic yard of upland placement of material determined unsuitable for open water placement. Placement of dredged material at the South Beach, South Jetty, and Point Chehalis Revetment Extension mitigation sites helps moderate the erosion of the shoreline and at the base of the south jetty (U.S. Army Corps of Engineers 2012). The placement of additional dredged material at these sites from the channel deepening under Alternative 2 would further assist the effort to reduce erosion that has occurred in these locations over the past several decades.

Dredged material from the initial channel deepening under this alternative would also likely be placed at the open-water dispersive sites of the shifted Point Chehalis and South Jetty. The estuary at the South Jetty location experienced up to 10 feet of erosion between 1955 and 2010 (U.S. Army Corps of Engineers 2012). Placement of the dredged material at this location would initially offset some of the observed erosion that has occurred at the site but over time would be transported seaward by the same processes. Placement of additional material at the South Jetty dredged material placement site will aid in the protection of the jetty from potential future erosion.

The one-time placement of additional material generated from deepening (1,031,000 cubic yards), and additional maintenance volumes attributable to deepening (50,000) the navigation channel represent an additional 38% of dredged material for deepening in the construction year, and 2% increase in annual maintenance under Alternative 2. The additional material placed at the beneficial nearshore sites (Half Moon Bay and South Beach) represent a potentially beneficial impact in stabilizing the substrate in those areas, and the shifted Point Chehalis site has been shifted to take advantage of deeper water and more favorable hydrodynamics. The potential to alter sediment transport dynamics is expected to be beneficial as it keeps sediment within the nearshore area and does not represent an adverse impact to existing infrastructure or marine transportation.

4.2.4.2 Potential to Alter Whitcomb Flats Morphology

The migration of Whitcomb Flats is attributed to large-scale morphological changes, including the long-term trend of accretion along Damon Point and the associated migration of the ebb channel south into deeper water that enabled larger waves to reach Whitcomb Flats and led to the eastward migration (Osborne 2003). Alternative 2 would increase the depth of the navigation channel by 2.5%, a minor change in navigation channel morphology that has limited influence on the larger morphological processes at work in the estuary. This larger scale morphological trend has been substantiated through analysis of historic bathymetric surveys and aerial photos in Osborne (2003). South Reach channel migration to the south is directly related to the growth of Damon Point to the Southeast as the channel has moved toward Damon Point. Therefore, the incremental potential for Alternative 2 to alter wave dynamics or enhance erosive currents and contribute to increased erosion of Whitcomb Flats, over and above the effects of the existence of features of the navigation project, including a channel of a depth of -36 feet MLLW and the jetties, all of which have been evaluated in prior NEPA documentation, would be minor.

4.2.4.3 Potential for Erosion of Navigation Channel Side Slopes

Under Alternative 2, the navigation channel would continue to be dredged in the manner conducted during annual maintenance dredging under baseline conditions. Because of the observed stability of the navigation channel since the late 1980s, and the dredging techniques employed to minimize side-slope erosion, the potential for Alternative 2 to increase side-slope erosion is expected to be minor.

4.2.4.4 Potential to Alter Ship-Wake Erosion

Alternative 2 would not result in an increase in the size of vessels navigating the harbor, nor vessel speed, compared to baseline conditions. Deepening of the navigation channel by 2.5% would result in a negligible increase in the cross-sectional area of the waterway, since the small increase in depth is limited to the navigation channel and the vast majority of the waterway's cross-section would not be altered. Alternative 2 would add as many as 33 annual deep-draft vessel transits as compared

with Alternative 1 by 2037. This 8.25% increase in vessel transits of the navigation channel annually would have no more than a minor incremental effect in ship-wake erosion of the Grays Harbor shoreline, as compared with Alternative 1. Thus, the increase in ship-wake waves would not change appreciably due to the deepening of the channel, and the potential for increased shoreline erosion is expected to be negligible.

4.2.4.5 Potential to Alter Salt Wedge Dynamics

A U.S. Geological Survey (USGS) (Beverage and Swecker 1969) study of Grays Harbor estuary dynamics under prenavigation channel deepening conditions reported the upper limit of saltwater intrusion varies with Chehalis River flow conditions. Under low-flow conditions, saltwater extends upstream to Montesano, about 12 miles inland from Cow Point. For Chehalis River flows greater than 50,000 cubic feet per second, the saltwater intrusion extends to Cosmopolis, about 4 to 5 miles inland of Cow Point. The USGS study also reported that saltwater and freshwater are fairly well mixed vertically during low-flow conditions, but become more stratified with increasing freshwater discharge (Beverage and Swecker 1969). Deepening of the estuary to construct the navigation channel may have enabled saltwater to extend further inland now compared to the 1969 study.

Alternative 2 would not alter groundwater pumping rates or the inflow of fresh water from the Chehalis River or other tributaries. Increasing the depth of the navigation channel by 1 foot would potentially allow the salt wedge to advance further upstream, if the deepening extended beyond the current freshwater-saltwater interface, by increasing the salt wedge's pressure beyond the fresh groundwater. However, Alternative 2 would not extend the navigation channel further inland as compared to baseline conditions.

Alternative 2 would deepen the navigation channel only through the Cow Point Reach, which is neither the farthest upstream extent of the navigation channel nor the upstream extent of the salt wedge in the Chehalis River between Cosmopolis and Montesano, as measured in 1969 (Beverage and Swecker 1969). While a 2.5% increase in channel depth, confined to the navigation channel, could result in a slight increase in salinity concentration, this would have a negligible effect on the pressure gradients controlling saltwater intrusion when considered over the much broader area of Grays Harbor. Therefore, the potential for Alternative 2 to create saltwater intrusion problems is expected to be negligible.

4.2.5 Alternative 3—Deepen Channel to −38 Feet MLLW

Alternative 3 would deepen the navigation channel by 2 feet, to a depth of −38 feet MLLW, and allow for 2 feet of advanced maintenance and 2 feet of allowable overdepth, as under baseline conditions. Thus, Alternative 3 would increase the depth of the navigation channel by 5% compared to baseline conditions. The initial dredging required to deepen the navigation channel under Alternative 3 would require approximately 1,972,000 cubic yards of dredged material. Subsequent annual maintenance dredging volumes attributable to the deepening are estimated to increase by approximately 107,000 cubic yards compared to baseline conditions.

4.2.5.1 Potential to Alter Sediment Transport Dynamics

The locations of dredged material placement sites would be the same for those used under baseline conditions, except for the shifted Point Chehalis site and the upland disposal of material determined unsuitable for open water placement (22,400 cubic yards). As is the case for Alternative 2, some of the dredged material generated from the deepening and subsequent maintenance would be placed

at beach nourishment sites or other locations that would protect against future erosion of shorelines, or the South Jetty site. Thus, the potential for a one-time placement of additional dredged material, and increased maintenance generated from deepening the navigation channel to −38 feet MLLW is expected to be undisruptive to sediment dynamics and beneficial as it keeps sediment within the nearshore drift cell and available to nourish area shorelines. The placement does not represent an adverse impact to existing infrastructure or marine transportation. The effects of deepening to -38 feet MLLW on sediment transport are expected to be similar to those of Alternative 2.

4.2.5.2 Potential to Alter Whitcomb Flats Morphology

Alternative 3 would increase the depth of the navigation channel by 5% in the affected reaches compared to baseline conditions. The likelihood that the proposed deepening would alter wave dynamics or enhance erosive currents, and contribute to increased erosion of Whitcomb Flats and result in a substantial adverse impact is low, because the change in navigation channel morphology is minor and has limited influence on the larger morphological processes at work. Deepening the channel to -38 feet MLLW versus -37 feet MLLW would have little effect on Whitcomb Flats relative to the large scale morphology related to the South channel migration. It is anticipated the channel morphology would continue this trend over time until a significant change in the southeast growth of Damon Point occurs.

4.2.5.3 Potential for Erosion of Navigation Channel Side Slopes

Under Alternative 3, the navigation channel would continue to be dredged in the manner conducted during annual maintenance under baseline conditions in the affected reaches. Because of the observed stability of the navigation channel since the late 1980s, and the dredging techniques employed to minimize side-slope erosion, the potential that deepening the navigation channel under Alternative 3 would substantially increase side-slope erosion is expected to be minor.

4.2.5.4 Potential to Alter Ship-Wake Erosion

As with Alternative 2, Alternative 3 would neither result in an increase in the size of vessels navigating the harbor, nor vessel speed, compared to baseline conditions (i.e. Alternative 1). Deepening of the navigation channel by 5% compared to baseline conditions and 2.5 % compared to Alternative 2 would result in a negligible increase in the cross-sectional area of the waterway, since the small increase in depth is limited to the navigation channel and the vast majority of the waterway's cross-section would not be altered. Alternative 3 would add as many as 51 annual deep-draft vessel transits as compared with Alternative 1 by 2037. This small increase (9.75% increase in vessel transits of the navigation channel annually would have no more than a minor incremental effect in ship-wake erosion of the Grays Harbor shoreline, in light of no alteration of ship transit speeds, no increase in size of transiting vessels, and the highly dynamic marine ecosystem in Grays Harbor, as compared with Alternative 1. Thus, the increase in ship-wake waves as compared to Alternative 2 would not change appreciably due to the deepening of the channel, and the potential for increased shoreline erosion is expected to be minor.

4.2.5.5 Potential to Alter Salt Wedge Dynamics

Alternative 3 would not extend the navigation channel further inland than under baseline conditions. While a 5% increase in channel depth, confined to the navigation channel, could result in

a slight increase in salinity concentration, this would have a negligible effect on the pressure gradients controlling saltwater intrusion when considered over the much broader area of Grays Harbor. The potential for Alternative 3 to create saltwater intrusion problems is expected to be negligible. While a stratified salinity wedge may be experienced further upstream in the channel with Alternative 3 compared to Alternative 2, the substantial mixing in the estuary would mean deepening the channel to -38 feet MLLW versus -37 feet MLLW will have a negligible effect on salt wedge dynamics.

4.3 Aquatic and Terrestrial Vegetation

4.3.1 Overview

This section discusses potential impacts of the proposed action on eelgrass, macroalgae, and salt marsh and dunegrass habitats found in Grays Harbor.

The proposed action could have direct effects on vegetation in Grays Harbor as well as indirect impacts by increasing turbidity, which reduces available light necessary for photosynthetic growth.

4.3.2 Methods

This analysis is based on review of available literature concerning aquatic vegetation distribution in Grays Harbor, including recent studies, and describing the environmental requirements of eelgrass, macroalgae, salt marsh, and dunegrass vegetation. A general assessment regarding the impacts that the proposed action could have on aquatic and terrestrial vegetation was based on consideration of the area of potential impacts due to dredging and the proximity of dredging and placement activities to habitats that are likely to support eelgrass, macroalgae, salt marsh, or dunegrass vegetation. Depositional and erosional forces are discussed in more detail in Section 3.2, *Geomorphology* (Affected Environment), and Section 4.2, *Geomorphology* (Environmental Consequences).

4.3.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

4.3.3.1 Eelgrass

The maximum depth at which eelgrass grows is dependent on the availability of suitable substrate, acceptable current velocity, and light penetration. Eelgrass is found in only the shallowest portions of Grays Harbor. Under baseline conditions, dredging occurs only in the navigation channel, which is currently maintained to a depth of −36 feet MLLW, deeper than where eelgrass is found and where light levels and shifting substrate do not provide suitable eelgrass habitat. Underwater video near the South reach recorded in 2008 indicates quickly shifting sands, high tidal current, and low light levels that are unable to support eelgrass (U.S. Army Corps of Engineers 2008). Thom et al. (2008) report −1.5 meters (−4.9 feet) as the upper depth limits of eelgrass in nearby Willapa Bay. Because dredging occurs well below this depth, no direct impacts on eelgrass beds would occur as a result of dredging. Dredged material placement sites are either too deep or have too dynamic substrates to support eelgrass beds under baseline conditions.

Short-term localized increases in turbidity due to dredging and dredge material placement may occur during dredging activities. For example, two exceedances of turbidity thresholds were reported in 2008 during maintenance dredging by clamshell in the inner navigation channel (U.S. Army Corps of Engineers 2008). These increases in turbidity may result in settlement of suspended sediments onto nearby eelgrass beds, which could reduce photosynthetic ability of the plants by blocking sunlight. These impacts are anticipated to be rare and of short duration. Wave action and tidal currents would likely wash the sediments from the eelgrass fronds returning their photosynthetic ability to a normal range within two or three tidal cycles (1 to 2 days) or less.

Placement of dredged material at any of the dredged material placement sites would also have no impact on eelgrass because eelgrass beds are unable to grow near the placement sites due to the depths and/or the shifting nature of the sediments in the highly dynamic areas of Grays Harbor. Potential impacts to eelgrass would be minor and localized.

4.3.3.2 Macroalgae

Macroalgae beds are not found within the navigation channel or the dredged material placement sites under baseline conditions. Indirect impacts due to siltation are also not likely because the silty sandy sediments of the navigation channel and nearby mudflats do not support macroalgae attachment and growth. Consequently, no direct impacts would occur on macroalgae due to dredging and dredged material placement under Alternative 1.

4.3.3.3 Salt Marsh

Under baseline conditions, dredging of the navigation channel and placement of dredged material at the open water placement sites would not have any effect on salt marsh because salt marsh vegetation occurs only in the shallowest of water along the outer edges of Grays Harbor, far removed from the open water placement sites and navigation channel. No salt marsh is located near the Half Moon Bay or South Beach nearshore sites or at the upland disposal sites so any placement at these sites similarly would not affect salt marsh habitat.

4.3.3.4 Dunegrass

Under baseline conditions, dredging of the navigation channel and placement of dredged material at the upland placement site at the Point Chehalis Revetment Extension (mitigation site) would not affect dunegrass habitats, because dredged materials are not placed on the vegetated sand dunes. The Point Chehalis Revetment Extension mitigation site is supplied with dredged material when quantities there are low and when upland placement is feasible (typically requires a hydraulic dredge). While dunegrass in the Damon Point area (nearly 2 miles north of the navigation channel) provides critical nesting habitat for the snowy plover, a Federally listed shorebird, no plovers are known to exist in the dunes along the south shores of Grays Harbor and therefore there would be no potential impacts to plovers (Section 3.5, *Threatened and Endangered Species*).

4.3.3.5 Sweet Grass

Under baseline conditions, dredging of the navigation channel and placement of dredged material at the upland placement sites at the Point Chehalis Revetment Extension mitigation site would not affect sweet grass habitats, because dredged materials are not placed on intertidal flats, along the shoreline of Bowerman Basin or within the Grays Harbor National Wildlife Refuge where sweet grass is known to occur (see Section 3.3, *Aquatic and Terrestrial Vegetation*).

4.3.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Alternative 2 would deepen the navigation channel 1 foot, to a depth of −37 feet MLLW, allowing for 2 feet of advanced maintenance and 2 feet of allowable overdepth (a 2.5% increase beyond baseline conditions in the affected reaches). As described in Chapter 2, *Alternatives*, deepening the channel an additional foot would require an additional 1,031,000 cubic yards of dredging during the initial deepening (approximately 954,00 cubic yards total for the inner harbor reaches and 77,000 cubic yards total for the outer harbor reaches). Subsequent maximum annual maintenance dredging volumes are estimated to increase by a relatively small amount (50,000 cubic yards) compared to baseline conditions.

Because macroalgae and saltmarsh vegetation do not occur near the navigation channel or at the dredged material placement sites, deepening the navigation channel to −37 feet MLLW under Alternative 2 would not result in direct or indirect impacts on these resources.

Short-term increases in turbidity due to dredging and dredge material placement may occur during dredging activities and would have the same potential for settlement of suspended sediments onto nearby eelgrass beds as could occur under Alternative 1. These impacts are anticipated to be not typical and of short duration. Turbidity is monitored during clamshell operations in accordance with the Ecology issued Water Quality Certification, and as discussed in Section 4.4.3.1 turbidity levels generally return to ambient conditions quickly and relatively little material separates from the plume as it descends through the water column when a clamshell dredge and bottom-dump barge are used. These impacts are a function of a single lift of the clamshell and are monitored as such. Multiple lifts and additional volumes dredged would not affect this conclusion. Additionally, within the high energy environment of Grays Harbor wave action and tidal currents would likely wash any sediments from the eelgrass fronds returning their photosynthetic ability to a normal range within two or three tidal cycles (1 to 2 days) or less. Hopper dredge pump ashore at the Point Chehalis Buried Revetment would be conducted to avoid macroalgae, eelgrass and terrestrial vegetation as much as practicable.

If a temporary hydraulic pipeline is laid from the Half Moon Bay intertidal zone to the Point Chehalis Revetment Extension mitigation site, dunegrass along that corridor would be avoided to the extent possible. Sweet grass is not expected to be present in this location. Therefore, the incremental potential for effects on aquatic or terrestrial vegetation under Alternative 2, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, is expected to be minor and localized.

4.3.5 Alternative 3—Deepen Channel to −38 Feet MLLW

Alternative 3 would deepen the navigation channel by 2 feet, to a depth of −38 feet MLLW, and allow for 2 feet of advanced maintenance and 2 feet of allowable overdepth. Thus, Alternative 3 would increase the depth of the navigation channel by 5% compared to baseline conditions. The initial dredging required to deepen the navigation channel under Alternative 3 would require an additional 1,972,000 cubic yards of dredged material, and subsequent annual maintenance dredging volumes attributable to the deepening are estimated to increase by approximately 107,000 cubic yards compared to baseline conditions.

Because macroalgae and saltmarsh vegetation do not occur near the navigation channel or at the dredged material placement sites, deepening the navigation channel to −38 feet MLLW under Alternative 3 would not result in direct or indirect impacts on these resources.

Short-term increases in turbidity due to dredging and dredge material placement may occur during dredging activities and would have the same potential for settlement of suspended sediments onto nearby eelgrass beds could occur as under Alternative 2 . These impacts are anticipated to be not typical and of short duration. Wave action and tidal currents would likely wash the sediments from the eelgrass fronds returning their photosynthetic ability to a normal range within two or three tidal cycles (1 to 2 days) or less.

The increased volume of dredged material compared to Alternatives 1 and 2 do not represent an increase in turbidity because, as discussed in Section 4.4.3.1 the Corps monitors turbidity to not exceed Ecology Water Quality Certification requirements. If a temporary hydraulic pipeline is laid from the Half Moon Bay intertidal zone to the Point Chehalis Revetment Extension mitigation site, dunegrass along that corridor would be avoided to the extent possible. Sweet grass is not expected to be present in this location. Therefore, the incremental potential for effects on aquatic or terrestrial vegetation under Alternative 3, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, and above Alternative 2 is expected to be minor and localized.

4.4 Invertebrates, Fish, and Wildlife

4.4.1 Overview

This section addresses how the proposed action could potentially affect invertebrates, fish, and wildlife resources. Dredging and placement of dredged materials have the potential to entrain, disturb, and alter habitat of invertebrates, fish, and wildlife that occur in Grays Harbor. Species listed as threatened or endangered under the Endangered Species Act are discussed in Section 4.5, *Threatened and Endangered Species*.

4.4.2 Methods

The potential effects of the proposed action were evaluated in the context of incremental impacts added to the environmental baseline (Alternative 1) under which the navigation channel is maintained at a depth of −36 feet MLLW by annual maintenance dredging. The Alternative 1 analysis considers the timing, duration, volume, and extent of dredging and dredged material placement activities that occur in any given year under baseline conditions, and the effects of these activities on invertebrate, fish, and wildlife species, and their habitats.

This analysis is based on a qualitative review of dredge impact literature, as well as a review of documents prepared for the Corps related to the occurrence and potential for impacts from dredging and placement on various invertebrate, fish and wildlife species in Grays Harbor. This analysis is organized around discussion of the following environmental effects: bed disturbance, water quality impacts, underwater noise, in-air noise, and entrainment. Following the general effects analysis are sections outlining more specific effects to particular species and species-groups that may have life stages present in Grays Harbor.

4.4.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of –36 Feet MLLW

Under Alternative 1, dredging and placement activities would continue per baseline conditions—same equipment, process, time period, and duration—as described in Chapter 2, *Alternatives*. Dredged material would be placed at the established placement sites, including open-water placement as appropriate and consistent with the results of the annual DMMP sediment suitability determinations.

4.4.3.1 Water Quality

Under Alternative 1, short-term localized increases in turbidity and reductions in dissolved oxygen (DO) levels could occur during maintenance dredging and the placement of dredged materials, as outlined in the 2011 maintenance dredging EA (Corps 2011). The severity and duration of potential turbidity and DO effects would be related to the type of sediment dredged and the type of dredge used. Sediments dredged from beneath the substrate surface could have some incompletely decomposed organic material that would consume DO when it is exposed during dredging and placement activities. There would be some resuspension of sediment into the water column during dredging and disposal. Dispersal and resuspension of these sediments results from the impact of the clamshell on the bottom and its subsequent withdrawal from the channel bottom through the water column to place the material in a waiting barge. The resuspension of sediment would decrease with distance from the Chehalis River because the fine grain content of the sediment decreases with distance from the Chehalis River.

In contrast, the hydraulic hopper dredges used in the outer harbor reaches hydraulically suction material and then transfer it to a hopper bin, resulting in far less suspended sediments arising from substrate disturbance. In addition, the bed materials in the outer harbor reaches have a coarser grain size on average and are subject to regular disturbance by strong tidal currents that limit the potential for development of anaerobic conditions. Consequently, the potential for water quality degradation is highest during dredging of the inner harbor reaches where a clamshell dredge is used on fine-grained bed materials.

Turbidity

Dredging-related turbidity impacts in Grays Harbor have periodically been monitored to assess the potential for adverse effects on aquatic resources. Turbidity can interfere with social behavior (Berg and Northcote 1985), foraging (Gregory and Northcote 1993; Vogel and Beauchamp 1999) and predator avoidance (Miner and Stein 1996; Meager et al. 2006) of fish and wildlife. Choker Research at Grays Harbor College monitored water quality during maintenance dredging of the inner harbor reaches in the summer of 1990 (Phipps et al. 1992). Samples were taken at 34 representative sites under a wide range of tidal current conditions. Out of 600 samples, 23 samples registered a value of total suspended solids (TSS) higher than 500 mg/L. Seven of these 23 elevated TSS samples resulted from measurements of ambient conditions. The highest value of TSS was 3,000 mg/L (the associated ambient measurement was 700 mg/L). The higher TSS values were predominantly measured in the lower one-third of the water column.

The Corps monitored turbidity associated with clamshell dredging in the inner harbor reaches in 2008 (Jones & Stokes 2008). Minor periodic exceedances of turbidity standards were observed during dredging activities, as determined by the terms of the Section 401 water quality certification

issued by Ecology. Any exceedances are addressed in accordance with a water quality monitoring plan developed in coordination with Ecology. This water quality monitoring plan utilizes a progressive sequence of increasingly aggressive reactive and management practices to minimize and resolve any observed exceedances.

Placement of dredged material can also result in elevated turbidity levels. During monitoring at other disposal sites across the country, maximum concentrations of suspended sediments observed during dredged material placement activities were less than 1,000 mg/L (Pequegnat 1983). Truitt (1986) found that very little suspended sediment persists near the surface or mid-water during placement of dredged material. The highest concentrations tend to occur in near-bottom waters, and are typically much lower (less than 200 mg/L) in mid- and upper water depths. Turbidity levels generally return to ambient conditions quickly and relatively little material separates from the plume as it descends through the water column when a clamshell dredge and bottom-dump barge are used. Material released from a hopper dredge has a far higher sand and water content and far less fine material, because the hopper dredge is used only in the outer harbor reaches, which inherently have more sand and less fine material. Thus, less turbidity is generated compared to bottom-dump barge release. Also, the material from both hopper and clamshell dredging is primarily disposed of at open-water dispersive sites and is expected to mostly disperse as it falls through the water column with little material settling to the bottom in the immediate area of the placement site.

The dredged material slurry hydraulically transported to the Point Chehalis Revetment Extension mitigation site would be fully contained within a bermed location. The slurry would temporarily pond, and sediments would be allowed to settle out of solution. The decant water would be collected and conveyed to a discharge point at the exposed rock revetment near Groin A, and returned to Half Moon Bay via an effluent pipe. In light of the highly dynamic conditions of the eastern shoreline of Half Moon Bay and the elevated background levels of turbidity, turbidity effects are expected to be minor and the Corps expects to fully comply with the 300-foot mixing zone requirement in the Water Quality Certification applicable to material placement at the Point Chehalis Revetment Extension mitigation site.

Some portion of the marine sands material placed upland at the Point Chehalis Revetment Extension mitigation site is expected to subsequently erode and enter the intertidal zone at Half Moon Bay through natural processes, and thus contribute to the littoral system. This erosion would mimic natural mechanisms with indigenous materials, and is thus expected to generate negligible turbidity or other water quality effects.

Dissolved Oxygen

The disturbance of bed sediments during dredging and dredged material placement can result in localized reduction of DO levels, primarily as a result of the exposure and resuspension of fine-grained anaerobic sediments. Anaerobic sediments create an oxygen demand when suspended in the water column that can rapidly decrease DO levels. Decreased DO levels can cause behavioral changes, restrict habitat access, and under extreme conditions, suffocate aquatic organisms. The potential for this to occur is minimal in the outer harbor reaches, because the sediments in this area are relatively coarse and highly mobile with low organic material content due to high tidal current velocities. Sediments from the inner harbor reaches are less mobile and fine grained, which suggests greater potential for DO effects. However, site-specific research indicates this effect is minimal.

Choker Research measured DO levels within dredge-related turbidity plumes at points ranging from 100 to 150 meters from a dredge operating in the inner harbor reaches. They found DO levels comparable to ambient conditions (Phipps et al. 1992). The differential between DO levels in the dredge plumes and ambient areas were within 1 to 2 mg/L of each other with most readings above 6 mg/L (Phipps et al. 1992), which is considered the threshold for excellent marine water quality (WAC 173-201A-210).

In comparison to dredging, the placement of sediments from the inner harbor reaches is far less likely to affect DO concentrations, particularly in the middle and upper portions of the water column. A clamshell dredge is used to remove sediments, which keeps the sediment consolidated and strains out most of the water before it is placed in the barge. This minimizes the tendency of the material to become resuspended in the water column. Moreover, the open-water placement sites have been specifically located in areas with high current conditions that quickly disperse any localized water quality effect.

Sediment Contamination

The primary sources of the sediments removed by maintenance dredging are the Chehalis River and nearshore drift originating in the Columbia River basin, as well as the mobilization and repositioning of existing highly mobile bed sediments. As a result, these sediments are characterized by contaminant levels that are typically below detection limits or, when they are detected at measurable concentrations, they are usually present at levels below thresholds set to protect aquatic life. This conclusion is based on the results of sediment sampling and related bioassay tests (Appendix A). Because the existing sediment standards are designed to be protective of organisms that come into contact with sediments, concentrations and bioavailability of contaminants in sediments suspended during dredging and placement of dredged material are expected to be below levels that could cause harm to organisms.

4.4.3.2 Underwater Noise

Underwater noise levels produced by dredging are relatively quiet in comparison to other noise sources like pile driving (Washington State Department of Transportation 2013). The area affected by elevated underwater noise is determined by calculating the distance required to attenuate each dredging-related noise to an estimated ambient noise level of 123 dB_{RMS} at 1 micro-Pascal (μPa), the median of observed values in areas of Puget Sound subject to equivalent levels of vessel traffic. Background underwater noise levels and baseline noise levels produced by dredging activities are shown in Table 4.4-1.

Table 4.4-1. Dredging-Related Underwater Noise Levels by Equipment Type and Distance from Source to Fish Behavioral Disturbance Threshold and Ambient Noise Levels in Grays Harbor

Noise Source	Underwater Noise Level[a]	Distance between receptor and source at which the disturbance threshold is exceeded [b]	Distance from source at which noise level is attenuated to ambient levels	Source
Ambient conditions	123 dB_{RMS}	N/A	N/A	Mid-range of observed ambient noise levels in Puget Sound (Washington State Department of Transportation 2013)
Clamshell dredge	142 dB_{RMS} @ 33 feet (10 meters)	10 feet	604 feet	Calculated from observed clamshell dredge noise levels using practical spreading loss formula (Dickerson et al. 2001; Washington State Department of Transportation 2013)
Cutterhead dredge[c]	135 dB_{RMS} @ 33 feet (10 meters)	3 feet	223 feet	Calculated from observed cutterhead dredge noise levels using practical spreading loss formula (Clarke et al. 2002; Washington State Department of Transportation 2013)
Hopper dredge	140 dB_{RMS} @ 33 feet (10 meters)	7 feet	448 feet	Calculated from observed cutterhead dredge noise levels using practical spreading loss formula (Clarke et al. 2002; Washington State Department of Transportation 2013)

[a] Root mean square decibels (dB_{RMS}) @ 1 micro Pascal (μPa).
[b] Underwater noise behavioral disturbance threshold for fish and marbled murrelet = 150 dB_{RMS}.
[c] Cutterhead dredge not proposed for this project.

The area in which adverse effects could occur is estimated by calculating the distance required to attenuate dredging equipment noise to 150 dB_{RMS}, the standard behavioral disturbance threshold for fish and marbled murrelet used by NMFS and USFWS for Section 7 consultation (Washington State Department of Transportation 2013). Dredging-related noise levels at the standard reference distance of 33 feet (10 meters) from the source are below the disturbance thresholds used by NMFS and USFWS to identify potential adverse effects on fish and diving birds (Washington State Department of Transportation 2013). Exposure to underwater noise levels in excess of these disturbance thresholds would require an organism to be within 10 feet of a clamshell dredge.

The behavioral disturbance threshold for marine mammals is estimated at 120 dB_{RMS} for continuous noise and 160 dB_{RMS} for pulsed noise (Table 4.4-2). Clamshell dredging is generally considered continuous noise by NMFS. Because ambient underwater noise levels exceed the marine mammal behavioral disturbance threshold for continuous noise, the distance at which the noise level attenuates to ambient levels is used as the criterion for determining the zone of potential adverse effects. Clamshell dredging noise, the loudest of the project's underwater noise sources, has been shown to dissipate to ambient levels of 123 dB_{RMS} within approximately 600 feet of dredging activities (Clarke et al. 2002).

Table 4.4-2. Marine Mammal and Fish Injury and Disturbance Thresholds for Marine Construction Activity

Functional Hearing Group	Airborne Noise Thresholds*	Underwater Noise Thresholds*		
	In air Sound Pressure Level (RMS)	Vibratory Pile Driving Disturbance Threshold (continuous noise)	Impact Pile Driving Disturbance Threshold (pulsed noise)	Injury Threshold
Cetaceans	NA	120 dB RMS	160 dB RMS	180 dB RMS****
Pinnipeds	Disturbance: 90 dB RMS (un-weighted) for harbor seals, and 100 dB RMS (un-weighted) for sea lions and all other pinnipeds (re: 20 $\mu Pa^2 sec$)**	120 dB RMS	160 dB RMS	190 dB RMS****
Fish ≥ 2 grams	NA	Behavior effects threshold 150 dB RMS***		187 dB Cumulative SEL«
Fish < 2 grams	NA			183 dB Cumulative SEL«
Fish all sizes	NA			Peak 206 dB

***** Noise levels measured in air are typically used to assess impacts on humans and thus are weighted (A-weighting) to reduce the contribution of low and high frequencies and correspond to how humans hear. Noise levels measured underwater are not weighted and thus measure the unaltered frequency range of interest, which may extend below and above the audible range of many organisms.

****** (email) on March 11, 2009 National Marine Fisheries Service, Office of Protected Resources, 1315 East-West Hwy, Rm 3525, Silver Spring, MD 20910. This is the in air SPL at which pinniped haulout disturbance has been documented.

******* Hastings 2002

RMS - Root-mean-square: For pile driving, this is the square root of the mean square of a single pile driving impulse pressure event.

******** Source: Southal et al. 2007; 71 FR 3260 Jan. 20, 2006

«Source: NOAA and USFWS Memorandum on the Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities, June 12, 2008 (available: http://www.wsdot.wa.gov/Environment/Biology/BA#Noise)

Ambient background noise and noise attenuation from the soft sediments in Grays Harbor would likely reduce the distance at which clamshell dredge noise attenuates to background levels. In addition, the low-frequency noise made by operating hopper dredges is not believed to mask calling and echolocation capabilities of dolphins and porpoises that rely on higher frequency sound (Clarke et al. 2002; Talus 2000). Because dredge vessels are typically stationary or slow-moving, marine mammals can readily avoid these vessels by a distance of 600 feet and thus direct disturbance of marine mammals is unlikely to cause alarm or displacement.

While noise measurements of dredging activities are somewhat rare in the literature, dredging is considered to be a low impact activity for marine mammals, producing non-pulsed sound and being substantially quieter in terms of acoustic energy output than sources such as seismic airguns and impact piledriving (78 Fed. Reg. 30873, 30875, May 23, 2013 "Takes of Marine Mammals Incidental to Specified Activities"). Noise produced by dredging has been compared to that produced by a commercial vessel travelling a modest speed (Robinson et al. 2011, as cited in 78 Fed. Reg. 30873, 30875, May 23, 2013). The NMFS has generally considered the effects of dredging on marine mammals to remain below the level of a take (78 Fed. Reg. 30873, 30875, May 23, 2013). Therefore,

underwater noise impacts of dredging operations under Alternative 1 at Grays Harbor are expected to be minor.

4.4.3.3 In-Air Noise

The annual maintenance dredging operation would produce in-air noise associated with vessel operation and positioning, operation of dredge equipment, and dredged material placement. In-air noise produced by these activities was calculated from available information on noise levels (Geier & Geier Consulting, Inc. 1997) and standard methods for calculating in-air noise attenuation (Federal Transit Administration 2006). Clamshell dredging was selected as the basis for this analysis, because it is typically the loudest type of dredging equipment and would therefore produce the farthest reaching effects. Noise levels produced by clamshell dredging are estimated at 88 dBA at a reference distance of 50 feet from the source. Large trucks used for upland dredged material placement produce similar or lower noise levels than dredging activities, typically 75 to 80 dBA depending on type (Washington State Department of Transportation 2013).

Ambient noise levels were assessed to be in the range of 50 to 60 dBA in the open-water portions of Grays Harbor, based on prevailing wind, waves, vessel traffic, and noise from adjacent roadways, which equates to light auto traffic at 100 feet or conversational speech (Washington State Department of Transportation 2013).

The noise levels generated by dredging are below the in-air noise disturbance thresholds of 92 dBA for marbled murrelet, and spotted owls, and the 100 dB_{RMS} for Steller sea lion (approximately 110 dBA) (Washington State Department of Transportation 2013). These levels were established by NMFS and USFWS for consideration of noise impacts on threatened and endangered species. The thresholds are applicable to the wide variety of seabirds and marine mammals that could be present in Grays Harbor during dredging activities and indicate a low potential for behavioral disturbance to wildlife.

4.4.3.4 Bed Disturbance and Entrainment

Bed disturbance results in the entrainment and likely mortality of benthic organisms that are slow-moving or immobile. This affects primarily prey organisms and the species that rely on benthic organisms as a food source. The slow nature of clamshell dredging allows most organisms the opportunity to escape entrainment and mortality during dredging. Some benthic and epibenthic organisms such as bivalves, mollusks, polychaetes, crustaceans, and other non-motile or very slow-moving organisms are entrained by clamshell dredging. Given the limited area being affected by dredging and dredged materials placement at any given time, and the ability of the benthic community to rapidly recolonize disturbed habitats, dredging activities have typically not been associated with long-term adverse effects that could result in a reduction in the availability of prey resources. Several studies have demonstrated that benthic organisms rapidly recolonize habitats disturbed by dredging and dredged materials placement and return these habitats to reference conditions (McCabe et al. 1996; Quian et al. 2003; Richardson et al. 1977; Van Dolah et al. 1984), including a site-specific study of the effects of dredged material placement at the Half Moon Bay site (Nakayama et al. 2005).

Planktonic larval stages of fish and oysters that are found in Grays Harbor are entrained at unknown rates. However, organisms with planktonic larval stages generally broadcast large numbers of juveniles that rely on currents to transport them to suitable habitats. During this passive transport, planktonic larvae experience extremely high natural mortality due to predation and exposure to

unsuitable environments. In comparison to these common environmental effects, entrainment of larval stages during dredging is typically not considered to have a long-term adverse effect on populations of these organisms.

4.4.3.5 Effects on Invertebrates

Effects on invertebrates listed under the Endangered Species Act (i.e., Oregon silverspot butterfly) that may occur in Grays Harbor are presented in Section 4.5, *Threatened and Endangered Species*.

Sessile, benthic, and epibenthic organisms within the sediments of the navigation channel that cannot move fast enough to avoid the capture of sediment by the clamshell bucket or hydraulic cutterhead dredge are entrained and experience high mortalities. Similarly, any such organisms present in the sediment of the open-water placement sites are smothered under dredged material when it is placed in those locations. Such organisms typically include polychaetes (worms), crustaceans (crabs/shrimp), mollusks (clams/oysters/mussels), cnidarians (anemones), scyphozoans (jellyfish) and echinoderms (starfish/sea urchins/sand dollars). However, the species of invertebrates adapted to the high-energy, shifting sediments of Grays Harbor are able to quickly recolonize areas of disturbance such as occurs during dredging and placement of dredged materials. Nakayama et al. (2005) surveyed Half Moon Bay before and after placement of materials and showed a rapid recovery of the benthic community. The infaunal community in Grays Harbor and Chehalis River Navigation channel would experience disruption during each dredge event. Because of recolonization by invertebrates and the small area of Grays Harbor that is affected the effects are not considered adverse.

4.4.3.6 Effects on Dungeness Crabs

The previous channel deepening project (1990) dredged nearly 11 million cubic yards from the navigation channel and the 1989 EISS estimated that 156,750 age 2+ crabs would be lost to the fishery from the initial construction, and additional crabs would be lost due to annual maintenance dredging (U.S. Army Corps of Engineers 1989). Prior to the 1990 deepening, numerous research projects were funded by the Corps to better define and understand the Grays Harbor Dungeness crab population dynamics and dredge impacts. Using the best available science, the University of Washington School of Fisheries developed the Dredge Impact Model (DIM) (Armstrong et al. 1987). This model integrated crab population data on age, season, and location with dredging gear type, volume dredged, and dredging season and location. An entrainment function was empirically derived from data on dredge-specific crab entrainment and resulting mortality. Projected crab losses of all ages were then adjusted for natural mortality to yield an equivalent adult loss to the fishery (unfished female losses were set equal to commercial sized males). The Corps has used this model to select dredge gear type and seasons for dredging at specific locations in such a way as to minimize crab losses. Remaining unavoidable losses of crabs were then mitigated by placement of intertidal oyster shell beds to provide new refuge habitat for age 0+ crabs. The number of 0+ crabs required for replacement of an adult crab was determined using the best data available to calculate natural mortality rates.

The concept of using oyster shell as artificial habitat was first suggested by University of Washington researchers when they observed high densities of young of the year crabs amongst piles of shells of eastern softshell clams (*Mya arenaria*). A series of pilot studies subsequently proved that artificial oyster shell plots deployed in Grays Harbor also served as preferred habitat for young of year Dungeness crabs (Dumbauld and Armstrong 1987; Armstrong et al. 1992; Dumbauld et al.

1993). The Corps first constructed full scale oyster shell mitigation plots in 1992 when almost 9 hectares of shell were placed in several Grays Harbor locations. By 1995, the amount of shell deployed had risen to almost 24 hectares. Dinnel Marine Research (1996) provides a historical perspective and analysis of the success of this program. Although shell mitigation efforts suffered from several significant problems (e.g., shell sinkage, escalating shell cost, competing species such as *Hemigrapsus* crabs) this program has shown to have produced 546,173 age 2+ crabs since 1990 (Table 4.4-3), and has offset earlier unavoidable impacts of age 2+ crabs for an estimated cumulative increase of 16,609 adult crabs in 2013(Table 4.4-3).

Table 4.4-3. Total of Cumulative Dredging Impacts on Adult (Age 2+) Dungeness Crab versus Mitigation Effect.

Year	Estimated Impact (loss)	Credit for clamshell dredge use	Adult 2+ Production	Net Impact	Cumulative Impact
1990	(156,750)	0	1,810	(154,940)	(154,940)
1991	(54,973)	0	5,329	(49,644)	(204,584)
1992	(60,497)	4,758	53,245	(2,494)	(207,078)
1993	(35,758)	21,200	730	(13,828)	(220,906)
1994	(18,624)	0	26,945	8,321	(212,585)
1995	(7,179)	3,358	35,957	32,136	(180,449)
1996	(15,275)	30,019	16,709	31,453	(148,996)
1997	(3,611)	1,867	4,550	2,806	(146,190)
1998	(15,066)	11,133	25,667	21,734	(124,456)
1999	(20,100)	26,067	23,413	29,380	(95,076)
2000	(28,353)	17,975	56,379	46,001	(49,075)
2001	(18,808)	3,339	39,311	23,842	(25,233)
2002	(31,001)	5,023	8,147	(17,831)	(43,064)
2003	(16,774)	10,931	46,459	40,616	(2,448)
2004	(23,849)	11,500	22,018	9,669	7,221
2005	(31,403)	8,701	31,234	8,532	15,753
2006	(18,589)	5,621	45,746	32,778	48,531
2007	(18,589)	5,621	4,578	(8,390)	40,141
2008	(23,657)	11,526	21,958	9,827	49,968
2009	(32,612)	13,533	14,133	(4,946)	45,022
2010	(16,427)	6,927	15,337	5,837	50,859
2011	(24,128)	4,550	17,226	(2,352)	48,507
2012	(26,907)	0	14,646*	(12,261)	36,246
2013	(34,283)	0	14,646*	(19,637)	16,609
Total	-733,213	203,649	546,173	16,609	

Notes: *Production estimated for 2012 and 2013 using the average from 2007–2011.
All units are in numbers of adult (age 2+) crabs.
Source: For data 1990-2011 see Visser 2012 (Discrepancies between Visser 2012 data and Table 4.4-3 are due to updated Corps dredging data, and mathematical errors in that consultant's 2012 report).

The crab mitigation program, as described in the 1989 SEIS, was based on several years of research in Grays Harbor. It was not, however, based on actual dredging or a full scale mitigation experience.

In the several years after project construction it was determined that assumptions basic to the original mitigation calculations were incorrect, costs of shell rose significantly, and demand for sediment for beneficial uses altered maintenance practices. These factors contributed to a deficit in the crab mitigation program, with crab impacts rising higher than expected and crab replacement falling behind.

To address these disparities, representatives from the Corps, Ecology, WDFW, EPA, Quinault Indian Nation, USFWS, and the NMFS convened a Crab Mitigation Work Group to evaluate the overall mitigation program. The purpose of the Work Group was to review the Dungeness crab mitigation plan developed for the 1990 deepening project, evaluate crab mitigation efforts to date, and devise a strategy for future mitigation efforts. The result was the 1998 Revised Crab Mitigation Strategy Agreement (RCMSA) (Appendix E).

The 1998 RCMSA was developed in order to balance the cost of maintenance dredging and mitigation with the associated risk to the resource. The resulting strategy refined avoidance and mitigation methods in light of several years of biological monitoring, shell placement, and dredging experience. The strategy emphasizes maximizing impact avoidance by limiting dredging within the inner harbor reaches (including Inner Crossover Reach and inward) to clamshell only (the Corps later added the Outer Crossover reach to areas available for clamshell dredging), and established work windows for each section (Chapter 2, Table 2-1) to avoid periods of high crab abundance. The agreement limits dredging to only the minimal amount necessary for navigation needs, regardless of government hopper dredge schedules. The agreement also established credit for method avoidance (use of clamshell with lower entrainment and mortality over a hopper dredge in the Cross-over and South Reaches). In accordance with the 1989 SEIS, as also reflected in the 1998 RCMSA, only crabs lost to maintenance of the widened and deepened portion (incremental maintenance) are subject to mitigation. Thus, crabs lost during historic, non-incremental dredging (represented by the volume of average cubic yards dredged over the period 1981 to 1989) are not subject to mitigation. The agreement also concluded that any changes in dredging equipment that avoid crab in the incremental portion also avoid large numbers of crabs usually lost to non-incremental dredging, and crabs "saved" in the non-incremental volumes by use of clamshell dredge in Crossover and South reaches would be credited against both historic and present impacts. The RCMSA stipulates the use of the University of Washington dredge impact model (DIM) to quantify both impacts and production.

The dredge impact model predictions were based on projected dredging schedules for construction, and crab abundance in different areas of the channel in different seasons of the year. The model was run for maintenance dredging, based on volumes currently dredged to maintain the channel at -36 feet MLLW in the affected reaches. The DIM results (Table 4.4-3) indicate that predicted Dungeness crab losses as a result of maintenance dredging under Alternative 1 are minimal and show little impact to harvestable size crabs (age 2+) for the dredging volumes estimated to maintain each respective reach of the channel at -36 feet MLLW (approximately 67 crabs, prior to applying credit for use of clamshell in accordance with the 1998 RCMSA). The resulting low impacts to Dungeness crab populations for maintenance dredging is primarily driven by the reduced volumes dredged in the areas of higher quality crab habitat and historically higher crab populations (outer harbor reaches), and the exclusive use of clamshell dredging in the entire Crossover reach (both inner and outer Crossover reaches) versus the historic maintenance dredging (using hopper dredge in entire Cross over Reach) conducted between 1981 and 1989 and used as the benchmark parameters underlying the RCMSA. If the Outer Cross-over Reach were to be hopper dredged (clamshell is the preferred and expected method) the estimated impacts to crabs would go up by approximately 560

crabs and the estimated credit for clamshell use would go down by just over 2,400 crabs (crab impacts of 562; credit of 3,919).

Table 4.4-4. Dredge Impact Model (DIM) Estimates of Age 2+ Crabs Lost Due to Dredging for Alternative 1

Grays Harbor Navigation Channel Reach	Historic Maintenance Volumes (cy (average 1981 to 1989)	Dredge Volume (cy)Estimated to Maintain Channel at -36 feet MLLW[a]	DIM Model of Crab Loss Impacts for -36 feet Clamshell use in Outer Crossover Reach	Credits for -36 feet with Clamshell dredge use in Outer Crossover Reach	DIM Model of Crab Loss Impacts for -36 feet Hopper Dredge use in Outer Crossover Reach	Credits for -36 feet with Hopper dredge use in Outer Crossover Reach
South Reach	474,000	190,000	-0		0	
Crossover Reach[b]	486,000	610,000	-10	6,375	-505	3,919
N. Channel (Moon Is.)	144,000	175,000	-3		-3	
Hoquiam Reach	85,000	150,000	-5		-5	
Cow Point	374,000	965,000	-49		-49	
Total	1,563,000	2,090,000	-67	6,375	-562	3,919

[a] Dredge volume is the amount estimated to maintain the channel at -36 feet MLLW[b] Includes both inner and outer crossover reaches , as estimated by DIM

Population estimates for Grays Harbor Dungeness crab have been estimated in the range of 3-28 million (see discussion in Section 3.4.2.1). This suggests that impacts as calculated by the DIM, in accordance with the 1998 RCMSA, from annual maintenance dredging on Dungeness crab may represent less than 1% of the total Dungeness crab population in Grays Harbor under the current dredging scenario. This would likely have little impact on the total Dungeness crab population of Grays Harbor.

Concerns about potential impacts on Dungeness crabs from dredged material placement operations during the project would include: burial effects, toxic effects, and direct effects on crab fishing. Burial effects on Dungeness crab are expected to be minimal and transient. Material placement sites and dredge placement operations have been designed through location and timing to avoid areas of high crab densities that were identified during ocean surveys (Pearson, et al. 1987). The dredge timing (see table 2-1) is scheduled to avoid times when large numbers of crabs would be present at both the dredge sites and the material placement sites. The Point Chehalis site is the most heavily used placement site in Grays Harbor. For the inner harbor reaches, material is typically deposited at the South Jetty or Point Chehalis sites, while for the outer harbor reaches, three beneficial use sites (Half Moon Bay nearshore nourishment, Point Chehalis Revetment Extension mitigation site, and South Beach nearshore nourishment site) and the Point Chehalis site are primarily utilized. Inner harbor reaches are dredged and material is placed from July 16 to February 14, and the outer hopper dredged channel material is placed primarily from April to May. Any crabs present would be

expected to easily escape from or avoid the material placement sites during disposal activities, and crabs would be expected to recolonize the area within a relatively short period of time. In addition the Corps routinely surveyed the Half Moon Bay nearshore placement site prior to placement activities to ensure that placement did not occur if crab densities exceeded Washington Department of Fish and Wildlife guidance (crab densities less than 750 per hectare, less than 25% of crab100 millimeters or larger are soft shelled, and if a large increase in YOY crab is encountered of any species of rockfish, flatfish, or lingcod is unusually abundant). To date the parameters have never been met to warrant deferment of material placement at Half Moon Bay.

Concerns for potential toxic effects of dredged material placement are addressed by extensive dredge material characterization and suitability testing (see Section 2.2.2.2). The material from Grays Harbor is relatively uncontaminated and is therefore mostly suitable for open-water placement. The latest suitability determination (Appendix A), showed that a vast majority (more than 98%) of the sediments from the inner harbor reaches are suitable for open-water placement (Sections 3.7 and 4.7), and 100% of the material for maintenance dredging to -36 feet MLLW tested suitable for open water placement.

Concerns over direct impacts on crab fishing were raised during preparation of the 1989 Environmental Impact Statement Supplement and were addressed in the document (US Army Corps of Engineers 1989). The Corps actively coordinates with tribal and local commercial crab fishermen to avoid active crab pot sites for all dredging and placement activities.

In accordance with the RCSMA, the Corps has a mitigation commitment of shell placement for future impacts. The production model produced by the University of Washington (DIM) will be used to calculate crab loss impacts and future crab production. The production model has fully accounted for past dredging (Table 4-4.3) impacts and future impacts will continue to be calculated under the RCSMA (Alternative 1 has no impacts to age 2+ crabs, Table 4.4-4). For future impacts arising from maintenance dredging the RCSMA parties, through the Crab Working Group, will evaluate appropriate mitigation measures for cost-effectiveness and efficacy, and will re-evaluate the terms of the Agreement and its mitigation conditions as necessary. This will allow the application of the most current science and information available to determine the most appropriate strategy to address crab impacts of the proposed action in Grays Harbor.

In summary, the impacts of the project on Dungeness crab population in Grays Harbor is an issue of prime importance. The dredging of the seven affected reaches will avoid higher quality crab habitat of the outer reaches, which minimizes impacts under the RCMSA. Inevitably some crab mortalities are expected to occur during the dredging and placement activities, impacts to the population as a whole are anticipated to be minimal.

4.4.3.7 Effects on Salmonids

Effects on salmonids listed under the Endangered Species Act (lower Columbia Chinook, upper Willamette Chinook, and bull trout) that may occur in Grays Harbor are presented in Section 4.5, *Threatened and Endangered Species*.

Juvenile Pacific Coast chum, Southwest Washington coho, Washington Coast Chinook, Washington Coast steelhead, and coastal cutthroat trout may use the nearshore and intertidal habitat in Grays Harbor. These five species occupy similar habitats in their juvenile stage.

Under Alternative 1, dredging operations would occur from early summer to late winter. Dredging would occur away from the nearshore and intertidal areas where juveniles of these five salmonid

species are found and during periods when juveniles of these species are least likely to be present. Thus, entrainment of juvenile salmonids is not typically a concern. Although there may be some localized water quality degradation (e.g., elevated turbidity and reduced DO) in and around the navigation channel and dredged material placement sites, these effects would not extend to habitat used extensively by these salmonid species and would not occur during time periods when they are likely to be present (see Table 2-1 for work windows).

A number of studies at the Port of Tacoma, Port of Seattle, and other locations within urban environments have examined the recolonization of disturbed sediments by benthic invertebrates that serve as an important prey resource for juvenile salmonids (Hiss et al. 1990; Jones & Stokes Associates, Inc. 1990a, 1990b, 1995; Nakayama et al. 2005). The results indicate that recolonization is rapid and that substantial densities of prey are available within a short period (within months) of substrate disturbance.

During their migration from the open ocean to freshwater spawning grounds, adult salmonids may be exposed to dredging and placement of dredged material and localized effects on water quality. However, such effects are considered to be temporary and short-lived due to the localized nature of effects on water quality and the ability of the adult salmon to quickly change direction to avoid such areas, and impacts to salmonids is expected to be minor.

4.4.3.8 Effects on Sturgeon

Effects on sturgeon listed under the Endangered Species Act (green sturgeon) that may occur in Grays Harbor are presented in Section 4.5, *Threatened and Endangered Species*.

Subadult and adult white sturgeon are known to regularly use Grays Harbor during the summer and early fall months (primarily May through October) (Lindley et al. 2011), indicating the potential for direct exposure to the effects of dredging and dredged materials placement under Alternative 1, and indirect effects resulting from impacts on benthic prey organisms. However, the nature of estuarine habitat use by this species suggests that the potential for direct exposure is somewhat limited. Kelly et al. (2007) found that foraging adult and subadult sturgeon in San Francisco and San Pablo Bays remained primarily in waters less than 33 feet (10 meters) in depth, moving on and off of shallow flats with the tidal fluctuations. In contrast, actively migrating sturgeon were typically found in deep-water habitats and exhibited rapid directional movement. The majority of Grays Harbor, specifically the areas outside the navigation channel, consists of shallow-water tidal flats with abundant sturgeon prey resources. The strong preference for this habitat type during estuarine foraging suggests that sturgeon in Grays Harbor will most commonly be found outside of the navigation channel and dredged material placement sites where the direct and indirect effects of Alternative 1 are concentrated.

Under Alternative 1, the potential for direct entrainment of sturgeon is considered to be limited. The adults and subadults are large, powerful swimmers capable of avoiding dredging-related disturbance, a fact illustrated by the lack of sturgeon observed in studies of entrainment rates associated with Grays Harbor dredging (Dredging Operations and Environmental Research 1998). The majority of the annual maintenance dredging occurs with a clamshell dredge, which is associated with much lower fish entrainment rates than suction-type dredging operations. Sturgeon may also be exposed to underwater noise levels in excess of background conditions, but as discussed in Section 4.4.3.2, *Underwater Noise*, dredging-related noise levels are not considered to exceed thresholds associated with behavioral disturbance in fish. This implies that any behavioral

alteration results from the direct disturbance of the bed during dredging, dredged material placement, and elevated turbidity plumes.

Under Alternative 1, bed disturbance would result in a temporary reduction in the availability of prey organisms, but these effects are concentrated at depths greater than −33 feet MLLW that are less frequently used by foraging sturgeon in estuaries. Under Alternative 1, the duration of dredging (4.5 months in the inner harbor reaches and 1 month in the outer harbor reaches) and defined spatial extent of these effects on sturgeon foraging habitat are very limited relative to the amount of foraging habitat available within Grays Harbor.

4.4.3.9 Effects on Flatfish, Rockfish, Lingcod, and Lamprey

Larson and Moehl (1990) and McGraw and Armstrong (1990) determined hydraulic entrainment rates for flatfish and lingcod. Neither rockfish nor lamprey were entrained during these studies, and it is believed that the lack of suitable rockfish habitat in Grays Harbor results in no effect on rockfish from maintenance dredging. Pacific and river lamprey life-history and behavioral patterns make entrainment by dredging in saline environs unlikely. Because larval Pacific and river lamprey rear as filter feeders in silty areas of freshwater rivers for 3 to 7 years, these life stages are not at risk of entrainment by maintenance dredging in the navigation channel. When filter-feeding larval stages metamorphose into their adult life stage they transition to a parasitic stage and leave the freshwater system in search of host fish upon which to feed in the ocean. This emigration happens gradually any time between fall and spring. This emigration timing overlaps the timing that dredging is anticipated to occur in both the inner and outer harbor reaches, indicating a minor possibility that lamprey would be entrained by maintenance dredging in the navigation channel. During their emigration from fresh water to the ocean, lamprey would be expected to pass dredges rather quickly and in low densities, so entrainment in large numbers is not a likely or anticipated effect. Adult lamprey return to rivers and migrate upstream to spawn in February to June, where they die after spawning. Because adults return during times when dredging is not taking place, no impacts on returning adults are anticipated.

Flatfish were entrained at average rates of 0.001 to 0.028 fish per cubic yard dredged, and lingcod were entrained at an average rate of 0.001 to 0.002 fish per cubic yard sediment dredged. Under baseline conditions (Alternative 1), the estimated annual volume of sediment typically hydraulically dredged from the outer harbor reaches (South Reach) is approximately 190,000 cubic yards, leading to entrainment estimates of between 190 and 5,320 flatfish and 190 and 380 lingcod. These estimates would increase to between 425 and 11,900 flatfish and 425 and 850 lingcod if both the Outer Cross-over and South reaches were hydraulically dredged (Outer Crossover can be hopper or clamshell dredged; clamshell is preferred). Relative to the high numbers of flatfish using Grays Harbor, such entrainment is not considered to have a long-term adverse effect on the flatfish population as a whole. Because lingcod habitat is uncommon in the navigation channel, low entrainment of lingcod is anticipated to result in only minor impacts on the population.

4.4.3.10 Effects on Forage Fish

Effects on forage fish listed under the Endangered Species Act (eulachon) that may occur in Grays Harbor are presented in Section 4.5, *Threatened and Endangered Species*.

Entrainment rates for all forage fish in hydraulic dredges range between 0.001 and 0.018 fish per cubic yard of material dredged as reported by Larson and Moehl (1990) and McGraw and Armstrong (1990). Under baseline conditions (Alternative 1), the estimated annual volume typically

hydraulically dredged from the outer harbor reaches (South Reach) is approximately 190,000 cubic yards, leading to entrainment estimates of between 190 and 3,420 forage fish. This estimate would increase to between 425 and 7,650 forage fish if both the Outer Cross-over and South reaches were hydraulically (Hopper) dredged. Grays Harbor is a well-known nursery of forage fish. Relative to the high numbers of forage fish using Grays Harbor, such entrainment is not considered to have any long-term adverse effect on the population. Therefore, impacts on forage fish is expected to be minor.

4.4.3.11 Effects on Birds

Effects on birds listed under the Endangered Species Act (western snowy plover, marbled murrelet, streaked horned lark) that may occur in Grays Harbor are presented in Section 4.5, *Threatened and Endangered Species*.

Under baseline conditions, maintenance dredging has minimal impact on waterfowl, seabirds, shorebirds and other bird species that may forage or loaf in the area, especially when considering the total amount of habitat available in Grays Harbor relative to the amount and type of open-water habitat affected by dredging and placement of dredged materials. Dredging operations occur in summer to late winter within the navigation channel (inner harbor reaches). Dredging occurs offshore, in the navigation channel and outside of the nearshore and intertidal areas where waterfowl and shorebirds forage and shoreline areas where birds nest.

Birds may forage or loaf within open-water areas around the navigation channel, or use intertidal mudflats exposed during low-tide conditions that are within the limits of measurable noise effects. Although these birds may be exposed to in-air and underwater noise from dredging activity that exceeds ambient conditions, noise from maintenance dredging is not sufficient to cause injury or behavioral alteration. Analysis of noise levels produced by dredging activity indicates that associated in-air and underwater noise levels are below the disturbance thresholds used by USFWS to establish harassment/injury levels for bird species, including federally threatened and endangered species such as marbled murrelets (Section 4.4.3.2) and spotted owls (Section 4.4.3.3).

Monitoring studies of Grays Harbor maintenance dredging indicate that the entrainment rate of potential prey species for seabirds and waterfowl is low and the resulting effect of this activity on prey availability is minor (Dredging Operations and Environmental Research 1998). The benthic habitats affected by dredging and dredged materials placement are all deeper than −33 feet MLLW, a depth well below the outer limit of intertidal foraging habitat accessible to shorebird species. This limits the potential for reductions in benthic prey resources, which could have indirect effects on shorebirds.

The presence of dredge vessels and the level of activity and turbidity effects associated with dredging may temporarily displace foraging seabirds and waterfowl from feeding habitats in the open water of the navigation channel. Considering the annual frequency of maintenance dredging and that dredges generally move slowly and the footprint of associated disturbance and noise effects is limited in size, some habituation to boat traffic and disturbance likely occurs. Increases in turbidity during dredging and consequent reduced visibility or foraging success for diving birds in the immediate vicinity of the dredge activities, is localized and dissipates rapidly upon completion of the dredging and/or material placement activities. Any such displacement is of short duration and affects an insignificant amount of foraging habitat relative to the amount of similar quality habitat available in Grays Harbor and nearby coastal habitats.

Because maintenance dredging occurs in the navigation channel and placement predominately occurs at open-water sites, nesting habitat is not affected. WDFW (2013) has identified five nesting colonies of seabirds in Grays Harbor (Table 3.4-6). One of these colonies, a small pigeon guillemot colony located on the South Jetty, lies near the navigation channel and Point Chehalis open-water placement site. As noted in Section 4.4.3.3, *In-Air Noise*, the noise levels produced by dredging are below disturbance thresholds that could cause injury or behavioral alteration in bird species, even at a distance of 50 feet from the source. Consequently, the pigeon guillemot colony and other birds nesting in upland area near the upland placement sites are not affected by maintenance dredging and placement activities. Overall impacts on birds is expected to be minor.

4.4.3.12 Effects on Marine Mammals and Reptiles

Effects on marine mammals and reptiles listed under the Endangered Species Act (Southern Resident Killer whales, humpback, blue, fin, sei, and sperm whales, and various sea turtles) that may occur in Grays Harbor are presented in Section 4.5, *Threatened and Endangered Species*.

Under Alternative 1, noise generated by dredging, vessel operations, and dredged material placement at the South Beach and Point Chehalis open-water sites has the potential to effect marine mammals such as seals, sea lions, dolphins, and porpoises, which may be present in the deeper waters of Grays Harbor or near South Jetty/Pacific Ocean shoreline.

Under baseline conditions, the abundance of potential prey for marine mammals, including salmon, forage fish, groundfish, or benthic invertebrates is not measurably affected by maintenance dredging. Noise levels associated with dredging and material placement activities may be detectable by marine mammals, however, dredging is considered to be a low impact activity for marine mammals, producing non-pulsed sound and being substantially quieter in terms of acoustic energy output than sources such as seismic airguns and impact piledriving (78 Fed. Reg. 30873, 30875, May 23, 2013). Noise produced by dredging has been compared to that produced by a commercial vessel travelling a modest speed (Robinson et al. 2011, as cited in 78 Fed. Reg. 30873, 30875, May 23, 2013). The NMFS has generally considered the effects of dredging on marine mammals to remain below the level of a take (FR78, 100 20875). Therefore, underwater noise impacts of dredging operations at Grays Harbor are expected to be minor.

High ambient background noise and noise attenuation from the soft sediments in Grays Harbor would likely lower the noise impacts even further. In addition, the low-frequency noise made by operating hopper dredges is not believed to mask calling and echolocation capabilities of dolphins and porpoises that rely on higher frequency sound (Clarke et al. 2002; Talus 2000). Because dredge vessels are typically stationary or slow-moving, direct disturbance of marine mammals is unlikely to cause alarm or displacement.

Gray whales typically occur in the outer coast open waters during their annual migrations, and often approach the coastline. The likelihood of exposure of gray whales to dredging and dredged material placement operations under baseline conditions (Alternative 1) is minimal. The frequency and duration of outer harbor dredging and barge traffic to the South Beach placement site is limited, and the duration of gray whale presence in coastal waters adjacent to the affected area is also brief.

Sea otters are not expected to occur in Grays Harbor. The current population along the Washington coast is centered north of Destruction Island, about 50 miles north of Grays Harbor (Lance et al. 2004).

The impacts on marine mammals and reptiles are expected to be minor under Alternative 1.

4.4.4 Alternative 2—Deepen Channel to −37 Feet MLLW

4.4.4.1 Water Quality

Alternative 2 would have minor effects on water quality in the vicinity of the active dredge operations and in the disposal areas. Because annual maintenance dredging would be required to reach -36 feet MLLW prior to any deepening, Alternative 2 represents an increase in dredging over baseline in the construction year (an increase of 1,031,000 cubic yards for the affected reaches, (Cow Point to South Reach)). Annual maintenance dredging would increase by an estimated 50,000 cubic yards after the completion of the construction deepening under this alternative. As is the case for Alternative 1, short-term localized increases in turbidity and reductions in dissolved oxygen (DO) levels could occur during dredging and during the placement of dredged materials. Dredging methods (equipment and timing) would be similar to those utilized in Alternative 1. An excavator, as discussed in Section 2.3 and elsewhere in the SEIS, may be used in hardpack areas of Cow Point Reach to break up the hardened material in place. The hardpack material is expected to break into large pieces and remain in place. Sediments that have settled on top of this hardpack material are not expected to migrate a significant distance or cause a turbidity plume because currents in this reach are generally less than 0.5 knots. Material removal is expected to be accomplished with a clamshell bucket, so water quality impacts are projected to be very similar to those described for the clamshell bucket utilized in the inner harbor reaches. Removal with a clamshell dredge is assumed to cause less turbidity than removal with an excavator due to less material overflow from the shape of the clamshell bucket and fewer lifts because the clamshell bucket has more than twice the capacity of the excavator bucket. Placement sites would be the same as Alternative 1, except for the upland placement of unsuitable material (13,500 cubic yards) and the shifted Point Chehalis placement site. Although there would be an increase (approximately 49%) in dredge quantities during the construction year, and a smaller increase (approximately 2%) in annual dredging thereafter, the increases would be spread across the work window (which is typically not fully utilized during annual maintenance dredging) and individually do not represent a large increase in turbidity. Turbidity is monitored during clamshell operations in accordance with the Ecology-issued Water Quality Certification, and as discussed in Section 4.4.3.1 turbidity levels generally return to ambient conditions quickly and relatively little material separates from the plume as it descends through the water column when a clamshell dredge and bottom-dump barge are used. These impacts are a function of a single lift of the clamshell and are monitored as such. Multiple lifts and additional volumes dredged would not exacerbate turbidity effects, as the turbidity impacts are not cumulative and each lift of the clamshell dredge bucket would still be subject to the same turbidity standards. As in Alternative 1 during dredging operations, DO in the Federal navigation channel is not expected to reach low levels because flushing from river and adjacent ocean flow into the bay will keep the water oxygenated. The incremental effects on turbidity and DO projected to be generated by Alternative 2, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be negligible. Discharge of decant water from upland placement at the Half Moon bay buried revetment extension site would be entering the bay into very dynamic environment where turbidity is common, and would be monitored for turbidity impacts in accordance with Ecology's Water Quality Certification. The turbidity and DO effects of material eventually eroding from the Point Chehalis Revetment Extension mitigation site are expected to be minimal, and identical to those under Alternative 1.

The 2012 sediment characterization identified a potential toxicity concern in one dredged material management unit in the Cow Point reach, and the Corps has elected to remove all dredged sediments from this unit. Approximately 13,500 cubic yards of material is slated to be placed upland at the former Hoquiam waste water treatment lagoon under Alternative 2. The removal of these sediments from the Cow Point reach is not likely to result in contaminant-related water quality impacts. This conclusion is supported by studies of sediment dispersal-related contaminant impacts resulting from a similar navigation channel dredging project in an estuarine environment with more extensive contamination (U.S. Army Corps of Engineers and Port of West Sacramento 2011).The material will be removed and handled as described in Section 2.3.

Given the relatively small quantities of sediment typically suspended, the short duration of suspension, and the dilution that occurs during dispersion, the suspension of sediments around dredges is not likely to lead to appreciable reductions in dissolved oxygen or increases in turbidity. The incremental effects arising from contaminated sediments projected to be generated by Alternative 2, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be minor. The environmental impacts of dredging and disposal of this volume of unsuitable material with these characteristics at the Hoquiam former WWTP lagoon or one of the alternative sites identified at section 2.3 would be expected to be similarly minor.

4.4.4.2 Underwater and In-Air Noise

Alternative 2 represents an increase in dredging volume over baseline in the construction year and an increase in annual dredging volume thereafter. Channel deepening would result in a slightly longer duration of dredging for the inner harbor reaches compared to Alternative 1 (6 months compared to 4.5 months). The approved work window would be adhered to under Alternative 2. Underwater and in-air generated noise levels would be the same as in Alternative 1, but spread out over the work period (work window). Although this Alternative represents an increase in work and underwater and in-air noise generated over any one day or period would not change appreciably from Alternative 1. The effects of Alternative 2 on noise are thus anticipated to be similar in scope and nature to those identified for Alternative 1. Noise generated from possible pump ashore activities at Half Moon Bay is expected to be minor and would consist of the slurry through the pipeline (either submerged or floating) and that of a booster pump if required. The incremental noise effects arising from increased length of exposure projected to be generated by Alternative 2, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be minor.

Alternative 2 would add as many as 33 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Resources in Grays Harbor would thus experience approximately 2.75 additional vessel passages per month, attributable to a median "high/moderate" growth projection in cargo tonnage moved through the Port as a result of a channel deepened to -37 feet MLLW. The continuous underwater noise generated by a deep-draft vessel transiting harbor waters at a moderate speed has been determined to be roughly equivalent to the level of noise generated by an operating dredge. (Robinson et al. 2011, as cited in 78 Fed. Reg. 30873, 30875, May 23, 2013). Unlike an operating dredge, however, the transit of a cargo vessel would be irregular and infrequent, and would cause only a fleeting effect. The marine organism populations are accustomed to the passage of a variety of vessels, including deep-draft ships. The underwater noise generated by the irregular and occasional additional vessel transit would generate no more than a minor increment of adverse effect as compared with Alternative 1. Likewise, the in-air noise generated by the additional

33 annual deep-draft vessel transits would be negligible and would generate no more than a minor increment of adverse effect as compared with Alternative 1.

In-air noise will have a similar minor increment of increase compared to Alternative 1. There would be an 8% increase in vessel traffic due to channel deepening; however, this does not mean that vessel noise would increase by 8%. The total noise level from multiple sound sources, such as two trucks idling, is not mathematically additive, meaning that if each of two trucks emits 85 decibels, the combined sound level would be approximately 88 decibels (not 170). The land-based sound sources of trains and industrial yard activity at the Port of Grays Harbor are typically louder at 100 to 125 decibels than the deep draft vessels in the channel or idling in port at 98 decibels. Therefore, the additional 33 vessels per year, for a daily average of 1.19 vessels, are not anticipated to noticeably increase shipping-related noise in Grays Harbor.

4.4.4.3 Bed Disturbance and Entrainment

Although Alternative 2 represents an increase in dredging volumes over baseline in the construction year and an increase in annual maintenance dredging thereafter, the channel and dredge footprint would not change appreciably. Alternative 2 would remove an estimated 1,031,000 cubic yards of sediment from the navigation channel to achieve a depth of −37 feet MLLW; of this total, a maximum of approximately 77,000 cubic yards would be hydraulically dredged from the outer harbor reaches (South Reach, and potentially Outer Crossover Reach). Based on entrainment rates reported by Larson and Moehl (1990) and McGraw and Armstrong (1990), hydraulic dredging related to initial channel deepening of the outer harbor reaches (both South and Outer Crossover Reaches) under Alternative 2 would result in an maximum estimated entrainment of 77 to 2,156 flatfish, 77 to 154 lingcod, and 77 to 1,386 forage fish in excess of Alternative 1 (baseline conditions) entrainment levels. Additional maintenance dredging after the construction year attributable to Alternative 2 would also increase the estimated volume dredged and associated entrainment due to annual maintenance dredging by roughly 2.3%.

Bed disturbance from deepening and subsequent maintenance would be largely within the same footprint (Point Chehalis Site shift represents a minor deviation) and within the same work window as those discussed in Alternative 1, therefore impacts would be minor.

4.4.4.4 Dungeness Crab

The dredge impact model results (Table 4.4-4) indicate that predicted Dungeness crab losses as a result of Alternative 2 using the worst case scenario of hopper dredging the Outer Crossover Reach (clamshell is preferred and expected in the Outer Cross-Over) are minimal and show little impact to harvestable size crabs (age 2+). The use of a clamshell dredge in the Outer Reach produces less entrainment and less impacts to Dungeness crab (Corps 2013).

Table 4.4-5. Dredge Impact Model (DIM) Estimates of Age 2+ Crabs Lost Due to Dredging for Alternative 2, Incremental Deepening One Foot to -37 feet MLLW with use of Hopper Dredge in Outer Crossover Reach.

Grays Harbor Navigation Channel Reach	Historic Maintenance Volumes (cy average 1981 to 1989)	Incremental Volume (cy) Dredged to Deepen Channel from -36 to -37 feet MLLW	Total volume Dredged to -36 ft MLLW plus incremental Deepening from -36 to -37 feet MLLW in same year[a]	DIM Model of Crab Loss Impacts for Deepening from -36 to -37 foot-Increment	DIM Model of Total Crab Loss Impacts for Dredging to -36 ft MLLW plus incremental Deepening from -36 to -37 feet MLLW in same year
South Reach	474,000	-18,000[b]	172,000	0	0
Crossover Reaches[c]	486,000	316,000	926,000	0	-1,661
N. Channel (Moon Is.)	144,000	196,000	371,000	-4	-19
Hoquiam Reach	85,000	521,000	671,000	-36	-48
Cow Point	374,000	16,000	981,000	0	-50
Total Impacted before Credit				-40	-1,778
Credit for Clamshell Use in Crossover Reach				3,302	6,228
Totals	1,563,000	1,031,000	3,121,000	3,262	4,450

[a] Includes volume to reach -36 feet MLLW (Alternative 1) and the additional one foot to -37 feet MLLW in the same dredge year.
[b] Represents 18,000 cubic yards less than dredged under the historic average baseline conditions (2011 EA)
[c] Includes both inner and outer crossover reaches , as estimated by DIM

Table 4.4-4 shows the estimated age 2+ crabs lost due to the incremental deepening of the channel from South Reach to Cow Point by one foot in depth from -36 feet MLLW to -37 feet MLLW. However, since the channel would first need to be maintained to -36 feet MLLW prior to any deepening in the construction year, the table also shows the total impacts to age 2+ crab for dredging to -36 feet MLLW plus incremental deepening from -36 feet to -37 feet MLLW in the same year. The credit for clamshell use in the Crossover Reach as calculated in accordance with the RCMSA produces a credit of crabs which can be used to account for future dredging impacts. While the scope of analysis of this document is limited to the incremental deepening, the impacts to crab is calculated to account for the dredging being completed all in the same year. The overall crab impacts for the construction dredging year with both impacts from dredging to -36 feet MLLW and the deepening of the channel by one foot to -37 feet MLLW in the same year are low (1,778 age 2+ crab before the RCMSA credit is added in). If the Outer Crossover Reach is clamshell dredged (the preferred and expected situation) the number of crabs impacted would be 152 and the credit would be 9,677 in the construction year. These estimates reinforce the environmental benefit of using of a clamshell dredge, and the Corps expects to use the clamshell as much as practicable in the Outer Crossover Reach and as agreed to in the RCMSA. The impacts for the maintenance dredging to -36 feet MLLW (Alternative 1) are accounted for in the 2011 maintenance dredging Environmental Assessment as discussed in chapter 1 and impacts attributable to the deepening are accounted for here. The additional maintenance dredging attributable to deepening the channel to -37 feet MLLW

would have a negligible impact on crab when added to the estimated volumes to dredge the channel to -36 feet MLLW, because the volumes are below the 1980-89 historic averages used as a baseline in the DIM.

Sediments would be dredged and placed in the same manner and with the same equipment as under baseline conditions (Alternative 1). Sediment would be placed in the same locations as under baseline conditions, with the exception of the 13,500 cubic yards of unsuitable material (as described in Section 4.7, *Sediment Characterization and Water Quality*), and the shifting of the Point Chehalis placement site. The Point Chehalis site shift as described in Appendix G moves the existing site 1,000 feet to the north parallel with the navigation channel. This move locates the site in deeper water and improves the hyrodynamic flushing, but does not increase the size of the site. As is the case with Alternative 1, burial effects on Dungeness crab, as a result of dredged material placement, even with the additional volumes associated with deepening the channel to -37 feet MLLW, are expected to be minimal and transient as discussed in Section 4.4.3.6 above.

Impacts to Dungeness crab from deepening to -37 feet MLLW under Alternative 2 and subsequent maintenance are very small. Avoidance and minimization measures outlined under the existing RCMSA would be implemented as discussed with respect to Alternative 1. Any future compensatory measures mitigating for crab losses would be undertaken pursuant to the RCMSA as outlined with respect to Alternative 1; no new compensatory mitigation measures would be introduced under Alternative 2 to address crab losses. Therefore, incremental crab loss impacts of Alternative 2 would be minor as compared with Alternative 1.

4.4.4.5 Fish and Wildlife

Alternative 2 would remove an additional 1,031,000 cubic yards of sediment from the navigation channel to achieve a depth of −37 feet MLLW; of this total, a maximum of approximately 77,000 cubic yards would be hydraulically dredged from the outer harbor reaches (South Reach, and potentially Outer Crossover Reach). While clamshell is the preferred method of dredging the Outer Crossover Reach, a hopper dredged may be used if clamshell dredging is not practicable. Based on entrainment rates reported by Larson and Moehl (1990) and McGraw and Armstrong (1990), hydraulic dredging related to initial channel deepening of the outer harbor reaches (both South and Outer Crossover Reaches) under Alternative 2 would result in an maximum estimated entrainment of 77 to 2,156 flatfish, 77 to 154 lingcod, and 77 to 1,386 forage fish in excess of Alternative 1 (baseline conditions) entrainment levels. If just the South Reach is hopper dredged the volume required for deepening to -37 is less than the historic average baseline volume evaluated under the 2011 EA by 18,000 cubic yards, and entrainment effects generated primarily by hopper dredging would be negligible for the incremental deepening volume. Additional maintenance dredging after the construction year attributable to Alternative 2 would also increase the estimated volume dredged and associated entrainment due to annual maintenance dredging by roughly 2.3%.

Except for the increased dredge duration required for Alternative 2 the impacts to sturgeon, lampreys, salmonids, marine mammals, reptiles, and birds are anticipated to be similar in scope and nature to those identified for Alternative 1. Channel deepening would result in a slightly longer duration of dredging for the inner harbor reaches compared to Alternative 1 (nearly 6 months compared to 4.5 months). The duration of dredging related to the initial channel deepening in the outer harbor reaches would be the same as maintenance dredging under Alternative 1.

Approximately 13,500 cubic yards of unsuitable material would go upland under Alternative 2. The most feasible upland placement location, from the perspective of the project's costs of

transportation and placement, as well as from the perspective of the POGH which is responsible for providing the necessary real estate instruments including for dredged material placement locations, is the former Hoquiam waste water treatment plant (WWTP) lagoon. The Hoquiam WWTP site is in close proximity to the location of the unsuitable material to be dredged from the Cow Point Reach, so minimal barging would be required. An offload site for the barge is located within a quarter mile of the lagoon, further minimizing transportation cost. The methodology for placing the material is expected to consist of dredging via clamshell dredge and barge with mechanical rehandling of material on land. During dredging the barge would be lined with geotextile fabric to prevent leakage. The barge would be transported to Port of Grays Harbor Terminal 3 and dewatered through a sump pump with a geofabric bag surrounding the discharge pipe to contain sediments. Land-based equipment would be used to transfer and transport the dewatered dredged material from the barge to the placement area. The site is bermed with containment dikes on the southern and eastern sides so minimal earthwork would be required to contain the dredged material within the former lagoon footprint. Upon placement along the southern edge of the former waste water treatment lagoon, which would be staked in the field in the location depicted in Figure 10, the deposited material would be backgraded to stabilize the positioning of the material within the designated footprint. The material determined unsuitable for open water disposal underwent extensive testing, consisting of three rounds of chemical analysis and bioassays. While the material is not classified as a hazardous waste under the Resource Conservation and Recovery Act (RCRCA), placement of the unsuitable material at an upland site would permanently remove this material from the aquatic environment.

The WWTP is located to the east of Bowerman Airport, and east of Grays Harbor National Wildlife Refuge. The site is currently not used by the city and the material would be placed in to the southern portion of the WWTP lagoon, and the existing treatment plant and airport will continue to operate. The small area of fill (as depicted in Figure 10) would come from Cow Point Reach (DMMU 32a) is of similar characteristics of the material currently found at the site, and would not represent habitat for area bird speicies. Land use for the upland disposal site includes foreseeable future development regardless of whether it is used for the placement of unsuitable material from the deepening action or not. This option represents a cost-effective method for the placement of the dredge material as well as achieving the City of Hoquiam's plans to fill the no-longer-utilized site. Three additional sites on the Port of Grays Harbor property were also considered (Terminal 3 uplands, Industrial Development District #1, and Slip 1), but these would add additional transportation costs to the project. The effects of placement at any of the alternative sites are anticipated to be similar to the effects of placement at the former Hoquiam WWTP site. The effects of Alternative 2 on fish and wildlife are thus anticipated to be similar in scope and nature to those identified for Alternative 1. The incremental effects on fish and wildlife projected to be generated by Alternative 2, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be minor.

4.4.5 Alternative 3—Deepen Channel to −38 Feet MLLW

4.4.5.1 Water Quality

Alternative 3 would have minor effects to water quality in the vicinity of the active dredge operations and in the disposal areas. Because annual maintenance dredging would be required to reach -36 feet MLLW prior to any deepening, Alternative 3 represents an increase in dredging over baseline in the construction year (an increase of 1,972,000 cubic yards for the affected reaches,

(Cow Point to South Reach)). Annual maintenance dredging would increase by an estimated 107,000 cubic yards after the completion of the construction deepening under this alternative. As is the case for Alternative 1, short-term localized increases in turbidity and reductions in dissolved oxygen (DO) levels could occur during dredging and during the placement of dredged materials. Dredging methods (equipment and timing) would be similar to those utilized in Alternative 1 and the same as those used in Alternative 2. An excavator, as discussed in Section 2.3 and elsewhere in the SEIS, may be used in hardpack areas of Cow Point Reach Reach to break up the hardened material in place. The hardpack material is expected to break into large pieces and remain in place. Sediments that have settled on top of this hardpack material are not expected to migrate a significant distance or cause a turbidity plume because currents in this reach are generally less than 0.5 knots. Material removal is expected to be accomplished with a clamshell bucket, so water quality impacts are projected to be very similar to those described for the much larger clamshell bucket utilized in the inner harbor reaches (the excavator bucket is essentially half of a small clamshell bucket). Removal with a clamshell dredge is assumed to cause less turbidity than removal with an excavator due to less material overflow from the shape of the clamshell bucket and fewer lifts because the clamshell bucket has more than twice the capacity of the excavator bucket. Placement sites would be the same as Alternative 1, except for the upland placement of unsuitable material (22,400 cubic yards) and the shifted Point Chehalis placement site. Although there would be an increase (approximately 49%) in dredge quantities during the construction year, and a smaller increase (approximately 5%) in annual dredging thereafter, the increases would be spread across the work window (which is typically not fully utilized during annual maintenance dredging) and individually not represent a large increase in water quality (turbidity and DO) effects. During dredging operations, DO in the Federal navigation channel is not expected to reach low levels because flushing from river and adjacent ocean flow into the bay will keep the water oxygenated. Turbidity is monitored during clamshell operations in accordance with the Ecology-issued Water Quality Certification, and as discussed in Section 4.4.3.1 turbidity levels generally return to ambient conditions quickly and relatively little material separates from the plume as it descends through the water column when a clamshell dredge and bottom-dump barge are used. These impacts are a function of a single lift of the clamshell and are monitored as such. Multiple lifts and additional volumes dredged would not exacerbate turbidity effects, as the turbidity impacts are not cumulative and each lift of the clamshell dredge bucket would still be subject to the same turbidity standards. As in Alternative 2, the incremental effects on turbidity and DO projected to be generated by Alternative 3, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be negligible.

The 2012 sediment characterization identified a potential toxicity concern in one dredged material management unit in the Cow Point reach, and the Corps has elected to remove all dredged sediments from this unit. Approximately 22,400 cubic yards of material is slated to be placed upland at the former Hoquiam waste water treatment lagoon under Alternative 3. The removal of these sediments from the Cow Point reach is not likely to result in contaminant-related water quality impacts. This conclusion is supported by studies of sediment dispersal–related contaminant impacts resulting from a similar navigation channel dredging project in an estuarine environment with more extensive contamination (U.S. Army Corps of Engineers and Port of West Sacramento 2011). The material will be removed and handled as described in Section 2.3. The incremental effects arising from contaminated sediments projected to be generated by Alternative 3, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be minor. Unsuitable material under Alternative 3 would be handled the same as in Alternative 2. The increased volume of unsuitable material in

Alternative 3 as compared to Alternative 2 represents a minor increase (22,400 cubic yards compared to 13,500 cubic yards) and water quality effects of removing the material are expected to be similar to those for Alternative 2. The environmental impacts of dredging and disposal of this volume of unsuitable material with these characteristics at the Hoquiam former WWTP lagoon or one of the alternative sites identified at section 2.3 would be expected to be similarly minor.

4.4.5.2 Underwater and In-Air Noise

Alternative 3 represents an increase in dredging over baseline in the construction year and a smaller increase in annual maintenance dredging thereafter. Channel deepening would result in a slightly longer duration of dredging for the inner harbor reaches compared to Alternative 1 (6 months compared to 4.5 months). The duration of dredging related to the initial channel deepening in the outer harbor reaches would be the same as maintenance dredging under Alternative 1. Underwater and in-air generated noise levels would be similar to those of Alternative 1, but would include two dredges with activities spread out over the work period (work window). Although this Alternative represents an increase in work and underwater and in-air noise generated over any one day or period would not change from Alternative 1. The effects of Alternative 3 on noise are thus anticipated to be similar in scope and nature to those identified for Alternative 1. The incremental noise effects arising from increased length of exposure projected to be generated by Alternative 3, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be minor. The increased dredged volumes in Alternative 3 as compared to Alternative 2 represent an increase in work for the dredges involved and likely a minor increase in generated noise. However, the dredging would be within the same geographical area and within the established work windows therefore any increase to noise would be expected to be minor.

Alternative 3 would add as many as 51 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Resources in Grays Harbor would thus experience approximately 4.25 additional vessel passages per month, or less than one per week, attributable to a “high” growth projection in cargo tonnage moved through the Port as a result of a channel deepened to -38 feet MLLW. The continuous noise generated by a deep-draft vessel transiting harbor waters at a moderate speed has been determined to be roughly equivalent to the level of noise generated by an operating dredge. (Robinson et al. 2011, as cited in 78 Fed. Reg. 30873, 30875, May 23, 2013). Unlike an operating dredge, however, the transit of a cargo vessel would be irregular and infrequent, and would cause only a fleeting effect. The marine organism populations are accustomed to the passage of a variety of vessels, including deep-draft ships. The underwater noise generated by the irregular and occasional additional vessel transit would generate no more than a minor increment of adverse effect as compared with Alternative 1. Likewise, the in-air noise generated by the additional 51 annual deep-draft vessel transits would be negligible and would generate no more than a minor increment of adverse effect as compared with Alternative 1.

In-air noise will have a similar minor increment of increase compared to Alternative 1. There would be a 10% increase in vessel traffic due to channel deepening; however, this does not mean that vessel noise would increase by 10%. The total noise level from multiple sound sources, such as two trucks idling, is not mathematically additive, meaning that if each of two trucks emits 85 decibels, the combined sound level would be approximately 88 decibels (not 170). The land-based sound sources of trains and industrial yard activity at the Port of Grays Harbor are typically louder at 100 to 125 decibels than the deep draft vessels in the channel or idling in port at 98 decibels. Therefore,

the additional 51 vessels per year (approximately one per week) are not anticipated to noticeably increase shipping-related noise in Grays Harbor.

4.4.5.3 Bed Disturbance and Entrainment

Although Alternative 3 represents an increase in dredging volumes over the baseline and over Alternative 2 in the construction year and an increase in annual maintenance dredging thereafter, the dredge footprint would not change appreciably. As compared to Alternative 1, Alternative 3 would remove an additional 1,972,000 cubic yards of sediment from the navigation channel to achieve a depth of −38 feet MLLW; of this total, a maximum of approximately 371,000 cubic yards would be hydraulically dredged from the outer harbor reaches (South Reach, and potentially Outer Crossover Reach). Based on entrainment rates reported by Larson and Moehl (1990) and McGraw and Armstrong (1990), hydraulic dredging related to initial channel deepening of the outer harbor reaches (assuming both South and Outer Crossover Reaches) under Alternative 3 would result in an maximum estimated entrainment of 371 to 10,388 flatfish, 371 to 742 lingcod, and 371 to 6,678 forage fish in excess of Alternative 1 (baseline conditions) entrainment levels. Additional maintenance dredging after the construction year attributable to Alternative 3 would also increase the estimated volume dredged and associated entrainment due to annual maintenance dredging by roughly 5%. This represents a minor increase in entrainment of flatfish, lingcod, and forage fish as compared to Alternatives 1 and 2.

Bed disturbance from deepening and subsequent maintenance would be within the same footprint and within the same work window as those discussed in Alternative 1 and Alternative 2, and therefore impacts would be minor.

4.4.5.4 Dungeness Crab

The dredge impact model results indicate that predicted Dungeness crab losses as a result of Alternative 3 using the worst case scenario of hopper dredging the Outer Crossover Reach are minimal and show little impact to harvestable size crabs (age 2+). The use of a clamshell dredge in the Outer Crossover Reach would produce less entrainment and less impact to Dungeness crab (Corps 2013). Table 4.4-5 shows the estimated crabs lost due to the incremental deepening of the channel from South Reach to Cow Point by two feet in depth from -36 feet MLLW to -38 feet MLLW. The table also shows the total impacts to crab for the construction year (volumes for dredging to -36 feet MLLW plus Alternative 2). While the scope of analysis of this document is limited to the incremental deepening, the impacts to crab are calculated to account for the dredging being completed all in the same year. The overall crab impacts for the construction dredge year with both impacts from maintenance dredging to -36 feet MLLW and the deepening of the channel by two feet to -38 feet MLLW in the same year are still low at 3,087 total age 2+ crab impacted before the RCMSA credit of 7,639 is included. If the Outer Crossover Reach is clamshell dredged the number of crabs impacted would be 216 and the credit would be 12,509 in the construction year. The Corps expects to use the clamshell dredge as much as practicable in the Outer Crossover Reach. The impacts for the maintenance dredging to -36 feet MLLW (Alternative 1) are accounted for in the 2011 maintenance dredging Environmental Assessment as discussed in chapter 1, and impacts attributable to the deepening are accounted for here. The additional maintenance dredging attributable to deepening the channel to -38 feet MLLW (107,000 cubic yards) would have a minimal impact on crab when added to the estimated volumes to maintain the channel at -36 feet MLLW, because the volumes are below the 1980-89 historic averages used as a baseline in the DIM.

Sediments would be dredged and placed in a similar manner and with similar equipment as under baseline conditions (Alternative 1). The use of a long arm excavator, as needed, in Cow Point Reach is considered to have entrainment similar to, or less than, that of clamshell dredging. The smaller excavator bucket would be used only in an area of hard substrate that would not allow crab to burrow. Sediment would be placed in the same locations as under baseline conditions, with the exception of the 22,400 cubic yards of unsuitable material (as described in Section 4.7, *Sediment Characterization and Water Quality*), and the shifting of the Point Chehalis placement site. This move locates the site in deeper water and improves the hyrodynamic flushing, but does not increase the size of the site. As is the case with Alternatives 1 and 2 burial effects on Dungeness crab as a result of dredged material placement, even with the additional volumes associated with deepening the channel to -38 feet MLLW, are expected to be minimal and transient as discussed in Section 4.4.3.6.

Table 4.4-5. Dredge Impact Model (DIM) Estimates of Age 2+ Crabs Lost Due to Dredging for Alternative 3, Incremental Deepening Two Feet to -38 feet MLLW with use of Hopper Dredge in Outer Crossover Reach.

Grays Harbor Navigation Channel Reach	Historic Maintenance Volumes (cy average 1981 to 1989)	Incremental Volume (cy) Dredged to Deepen Channel from -36 to -38 feet MLLW	Total volume Dredged to -36 ft MLLW plus incremental Deepening from -36 to -38 feet MLLW in same year[a]	DIM Model of Crab Loss Impacts for Deepening from -36 to -38 foot-Increment	DIM Model of Total Crab Loss Impacts for Dredging to -36 ft MLLW plus incremental Deepening from -36 to -38 feet MLLW in same year
South Reach	474,000	140,000	330,000	0	0
Crossover Reaches[b]	486,000	587,000	1,197,000	-421	-2,927
N. Channel (Moon Is.)	144,000	344,000	519,000	-16	-31
Hoquiam Reach	85,000	708,000	858,000	-51	-64
Cow Point	374,000	193,000	1,158,000	0	-65
Total impacted before credit				-488	-3,087
Credit for Clamshell Use in Crossover Reach				3,720	7,639
Totals	1,563,000	1,972,000	4,062,000	3,232	4,552

[a] Includes volume to reach -36 feet MLLW (Alternative 1) and the additional two foot to -38 feet MLLW in the same dredge year.

[b] Includes both inner and outer crossover reaches, as estimated by DIM.

As is the case for Alternative 2, impacts to Dungeness crab from deepening to -38 feet MLLW under Alternative 3 and subsequent maintenance are very small. Avoidance and minimization measures outlined under the existing RCMSA would be implemented as discussed with respect to Alternative 1. Any future compensatory measures mitigating for crab losses would be undertaken pursuant to the RCMSA as outlined with respect to Alternative 1; no new compensatory mitigation measures would be introduced under Alternative 3 to address crab losses. Therefore, crab loss impacts of Alternative 3 would be minor as compared with Alternatives 1 and 2.

4.4.5.5 Fish and Wildlife

Alternative 3 would remove an additional 1,972,000 cubic yards of sediment from the navigation channel to achieve a depth of −38 feet MLLW; of this total, a maximum of approximately 371,000 cubic yards would be hydraulically dredged from the outer harbor reaches (South Reach, and potentially Outer Crossover Reach). While clamshell is the preferred method of dredging the Outer Crossover Reach, a hopper dredge may be used if clamshell dredging is not practicable. Based on entrainment rates reported by Larson and Moehl (1990) and McGraw and Armstrong (1990), hydraulic dredging related to initial channel deepening of the outer harbor reaches (both South and

Outer Crossover Reaches) under Alternative 3 would result in an maximum estimated entrainment of 371 to 10,388 flatfish, 371 to 742 lingcod, and 371to 6,678 forage fish in excess of Alternative 1 (baseline conditions) entrainment levels. If just the South Reach is hopper dredged entrainment estimates would be 140 to 3,920 flatfish, 140 to 280 lingcod, and 140 to 2,520 forage fish. Additional maintenance dredging after the construction year attributable to Alternative 3 would also increase the estimated volume dredged and associated entrainment due to annual maintenance dredging by roughly 5%.

Under Alternative 3, initial channel deepening would result in a slightly longer duration of dredging for the inner harbor reaches compared to Alternative 1 (6 months compared to 4.5 months). The duration of dredging related to the initial channel deepening in the outer harbor reaches would be the same as maintenance dredging under Alternative 1.Except for the increased dredge duration required for Alternative 3 the impacts to sturgeon, lampreys, salmonids, marine mammals, reptiles, and birds are anticipated to be similar in nature and magnitude to those identified for Alternatives 1 and 2.

Two clamshell dredges may be used to accomplish both the annual maintenance and deepening in the same year, but the sediments would be dredged in a similar manner as occurs under baseline conditions (Alternative 1). Sediment would be placed as under baseline conditions, with the exception of the 22,400 cubic yards of unsuitable material (as described in Section 4.7, *Sediment Characterization and Water Quality*), and the shifting of the Point Chehalis placement site. The Point Chehalis site shift as described in Appendix G moves the existing site 1,000 feet to the north parallel with the navigation channel.

The effects of Alternative 3 on invertebrates, fish, and wildlife are thus anticipated to be similar in nature and magnitude to those identified for Alternative 1. The incremental effects on fish and wildlife projected to be generated by Alternative 3, over and above the effects of annual maintenance dredging as evaluated in prior NEPA documentation including the FY 2012-18 maintenance dredging EA, are expected to be minor.

The increase in volumes dredged in Alternative 3 as compared to Alternative 2 represents a moderate increase in flatfish, lingcod and forage fish entrained. Relative to the high numbers of flatfish, and forage fish using Grays Harbor, such entrainment is not considered to have a long-term adverse effect on the flatfish or forage fish populations as a whole. Because lingcod habitat is uncommon in the navigation channel it is unlikely that the hopper dredges would encounter many lingcod. This along with the low entrainment rates noted for lingcod would result in only minor impacts on the population.

The most feasible upland placement location, from the perspective of the project's costs of transportation and placement, as well as from the perspective of the POGH which is responsible for providing the necessary real estate instruments including for dredged material placement locations, is the former Hoquiam waste water treatment plant (WWTP) lagoon. The Hoquiam WWTP site is in close proximity to the location of the unsuitable material to be dredged from the Cow Point Reach, so minimal barging would be required. An offload site for the barge is located within a quarter mile of the lagoon, further minimizing transportation cost. The site is bermed with containment dikes on the southern and eastern sides so minimal earthwork would be required to contain the dredged material within the former lagoon footprint. Upon placement along the southern edge of the former waste water treatment lagoon, which would be staked in the field in the location depicted in Figure 10, the deposited material would be backgraded to stabilize the positioning of the material within the designated footprint. Land use for the upland disposal site includes foreseeable future development regardless of whether it is used

for the placement of unsuitable material from the deepening action or not. This option represents a cost-effective method for the placement of the dredge material as well as achieving the City of Hoquiam's plans to fill the no-longer-utilized site. Placement of the unsuitable material at an upland site would permanently remove this material from the aquatic environment. The 22,400 cubic yards of material represents less than 1% of the more than 4 million cubic yards of material that would be dredged in the construction year of this project. Three additional sites on the Port of Grays Harbor property were also considered (Terminal 3 uplands, Industrial Development District #1, and Slip 1). The material determined unsuitable for open water disposal underwent extensive testing, consisting of three rounds of chemical analysis and bioassays. The material is not classified as a hazardous waste under the Resource Conservation and Recovery Act (RCRCA). The effects of placement at any of the alternative sites are anticipated to be similar to the effects of placement at the former Hoquiam WWTP site. The material would be confined to the southern portion of the WWTP lagoon, and the existing treatment plant will continue to operate.

4.5 Threatened and Endangered Species

4.5.1 Overview

This section addresses how the proposed action could affect threatened or endangered species. The nature and extent of these potential effects are evaluated in the context of incremental impacts added to baseline conditions (Alternative 1). The Corps completed an ESA consultation in 2011 that covered the continuation of maintenance dredging and dredged material placement from 2012 through 2026. NMFS (2011) and USFWS (2011) concurred with Corps determination of "may affect, but likely to adversely affect" to any ESA-listed species or designated critical habitat occurring in Grays Harbor or the vicinity. In 2012 the Corps supplemented the concluded consultation, addressing a proposal to utilize clamshell dredging in the Outer Crossover Reach, as an alternative to the historic use of hopper dredges in the area, and in late 2012 the Services again concurred with the Corps determinations of "may affect, not likely to adversely affect" for designated critical habitat and all the listed species covered by the previous consultation (NMFS Reference 2011/02093 of November 26, 2012 and USFWS Reference 13410-2011-1-0274-R001).

In 2013 the Corps reinitiated consultation on the above actions for a minor realignment of specified segments of the navigation channel intended to follow natural changes in the channel thalweg. Dredging of the channel as realigned represents less substrate disturbance, less volume dredged, and less sediment disposal. This minor channel realignment is also expected to continue to significantly reduce dredging needs at these locations. Once complete, the deepened channel – following the realigned orientation – will be maintained in a manner nearly identical to the existing annual dredging program. The Corps received concurrence on the determination of "may affect, not likely to adversely affect" for all of the species in the previous consultations as well as for the recently listed streaked horned lark.

The recent change to use of a clamshell dredge in the formerly hopper-dredged Outer Crossover Reach represents greatly reduced entrainment and mortality of aquatic organisms in that area. The effects of these two actions, analyzed separately, along with the current channel maintenance at -36 feet MLLW form part of the environmental baseline for this deepening project. The Corps has prepared a Supplemental Biological Evaluation for this project and is currently undergoing consultation with USFWS and NMFS.

4.5.2 Methods

The potential effects of the proposed action were evaluated in the context of incremental impacts added to the environmental baseline established by the existing maintenance dredging program, the continuation of which is Alternative1. The analysis of Alternative 1 considers the timing, duration, volume, and extent of dredging and dredged material placement activities that could occur in any given year, and the effects of these activities on threatened and endangered species and their habitat in the action area. The action area was defined for the previous Biological Evaluation as within 0.11 mile of the navigation channel and the dredged material placement sites below the water surface and within 0.76 mile above the water surface, based on the maximum potential extent of dredging-related underwater and in-air noise and water quality effects. Species that received concurrence for a "no effect" determination in the Corps' most recent maintenance program consultation from NMFS (2011) and USFWS (2011), and subsequent consultations are identified and were generally excluded from further analysis under the action alternatives, unless those alternatives could result in measurable effects on those species. The Alternative 1 analysis also considers new critical habitat designations that have occurred since the Corps' 2011 and subsequent consultations were completed.

The direct and indirect effects of the action alternatives on threatened and endangered species and their habitats are evaluated by assessing the extent of any effects that would result above and beyond baseline conditions established in Alternative 1. Generally speaking, the effects of the action alternatives are related to the channel deepening and annual maintenance dredging during the construction year.

This assessment relies on the analyses presented in the ESA Biological Evaluation (U.S. Army Corps of Engineers 2013), which considered the effects of dredging and dredged materials placement in detail.

4.5.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Under Alternative 1, the inner and outer harbor reaches would be dredged with the equipment and in the manner, time period, and duration consistent with baseline conditions (Chapter 2, *Alternatives*). Dredged material would continue to be placed at the established placement sites, including open-water placement as appropriate and consistent with the results of the annual DMMP sediment suitability determinations. In the 2011, and subsequent ESA consultations, NMFS (2011) and USFWS (2011) concurred that continuation of this program from 2011 through 2026 "may affect, but is not likely to adversely affect" any listed species or designated critical habitat. If no action were taken, then the conclusions would remain the same as the previous Biological Evaluation (Corps 2011) and the subsequent 2012 and 2013 consultations.

Threatened and endangered species and their habitats that occur or may occur in the Grays Harbor vicinity are identified in Table 4.5-1, with species and critical habitat effect determinations and supporting rationale. They were identified from region- and county-specific lists of ESA-listed species maintained by NMFS (2013a) and USFWS (2013). This table also addresses threatened and endangered species and critical habitats that were not addressed in the 2011 and subsequent consultations, or that have been listed or designated since that consultation took place. A Supplemental BE has been prepared by the Corps for this project and that document will be coordinated with the Services. Several of the species known or likely to occur in the vicinity of Grays

Harbor are unlikely to occur in the action area, on the basis of habitat suitability and/or a lack of documented observations. No threatened or endangered plant species are known to occur in Grays Harbor based on information received and maintained by USFWS (U.S. Fish and Wildlife Service 2013).

Table 4.5-1. Species Listed under the Endangered Species Act and Designated and Proposed Critical Habitat that Potentially Occur in the Grays Harbor Vicinity, and Effect Determinations and Rationale Presented in the 2011, 2012, and 2013 ESA Consultations for the Maintenance Dredging Program

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Coastal/Puget Sound bull trout *Salvelinus confluentus*	Threatened	Yes	Not likely to adversely affect	Not likely to adversely affect	Species: Most likely to be present as adults only in Grays Harbor from March through mid-July, outside of the in-water work window for the maintenance dredging program. Critical Habitat: Majority of project impacts occur below −33 feet MLLW, which is outside of designated critical habitat. Effects of the maintenance dredging program on the water quality component of critical habitat are insignificant relative to natural variability.
Lower Columbia River Chinook salmon *Onchorhynchus tshawytscha*	Threatened	Yes	Not likely to adversely affect	No effect	Species: ESA-listed Columbia River salmonids may occur in Grays Harbor as juveniles during early marine rearing period. Likelihood of direct exposure to the maintenance dredging program is minimal, noise and disturbance effects are insignificant. Critical Habitat: Designation does not include Grays Harbor or coastal Washington waters.
Upper Willamette River Chinook salmon *Onchorhynchus tshawytscha*	Threatened	Yes	Not likely to adversely affect	No effect	
Columbia River chum salmon *Onchorhynchus keta*	Threatened	Yes	Not likely to adversely affect	No effect	

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Eulachon *Thaleichthys pacificus*	Threatened	Yes	Not likely to adversely affect	No effect	Species: Eulachon occurrence in Grays Harbor is rare. This species is most likely to occur during the mid-March to mid-July in-water work closure period; therefore, exposure to the direct and indirect effects of the maintenance dredging program is unlikely. Critical Habitat: Designation does not include Grays Harbor or coastal Washington waters.
Southern green sturgeon *Acipenser medirostris*	Threatened	Yes	Not likely to adversely affect	Not likely to adversely affect	Species: Green sturgeon are likely to be present in Grays Harbor during dredging in mid- to late summer and may be exposed to disturbance and displacement under the maintenance dredging program. However, the area of habitat affected at any given time relative to the amount of habitat available will be insignificant. Critical Habitat: The effects of the project on green sturgeon critical habitat will be insignificant, because they are temporary and the area of habitat affected at any given time relative to the area of habitat available is insignificant.

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Marbled murrelet *Brachyramphus marmoratus*	Threatened	Yes	Not likely to adversely affect	No effect	Species: Marbled murrelet may occur in the navigation channel and vicinity during the in-water work period and may potentially be exposed to in-air and underwater noise, disturbance, and turbidity associated with dredging. Anticipated noise levels are below disturbance thresholds for this species. Marbled murrelet may be displaced from foraging habitats, but the extent of disturbance at any given time will be insignificant relative to available habitat. Critical Habitat: Designation does not include Grays Harbor or coastal Washington waters.
Short-tailed albatross[a] *Phoebastria albatrus*	Endangered	No	No effect	Not designated	Species: Short-tailed albatross are pelagic seabirds that spend the majority of their lives soaring over the open ocean. They have never been recorded closer than 5 miles to the Washington State coastline in the vicinity of Grays Harbor and sightings are exceptionally rare. This species will not be exposed to maintenance dredging effects. Critical Habitat: Has not been designated for this species.

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Streaked-horned lark *Eremophila alpestris strigata*	Threatened	Yes	Not likely to adversely affect	Not likely to adversely affect	Species: Suitable habitat for streaked-horned lark does not occur within the area affected by the maintenance dredging program. Therefore, this species will not be exposed to maintenance dredging effects. Critical habitat: Proposed critical habitat unit on northern Grays Harbor shoreline. This critical habitat unit and other suitable habitats do not occur within the area affected by the maintenance dredging program.
Western snowy plover *Charadrius alexandrius nivosus*	Threatened	Yes	Not likely to adversely affect	Not likely to adversely affect	Species: Exposure to noise and other direct effects of dredging and dredging-related effects on foodweb productivity would be insignificant. Critical Habitat: Designation is restricted to nesting areas on Damon Point outside of the limits of effects of the maintenance dredging program. Therefore, the program will have no effect on critical habitat.
Oregon silverspot butterfly[a] *Speyeria zerene hippolyta*	Threatened	No	No effect	No effect	Species: Last known colony of Oregon silverspot in coastal Washington is believed to have been extirpated by 1991. Suitable habitats do not occur within the area affected by the maintenance dredging program. Critical Habitat: Designation does not include habitats on the Grays Harbor shoreline.

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Southern resident killer whale *Orcinus orca*	Endangered	Yes	Not likely to adversely affect	No effect	Species: Southern resident killer whale occurrence in Grays Harbor is exceptionally rare, and the species only occurs in nearshore marine waters for brief periods in January and March during coastal migration. Therefore, they are unlikely to be exposed to the effects of the maintenance dredging program. Critical Habitat: Designation does not include Grays Harbor or coastal Washington waters.
Humpback whale *Megaptera novaeangliae*	Endangered	Yes	Not likely to adversely affect	Not designated	Species: Humpback whales have rarely been observed inside of the mouth of Grays Harbor and are typically seen farther than 2 miles offshore. Therefore, they are unlikely to be exposed the effects of the maintenance dredging program. Critical Habitat: Not designated for this species.
Blue whale *Balaenoptera musculus*	Endangered	No	No effect	Not designated	Species: When these whale species occur off of coastal Washington they are nearly always associated with the continental shelf and slope greater than 30 miles offshore. They have never been observed in Grays Harbor or nearshore coastal waters and would not be exposed to the effects of the maintenance dredging program. Therefore, the maintenance dredging program would have no effect on these species. Critical Habitat: Has not been designated for these species.
Fin whale *Balaenoptera physalus*	Endangered	No	No effect	Not designated	
Sei whale *Balaenoptera borealis*	Endangered	No	No effect	Not designated	
Sperm whale *Physeter macrocephalus*	Endangered	No	No effect	Not designated	
Leatherback sea turtle *Dermochelys coriacea*	Endangered	No	No effect	No effect	Species: Adult loggerhead and leatherback sea turtles occur regularly in offshore coastal

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Loggerhead sea turtle *Caretta caretta*	Threatened	No	No effect	No effect	waters pursuing large aggregations of pelagic jellyfish. Strandings have been recorded but they are exceptionally rare and involve dead or sick individuals. Healthy adults have not been observed closer than 9 miles from shore and are rarely observed closer than 30. Therefore, there is no potential for exposure to the maintenance dredging program. Critical Habitat: Leatherback sea turtle critical habitat includes all coastal Washington waters out to the edge of the continental shelf, including the South Beach dredged material placement site. However, the maintenance dredging program will have an insignificant effect on the pelagic jellyfish aggregations that are the primary constituent element of critical habitat. The loggerhead turtle critical habitat designation does not include Grays Harbor or coastal Washington waters.
Mexican nesting green sea turtle *Chelonia mydas*	Endangered	No	No effect	No effect	Species: Green and olive ridley sea turtles occasionally occur in coastal Washington waters when carried north of their usual range

Species	Listing Status	Occurs or May Occur in Affected Habitats	2011 ESA Consultation Determination on Continued Maintenance Dredging Program to −36 feet MLLW		Rationale for Existing or Proposed Effect Determinations
			Effect Determination	Critical Habitat Determination	
Mexican nesting olive ridley sea turtle *Lepidochelys olivacea*	Endangered	No	No effect	No effect	by warm El Nino–related eddy currents. They cannot survive extended exposure to typical ocean temperatures off of coastal Washington. Strandings occur but are rare and limited to individuals dead or dying from cold-water exposure. Therefore, there is no potential for exposure to the effects of the maintenance dredging program. Critical Habitat: Designations do not include Grays Harbor or coastal Washington waters.

Source: U.S. Army Corps of Engineers 2011, except where noted below.
[a] Not addressed in the Corps (2011) biological evaluation, but were addressed in the 2013 BE (Corps 2013).

4.5.3.1 Bull Trout and Salmon

Bull Trout

Under baseline conditions (Alternative 1), bull trout exposure to the direct and indirect effects of maintenance dredging and dredged material placement is minimal based on the timing and location of these effects relative to bull trout occurrence, and the nature and extent of these effects. Bull trout occurrence in Grays Harbor and its tributary watersheds is limited to feeding, migration, and overwintering associated with the presence of prey species. Bull trout are most likely to be present between early March and mid-July, and are least likely to be present from mid-July through February when adult bull trout return to their natal habitats for spawning.

This species does not appear to spawn in the Chehalis River basin, and individuals that may be in Grays Harbor probably originate from spawning populations of native char in other Olympic Peninsula drainages north of Grays Harbor (R2 Resource Consultants 2006; Chan pers. comm.). Two of the fish tagged as part of the R2 Resource Consultants (2006) study were recaptured in the Hoh River basin. Therefore, baseline conditions (Alternative 1) do not affect spawning behaviors or spawning habitat and their associated critical habitat primary constituent elements.

Under baseline conditions (Alternative 1), dredging of the inner harbor reaches occurs during a portion of the year when bull trout are least likely to be present (mid-July through mid-February), so minimal effects occur. Dredging of the inner harbor reaches is scheduled to avoid impacts on bull trout, and it provides the added benefit of avoiding impacts on outmigrating juvenile salmon. Therefore, Alternative 1 avoids adverse effects on this important component of the bull trout's food base. Dredging activities are also limited to habitats that are deeper than −33 feet MLLW, which is outside of designated critical habitat and the range of nearshore marine habitats typically used by this species (U.S. Fish and Wildlife Service 2004). Turbidity and underwater noise levels extend into habitats that are likely to be used by bull trout, but occur only during periods when this species is least likely to be present. Therefore, the likelihood of exposure to disturbance and water quality effects under baseline conditions (Alternative 1) is minimal.

Under Alternative 1, dredging of the outer harbor reaches (South reach to Outer Crossover reach) would occur during periods when native char are known to occur in the lower Chehalis River (summer). This means that bull trout could be exposed to the effects of annual maintenance dredging and dredged material placement. Outer Grays Harbor is clearly used as a migration corridor, but the extent to which adjacent nearshore habitats are used for other purposes is unknown. No native char were observed in Half Moon Bay during the R2 Resources Consultants (2006) studies, despite the presence of suitable nearshore habitats and ample prey resources. This suggests that the potential for extended exposure to dredged materials placement and related effects is limited. Effects of dredging in the outer harbor reaches by hopper dredge could include exclusion from migratory or foraging habitat as a result of reductions in water quality, and loss of prey from entrainment and/or benthic disturbance. However, water quality and direct disturbance effects are limited for the following reasons.

- Dredging activities and dredged materials placement are limited to aquatic habitats below −33 feet (-10 meters) MLLW, which is deeper than the nearshore marine and estuarine habitats most commonly occupied by bull trout (U.S. Fish and Wildlife Service 2004) and outside of bull trout critical habitat (75 FR 63898).

- Sediments removed from the outer harbor reaches are primarily sands of marine origin that are extracted using a hopper dredge (U.S. Army Corps of Engineers 2011). These heavy particles settle out of suspension rapidly and generally do not disperse to adjacent areas. Moreover, the hopper dredge is not likely to cause significant suspension of these heavier sediments.
- Strong tidal currents and wave action suspend and mobilize coarse sediments even under ambient conditions when dredging is not occurring under baseline conditions (Osborne 2005; Watts et al. 2011).
- Only a small portion of available habitat in outer Grays Harbor is affected at any moment in time. Dredging occurs in the spring when observed entrainment rates of prey species are relatively low (U.S. Army Corps of Engineers 2011), meaning that prey species are likely to be concentrated higher in the water column or in shallower areas near the shoreline, and outside the reach of dredging and disposal activities.

Alternative 1 "may affect, but is not likely to adversely affect" bull trout because this species is most likely to be present as adults only in Grays Harbor from March through mid-July, outside of the in-water work window for the maintenance dredging program. Majority of project impacts occur below −33 feet MLLW, which is outside of designated critical habitat. Effects of the maintenance dredging program on the water quality component of critical habitat are minimal relative to natural variability.

Salmon

Juvenile lower Columbia River Chinook salmon, upper Willamette River Chinook salmon, and Columbia River chum salmon may potentially use the nearshore and intertidal habitat in Grays Harbor. These three species are considered herein as a single group, because they occupy similar habitat in the juvenile life-history stage, and thus experience baseline conditions (Alternative 1) in a similar manner and during similar periods of the year.

If juveniles of these three species are present in Grays Harbor during dredging under baseline conditions, they would generally be found in the intertidal and nearshore areas of the outer portion of Grays Harbor. Dredging operations occur in the navigation channel in late summer to late winter. As such, dredging occurs in deeper-water areas where juveniles of these three species are not likely to be present and during periods when these species are least likely to be present in the estuary. As discussed above for bull trout, the transport and placement of dredged material does not result in adverse impacts on these three species. Although there may be some water quality degradation (elevated turbidity) in and around the navigation channel and dredged material placement sites, these effects do not extend to habitats used by these species during periods when they are likely to be present. The potential for dredging entrainment is similarly unlikely, given that both clamshell and hopper dredging activities are taking place at depths greater than −33 feet (-10 meters) MLLW, while juvenile salmonids tend to use the top 6 feet (2 meters) of the water column (Healy 1991; Moulton 1997). This conclusion is supported by the minimal numbers of salmonids observed in site specific dredging studies (Reine and Clarke 1998). Alternative 1 "may affect, but is not likely to adversely affect" listed salmon because although listed Columbia River salmonids may occur in Grays Harbor as juveniles during early marine rearing period the likelihood of direct exposure to the maintenance dredging program is minimal, noise and disturbance effects are negligible. There is no designated critical habitat within Grays Harbor or coastal Washington waters for these species.

4.5.3.2 Southern Green Sturgeon

Subadult and adult southern green sturgeon are known to regularly use Grays Harbor during the summer and early fall months (primarily May through October) (Lindley et al. 2011), indicating the potential for direct exposure to the effects of dredging and placement activities, and indirect effects resulting from impacts on benthic prey organisms. However, the nature of estuarine habitat use by this species suggests that the potential for direct exposure is somewhat limited. Kelly et al. (2007) found that foraging adult and subadult sturgeon in San Francisco and San Pablo Bays remained primarily in waters less than 33 feet (10 meters) in depth, moving on and off of shallow flats with the tidal fluctuations. In contrast, actively migrating sturgeon were typically found in deep-water habitats and exhibited rapid directional movement. The majority of Grays Harbor, specifically the areas outside the navigation channel, consists of shallow-water tidal flats with abundant green sturgeon prey resources. The strong preference for this habitat type during estuarine foraging suggests that green sturgeon in Grays Harbor would most commonly be found outside of the navigation channel and dredged material placement sites where the direct and indirect effects of maintenance dredging are concentrated.

The potential for direct entrainment of green sturgeon is unlikely. The adults and subadults are large, powerful swimmers capable of avoiding dredging-related disturbance (Huff et al. 2012; Lindley et al. 2008), a fact illustrated by the lack of green sturgeon observed in studies of entrainment rates associated with Grays Harbor dredging (Reine and Clarke 1998). Further, the majority of the dredging is conducted with a clamshell dredge, which is associated with lower fish entrainment rates. Sturgeon may also be exposed to underwater noise levels in excess of background conditions, but as discussed previously in Section 4.4.3.2, *Underwater Noise*, dredging-related noise levels are not expected to exceed thresholds associated with behavioral disturbance in fish. This implies that any behavioral alteration results from the direct disturbance of the bed during dredging and placement activities and elevated turbidity plumes.

Bed disturbance results in a temporary reduction in the availability of prey organisms, but these effects are concentrated at depths greater than −33 feet MLLW that are less frequently used by foraging sturgeon in estuaries, and the duration and extent of these effects are limited relative to the amount of foraging habitat available.

Although present in the action area, the overall potential effects from the proposed dredging and disposal activities on green sturgeon are expected to be negligible. Thus, Alternative 1"may affect, but is not likely to adversely affect" Southern green sturgeon.

4.5.3.3 Southern Eulachon

Eulachon presence in Grays Harbor is likely rare, with the last large spawning run observed in the Wynoochee River in 1993. Under Alternative 1, maintenance dredging would occur as described in Chapter 2, *Alternatives*, with NMFS (2011) and USFWS (2011) ESA concurrence in effect through 2026. Thus there is some potential for large numbers of eulachon to occur in Grays Harbor during this period but the probability of such occurrence in any year is low. In the event that a spawning run of adult eulachon were to occur, adults and their planktonic larvae are most likely to be present during the in-water work closure period from mid-February through June, so they would not be exposed to any direct or indirect effects under Alternative 1.

Juvenile and subadult eulachon may periodically occur in Grays Harbor in small numbers, but the frequency and extent of this occurrence is unknown. However, the number of eulachon occurring in the area would likely be small based on the lack of documented observations of this species in recent years. These individuals may be exposed to limited turbidity and disturbance effects associated with dredging and dredged materials placement under baseline conditions, but the extent of these effects and area affected is limited.

Direct entrainment of adult and larval eulachon by hopper dredges has been observed in Grays Harbor (Larson and Moehl 1990; McGraw and Armstrong 1990). Hopper dredged entrainment rates averaged 0.0006 fish per cubic yard of dredged material (Larson and Moehl 1990; McGraw and Armstrong 1990; Reine and Clarke 1998). These entrainment studies were conducted in the late 1980s during the period from March through July (U.S. Army Corps of Engineers 1989), which overlaps the peak period of potential eulachon occurrence. This indicates that eulachon exposure to dredging entrainment is minimal even during periods when they are most likely to occur.

While adults are unlikely to be present during spring hopper dredging in the outer harbor; hopper dredging would occur during juvenile outmigration-if juveniles are present. Thus, hopper dredging in the outer harbor could potentially entrain larval eulachon. Although some risk of larval eulachon entrainment exists, the risk is negligible because larval eulachon are not likely to be present in the action area during dredging operations. Eulachon prefer large river systems, such as the Columbia and Fraser rivers that are fed by snowmelt or extensive spring freshets. The WDFW and ODFW (2001) reported eulachon in "large abundance" in the Wynoochee River, a tributary of the Chehalis River, in 1993 when the run into the Columbia River was delayed, presumably due to cold water conditions. Observances over a relatively long period suggest that this was a unique occurrence and that their use of the Chehalis system is highly irregular. Deschamps et al. (1970 in Gustafson 2011; Monaco et al.. 1990) and Simenstad et al. (2001 in Gustafson 2011) stated their observances of adult eulachon in the Chehalis River system were rare. Deschamps et al. (1970) further stated that a eulachon run of any consequence in the Chehalis system was unlikely, "although strays or feeding fish from other areas probably visit the upper harbor at times." Consequently, eulachon appear to utilize the Grays Harbor watershed very infrequently, which further reduces the likelihood of the species being encountered during dredge operations. It is unlikely that larval eulachon produced in small spawning events would be entrained during hopper dredging, given the small area being dredged and the small numbers of larval eulachon potentially present in the harbor as the result of minor spawning events. The entire navigation channel represents only 3 percent of Grays Harbor, and each dredging event would be even smaller. Thus the likelihood of larval entrainment is expected to be low. Given the timing, location and duration of dredging and disposal operations, and the low likelihood of eulachon presence, the likelihood of effects on eulachon is minor. Therefore Alternative 1 "may affect, but is not likely to adversely affect" Southern Pacific eulachon.

4.5.3.4 Snowy Plover

Under baseline conditions (Alternative 1), snowy plovers foraging on the intertidal mudflats exposed at low tide can be exposed to in-air noise from dredging operations, if they are close enough to the dredging to be within the limits of measurable noise effects. As noted in Sections 4.4.3.2 and 4.4.3.3, the noise levels produced by dredging are not expected to exceed disturbance thresholds used for marbled murrelet and other bird species (160 dbrms), even at a distance of 50 feet from the source. Even under low-tide conditions, only a small amount of intertidal habitat would be

accessible within the limits of measurable noise effects. Plover nesting habitat at Damon Point (north shore of Grays Harbor) is outside of the limits of measurable noise effects and thus is not affected.

Under baseline conditions (Alternative 1), benthic habitats affected by dredging and dredged materials placement are all deeper than −33 feet MLLW. This is well below the outer limit of intertidal foraging habitat accessible to snowy plovers. Thus, the availability of prey organisms would not be measurably affected by annual maintenance dredging and placement activities under Alternative 1.

The 2011 USFWS concurrence letter on Grays Harbor dredging (previously-consulted-on action) stated, "Based on distance of the dredging and disposal sites from the nesting area and the fact that habitat conditions at Damon Point have remained suitable for western snowy plovers since the species was listed, we do not expect that changes in sediment transport and deposition resulting from the proposed maintenance dredging and disposal activities will have measurable effects on western snowy plover nesting habitat. Because the proposed action will not measurably affect habitat conditions for the western snowy plover, any effects to western snowy plover nesting and foraging areas are considered insignificant." Therefore Alternative 1 "may affect, but is not likely to adversely affect" western snowy plover.

4.5.3.5 Marbled Murrelet

Under baseline conditions (Alternative 1), outer Grays Harbor dredging and placement of dredged material occurs between July and February in and adjacent to marbled murrelet foraging habitat. Some disturbance to prey items (fish) and foraging behaviors can occur. The recent 5-year review of the status of marbled murrelets (U.S. Fish and Wildlife Service 2009) indicates that a long-term, region-wide negative abundance trend is continuing. One of the primary causes of this trend appears to be starvation caused by inadequate prey availability during nesting season, during which marbled murrelets fly long distances between the coast and upland nests. The existing ESA consultation for maintenance dredging concluded that continuation of maintenance dredging under Alternative 1 would have no effect on marbled murrelet nests, nesting habitat (coastal old growth forests), or young (U.S. Fish and Wildlife Service 2011). USFWS (2011) also concluded that the direct and indirect effects of dredging on nesting season foraging behaviors are not likely to adversely affect marbled murrelets. Moreover, there is a general lack of sightings during the late spring period (Carlson et al. n.d.), suggesting that murrelet exposure to dredging activities would be minimal during this period.

The presence of dredge vessels and the level of activity and turbidity effects associated with dredging may temporarily displace foraging marbled murrelet from feeding habitats under baseline conditions (Alternative 1). The effects of anthropogenic disturbance on marbled murrelet at sea are not well-documented, but marbled murrelet have been shown to habituate to boat traffic (Strachan et al. 1995). Dredges generally move slowly and the footprint of associated disturbance and noise effects is limited in size. Increases in turbidity during dredging could reduce visibility in the immediate vicinity of dredging activities, thereby potentially reducing foraging success for any murrelets that remain in the area. However, this effect would be localized and would dissipate rapidly upon completion of the dredging and/or material placement activities. Marbled murrelets are relatively opportunistic foragers; they have flexibility in prey choice, which likely enables them to respond to changes in prey abundance and location (61 FR 26256; Strachan et al. 1995). This suggests that any displacement effect from dredging is of short duration and would affect a limited

amount of foraging habitat relative to the amount available in Grays Harbor and nearby coastal habitats.

Under baseline conditions (Alternative 1), murrelets may be exposed to in-air and underwater noise from dredging activity that exceeds ambient conditions. Analysis of noise levels produced by dredging activity indicates that associated in-air and underwater noise levels are below the disturbance thresholds for marbled murrelet (see Sections 4.4.3.2 and 4.4.3.3). The underwater sound generated by dredges is not considered significant (Jensen pers. comm., March 2011), and noise levels are not sufficient to cause injury or behavioral alteration.

As described in Section 4.4.3.4, *Bed Disturbance and Entrainment*, and Section 4.5.3.2, *Entrainment and Burial of Threatened and Endangered Species*, the loss of prey resources, as a result of entrainment is limited. Monitoring studies of Grays Harbor maintenance dredging (Dredging Operations and Environmental Research 1998) indicate that the entrainment rate of potential murrelet prey species is low and the resulting effect of this activity on prey availability is likely to be minimal.

The 2011 USFWS concurrence letter on Grays Harbor dredging (previously-consulted-on action) stated, "The proposed maintenance dredging and disposal activities do not occur within suitable marbled murrelet nesting habitat and there is no suitable nesting habitat within 0.25 mile of the action area. The distance from suitable marbled murrelet nesting habitat should preclude any adverse effects to nesting marbled murrelets or their young. The proposed maintenance dredging and disposal activities will not directly affect documented forage fish spawning habitat. However, forage fish may be entrained during suction dredging. Additionally, small amounts of eelgrass may be affected. The proposed dredging will occur during the marbled murrelet nesting season (April through September) when marbled murrelets will be foraging to provide food for their young. Marbled murrelets have been documented along the outer coast and may enter Grays Harbor during inclement weather. However, there are no records or sightings of marbled murrelets in inner Grays Harbor, likely because of limited foraging opportunities. Although marbled murrelets forage along the coast and outer harbor, project-related impacts to forage fish in Grays Harbor are not expected to be measurable. Therefore, effects to marbled murrelets via their prey base are considered insignificant. Due to the existing shipping traffic within Grays Harbor, we do not expect that foraging marbled murrelets will be measurably affected by sound pressure or other temporary disturbances resulting from the action. Therefore, the effects of the vessel operations on foraging marbled murrelets are considered insignificant."

For the reasons listed above, and as summarized in Table 4.5-1, Alternative 1 "may affect, but is not likely to adversely affect" marbled murrelet, and would have no effect on marbled murrelet critical habitat.

4.5.3.6 Streaked Horned Lark

The streaked horned lark was listed as a threatened species habitat in November 2013 with concurrent critical habitat designation (78 FR 61506). This designation includes documented nesting habitats at Damon Point and the adjacent Oyhut Wildlife Area which are located adjacent to but not within the action area.

Critical habitat PCEs for streaked horned lark include:

1. Areas having a minimum of 16% bare ground with sparse, low stature vegetation composed primarily of grasses and forbs less than 13 inches (33 cm) in height, which are found in:
   a. Large (300-ac (120-ha)), flat (0–5% slope) areas within a landscape context that provides visual access to open areas such as open water or fields, or
   b. Areas smaller than described in (a), but that provide visual access to open areas such as open water or fields.

These PCEs are present on Damon Point and associated shoreline habitats, and these habitats are located in the action area. Maintaining the channel could cause a discountable and insignificant change in the sand budget and sand movement in the inner and outer portions of Grays Harbor Federal Navigation Channel. These in turn, could have a discountable and insignificant effect on Damon Point. The existence of the Navigation Channel and a connecting channel from the North Bay present a barrier to Damon Point elongating much further in a southeastern direction. The southeastern end of Damon Point will likely remain static as the eroding sand enters the two channels. Sand eroding off the southeastern end of Damon Point will be moved into an adjacent shallow area or out of Grays Harbor via the navigation channel on the ebb tide, simultaneously sand will be entering along the northern side of the entrance channel during flood tide and feeding sand to Damon Point. Thus, Damon Point is likely to remain as a feature (although it will likely continue to change shape) into the foreseeable future. The Corps determined that maintenance dredging "may affect, but is not likely to adversely affect" streaked horned lark or critical habitat for streaked horned lark, and the Services concurred with that determination(NMFS ref: WCR-2013-68; USFWS ref: 13410-2011-I-0274-R002).

4.5.3.7 Southern Resident Killer Whale

Under baseline conditions (Alternative 1), potential effects on southern resident killer (SRK) whales involve possible sound exposure and disturbance caused by vessel operations during maintenance dredging in the outer reaches and dredged material placement at the South Beach open-water dispersive site. The likelihood of exposure to these activities is minimal, because the frequency and duration of outer harbor dredging and barge traffic between the outer harbor and the South Beach site are limited and the duration of southern resident killer whale presence in coastal waters adjacent to the action area each year appears to be brief (National Marine Fisheries Service 2013b). As discussed in Section 4.4, Invertebrates, Fish, and Wildlife, and above in Section 4.5.3.3, Bull Trout, Alternative 1 would not measurably affect the abundance of salmon species. Therefore, any indirect effects on southern resident killer whales resulting from impacts on their prey would not be significant.

Southern resident killer whales occurring in the area when dredge equipment is present would not experience substantial disturbance under Alternative 1. The low-frequency noise made by operating hopper dredges is not expected to mask calling and echolocation capabilities of southern resident killer whales that rely on higher frequency sound (Clarke et al. 2002; Talus 2000). The current guidance for continuous underwater noise sources (clamshell dredging, the loudest of the project's noise sources, is considered a continuous noise source by NMFS), 120 dB_{RMS} (73 FR 14443 and 73 FR 41318), is below the estimated ambient noise level of 123 dB_{RMS}. Therefore, the latter is used as the disturbance threshold. The distance at which noise levels attenuate to ambient levels is approximately 600 feet from the source. Ambient background noise and noise attenuation from the soft sediments in Grays Harbor would likely reduce the distance at which clamshell dredge noise

attenuates to background levels. The likelihood of southern resident killer whale occurrence within a 600-foot radius of dredging activity is discountable given the nature and duration of nearshore marine habitat use by this species in proximity to the action area. Direct disturbance effects are similarly unlikely to cause alarm or displacement, because dredge vessels are typically stationary or slow-moving and occur primarily in areas where the potential for southern resident killer whale occurrence is minimal at best, and marine mammals can readily avoid these vessels by a distance of 600 feet.

The 2011 NMFS concurrence letter on Grays Harbor dredging (previously-consulted-on action) stated, "ESA-listed marine mammal species are extremely unlikely to occur in the Grays Harbor navigation channel or the harbor proper, and therefore the proposed dredging actions, including vessel traffic, have a discountable potential to affect these species. These species may occur nearshore along the outer Washington coast at the Grays Harbor entrance, where disposal of dredge materials is proposed to occur. Therefore dredge disposal activities may have some effects on marine mammal species. These effects are likely to be insignificant…"

For these reasons, and as summarized in Table 4.5-1, the Corps determined that Alternative 1 "may affect, but is not likely to adversely affect" southern resident killer whale, and would have no effect on SRK whales critical habitat.

4.5.3.8 Humpback Whale

Humpback whale occurrence within Grays Harbor is exceptionally rare and observed occurrences have been limited to the outer harbor in the vicinity of the jetties and the harbor mouth. Therefore, the potential for species exposure to any effects of Alternative 1 is improbable. For these reasons, and as summarized in Table 4.5-1, Alternative 1 "may affect, but is not likely to adversely affect" humpback whale.

4.5.3.9 Threatened and Endangered Species Excluded from Further Analysis

The remaining threatened and endangered species known to occur in the general vicinity of Grays Harbor are not exposed to the environmental effects of the maintenance dredging program (i.e., baseline conditions/Alternative 1) and were therefore excluded from further analysis. These species include:

- Blue whale, fin whale, sei whale
- Sperm whale
- Short-tailed albatross
- Loggerhead, leatherback, green and olive Ridley sea turtle
- Oregon silverspot butterfly

These species would not be affected under Alternative 1, because they have never been recorded in the affected habitats and the habitats are not suitable for any species life stages that occur in the Grays Harbor vicinity.

4.5.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Alternative 2 would employ similar methods to those used under baseline conditions (Alternative 1), and these methods would be employed on the same schedule and at the same intensity (i.e., number of dredging vessels, number of work hours per day) as occurs under baseline conditions. The entire 6 month work window would likely be used under Alternative 2, as compared to the approximately 4.5 months under Alternative 1. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). The dredged material would then be placed in the same manner as under baseline conditions. Placement sites would be the South Jetty, South Beach, Half Moon Bay sites as under baseline conditions and would also include the shifted Point Chehalis and the Hoquiam waste water treatment lagoon upland sites as described previously.

The 2012 sediment characterization identified a potential contaminant concern in the Cow Point reach, and the Corps has elected to remove all dredged sediments from this DMMU (subunit 32a) and place them upland, permanently removing them from the aquatic environment. Approximately 13,500 cubic yards of material would require upland placement under Alternative 2. The removal of contaminated sediments from the Cow Point reach is not likely to result in contaminant-related water quality impacts that could affect threatened and endangered species, based on the best management practices selected and experience from similar dredging projects. These materials will be removed using a clamshell dredge as described in Chapter 2. Dredging associated with the initial channel deepening in the inner harbor reaches would remove an additional 1,031,000 cubic yards of material and require an additional 45 days beyond the time required for maintenance dredging under baseline conditions, with these activities limited to the same in-water work window, but this would result in only a minimal increment in the extent of bed disturbance, water quality and sediment quality effects, underwater noise, in-air noise, and entrainment effects when added to baseline conditions. Given that baseline conditions would not result in adverse effects on any listed species or designated critical habitat (National Marine Fisheries Service 2011; 2012; 2013 and U.S. Fish and Wildlife Service 2011; 2012; 2013), these effect mechanisms would likewise be minor under Alternative 2.

Alternative 2 would require placement of 1,031,000 cubic yards of sediment above and beyond the maintenance dredging volume required to maintain the channel at -36 feet MLLW. This presents additional potential burial of organisms present in the placement sites. As discussed in Section 4.5.3.2, *Entrainment and Burial of Threatened and Endangered Species*, listed species, including sensitive life stages (e.g., juveniles), are not likely to be exposed to burial effects at the dredged material placement sites, because they are unlikely to use the affected habitats, and/or they are not likely to be present in these sites during life-history stages that are vulnerable to burial.

Alternative 2 would result in a permanent alteration of the depth profile of the Grays Harbor navigation channel, albeit by the marginal amount of 1 foot. Channel deepening is unlikely to result in adverse effects on any threatened or endangered species occurring in the Grays Harbor vicinity for the following reasons:

- The bird species occurring in the Grays Harbor vicinity either do not depend on the deeper subtidal habitats (e.g. snowy plover) or are not likely to be significantly affected by an incremental change in a small percentage of subtidal habitat area in Grays Harbor because such

a change is not expected to have any significant effect on the suitability of foraging habitat (e.g., marbled murrelet).

- Threatened and endangered fish species occurring in the Grays Harbor vicinity preferentially select estuarine habitats shallower than −33 feet (-10 meters) MLLW and therefore would be relatively insensitive to bathymetric changes below this threshold; and the area affected is insignificant relative to habitat available across a range of depth profiles.
- Threatened and endangered marine mammal occurrence in the Grays Harbor vicinity is rare and typically of limited duration, meaning that the potential for exposure to any of the areas affected is very unlikely.

Alternative 2 would add as many as 33 annual deep-draft vessel transits by the year 2037 as compared with Alternative 1. Listed species in Grays Harbor would thus experience approximately 2.75 additional vessel passages per month, attributable to a median "high/moderate" growth projection in cargo tonnage moved through the Port as a result of a channel deepened to -37 feet MLLW. The principal disturbance effect of passing vessels would be underwater noise: the continuous noise generated by a deep-draft vessel transiting harbor waters at a moderate speed has been determined to be roughly equivalent to the level of noise generated by an operating dredge. (Robinson et al. 2011, as cited in 78 Fed. Reg. 30873, 30875, May 23, 2013). Unlike an operating dredge, however, the transit of a cargo vessel would be irregular and infrequent, and would cause only a temporary effect. The infrequent additional transits of deep-draft vessels would have minimal effect. Any adult bull trout that may be present would not be affected as they would be feeding in shallow water along the shoreline, and would not be present in or near the channel. Adult sturgeon would be present on the bottom in deeper waters, would be accustomed to disturbance caused by passing vessels, and could readily avoid the source. To the extent eulachon may actually be present in Grays Harbor, they would be accustomed to disturbance caused by passing vessels, and could readily avoid the source. SRKW are also likely to be impacted by marine traffic, and would likewise be accustomed to disturbance caused by passing vessels, and could readily avoid the source. The fleeting underwater noise generated by the irregular and occasional additional vessel transit would generate no more than a minor increment of adverse effect as compared with Alternative 1.

The effects of Alternative 2 on threatened and endangered species are therefore anticipated to be similar to nature and magnitude of the dredging effects which occur under baseline conditions (Alternative 1).

Based on the above discussion, the potential for incremental impacts on threatened and endangered species from initial channel deepening, and subsequent maintenance and related placement of the dredged material under Alternative 2 over and above the effects of maintenance dredging evaluated in the FY 2012-18 EA (as supplemented) and the 2011 BE (as supplemented) are minor. The same determinations for Alternative 1, as summarized in Table 4.5-1 would also apply to Alternative 2.

4.5.5 Alternative 3—Deepen Channel to −38 Feet MLLW

Alternative 3 would employ similar methods as those used under baseline conditions (Alternative 1), and these methods would be employed on the same schedule and at the same intensity (i.e. number of work hours per day) as occurs under baseline conditions. As is the case with Alternative 2, the entire 6 month work window would likely be used under Alternative 3. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point and a

hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). An additional clamshell dredge would be utilized under Alternative 3. The dredged material would then be placed in the same manner as under baseline conditions. Placement sites would be the South Jetty, South Beach, Half Moon Bay sites as under baseline conditions and would also include the shifted Point Chehalis and the Hoquiam waste water treatment lagoon upland sites as described previously.

The 2012 sediment characterization identified a potential contaminant concern in the Cow Point reach, and the Corps has elected to remove all dredged sediments from DMMU subunit 32a. Approximately 24,000 cubic yards of material would require upland placement under Alternative 3. The removal of contaminated sediments from the Cow Point reach is not likely to result in contaminant-related water quality impacts that could affect threatened and endangered species, based on the best management practices selected and experience from similar dredging projects. These materials will be removed using a clamshell dredge as described in Chapter 2. One additional clamshell dredge and bottom dump barge would be employed during dredging of the inner harbor reaches. Dredging associated with the initial channel deepening in the inner harbor reaches would require an additional 45 days beyond the time required for maintenance dredging under baseline conditions, with these activities limited to the same in-water work window. Compared to baseline conditions, the use of two clamshell dredges would potentially double the area that could affect water quality, noise, and disturbance during this time; however, the existing maintenance dredging program has previously evaluated the effects of dredging throughout the entire in-water work window. This means that the duration and area of disturbance associated with dredging activities under Alternative 3 would not differ significantly from levels that occur under baseline conditions. Further, the habitat area subject to these effects under baseline conditions is small relative to the amount of habitat available for all listed species in Grays Harbor.

Alternative 3 would add as many as 51 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Listed species in Grays Harbor would thus experience fewer than one additional vessel passage per week, attributable to a "high" growth projection in cargo tonnage moved through the Port as a result of a channel deepened to -38 feet MLLW. The principal disturbance effect of passing vessels would be underwater noise: the continuous noise generated by a deep-draft vessel transiting harbor waters at a moderate speed has been determined to be roughly equivalent to the level of noise generated by an operating dredge. (Robinson et al. 2011, as cited in 78 Fed. Reg. 30873, 30875, May 23, 2013). Unlike an operating dredge, however, the transit of a cargo vessel would be irregular and infrequent, and would cause only a temporary effect. The infrequent additional transits of deep-draft vessels would have minimal effect. Any adult bull trout that may be present would not be affected as they would be feeding in shallow water along the shoreline, and would not be present in or near the channel. Adult sturgeon would be present on the bottom in deeper waters, would be accustomed to disturbance caused by passing vessels, and could readily avoid the source. To the extent eulachon may actually be present in Grays Harbor, they would be accustomed to disturbance caused by passing vessels, and could readily avoid the source. SRKW are also likely to be impacted by marine traffic such as dredging operations and thus would be unlikely to be disturbed by transiting ships, and would likewise be accustomed to disturbance caused by passing vessels, and could readily avoid the source. The fleeting underwater noise generated by the irregular and occasional additional vessel transit would generate no more than a minor increment of adverse effect as compared with Alternative 1.

As is the case with Alternative 2, Alternative 3 would likely result in only minor and discountable impacts on any threatened or endangered species occurring in the Grays Harbor vicinity, based on the same rationale presented for Alternative 2 (Section 4.5.4). In addition, given that baseline conditions would not result in adverse effects on any listed species or designated critical habitat (National Marine Fisheries Service 2011; 2012; 2013 and U.S. Fish and Wildlife Service 2011; 2012; 2013), these effect mechanisms would add only a minor additional increment under Alternative 3 (as compared to Alternative 2) to the effects of maintenance dredging on listed species as evaluated in the 2011 BE (as supplemented in 2012 and 2013). The same determinations for Alternative 1, as summarized in Table 4.5-1 would also apply to Alternative 3.

4.6 Historic and Cultural Resources

4.6.1 Overview

Cultural resources are locations of past human activities on the landscape. The term generally includes any material remains that are at least 50 years old and are of archaeological interest. Examples include archaeological sites such as prehistoric lithic scatters, villages, procurement areas, resource extraction sites, rock shelters, rock art, shell middens; and historic era sites such as trash scatters, homesteads, railroads, ranches, and any structures that are over 50 years old. Under the National Historic Preservation Act (as amended in 2006), cultural resources that are eligible for listing in the NRHP are referred to as historic properties.

4.6.2 Methods

The Corps has reviewed existing cultural resources information available for the area of potential effects (APE) and prior cultural resources studies conducted the Grays Harbor and Chehalis River Navigation Project. The review consisted of searching the online Washington Information System Architectural and Archaeological Records Data and internal Corps records in January 2013 (as described in Section 3.6).

On February 15, 2013, the Corps sent Section 106 and Tribal notification letters to the Confederated Tribes of the Chehalis Reservation, the Hoh Indian Tribe, the Quinault Indian Nation, and the Shoalwater Bay Tribe. The letter provided a description of the proposed deepening of the navigation channel, background on the cultural resource effects to date, and requested assistance identifying issues and concerns. In addition, the letter notified the Tribes that the Corps anticipated submitting a finding of no historic properties affected. On May 6, 2013, Corps staff met with the natural resources, fisheries, and cultural resources staff of the Confederated Tribes of the Chehalis Reservation to discuss the project in further detail. Topics of discussion included: hydrology, salinity, wave action, effects to fish and potential effects to cultural resources and traditional gathering areas of sweet grass. Based on the most current hydrology information, there would only be a minimal increase in wave action and salinity and there would be no affect to archaeological sites or gathering areas.

The Confederated Tribes of the Chehalis Reservation, the Hoh Indian Tribe, the Quinault Indian Nation, and the Shoalwater Bay Tribe did not comment on the Corps' determination and findings.

On May 16, 2013, the Corps sent a Determination of Effects letter with a finding of no historic properties affected to the Washington State Historic Preservation Officer (SHPO). The SHPO responded on May 22, 2013, only agreeing with the project's APE. On May 24, 2013, the Corps resent the Determination of Effects letter. The SHPO responded on May 28, 2013, agreeing with the Corps' determination of no historic properties affected (Appendix H).

4.6.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

In light of the previous cultural resources investigations that have been conducted, the Corps has determined that the prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE Therefore, Alternative 1 would have no effect on historic and cultural resources.

4.6.4

Alternative 2—Deepen Channel to −37 Feet MLLW

The results for Alternative 2 are the same as Alternative 1.

4.6.5 Alternative 3—Deepen Channel to −38 Feet MLLW

The results for Alternative 3 are the same as Alternative 1.

4.7 Sediment Characterization and Water Quality

4.7.1 Overview

This section discusses potential impacts on water quality within Grays Harbor due to the proposed action and the characterization of the sediments in the navigation channel that occurs prior to dredging and placement.

4.7.2 Methods

4.7.2.1 Sediment Characterization

The Corps samples and tests sediments prior to any dredging activities to determine placement options and ensure that sediments meet DMMP criteria for open water placement. The results of this testing are detailed in the DMMP suitability determination for the proposed action (Appendix A). These results were used in this analysis to characterize the sediments that would be dredged under the proposed action and to describe placement of the dredged sediments, either at one of the aquatic dredged material placement sites or at an appropriate upland location.

4.7.2.2 Water Quality

The sediment characterization results, data from past water quality monitoring during dredging, and conditions that would likely be included in the Clean Water Act Section 401 water quality certification from Ecology were used to evaluate the potential effects of the proposed action on water quality.

4.7.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

4.7.3.1 Sediment Characterization

Under Alternative 1, the inner and outer harbor reaches would be dredged with the equipment and in the manner, time period, and duration described for baseline conditions in Chapter 2, *Alternatives*. Dredged material would be placed at the established placement sites, including open-water placement sites, as appropriate, and consistent with the results of the February 2012 DMMP sediment suitability determination, and other pertinent DMMP documents (Appendix A).

Sediments of the outer harbor reaches (South Reach in this case) have typically been found to meet exclusionary criteria specified in Section 40 CFR 230.60 of the Clean Water Act, consisting mainly of coarse-grained material in a high-energy environment, geographically removed from sources of contamination. As such, these sediments require only confirmation of their exclusionary status (i.e., confirmation that they still meet criteria for open-water placement). In contrast, the inner harbor reaches require full sediment characterization, including characterization for chemical contamination, because the sediments in these reaches contain larger fractions of fine-grained sediment and are closer to historical sources of contamination.

Based on the results of the February 2012 determination, all of the sediment that would be maintenance dredged under Alternative 1 is suitable for open-water placement.

4.7.3.2 Water Quality

Under Alternative 1, the inner and outer harbor reaches would be dredged with the equipment and in the manner, time period, and duration described for baseline conditions in Chapter 2, *Alternatives*. Dredged material would be placed at the established placement sites, including open-water placement sites, as appropriate, and consistent with the results of the February 2012 DMMP sediment suitability determination, as supplemented. Timing of dredging and placement of materials will also help reduce potential temporary local impacts on fish and wildlife.

As outlined in the 2011 maintenance dredging EA (Corps 2011), dredging and placement of dredge materials at open-water and beneficial use placement sites has only short-duration, localized impacts on water quality. The turbidity and low-DO plume associated with the dredging and placement of dredged materials typically dissipates quickly due to the strong mixing from tidal currents and wave exposure, particularly at the open-water placement sites.

The Corps was issued a 50 year Clean Water Act Section 401 Water Quality Certification/Modification (WQC) from Ecology for the Point Chehalis Revetment Extension Project in August 1999 (WQC- Order #TB-98-02) which implemented the *Point Chehalis Revetment Extension and Half Moon Bay Inter-Agency Mitigation Agreement*, dated October 1998. This included upland dredged material placement at the buried revetment extension mitigation site.

In addition, the Corps was issued a Clean Water Act Section 401 water quality certification (WQC) from Ecology for continued maintenance dredging and disposal in February 2012 (WQC- Order #8992) for the current maintenance dredging program, and WQC 10742 was issued for the Navigation Improvement Project on 13 June 2014. The WQC includes requirements for water quality monitoring with a mixing zone of 600 feet downstream/down current from in-water activity, and specifies the handling of unsuitable material for DMMU 32a (Appendix H).

4.7.4 Alternative 2—Deepen Channel to −37 Feet MLLW

4.7.4.1 Sediment Characterization

The suitability determination and other pertinent DMMP documents(Appendix A) concluded that all sediment that would be dredged under Alternative 2 is suitable for open-water placement, with the exception of 13,500 cubic yards of material from the Cow Point 32a subunit. The sediment deemed unsuitable for open-water placement showed elevated mortality in the sediment larval development test.

The unsuitable material would be dredged and then removed to an upland placement site (slated as the former Hoquiam waste water treatment lagoon) as described in section 2.3. DMMU sub-unit 32a will be physically surveyed after construction, and a determination will be made at that time whether an additional round of testing is required of that sub-unit prior to any subsequent maintenance dredging episode in that sub-unit's footprint.

Because unsuitable sediments would be removed to an upland placement site, and permanently removed from the aquatic environment the potential for water quality impacts due to contaminated sediments is expected to be minor and localized.

4.7.4.2 Water Quality

While the duration of dredging activities under Alternative 2 would be extended by 1.5 months relative to baseline conditions, best management practices will ensure that water quality impacts remain localized and overall impacts remain negligible.

Initial dredging from channel deepening would result in placement of an additional 1,017,500 cubic yards of material (1,031,000 cubic yards minus 13,500 cubic yards that will be placed upland) at the open-water placement sites as compared to Alternative 1. Maintenance dredging would add an additional 50,000 cubic yards annually. These activities would be conducted in the same manner and using barges with the same capacity as under baseline conditions.

As reflected in further detail in the Section 404(b)(1) Evaluation, discharge of dredged material in a water of the United States at the shifted Point Chehalis aquatic site would be justified, among the practicable and reasonable alternatives, as the least costly and most practicable discharge site, consistent with engineering and environmental requirements. During the construction year when the Point Chehalis site would be used, insufficient capacity would be available at the placement sites in use under Alternative 1 to accommodate the increased volumes attributable to deepening and maintenance dredging. Insufficient capacity would be available in upland sites proximate to the shoreline to accommodate the large increment of dredged material volume, and thus discharge into waters of the U.S. could not be completely avoided; in any event, return of dredged material to the littoral system through aquatic discharge provides environmental benefits. The upland capacity of the Point Chehalis Revetment Extension mitigation site would be utilized to the extent feasible. The capacity of nearshore nourishment sites at South Beach and Half Moon Bay would be utilized to the extent that conditions and placement site depths allow. The South Jetty dispersive site would likewise be utilized to the extent that conditions and site capacity allow. After having exhausted the other practicable alternatives, dredged material would be placed for aquatic disposal at the shifted footprint of the dispersive Point Chehalis aquatic site.

Materials from the dredging would require multiple deposits at the placement sites, in addition to those from subsequent annual maintenance dredging. Similar to baseline conditions, the turbidity and low-DO plume associated with placement of dredge materials would dissipate quickly due to the strong tidal currents and wave exposure at the open-water placement sites.

The Corps received a CWA Section 401 water quality certification from Ecology 13 June 2014 (Appendix H), and would abide by requirements associated with the discharge of dredged material included in that Certification for the protection of water quality.

Therefore, the potential for the dredging and placement of materials under Alternative 2 to generate incremental effects on water quality over and above the effects of maintenance dredging evaluated in the FY 2012-18 EA is expected to be minor.

4.7.5 Alternative 3—Deepen Channel to −38 Feet MLLW

4.7.5.1 Sediment Characterization

The suitability determination (Appendix A) concluded that all sediment that would be dredged under Alternative 3, with the exception of the 22,400 cubic yards of material from the Cow Point 32a subunit, is suitable for open-water placement. The sediment determined unsuitable for open-water placement showed elevated mortality in the sediment larval development test.

The unsuitable material would be dredged and then removed to an upland placement site (slated as the former Hoquiam waste water treatment lagoon) as described in Section 2.3. DMMU sub-unit 32a will be physically surveyed after construction, and a determination will be made at that time whether an additional round of testing is required of that sub-unit prior to any subsequent maintenance dredging episode in that sub-unit's footprint.

Although Alternative 3 removes more unsuitable material than Alternative 2 (22,400 cubic yards versus 13,500 cubic yards) all of the unsuitable sediments would be removed to an upland placement site, thus the potential for water quality impacts due to contaminated sediments is expected to be negligible because the project permanently removes these sediments from the Chehalis River and Grays Harbor system.

4.7.5.2 Water Quality

While the duration of dredging activities under Alternative 3 would be extended by 1.5 months relative to baseline conditions, water quality monitoring and best management practices will ensure that water quality impacts remain localized and overall impacts are negligible.

Initial dredging from channel deepening would result in placement of an additional 1,949,000 cubic yards of material (1,972,000 minus 22,400 cubic yards for upland disposal) at the open-water placement sites as compared to Alternative 1 and 783,000 cubic yards more than Alternative 2. These activities would be conducted in the same manner and using barges with the same capacity as under both Alternatives 1 and 2.

While the same placement sites would be utilized as described for Alternative 2, materials from the initial dredging would require more deposits at the placement sites than under Alternative 2. The potential for turbidity and low-DO plume would be the same as described for the other alternatives. The Corps received a CWA Section 401 water quality certification from Ecology on 13 June 2014 for the deepening project (Appendix H), and would abide by requirements associated with the discharge of dredged material included in that Certification for the protection of water quality.

The Corps was issued a 50 year Clean Water Act Section 401 Water Quality Certification/Modification (WQC) from Ecology for the Point Chehalis Revetment Extension Project in August 1999 (WQC- Order #TB-98-02) which implemented the *Point Chehalis Revetment Extension and Half Moon Bay Inter-Agency Mitigation Agreement*, dated October 1998. This included upland dredged material placement at the buried revetment extension mitigation site, and the associated water quality impacts.

Therefore, the potential for the dredging and placement of materials under Alternative 3 compared to Alternative 2 to generate incremental effects on water quality over and above the effects of maintenance dredging evaluated in the FY 2012-18 EA is expected to be minor.

4.8 Air Quality, Noise, and Artificial Lighting

4.8.1 Air Quality

4.8.1.1 Overview

This section presents potential impacts on air quality associated with the implementation of the proposed action. Impacts are based on an analysis of the extent to which the proposed action would generate emissions from engines operating on the vessels, dredges, and tugboats used to dredge and place sediment. The dredge and tugs used for the proposed action create emissions of carbon dioxide, nitrous oxide, ozone, carbon monoxide, particulate matter, and sulfur dioxide.

4.8.1.2 Methods

Emissions were estimated for dredging and material movement using information regarding emissions provided by the Corps (2009) and methodology developed by ICF International (2009) for the EPA in the report, *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories*. Emissions are calculated considering the load factor, emission factor, average annual activity, reated engine horsepower, and fuel factors.

Table 2-5 presents a summary of the assumptions used to estimate emissions from the proposed action. The calculations are based on the type of equipment used, and duration of use. This analysis is focused on a comparison of the emissions and air quality impacts resulting from the activities associated with the initial channel deepening, subsequent increase in maintenance dredging and associated placement of dredged materials under the action alternatives.

These assumptions reflect a fully efficient dredging scenario for dredging emissions calculations. In reality, it is likely that dredging equipment would not be operating at full power for 24 hours a day, 7 days a week, for up to 6 straight months. The equipment would be docked to change crew and refuel, and would spend some time moving into position in the navigation channel, during which time the dredging equipment would not be operating. In addition, the onboard engines would likely not be operating at 100% power during the entire dredging window. Even the more efficient dredges while operating 24 hours a day are not typically at full power operation for more than 18-20 hours per day. The projections likely overstate the levels of emissions that would be experienced under each alternative, as a result.

4.8.1.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Table 4.8-1 presents the emissions that were estimated for each alternative, including maintenance dredging, based on the assumptions presented in Table 2-5. Subsequent incremental maintenance due to each alternative (50,000 cubic yards for Alternative 2 and 107,000 cubic yards for Alternative 3) result in only very minor increases as compared to Alternative 1 dredging activities.

Table 4.8-1. Summary of Total Emissions (tons)

Activity	Nitrogen Oxides	Volatile Organic Compounds	Carbon Monoxide	PM10[a]	Sulfur Dioxide
Construction Year Deepening					
Alternative 1 (no deepening)	63	3	23	4	8
Alternative 2 (1 foot increment)	13	0	4	1	2
Alternative 2 (total construction year)	76	3	27	4	10
Increased vessel traffic due to Alt 2	9	0	1	0	1
Alternative 3 (2 feet increment)	21	1	7	1	3
Alternative 3 (total construction year)	84	4	30	5	11
Increased vessel traffic due to Alt 3	34	1	3	2	3

[a] PM10 = Particulate matter with a diameter of 10 micrometers or less.

For comparison purposes only, General Conformity thresholds are shown in Table 4.8-2. If emissions are projected to rise above these levels and the project was located in a non-attainment or maintenance area, a project-specific conformity determination to the State Implementation Plan would be required. Grays Harbor County is not located in a nonattainment or maintenance area (i.e., local air quality within Grays Harbor County meets all applicable air quality standards listed in Table 3.8-1) (Washington State Department of Ecology 2008).

Table 4.8-2. General Conformity Thresholds for Nonattainment or Maintenance Areas

Pollutant	Area Type	Tons/Year
Ozone (volatile organic compounds or nitrogen oxides)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (nitrogen oxides)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (volatile organic compounds)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon monoxide, sulfur dioxide, and nitrogen dioxide	All nonattainment and maintenance	100
PM10	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
PM 2.5	Direct emissions	100
Lead	All nonattainment and maintenance	25

PM10 = particulate matter with a diameter of 10 micrometers or less; PM2.5 = particulate matter with a diameter of 2.5 micrometers or less.

The dredge and tugboat necessary to move the dredge and barges are diesel powered and thus contribute to air pollution. Under Alternative 1, no deepening of the navigation channel would occur. The Corps would continue annual channel maintenance dredging to a depth of −36 feet MLLW and placement of dredged materials at the designated placement sites, which generates emissions as presented in Table 4.8-1. Alternative 1 assumes dredging activities involving one clamshell dredge working in the inner harbor reaches for approximately 4.5 months, and up to two hopper dredges in the outer channel for approximately one month. The estimate includes operating the equipment for the entire duration of dredging and represents the current maintenance practices of dredging to funding level. Alternative 1 constitutes a routine facility repair activity generating an increase in emissions that is clearly *de minimis* under 40 CFR 93.153(c)(1)(ix), and represents no changes in emission or air quality effects from the baseline conditions. Engine technology advancements are expected to promote increased combustion efficiency, which would in turn reduce air pollutant emissions over time; however, the degree and occurrence of such reduction is uncertain at this time.

Alternative 1 would continue the practice of maintenance dredging to -36 feet MLLW. Emissions as shown in Table 4.8-1 would continue under this alternative. Emissions calculated for this alternative were used as the baseline for determining the incremental emissions and air quality effects resulting from Alternatives 2 and 3.

4.8.1.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Under Alternative 2, activities related to the initial channel deepening would result in an increment of air pollutant emissions over and above those of Alternative 1 (baseline conditions). Diesel emissions generated by the dredging and placement vessels operating for an additional 1.5 months, compared to Alternative 1, would add to emissions produced under existing conditions in Grays

Harbor by the annual maintenance dredging and material placement. While commercial and recreational vessel traffic would likely continue to grow in the area for many reasons, a small increase in vessel traffic is anticipated as a result of the incremental deepening the navigation channel. While subsequent maintenance dredging requirements would rise slightly (i.e. more volume would be required, 50,000 cubic yards) under Alternative 2 the emissions associated with subsequent maintenance activities would only add a slight increment to Alternative 1, because these activities would have a similar duration and use similar machinery.

Since General Conformity thresholds are not applicable in Grays Harbor County, there is not a specific threshold for air pollutant emissions in Grays Harbor County. As described above in Section 4.8.1.2, *Methods*, a comparison is provided here for reference to describe the intensity of emissions under Alternative 2.

Based on the emissions presented in Table 4.8-2 , emissions of nitrogen oxides associated with deepening of the navigation channel under Alternative 2 (76 tons per year) in the construction year are below the General Conformity thresholds for non-attainment or maintenance areas (Grays Harbor is neither a non-attainment area nor a maintenance area). Dredging activities associated with deepening the navigation channel under Alternative 2 would have a relatively short duration (i.e., 6 months for the inner harbor reaches and 1 month for the outer harbor reaches), and would take place in a single year. Once deepening activities have ceased, the dredging-related emissions would return to levels of maintenance dredging emissions that were previously evaluated in the FY 2012-2018 EA.

Section 3.8 presents the relative location of sensitive receptors in the navigation channel and dredged material placement sites. The nearest sensitive receptors are located 0.2 mile (1,000 feet) from portions of the inner reaches of the navigation channel in the residential areas of Aberdeen and Cosmopolis. Dredging activities would take place in any one location for only a short period of time (several days) over the duration of deepening the channel (i.e., approximately 6 months while dredging the inner harbor reaches and over approximately 1 month while dredging the outer harbor reaches). Winds along the coastline are generally fairly strong and constant. Consequently, air pollutant emissions generated by the dredges and tugs would be dispersed quickly due to the strong winds. This would help to limit any potential air pollutant concentrations and ameliorate exposure of all receptors to any potential for elevated concentrations of air pollutants.

Air quality impacts under Alternative 2, when compared to Alternative 1 are considered minor because of the low emissions generated for the incremental deepening activity and their relatively short duration (i.e., construction emissions would cease after 6 months of activity associated with the inner harbor reaches and 1 month for the outer harbor reaches) and given the low potential for pollutant concentrations to reach sensitive receptor locations.

Alternative 2 would add as many as 33 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Grays Harbor would experience approximately 2.75 additional vessel passages per month, attributable to a median “high/moderate” growth projection of cargo tonnage moved through the Port as a result of a channel deepened to -37 feet MLLW. The analysis computed the direct and indirect effects of emissions of the additional vessel transits as limited by the action area – i.e., during vessel transits each direction between the sea buoy and the Port terminal. As reflected in Table 4.8-1, the increased NOx emissions attributable to the additional annual vessel traffic would generate no more than a minor incremental air quality effect, as compared with Alternative 1.

4.8.1.5 Alternative 3—Deepen Channel to −38 Feet MLLW

Under Alternative 3, activities related to the initial channel deepening would result in an increment of air pollutant emissions over and above those of Alternative 1 (baseline conditions) and Alternative 2. Diesel emissions generated by the dredging and placement vessels operating for an additional 1.5 months, compared to Alternative 1, would add to emissions produced under existing conditions in Grays Harbor by commercial and recreational vessel traffic and the annual maintenance dredging and material placement. Additionally, under Alternative 3, initial channel deepening of the inner harbor reaches would use more dredging machinery than under Alternatives 1 and 2 (Table 4.8-1), resulting in greater air pollutant emissions. While subsequent maintenance dredging requirements would rise slightly (i.e. more volume would be required, 107,000 cubic yards) under Alternative 3, the emissions associated with subsequent maintenance activities would only add a slight increment to Alternative 1, because these activities would have a similar duration and use similar machinery.

Since General Conformity thresholds are not applicable in Grays Harbor County, there is not a specific threshold for air pollutant emissions in Grays Harbor County. As described above in Section 4.8.1.2, *Methods*, a comparison is provided here for reference to describe the intensity of emissions under Alternative 3.

Based on the emissions presented in Tables 4.8-1, emissions of nitrogen oxides associated with deepening of the navigation channel under Alternative 3 (84 tons per year) in the construction year are below the General Conformity thresholds for non-attainment or maintenance areas (Grays Harbor is neither). Total emissions for Alternative 3 are greater than those of Alternatives 1 and 2, but still relatively minor. As is the case with Alternative 2 dredging activities associated with deepening the navigation channel under Alternative 3 would have a relatively short duration (i.e., 6 months for the inner harbor reaches and 1 month for the outer harbor reaches), and would take place in a single year. Once deepening activities have ceased, the dredging-related emissions would return to levels of maintenance dredging emissions that were previously evaluated in the FY 2012-2018 EA.

Similar to Alternative 2, dredging activities would take place in any one location for only a short period of time (several days), over a limited duration, and more than 1,000 feet away from the nearest sensitive receptors along the shoreline of Grays Harbor.

Air quality impacts under Alternative 3 are considered minor because of their relatively short duration and given the low potential for pollutant concentrations to reach sensitive receptor locations.

Alternative 3 would add as many as 51 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Grays Harbor would experience an increase of less than 10% in annual vessel transits, attributable to a “high” growth projection of cargo tonnage moved through the Port as a result of a channel deepened to -38 feet MLLW. The analysis computed the direct and indirect effects of emissions of the additional vessel transits as limited by the action area – i.e., during vessel transits each direction between the sea buoy and the Port terminal. As reflected in Table 4.8-1, the increased NOx emissions attributable to the additional annual vessel traffic would generate no more than a minor incremental air quality effect, as compared with Alternative 1.

4.8.2 Noise

4.8.2.1 Overview

This section analyzes the extent to which the proposed action would generate noise as a result of operating the dredging machinery and vessels associated with the dredging and placement of dredged materials. Additional discussion of noise relative to fish and wildlife and threatened and endangered species is presented in Sections 4.4 and 4.5, respectively.

4.8.2.2 Methods

The assessment of potential noise levels as a function of distance from dredging and placement activities is based on methodology developed by the Federal Transit Administration (2006). Potential worst-case noise levels from dredging activities were evaluated by combining the noise levels of up to three vessels (one tug and two clamshell dredges) operating in the same area at a given time. Dredges do not typically operate in close proximity to each other, but rather are generally working in different locations along the navigation channel. Typical source noise levels are 82 dBA for a tugboat and 84 dBA for a clamshell dredge (Geier & Geier Consulting, Inc. 1997). This analysis assumes that noise levels from equipment associated with channel deepening operations are equivalent to noise levels from maintenance dredging.

The estimated sound levels as a function of distance from dredging activities are based on calculated point-source attenuation over water, which is considered to be a “hard” or acoustically reflective surface. Assuming 100% utilization of dredges during a given hour of day, the combined noise level would be 88 dBA Leq (1 hour) at a distance of 50 feet. Noise levels from dredging activities as a function of distance are presented in Table 4.8-3.

Table 4.8-3. Estimated Noise Levels from Dredging Operations

Distance Between Source and Receiver (feet)	Calculated Sound Level (dBA)
50	88
100	82
200	76
300	72
500	68
700	65
1,000	62
1,200	60
1,500	58
2,000	56
3,800	50

Note: Calculations are based on Federal Transit Administration 2006. Calculations do not include the effects, if any, of local shielding from walls, topography, or other barriers that may reduce sound levels further.
dBA = A-weighted decibel.

4.8.2.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Under Alternative 1, current levels of channel maintenance dredging would continue. Maintenance dredging in the inner navigation channel reaches is typically a 24 hours a day, 7 days a week operation, for approximately 4.5 months per year; outer harbor reaches are typically dredged over a period of approximately 1 month. During these periods, noise from maintenance dredging activities contributes to the ambient noise environment, which includes commercial and industrial sources along the shoreline and associated with the Port (Section 3.8).

Maintenance dredging would increase noise levels above ambient levels in the vicinity of the dredge and tugs during dredge operations. Although being aware of decibel levels is important to protect human hearing, how far away a receptor is from the source and how long the exposure to the sound are equally important. A good rule of thumb is to avoid noises that are too loud, too close, or last too long. The National Institutes of Health (NIH) cites noise levels of 85 db or higher as levels that can cause damage to human hearing. Noise and activity during dredging operations could temporally disturb some animal species from the adjacent shoreline areas and from the immediate area of the working dredge, but this effect is expected to be limited in both space and time because the disturbance would affect only the immediate area around the dredge and tug (noise would likely drop to lower levels within 50 ft., and below NIH levels within 100ft) and this disturbance would move with the active dredge so only a small portion of Grays Harbor would be affected at any given time. A relatively discrete segment of channel (Cow Point and Hoquiam reaches) and only the Half Moon Bay in-water placement site have populated areas that are within the radius of effects of in-air noise.

4.8.2.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Under Alternative 2, dredging source noise levels from channel deepening would be similar to those of maintenance dredging described for Alternative 1. During initial channel deepening, one clamshell dredge would be operated in conjunction with one tugboat in the inner harbor reaches for

approximately 6 months, and two hydraulic dredges would be operated in the outer reaches for approximately 1 month.

Dredging activities are classified as construction and are thus exempt during daytime hours (7:00 a.m. to 10:00 p.m.), applying the standards of WAC 173-60 solely as a frame of reference. Dredging operations associated with the initial channel deepening would occur 24 hours a day, 7 days a week, until work is complete. Once the initial channel deepening is complete, annual maintenance dredging would continue as described above under Alternative 1, with the possible use of a hopper dredge with pump ashore capabilities to place material at the upland Point Chehalis Revetment Extension mitigation site. Noise from this activity would consist of the slurry through the pipeline and use of any booster pump(s).

The results shown in Table 4.8-3 indicate that noise-sensitive land uses within 1,200 feet of an active dredge could be exposed to noise in excess of the Washington State daytime (7:00 a.m. to 10:00 p.m.) noise standard of 60 dBA Leq (1 hour). As indicated in Section 3.8, under WAC 173-60, noise from dredging activities is exempt from state and local noise standards between the hours of 7:00 a.m. and 10:00 p.m. as a temporary construction activity. The nighttime (10:00 p.m. to 7:00 a.m.) noise standard of 50 dBA Leq (1 hour) could be exceeded at a distance of up to 3,800 feet from an active dredge; however, the activity is temporary, intermittent, and ceases once work is complete. In general, residential areas are set back from shoreline locations facing the navigation channel and buffered by industrial and commercial land use along the shoreline. Residences located adjacent to shoreline areas (Figure 34) that would have direct line-of-sight to dredging activities could be exposed to noise levels from dredging activities that exceed the nighttime noise standards. While dredging noise from the initial channel deepening, under Alternative 2, would occur over a longer period of time in the reaches nearest to shoreline residences (i.e., approximately 6 months for the inner harbor reaches) compared to annual maintenance dredging under baseline conditions (Alternative 1) (i.e., 4.5 months for the inner harbor reaches), noise levels would be confined in location at any given time, thus ameliorating the consideration of a longer extent of work encompassing the entire channel.

Alternative 2 would add as many as 33 annual deep-draft vessel transits as compared with Alternative 1 by 2037. The navigation channel would experience approximately 2.75 additional vessel passages per month, attributable to a median “high/moderate” growth projection in cargo tonnage moved through the Port as a result of a channel deepened to -37 feet MLLW. As ships transit the channel noise levels would occur only for a short period of time in any one location, reducing the potential for an extended exceedance of nighttime noise standards. Therefore, Alternative 2 would not result in more than a minor increment of noise levels added to dredging noise, and a small increase in vessel traffic experienced under Alternative 1 and would not result in a long-term increase in noise above existing ambient levels.

The potential for noise impacts to affect nearby sensitive noise receptors under Alternative 2 is considered to be minor.

4.8.2.5 Alternative 3—Deepen Channel to –38 Feet MLLW

Under Alternative 3, dredging source noise levels from channel deepening would be similar to those of maintenance dredging described for Alternative 1. During initial channel deepening, two clamshell dredges and two bottom dump barges would be operated in the inner harbor reaches for approximately 6 months, and two hydraulic dredges would operate in the outer reaches for

approximately 1 month (Table 4.8-3. A hopper dredge with pump ashore capabilities may be used to place material at the upland Point Chehalis Revetment Extension mitigation site. Noise from this activity would consist of the slurry through the pipeline and use of any booster pump(s).

Potential noise levels from dredging activities under Alternative 3 are assumed to be the same as Alternative 2. While the accumulated noise levels of two active dredges operating in close proximity to one another could increase noise levels by as much as 3 dB, dredges do not typically operate in close proximity to each other, but rather are generally working in different locations along the navigation channel. Therefore, noise levels at a given receiver location under Alternative 3 are anticipated to be the same as under Alternative 2.

Residences located adjacent to shoreline areas that would have direct line-of-sight to dredging activities (Figure 34) could be exposed to noise levels from dredging activities that exceed nighttime noise standards. While dredging noise from the initial channel deepening, under Alternative 3, would occur over a longer period of time in the reaches nearest to shoreline residences compared to annual maintenance dredging under baseline conditions (Alternative 1), noise levels would be confined in location at any given time, thus ameliorating the consideration of a longer extent of work encompassing the entire channel.

Alternative 3 would add as many as 51 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Resources in Grays Harbor would thus experience approximately 4.25 additional vessel passages per month, or less than one per week, attributable to a “high” growth projection in cargo tonnage moved through the Port as a result of a channel deepened to -38 feet MLLW. Noise levels would occur only for a short period of time in any one location, reducing the potential for an extended exceedance of nighttime noise standards. Therefore, Alternative 3 would not result in more than a minor increment of noise levels attributable to increased dredging volumes and increased deep-draft vessel transits added to Alternative 1 and would not result in a long-term increase in noise above existing ambient levels.

The potential for noise impacts to affect nearby sensitive noise receptors under Alternative 3 would be greater than Alternative 2 due to the additional dredge equipment utilized, but is still considered to be minor.

4.8.3 Artificial Lighting

4.8.3.1 Overview

This section presents potential impacts associated with artificial lighting that could result from implementation of the proposed action. This section analyzes the extent to which the proposed action would generate artificial lighting as a result of operating the dredging machinery and vessels associated with the dredging and placement of dredged materials.

4.8.3.2 Methods

A qualitative analysis based on known sources of artificial light and the degree of lighting present on dredges and associated vessels was used to evaluate artificial lighting impacts. Impacts were evaluated relative to nearby sensitive receptors.

4.8.3.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Because dredging must be accomplished within a limited window of time due to considerations related to fish and wildlife (Section 3.4) and threatened and endangered species (Section 3.5), dredges and associated barges and tugboats can operate 24 hours a day. As a result, maintenance dredging occurs at night under baseline conditions and would continue as such under Alternative 1. Lights operating on the dredges and related vessels temporarily increase ambient lighting levels at night in the immediate vicinity of the dredge. This is similar to lights operated on other vessels using the navigation channel at night.

Once the dredge operation ceases in a particular location, the lighting and associated impacts cease. Because the dredge operation gradually moves along the navigation channel, lighting impacts only occur at a single discrete location at any given time.

4.8.3.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Under Alternative 2, lighting from dredges and related vessels would temporarily increase ambient lighting levels at night in the immediate vicinity of the dredge in the same manner as described for Alternative 1 during maintenance dredging. During the initial channel deepening in the inner harbor reaches, the duration of activity and related artificial lighting would extend for approximately 1.5 months longer compared with Alternative 1.

Such lighting is not expected to adversely affect adjacent habitats beyond the immediate vicinity of the dredge operation or sensitive receptors along the shoreline. Effects would endure only for the duration of dredge operations and there would be no long-term effects from the noise or light of the dredge operation. A small increase in vessel traffic would also contribute to a minimal increase in short-term lighting impacts. Only a single discrete location at a time would experience this short-term artificial lighting.

Because of the small scale and discrete location of the lighting at any one time relative to the size of the navigation channel, and because lights in the navigation channel at night are not an unusual occurrence under baseline conditions and do not occur near sensitive receptors, the potential for incremental artificial lighting impacts to affect nearby sensitive receptors under Alternative 2 in a manner over and above previously evaluated baseline conditions is considered to be minor.

4.8.3.5 Alternative 3—Deepen Channel to −38 Feet MLLW

As described above for Alternative 2, lights operating on the dredge would temporarily increase ambient lighting levels at night in the immediate vicinity of the dredge under Alternative 3, but are not expected to adversely affect adjacent habitats beyond the immediate vicinity of the dredge operation. Lighting effects would be greater than under Alternative 2, because of the operation of an additional clamshell dredge, and barge in the inner harbor reaches; however, the increase would be of a similarly short duration.

Effects would endure only for the duration of dredge operations. A small increase in vessel traffic would also contribute to a minimal increase in short-term lighting impacts. Only a limited area, immediately around the active dredge, would experience this short-term artificial lighting at a given time. This limited area represents a minor fraction of available habitat within Grays Harbor.

Because of the small scale and discrete location of the lighting at any one time relative to the size of the navigation channel, and because lights in the navigation channel at night are not an unusual occurrence under baseline conditions and do not occur near sensitive receptors, the potential for incremental artificial lighting impacts to affect nearby sensitive receptors under Alternative 3 in a manner over and above previously evaluated baseline conditions is considered to be minor.

4.9 Land Use and Aesthetics

4.9.1 Overview

This section discusses the potential for land use and aesthetic resources in the study area to be affected by the proposed action.

4.9.2 Methods

To evaluate the potential effects of the proposed action on land use, the types of land uses near the navigation channel and dredged material placement sites were assessed to determine if implementation of the proposed action would pose any conflicts. Land use conflicts often result when implementation of a proposed action involves changes to land use. Also, local land use plans and development regulations were evaluated to assess potential conflicts. Land use within 0.25 mile of the shoreline of Grays Harbor was categorized in a GIS, based on available datasets and then illustrated on an aerial photo base (Figure 343), to analyze the types of land use and the aesthetics of the shoreline surrounding Grays Harbor.

The visual quality and aesthetics assessment was based on information gathered by reviewing local planning documents and aerial photographs, as well as through a GIS analysis of land use within and along the shoreline of Grays Harbor. Before evaluating visual effects of the proposed action, a visual quality and aesthetics assessment to determine baseline conditions in the study area was conducted. All of the factors that shape an environment, such as the presence of parks, neighborhoods, or manufacturing districts influence visual quality, visual character, and aesthetics. This assessment took into account the following.

- The visual and aesthetic experience of people looking at or from the navigation channel or dredged material placement sites.
- The panoramic, special, or scenic views visible from the navigation channel or dredged material placement sites or from the surrounding landscape toward these areas.
- The overall visual and aesthetic character and quality of the study area and the scale and contrast between existing features and elements included in the proposed action.

4.9.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Under Alternative 1, the Corps would continue channel maintenance dredging and dredged material placement as currently conducted, with no changes to land use in the terrestrial/shoreline areas adjacent to navigation channel or dredged material placement sites. Under Alternative 1, maintenance dredging activities do not conflict with current uses in Grays Harbor (e.g., shipping,

recreational boating, fishing) or involve any elements that conflict with local plans or development regulations. Maintenance dredging of the navigation channel provides access to Port facilities and supports marine transportation, recreation, and commercial vessel traffic in the harbor. Alternative 1 continues to support the variety and interspersion of existing land uses present surrounding Grays Harbor.

Under Alternative 1, the Grays Harbor viewshed includes annual maintenance dredging and placement of dredged materials. During maintenance dredging, the dredge equipment (including barges and tugs) are existing elements of the viewshed, visible to observers from the shore and from the water. The Point Chehalis buried revetment extension and mitigation site as maintained in accordance with the mitigation agreement is considered part of the baseline condition. The visual appearance of these features is compatible with the existing large ships and commercial and recreational vessel traffic that currently exist throughout Grays Harbor and particularly within the navigation channel.

4.9.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Alternative 2 would employ similar methods as those used under baseline conditions (Alternative 1), and these methods would be employed on the same schedule and at the same intensity (i.e., number of dredging vessels, number of work hours per day) as occurs under baseline conditions. The entire 6 month work window would likely be used under Alternative 2, as compared to the approximately 4.5 months under Alternative 1. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point Reach and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). The dredged material would then be placed in the same manner as under baseline conditions. Placement sites would be the South Jetty, South Beach, Half Moon Bay and Point Chehalis Revetment Extension mitigation sites as under baseline conditions and would also include the shifted Point Chehalis and the Hoquiam waste water treatment lagoon upland sites as described previously. Mobilization of a hydraulic pipeline for a period sufficient to transport approximately 200,000 cy of dredged material to the Point Chehalis Revetment Extension mitigation site would be irregular and of short duration, and have minimal aesthetic or land use effects. The Hoquiam wastewater pond is an unused pond that is slated to be partially filled by upland placement of unsuitable materials under Alternative 2 (13,500 cubic yards). A small increase in vessel traffic would represent a negligible effect on current area aesthetics. The increased volume of dredged material deposited at the placement sites from the initial deepening would not introduce any new features or elements that would potentially conflict with or affect current land uses, land use planning, or aesthetic resources. Therefore, the incremental effects above baseline (Alternative 1) of Alternative 2 would have no impacts on land use or aesthetic resources.

4.9.5 Alternative 3—Deepen Channel to −38 Feet MLLW

Alternative 3 would employ similar methods as those used under baseline conditions (Alternative 1), and these methods would be employed on the same schedule and at the same intensity (i.e. number of work hours per day) as occurs under baseline conditions. As is the case with Alternative 2, the entire 6 month work window would likely be used under Alternative 3. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point Reach and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). An additional clamshell dredge would

be utilized under Alternative 3. The dredged material would then be placed in the same manner as under baseline conditions.

Channel deepening would not result in adverse impacts on land use or aesthetic resources, because as under Alternatives 1 and 2, dredging and dredged material placement represents a very minor change to land use in the terrestrial/shoreline areas adjacent to navigation channel or dredged material placement sites. The location of placement sites would include the same used under Alternative 1 and add the temporary shift of the Point Chehalis site and the upland site at the former Hoquiam wastewater pond. The increased volume of dredged material deposited at the placement sites from the initial deepening would not introduce any new features or elements that would potentially conflict with or affect current land uses, land use planning, or aesthetic resources. A small increase in vessel traffic would represent a negligible effect on current area aesthetics. Therefore, the incremental effects above baseline (Alternative 1) and above those of Alternative 2 would have no impacts on land use or aesthetic resources.

4.10 Recreation

4.10.1 Overview

This section discusses the potential for recreational resources in the vicinity of the navigation channel and dredged material placement sites to be affected by the proposed action.

4.10.2 Methods

To evaluate potential effects of the proposed action on recreation, the location of recreational parks, wildlife viewing areas, and known recreational activities near the navigation channel and dredged material placement sites were assessed to determine if implementation of the proposed action would pose any conflicts. Additionally, indirect effects were evaluated based on the findings of other relevant environmental elements, such as land use and aesthetics (Section 4.9, *Land Use and Aesthetics*).

4.10.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Two areas were evaluated relative to recreational impacts: the navigation channel and the dredged material placement sites. The navigation channel is located far from any recreational park or wildlife viewing area (Figure 38). The Half Moon Bay and South Beach placement sites are in the immediate vicinity of Westhaven State Park, but the placement there is intended to reduce erosion and protect the existing shoreline, thus preserving recreational activities in the area. Therefore, the maintenance dredging and placement of dredged material do not conflict with recreational uses in such areas. These are activities that regularly occur in Grays Harbor under baseline conditions; as such, they are part of the current aesthetics surrounding the parks, wildlife areas, and recreational activities in such areas.

During active dredging the dredge vessel is classified as a vessel restricted in ability to maneuver under U.S. Coast Guard Navigation Rules (COMDINST M16672.2D) and recreational boaters are required to avoid the immediate area of dredging and placement equipment for safety reasons. The

U.S. Coast Guard also issues a Notice to Mariners announcing the locations and duration of dredging. Wave riding/surfing is a popular activity in the area. The three prime surfing locations include South Beach near the South Jetty, Half Moon Bay, and the groin areas of the Point Chehalis revetment. Surfers report that one of these three spots usually produces rideable waves, making this an all-season surfing locale on the Washington coast. Deeper water in the harbor entrance allows swells to gain momentum before shoaling up offshore to produce smoothly breaking waves which are sought by surfers. The extent of dredging and placement of material is small and highly localized at any one time and can be easily avoided, particularly relative to the extent and area of the navigation channel and relative to the size of Grays Harbor available for vessels (particularly at high tide) and for many other types of recreation such as clamming, bird watching, surfing, and beach combing at low tide.

Westhaven State Park is the closest recreational area to the dredged material placement sites, located adjacent to the Half Moon Bay placement site and within 1 mile of the South Jetty and Point Chehalis open-water placement sites. The dredged materials placed at these sites are clean silt and sand, and do not result in adverse impacts on the park. Additionally, placement of dredged materials at these sites slows erosion in these areas, which helps to maintain their use for recreational activities.

The next nearest recreational areas to the placement sites include the Oyhut Wildlife Recreation Area, Damon Point State Park, and the Westport Light State Park (Figure 38). These recreation areas are not in close to the placement sites and, therefore, are not affected by dredged material placement operations.

4.10.4 Alternative 2—Deepen Channel to −37 Feet MLLW

Alternative 2 would employ similar methods as those used under baseline conditions (Alternative 1), and these methods would be employed on the same schedule and at the same intensity (i.e., number of dredging vessels, number of work hours per day) as occurs under baseline conditions. The entire 6 month work window would likely be used under Alternative 2, as compared to the approximately 4.5 months under Alternative 1. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). The dredged material would then be placed in the same manner as under baseline conditions. Placement sites would be the South Jetty, South Beach, Half Moon Bay, and Point Chehalis Revetment Extension mitigation sites as under baseline conditions and would also include the shifted Point Chehalis and the Hoquiam waste water treatment lagoon upland sites as described previously. As such, these activities would not significantly affect recreational boating, bird watching, beach combing, surfing, or similar recreational activities on the water or along the shoreline of Grays Harbor. Temporary placement of a pipeline for pump ashore in Half Moon Bay could restrict some access to recreational boaters and surfers. Access would be restricted only during the approximately one month that pump ashore would be completed. This is not an annual event and would be conducted only when feasible (i.e. when hopper dredge with pump ashore capabilities is available). The increased volume of dredged materials some of which could be placed at sites such as Half Moon Bay to slow shoreline erosion, relative to baseline conditions, could represent a beneficial effect on recreational resources. Mobilization of a hydraulic pipeline for a period sufficient to transport approximately 200,000 cy of dredged material to the Point Chehalis Revetment Extension mitigation site would be irregular and of short duration, and have minimal effect on waterborne recreational activities such as surfing.

Thus, there would be very low potential for implementation of Alternative 2 to result in incremental adverse effects on recreational resources in Grays Harbor, over and above those exhibited under the baseline conditions evaluated in the FY 2012-18 maintenance dredging EA.

4.10.5 Alternative 3—Deepen Channel to −38 Feet MLLW

As described for Alternative 2, dredging and placement activities would not likely affect recreational boating, bird watching, beach combing, surfing, or similar recreational activities on the water or along the shoreline of Grays Harbor.

The deepening of the navigation channel under Alternative 3 would not result in adverse impacts on recreational activities for the same reasons as described under Alternative 2. Alternative 3 would employ similar methods as those used under baseline conditions (Alternative 1), and these methods would be employed on the same schedule and at the same intensity (i.e. number of work hours per day) as occurs under baseline conditions. As is the case with Alternative 2, the entire 6 month work window would likely be used under Alternative 3. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). An additional clamshell dredge would be utilized under Alternative 3. The dredged material would then be placed in the same manner as under baseline conditions. Placement sites would be the South Jetty, South Beach, Half Moon Bay and Point Chehalis Revetment Extension mitigation sites as under baseline conditions and would also include the shifted Point Chehalis and the Hoquiam waste water treatment lagoon upland sites as described previously.

This alternative would not change recreational opportunities or availability on the water or along the shoreline of Grays Harbor.

The increased volume of dredged materials, some of which could be placed at sites such as Half Moon Bay to slow shoreline erosion, relative to baseline conditions and Alternative 2, could represent a beneficial effect on recreational resources.

As is the case with Alternative 2 there would be a very low potential for implementation of Alternative 3 to result in incremental adverse effects on recreational resources in Grays Harbor, over and above those exhibited under the baseline conditions evaluated in the FY 2012-18 maintenance dredging EA.

4.11 Global Climate Change

4.11.1 Overview

This section addresses how the proposed action could affect global climate change, by analyzing the extent to which the proposed action would emit GHGs from engines operating on the vessels, dredges, and tugboats used to dredge sediment from the navigation channel and place it at the dredged material placement sites. The dredge and tugs used to implement the proposed action would create emissions of CO_2, N_2O, and CH_4.

This section also qualitatively analyzes the extent to which global climate change could affect the proposed action by altering climatic patterns and precipitation, which could affect Grays Harbor and the rivers that contribute sediment to the navigation channel.

4.11.2 Methods

To date, no national or state regulations have been established for GHG emissions, and neither EPA nor Ecology has established NEPA environmental impact thresholds for GHG emissions. No regulations are established for evaluating GHG impacts under NEPA; however CEQ's (2010) draft NEPA guidance uses 25,000 metric tons of CO_2e as the threshold for when a quantitative analysis of GHG emissions should be conducted. For this analysis, an emission level of 25,000 metric tons of CO_2e was considered as an indicator of a potentially substantial effect.

GHG emissions were estimated for the dredging and transport of dredged material using information on the types of vessels used and the duration of typical maintenance dredging provided by the Corps, and methodology developed by ICF International (2009) for EPA in the report *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories*.

A summary of the assumptions that were used to estimate emissions from the proposed action are presented in Table 2-5 of Section 2.4, *Comparison of Alternatives*. This analysis is focused on a comparison of the emissions resulting from the activities associated with deepening of the navigation channel to −37 feet MLLW under Alternative 2 and to −38 feet MLLW under Alternative 3, as well as from the placement of dredged materials under these alternatives and subsequent maintenance.

Based on the assumptions of dredging equipment and duration, presented in Table 2-5, emissions were estimated for each alternative (Table 4.11-1).

Table 4.11-1. Summary of Estimated Total Greenhouse Gas Emissions (metric tons)

Action	CO_2	N_2O	CH_4	CO_2e
Deepening of the Navigation Channel				
Alternative 1	3,937	0.1	0.5	3,984
Alternative 2 (1 foot increment)	811	0.0	0.1	821
Alternative 2 (total construction year)	4,749	0.1	0.6	4,805
Increased vessel traffic due to Alt 2	425	0.0	0.1	430
Alternative 3 (2 feet increment)	1,359	0.0	0.2	1,375
Alternative 3 (total construction year)	5,297	0.2	0.7	5,359
Increased vessel traffic due to Alt 3	1,597	0.0	0.2	1,616
CO_2 = carbon dioxide, N_2O = nitrous oxides, CH_4 = methane, CO_2e = carbon dioxide equivalent				

4.11.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

4.11.3.1 Greenhouse Gas Emissions

Under Alternative 1, no deepening of the navigation channel would occur. The Corps would continue annual channel maintenance dredging to a depth of −36 feet MLLW, which generates GHG emissions as presented in Table 4.11-1. These emissions would continue to contribute to the total GHG atmospheric burden, but the quantity of emissions is a tiny fraction of all anthropogenic sources of GHGs. However, because global climate change is recognized to be a potentially significant evolving cumulative effect, this relatively small amount of GHG emitted from dredging activities under baseline conditions is acknowledged to be a contributor (albeit minor) to cumulative global emissions of GHGs.

While it is possible that GHG emissions generated by maintenance dredging may decrease over time as a result of ongoing improvements in fuel quality and efficiency in diesel engine and emissions control technology, only slight changes in GHG emissions from baseline conditions are proposed.

Alternative 1 would continue the practice of maintenance dredging to -36 feet MLLW. Emissions as shown in Table 4.11-1 would continue under this alternative. Emissions calculated for this alternative were used as the baseline of GHG emissions for determining the incremental emissions generated from Alternatives 2 and 3.

4.11.3.2 Climate Change

Given the uncertainties associated with predicting global climate change impacts on local areas and regions, it is difficult to predict the impact of climate change on the need for continued maintenance dredging of the navigation channel and the placement of dredged materials at the placement sites. According to a recent report prepared by the Wild Fish Conservancy (2013) that specifically evaluated climate change on the Grays Harbor estuary, the following changes are expected to occur along the Washington coast as a result of climate change.

- Inundation. As sea level rise occurs, low-lying areas will be regularly flooded with high tides.
- Flooding. Sea level rise will increase the effects of storm surges during major storm events, which can cause more extensive coastal flooding. Changes in seasonal rainfall patterns and runoff times and quantities can also lead to additional coastal flooding.
- Erosion and landslides. Sea level rise will worsen the conditions that lead to major episodes of coastal erosion events, accelerating bluff and beach erosion. Increased storm strength or frequency has the potential to exacerbate this problem. Winter precipitation is expected to increase in the Pacific Northwest due to climate change, which can also contribute to erosion and landslides.
- Saltwater intrusion. Coastal freshwater aquifers will be subject to increased intrusion by saltwater as the sea level rises.
- Increased ocean surface temperature and acidity. Warming atmospheric temperatures will increase ocean surface temperatures, and ocean absorption of additional CO_2 in the atmosphere will lead to increasing acidity.

Relative sea level rise[24] is predicted to be in the range of 3 to 45 centimeters (1 to 18 inches) by 2050 and 6 to 108 centimeters (2 to 43 inches) by 2100 (Mote et al. 2008). It is worth noting that these estimates are for advisory purposes and are not actual predictions because of uncertainties in the models and the difficulty in accurately predicting sea level rise for specific locations.

Sea level rise and changes in sediment transport into Grays Harbor may alter the need for maintenance dredging in the future. For example, if sea level rise outpaces sediment deposits into the harbor, then the depth of the navigation channel will increase over time, lessening the need for maintenance dredging and reducing related GHG emissions. Since the construction of the Columbia River hydropower system, sediment transport into Grays Harbor has been greatly reduced (Wild Fish Conservancy 2013). Erosion has become a concern in the harbor because this loss of sediment transport, combined with sea level rise and stronger storm surges, intensifies coastal erosion in the area. If this trend of reduced sediment transport into the harbor continues, and if sea levels continue to rise as a result of climate change, the need for dredging may decline over time. However, due to the many variables affecting sediment transport into Grays Harbor and the difficulty in projecting climate change effects on the regional scale, it is not clear what impact climate change will have on sediment transport in the future. Consequently, it is not possible to determine whether the frequency and duration of maintenance dredging will increase or decrease in the future because of climate change.

[24] Relative sea level rise is the difference between land movement and sea level rise (in some areas the land is rising).

4.11.4 Alternative 2—Deepen Channel to −37 Feet MLLW

4.11.4.1 Greenhouse Gas Emissions

Because the deepening project assumes that the channel is at -36 feet MLLW prior to any deepening occurring, annual maintenance dredging to -36 feet MLLW would be required to be performed in the same year as the deepening construction dredging. Deepening the navigation channel by an additional 1 foot to -37 feet MLLW in the construction year would result in greater GHG emissions compared to Alternative 1 (Table 4.11-1). Because Alternative 2 would use the same number and type of dredges and vessels as used for maintenance activities under baseline conditions, the increase in emissions is related only to the increased duration of activities required for the initial channel deepening (i.e., 6 months of activity to dredge the inner harbor reaches under Alternative 2, compared to approximately 4.5 months of activity to dredge these same reaches under Alternative 1) (Table 2-5).

Activities related to the initial channel deepening under Alternative 2 represent 4,804 metric tons CO_2e (Table 4.11-1) in the construction year. These emissions are below the recommended threshold identified by the CEQ's NEPA guidance for conducting a quantitative analysis of GHG impacts: greater than 25,000 metric tons of CO_2e.

While subsequent maintenance dredging requirements would rise slightly (i.e. more volume would be required, 50,000 cubic yards) under Alternative 2 the emissions associated with subsequent maintenance activities would have only a slight increase from Alternative 1, because these activities would have similar duration and use the same machinery.

Under Alternative 2, activities associated with the initial channel deepening would add a minor incremental contribution of maintenance dredging under baseline conditions to the total GHG atmospheric burden, but the quantity of emissions is a small fraction of all anthropogenic sources of GHGs. The GHG emissions produced from Alternative 2 would be a small fraction of region-wide and county-wide GHG emissions contributing to global climate change. Emissions are well below the 25,000 metric tons of CO_2e guidance threshold, and emissions from Alternative 2 are considered minor in comparison to the threshold. The emissions similarly represent a miniscule contribution to the annual statewide emissions of over 100 million metric tons of CO_2e . However, because global climate change is recognized to be a potentially significant evolving cumulative effect, this relatively small amount of GHGs emitted from dredging activities under Alternative 2 is acknowledged to be a contributor (albeit small) to cumulative global emissions of GHGs.

Alternative 2 would add as many as 33 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Grays Harbor would experience approximately 2.75 additional vessel passages per month, attributable to a median "high/moderate" growth projection of cargo tonnage moved through the Port as a result of a channel deepened to -37 feet MLLW. The analysis computed the direct and indirect effects of GHG emissions of the additional vessel transits as limited by the action area – i.e., during vessel transits each direction between the sea buoy and the Port terminal. As reflected in Table 4.11-1, the increased CO_2 and CO_2e emissions attributable to the additional annual vessel traffic would generate no more than a minor incremental greenhouse gas emissions effect, as compared with Alternative 1. The incremental emissions would fall well below the level at which CEQ guidance would call for a quantitative assessment of effects on global climate change.

4.11.4.2 Climate Change

The potential impacts of climate change on the proposed action under Alternative 2 are expected to be the similar to those described for Alternative 1. The project covers 14.5 miles of the existing channel. The estimated range of sea level change scenarios range between 0.24 and 2.0 feet by 2065. The project area does not have any bridge crossings within the reaches being deepened, thus clearance issues associated with sea level rise are not a factor. Existing bridges are located upstream in the navigation channel in the Aberdeen Reach. These include the Union Pacific Railroad Bridge and the WA Route 101 Bridge. Deck heights at the Port of Grays Harbor Terminals are above 18 feet MLLW, thus will not be impacted by sea level change. The greatest impact from sea level change is likely the morphology near the inlet throat. As discussed in Section 3.2, the growth of Damon Point has constricted the inlet throat which has forced the thalweg into the inner harbor to maintain a position where the South Reach channel currently is aligned. Diminishing sediments feeding Damon Point coupled with sea level rise could result in breaches through Damon Point opening new channels into the inner harbor. Should a breach through Damon Point result in a permanent channel into the inner harbor, this could result in greater O&M dredging requirements in the South Reach.

4.11.5 Alternative 3—Deepen Channel to −38 Feet MLLW

4.11.5.1 Greenhouse Gas Emissions

Deepening the navigation channel by an additional 2 feet in the construction year would result in greater GHG emissions than Alternative 2 (Table 4.11-1). Compared to Alternative 2, Alternative 3 would use an additional clamshell dredge and tugboat to deepen the inner harbor reaches (the use of hydraulic dredges in the outer harbor reaches would be the same under all alternatives). Duration of dredging and placement activities would be the same as described for Alternative 2.

Under Alternative 3, activities related to the initial channel deepening would represent an increase of 1,359 metric tons of CO_2e over baseline conditions (Table 4.11-1). These emissions are far below the recommended threshold identified for conducting a quantitative analysis of GHG impacts: greater than 25,000 metric tons of CO_2e. The emissions similarly represent a miniscule contribution to the annual statewide emissions of over 100 million metric tons of CO_2e .

While subsequent maintenance dredging requirements would rise slightly (i.e. more volume would be required, 107,000 cubic yards) under Alternative 3 the emissions associated with subsequent maintenance activities would have only a slight increase from Alternative 1, because these activities would have similar duration and use the same machinery.

Under Alternative 3, activities associated with the initial channel deepening would add a minor increment to the contribution of maintenance dredging under baseline conditions to the total GHG atmospheric burden, but the quantity of emissions is a small fraction of all anthropogenic sources of GHGs.

The incremental contribution of emissions over and above the baseline conditions evaluated in the FY 2012-18 maintenance dredging EA would be below the 25,000 metric tons of CO_2e guidance threshold, and the emissions from Alternative 3 are considered minor in comparison to this threshold. Alternative 3 represents additional work and additional GHG emissions as compared to Alternative 2 (Table 4.11-1), but still well below the guidance threshold. Because global climate

change is recognized to be a potentially significant evolving cumulative effect, this relatively small amount of GHGs emitted from dredging activities under Alternative 3 is acknowledged to be a contributor to cumulative global emissions of GHGs.

Alternative 3 would add as many as 51 annual deep-draft vessel transits as compared with Alternative 1 by 2037. Grays Harbor would experience approximately 3.25 additional vessel passages per month, attributable to a median "high/moderate" growth projection of cargo tonnage moved through the Port as a result of a channel deepened to -38 feet MLLW. The analysis computed the direct and indirect effects of GHG emissions of the additional vessel transits as limited by the action area – i.e., during vessel transits each direction between the sea buoy and the Port terminal. As reflected in Table 4.11-1, the increased CO_2 and CO_2e emissions attributable to the additional annual vessel traffic would generate no more than a minor incremental greenhouse gas emissions effect, as compared with Alternative 1. The incremental emissions would fall well below the level at which CEQ guidance would call for a quantitative assessment of effects on global climate change.

4.11.5.2 Climate Change

The potential impacts of climate change on the proposed action under Alternative 3 are expected to be the same as those described for both Alternative 2 and Alternative 1.

4.12 Local Economy/Socioeconomics

4.12.1 Overview

This section discusses potential impacts of the proposed action on the local economy and socioeconomics of the Grays Harbor area.

As discussed in Section 4.1, *Marine Transportation*, vessels calling at the Port of Grays Harbor have experienced a steady increase in deadweight tons, length, beam, design draft and actual draft, increases which are projected to continue. The proposed action was requested by the Port to address issues related to accommodating current and projected future vessel traffic for existing port tenants and commodities.

4.12.2 Methods

This analysis is based on review of vessel operations at the Port, during the period from 2005 through 2012, focusing on historic data of the increased numbers and sizes of vessels calling at the Port over that period as well as the increases in the actual draft of arriving and departing vessels and the tidal requirements to enable vessel operations.

This analysis is also based on a review of the local economy and particularly the jobs associated with marine terminal operations in Grays Harbor.

4.12.2.1 Impact of Channel Depth on Marine Operations and the Local Economy

The viability of the Port depends directly on the efficiency and cost-effectiveness of its transportation systems. This is particularly the case for products that are not produced or consumed

in the immediate hinterland of the Port (in this case, in Grays Harbor County). Much of the new cargo handled at the Port (i.e., automobiles, equipment, grain and related products) is shipped by rail to/from distant locations (in excess of 500 miles). As the distance to the source (origin) or destination of the commodity increases, the cargo is referred to as discretionary cargo, and is susceptible to increased competition from other ports that may offer a lower cost supply chain. This is especially the case for lower valued cargoes, for which the cost of transportation is a large share of delivered product price; however, it is also increasingly the case for higher valued products, since shippers of higher valued products seek to minimize supply chain costs. As transportation costs become higher from the constraints imposed by the navigation channel, it could result in a loss of discretionary cargo. This would result in a decline in the number of jobs associated with cargo and vessel operations.

4.12.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of –36 Feet MLLW

Under baseline conditions, the maintenance dredging benefits the economy. The removal of shoaled sediments is essential to maintaining the federal navigation channel as a deep-draft vessel channel, which is necessary to most marine-oriented businesses in Grays Harbor. The depth of the existing channel constrains maritime operations, resulting in delays to arrivals and departures as well as light loading of vessels.

Under Alternative 1, the cost of marine traffic at the Port would increase relative to other competing ports. Over time, this could lead to reduced volumes of marine traffic and decreases in the number of direct jobs and income associated with marine traffic. If the increased costs become too high, shippers may seek alternative ports and there could be a decline in marine traffic.

Loss of direct jobs and income would also cause a loss of indirect jobs (i.e., goods and services that are purchased by the firms engaged in marine operations, such as professional services, office supplies, equipment and like activities) as well as induced jobs (i.e., goods and services purchased by the direct employees of marine operators).

4.12.4 Alternative 2—Deepen Channel to –37 Feet MLLW

Deepening the navigation channel to −37 feet MLLW under Alternative 2 would increase the underkeel clearance for vessels and thus lengthen the available tidal windows of opportunity for loaded vessels to use the navigation channel. Deepening the channel would improve the tidal delay and light loading conditions that currently increase transportation costs and affect the economic vitality of the Port and its tenants.

Alternative 2 thus would provide increased socioeconomic support to the region. While entrainment of fish and crabs would occur during the deepening, these impacts are not expected to be adverse or substantial to the local fishing industry (Section 4.4, *Invertebrates, Fish, and Wildlife*). As presented in Chapter 5, *Mitigation Measures*, avoidance measures of timing and equipment choice, particularly for impacts on Dungeness crabs, is expected to greatly minimize crab entrainment and reduce adverse effects on socioeconomics to a minor level.

Therefore, the potential for Alternative 2 to generate an adverse incremental effect on the local economy and socioeconomics of the Grays Harbor area, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minor.

Alternative 2 would in fact have a beneficial effect on the local economy and socioeconomics of the area because vessel operations would be improved, allowing fuller loads per vessel and reducing ocean transportation costs. This is considered to be a positive economic effect, and would be minor in light of the total regional economic output.

The 600 additional tons of cargo that would be projected to move through the Port of Grays Harbor by 2037 under Alternative 2, under a median "high/moderate" economic growth forecast would reflect a 5% increase. This increase would lead to a small rise in direct employment and wages, as well as an increase in direct jobs and induced jobs, in comparison to economic conditions under Alternative 1. This is considered to be a positive economic effect, and would be minor in light of the total regional economic output.

4.12.5 Alternative 3—Deepen Channel to –38 Feet MLLW

Deepening the navigation channel to −38 feet MLLW under Alternative 3 would increase the underkeel clearance for vessels over both Alternatives 1 and 2. As with Alternative 2, this alternative would lengthen the available tidal windows of opportunity for loaded vessels to use the navigation channel. Deepening the channel would improve the tidal delay and light loading conditions that currently increase transportation costs and affect the economic vitality of the Port and its tenants.

Alternative 3 thus would provide more increased socioeconomic support to the region compared to Alternative 2. While this alternative would result in greater entrainment of fish and crabs relative to Alternative 2, these impacts are not expected to be substantially adverse (Section 4.4, *Invertebrates, Fish, and Wildlife*). As presented in Chapter 5, *Mitigation Measures*, avoidance measures of timing and equipment choice, particularly for impacts on Dungeness crab, is expected to greatly minimize crab entrainment and reduce negative socioeconomic impacts.

As is the case with Alternative 2 , the potential for Alternative 3 to generate an adverse incremental effect on the local economy and socioeconomics of the Grays Harbor area, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minor. Alternative 3 would have a beneficial effect on the local economy and socioeconomics of the area, because vessel operations would be improved, allowing fuller loads per vessel and reducing ocean transportation costs. This beneficial effect is expected to be greater than Alternative 2 as the additional one foot of depth would further improve vessel operations, and further reduce ocean transportation costs.

The approximately 1300 additional tons of cargo that would be projected to move through the Port of Grays Harbor by 2037 under Alternative 3, under a "high" economic growth forecast would reflect an 11% increase. This increase would lead to a small rise in direct employment and wages, as well as an increase in direct jobs and induced jobs, in comparison to economic conditions under Alternative 1. This is considered to be a positive economic effect, and would be minor in light of the total regional economic output.

4.13 Environmental Justice Communities

4.13.1 Overview

This section discusses potential impacts on environmental justice communities within the communities surrounding the Grays Harbor navigation channel and dredged material placement sites: Aberdeen, Cosmopolis, Hoquiam, and Westport. As presented in Section 3.13, *Environmental Justice Communities,* the proposed action is located near communities that are predominantly low-income, with sectors of their populations that could be considered environmental justice communities.

4.13.2 Methods

The environmental justice analysis used data from the 2010 U.S. Census for the cities located near proposed activities, as well as for Grays Harbor County and Washington State, to determine the presence of environmental justice communities. Specific data reviewed included race/ethnicity, age structure, unemployment, and median annual income by race (as presented in Section 3.13, *Environmental Justice Communities,*). Principal employers in the four area cities were reviewed to determine potential economic impacts.

The results of public outreach, as described in detail in Chapter 8, *Agency Coordination and Public Outreach*, provided opportunities for community input, including input from potential environmental justice communities, into the analysis of potential effects of the proposed action. Any such input was also considered in this analysis.

4.13.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of –36 Feet MLLW

The navigation channel and the dredged material placement sites are located near communities along the shoreline of Grays Harbor that are predominantly low-income. Under Alternative 1 (baseline conditions), both dredging and placement of dredged materials occurs within the waterways of Grays Harbor, away from residential areas.

Under Alternative 1, maintenance dredging of the navigation channel would continue to provide economic support to the communities surrounding the navigation channel and placement sites in Grays Harbor. However, the extent of that support would continue to be limited due to the shoaling, tidal delays, and related constraints on navigation and shipping in the navigation channel associated with continued maintenance of the channel at −36 feet MLLW. The constraints on navigation have the potential to cause a decrease in the demand and use of the port. This decline in demand could lead to negative impacts to the local community and its associated economy. There would be no potential for disproportionately high or adverse human health impacts from Alternative 1.

4.13.4 Alternative 2—Deepen Channel to –37 Feet MLLW

Under Alternative 2, deepening the navigation channel to −37 feet MLLW would improve the function of the channel for vessels shipping into and out of the Port. Consequently, relative to Alternative 1 (baseline conditions), Alternative 2 would better support jobs related to the Port

facilities, manufacturing and commercial businesses, and recreation that depend on reliable navigation through the harbor.

Alternative 2 would not result in disproportionately high or adverse human health or environmental effects on minority and low-income communities, because the channel deepening would not result in any direct impacts on such communities. The partial filling of the former Hoquiam waste water lagoon does not reflect a decision of the Corps as to siting of a fill and development opportunity, as that location has previously been selected by non-Federal parties for filling and reuse. Public outreach, as described in detail in Chapter 8, *Agency Coordination and Public Outreach*, has also provided opportunities for community input, including by potential environmental justice communities, into the analysis of potential effects of Alternative 2. Few comments were received.

Alternative 2 would improve navigation conditions, thus providing economic support to the area, which would be expected to have a beneficial effect on nearby communities, including any environmental justice communities. Therefore, the potential for incremental adverse effects on environmental justice communities from Alternative 2, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minor.

4.13.5 Alternative 3—Deepen Channel to –38 Feet MLLW

Under Alternative 3, deepening the navigation channel to −38 feet MLLW would improve the function of the channel for vessels shipping into and out of the Port to a greater extent than Alternative 2. Maintaining the channel at this depth would further reduce the risk of shoals and tidal delays, which currently affect navigation in the channel. Consequently, Alternative 3 would better support jobs related to the Port facilities, manufacturing and commercial businesses, and recreation that depend on reliable navigation through the harbor.

Alternative 3 would not result in disproportionately high or adverse human health or environmental effects on minority and low-income communities, because the channel deepening would not result in any direct impacts on such communities. The partial filling of the former Hoquiam waste water lagoon does not reflect a decision of the Corps as to siting of a fill and development opportunity, as that location has previously been selected by the City and/or Port for filling and reuse. In addition, public outreach, as described in detail in Chapter 8, *Agency Coordination and Public Outreach*, has provided opportunities for community input, including by potential environmental justice communities into the analysis of potential effects of Alternative 3.

Alternative 3 would further improve navigation conditions compared to Alternatives 1 and 2, thus providing economic support to the area, which would be expected to have a beneficial effect on nearby communities, including any environmental justice communities. Therefore, the potential for incremental adverse effects on environmental justice communities from Alternative 3, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minor.

4.14 Indian Treaty Rights

4.14.1 Overview

This section discusses potential impacts on Indian treaty rights of the Quinault Indian Nation related to the proposed action within Grays Harbor and associated dredged material placement sites.

In addition to the Federal government's responsibilities under NHPA, the Federal government must consider the effects its actions may have on American Indian traditions and cultural practices. The Federal basis of a tribe's legal status rests within the context of U.S. Constitutional provisions for Federal government's powers for treaty making with other sovereign nations, and American Indian tribes' inherent sovereignty.

The Quinault Indian Nation, along with the Hoh, Queets and Quileute Tribes, signed the Quinault River Treaty with the Federal Government on July 1st, 1855. The Quinault Reservation was formed through this treaty and required these Indians to move to the current reservation located between Queets and Moclips and encompassing the Quinault River. The reservation boundaries were expanded by executive order in November 4, 1873. Currently, the reservation is 208,150 acres in size. Today, many tribal members continue to work within the region's fishing and logging industries. In an attempt to diversify its economy, the Tribe operates a casino, the Quinault Pride Seafood, a mercantile and Land and Timber programs.

The priorities of the Quinault Indian Nation are protection of the marine, freshwater, and land resources of the Quinault River and surrounding areas. These resources are the backbone of the Tribal economy and spiritual beliefs. Hunting, fishing, and gathering are central to the cultural and economic existence of the Tribe and its members. Acquisition of food through hunting, fishing, and gathering is part of a complex culture that emphasizes the concept that all of life is interrelated. Fish, wildlife, and other natural resources sustain the cultural and spiritual identity of the community in addition to providing economic stability for present and future generations.

In addition to salmon, razor clams, halibut, black cod and Dungeness crabs have been a mainstay of the Quinault Indian Nation for thousands of years. Historically, clams, crab, and oysters were readily available for harvest year-round. The rapid decline of many western Washington salmon stocks, due in large part to habitat loss from the region's burgeoning human population, has pushed shellfish to the forefront of many tribal economies. The Quinault Indian Nation is involved in the Grays Harbor Crab Mitigation Work Group whose purpose is to evaluate crab mitigation effects to dates, and devise a revised strategy to be used for future mitigation effects.

Along with hunting, fishing, and gathering, the intricate basketry and artwork of the Quinault Indian Nation is widely renowned and culturally significant. Sweetgrass (*Scirpus americanus*) is harvested for basket making by members of the Quinault Nation. Industrial and agricultural development in many western Washington estuaries has all but eliminated sweetgrass from the intertidal zones. However, sweetgrass is found along the shoreline of Bowerman Basin and within the Grays Harbor Wildlife Refuge.

Members of the Quinault Indian Nation fish for sturgeon, salmon, and Dungeness crabs in Grays Harbor and are allotted 50% of the harvestable fish and crabs within their usual and accustomed fishing areas under treaty agreement. Gillnetting for salmon in Grays Harbor occurs at the mouth of the Humptulips River and in the navigation channel near the mouth of the Chehalis River. Ship movement can disrupt tribal gillnetting activities and reduce efficiency as fishers move to avoid

large vessels moving through the navigation channel. Direct impacts due to entrainment of juvenile fish and crabs could also result in impacts on tribal fisheries. Consultations with the Quinault tribe have identified disruption of the gillnet fishery near the mouth of the Chehalis River as a main concern.

The Quinault Indian Nation harvests Dungeness crabs in Grays Harbor. Potential impacts on that fishery include direct mortality associated with entrainment during dredging, which removes crabs from potential harvest. This impact is discussed in detail in Section 4.4, *Invertebrates, Fish, and Wildlife,* along with direct impacts on salmon and sturgeon.

4.14.2 Methods

A qualitative assessment of the typical timing and locations of tribal fisheries relative to the timing and location of the proposed action was employed to analyze potential impacts. The potential for long-term impacts on crab and salmon fishing by tribal members due to ship movements in the navigation channel was also assessed.

4.14.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of −36 Feet MLLW

Dredging can occur in the inner harbor reaches from July 16 through February 14 under baseline conditions. The dredging schedule overlaps with the a portion of the tribal gillnetting season, which typically occurs in the later winter and early spring from late January to mid-April. Some gillnetters may be displaced by the location of the dredging barge in the navigation channel, but would be able to deploy their nets upstream or downstream of the barge and continue fishing. Because gillnets can be deployed to avoid the dredging barge, only very minor reductions in fishing efficiency would be experienced under Alternative 1 (baseline conditions) due to dredging activities.

The Corps (1989) estimated that all vessel traffic results in vessel movements within the channel that reduce the potential of the gillnet fishery by only 15%, because gillnets that cross or enter the channel have to be moved to accommodate vessel movement in the channel. The maintenance dredging of the navigation channel, under Alternative 1 (baseline conditions), would not alter the degree or ability of ship movement in the channel or to the Port terminals, including the nature and estimated degree of impact on the Quinault Indian Nation gillnet fishery.

Amount of vessel traffic in the navigation channel can affect Quinault Indian Nation Dungeness crab fishers, if buoy lines marking the location of any crab pots placed in or near the navigation channel become entangled in the propellers of passing vessels. When the buoy line is entangled, the line is cut and the pot is lost causing a financial impact on the fishers. The nature and degree of impact on the Quinault Indian Nation Dungeness crab fishery from vessel traffic would continue per baseline conditions under Alternative 1.

Placement of dredged materials, particularly at open-water placement sites, has the potential to temporarily affect the activities of Quinault Indian Nation Dungeness crab fishers. Under Alternative 1, the degree and nature of such temporary effects would continue per baseline conditions.

4.14.4 Alternative 2—Deepen Channel to –37 Feet MLLW

Under Alternative 2, the duration of dredging activities could increase, but still be restricted to the approved work windows (Table 2-1). The initial channel deepening of the inner harbor reaches would occur over the course of approximately 6 months, compared to a typical dredging period of approximately 4.5 months of dredging under Alternative 1. This could result in 45 additional days of the temporary impacts described for Alternative 1 on the Quinault Indian Nation gillnet and Dungeness crab fisheries. However, because gillnets and crab pots can be deployed to avoid the dredging barge, and all dredging is closely coordinated with the tribe only very minor reductions in fishing efficiency would result from dredging activities under Alternative 2. As discussed in Section 4.4.4.4 entrainment and mortality impacts to the Grays Harbor Dungeness crab population under Alternative 2 are minimal. During gill netting season, an additional incidence of as many as 2.75 deep-draft vessel transits per month would generate an irregular and infrequent incremental disruption to gill netting activities, which would have no more than a minor effect on tribal fishing.

Subsequent annual maintenance dredging under this alternative would be approximately the same duration with an estimated marginal annual volume increase of approximately 50,000 cubic yards of material.

Dredging under Alternative 2 would use similar methods and the same dredged material placement sites as Alternative 1, with the exception of the shifted Point Chehalis site and the upland site for the unsuitable material. Additional dredged material from the initial channel deepening, under Alternative 2, would result in an increase in trips to the placement sites by the bottom-dump barges, relative to Alternative 1. This increase in trips has the potential to increase the duration of temporary effects on the activities of Quinault Indian Nation Dungeness crab fisheries, relative to Alternative 1. Subsequent annual maintenance dredging under this alternative would be the same duration and generate no more than a minor increase in volume of material as under Alternative 1. Although the duration of disruption to the Quinault Indian Nation fisheries crab fisheries would increase under this alternative, the degree and nature would not change and the disruptions would remain temporary. Therefore, the potential for incremental impacts on these fisheries, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minimal under Alternative 2.

As reflected in section 3.4.2.1, the most recent estimate for Grays Harbor indicates that there is a harvestable crab population of 10 million. Alternative 2 would be anticipated to generate a loss of 1,178 crabs during the construction year in which both deepening and maintenance dredging would take place. The numbers of crab lost due to entrainment would be miniscule in comparison to the overall harvestable population, and Alternative 2 would thus have no discernible effect on the ability of tribal members to harvest a fair economic share.

4.14.5 Alternative 3—Deepen Channel to –38 Feet MLLW

Under Alternative 3, the duration of dredging activities could increase, during the initial channel deepening of the inner harbor reaches, relative to Alternative 1, as described for Alternative 2.

Temporary disruption of Quinault Indian Nation gillnet and Dungeness crab fisheries under Alternative 3 would be the same as described for Alternative 2. The potential for net displacement and for the fishers to have to move nets or crab pots, if active dredging is taking place at their preferred locations in the inner harbor reaches, has the potential to be higher under Alternative 3,

because two clamshell dredges could be operating at the same time (albeit in different locations). However, this impact is still evaluated as minor under Alternative 3 as all dredging is closely coordinated with the tribe. During gill netting season, an additional incidence of as many as 3.25 deep-draft vessel transits per month would generate an irregular and infrequent incremental disruption to gill netting activities, which would have no more than a minor effect on tribal fishing.

A small increase in ship movements or ship traffic, relative to Alternative 1, is expected as a result of the initial channel deepening under Alternative 3. Subsequent annual maintenance dredging under this alternative would be approximately the same duration with an estimated marginal annual volume increase of approximately 107,000 cubic yards of material.

Dredging under Alternative 3 would use similar methods and the same dredged material placement sites as Alternative 1, with the exception of the shifted Point Chehalis site and the upland site for the unsuitable material. Under Alternative 3, additional dredged material from the initial channel deepening, relative to Alternative 2, would result in an increase in trips to the placement sites by the bottom-dump barges, relative to Alternatives 1 and 2. This increase in trips has the potential to increase the duration of temporary effects on the activities of Quinault Indian Nation Dungeness crab fisheries, relative to Alternatives 1 and 2, but with close coordination this increase would be negligible when compared to Alternative 2. Subsequent annual maintenance dredging volumes under this alternative would see a minor increase while the work duration would be similar to that under Alternative 1.

Although the duration of disruption to the Quinault Indian Nation fisheries crab fisheries potentially could increase under this alternative, the degree and nature would not change and the disruptions would remain temporary. Close coordination with the tribe would continue. Thus, the potential for incremental impacts on these fisheries, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minor under Alternative 3.

As reflected in section 3.4.2.1, the most recent estimate for Grays Harbor indicates that there is a harvestable crab population of 10 million. Alternative 3 would be anticipated to generate a loss of 3,087 crabs during the construction year in which both deepening and maintenance dredging would take place. The numbers of crab lost due to entrainment would be miniscule in comparison to the overall harvestable population, and Alternative 3 would thus have no discernible effect on the ability of tribal members to harvest a fair economic share.

4.15 Placement Site Environment

4.15.1 Overview

This section addresses how the proposed action could affect the dredged material placement sites. Placement of the sediments dredged from the navigation channel would occur at the designated placement sites (South Jetty, South Beach, Half Moon bay Nearshore and Point Chehalis Revetment Extension mitigation sites) as described in Section 3.15, the shifted Point Chehalis Site and upland at the Hoquiam waste water lagoon (described in Section 2.3). As described in Chapter 2, the determination of which placement site would be used at any one time is based on a variety of factors including placement site capacity, weather, contractor equipment, and need. Dredged material could be placed at any or all of the placement sites under the various alternatives.

Initial channel deepening, under Alternatives 2 and 3, would result in greater volumes of dredged material supplied to placement sites, over and above the baseline conditions evaluated under the FY 2012-18 maintenance dredging EA (Alternative 1). In order to ensure the existing placement sites have suitable capacity to accept additional dredged material a modeling study was performed to investigate the short term fate and dispersive nature of dredged material placed at each site (Hayter et al. (2012)). Model results indicate there is high confidence that the existing sites will have sufficient capacity to accept up to 4.5 million cubic yards of dredged material in one year if the Point Chehalis site is shifted 1,000 feet north-northwest.

4.15.2 Methods

The analysis of potential impacts on placement site environments is based on a review of the quantities of dredged materials that have been placed at each of the placement sites during past annual maintenance dredging (Table 2-3). Because all of the placement sites, with the exception of the shifted Point Chehalis aquatic site and the Hoquiam former wastewater treatment plant site at which unsuitable material will be placed, have historically received dredged sediments and continue to do so under baseline conditions, the analysis focuses primarily on impacts of the additional dredged material placed under Alternatives 2 and 3. Refer to Table 2-6 for a comparison of the volumes that would be dredged under each alternative.

4.15.3 Alternative 1 (No Action Alternative)—Continue Channel Maintenance of –36 Feet MLLW

Under baseline conditions (Alternative 1), dredged material is placed at the five locations described in Table 2-2. Historically, Point Chehalis and South Jetty placement sites have received the most material. Annual placement of dredged material occurs at the South Jetty open-water placement site to protect the South Jetty's toe. Nourishment of Half Moon Bay beach and continued protection of the Point Chehalis revetment extension also occur in compliance with the *Point Chehalis Revetment Extension Project, Westport, Washington, InterAgency Mitigation Agreement* (U.S. Army Corps of Engineers 1998).

The dredged material placement sites are described in the following sections. These sites are intended to provide beneficial functions, beach nourishment, and habitat enhancement (when feasible). As with the maintenance program, site selection for dredged material placement from channel deepening will be determined based on a number of factors, including the following:

- The depth of each placement site and the size of the Point Chehalis revetment extension mitigation site, as surveyed annually.
- Weather and wave conditions at the time of material placement.
- Presence of commercial crab pots in a placement site and/or access lane.

The placement sites include two Washington Department of Natural Resources (DNR) dredged material placement sites, the Point Chehalis site and South Jetty site, which are located directly adjacent to the navigation channel. These two sites are located on state-owned aquatic lands and are managed by DNR for multi-user, unconfined placement. Dredged materials are deposited at these sites because their naturally high sediment transport capacity rapidly disperses fine sediments and distributes coarse sediments in ways that are beneficial to the structural integrity of the harbor jetties (South Jetty site), or due to more dispersive hydrodynamics (Point Chehalis site). The

remaining sites (Half Moon Bay nearshore, South Beach nearshore, and Point Chehalis Revetment Extension mitigation sites) are used for beach and/or subtidal habitat nourishment.

Materials dredged from inner Grays Harbor reaches are primarily fine grain suspended/bedload material from tributary streams and rivers. Inner Grays Harbor material will be disposed of primarily at the South Jetty and at the Point Chehalis sites during adverse weather/wave conditions. Materials dredged from outer Grays Harbor reaches are marine sands deposited by tidal action, and silty sand/sandy silt redistributed within the estuary by wind and wave action. Some outer Grays Harbor material will be disposed of at three "beneficial use" sites, including the Half Moon Bay nearshore nourishment site, the Point Chehalis Revetment Extension mitigation site (when feasible), and the South Beach nearshore nourishment site. See Figure 7 for the location of these sites, which are discussed individually below. Historic dredge volumes and typical material placement sites by dredge location are summarized in Table 2-2. Dredged material will be transported to the placement sites either by a bottom-dump hopper dredge or by a tugboat and bottom-dump (or split-hull) barge. These latter vessels generally have the ability to transport up to 6,000 cubic yards of material each trip.

4.15.3.1 Point Chehalis Open Water Placement Site

The depth of this site varies roughly between –50 to –80 feet MLLW. It is a dispersive site subject to wave energy and strong, predominantly westward currents and overlaps the present navigation channel. The irregular bottom consists of fine- to medium-sized sand grains of marine and riverine origin. Historically, this area has been extremely deep. Charts that predate jetty construction show depths of –100' MLLW in this area. Over 40 million cubic yards of dredged material have been placed in this area since 1977, at an average rate of about 960,000 cubic yards/year since 2000. Annual surveys and sediment transport modeling indicate that up to 75% of material placed in this area is transported out of the site in suspension during placement, and 6 to 53% of the material reaching the seabed erodes during the following winter (Demirbilek et al. 2010; Hayter et al. 2012). Bathymetric surveys indicate that most of this eroded material moves seaward, but remains within the nearshore littoral drift cell. Placement of material at this location reduces erosion near the Point Chehalis revetment and groins and retains sediment within the nearshore littoral. The Point Chehalis site is the most heavily used placement site in Grays Harbor.

4.15.3.2 South Jetty Open Water Placement Site

The depth of this site varies between –40 to –50 feet MLLW. This area is subject to strong, predominantly west-flowing tidal currents that sweep along the jetty toe. The site is considered dispersive, with seaward transport of placed material generally occurring rapidly; however, in the last decade, material within the eastern portion of the site has accumulated faster than it has dispersed. Site capacity is closely monitored and strict placement restrictions have been implemented to ensure that placement activities do not have adverse impacts on navigation. The irregular bottom consists of fine- to medium-sized sand grains of marine origin. Placement of dredged material at this site is necessary to prevent scour and undermining of the toe of the South Jetty. This site is the preferred placement area for inner Grays Harbor materials, although when weather/wave conditions are hazardous then inner Grays Harbor materials are placed at the Point Chehalis site.

4.15.3.3 Half Moon Bay Nearshore Nourishment and Point Chehalis Revetment Extension Mitigation Sites

The purpose of these two sites is to maintain a stable beach profile west of the Point Chehalis revetment extension constructed in 1998-1999 and to ensure that the armor stone toe of the revetment extension is not exposed. Sandy material from outer Grays Harbor is placed upland proximate to the Point Chehalis revetment extension (direct nourishment) and in the bay as close to shore as possible (nearshore nourishment), in accordance with the October 1998 *Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement* (USACE 1998). The nearshore nourishment site is used for placement as bathymetric conditions permit (i.e., when the bay is deep enough for bottom-dump barges to navigate). Typically, the Corps uses its shallowest draft hopper dredge (MV *Yaquina*) to place material at the Half Moon Bay site. Dredge material is placed so that material will be transported, via natural processes, to the nearshore and intertidal areas to assist in maintaining a stable beach profile.

The Point Chehalis Revetment Extension mitigation site is located above the mean higher high water (MHHW) elevation (+9 MLLW at this location), but sand from the site erodes into Half Moon Bay during high tide and storm events. The site is intended to cover the buried revetment. A hydraulic pipeline has been used when placing outer harbor materials at the Point Chehalis Revetment Extension mitigation site. A hopper dredge full of a sand and water slurry utilized the existing rock dock at Firecracker Point and pumped the slurry through a pipeline to the mitigation site. Firecracker Point is a jetty extension located on the southeastern side of the southeastern entrance to the Westport Marina. Booster pumps were required to pump the slurry 1.7 miles across-town. The temporary pipeline was installed in 1994, and is buried along the road that generally crosses the Westport peninsula from Firecracker Point to Half Moon Bay. The slurry of sand and water was discharged to the area in front of the buried revetment. A sand berm/perimeter dike separated the discharge area from Half Moon Bay. The slurry of water and sand temporarily ponds in the placement site, and water is conveyed via effluent pipe into Grays Harbor at the exposed rock revetment near Groin A. The sandy dredged material quickly dewaters and a bulldozer graded the sand uniformly over the placement area. Following initial placement, the material is expected to erode through natural processes and enter the intertidal zone and thus the littoral system.

4.15.3.4 South Beach Nearshore Nourishment Site

The purpose of placement at this site is to slow beach erosion on the south side of the South Jetty resulting from the interruption of longshore sediment transport by the two jetties at the mouth of Grays Harbor. Sandy material from the Bar Channel is placed as close to shore as possible, generally between –35 and –45 feet MLLW. Placement at this location extends the residence time of dredged material in the littoral system, and avoids deposition on productive crabbing areas.

4.15.4 Alternative 2—Deepen Channel to –37 Feet MLLW

The volumes of dredged material anticipated from initial channel deepening under Alternative 2 are shown in Table 2-3 by reach.[25] An additional 788,336 cubic yards of material would be removed as compared to the amount required to conduct maintenance dredging of the affected reaches to -36 feet MLLW under Alternative 1: approximately 600,596 cubic yards from the inner harbor reaches

[25] The volumes listed include 2 feet of advanced maintenance and 2 feet of allowable overdepth.

and turning basins and approximately 187,740 cubic yards from the outer harbor reaches. Subsequent annual maintenance volumes (Table 2-6) would increase by an estimated 50,000 cubic yards. The additional dredged material would be placed at the established placement sites. Half Moon Bay and South Beach nearshore nourishment placement sites would be expected to continue to receive material, as needed, to maintain beach nourishment activities, but could receive a larger volume of material if such a need were present during the implementation of Alternative 2. The South Jetty site would receive material as well. In addition, the shifted Point Chehalis site (Appendix G) would be utilized. The additional material placed at the Point Chehalis and South Jetty sites would result in a temporary accretion of the seabed in the first few years after placement. However, due to the strong currents and wave energy this material will be quickly dispersed to the northwest of the sites toward the bar and result in similar conditions as presently observed a few years following the previous deepening project.

The former Hoquiam wastewater treatment pond is slated to be used for the placement of material determined unsuitable for open water placement (13,500 cubic yards for Alternative 2). The pond is the Hoquiam sewage treatment plant lagoon located adjacent to the Port of Grays Harbor Terminal 3. The methodology for placing the material is assumed to be via clamshell dredge and barge with mechanical rehanding of material on land. During dredging the barge would be lined with geotextile fabric to prevent leakage. The barge would be transported to Port of Grays Harbor Terminal 3 and dewatered through a sump pump with a geofabric bag surrounding the discharge pipe to contain sediments. Land based equipment would be used to excavate and transport the dewatered dredged material from the barge to the placement area. The lagoons have some containment dikes already constructed on the southern and eastern boundaries of the former lagoon, and thus minimal earthwork would be necessary to ready the site. The surface area to be covered by the Corps' placement of material will constitute less than 5% of the total footprint of the former WWTP lagoon (Figure 10).

Placement of the 13,500 cubic yards of unsuitable material at the former wastewater treatment pond would permanently remove this material from the aquatic environment. The placement of the additional dredged material at the placement sites, as compared to baseline conditions, is not expected to alter sediment transport dynamics, including the dynamics of the flood and ebb currents and patterns of shoaling and erosion, as described in Sections 4.2.4.1 and 4.2.4.3. Therefore, the potential for placement of additional dredged materials to generate an incremental adverse effect the placement sites under this alternative, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, is expected to be minimal.

4.15.5 Alternative 3—Deepen Channel to –38 Feet MLLW

The volumes of dredged material anticipated from initial channel deepening under Alternative 3 are shown in Table 2-4 by reach.[26] An additional 1,972,000 cubic yards of material would be removed as compared to the amount required to conduct maintenance dredging of the affected reaches to -36 feet MLLW under Alternative 1: approximately 1,601,000 cubic yards from the inner harbor reaches and turning basins and approximately 371,000 cubic yards from the outer harbor reaches. Subsequent annual maintenance volumes (Table 2-6) would increase by approximately 107,000 cubic yards.

[26] The volumes listed include 2 feet of advanced maintenance and 2 feet of allowable overdepth.

The additional dredged material would be placed at five placement sites. Half Moon Bay and South Beach nearshore nourishment placement sites would continue to receive material, if/as needed, to maintain beach nourishment activities, but could receive a larger volume of material if such a need were present during the implementation of Alternative 3. The South Jetty site would receive material as well. In addition, the shifted Point Chehalis site (Appendix G) would be utilized. The additional material placed at the Point Chehalis and South Jetty sites will result in a temporary accretion of the seabed in a couple of years after placement. However, due to the strong currents and wave energy this material will be quickly dispersed to the northwest, toward the bar and result in similar conditions as presently observed a few years following the previous deepening project.

The former Hoquiam wastewater treatment pond is slated to be used for the placement of material determined unsuitable for open water placement (22,400 cubic yards for Alternative 3). The pond is the Hoquiam sewage treatment plant lagoon located adjacent to the Port of Grays Harbor Terminal 3. The lagoons have some containment dikes already constructed on the southern and eastern boundaries of the former lagoon, and thus minimal earthwork would be necessary to ready the site. The surface area to be covered by the Corps' placement of material will constitute approximately 5% of the total footprint of the former WWTP lagoon (Figure 10).

Placement of the 22,400 cubic yards of unsuitable material at the former wastewater treatment pond would permanently remove this material from the aquatic environment.

The placement of increased quantities of dredged material at the five placement sites, relative to baseline conditions is not expected to alter sediment transport dynamics, including the dynamics of the flood and ebb currents and patterns of shoaling and erosion, as described in Section 4.2.3.1, *Potential to Alter Sediment Transport Dynamics*, as presented in Section 4.2, *Geomorphology* . The former Hoquiam wastewater treatment lagoon site has plenty of capacity, and can readily accommodate the 8,900 additional cubic yards of material removed under Alternative 3 as compared to Alternative 2. Therefore, potential for placement of additional dredged materials to generate an incremental adverse effect the placement sites under this alternative, over and above the baseline condition effects evaluated under the FY 2012-18 maintenance dredging EA, and over and above the effects of Alternative 2 are expected to be minor. The use of one of the upland sites alternative to the former Hoquiam wastewater treatment lagoon site, as delineated in section 2.3, would be expected to have similarly minor environmental effects.

Chapter 5
Mitigation

5.1 Introduction

Mitigation is intended to avoid, reduce, and compensate for unavoidable effects from the proposed action. The Corps has generally adopted the mitigation philosophy of the CEQ, including the following five sequenced mitigation components:

1. Avoiding the impact altogether by not taking a certain action or parts of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life cycle of the action.
5. Compensating for the impact by replacing or providing substitute resources or environments.

The Corps has incorporated mitigation measures into the annual navigation channel maintenance dredging and placement of dredged materials and has similarly incorporated these measures into the proposed action for deepening the navigation channel.

The environmental consequences analysis conducted for this reevaluation (and documented in Chapter 4 of this SEIS) shows the potential impact on resources of the preferred alternative (i.e. the increment to dredge from -36 feet MLLW to -38 feet MLLW) would be minor. Based on this analysis, no new compensatory mitigation measures are proposed specifically for the construction or maintenance of the preferred alternative. The potential impact of dredging would be minor to the overall Dungeness crab population based on modeling that was conducted as part of the environmental analysis.

The Corps will continue to coordinate with interested stakeholders to address mitigation associated with O&M of the existing navigation channel dimensions separate from the deepening proposed in the recommended plan for this SEIS.

The Corps currently implements the following avoidance and minimization measures in the study area as part of regular maintenance dredging. These same avoidance and minimization measures, adjusted as necessary to apply to the modifications in timing, dredging volumes, dredging/placement methods, and placement locations associated with Alternatives 2 and 3, would be implemented for maintenance of the recommended plan after construction.

5.1.1 Impact Avoidance Measures

The following impact avoidance measures are incorporated into annual maintenance dredging (Alternative 1), and would also be incorporated for both action alternatives (Alternatives 2 and 3) under the proposed deepening of the navigation channel.

- To avoid impacts on bull trout and out-migrating juvenile salmon, the Corps would not dredge the South Aberdeen Reach, Cow Point Reach, Hoquiam Reach, and turning basins between

February 15 and July 15. No timing restrictions related to salmonids apply downstream of Hoquiam Reach. The estuary is wider downstream of Hoquiam Reach, so a smaller proportion of the migratory pathway is affected by sediment plumes. Also, the relative distance between dredging activities and the shallow subtidal habitat where juvenile foraging occurs is greater.

5.1.2 Impact Reduction Measures

The following impact reduction measures are incorporated into annual maintenance dredging (Alternative 1), and would also be incorporated for both action alternatives (Alternatives 2 and 3) under the proposed deepening of the navigation channel:

- To reduce the volume of material that needs to be dredged from the navigation channel, the Corps implemented minor channel alignment modification from South Reach to Hoquiam Reach to take advantage of greater scour from river and tidal currents to reduce the volume of material accumulating in these portions of the navigation channel.
- To reduce entrainment of fish and crabs, the inner harbor reaches are dredged using a clamshell dredge. The Outer Crossover Reach can be dredged with either a hydraulic hopper dredge or a clamshell dredge; however, clamshell is the preferred method. To reduce entrainment of Dungeness crabs, the dredging schedule is set so that no hydraulic hopper dredging occurs in outer harbor reaches during periods of peak crab abundance (April 1 –June 30).
- To reduce the potential for damage to crab pots, placement of dredged materials at the Half Moon Bay nearshore placement site and the South Beach placement site is coordinated with commercial and tribal crab fishers.
- Impacts on Native American fishing rights, specifically those of the Quinault Indian Nation, are minimized mainly by timing and equipment use parameters aimed at reducing impacts on the target species important to the tribe. By avoiding times when juvenile salmonids and Dungeness crab are using the inner harbor reaches and restricting equipment to clamshell dredges in the inner harbor reaches, impacts on salmon and Dungeness crab are minimized.
- As part of the Corps' beneficial use of dredged materials, dredged materials are used to facilitate a stable beach profile along Half Moon Bay. Dredged material placement at the Point Chehalis Revetment Extension mitigation site is restricted to 9 feet above MLLW (the mean higher high water line at this location), pursuant to the *Point Chehalis Revetment Extension Mitigation Agreement* (U.S. Army Corps of Engineers 1998) to facilitate a more stable beach profile and to avoid nearshore and wetland impacts from material placement at this site. Discharge of decant water from upland placement at the Point Chehalis Revetment Extension mitigation site would be controlled so that suspended sediment settles out, before entering the bay into very dynamic environment where turbidity is common, and would be monitored for turbidity impacts in accordance with Ecology's Water Quality Certification.

In addition to these impact reduction measures specific to dredging and dredged material placement in Grays Harbor, the Corps implements ballast water exchange protocols to avoid and minimize the potential for dredging to facilitate the transfer of nonnative and potentially invasive organisms during dredging and dredged material disposal from different estuaries along the Pacific Coast and Hawaii. Offshore ballast water exchange is required for dredges traveling to Grays Harbor from the Columbia River, Coos Bay, San Francisco Bay, Humboldt Bay, Alaska, and Hawaii. Exchange of ballast

water occurs at least 50 nautical miles off shore. Sand ballast is dredged from the ocean entrance of the departing location and disposed of at the most seaward point of the arriving project's approved location.

Ballast management plans have been developed for both government hopper dredges operated by the Portland District Corps (i.e., the *Essayons* and *Yaquina)* which have annual assignments to Grays Harbor. They use both water and partial loads of sand as ballast. The management plans were written to ensure that operation of the dredges complies with federal and state ballast management laws and regulations.

Other specific mitigation measures included in these ballast management plans include:

- Two of the *Yaquina's* ballast tanks are filled with potable (i.e., fresh) water at its yearly dry-docking. The intent is to hold this ballast all year, if possible. Filling the ballast tanks with fresh water can reduce the potential for marine organisms to persist in the tanks.
- Sand ballast is carried only when sea conditions are such that not carrying it would adversely affect the handling of the vessel and endanger the crew.
- Sand ballast consists of material that has been determined to meet all criteria for unconfined open water disposal in accordance with the provisions of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended and the Testing Manual for Evaluation of Dredged Material Proposed for Ocean Disposal (U.S. Environmental Protection Agency Publication 503/8-91/001).
- Before departing from a dredged material placement site for the last time, the hopper and vessel piping is flushed with at least one full load of water to ensure all remaining sediments are washed from the vessel.
- Records of ballast management are reported to the U.S. Coast Guard and Washington State and are maintained for a minimum of 2 years.

When contractor dredges are used, contract specifications require compliance with the Washington Ballast Water Management Act (RCW 77.120) and Federal ballast water management regulations (33 CFR 151.2000 *et seq.*). Best management practices for ballast management and equipment cleaning prior to arrival/departure are also reviewed during preconstruction safety meetings. Ballast is typically not present on the tug boats (because tug boats have displacement hulls) or on the barges used during clamshell dredging of the inner harbor reaches (because the barges are towed without people on board, so ballast is generally not necessary for crew safety).

5.1.3 Mitigation for Impacts on Dungeness Crab

Because Grays Harbor functions as an important nursery ground for juvenile Dungeness crabs, which eventually migrate to the Pacific Ocean and enter an important fishery, the Corps incorporates specific mitigation measures into dredging and dredged material placement in Grays Harbor for any potential adverse and substantial impacts. These impact avoidance, reduction, and compensatory mitigation measures are summarized in the 1998 Revised Crab Mitigation Strategy Agreement (Appendix E) and are incorporated into annual maintenance dredging (Alternative 1), and would also be incorporated into both action alternatives (Alternatives 2 and 3), as required, under the proposed deepening of the navigation channel.

5.1.3.1 Dungeness Crab Impact Minimization Measures

The construction schedule for the proposed project has been carefully considered to minimize impacts on crabs wherever practicable. It is based on the best available data regarding Dungeness crab life history, ecology, and population dynamics and estimates of crab losses derived from a mathematical impact prediction model developed by the University of Washington (Armstrong et al. 1987). Dredging schedules have been developed and dredged material placement site locations have been selected to avoid or minimize impacts on Dungeness crabs and other aquatic resources.

The following project elements are incorporated into annual maintenance dredging (i.e., Alternative 1), and would be under both action alternatives (Alternatives 2 and 3) to minimize adverse impacts on crabs:

- Scheduling of dredging to the extent practicable to avoid times and areas of high crab densities,
- Locating offshore disposal sites to avoid high concentrations of crabs and interference with the crab fishery, and
- Using clamshell dredges instead of hopper dredges wherever cost-effective to avoid entraining crabs.

Although these actions are embodied in the timing of dredging and the locations of the dredged material placement sites (Table 2-1), some crabs would be lost as a result of dredging and placement of dredged materials under the proposed action and, thus, some unavoidable losses of adult crabs may still occur, and impacts on the crab fishery (both tribal, sport, and commercial) would also still occur.

Impacts are correlated with the volume of dredged material and also thus occur under baseline (i.e., Alternative 1) maintenance dredging and placement of dredged materials and would continue to occur during annual maintenance dredging of the deepened channel and placement of dredged materials under both action alternatives.

5.1.4 Minimization Measures for Alternatives 2 and 3

The following impact reduction measures are incorporated into Alternatives 2 and 3 including subsequent annual maintenance dredging attributable to these alternatives

- In light of the determination that the material at DMMU 32a passed chemical testing, it did possess unspecified potential toxicity in the bioassay, the Corps made the conservative decision to remove the entire section of DMMU 32a and place upland, permanently removing it from the aquatic environment.
- The unsuitable material will be clamshell dredged. Implementation of best management practices – such as control of the speed of the dredging bucket during descent and ascent – and compliance with the water quality monitoring plan will ensure that turbidity is reduced to the maximum extent possible during dredging. Dredged material will be placed in a fully fenced haul barge where it will be dewatered through filtered scuppers.
- Unsuitable dredged material would be dewatered and taken by barge to be offloaded at nearby Port of Grays Harbor Terminal 3 (a distance of less than 4 miles) and is slated to be trucked the

short distance to the former Hoquiam city wastewater treatment lagoon for offload (less than half-a-mile), and dumped from the transport trucks directly into the offload site. The dewatered dredged material would be mechanically transferred from the barge to trucks using an excavator or front load excavator.

Chapter 6
Cumulative Effects

The CEQ regulations for implementing NEPA define cumulative effects as:

> …the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR 1508.07).

Cumulative impacts can result from individually minor but collectively significant actions taking place over time. NEPA requires the evaluation of cumulative impacts to assess the overall effect of a proposed action on resources, ecosystems, or human communities in light of past, present, and reasonably foreseeable future projects. The cumulative impact analysis includes actions by federal, non-federal, and private entities within Grays Harbor.

This chapter describes baseline conditions of Grays Harbor for the cumulative effects analysis; identifies past, present, and reasonably foreseeable future actions; and analyzes incremental effects of the proposed action.

6.1 Baseline Conditions for Cumulative Effects Analysis

The Grays Harbor estuary and its shoreline have been altered by previous dredging, diking, filling, jetty construction, industrial discharges, shoreline development, and other anthropogenic activities over the past century including extensive use of the intertidal zone for activities associated with log processing and lumber mills. Maintenance dredging of the navigation channel has been a regular occurrence since 1910.

These human activities have resulted in loss of intertidal habitats such as mudflats and marsh, conversion of shallow-water habitats to deeper water, erosion and migration of sand islands, and periodic localized reductions in water quality and a minor reduction in overall sediment and water quality in the estuary. Jetty construction between 1898 and 1916, subsequent rehabilitation in 1939, construction of the Point Chehalis revetment and groins in 1952, the ongoing regular maintenance dredging of the navigation channel, and the placement of dredged material within open water placement sites in the estuary, has altered the configuration of the mouth of the estuary, and changed the patterns of sediment movement along the ocean shoreline and within Grays Harbor. For example, the South Jetty forms a barrier to northerly long-shore drift, which has resulted in erosion and recession of South Beach, the 1993 breach of the connection between the jetty and land, offshore steepening of the shoreline, and creation (and subsequent erosion) of Half Moon Bay (U.S. Army Corps of Engineers 2012).

Degradation of ecological functions associated with these types of changes has altered the condition of the shoreline in many places, reduced the extent of intertidal marsh and mudflat habitats, and altered the bathymetry of the estuary along the navigation channel. By one estimate, approximately 14,579 acres or 30% of historic intertidal habitats in Grays Harbor have been lost (Smith and Wenger 2001, as cited in U.S. Army Corps of Engineers 2011). These changes have thus affected the natural environment and the types of fish and wildlife that use Grays Harbor.

While these historic impacts may have been detrimental to certain aspects of the natural environment, the cumulative effects of these changes have also had positive implications for aspects of the human environment. The jetties, revetments, and groins, as well as regular maintenance dredging, have supported commercial, industrial and residential development of the area and supported local and regional economies by removing hazardous areas of shoaling, promoting ocean-going commercial vessel access to and from the Port of Grays Harbor, and by thus creating local centers of employment. As a result, the baseline condition is one of historic and ongoing modifications to the natural environment of Grays Harbor, and of associated benefits to import and export related industries and businesses in the area and broader region.

6.2 Past, Present, and Reasonably Foreseeable Future Actions

For this cumulative effects analysis, the study area was defined to encompass water-based activities in Grays Harbor and activities along its shoreline with the potential to affect the same resources that could be affected by the proposed action.

Annual maintenance dredging of the Grays Harbor navigation channel by the Corps is likely to continue into the near future. Some level of annual maintenance dredging has occurred every year since 1910, but no new areas have been dredged outside of the authorized channel and no new placement sites have been designated since the late 1990s. However, only areas previously designated as navigation channel or as dredged material placement sites are disturbed during annual maintenance dredging. Similarly, dredged material placement practices no longer contribute to the conversion of intertidal wetlands to uplands, as has occurred in the past prior to passing of the Clean Water Act in 1972.

Up to 1,725 acres of the subtidal zone of Grays Harbor are disturbed by the Corps' annual maintenance dredging, with an additional 697 acres disturbed by the placement of dredged material. This area is equivalent to approximately 12% of the total acres of subtidal habitat in Grays Harbor (U.S. Army Corps of Engineers 2011).

In addition to the continued maintenance dredging of the navigation channel, several other activities were considered for this cumulative effects analysis. The following sections describe past, present, and reasonably foreseeable future actions in Grays Harbor that were considered likely to contribute to cumulative effects on the resources in and around Grays Harbor. The effects falling under Section 404 of the CWA and Section 10 of the River and Harbor Act of 1899 of these non-Corps projects are subject to Corps permitting. In the course of permitting, effects under NEPA, ESA, CWA and other regimes falling within the appropriate scope of analysis are subject to independent evaluation by the Corps, as well as by other regulatory agencies.

6.2.1 Port of Grays Harbor Maintenance Dredging

The Port of Grays Harbor conducts maintenance dredging of their marine terminal facilities adjacent to the federal navigation channel. This dredging typically occurs to maintain the terminals along the shoreline, adjacent to the Cow Point and Hoquiam reaches of the navigation channel. Dredged material from Port dredging is typically placed at the South Jetty and Point Chehalis placement sites (U.S. Army Corps of Engineers et al. 2010). The timing of the Port's dredging is limited by the same types of

regulatory windows that apply to the Corps' annual maintenance dredging, and that would govern the proposed action (i.e., WDFW and ESA-related in-water work windows).

Between late January and early February 2012, the Port had approximately 125,000 cubic yards of material removed from their terminals via clamshell dredging; the material was placed at the Point Chehalis open water placement site (Port of Grays Harbor). Between November 29, 2012 and January 31, 2013, the Port had approximately 78,300 cubic yards of material removed from their terminals via clamshell dredging; the material was also placed at the Point Chehalis open water placement site (Port of Grays Harbor).

Port of Grays Harbor dredging results in similar types of impacts to those related to the Corps' maintenance dredging program, and dredging that would occur under the proposed action, but the scale of Port dredging activities is much smaller and, therefore, the volume of material removed and the duration and physical extent of Port dredging is much more limited. Dredging of the Port's basins would add to the benthic invertebrate, fish and wildlife, and water quality impacts occurring near the Cow Point and Hoquiam reaches of Grays Harbor because of the proposed action and the Corps' annual maintenance dredging, but would occur closer to the shoreline than the proposed action. As is true with all dredging in Grays Harbor, water quality impacts are limited by conditions of each project's Clean Water Act Section 401 Water Quality Certification (including limits on low DO and elevated turbidity extent and magnitude) and by the limitations placed on each project's timing, equipment, and physical extent by other federal, state, and local permit conditions (e.g., ESA consultation, Clean Water Act Section 404 permits, and WDFW Hydraulic Project Approval).

6.2.1 Proposed Port of Grays Harbor Terminal Expansions

Three independent projects to bring crude oil (and other bulk liquids) by rail to the Port of Grays Harbor are being proposed for Terminals 1 and 3. The Port owns the property on which the projects are proposed, but is not the proponent/applicant of any of the projects. The projects are currently in preliminary planning stages.

If one or more of the proposed terminal expansion projects are implemented, temporary construction impacts related to noise, air pollution, GHG emissions, and the potential for spills that could affect water quality could occur along the shoreline and uplands adjacent to the inner reaches of the navigation channel. Such impacts could occur during the period when dredging would be occurring in the inner reaches of the navigation channel (i.e., between July 15 and February 15) under any of the action alternatives. Such impacts would add to the impacts associated with the proposed action.

Operation of these terminal expansion projects would similarly increase noise, air pollution, GHG emissions, and the potential for spills that could affect water quality in Grays Harbor because of increased train traffic transporting bulk liquids to the terminals and increased marine traffic associated with the tugs and transport vessels conveying bulk liquids to and from the terminals. Although spill prevention and protection plans would be required to minimize and reduce the potential for oil spill impacts, and aggressive response measures are planned with equipment pre-staged, the possibility of adverse effects of a spill cannot be fully discounted.

The environmental effects of increased marine traffic and the socioeconomic effects of the commensurate increase in cargo movement through the Port attributable to the proposed terminal expansion projects would be generated independent of the implementation of the Corps' preferred

alternative, and thus would not constitute proximate direct or indirect consequences of the proposed Federal action.

6.2.1.1 Westway Terminal Company Crude by Rail, Terminal 1

The Westway Terminal Company is proposing to expand its current bulk liquid storage operations at Terminal 1 to allow for receipt of crude oil unit trains, storage of crude oil delivered by these trains, and shipment of crude oil by vessel and/or barge (Westway Terminal Company 2013a). The proposed action would add four 200,000 barrel (8.4-million-gallon) storage tanks to the site, south of the company's existing storage tanks and would expand the existing rail facility at the terminal from two short spur tracks with a total of 18 loading/unloading locations to four longer spurs with a total of 76 loading/unloading locations (Westway Terminal Company 2013a). Work performed on the terminal's dock would be limited to the addition of loading arms and parts of the Marine Vapor Combustion System. No in-water work is proposed. Crude oil received at the facility would be stored and ultimately loaded via pipeline onto barges or vessels to be transported to refineries on the west coast of the United States.

It is estimated that the terminal would receive approximately 9.6 million barrels of oil per year, equivalent to two unit trains (i.e., 120 railcars) every three days and 60 tankers or barges a year (i.e., 120 entry and departure transits in the navigation channel) (Westway Terminal Company 2013a, 2013b). The current baseline for rail traffic to the terminal is approximately seven loaded trains per week. The Puget Sound and Pacific (PSAP) Railroad and Port of Grays Harbor have drafted a freight rail plan that identifies infrastructure enhancements for an increase of three to seven loaded trains per week. Should both the Westway and Imperium Renewables proposals (as described below) be constructed at Terminal 1, the combination would add approximately nine additional loaded trains (18 loaded and unloaded trains) a week (Westway Terminal Company 2013b).
A SEPA Mitigated Determination of Non-Significance (MDNS) was issued by the City of Hoquiam and Ecology on March 14, 2013 (Westway Terminal Company 2013b). Among mitigation conditions specified in the approval, Westway is required to complete a Rail Transportation Impact Analysis (RTIA) and a Vessel Traffic Impact Analysis (VTIA) prior to the City of Hoquiam granting the Certificate of Occupancy for facility operation. The RTIA will determine the potential for impacts directly caused by changes and increases in rail traffic on local vehicular traffic and other rail commodities and will identify any improvements or mitigation needed. The VTIA will determine the potential for impacts that may result from changes or increases in vessel traffic in Grays Harbor.

In November 2013 the Washington Shorelines Hearings Board reversed permits for two crude oil shipping terminals in Grays Harbor, Washington for failure to address significant public safety and environmental issues. The projects cannot go forward until full and detailed environmental reviews assess all individual and cumulative impacts.

6.2.1.2 Imperium Renewables Crude by Rail, Terminal 1

Imperium Renewables is considering constructing a crude biodiesel unloading and storage facility adjacent to its existing biodiesel production facility and tank farm at Terminal 1 (Port of Grays Harbor 2013). The company's existing facility consists of 14 storage tanks, totaling 18 million gallons of storage for either vegetable oil or biodiesel.

According to a 2013 press release prepared by Imperium Renewables, a permit application for the construction of 10.7 acres of new storage tanks, rail infrastructure and office space adjacent to the

existing Imperium Renewables biodiesel plant is planned for 2013. The company anticipates that the products stored on site will vary over the life of the facility, and may include biodiesel, ethanol, U.S. crude oil, jet fuel, gasoline, diesel, vegetable oil, and feedstock (material used to produce biodiesel). Approximately 60 construction jobs and approximately 20 full time Imperium Renewables employees are anticipated as a result of the proposed expansion (Imperium Renewables 2013).

The Imperium Renewables proposal could result in two additional unit trains every day (one loaded and one empty) and up to 200 tankers or tank barges a year (i.e., 400 entry and departure transits in the navigation channel) (Westway Terminal Company 2013b).

6.2.1.3 Grays Harbor Rail Terminal Crude by Rail, Terminal 3

Grays Harbor Rail Terminal (part of the U.S. Development Group) has performed a feasibility analysis on the construction and operation of a bulk liquid handling and storage facility at the Port of Grays Harbor Terminal 3 to handle liquid bulk, primarily crude oil or light oil (U.S. Development Group 2013a). Liquid bulk cargo such as crude oil would be transported via rail unit trains from producing locations across North America to the terminal where it would be unloaded via pipe connections into storage tanks at the site (until a transportation vessel arrives) and then piped from the tanks to barges or ships for transport to destinations along the west coast of the United States. The facility may additionally export cargo to Asia and import light oil for delivery via rail to other locations (U.S. Development Group 2013b).

In April 2013, the Port Commission recently approved a Grant of Option to Lease for the property, which allows the company 24 months for project planning and permitting, with a long-term lease following once project permits are obtained (Port of Grays Harbor 2013).

6.2.2 Point Chehalis Revetment Maintenance Project

The Corps anticipates repair and maintenance of the armor rock at the Point Chehalis Revetment in Westport. The revetment is located along the shoreline of Point Chehalis, just south of the Point Chehalis reach of the navigation channel and within 0.5 mile of the Point Chehalis open water dredged material placement site. The revetment, in combination with a system of groins, stabilizes Point Chehalis against erosion and protects the federally authorized small boat harbor at Westport. The revetment also protects private and commercial property and public infrastructure in central Westport. The revetment is frequently damaged during winter storm winds and waves and has been repaired several times since it was rehabilitated in 1972, often conducted on an emergency basis with undersized stone (U.S. Army Corps of Engineers 2013). Light Detection and Ranging (LiDAR) data collected in 2010 by the National Coastal Mapping Program revealed deterioration of the revetment and triggered an evaluation that resulted in a determination that the revetment is at risk of failure.

The Corps has historically conducted repairs of the Point Chehalis revetment and groins on a reactive basis, often under urgent conditions and under less than ideal circumstances, such as conducting repairs outside of the species work windows. The Corps completed a NEPA evaluation of a project that would allow for long-term planning of repairs in a less impacting manner, including the preferred alternative of an estimated minimum eight year comprehensive repair of the entire revetment structure (3,100 linear feet), including six groins (Corps 2013). Repair is being conducted in periodic increments based on funding availability and is prioritized based on severity of damage and risk to the structure. The repair involves reworking approximately 40,000 tons of existing rock along approximately 3,100 linear feet of the revetment and the addition of approximately 140,000 tons of Class V armor stone (maximum diameter of 21 inches). Construction would occur between July 15 and February 15 to minimize the

potential for impacts on listed salmonids. Reworking and replacement of toe rock would take place below MHHW, but would be accomplished during low tides and in the dry using a hydraulic excavator to place the rock (U.S. Army Corps of Engineers 2013).

Although rock placement will be accomplished during low tide and in the dry, it would still eliminate benthic organisms beneath the newly placed rock. Temporary impacts on water quality and intertidal habitat could occur as a result of increases in turbidity as toe rock is reworked and new toe rock placed below MHHW on the sandy substrate. Temporarily elevated turbidity and decreased DO could affect juvenile salmonids that utilize the nearshore environment, but the degree of effect is reduced by the timing of the work within the established work window. Construction-related noise and vibrations could also temporarily disturb wildlife near the construction. During construction, there would be temporary and localized reduction in air quality due to particulate emissions from heavy machinery (primarily trucks and excavators) placing and rearranging rock along the revetment. Construction vehicles and heavy equipment would generate gasoline and diesel exhaust fumes, particulates, carbon monoxide, nitrogen and sulfur oxides, hydrocarbons, unburned carbon particles, and dust on roadways. Fuel, hydraulic fluid, or other spills could occur from heavy equipment used during construction, but this potential would be minimized through the use of standard construction BMPs. The work would take up to 400 days to complete over the planned 8-year period.

In July, 2013 the Services concurred with the Corps' determination of "may affect, not likely to adversely affect" species listed as threatened or endangered or critical habitat designated under the Endangered Species Act (NMFS reference: NWR-201309858; USFWS Reference:01EWFW00-2013-I-0216) for the revetment repair project.

6.2.3 Grays Harbor Long-Term Management Strategy

Features of the Grays Harbor and Chehalis River Navigation Project include the navigation channel, North and South Jetties, and the Point Chehalis revetment. The Corps' mission is to maintain all of these features in an environmentally acceptable way and in the most cost-effective manner possible, in order to provide safe navigation in Grays Harbor. The Corps has been conducting a study, the Grays Harbor LTMS, to identify a technically feasible, cost effective, environmentally sound, and publicly acceptable solution that minimizes risk to operation and maintenance over the next 50 years of all aspects of the Grays Harbor and Chehalis River Navigation Project (U.S. Army Corps of Engineers 2012). The LTMS is evaluating the implications and management of the persistent loss of sediment from the Grays Harbor entrance (including North Beach and South Beach). This loss of sediment is expected to continue indefinitely due to the interruption of long-shore sediment transport by the South Jetty. Without intervention, shoreline erosion near the South Jetty is expected to eventually breach the landmass adjacent to the jetty, as occurred in 1993.

Four alternatives were screened through the LTMS' Multi-Criteria Decision Analysis process to arrive at a LTMS preferred alternative. These alternatives included:

- Alternative 1A—No Action
- Alternative 1B—Modified Current Practice (with Modified Diffraction Structure)
- Alternative 3A—Jetty Extension (with Beach Nourishment and Modified Diffraction Structure)
- Alternative 4C—Breach Closure

The Corps has conducted interim actions since 1993 when the area of land between the South Jetty and Half Moon Bay was breached. The Corps' current, interim practice pending completion of the LTMS, is based on two predesigned triggering criteria and includes contingent placement of sand to avert undue risk of a breach in the spit of land adjoining the South Jetty.

The Corps is currently conducting environmental evaluations to support a decision document for approval of the LTMS preferred alternative. Preparation of a separate final LTMS NEPA analysis would occur simultaneously with formulation of a recommended plan and would further evaluate potential effects of implementing an LTMS in Grays Harbor.

6.2.3.1 Contingent Interim Actions Adjacent to the South Jetty

In 2005, the Corps put in place an interim action plan until a LTMS could be comprehensively evaluated and a preferred alternative implemented, to address the potential for a breach at the base of the South Jetty and the Half Moon Bay erosion. Under this plan, the Corps uses triggering criteria (i.e., thresholds) to proactively identify and address evidence of a breach reforming. Sand placement is initiated when topographic surveys indicate 15,000 cubic yards of sand have eroded from the southwest corner of Half Moon Bay (Trigger No. 1) or when overtopping of the breach fill footprint (Trigger No. 2) is observed. These triggers are used as indicators that an undue risk of a breach is developing (U.S. Army Corps of Engineers 2012). The use of such triggering criteria as an interim approach to managing the situation affords the Corps time to coordinate internally and externally, design, procure necessary materials, and implement a response to a potential breach before a breach occurs and an emergency repair would be necessary. This interim action plan is expected to remain in place until the evaluation of the LTMS is completed and any recommended components are implemented.

The Corps continues to monitor the vicinity of the South Jetty under the interim action plan and, in order to preserve the status quo, continues to place material in strategically selected areas as needed to protect against undue risk of a breach recurring due to continued erosion. Periodic mechanical rehandling of material from the Half Moon Bay direct upland beach nourishment site may occur as part of this interim measure, if survey data indicate the need for such action.

6.2.4 State Route 520 Bridge Pontoon Construction Area Dredging

The SR 520 Bridge Pontoon Construction Project, which broke ground in February 2011 at a 55-acre site in Aberdeen, will replace the aging SR 520 floating bridge on Lake Washington. Since the groundbreaking, WSDOT and contractor Kiewit-General have built a casting basin facility featuring a concrete batch plant, onsite water treatment, and a 4-acre casting basin, where pontoon construction is underway. By its estimated 2015 completion date, the project will have constructed 33 pontoons, 21 of which will be 360 feet long, 75 feet wide, and nearly 30 feet tall. Once complete, each batch of pontoons will be floated out of the casting basin, inspected, and towed into place on Lake Washington, where the pontoons will serve as the floating foundation for the new SR 520 bridge.

Dredging of approximately 87,000 cubic yards of material occurred in November and December 2011, to open a launch channel between the navigation channel and the pontoon casting basin, which was under construction. Dredging will occur in the near future for maintenance activities. Dredging methods are limited to the use of an environmental clamshell bucket, when possible, and a standard clamshell when necessary to clear debris and obstructions. The bottom of the launch channel was initially dredged to

approximately 138 feet wide, 430 feet long, and at least 13 feet below MLLW (with up to a 2-foot over-dredge allowance).

Maintenance dredging will occur up to six times, once in advance of each pontoon or set of pontoons being launched. During each maintenance dredging event, between 13,000 and 25,000 cubic yards of substrate will be dredged from within the previously constructed launch channel. Each maintenance dredging event is anticipated to take up to 15 days to complete and will be performed only between June 16 and February 28, consistent with WDFW in-water work windows. Sediment removed during maintenance dredging through 2015 has been approved for unconfined open-water disposal by the Dredged Material Management Office (U.S. Army Corps of Engineers et al. 2010; Kendell & White pers. comm.) and will be disposed of at the approved Point Chehalis and/or South Jetty dispersive open-water disposal site(s). All material placement is coordinated through the interagency Dredge Material Management Program.

In April 2013, the project removed approximately 23,439 cubic yards of material via clamshell dredging to prepare for the second float-out. The final float-out for the project and last potential dredging event are currently anticipated to occur by July 2015 (Davies pers. comm.).

Dredging related to the SR 520 Pontoon Construction Project results in similar types of effects on the aquatic environment as annual maintenance dredging of the navigation channel (Alternative 1) and as would occur under the action alternatives. However, the scale of the pontoon project dredging activities is much smaller and the volume of material removed and the duration and physical extent of dredging is much more limited. Dredging for the SR 520 Pontoon Construction Project will affect the benthic invertebrate, fish and wildlife, and water quality of the Aberdeen reach of the navigation channel; specifically, the portion of the reach upstream of the Port's Terminal 4 (Figure 2). Pontoon construction dredging will occur closer to the shoreline than dredging in the navigation channel under the proposed action. As is true with all dredging in Grays Harbor, water quality impacts are limited by conditions of each project's Clean Water Act Section 401 Water Quality Certification (including limits on low DO and elevated turbidity extent and magnitude). Impacts are also limited by the constraints placed on each project's timing, equipment, and physical extent by other federal, state, and local permit conditions (e.g., ESA consultation, Clean Water Act Section 404 permits, and WDFW Hydraulic Project Approval).

6.2.5 Other In-Water Work and Over-Water Structures

Reasonably foreseeable future actions that could contribute to cumulative effects in Grays Harbor also include projects that would result in in-water construction and overwater structures. In May 2013, the Corps completed a review of all applications pending review by the Seattle District Regulatory Branch in Grays Harbor County under Section 404 of the Clean Water Act for the placement of dredged or fill material into a water of the U.S. (including tidal wetlands) and Section 10 of the Rivers and Harbors Act for the placement of structures into a navigable water. There were no applications proposing in-water work or over-water structures pending review with the Corps Regulatory Branch for Clean Water Act Section 404 or Section 10 permits at the time the review was conducted (May 30, 2013).

In-water work and the construction of over-water structures that could be proposed in the future would cumulatively contribute to temporary air, noise, and water quality impacts in Grays Harbor during construction activities, and could cumulatively contribute to disturbance and/or displacement of invertebrates, fish and wildlife from the area of the proposed projects. As with over-water structures, the types of projects with in-water work would be located along the shoreline near the inner reaches of

the navigation channel, and would occur in proximity to the proposed action occurring in those inner reaches.

6.2.6 Implementation of a Whitcomb Flats Section 111 Study

DNR leases over 2,000 acres of state-owned aquatic lands in Grays Harbor for the purpose of oyster culture. Oyster cultivation lands in South Bay have been lost due to migration and erosion of Whitcomb Flats. The changes occurring at Whitcomb Flats are a result, in part, of the installation of the North and South Jetties over a century ago. The jetties are causing a general deepening of the harbor inlet, as intended. The effects of the jetties, channel, and other features of the navigation project are elements of the environmental baseline, previously evaluated in NEPA documentation, as discussed above.

Section 111 of the Water Resources Development Act of 1968, as amended, gave the Corps authority to study and implement projects for prevention or mitigation of shore damages attributable to federal navigation projects. Section 111 requires involvement of a local sponsor, i.e., a state or local government agency willing to share project costs and accept responsibility for maintenance requirements.

After completion of the 2001 *Grays Harbor and Chehalis River Navigation Project Programmatic Environmental Assessment* (U.S. Army Corps of Engineers 2001), DNR requested the Corps initiate a Section 111 study for Whitcomb Flats (Behrens pers. comm.). Seattle District Corps staff visited the site and met with DNR staff and other stakeholders to determine whether there is a federal interest in pursuing a Section 111 study. In February 2010, the Corps determined that there is a federal interest; however, around the same time, DNR requested that the project be suspended until State funding becomes available for their participation in further planning of the project under a feasibility cost-share agreement. No State funding is currently anticipated for a Section 111 study, and thus, there are currently no plans for implementation of projects to mitigate for shore damages associated with Whitcomb Flats.

6.3 Incremental Effects of the Proposed Action

The previous section in this chapter describes past, present, and reasonably foreseeable future actions that could contribute to cumulative effects in the Grays Harbor study area. Based on the information presented above, these actions viewed collectively could have cumulatively substantial effects on several resources areas including, but not limited to, cumulative effects on marine transportation, benthic invertebrates, fish and wildlife, water quality, noise, air pollution, and geomorphology. This section describes the proposed action's contribution to these potentially substantial cumulative effects.

As discussed in Chapter 4, *Environmental Consequences*, direct and indirect effects of the proposed action on the natural environment are expected to generate a minor increase in impacts on the quality of the human environment, over and above the effects of Alternative 1 (i.e., baseline conditions), as previously evaluated in the FY 2012-18 maintenance dredging EA. Direct effects associated with the proposed action would occur primarily in areas previously disturbed by dredging and dredged material placement activities. The Point Chehalis site would be shifted 1,000 feet northwest into an area of deeper water with better hydrodynamic properties. The upland placement site at the former Hoquiam waste water treatment lagoon was a previously disturbed site used as a holding and treatment pond.

An incremental effect would be generated under Alternatives 2 and 3 because the initial dredging to deepen the navigation channel would require a longer duration of dredging, as well as the removal and

placement of an additional volume of sediment to deepen the channel compared to baseline conditions (Alternative 1). A longer duration of dredging results in the engines of the dredging machinery and vessels operating for a longer period of time, and thus, producing more air pollutants, noise, and artificial light (when dredging at night), and a longer duration during which fish and wildlife species may be temporarily displaced from the portion of the navigation channel being actively dredged. Removing additional material to deepen the channel results in the entrainment of additional invertebrates and fish species during the dredging process compared to baseline conditions (Alternative 1). The need to place this additional volume of dredged material results in more transport trips to the placement sites and the deposition of this additional volume into the open water and/or upland or beneficial use placement sites.

The proposed action would contribute to the cumulative effects on Grays Harbor that include the baseline conditions generated as a result of the construction of the jetties and groins, creation of the navigation channel, and annual maintenance dredging to remove shoaling from the navigation channel. In summary, cumulative effects associated with the proposed action, including a small increase in vessel traffic as a result of the incremental deepening of the channel in combination with the past, present, and reasonably foreseeable future projects identified previously in this chapter may include the following:

- Improving existing efficiency of marine transportation use of the Grays Harbor navigation channel by deepening the channel to depths that are suitable for efficient navigation by commercial and recreational vessels (most likely a beneficial cumulative effect on marine transportation).
- Geomorphic changes to sediment transport and long-shore drift from the jetties and regular removal and/or redistribution of sediments during dredging and dredged material placement (potential cumulative effect on geomorphology).
- Periodic annual entrainment and smothering of invertebrates and fish during dredging and the placement of dredged materials at the established placement sites (potential cumulative effect on invertebrates and fish species).
- Potential temporary disturbance and displacement of threatened and endangered fish and wildlife species from the immediate area of dredging and dredged material placement and the potential for minor impacts on some fish and benthic prey species (potential cumulative effect on threatened and endangered fish and wildlife species).
- Temporary and localized reductions in water quality during dredging and placement of dredged materials (potential cumulative effect on water quality).
- Temporary and localized increases in air pollutants, noise, and duration of artificial lighting as a result of operation of the dredging equipment and related vessels during dredging and placement of dredged materials, plus a small increase in vessel traffic (potential cumulative effect on air quality, noise, and artificial lighting).
- Increased GHG emissions resulting from operation of the dredging equipment and related vessels during dredging and placement of dredged materials, plus a small increase in vessel traffic (potential cumulative effect associated with GHG emissions).
- Continued support of the local economy by improving conditions in the navigation channel to maintain channel depths that are suitable for safe and efficient navigation by commercial and recreational vessels (most likely a beneficial cumulative effect on the local economy).

- Potential temporary displacement of tribal salmon and Dungeness crab fisheries in localized areas during dredging and placement of dredged materials, plus a small increase in vessel traffic (potential cumulative effect on tribal salmon and Dungeness crab fisheries).
- Continued placement of dredged materials at the designated placement sites, including upland placement of dredged material to offset erosion at the Point Chehalis revetment extension if needed (potential cumulative effect at the designated placement sites).
- Minimal to no effects on aquatic vegetation, historic and cultural resources, land use and aesthetics, recreation, and environmental justice communities (most likely no cumulative effect on these resources).

The proposed action's contribution to the cumulative effects listed above are expected to be minor because effects associated with the proposed action would occur in the same general physical and spatial context as under baseline conditions, and because the intensity of the anticipated effects would add an increment of effects that is insubstantial in terms of duration (in the case of channel deepening during the construction year) and volume of material dredged and placed, over and above the effects that currently occur under baseline conditions during annual maintenance dredging (Alternative 1). This determination is based on the general similarities between the action alternatives and baseline conditions with respect to dredging methods, type of dredging equipment, geographic extent of dredging, and use of generally the same placement locations for dredged materials, plus a small increase in vessel traffic. Mitigation measures implemented to avoid and minimize effects on water quality, invertebrates, fish and wildlife, threatened and endangered species, and Indian Treaty Rights related to fisheries for salmonids and Dungeness crabs (Chapter 5, *Mitigation*) also reduce the potential for the proposed action to have significant effects on the natural environment.

The proposed action would facilitate a continuation of the current type and intensity of human use in the Grays Harbor area by addressing issues of safe and reliable depths in the navigation channel and thereby supporting the local economy. Both action alternatives (Alternatives 2 and 3) are designed to facilitate safe and efficient navigation within Grays Harbor and to maintain commercial and recreational vessel use of the navigation channel. By deepening the navigation channel, the proposed action would remove shoaled sediments from the navigation channel that are currently restricting the loading and timing of vessel traffic from the Port of Grays Harbor. Placement of dredged materials at upland and beneficial use sites would moderate the effects of erosional impacts and facilitate shoreline protection in critical areas (such as the base of the South Jetty).

In the context of past, present, and reasonably foreseeable future actions, the incremental effects of the proposed deepening and continued maintenance of the navigation channel to the depths proposed under Alternatives 2 and 3 are anticipated to be minor and should not have a significant contribution to the cumulative effects identified in this SEIS.

Chapter 7
Conclusion

7.1 Summary of Effects

The Corps is proposing to deepen the federal navigation channel in Grays Harbor from its currently maintained depth of −36 feet MLLW up to its authorized depth of −38 feet MLLW, including placement of the dredged material at existing authorized dredged material placement sites. This SEIS analyzes project-related effects of this proposed action on each of the following resources.

- Marine transportation
- Geomorphology
- Aquatic vegetation
- Invertebrates, fish, and wildlife
- Threatened and endangered species
- Historic and cultural resources
- Water quality
- Air quality, noise, and artificial lighting
- Land use and aesthetics
- Recreation
- Hazardous materials
- Global climate change
- Local economy/socioeconomics
- Environmental justice communities
- Indian treaty rights
- Placement site environment

The analyses presented in Chapter 4, *Environmental Consequences*, determined that the action alternatives (i.e., initial deepening of the navigation channel) would have a minor impact on the quality of the human environment. Each impact identified in this document was determined to generate only a minor increase in impacts over baseline conditions or no adverse impact, or have a beneficial effect on the quality of the human environment.

Alternative 3 would have a slightly greater effect on the natural environment compared to Alternative 2 because the navigation channel would be dredged to a greater depth requiring the removal and placement of an additional 1,972,000 cubic yards for construction and 107,000 cubic yards for annual maintenance of material as compared to Alternative 2. Alternative 3 would remove a greater volume of material during the deepening of the channel and subsequent maintenance, which could have potentially greater effects on invertebrates, fish and wildlife, and water quality (Table 7.1).

Table 7-1. Estimated Dredged Material Volumes (cubic yards) for the affected Grays Harbor Reaches (South Reach to Cow Point) under Each Alternative.

	-36 foot Channel (Alternative 1)	Alternative 2		Alternative 3	
		Construction	Operation	Construction	Operation
Navigation Channel Reach	Average Annual Maintenance	Estimated Incremental Deepening to -37 feet MLLW	Estimated increase in Annual Maintenance attributable to deepening to -37 feet MLLW	Incremental Deepening to -38 feet MLLW	Estimated increase in Annual Maintenance Attributable to deepening to -38 feet MLLW
Inner Harbor Reaches	1,665,000	954,000	37,000	1,601,000	76,000
Outer Harbor Reaches	425,000	77,000	13,000	371,000	31,000
TOTAL	2,090,000	1,031,000	50,000	1,972,000	107,000

In addition, Alternative 3 may require the use of two clamshell dredges during dredging of the inner harbor reaches, compared to the use of one clamshell dredge under Alternative 2, to allow for a larger volume of material to be dredged during the same in-water work window. Each episode of maintenance dredging would extend marginally longer, as well, to accommodate the larger volumes. The longer duration of maintenance dredging and the use of two dredges as opposed to one during the construction year, plus a small increase in vessel traffic would result in a greater effect on air quality, noise, artificial lighting, and GHG emissions.

Alternative 3, however, would also have a greater benefit on the human environment compared to Alternative 2. Deepening the navigation channel would alleviate tidal delays and light loading of the current vessel fleet, which is currently caused by insufficient channel depths. Because Alternative 3 would be deepening the navigation channel to its legislatively authorized depth of –38 feet MLLW, compared to –37 feet MLLW under Alternative 2, greater benefits would be achieved under Alternative 3, such as increasing the Port's efficiency to transport goods in and out of the harbor. For these reasons, Alternative 3 is the environmentally acceptable alternative that meets the purpose and need by reducing navigation transportation costs, and improving efficiency, reliability and safety of deep-draft vessel transits to and from Grays Harbor to the maximum extent possible over the next 50 years within the limits of existing legislative authority.

7.2 Mitigation Measures

The environmental consequences analysis conducted for this reevaluation (and documented in Chapter 4 of this SEIS) shows the potential impact on resources of the recommended plan (i.e. the increment to dredge from -36 feet MLLW to -38 feet MLLW, and subsequent maintenance dredging) would be minor. Based on this analysis, the Corps proposes no new compensatory mitigation measures specifically for the construction or maintenance of the recommended plan. The potential impact of dredging would be minimal to the overall Dungeness crab population based on modeling that was conducted as part of the environmental analysis. Because Grays Harbor functions as an important nursery ground for juvenile

Dungeness crabs, which eventually migrate to the Pacific Ocean and enter an important fishery the current interagency agreement on Dungeness crab mitigation (RCMSA) would be maintained for future O&M dredging until modified by the signatories.

The Corps currently implements the following avoidance and minimization measures in the study area as part of regular maintenance dredging. These same avoidance and minimization measures would be implemented for maintenance of the recommended plan after construction.

- Dredge the Aberdeen Reach, Cow Point Reach, Hoquiam Reach, and turning basins between February 15 and July 15 to avoid impacts on bull trout and outmigrating juvenile salmon.
- Use a clamshell dredge to reduce entrainment of fishes and crabs in the inner harbor reaches.
- Dredge the outer harbor reaches during periods to avoid peak crab abundance.
- Coordinate with local fishers to reduce the potential to damage crab pots.
- Coordinate the timing of dredging to minimize impacts on target species important to Native Americans.
- Place dredged material at Half Moon Bay and South Beach sites to facilitate a stable beach profile.
- Implement ballast water exchange protocols to avoid and minimize the potential for dredging activities to facilitate the transfer of nonnative and potentially invasive organisms from different estuaries along the Pacific Coast and Hawaii.

The Corps also implements the following avoidance and minimization measures specifically to protect Grays Harbor as an important nursery for juvenile Dungeness crabs.

- Schedule dredging to the extent practicable to avoid times and areas of high crab densities.
- Locate offshore placement sites to avoid high concentrations of crabs and interference with the crab fishery.
- Use clamshell dredges instead of hopper dredges whenever cost-effective to avoid entraining crabs.

The following impact reduction measures are incorporated into Alternatives 2 and 3 including subsequent annual maintenance dredging attributable to these alternatives

- In light of the determination that the material at DMMU 32a passed chemical testing, it did possess unspecified potential toxicity in the bioassay, the Corps made the conservative decision to remove the entire section of DMMU 32a and place upland, permanently removing it from the aquatic environment.
- The unsuitable material will be clamshell dredged. Implementation of best management practices – such as control of the speed of the dredging bucket during descent and ascent – and compliance with the water quality monitoring plan will ensure that turbidity is reduced to the maximum extent possible during dredging. Dredged material will be placed in a fully fenced haul barge where it will be dewatered through filtered scuppers.
- Unsuitable dredged material would be dewatered and taken by barge to be offloaded at nearby Port of Grays Harbor Terminal 3 (a distance of less than 4 miles) and is slated to be trucked the short distance to the former Hoquiam city wastewater treatment lagoon for offload (less than half-a-mile), and dumped from the transport trucks directly into the offload site. The

dewatered dredged material would be mechanically transferred from the barge to trucks using an excavator or front load excavator.

7.3 Unavoidable Effects

Unavoidable effects of the project include physical alteration of the channel, a minor increase in air pollution and green house gases, temporary and minor degradation of water quality, temporary minor increases in noise and noise disturbance, entrainment and associated mortality of lingcod, flatfishes, and forage fish species.

7.4 Cumulative Impacts

The cumulative effects analysis describes baseline conditions; identifies past, present, and reasonably foreseeable future actions; and analyzes incremental effects of the proposed action on cumulative impacts. Past, present, and reasonably foreseeable future actions described in this analysis include the Port of Grays Harbor maintenance dredging, proposed Port of Grays Harbor terminal expansions, Point Chehalis revetment maintenance project, Grays Harbor long-term management strategy, and other in-water work and over-water structures which are proposed in Grays Harbor. Collectively, these actions could have significant cumulative effects on several resource areas, including, but not limited to, marine transportation, benthic invertebrates, fish and wildlife, water quality, noise, air pollution, and geomorphology. As analyzed throughout this document deepening would require completion of annual maintenance to -36 feet MLLW in the same year as construction of the proposed action, therefore impacts are evaluated for the incremental effects generated by the action alternatives over and above the previously evaluated maintenance dredging activities.

The proposed action's contribution to these cumulative effects is expected to be minor and/or not adverse because effects associated with the proposed action are of a similar nature and would occur in the same general physical context as during annual maintenance dredging under baseline conditions. Additionally, the intensity of the anticipated effects would add only a small increment to the magnitude of effects that currently occur under baseline.

7.5 Agency Coordination and Public Outreach

Throughout the development of this SEIS, the Corps has been coordinating with Federal, State, and local agencies, as well as the general public. Specifically, the Corps has been coordinating with NMFS, USFWS, Ecology, the Crab Mitigation Work Group, and local Native American tribes including Confederated Tribes of the Chehalis Reservation, Hoh Indian Tribe, Quinault Indian Nation, and Shoalwater Bay Tribe. The Corps also presented a public information meeting in December 2012, at the beginning of the development of this SEIS, and accepted comments on the development of the SEIS. The Corps also held a public community workshop in February 2014, to solicit comments on the Draft SEIS.

7.6 Environmental Compliance

The Corps' proposed action must comply with several federal, state, and local environmental regulations before it can be authorized. The following is a list of the regulations with which the Corps has demonstrated its compliance in this SEIS (see Chapter 9, *Environmental Compliance*).

- National Environmental Policy Act
- Tribal Treaty obligations
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- Fish and Wildlife Coordination Act
- Coastal Zone Management Act
- Marine Protection, Research, and Sanctuaries Act
- Marine Mammal Protection Act
- Federal Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- National Historic Preservation Act
- Clean Air Act
- Clean Water Act
- Executive Order 11988, Floodplain Management
- Executive Order 11990, Protection of Wetlands
- Executive Order 12898, Environmental Justice

7.7 Recommendations

Based on the information presented in this SEIS, the Corps has identified Alternative 3 as the preferred agency alternative because Alternative 3 best meets the project purpose and need of reducing navigation transportation costs for the existing and future projected traffic of deep-draft vessels, and improving efficiency and reliability to and from Grays Harbor as feasible and economically justified, within the parameters of the navigation channel as legislatively authorized. Alternative 1 (No Action Alternative) would not deepen the navigation channel and would continue to constrain maritime operations, resulting in tidal influenced delays to arrival and departures , as well as light loading of ships, and thus would not meet the purpose and need for the project. Alternative 2 would not dredge the navigation channel deep enough to provide the most efficient marine transportation route in Grays Harbor within the parameters of the navigation channel as legislatively authorized, which would also constrain maritime operations by continuing to a lesser extent the practice of light loading, and shipping delays.

Although Alternative 3 would have a slightly greater effect on the natural environment compared to Alternatives 1 and 2, Alternative 3 is identified as the preferred agency alternative because it would best

meet the project purpose and need. Additionally, although Alternative 3 would have a greater effect on the environment, the environmental consequences analysis presented in this SEIS determined that these effects would be be minor and or not adverse and appropriate mitigation measures would be implemented.

Chapter 8
Agency Coordination and Public Outreach

8.1 Coordination with Public Agencies

This section describes the coordination that has taken place between the Corps and other public agencies during the development of this SEIS for the proposed action. Coordination was conducted with the following entities and agencies:

- National Marine Fisheries Service
- U.S. Fish and Wildlife Service
- Washington State Department of Ecology
- Washington State Department of Archaeology and Historic Preservation
- Washington State Department of Natural Resources
- Crab Mitigation Work Group
- Local Native American Tribes
    - Confederated Tribes of the Chehalis Reservation
    - Hoh Indian Tribe
    - Quinault Indian Nation
    - Shoalwater Bay Tribe

Each coordination effort is described below.

8.1.1 National Marine Fisheries Service

The Corps consulted with NMFS on the proposed action pursuant to its jurisdiction over anadromous fish and its mandates under the ESA Section 7 consultation process (16 USC 1531-1544, as amended), and the MSA (U.S. Public Law 109-497) . The Corps prepared and submitted a supplemental biological evaluation in conjunction with this SEIS for the proposed action to initiate consultation under these statutes. This consultation was concluded on 5 June 2014 with the receipt of a letter concurring in the conclusion that the preferred alternative is not likely to adversely affect listed species and designated critical habitat (NMFS-WCR-2014-476).

In addition to the agency's federal regulatory compliance responsibilities, NMFS and USFWS are also participating agencies guiding the implementation of the 1998 *Revised Crab Mitigation Strategy Agreement* (RCMSA) (Appendix E).

8.1.2 U.S. Fish and Wildlife Service

The Corps consulted with USFWS on the proposed action pursuant to the ESA (16 USC 1531-1544, as amended), and the Fish and Wildlife Coordination Act (16 USC 661-667e). ESA consultation was initiated with USFWS using the same supplemental biological evaluation identified above.

USFWS reviewed documents related to the proposed action and submitted a Planning Aid Letter Report, and a Fish and Wildlife Coordination Act Report (Appendix H) to the Corps, addressing the Corps' plans for the proposed action and outlining its recommendations to mitigate impacts on fish and wildlife. USFWS emphasized the following elements and encouraged the Corps to include these elements in its project planning.

- Continue to implement existing fish and wildlife impact mitigation responsibilities outlined in the 1989 Fish and Wildlife Coordination Act report provided by the USFWS for the 1990 navigation channel improvement project.
- Continue coordination with the ongoing implementation of the RCMSA (Appendix E), and participate in the development of revised crab mitigation strategies based on recent discussions and agreements between the participating RCMSA agencies.
- Pursue mitigation strategies that provide more general habitat restoration and enhancement benefits beyond those directed primarily at increasing Dungeness crab recruitment.
- Pursue beneficial use of dredged materials through placement in nearshore and shallow intertidal habitats (USFWS has asked that the Corps consider the feasibility of pumping dredged materials ashore with enough frequency to ensure sand spits, sand islands, and exposed beaches remain available to support and recover protected species that utilize these habitats).
- Prepare a project schedule and implementation methodology that supports the health and resilience of locally significant migratory bird populations that use the Grays Harbor National Wildlife Refuge.
- Continue cooperation with the Quinault Indian Nation and other tribal governments.
- Conduct additional research to improve understanding of the potential bottlenecks that constrain the current Dungeness crab population and dependent fishery in Grays Harbor (USFWS has asked that the Corps plan and execute studies and field reconnaissance soon so that improved information is available to inform the planning and decision-making processes).
- Reconsider wasting dredge material at the former Hoquiam Waste Water Treatment Plant Lagoon.

The comments listed above are addressed individually in Appendix G of the LRR, Public Comments.

The Corps recived a letter letter concurring in the conclusion that the preferred alternative is not likely to adversely affect listed species and designated critical habitat from USFWS on 11 June 2014 (USFWS-01EWFW00-2014-I-04444).

8.1.3 Washington State Department of Ecology

The Corps has coordinated the Navigation Improvement Project with Ecology, and a Clean Water Act Section 401 water quality certification for the agency preferred alternative was issued 13 June 2014. The Corps will implement the conditions applicable to the discharge of dredged material into waters of the U.S. required by the certification.

The Corps has also prepared a Consistency Determination under the Coastal Zone Management Act, containing a determination that the preferred alternative is consistent to the maximum extent practicable with the approved enforceable policies of the State's Coastal Zone Management Program. The State has not responded to the submission of this consistency determination. Pursuant to 15 CFR 930.41(a) and 33 CFR 336.1(b)(9)(iv), the Corps has presumed Department of Ecology concurrence that

the proposed action is consistent with the enforceable provisions of the State's Coastal Zone Management Program.

8.1.4 Washington State Department of Archaeology and Historic Preservation

The Corps has coordinated its review of cultural resources impacts for NEPA with agency responsibilities under Section 106 of the NHPA. The Corps reviewed cultural resources investigations previously conducted for the maintenance and/or improvements of the navigation channel, and has determined that the prior research and field investigations were adequate to identify historic properties. The Corps has determined a finding of *no historic properties affected.* The Corps initiated consultation with the SHPO with a letter dated May 16, 2013. The SHPO has concurred with this finding in a letter dated May 28, 2013 (Appendix H).

8.1.5 Washington State Department of Natural Resources

Dredged material placement is coordinated through the DMMP, of which DNR is a member.

8.1.6 Native American Tribes

The Corps has been coordinating with local Native American tribes under Section 106 of the NHPA (Section 4.6, *Historic and Cultural Resources*). On February 15, 2013, the Corps sent Section 106 and tribal notification letters to the Confederated Tribes of the Chehalis Reservation, the Hoh Indian Tribe, the Quinault Indian Nation, and the Shoalwater Bay Tribe, notifying them about the proposed action. To date, the Corps has not received a response from the tribes related to Section 106 of the NHPA. Government-to-government coordination on tribal treaty obligations is discussed in Section 3.14, Indian Treaty Rights. Close coordination between the Corps Navigation Section and Tribal fishers and fisheries mangers, including a meeting on 5 June 2014, has ensured disruptions to fishing in Grays Harbor remain minimal.

8.1.7 Crab Mitigation Work Group

Since 1995, the Corps has been coordinating with the Crab Mitigation Work Group to develop Dungeness crab mitigation for the Grays Harbor Navigation Improvement Project. The Crab Mitigation Work Group includes participation from the following federal, state, and local agencies and tribes:

- National Marine Fisheries Service
- U.S. Army Corps of Engineers, Seattle District
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Washington Department of Fish and Wildlife
- Washington State Department of Ecology
- Quinault Indian Nation
- Port of Grays Harbor

- Dungeness Crab Experts Panel

The original intent of the Crab Mitigation Work Group was to outline a crab mitigation strategy agreement that would establish a long-term agreement among agencies for implementing mitigation efforts in Grays Harbor. The original strategy was developed in 1989, which included placing 8 hectares of oyster shell in 1992 in the Grays Harbor crab shell mitigation plots located southeast of the Crossover Channel reach.

The Crab Mitigation Work Group's purpose was to review the 1989 Dungeness crab mitigation plan, evaluate crab mitigation efforts to date, and devise a revised strategy that could be used for future mitigation efforts. As a result of these efforts, the Crab Mitigation Work Group developed the RCMSA in 1998. The revised agreement from 1998 included several additional elements that were added to the original strategy from 1989 (Appendix E).

An additional 35 hectares of oyster shell were placed between 1994 and1998 and the sites were replenished as necessary in 1999, 2000, 2003, and 2006. Periodic monitoring of the sites to estimate fourth juvenile instar crab abundance was conducted from 1990 to 2011. The monitoring data were used as inputs into the DIM to calculate the number of age 2+ crabs "produced" at the mitigation sites (Section 4.4, *Invertebrates, Fish, and Wildlife*). The results indicate that more Dungeness crabs were produced at the mitigation sites than affected since the 1990 deepening project.

The Crab Mitigation Work Group was reconvened in July 2012. The group met to review the current program and consider new science and information on dredging and reduced dredge volumes in areas of high quality habitat in order to better quantify future impacts and to identify more effective or efficient potential mitigation strategies. The Corps is in full compliance with the RCMSA presently in effect.

Identification of a possible limiting factor or bottleneck for Grays Harbor Dungeness crab populations. Coordination efforts among members of the Crab Mitigation Work Group are ongoing as the group tries to quantify actual impacts from the Corps' proposed action and subsequent mitigation strategies.

8.2 Public Outreach and Involvement

This section explains how the Corps involved the general public throughout development of the SEIS for the proposed action. A description of the public information meeting, community workshop, and public review of the Draft SEIS is presented in the following sections.

8.2.1 Federal Register, Notice of Intent

In 1982, the Corps prepared the *Environmental Impact Statement for the Grays Harbor, Chehalis and Hoquiam Rivers, Washington, Channel Improvements for Navigation* (U.S. Army Corps of Engineers 1982). On November 12, 1987, the Corps placed a Notice of Intent in the *Federal Register* to prepare the 1989 *Supplemental Environmental Impact Statement for the Grays Harbor, Washington, Navigation Improvement Project* (U.S. Army Corps of Engineers 1989); the Corps completed preparation of this document in February 1989. A Notice of Intent for this second SEIS was published in the Federal Register on September 13, 2013, and Notice of Availability for the Draft SEIS was published in the Federal Resister 7 February 2014.

8.2.2 Public Information Meeting

According to CEQ NEPA regulations, a lead agency "shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement…" (40 CFR 1502.9[c][4]).

For the proposed action, the Corps held a public information meeting to inform the public of the Corps' intent to prepare an SEIS. On November 9, 2012, the Corps released a public announcement explaining that a public information meeting regarding the proposed action would be held on Wednesday, December 5, 2012, at the Port of Grays Harbor offices in Aberdeen, Washington (Appendix F).

The public information meeting took place from 6:30 p.m. to 8:00 p.m. in the Port Commission chambers at 111 South Wooding Street, Aberdeen, Washington. Approximately 30 people were in attendance. Comment sheets were provided for the public to provide written comments, and a sign-in sheet was also available for individuals to request additional information about the proposed action. No one provided written comments at the meeting, and only one person signed up to request additional information about the proposed action.

The agenda for the meeting included a presentation by the Corps' Seattle District project team, followed by clarifying questions and a public Open House. The following main topics were addressed during the meeting.

- Project authority
- Project overview
- Dredging and dredged material placement
- Economic analysis
- Environmental analysis

At the end of the presentation, the meeting was opened to questions. The Corps responded to the few clarifying questions that were asked following the presentation. The question that elicited the greatest explanation and exchange of information pertained to the relationship between the SEIS being developed for the proposed action and the Grays Harbor Long Term Management Strategy (LTMS) project.

Following the presentation, some members of the public remained to review the following poster boards and converse with the project team.

- Project Purpose and Need and Project Description
- National Environmental Policy Act Process and Schedule
- Grays Harbor Navigation Project Features
- Representative Cross Sections of Navigation Channel
- Photos of Dredging and Disposal Site Placement
- 5-Year Growth at Port of Grays Harbor

Copies of the public comment form, Microsoft PowerPoint presentation, and poster boards for the meeting are provided as attachments in Appendix F. A 21-page transcript of the meeting is also available as an attachment in Appendix F.

8.2.3 Public Review of the Draft Supplemental Environmental Impact Statement

The release of the Draft SEIS was another opportunity for the public to provide input on the analysis of the environmental effects of the proposed action and the other alternatives examined in the SEIS. Circulation of the Draft SEIS incorporated a 45-day public review period that commenced 7 February 2014. The public review period was extended, upon request, to 8 April 2014. Responses to comments received during the review of the Draft SEIS are included and addressed in the Final SEIS (Appendix G of the LRR).

8.2.4 Community Workshop

According to CEQ NEPA regulations (40 CFR 1506.6[c]), a lead agency should:

> [c] hold or sponsor public hearings or meetings whenever appropriate or in accordance with statutory requirements applicable to the agency. Criteria shall include whether there is:
>
> > (1) Substantial environmental controversy concerning the proposed action or substantial interest in holding a public hearing.
> >
> > (2) A request for a hearing by another agency with jurisdiction over the action (e.g. a cooperating agency) supported by reasons why a public hearing will be helpful.

As part of the public review process for the SEIS, the Corps held a Community Workshop within a few weeks of releasing the Draft SEIS for public review on 27 February 2014. The purposes for holding the Community Workshop were to inform the public regarding the scope, analysis, and proposed conclusions of the Draft SEIS during the public comment review period, and to solicit and collect written and verbal comment.

Chapter 9
Environmental Compliance

In Chapter 4, *Environmental Consequences*, the Corps analyzed the environmental effects of the action alternatives. The following sections describe how the proposed action complies with applicable federal, state, and local environmental regulations, including:

- National Environmental Policy Act
- Tribal Treaty obligations
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- Fish and Wildlife Coordination Act
- Coastal Zone Management Act
- Marine Protection, Research, and Sanctuaries Act
- Marine Mammal Protection Act
- Federal Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- National Historic Preservation Act
- Clean Air Act
- Clean Water Act
- Executive Order 11988, Floodplain Management
- Executive Order 11990, Protection of Wetlands
- Executive Order 12898, Environmental Justice

9.1 National Environmental Policy Act

In accordance with NEPA, federal agencies are required to outline project alternatives, declare the potential environmental effects of project alternatives, and solicit public comment to determine the topics and issues that most concern the interested public.

The purpose of this SEIS is to inform the public of the nature of potential impacts, solicit public comment, and fulfill the Corps' documentation requirements under NEPA. By providing an assessment and comparison of impacts associated with the action alternatives, NEPA documentation provides a basis for informed decision-making. This SEIS, along with the documents listed in Section 1.4, *Relevant Documents*, satisfies the requirements of NEPA and USACE NEPA implementing regulations. A Record of Decision (ROD) will be prepared in conclusion of the NEPA process.

9.2 Tribal Treaty Obligations

Native American tribes and the federal government have entered into contractual agreements concerning tribal hunting and fishing rights. In 1856, the Qui-nai-elt (Quinault) Indian Nation entered into the Treaty of Olympia which secured rights to its "usual and accustomed" fishing and hunting areas. Hunting and fishing within Quinault usual and accustomed hunting and fishing areas are co-managed by the tribe and WDFW.

By signing the treaty the tribes retain the "right" to fish and the "privilege" to hunt within the boundaries of their usual and accustomed hunting and fishing areas. Treaty rights also include access to plant materials used in the making of traditional crafts, preservation of sacred sites important in the practice of traditional Indian religion, and the preservation of fish habitat. Treaty rights may be exercised by tribal members only and must be exercised in accordance with tribal regulations. Grays Harbor is within the federally adjudicated usual and accustomed fishing area of the Quinault Indian Nation

Negotiations between the WDFW and the Northwest Indian Fisheries Commission (of which the Quinault Indian Nation is a part) resulted in the agreed upon fishing arrangements for treaty and non-treaty fisheries within Grays Harbor. Fisheries biologists employed by the Quinault Indian Nation actively work with WDFW to responsibly manage salmon and shellfish within their usual and accustomed fishing and hunting areas.

No interference with treaty rights is anticipated. Impacts to Tribal fisheries (fish, crab, oysters, etc.) are expected to be minimal to none. Projects executed in the Federal Navigation Channel are routinely coordinated with the Quinault Tribe staff to ensure no conflicts with Tribal Treaty Rights. The Quinault Tribe staff provides schedule and fishing input in the planning of these projects as well as at the initial preconstruction meetings prior to the start of construction/dredging. Close coordination between the Corps Navigation Section and Tribal fishers and fisheries mangers has ensured disruptions to fishing in Grays Harbor remain minimal. The Tribe was also involved in the development of, and remain involved with, the Dungeness crab mitigation agreement. These ongoing project coordination efforts, both in planning and execution phases, ensure that Federal project execution does not interfere with Tribal fishing activities.

The potential for temporary disruptions to the Quinault Indian Nation salmon and crab fisheries during deepening of the navigation channel and active placement periods at the open water dispersive sites is expected to be similar to that which could occur under existing conditions based on the volume of material placed. Thus, the potential for a change in the degree or nature of such temporary disruptions to these fisheries is also expected to be minor under either action alternative.

Other specific tribal concerns were addressed in a letter from the Quinault Tribe dated 9 April 2014. The letter and Corps responses are in Appendix G of the LRR.

9.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 protects numerous species of migratory birds. The list of species protected under the MBTA is maintained by USFWS (2008). The MBTA states that it is:

> unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. Subject to limitations in the Act, the

> Secretary of the Interior may adopt regulations determining the extent to which, if at all, hunting, taking, capturing, killing, possessing, selling, purchasing, shipping, transporting or exporting of any migratory bird, part, nest or egg will be allowed, having regard for temperature zones, distribution, abundance, economic value, breeding habits and migratory flight patterns. Regulations are effective upon Presidential approval. §§ 703 and 704.

Although a variety of migratory birds use the habitats of Grays Harbor, the proposed action is not reasonably anticipated to result in the hunting, capturing, killing, possessing, selling, purchasing, shipping, transporting or exporting or deliberate taking of any migratory bird, part, nest or egg. Only minimal impacts on migratory birds are expected. Thus, a take authorization under the MBTA is not required.

9.4 Bald and Golden Eagle Protection Act

The bald eagle was given legal protection by the Bald and Golden Eagle Protection Act of 1940 (BGEPA). This act was expanded to include the golden eagle in 1962. The bald eagle has previously also been protected as a federally threatened species under the ESA. It was removed from listing under the ESA on August 8, 2007, but is still protected under the Bald and Golden Eagle Protection Act.

The Bald and Golden Eagle Protection Act (16 USC 668-668d), as amended, provides protection to bald and golden eagles and prohibits anyone, without a permit from the Secretary of the Interior, from "taking" bald or golden eagles. Taking is described to include eagle parts, nests, or eggs, and molesting or disturbing of eagles. The Act provides criminal penalties for persons who take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof.

WDFW has identified bald eagle nests along undisturbed portions of the margins of Grays Harbor (Washington Department of Fish and Wildlife 2013), but no nests are located in proximity to the navigation channel or dredged material placement sites. Bald eagles are observed soaring and hunting over Grays Harbor. Low levels of noise and related activity from dredging and placement of dredged materials of the navigation channel are not anticipated to result in molestation or disturbance of bald eagles or take of bald eagles, their nests, or eggs. Thus, a take authorization under the BGEPA is not required.

9.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA), as amended, was enacted in 1964, and is intended to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. Federal agencies must take into consideration the effect that water-related projects could have on fish and wildlife resources, provide for the development and improvement of these resources, and take appropriate actions to prevent loss or damage to these resources.

Proponents of projects to be constructed, licensed, or permitted by a federal agency must consult with USFWS and/or NMFS, if appropriate, to develop mitigation measures to avoid and reduce project-related losses of fish and wildlife resources. Any subsequent reports or decision-making documents prepared by the action agency must include the recommendations of USFWS and/or NMFS for protecting fish and wildlife.

Chapter 8, *Agency Coordination and Public Outreach*, explains how the Corps has been coordinating with USFWS under the FWCA. Chapter 8 also lists several elements that USFWS encouraged the Corps to include in its project planning. A planning aid letter was prepared by USFWS for this project on June 7, 2013, and a Fish and Wildlife coordination Act Report was received 20 May 2014. These documents are included in Appendix H of this SEIS.

9.6 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972, as amended, requires federal agencies to carry out their activities in a manner that is consistent, to the maximum extent practicable, with the enforceable policies of the approved Washington Coastal Zone Management Program. The Corps has prepared a CZMA Consistency Determination for the proposed action (Appendix C).

This evaluation established that the proposed action complies with the policies, general conditions, and general activities specified in the approved *Grays Harbor County Shoreline Management Master Plan*, the *City of Westport Shoreline Management Master Plan*, and the *Grays Harbor Estuary Management Plan*.

The proposed action is, thus, considered consistent, to the maximum extent practicable, with the State of Washington Shoreline Management Program. The State has not responded to the submission of this consistency determination. Pursuant to 15 CFR 930.41(a) and 33 CFR 336.1(b)(9)(iv), the Corps has presumed Department of Ecology concurrence that the proposed action is consistent with the enforceable provisions of the State's Coastal Zone Management Program.

9.7 Marine Protection, Research, and Sanctuaries Act

The Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, also known as the Ocean Dumping Act, prohibits the dumping of material into the ocean that would unreasonably degrade or endanger human health or the marine environment. Ocean dumping cannot occur unless a permit is issued under the MPRSA. In the case of dredged material, the decision to authorize ocean disposal of dredged material is made by the Corps, using EPA's environmental criteria and subject to EPA's concurrence.

Section 102 of the MPRSA authorizes EPA to promulgate ocean dumping criteria and designate recommended ocean disposal sites. The Southwest 3.9 Mile site was designated as an ocean disposal site (currently inactive) under Section 102 of the MPRSA. This site is not being proposed for use under the proposed action, nor is it in use under Alternative 1. None of the other dredged material placement sites are ocean disposal sites. Therefore, the project is in full compliance with the MPRSA.

9.8 Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972, as amended, prohibits "take" of marine mammals in United States waters by any person and by citizens of the United States in international waters, except under certain conditions (16 USC 1361).

Several species of marine mammals can be found in Grays Harbor or the adjacent Pacific Ocean waters (see Section 3.4, *Invertebrates, Fish, and Wildlife*, and Section 3.5, *Threatened and Endangered Species*, for a detailed discussion). The most likely occurring marine mammals are harbor seals and sea lions.

All known haulouts in Grays Harbor for seals and sea lions are located nearly 1 mile from the navigation channel, so disturbances to resting individuals would not occur. Underwater noise levels at the standard reference distance of 33 feet (10 meters) are below the disturbance thresholds for all marine mammals (Table 4.4-2)), so feeding and traveling individuals would not experience disturbance. For these reasons, dredging in the navigation channel and placement of materials at the dredged material placement sites would have a minor effect on marine mammals in Grays Harbor, and the Corps would not need to obtain a letter of authorization for harassment or other take under the Marine Mammal Protection Act.

9.9 Federal Endangered Species Act

In accordance with Section 7(a)(2) of the ESA of 1973, as amended, federally funded projects must take into consideration impacts on federally listed or proposed threatened or endangered species. Since dredging in Grays Harbor to deepen the navigation channel could affect listed species, a Section 7 consultation with NMFS and USFWS is required under the federal ESA.

In support of this consultation, the Corps prepared a supplemental biological evaluation (BE) that was submitted to NMFS and USFWS. The Corps' effect determinations for species listed as threatened or endangered under the ESA can be found in Section 4.5, *Threatened and Endangered Species* (Table 4.5-1); no species or critical habitat are likely to be adversely affected by the proposed action. The NMFS project concurrence was received 5 June 2014, and USFWS concurrence was received 11 June 2014 (Appendix H).

9.10 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson–Stevens Fishery Conservation and Management Act, commonly referred to as the Magnuson–Stevens Act (MSA), is the primary law governing marine fisheries management in the United States. The Magnuson–Stevens Act was originally enacted as the Fishery Conservation and Management Act of 1976. The act has been amended many times over the years. Two major recent sets of amendments to the law were the Sustainable Fisheries Act of 1996, and then 10 years later the Magnuson–Stevens Fishery Conservation and Management Reauthorization Act of 2006.

The MSA requires federal agencies to consult with NMFS regarding actions that may adversely affect Essential Fish Habitat (EFH) for groundfish, coastal pelagic species, and Pacific salmon. An EFH determination is included in the supplemental BE; EFH is not likely to be adversely affected by the proposed action. The NMFS concurred that the conservation measures that the Corps included as part of the proposed action to address ESA concerns are also adequate to avoid, minimize, or otherwise offset potential impacts to the EFH in letter NMFS-WCR-2014-476 received 5 June 2014 (Appendix H).

9.11 National Historic Preservation Act

The NHPA of 1966, as amended through 2006, was established to preserve additional historic properties through the nation and for other purposes. The NHPA requires that the effects of proposed actions on sites, buildings, structures, or objects included or eligible for the National Register of Historic Places must be identified and evaluated. Historic properties are not normally found in previously constructed navigation channels or in previously used disposal sites. It is the policy of the Corps that historic resource surveys should not be conducted for maintenance dredging and placement activities proposed within the boundaries of previously constructed navigation channels or previously used placement areas unless there is good reason to believe that historic properties exist (33 CFR 336.1[c][6]).

Section 106 of the NHPA (16 USC 470) requires that federal agencies evaluate the effects of federal undertakings on historical, archeological, and cultural resources and afford the Advisory Council on Historic Preservation opportunities to comment on the proposed undertaking if there is an adverse effect to an eligible historic property. The lead agency must examine whether feasible alternatives exist that would avoid eligible cultural resources. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

The Corps has coordinated its review of cultural resources impacts for NEPA with agency responsibilities under Section 106 of the NHPA. The Corps consulted with the Confederated Tribes of the Chehalis Reservation, the Hoh Indian Tribe, the Quinault Indian Nation, the Shoalwater Bay Tribes, and the Washington SHPO. The Corps reviewed previous cultural resources investigations that have been conducted for the maintenance and/or improvements of the navigation channel, and has determined that the prior research and field investigations were adequate to identify historic properties. The Corps has determined a finding of *no historic properties affected.* The SHPO has concurred with this finding in a letter dated May 28, 2013 (Appendix H).

9.12 Clean Air Act

The Clean Air Act (CAA) of 1970, 42 U.S.C. 7401 et seq, is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Among other things, this law authorizes EPA to establish the NAAQS to protect public health and public welfare and to regulate emissions of hazardous air pollutants.

Impacts to air quality are expected to be minor. Grays Harbor County is neither a maintenance nor a non-attainment area. Applying the provisions of 40 CFR 93.153(c), the projected direct and indirect pollutant emissions levels would fall below the levels specified in 40 CFR 93.153(b)(1) and (b)(2). For these reasons, a CAA conformity determination is not required for this project.

9.13 Clean Water Act

The Clean Water Act (CWA), passed in 1972, requires Federal agencies to protect waters of the United States. CWA Section 404 regulates the placement of dredged or fill material into waters of the United States and requires demonstration that there are no less environmentally damaging practicable alternatives to meet the need for the proposed placement of fill. The Corps has prepared a 404(b)(1)

evaluation to document findings regarding the proposed action pursuant to Section 404 of the Clean Water Act (Appendix D).

The Corps requested certification under CWA Section 401 that the effects of discharges of dredged or fill material into the waters of the U.S. are consistent with state water quality standards. The Federal government has delegated authority for oversight over Section 401 of the CWA to the states. In Washington, Ecology oversees 401 water quality certifications for discharges in State waters. The Corps received a Section 401 water quality certification from Ecology for the proposed action and will abide by the conditions of the certification pertaining to discharges of dredged material into waters of the U.S., to ensure compliance with state water quality standards.

9.14 Executive Order 11988, Floodplain Management

Executive Order 11988 requires federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities" for the following actions.

- Acquiring, managing, and disposing of federal lands and facilities.
- Providing federally undertaken, financed, or assisted construction and improvements.
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

As explained above, Executive Order 11988 requires federal agencies to consider how their activities may encourage future development in floodplains.

The proposed action maintains existing access to Port of Grays Harbor facilities and existing floodplain development. The proposed action will not induce regional economic growth, and does not encourage future floodplain development.

9.15 Executive Order 11990, Protection of Wetlands

Executive Order 11990 is an overall wetlands policy applicable to all agencies managing federal lands, sponsoring federal projects, or providing federal funds to state or local projects. It requires affected federal agencies to follow avoidance, mitigation, and preservation procedures and to obtain public input before proposing new construction in wetlands. Derived from Executive Order 11990 is the Corps' "no net loss" policy for wetlands, which requires that any loss of wetlands be compensated for by creating wetlands with the same or similar value at a minimum one-to-one compensation-to-loss ratio.

Consistency with the overall wetlands policy contained in Executive Order 11990 is achieved through CWA Section 404 compliance requirements and the Corps' preparation of the 404(b)(1) evaluation. The proposed action involves no loss of or other impact on wetlands.

9.16 Executive Order 12898, Environmental Justice

Executive Order 12898 directs all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations.

The proposed action would not result in disproportionately high or adverse human health or environmental effects on minority and low-income communities because the channel deepening would not result in any direct impacts on such communities. Dredged material is thoroughly tested for a wide variety of contaminants prior to placement to ensure that the material is suitable for unconfined, open-water placement. The material determined unsuitable for open water disposal underwent extensive testing, consisting of three rounds of chemical analysis and bioassays (Appendix A). The material is not a Resource Conservation and Recovery Act regulated material (i.e. not a hazardous waste). The material would be placed in the contained former Hoquiam wastewater treatment lagoon. The designation of location is a consequence of a non-Federal siting decision previously made for the placement of fill material and for redevelopment purposes. Therefore, no human health effects would occur. The proposed action would not negatively affect property values in the area, or socially stigmatize local residents or businesses.

The proposed action would improve navigation conditions, thus providing economic support to the area, which would be expected to have a beneficial impact on nearby communities, including any sectors of their populations that could be considered environmental justice communities.

Public outreach, as described in detail in Chapter 8, *Agency Coordination and Public Outreach*, has also provided opportunities for community input, including potential environmental justice communities, into the analysis of potential effects of the proposed action.

Chapter 10
List of Preparers

This chapter identifies individuals from the agencies and organizations that assisted with the preparation of this SEIS.

10.1 U.S. Army Corps of Engineers, Seattle District

Name	Education	Qualifications	Years of Experience	Project Role
Joshua Jackson	B.S., Environmental Earth and Space Sciences	Project management	3.5	Project Manager
Robert Donnelly	B.S., Fisheries; M.S., Fisheries; Ph.D., Fisheries	Fisheries Biologist; ESA Section 7 consultations for NMFS	30+	Threatened and Endangered Species
David Fox	B.S., Biology; B.S., Civil Engineering; M.S., Civil Engineering	Environmental Engineering	25	Sediment Evaluation
Patricia Graesser	M.A., Print Journalism; Graduate, Public Affairs Officer Qualification Course DINFOS	Accredited in Public Relations	25	Public Information
Kara Kanaby	B.A., Anthropology; M.A., Anthropology/ Archaeology	Archaeologist, NHPA compliance	8	Cultural Resources
Don Kramer	B.A., Political Studies; M.P.A., Public Administration; M.U.P., Urban Planning	Plan formulation/ evaluation	4	Lead Planner
Scott Long	B.A., Economics; B.A., Political Science; M.B.A., Business Administration	Deep Draft Economist	4	Economics
Kevin McKeag	B.S., Water Resources and Fisheries Biology; M.S., Fisheries	NEPA, regulatory compliance, Fisheries biology,	16	Environmental Effects

Name	Education	Qualifications	Years of Experience	Project Role
	Biology	aquatic ecology		
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10.2 ICF International

Name	Education	Qualifications	Years of Experience	Project Role
Program Management				
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Technical Support				
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Name	Education	Qualifications	Years of Experience	Project Role
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Erin Pace	B.A., Geography, Environmental Policy	CEQA and NEPA compliance requirements, mitigation and monitoring plans, and permit conditions	7	Land Use and Aesthetics; Recreation
Brian Schuster	B.S., Atmospheric, Oceanic, and Environmental Science	Air quality, climate change, and noise studies; GHG impact assessment	5	Air Quality; Artificial Lighting; Global Climate Change
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Bob Sullivan	B.S., Fisheries Biology	WSDOT-Certified Senior BA author	31	Threatened and Endangered Species
Jason Volk	B.S., Mechanical Engineering	Environmental noise and air quality modeling	13	Noise
Jenna Wallis	B.S., Environmental Conservation Studies; M.E.M., Environmental Economics and Policy	NEPA EIS preparation and support	6	Environmental Justice; Placement Site Environment

10.3 BST Associates

Name	Education	Qualifications	Years of Experience	Project Role
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10.4 ECO Resource Group

Name	Education	Qualifications	Years of Experience	Project Role
Sandra Davis	B.S., Environmental Studies M.S., Regional Planning	Facilitation, Mediation, and Public Outreach & Engagement	33	Public Information
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US Army Corps of Engineers
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix A: Determination Regarding the Suitability of Dredged Material from the Grays Harbor Navigation Improvement Project, and other pertinent DMMP Documents

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD February 5, 2013

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF DREDGED MATERIAL FROM THE GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT, FOR OPEN-WATER DISPOSAL AT THE SOUTH JETTY OR POINT CHEHALIS DISPERSIVE SITES, OR FOR BENEFICIAL USE.

A. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the suitability of material from the Grays Harbor Navigation Improvement Project (GHNIP) for unconfined open-water disposal at the South Jetty or Point Chehalis estuarine sites, or for beneficial use. The requirements for determining the suitability of this material are documented in the "*Dredged Material Evaluation and Disposal Procedures – Users Manual*" (DMMP, 2008a), as amended by updates subsequently made through the Sediment Management Annual Review process.

B. Project Background. The Water Resources Development Act (WRDA) of 1986 authorized the deepening of portions of the Grays Harbor navigation channel to -38 feet mean lower low water (MLLW). However, a subsequent economic analysis could only justify deepening to -36 feet MLLW. The channel was deepened to this depth in 1990. Annual maintenance dredging since that time has included up to two feet of advanced maintenance and two feet of overdepth for a maximum dredging depth of -40 feet MLLW.

In 2005, the Port of Grays Harbor requested Seattle District to re-evaluate the deepening study to determine whether dredging to the authorized depth of -38 feet MLLW could now be justified (plus two feet of advanced maintenance and two feet of overdepth for a maximum dredging depth of -42 feet MLLW). The Corps completed a reconnaissance study in 2009 (USACE, 2009), which determined there was a federal interest in continuing the planning investigation.

A critical element in completing the economic evaluation of channel deepening is the characterization of sediment associated with deepening and determination of disposal options. Sediment sampling and testing were conducted for this purpose in 2012. This suitability determination memorandum summarizes the sediment characterization results and evaluates the suitability of the dredged material for in-water disposal and beneficial-use options.

The proposed deepening project includes dredging in South Reach, Crossover Reach, North Channel, Hoquiam Channel and Cow Point Reach (see Figure 1). Nearly 2 million cubic yards of material will need to be dredged to deepen the federal navigation channel by two feet. Approximately 1.7 million cubic yards of this material are in the inner reaches that require contaminant testing. The remainder is in South Reach, which would normally only require confirmation of its exclusionary status.

C. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	Low/Low-moderate
Proposed dredging volume	1,973,812 cubic yards
Proposed dredging depth	-42 feet MLLW (including 2 feet of overdepth and 2 feet of advanced maintenance)
Draft SAP received	February 13, 2012
Draft SAP returned for revisions	February 15, 2012
Revised SAP received	February 19, 2012
Revised SAP approved	February 21, 2012
Round 1 sampling dates	February 21 to April 11, 2012
Round 2 sampling dates	September 19 to 24, 2012
Draft data report received	January 14, 2013
Comments provided on draft report	January 29, 2013
Final data report received	February 1, 2013
DMMP tracking number	GHNIP-1-B-F-326
Recency Determination (7 years due to the generally nontoxic nature of the sediment and lack of active sources)	April 2019

D. Project Ranking and Sampling Requirements. The navigation channel has historically been divided into outer-harbor reaches (Entrance, Bar, and South Reach) and inner-harbor reaches (Crossover Reach, North Channel, Hoquiam Channel, Cow Point Reach, Aberdeen Reach and South Aberdeen Reach). The outer-harbor reaches have been found to meet the exclusionary criteria specified in Section 40 CFR 230.60 of the Clean Water Act, consisting mainly of coarse-grained material in a high-energy environment, geographically removed from sources of contamination. As such, these reaches are generally not subject to contaminant testing, but do require periodic confirmation of their exclusionary status. The inner-harbor reaches contain larger fractions of fine-grained sediment and are closer to historical sources of contamination. Contaminant testing is always required in these reaches. Table 2 includes the estimated dredging volume for each reach.

For DMMP characterization of annual maintenance dredging, the Grays Harbor federal navigation channel is normally ranked “low” regarding concern for potential contamination (DMMP, 2008a). For the GHNIP, the ranking and sampling requirements for the inner-harbor reaches were modified to reflect increasing concern for contamination in the upstream reaches, as will be explained later in this section.

South Reach is the only outer-harbor reach included in the GHNIP. As mentioned previously, it has been classified as "exclusionary" by the DMMP agencies for maintenance dredging, which means that the only testing required on a periodic basis for maintenance dredging is for grain size and total organic carbon. For the GHNIP, verification was required that the *deepening* material in South Reach also meets the exclusionary guidelines (less than 20% fines and less than 0.5% organic carbon). Therefore, the first tier of testing specified in the project sampling and analysis plan (SAP) for South Reach included only grain size and total organic carbon. However, the SAP indicated that should any portion of South Reach fail to meet the exclusionary guidelines, it would need to be fully characterized as non-exclusionary material. The DMMP agencies agreed to divide South Reach into dredged material management units (DMMUs) of approximately 72,000 cy (see Table 3). Three samples would be taken from each DMMU and composited for analysis. Initial analysis was to include grain size, sediment conventionals and mercury (due to holding-time constraints). The remaining sediment was to be archived for potential chemical and biological testing.

The remaining reaches – Crossover, North Channel, Hoquiam Channel and Cow Point – required full characterization. The DMMP agencies agreed that sediment in Crossover Reach and North Channel could be considered low-ranked and homogeneous. The DMMP Users Manual assigns a volume of 60,000 cubic yards per DMMU in such areas, with each field sample representing up to 8,000 cubic yards. However, based on past dioxin testing results, the DMMP agencies expressed increased concern for the deepening material in Hoquiam Channel and Cow Point Reach and classified this material as low-moderate and heterogeneous. This classification requires DMMUs of 48,000 cy and field samples representing up to 8,000 cy. Using these sampling requirements and the volumes included in Table 2, the inner-harbor reaches were divided into the DMMUs found in Table 3. The average volume of material in the DMMUs in Crossover Reach and North Channel is 57,704 cubic yards, while the average DMMU volume in Hoquiam Channel and Cow Point Reach is 47,702 cy. To better reflect the increasing concern for dioxin as one moves upstream, the size of DMMUs in Crossover Reach and North Channel were gradually decreased, rather than being assigned equal volumes. This strategy resulted in relatively large DMMUs near South Reach (exceeding the nominal volume of 60,000 cy), with DMMU volumes approaching 48,000 cubic yards in DMMUs near Hoquiam Channel.

The most recent site condition surveys were used to locate sampling stations within each DMMU. Core samples were to be collected from a total of 224 sampling locations, allocated to the DMMUs as indicated in Table 3.

E. Sampling and Analysis. Sampling and testing took place in two rounds. One DMMU (CO7) failed biological testing in Round 1 and was split into two subunits in Round 2. A second DMMU (CP32) had conflicting data from chemical and bioassay testing in Round 1, necessitating a second round of sampling and testing for that DMMU as well. The two rounds of sampling and testing are described in the following sections.

1. Round 1 Sampling and Analysis.

Sampling. Round 1 sampling and processing took place February 21 to April 11, 2012. Thirty-six DMMUs were sampled, all with a vibracore sampler. Three samples were taken from each of the South Reach DMMUs and composited, while 6-8 samples were taken from each of the inner-harbor

DMMUs and composited. Sectioned cores were kept on ice until they could be processed at a dock-side facility owned by the Port of Grays Harbor. Target and actual sampling locations are shown in Figures 2 through 10. Sampling station coordinates, mudline elevations and sampling depths can be found in Table 4.

Glacial till was encountered in four of the Cow Point DMMUs, resulting in limited penetration or outright refusal (see Figure 11). Two or more attempts were required at some sampling stations to achieve adequate penetration and, in some cases, the sampling stations needed to be moved. Despite these difficulties, sediment samples from the primary layer (i.e. representing the deepening material) were recovered at all stations but one (CP34-4). The glacial till did prevent penetration to the bottom of the z-sample (-44 feet MLLW) at numerous stations, but analysis of the z-samples was not required by the agencies for the Cow Point DMMUs in Round 1, so this had no repercussions on decision-making.

Physical and Chemical Analysis. Analysis of the inner-harbor reaches included sediment conventionals, grain size and the full suite of standard DMMP chemicals of concern. Table 5 includes the results. DMMUs CP32 and CP33 both exceeded the DMMP screening level (SL) for benzyl alcohol (SL = 57 ug/kg), with concentrations of 100 and 110 ug/kg respectively. None of the other DMMUs had any detected SL exceedances. However, the reporting limit of 3.4 ug/kg for total chlordane for DMMU CO7 exceeded the SL of 2.8 ug/kg. The two detected and one reporting-limit exceedances of SLs triggered bioassay testing for CO7, CP32 and CP33.

The South Reach DMMUs were anticipated to meet the DMMP exclusionary guidelines and were first analyzed for grain size, total organic carbon and mercury only (mercury was included due to holding time constraints). However, DMMUs SR1, SR3 and SR4 all had organic-carbon content that exceeded the exclusionary limit of 0.5%. Per the requirements in the sampling and analysis plan, these three DMMUs were then subjected to full chemical testing. While the chemical testing resulted in no SL exceedances, the holding time for the bioassays would have expired prior to receiving results from the full chemical testing, so a decision was made to conduct bioassays on these three DMMUs concurrently with the chemical testing.

In addition to the standard suite of DMMP chemicals of concern, dioxins/furans were analyzed for all DMMUs except SR2, which met the exclusionary guidelines for testing. Results for individual dioxin/furan congeners are included in Table 5. Toxic equivalents (TEQs, with u = ½ detection limit) were calculated for each DMMU using the congener concentrations and the toxic equivalency factors (TEFs) found in Table 6. The TEQs (see Table 7) ranged from 0.3 to 10.1 parts per trillion (pptr), with a mean of 3.3 pptr. Hoquiam Channel and Cow Point Reach had the highest concentrations with means of 4.8 and 4.6 pptr respectively. These concentrations are similar to what has been found historically in maintenance dredged material from the federal navigation channel.

Chemical Analysis QA/QC. Stage-4 data validation (EPA, 2009) was conducted for dioxins/furans, semivolatiles, PCBs and pesticides. Stage-3 data validation was conducted for sediment conventional and metals analyses. Data qualifiers assigned during validation have been incorporated into Table 5.

Bioassays. Biological testing was performed in two batches, with CP32 and CP33 tested in the first batch and CO7, SR1, SR3 and SR4 tested in the second batch. Two reference sediment samples were collected from North Bay on April 7, 2012 (see Figure 12). NB02 was run with the first batch and

NB01 was run with the second batch.

The standard suite of three bioassay tests (amphipod mortality, larval development, and polychaete growth) was performed. The DMMP interpretation guidelines for dispersive disposal sites in Table 8 were used to assess the bioassay results.

Amphipod Mortality. The 10-day amphipod bioassay was run using *Eohaustorius estuarius* as the test species. Test results are shown in Table 9. DMMUs CP32 and CP33 both scored hits under the 1-hit rule in batch 1. There were no hits in batch 2.

The negative control and reference sediments met the DMMP performance criteria. Water quality and positive control results were also within their acceptance ranges. However, an unforeseen variable was discovered for the first batch that could have resulted in nontreatment effects. The clay content of CP32 and CP33 was 24.2% and 30.6% respectively. This was much higher than the clay content of any dredged material tested in Grays Harbor in the past, and was therefore unanticipated. *Eohaustorius estuarius* has been documented to underperform in sediment with high clay content (DMMP, 2000). The DMMP Users Manual (DMMP, 2008a) indicates that for sediment with clay content higher than 20% the amphipod species of choice is *Ampelisca abdita*.

Due to the mix-up in species selection, the DMMP agencies allowed the amphipod bioassay to be rerun, using *Eohaustorius estuarius* and *Ampelisca abdita* in a side-by-side test. Because the holding time had expired for the test material, the agencies were concerned that the chemical nature of the dredged material might have changed during storage. Specifically, the concern was that benzyl alcohol, the chemical that triggered biological testing, could have been converted to benzoic acid, which is less toxic than benzyl alcohol. In order to address this problem the archived dredged material was tested again for semivolatile organics, including benzyl alcohol. The chemical testing indicated that there had not been a consistent shift in the benzyl alcohol concentrations to lower concentrations. The concentration detected in CP32 decreased, but the concentration in CP33 increased. These changes in concentration could easily be attributable to sampling and analytical variability.

DMMU	original benzyl alcohol concentration (ug/kg)	benzyl alcohol concentration after storage (ug/kg)
CP32	100	57
CP33	110	140

The amphipod retest was carried out on unfrozen archived sediment. It was anticipated that the *Eohaustorius* results would be similar to the first-round results due to the high clay content, with *Ampelisca* exhibiting less toxicity. However, the results (Table 10) indicated that there were no hits for either of the test species.

The negative control and reference sediment met the DMMP performance criteria for the amphipod retest. Water quality and positive control results were also within their acceptance ranges. Therefore, the amphipod retest was considered a valid test by the DMMP agencies.

Larval Development. The larval development bioassay - using *Mytilus galloprovincialis* - was run with two different termination protocols. The standard protocol involved carefully decanting the overlying water at the end of the test so as not to disturb the sediment, while for the resuspension protocol the sediment and overlying water were thoroughly mixed at the end of the test and allowed to settle for 24 hours prior to decanting.

The results are shown in Tables 11 and 12 for the standard and resuspension termination protocols respectively. In batch 1, CP32 scored a hit under the 2-hit rule using the standard protocol but no hit under the resuspension protocol. CP33 had no hit under either protocol. In batch 2, both SR4 and CO7 scored hits under the 1-hit rule for the standard protocol, but under the resuspension protocol, SR4 scored no hit at all, while CO7 again scored a hit under the 1-hit rule.

The negative control and reference sediments met the DMMP performance criteria for both termination protocols. Water quality and positive control results were also within their acceptance ranges. Therefore, the larval development bioassay was considered a valid test by the DMMP agencies.

Polychaete Growth. The 20-day juvenile polychaete growth test - using *Neanthes arenaceodentata* as the test species - was also run with two endpoints: dry-weight (DW) and ash-free dry-weight (AFDW). The AFDW endpoint was officially adopted over the DW endpoint in August of 2012 (DMMP, 2012). Therefore, only the AFDW endpoint was used for decision-making. Results for this endpoint are displayed in Table 13. There were no hits in either batch.

The negative control and reference sediments met the DMMP performance criteria. Water quality and positive control results were also within their acceptance ranges. Therefore, the polychaete growth bioassay was considered a valid test by the DMMP agencies.

Interpretation of Round 1 Bioassay Data. Tables 14 and 15 summarize the interpretation of bioassay data from batch 1 and batch 2 respectively, using the guidelines for dispersive sites provided in Table 8. Given the many bioassay endpoints, with sometimes conflicting outcomes, the DMMP agencies needed to use best professional judgment in determining the suitability of the dredged material for open-water disposal.

The results for DMMUs SR1 and SR3 were straightforward. These DMMUs had no exceedances of the DMMP SLs and scored no hits in any of the bioassays, so were clearly suitable for open-water disposal. For SR4, the agencies used a weight-of-evidence approach. There were no SL exceedances and it passed the amphipod and *Neanthes* tests. It barely scored a hit under the 1-hit rule in the larval development test using the standard termination protocol, with combined mortality and abnormality just 15.5% greater than reference. It scored no hit at all when the resuspension protocol was used. SR4 was also 85% sand, which has much less of a tendency to sorb organic contaminants than fine-grained sediment. On the basis of this combination of evidence, the agencies agreed that SR4 was suitable for open-water disposal.

The agencies also determined – using a weight-of-evidence approach – that CP33 was suitable for open-water disposal. There were no hits in either larval test or in the *Neanthes* bioassay. In the initial amphipod test, the wrong test species was used (based on clay content); the grain-size match with the reference was poor; and both control and reference performed extremely well. Despite these

handicaps, CP33 barely failed the dispersive disposal guideline in the first round of testing. In the amphipod retest, CP33 passed using both test species.

Decision to Resample and Retest CO7 and CP32. Based solely on the results from the Round 1 larval tests, CO7 would have been found unsuitable for open-water disposal. Due to the size of CO7 (63,150 cubic yards), the Corps was concerned about the impact this volume of failed sediment could have on the viability of the project. Hence, the Corps petitioned the agencies to allow CO7 to be split into subunits for resampling in an effort to determine if the toxicity could, perhaps, be isolated to a smaller volume of material. The agencies agreed to this request, but only allowed CO7 to be split into two subunits so as to avoid a possible patchwork of suitable and unsuitable units.

While the weight-of-evidence approach worked well for CP33, the first-round results for CP32 were less amenable to interpretation. For example, the *Eohaustorius* mortality was 40% for CP32 in the initial amphipod test, but only 25% for CP33. In the *Ampelisca* test, while the CP32 mortality was not significant enough to score a hit, it *was* statistically different from reference; the mortality for CP33 was not statistically different from reference. Finally, CP32 scored a hit under the 2-hit rule in the larval test, while CP33 did not. Since the Corps was planning to resample and retest CO7 as two subunits, the DMMP agencies requested that the Corps also do the same for CP32, so as to gather more definitive data on which to base a decision for that DMMU.

A summary of the round-1 results can be found in Table 16, along with the overall interpretation for each DMMU.

For the resampling/retesting effort, DMMUs CO7 and CP32 were each divided into two subunits as shown in Figures 13 and 14. The volumes of CO7a and CO7b were 31,593 and 31,557 cubic yards respectively. DMMU CP32 was divided such that CP32a consisted of sediment within the 350-foot-wide navigation channel and CP32b consisted of material within the Cow Point turning basin. The volumes of CP32a and CP32b were 22,400 and 25,300 cubic yards respectively. An abbreviated sampling and analysis plan was developed, which included the following requirements:

- Six cores were to be taken from each subunit.
- Sampling locations were to provide a good spatial distribution within each subunit.
- First-round locations were to be used where possible.
- Testing was to include semivolatiles, pesticides, sediment conventionals and grain size. Semivolatiles and pesticides were chosen because it was chemicals in these analytical groups (benzyl alcohol and total chlordane) that had detected or reporting-limit exceedances of SL in the first round.
- Bioassays were to include the amphipod test, both the standard and resuspension protocols for the larval test, and the *Neanthes* AFDW endpoint.
- Due to the high-clay content found in CP32 during the first round of testing, *Ampelisca abdita* was to be used for all samples.
- Z-samples were to be analyzed concurrently with the primary dredged material samples (P-samples).

2. Round 2 Sampling and Analysis – CO7 and CP32.

Sampling. Sampling took place September 19-24, 2012 using a vibracore sampler. The 2nd round target and actual sampling stations can be seen in Figures 13 and 14. Table 17 includes the sampling coordinates, mudline elevations, sampling depths and compositing information. Z-samples were also collected and tested in Round 2.

Physical and Chemical Analysis. Analysis of the CO7 and CP32 subunits and their respective z-samples included semivolatiles, pesticides, sediment conventionals and grain size. Table 18 includes the results. There were no SL exceedances for any of the subunits or z-samples.

Chemical Analysis QA/QC. Stage-4 data validation was conducted for the semivolatile and pesticide analyses. Stage-3 data validation was conducted for the sediment conventionals. Data qualifiers assigned during validation are reflected in Table 18.

In the initial analysis of semivolatiles, the analytical lab reported diethyl phthalate concentrations of 360 and 510 ug/kg respectively for subunit CO7a and its corresponding z-sample. These results were unexpected, as diethyl phthalate had not been detected in any of the Round 1 samples. The lab subsequently reanalyzed these two samples to determine whether the initial results were valid. Rather than test aliquots from the same sample jars used for the initial test, the lab took aliquots from separate sample jars. Further, to increase the rigor of the retest, two independent aliquots were taken from two separate jars for each of the two samples, CO7a-P and CO7a-Z. Diethyl phthalate was undetected in both of the CO7a-P samples, with a reporting limit of 48 ug/kg for both samples. For CO7a-Z, one sample had a detected concentration of diethyl phthalate of 53 ug/kg, while in the second sample, diethyl phthalate was undetected at a reporting limit of 48 ug/kg.

The data validator reviewed the results from both the initial analysis and re-analysis. All semivolatile chemicals, with the exception of diethyl phthalate, showed consistent results between the initial analysis and re-analysis. In the best professional judgment of the validator, the initial diethyl phthalate detections were likely artifacts of the sampling/analytical process, and were not representative of CO7a-P and CO7a-Z. The DMMP agencies accepted this opinion. The results reported in Table 18 are the highest concentrations reported for the re-analysis, namely 48 ug/kg (undetected) for CO7a-P and 53 ug/kg (detected) for CO7a-Z.

Bioassays. Bioassays were run concurrently with the chemical analysis in Round 2. The four subunits and associated z-samples were subjected to the standard suite of three bioassay tests (amphipod mortality, larval development, and polychaete growth). The DMMP interpretation guidelines for dispersive disposal sites in Table 8 were used to assess the bioassay results.

Three reference sediment samples were collected from North Bay on September 26, 2012 (see Figure 12). Wet-sieving at the time of sampling indicated that the percentage of fines in NB13, NB14 and NB15 was 48%, 68% and 25% respectively. Due to contractual constraints, only two of these reference sediments could be used for bioassay testing. Therefore, the analytical lab archived these reference samples until the grain-size analysis could be completed for the eight test samples. When the grain-size results for the test samples became available, the DMMP agencies matched the wet-sieving results for the reference samples to the analytical grain-size results for the test samples and

selected NB13 and NB15 for bioassay testing. These two reference samples were then analyzed by the testing lab for grain size and sediment conventionals at the same time the bioassays were under way. The laboratory grain-size results for NB13 and NB15 indicated that the actual fines content of these two reference samples was 28.2% and 11.1% respectively, much lower than that predicted by the wet-sieving results. The low fines content for NB15 eliminated this reference sediment as a match for any of the test sediments. Therefore, NB13 became the sole reference sediment used for test interpretation. The results for NB15 are provided in the tables of bioassay results, but were not used in test interpretation.

Amphipod Mortality. The 10-day amphipod bioassay was run using *Ampelisca abdita* as the test species. Unusually high mortality was encountered, as can be seen in the in Table 19. An evaluation of the water quality results indicated that ammonia was the likely cause. Table 20 includes the overlying and interstitial ammonia data from the test. Mortality is plotted against overlying ammonia in Figure 15. This figure shows that mortality was strongly correlated with ammonia. A review of the literature indicated that levels of ammonia such as these would be expected to result in toxicity (see Table 25). As a result of the ammonia toxicity, the DMMP agencies set aside the amphipod results for Round 2 and based their decision-making on the larval development and *Neanthes* growth tests.

Larval Development. The larval development bioassay - using *Mytilus galloprovincialis* - was run with two different termination protocols. The results are shown in Tables 21 and 22 for the standard and resuspension termination protocols respectively. All four subunits scored hits under the 2-hit rule using the standard protocol. For the resuspension protocol, CO7a, CO7b and CP32b did not score a hit of any kind, while CP32a scored a hit under the 1-hit rule.

As for the z-samples, CO7a-Z did not score a hit under either protocol. CO7b-Z scored a hit under the 2-hit rule for the standard protocol but no hit under the resuspension protocol. CP32a-Z and CP32b-Z both scored hits under the 1-hit rule for both protocols.

The negative control and reference sediments met the DMMP performance criteria for both termination protocols. The standard water quality parameters (temperature, pH, salinity and dissolved oxygen) and positive control results were also within their acceptance ranges. Therefore, the larval development bioassay was considered a valid test by the DMMP agencies. However, as in the amphipod test, ammonia was present at concentrations that would be expected to be toxic, at least for some of the test samples. The effects of ammonia will be discussed in the interpretation section below.

Polychaete Growth. Results from the 20-day *Neanthes* growth test are shown in Table 23. There were no hits for any of the samples. The negative control and reference sediments met the DMMP performance criteria. Water quality and positive control results were also within their acceptance ranges. Therefore, the polychaete growth bioassay was considered a valid test by the DMMP agencies.

Interpretation of Round 2 Bioassay Data. Table 24 summarizes the interpretation of bioassay data from Round 2, using the guidelines for dispersive sites provided in Table 8. Using only the Round 2 data, all of the samples associated with DMMU CO7 would be suitable for open-water disposal. The only hits were hits under the 2-hit rule in the larval test using the standard termination protocol. Because the amphipod results were rejected due to ammonia and there were no corroborating hits in

the *Neanthes* growth test, both subunits and their respective z-samples would pass the dispersive interpretation for open-water disposal.

Subunit CP32b-P scored a hit under the 2-hit rule under the standard larval protocol, but no hit under the resuspension protocol. Again, because the amphipod results were set aside and there was no corroborating hit in the *Neanthes* growth test, this subunit would pass the dispersive interpretation for open-water disposal.

The results for CP32a-P, CP32a-Z and CP32b-Z were more complicated due to ammonia. Figure 16 shows seawater-normalized combined mortality and abnormality (NCMA) plotted against ammonia concentrations for all of the larval results from both rounds of testing. There is a strong statistical correlation between NCMA and ammonia. But correlation is insufficient to determine causality. The literature was reviewed for effects of ammonia on the test species *Mytilus galloprovincialis* and other mussel species. Table 25 provides the literature findings.

The ammonia concentrations associated with CP32a-P did not appear to be high enough to explain the mortality seen in this subunit. However, the ammonia concentrations associated with CP32a-Z and CP32b-Z did appear to be high enough to contribute to the toxicity seen in those two z-samples. On the basis of the strong correlation with ammonia and concentrations high enough in the z-samples to contribute to toxicity, the DMMP agencies determined that the sediment that would be exposed by dredging of CP32a and CP32b would not be considered degraded relative to the dredged material tested. Ammonia is a naturally occurring chemical in anoxic sediment and would be expected to quickly dissipate once exposed to more oxygenated conditions.

As for CP32a-P, the DMMP agencies reviewed other potential nontreatment effects, including fines content, clay content and depth of sampling. There was not a strong correlation with any of these variables. Given that there were no chemicals at concentrations of concern associated with CP32a-P and individual nontreatment factors did not appear to be responsible, the toxicity seen in the larval test cannot be easily explained by the data in hand. It is possible that a combination of nontreatment factors resulted in the toxicity manifested for this subunit, but without strong empirical evidence, the DMMP agencies made an environmentally-conservative call and found this subunit unsuitable for open-water disposal. However, the agencies also expressed their willingness to allow additional sampling and testing of CP32a-P prior to dredging to determine if it could be disposed at an open-water site.

F. <u>Summary of Rounds 1 and 2.</u> Results from the two rounds of chemical and biological testing can be summarized as follows:

- Dioxin concentrations were similar to what has been found historically in the federal navigation channel. The limits for disposal in Grays Harbor are 5 pptr for 2,3,7,8-TCDD and 15 pptr for TEQ (DMMP, 2008a). None of the DMMUs exceeded these limits. Therefore, with regard to dioxin, all the DMMUs are suitable for open-water disposal.
- Most DMMUs did not exceed any chemical screening levels and did not require biological testing. Therefore, the majority of DMMUs are suitable for open-water disposal on the basis of chemistry alone.
- DMMUs SR1, SR3, SR4 were subjected to bioassays due to holding-time constraints only, and were all found suitable for open-water disposal.

- CP33 was found suitable for open-water disposal based on the Round 1 results and a weight-of-evidence approach.
- A summary of first and second round results for CO7 and CP32 can be found in Table 26. The second round of sampling was more intensive than in the first round, thus providing a better spatial and volumetric representation of the dredged material in these DMMUs. Therefore, the DMMP agencies weighted the results from Round 2 more heavily than the results from Round 1.
- CO7 scored a hit under the 1-hit rule in the larval test in Round 1, but larval toxicity in Round 2 was low. There were no hits in the amphipod or *Neanthes* bioassays. The chemistry for this DMMU was benign, with only a detection-limit exceedance of the total chlordane SL in Round 1. The DMMP agencies used a weight-of-evidence approach and found CO7 suitable for open-water disposal.
- CP32 was more complicated. In Round 1, this DMMU scored a hit under the 1-hit rule in the amphipod test using *Eohaustorius estuarius*, but was retested with both *Eohaustorius estuarius* and *Ampelisca abdita* in an amphipod retest. There were no hits in the retest. In Round 2, subunit CP32a exhibited toxicity in the larval test that could not be explained by any single nontreatment effect. Therefore, the DMMP agencies found this subunit unsuitable for open-water disposal, but will allow the Corps to conduct additional sampling and testing of this subunit prior to dredging. Subunit CP32b only scored a hit under the 2-hit rule in the standard larval test in Round 2 and was found suitable for open-water disposal.

G. Sediment Exposed by Dredging. Sediment exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) (Ecology, 1995) or the State's antidegradation standard (DMMP, 2008b). A direct evaluation can be made for those z-samples tested for the project. From a chemical perspective, all of these samples (CO7a-Z, CO7b-Z, CP32a-Z and CP32b-Z) were below SQS. With regard to the bioassay results, the z-samples for CO7a and CO7b met SQS, while the z-samples for CP32a and CP32b had higher combined mortality and abnormality in the larval test than exhibited by the dredged material samples. But, as indicated previously, there was evidence that this was due to ammonia. Because ammonia would be expected to dissipate quickly when exposed to more oxygenated conditions, the DMMP agencies determined that any detrimental effects from the exposure of sediment underlying CP32 would be short-lived.

In summary, the vast majority of dredged material had no SQS exceedances, and where exceedances did occur the biological testing data indicated that the z-layer was not degraded in any significant way compared to the dredged material. In addition, the limited chemical testing of z-samples that was done provided evidence that concentrations of chemicals of concern in the newly exposed sediment are generally lower than those in the dredged material. Therefore, the DMMP agencies determined that the sediment to be exposed by dredging is in compliance with the State of Washington anti-degradation policy.

H. Beneficial-Use Analysis. A portion of the material dredged for this project could be used for beneficial use. Examples include beach nourishment at Half Moon Bay/South Beach and Damon Point, and creation of shorebird habitat on low-relief islands such as Whitcomb Flats or Sand Island. Material for beneficial use would likely come from South Reach or Outer Crossover Reach. This material all met SQS and would be suitable for beneficial use from a sediment quality perspective.

I. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for the deepening of the Grays Harbor federal navigation channel for open-water disposal. The approved sampling and analysis plan was followed and the data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP.

Based on the results of the previously described testing, the DMMP agencies concluded that all of the material from this project, with the exception of subunit CP32a, is suitable for open-water disposal. The total volume of sediment suitable for open-water disposal is 1,951,412 cubic yards. The volume of unsuitable sediment is 22,400 cubic yards.

With regard to dioxin, all DMMUs had concentrations below the current guidelines for Grays Harbor of 5 pptr 2,3,7,8-TCDD and 15 pptr TEQ, and are therefore suitable for open-water disposal. However, during the planning phase for the dredged material characterization, the DMMP agencies agreed that should revised dioxin guidelines for Grays Harbor be adopted prior to dredging, that this suitability determination could be revisited.

This suitability determination does ***not*** constitute final agency approval of the project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

J. References.

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Kohn, 1994. *Acute Toxicity of Ammonia to Four Species of Marine Amphipod*. Marine Environmental Resources (1994) 38:1-15, N.P. Kohn et al.

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SEE, 2013. *Sediment Characterization Report, Grays Harbor Federal Navigation Improvement Project – Sediment Sampling and Characterization, Grays Harbor, Washington.* Prepared for the US Army Corps of Engineers, Seattle District by Ahtna Facility Services, Inc and Science and Engineering for the Environment, Seattle, Washington. January 2013.

USACE, 2009. *Grays Harbor, Washington – Reconnaissance Report – Section 905(b) Analysis*. U.S. Army Corps of Engineers, Seattle District. March, 2009.

K. Agency Signatures.

Concur:

2/7/13 David Fox
Date David Fox, P.E. - Seattle District Corps of Engineers

2/7/13
Date Erika Hoffman - Environmental Protection Agency

02/07/2013 Laura Inouye
Date Laura Inouye, Ph.D. - Washington Department of Ecology

2/7/13 Celia Barton
Date Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Marc Horton, Port of Grays Harbor
John Hicks, CENWS-OD-TS-NS
Josh Jackson, CENWS-PM-CP

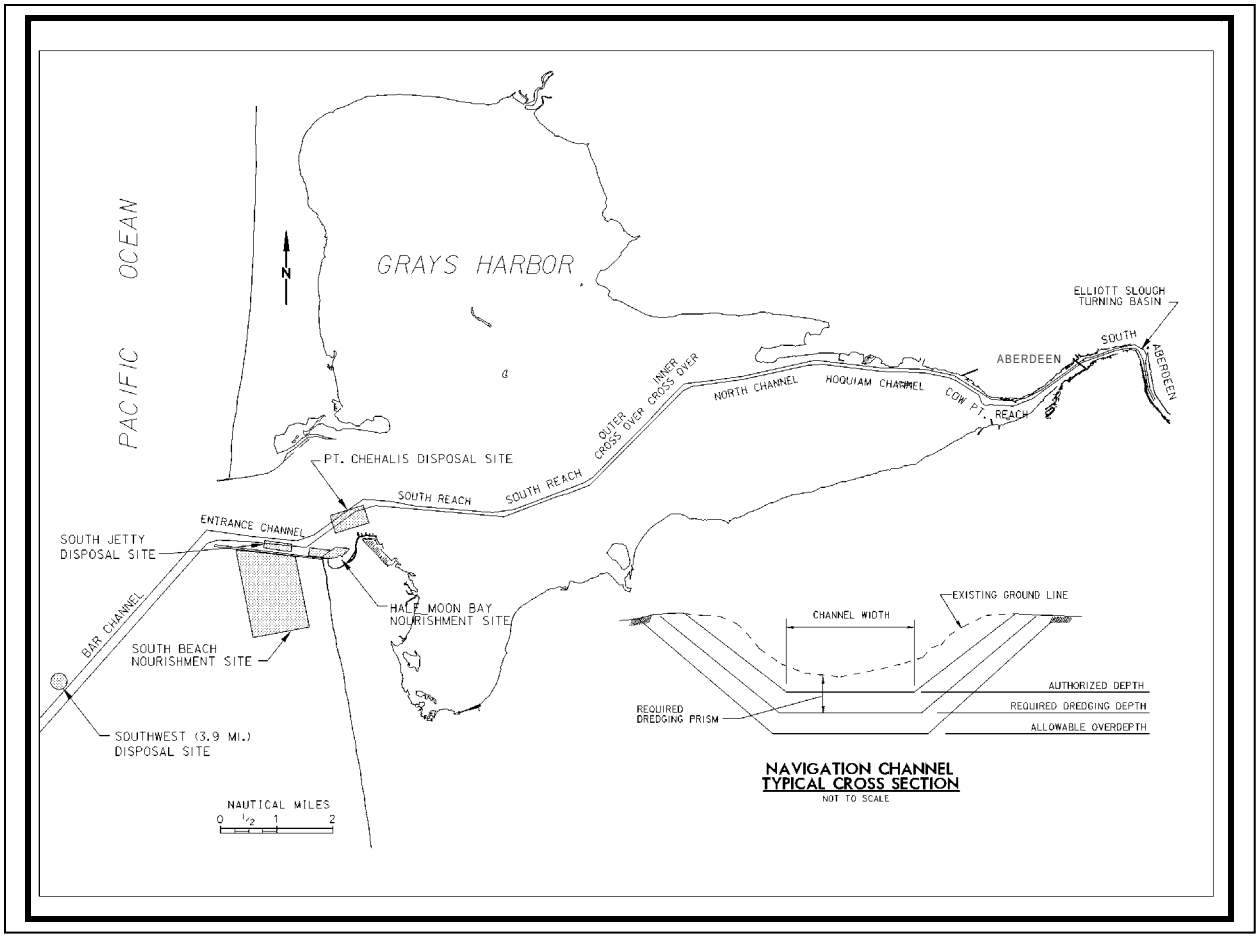


Figure 1. Grays Harbor Navigation Improvement Project. Samples taken for this characterization were from South Reach, Crossover Reach, North Channel, Hoquiam Channel and Cow Point Reach.

South Reach

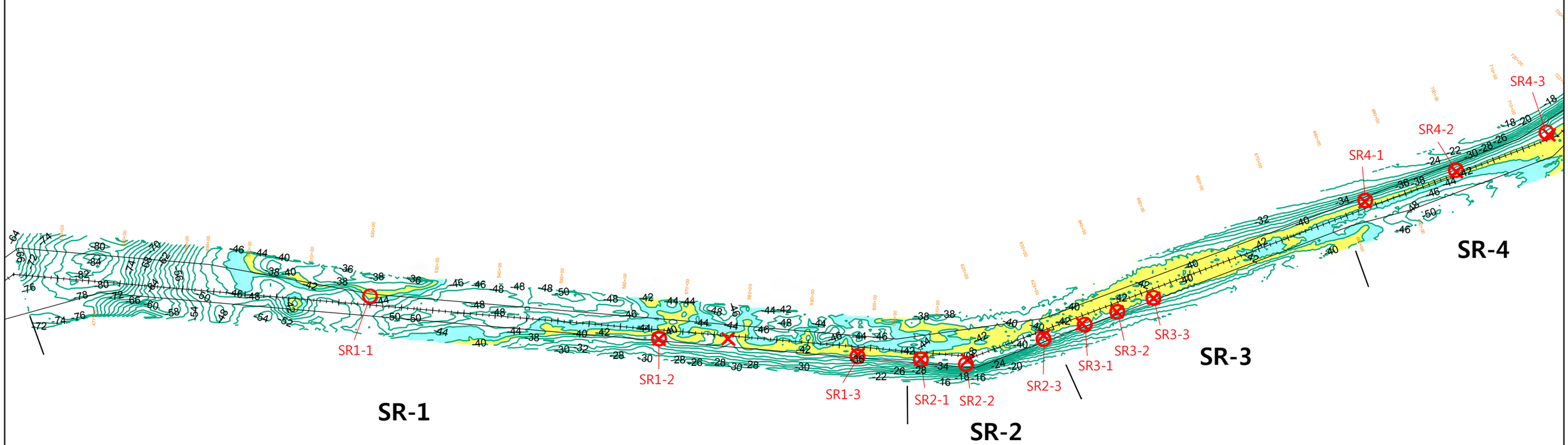


Figure 2

Legend

- Actual Core Locations
- Proposed Core Location
- Channel
- Actual Depth Relative to MLLW
- -40 to -42 MLLW
- -42 to -44 MLLW

Bathymetric Survey: 24 May 2011

0 750 1,500 3,000 4,500 6,000 Feet

N

ExA Data & Mapping Services

Crossover Channel West

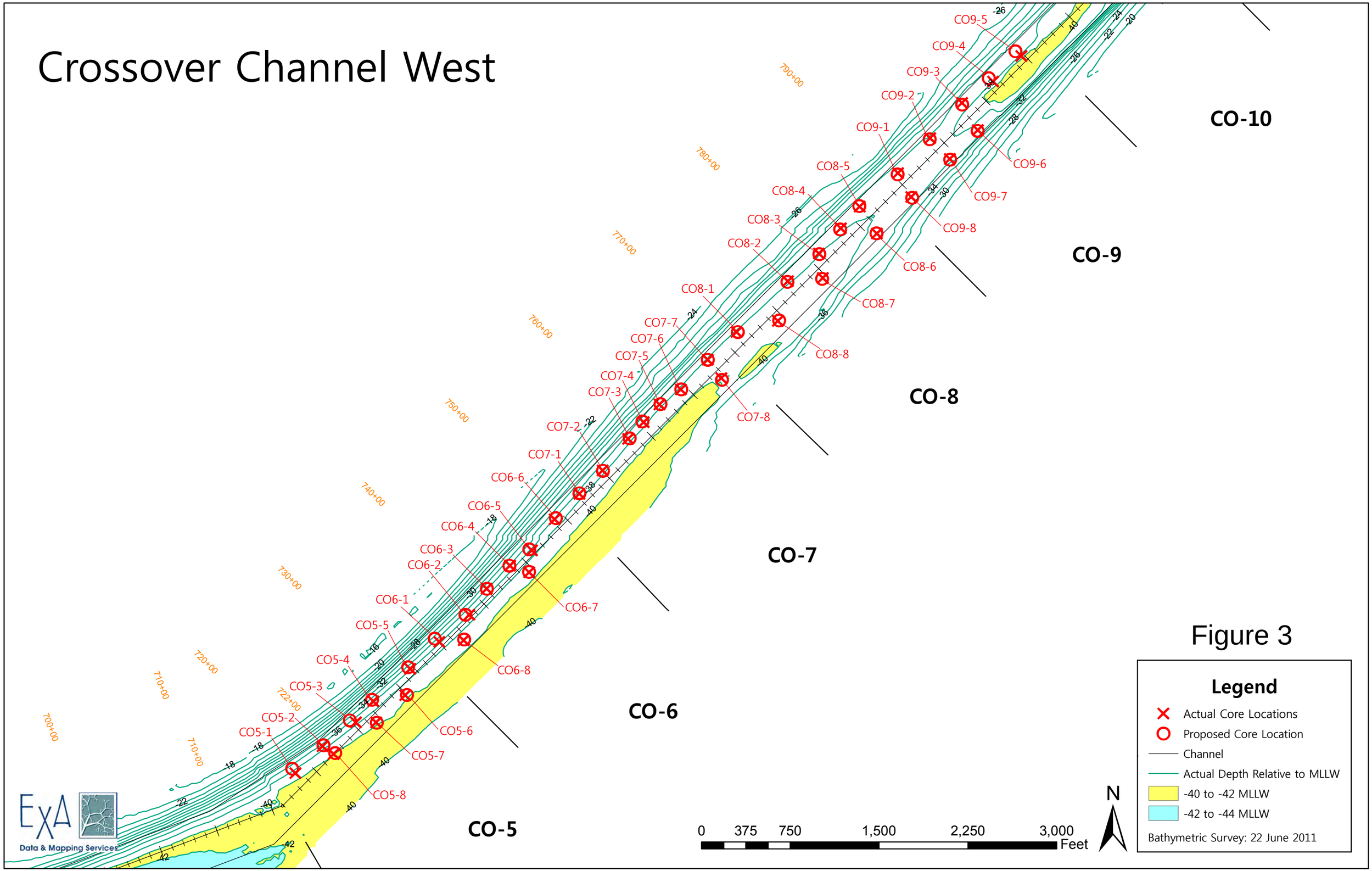


Figure 3

Crossover Channel East

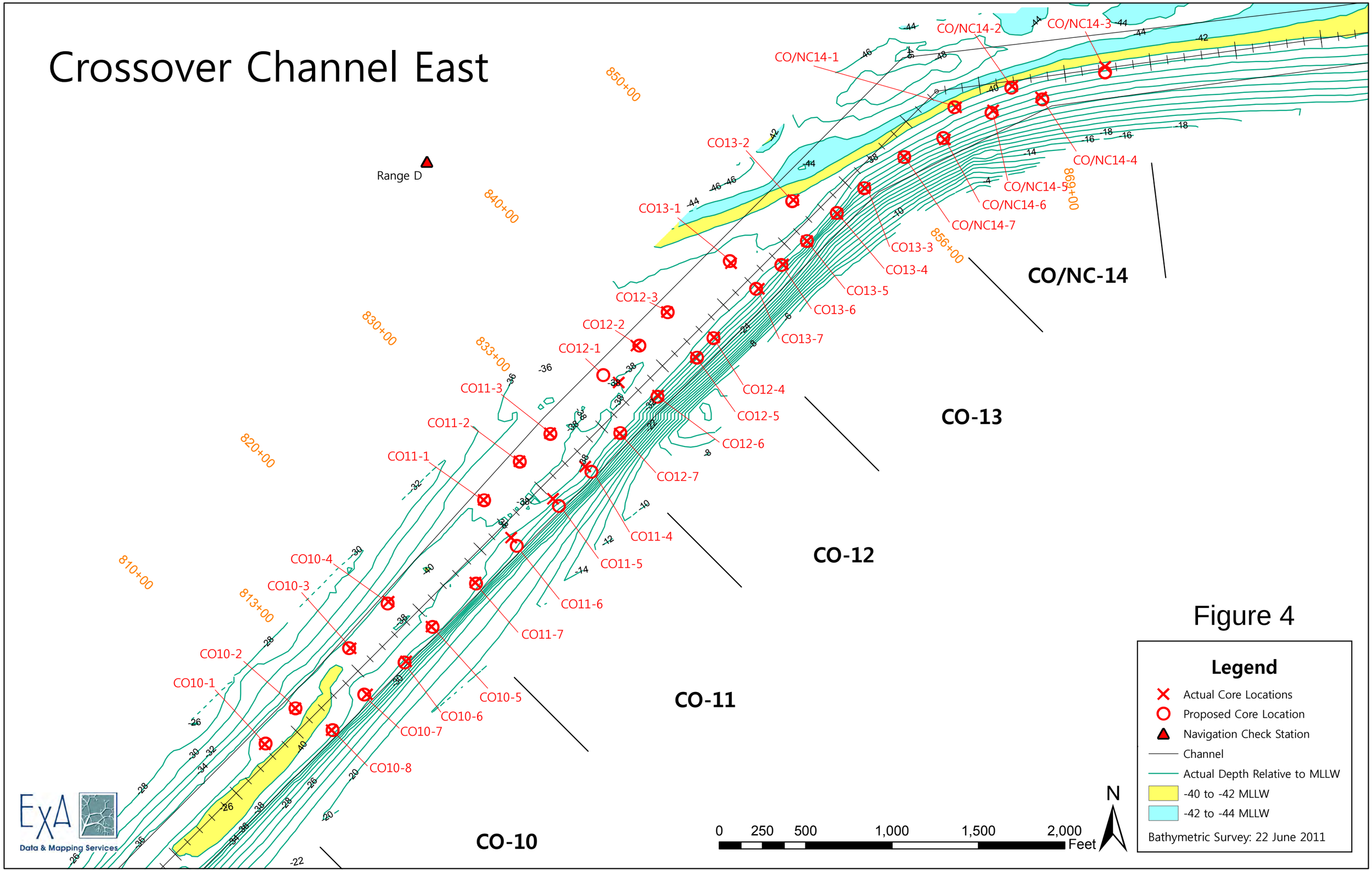


Figure 4

North Channel West

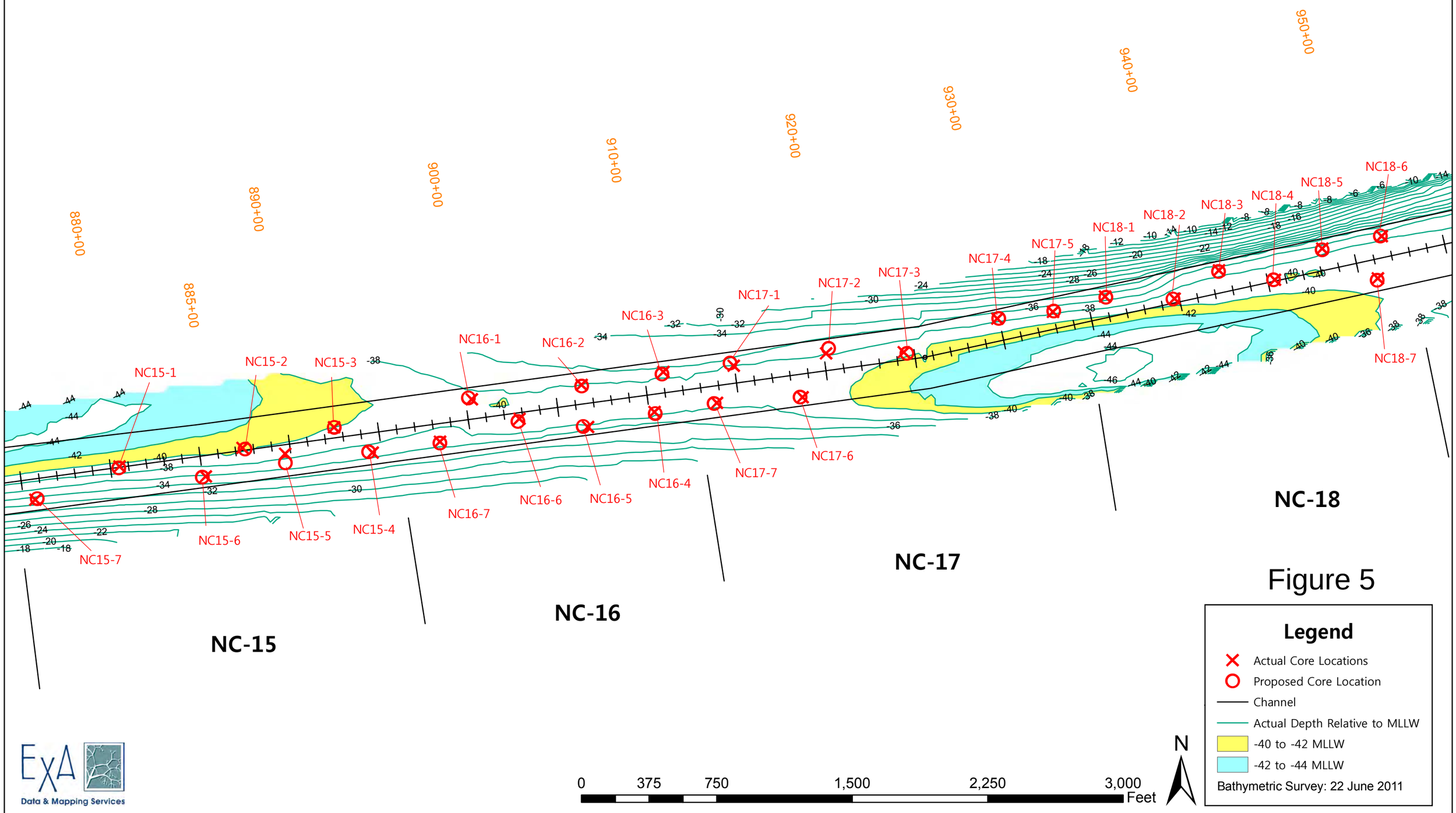


Figure 5

North Channel East

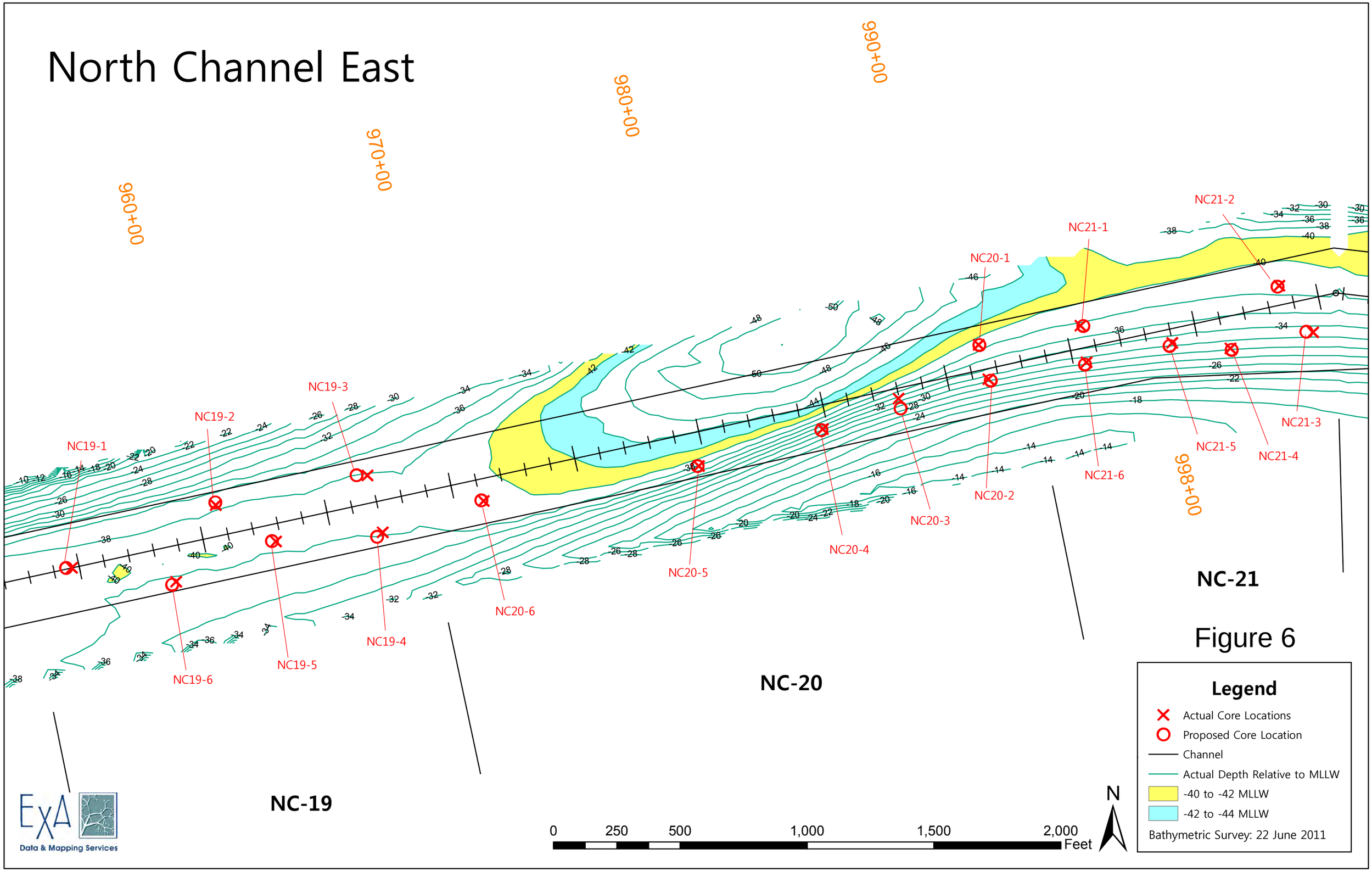


Figure 6

Hoquiam Reach West

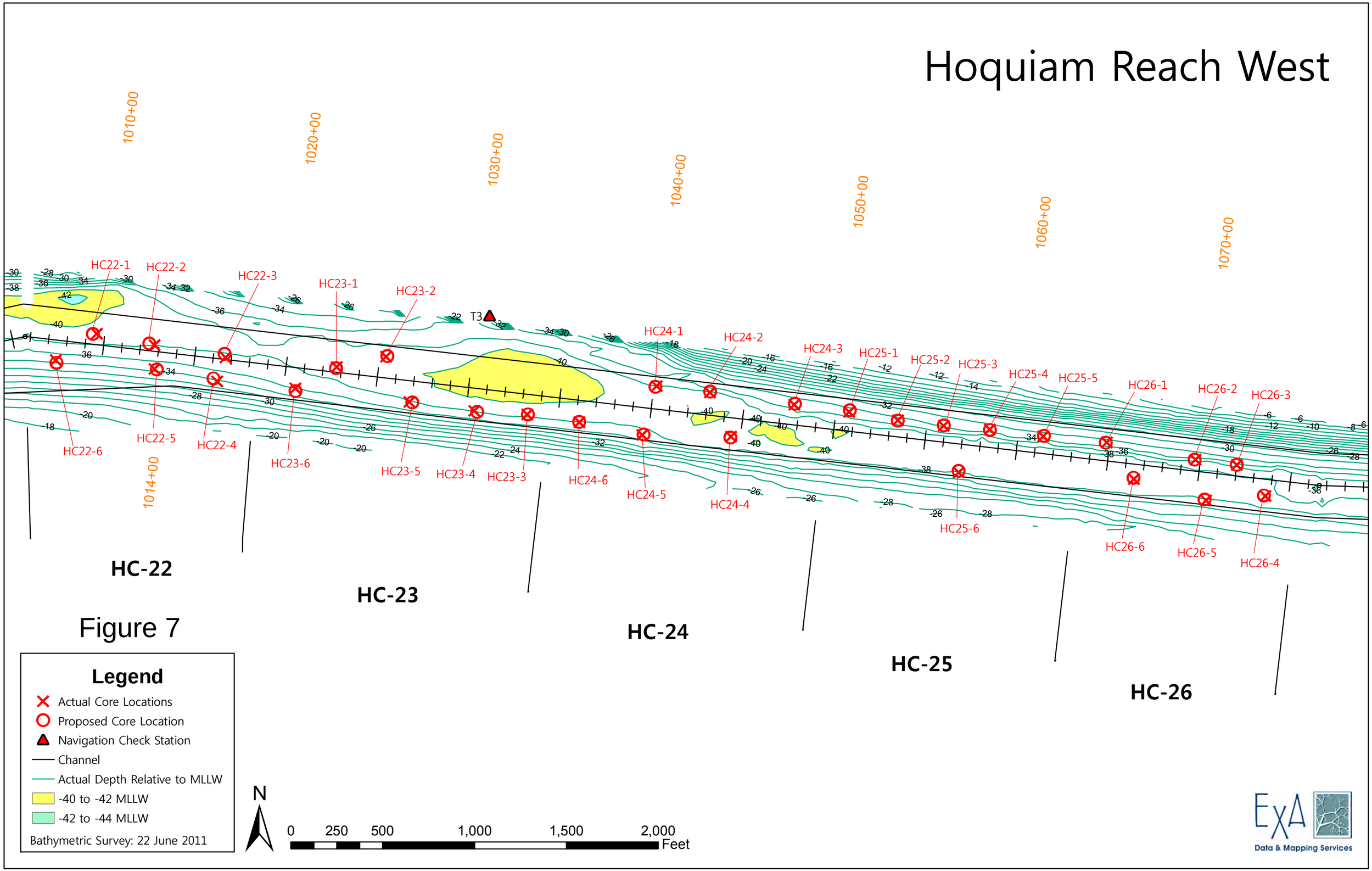


Figure 7

Hoquiam Reach East

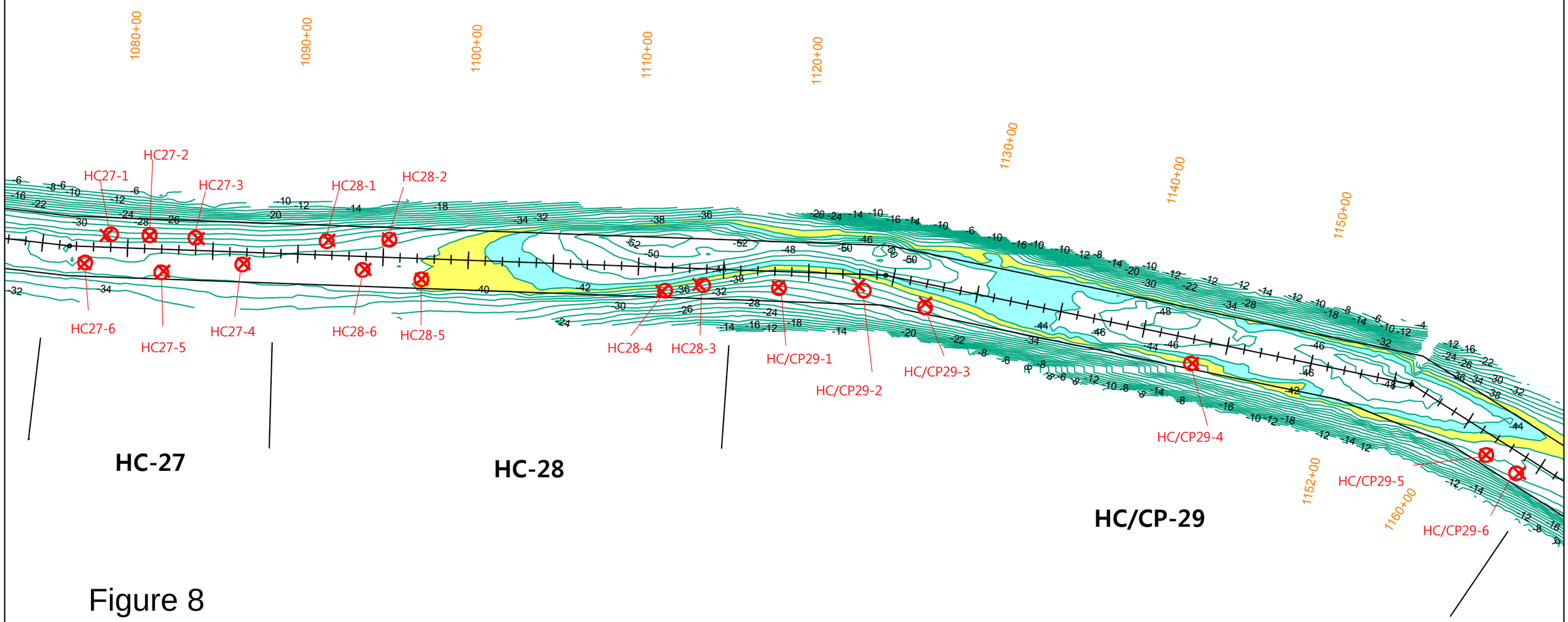


Figure 8

Legend

- Actual Core Locations
- Proposed Core Location
- Channel
- Actual Depth Relative to MLLW
- -40 to -42 MLLW
- -42 to -44 MLLW

Bathymetric Survey: 22 June 2011

N

0 375 750 1,500 2,250 3,000 Feet

ExA Data & Mapping Services

Cow Point Reach West

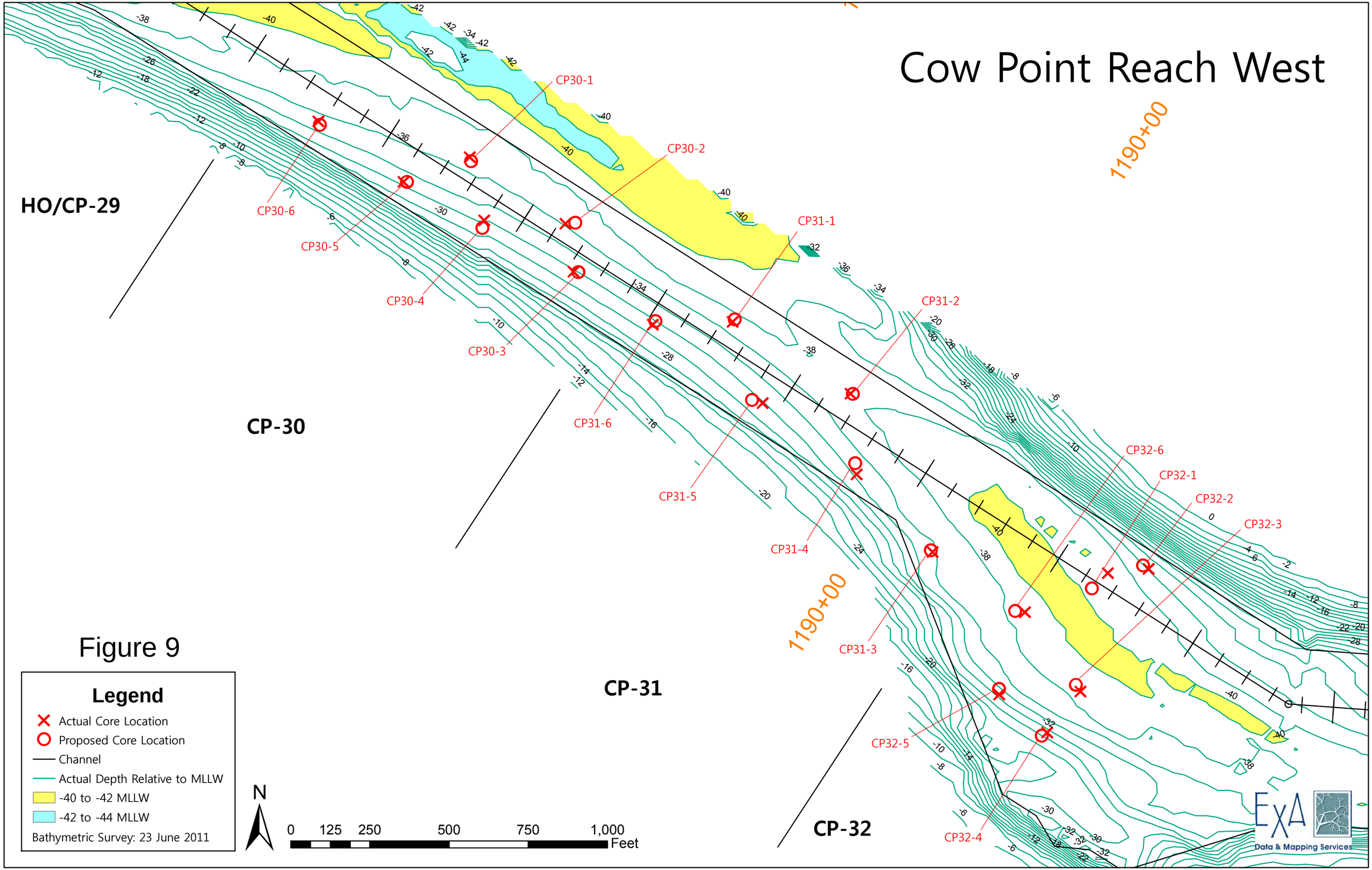


Figure 9

Cow Point Reach East

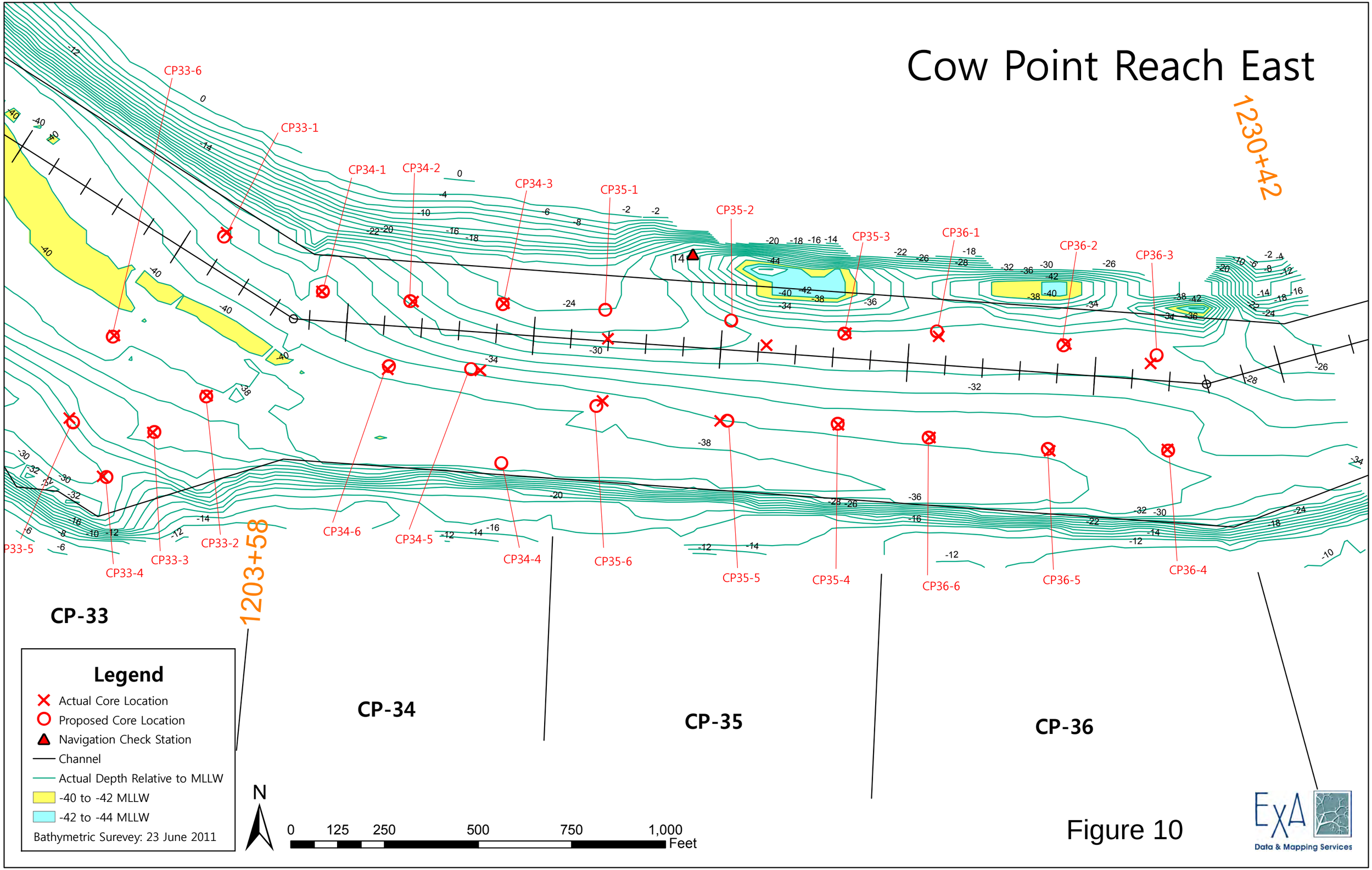


Figure 10

ExA Data & Mapping Services

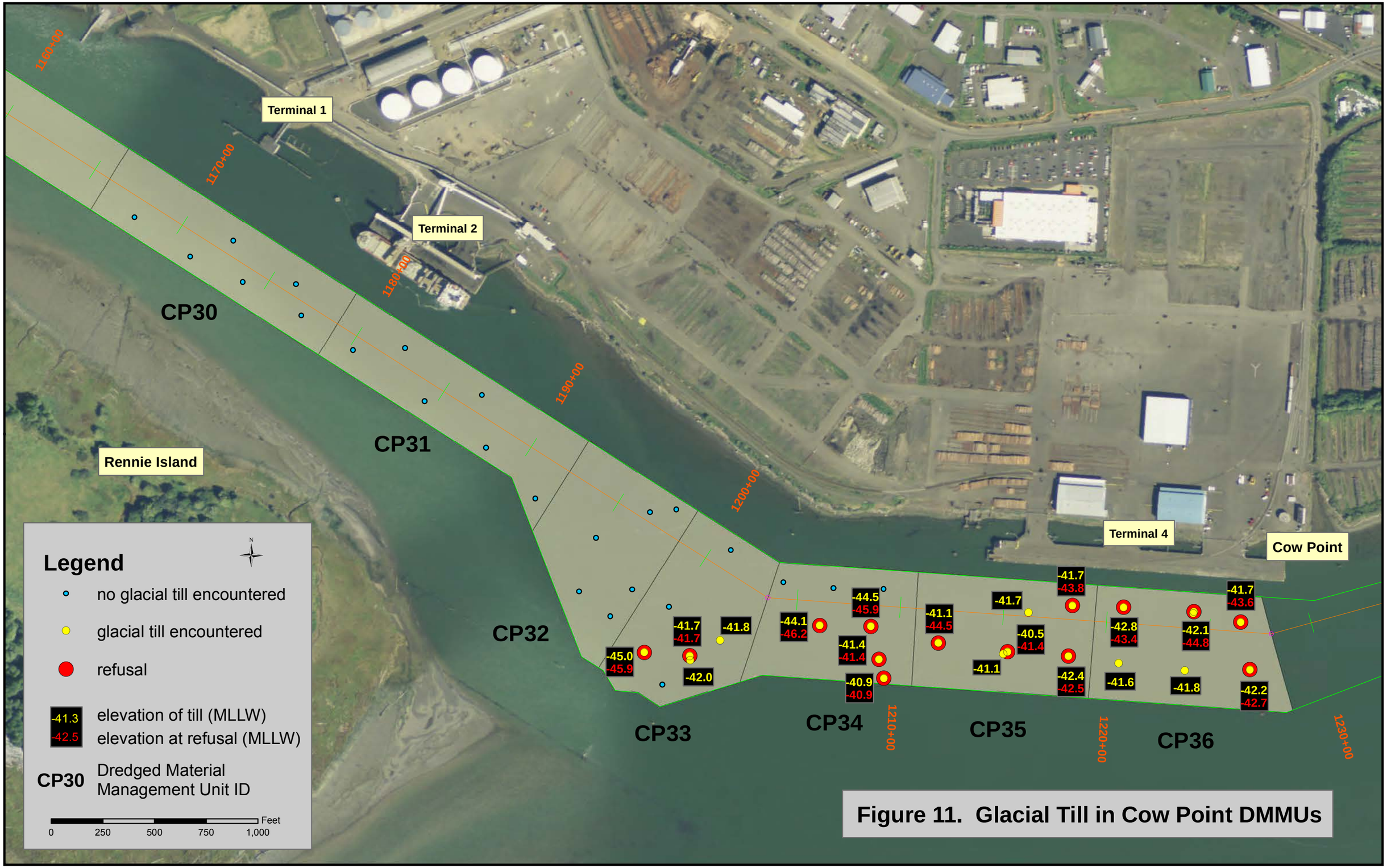


Figure 11. Glacial Till in Cow Point DMMUs

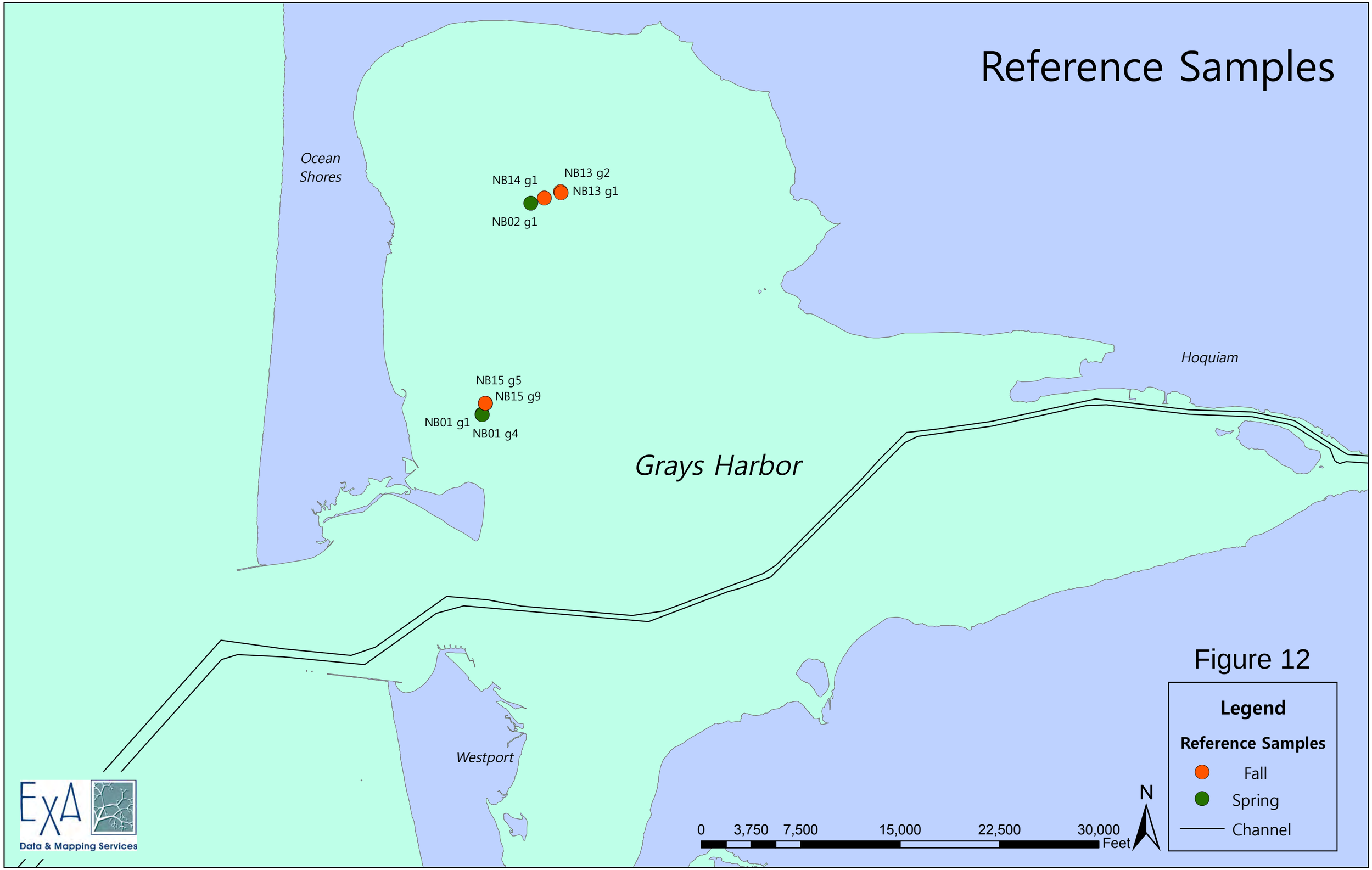
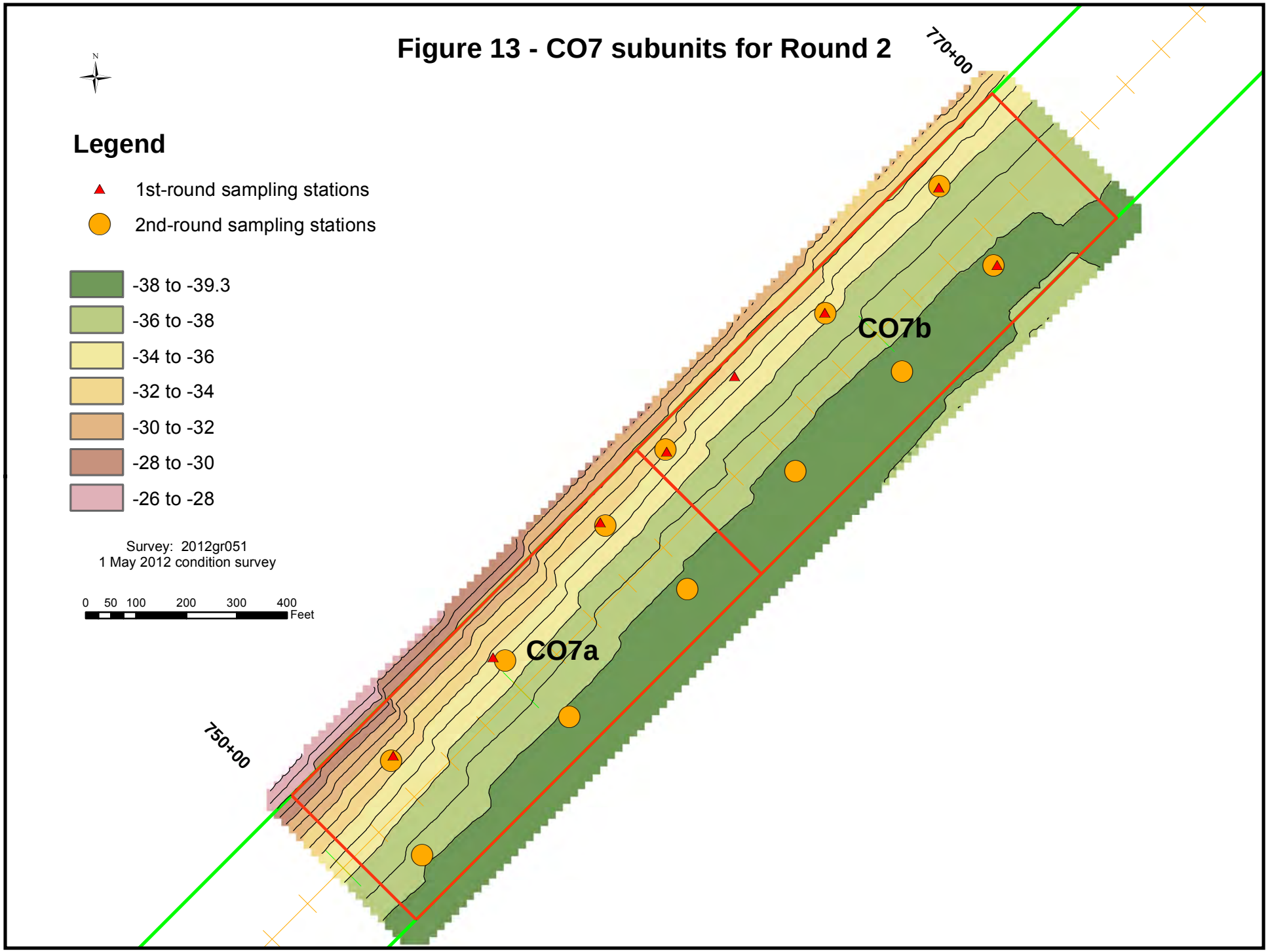

Reference Samples
Ocean Shores
NB14 g1
NB13 g2
NB13 g1
NB02 g1
Hoquiam
NB15 g5
NB15 g9
NB01 g1
NB01 g4
Grays Harbor
Westport
Figure 12
Legend
Reference Samples
Fall
Spring
Channel
N
0
3,750
7,500
15,000
22,500
30,000
Feet
ExA
Data & Mapping Services

Figure 13 - CO7 subunits for Round 2



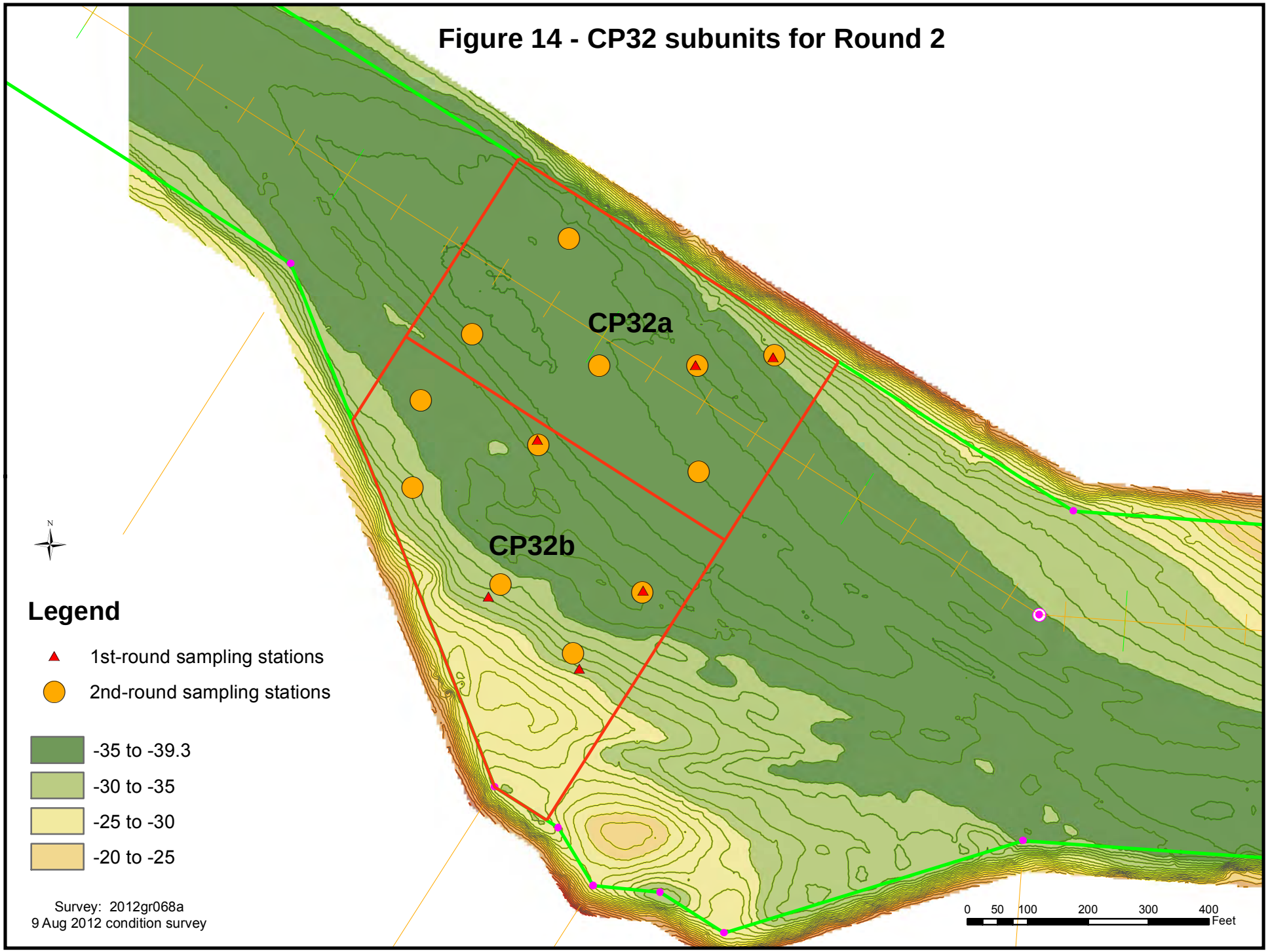


Figure 14 - CP32 subunits for Round 2
CP32a
CP32b
N
Legend
1st-round sampling stations
2nd-round sampling stations
-35 to -39.3
-30 to -35
-25 to -30
-20 to -25
Survey: 2012gr068a
9 Aug 2012 condition survey
0 50 100 200 300 400
Feet

Figure 15 - Round 2 Amphipod Mortality vs. Overlying Ammonia

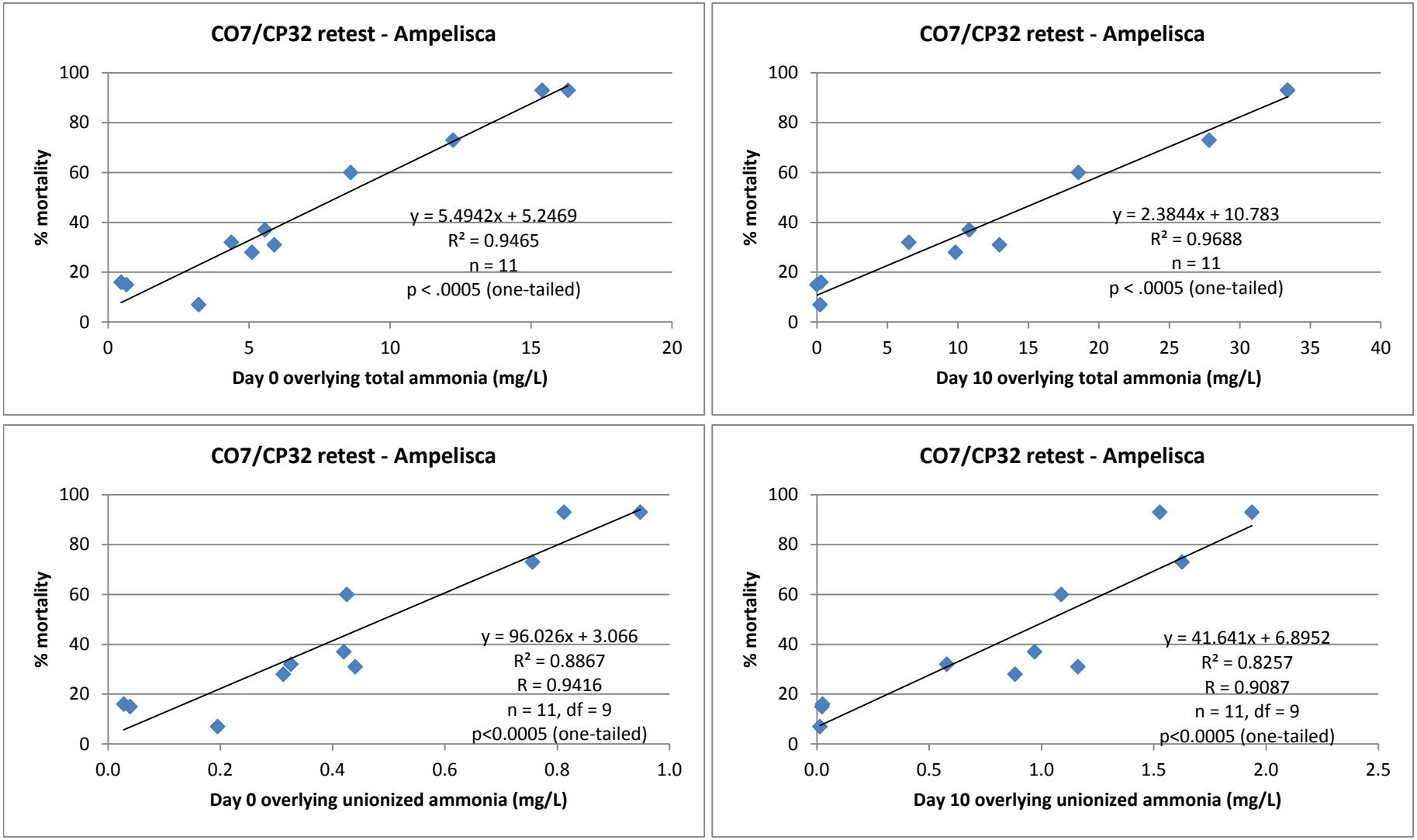
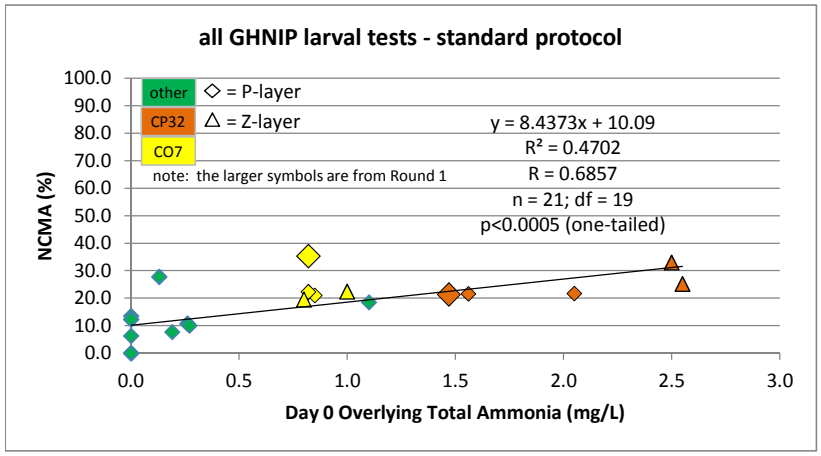
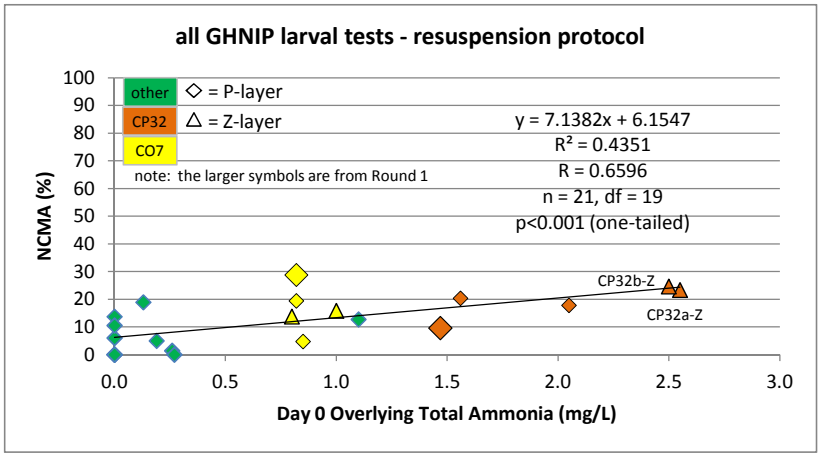
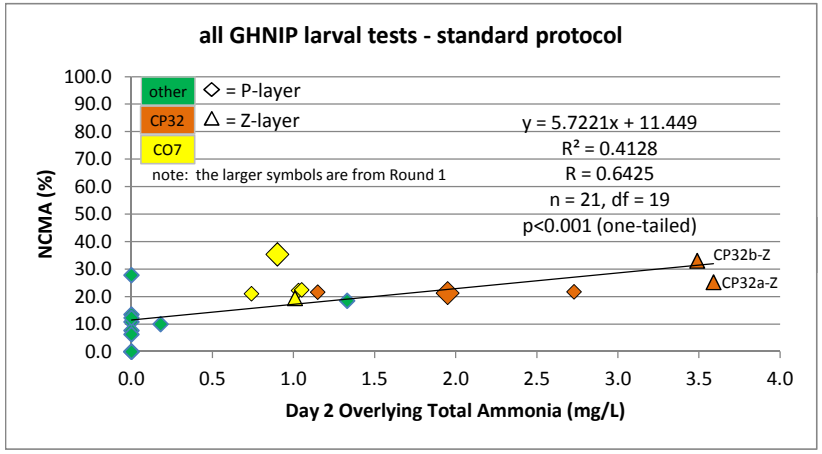


Figure 16-1. Round 2 Larval Bioassay - Normalized Combined Mortality and Abnormality vs. Overlying Total Ammonia







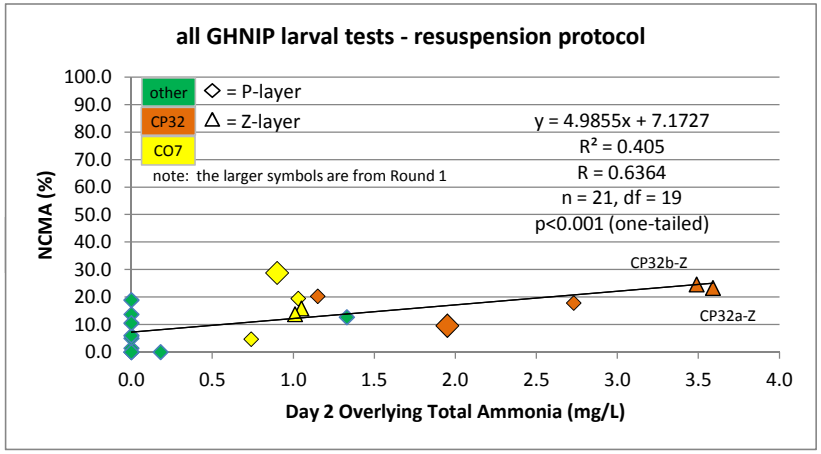
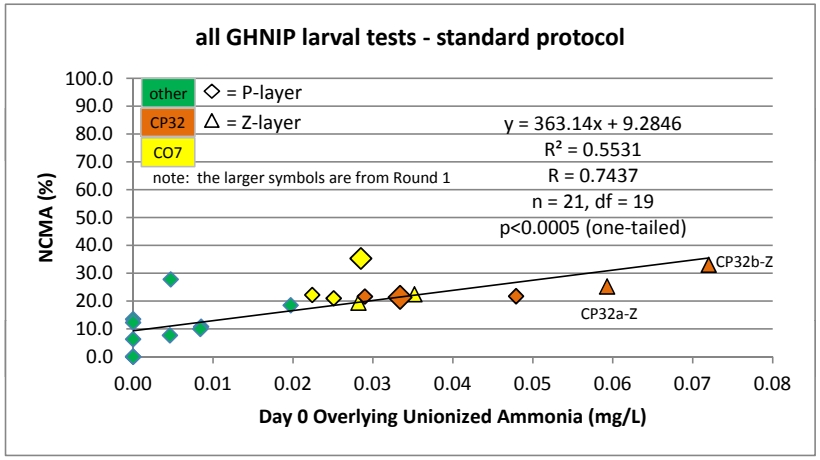
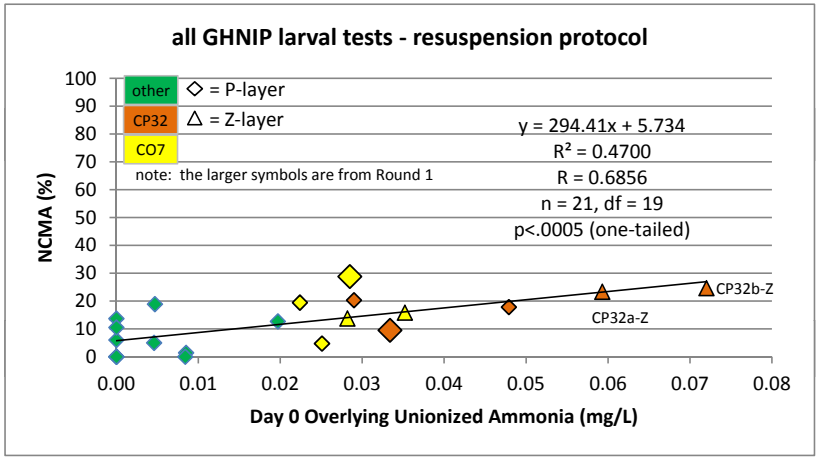
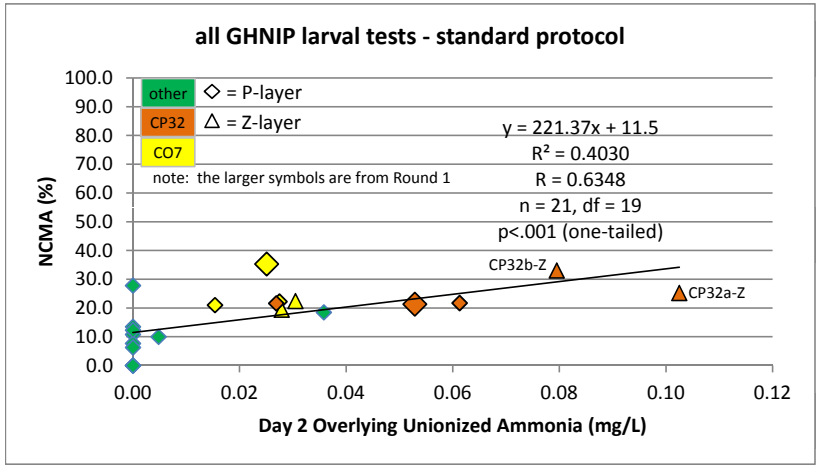


Figure 16-2. Round 2 Larval Bioassay - Normalized Combined Mortality and Abnormality vs. Overlying Unionized Ammonia







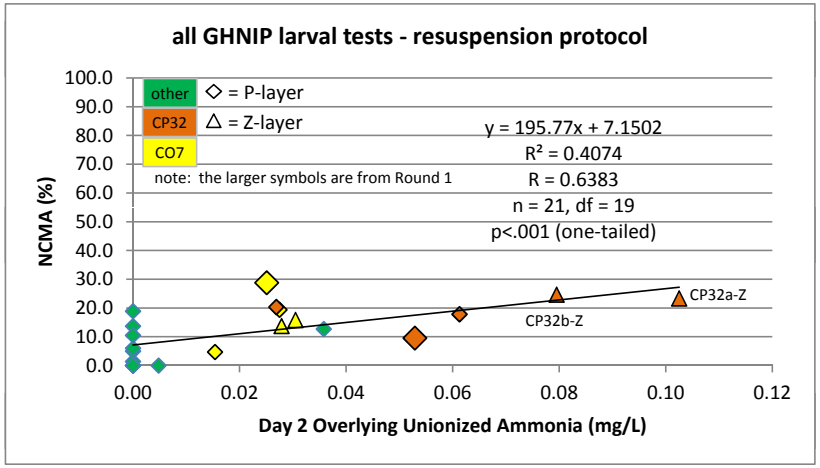


Table 2 – Calculated dredged material volumes from -40 to -42 feet MLLW

Reach	depth (ft, MLLW)	Stations	Side Slope	Volume (cy)	Volume (cy) w/ 15% Contingency
South	-40 to -42	463+00 to 715+93	1:5	250,454	288,022
Crossover	-40 to -42	715+93 to 869+00	1:5	516,782	594,299
North Channel	-40 to -42	869+00 to 1005+71	1:3	326,927	375,966
Hoquiam Channel	-40 to -42	1005+71 to 1156+02	1:3	317,484	365,106
Cow Point	-40 to -42	1156+02 to 1227+99	1:3	304,712	350,419
TOTAL				1,716,359	1,973,812

Table 3. DMMU stationing and volumes.

Reach	DMMU #	begin station	end station	volume	# of field samples
SR	1	463+00	605+16	72,002	3
SR	2	605+16	628+97	72,014	3
SR	3	628+97	679+12	72,003	3
SR	4	679+12	715+93	72,003	3
CO	5	715+93	733+62	65,163	8
CO	6	733+62	750+28	64,162	8
CO	7	750+28	769+71	63,150	8
CO	8	769+71	788+39	62,143	8
CO	9	788+39	806+07	61,124	8
CO	10	806+07	821+53	60,128	8
CO	11	821+53	834+07	59,106	7
CO	12	834+07	844+65	58,089	7
CO	13	844+65	856+41	57,093	7
CO/NC	14	856+41	874+10	56,063	7
NC	15	874+10	895+90	55,073	7
NC	16	895+90	912+50	54,045	7
NC	17	912+50	934+26	53,037	7
NC	18	934+26	952+71	52,033	7
NC	19	952+71	968+20	51,022	6
NC	20	968+20	993+07	50,019	6
NC	21	993+07	1005+71	48,815	6
HC	22	1005+71	1018+51	47,692	6
HC	23	1018+51	1034+38	47,702	6
HC	24	1034+38	1049+44	47,715	6
HC	25	1049+44	1063+01	47,704	6
HC	26	1063+01	1075+80	47,701	6
HC	27	1075+80	1088+30	47,701	6
HC	28	1088+30	1115+43	47,696	6
HC/CP	29	1115+43	1165+85	47,689	6
CP	30	1165+85	1178+91	47,693	6
CP	31	1178+91	1192+22	47,687	6
CP	32	1192+22	1198+47	47,700	6
CP	33	1198+47	1203+58	47,812	6
CP	34	1203+58	1210+78	47,695	6
CP	35	1210+78	1219+42	47,669	6
CP	36	1219+42	1227+99	47,669	6
			total:	1,973,812	224

CO = Crossover Reach
CP = Cow Point Reach
HC = Hoquiam Channel
NC = North Channel
SR = South Reach

Table 4. Sampling Data

DMMU	Station	Latitude	Longitude	Mudline Elevation (ft, MLLW)	Acquisition Depth (ft, MLLW)	Sample Length Acquired (ft)	Z-sample Length Acquired (ft)
SR1	SR1-1	46.92063	-124.07107	-39.9	-44.0	2.0	2.0
	SR1-2	46.92049	-124.07546	-39.8	-43.6	2.0	1.6
	SR1-3	46.92019	-124.06274	-38.4	-44.0	2.0	2.0
SR2	SR2-1	46.92011	-124.05874	-38.7	-44.0	2.0	2.0
	SR2-2	46.92018	-124.05574	-37.4	-44.0	2.0	2.0
	SR2-3	46.92139	-124.05098	-39.4	-44.0	2.0	2.0
SR3	SR3-1	46.92198	-124.04854	-38.8	-44.0	2.0	2.0
	SR3-2	46.92257	-124.04638	-38.4	-44.0	2.0	2.0
	SR3-3	46.92324	-124.04408	-39.6	-44.0	2.0	2.0
SR4	SR4-1	46.92786	-124.03089	-39.6	-44.0	2.0	2.0
	SR4-2	46.92934	-124.02516	-39.9	-44.0	2.0	2.0
	SR4-3	46.93113	-124.01937	-39.3	-44.0	2.0	2.0
CO5	CO5-1	46.93187	-124.01843	-36.4	-44.0	2.0	2.0
	C05-2	46.93252	-124.01756	-32.6	-44.0	2.0	2.0
	C05-3	46.93311	-124.01647	-34.0	-44.0	2.0	2.0
	CO5-4	46.93361	-124.01591	-32.6	-44.0	2.0	2.0
	CO5-5	46.93440	-124.01471	-33.0	-44.0	2.0	2.0
	CO5-6	46.93379	-124.01484	-36.9	-44.0	2.0	2.0
	CO5-7	46.93313	-124.01578	-37.2	-44.0	2.0	2.0
	CO5-8	46.93235	-124.01716	-37.3	-44.0	2.0	2.0
CO6	CO6-1	46.93506	-124.01377	-33.6	-44.0	2.0	2.0
	CO6-2	46.93571	-124.01280	-33.7	-44.0	2.0	2.0
	CO6-3	46.93634	-124.01224	-32.5	-44.0	2.0	2.0
	CO6-4	46.93689	-124.01150	-33.4	-44.0	2.0	2.0
	CO6-5	46.93726	-124.01078	-34.9	-44.0	2.0	2.0
	CO6-6	46.93800	-124.01006	-33.3	-44.0	2.0	2.0
	CO6-7	46.93676	-124.01084	-36.9	-44.0	2.0	2.0
	CO6-8	46.93512	-124.01294	-37.2	-44.0	2.0	2.0
CO7	CO7-1	46.93862	-124.00927	-33.8	-44.0	2.0	2.0
	CO7-2	46.93919	-124.00851	-35.7	-44.0	2.0	2.0
	CO7-3	46.93994	-124.00770	-34.8	-44.0	2.0	2.0
	CO7-4	46.94035	-124.00720	-34.9	-44.0	2.0	2.0
	CO7-5	46.94077	-124.00669	-35.1	-44.0	2.0	2.0
	CO7-6	46.94114	-124.00599	-36.9	-44.0	2.0	2.0
	CO7-7	46.94185	-124.00513	-36.7	-44.0	2.0	2.0
	CO7-8	46.94144	-124.00464	-39.7	-44.0	2.0	2.0
CO8	CO8-1	46.94252	-124.00419	-37.2	-44.0	2.0	2.0
	CO8-2	46.94375	-124.00254	-36.5	-44.0	2.0	2.0
	CO8-3	46.94443	-124.00154	-36.6	-44.0	2.0	2.0
	CO8-4	46.94503	-124.00083	-36.4	-44.0	2.0	2.0
	CO8-5	46.94555	-124.00023	-35.2	-44.0	2.0	2.0
	CO8-6	46.94495	-123.99961	-36.7	-44.0	2.0	2.0
	CO8-7	46.94386	-124.00136	-38.3	-44.0	2.0	2.0
	CO8-8	46.94282	-124.00281	-38.8	-44.0	2.0	2.0

Table 4. Sampling Data

DMMU	Station	Latitude	Longitude	Mudline Elevation (ft, MLLW)	Acquisition Depth (ft, MLLW)	Sample Length Acquired (ft)	Z-sample Length Acquired (ft)
CO9	CO9-1	46.94637	-123.99899	-35.3	-44.0	2.0	2.0
	CO9-2	46.94720	-123.99795	-35.6	-44.0	2.0	2.0
	CO9-3	46.94805	-123.99692	-36.3	-44.0	2.0	2.0
	CO9-4	46.94858	-123.99591	-37.6	-43.3	2.0	1.3
	CO9-5	46.94920	-123.99499	-38.4	-44.0	2.0	2.0
	CO9-6	46.94744	-123.99635	-38.7	-44.0	2.0	2.0
	CO9-7	46.94675	-123.99726	-36.3	-44.0	2.0	2.0
	CO9-8	46.94583	-123.99849	-36.9	-44.0	2.0	2.0
CO10	CO10-1	46.94993	-123.99416	-37.5	-44.0	2.0	2.0
	CO10-2	46.95053	-123.99349	-36.8	-44.0	2.0	2.0
	CO10-3	46.95152	-123.99227	-38.0	-44.0	2.0	2.0
	CO10-4	46.95228	-123.99143	-37.6	-44.0	2.0	2.0
	CO10-5	46.95192	-123.99041	-36.0	-44.0	2.0	2.0
	CO10-6	46.95135	-123.99097	-33.3	-44.0	2.0	2.0
	CO10-7	46.95080	-123.99184	-36.1	-44.0	2.0	2.0
	CO10-8	46.95020	-123.99262	-37.0	-44.0	2.0	2.0
CO11	CO11-1	46.95397	-123.98933	-38.0	-44.0	2.0	2.0
	CO11-2	46.95461	-123.98854	-37.5	-43.8	2.0	1.8
	CO11-3	46.95507	-123.98786	-37.1	-43.1	2.0	1.1
	CO11-4	46.95457	-123.98701	-35.8	-44.0	2.0	2.0
	CO11-5	46.95404	-123.98772	-36.3	-44.0	2.0	2.0
	CO11-6	46.95339	-123.98865	-34.1	-44.0	2.0	2.0
	CO11-7	46.95265	-123.98944	-35.1	-44.0	2.0	2.0
CO12	CO12-1	46.95593	-123.98632	-36.9	-44.0	2.0	2.0
	CO12-2	46.95652	-123.98594	-36.5	-41.9	1.9	none
	CO12-3	46.95708	-123.98527	-35.9	-44.0	2.0	2.0
	CO12-4	46.95671	-123.98415	-31.3	-44.0	2.0	2.0
	CO12-5	46.95638	-123.98455	-31.1	-43.8	2.0	1.8
	CO12-6	46.95575	-123.98539	-32.8	-43.9	2.0	1.9
	CO12-7	46.95512	-123.98624	-33.9	-44.0	2.0	2.0
CO13	CO13-1	46.95790	-123.98383	-36.9	-44.0	2.0	2.0
	CO13-2	46.95895	-123.98245	-39.9	-44.0	2.0	2.0
	CO13-3	46.95919	-123.98081	-32.1	-44.0	2.0	2.0
	CO13-4	46.95876	-123.98142	-33.0	-44.0	2.0	2.0
	CO13-5	46.95830	-123.98209	-33.8	-44.0	2.0	2.0
	CO13-6	46.95792	-123.98263	-33.0	-44.0	2.0	2.0
	CO13-7	46.95752	-123.98316	-32.8	-44.0	2.0	2.0
CO/NC14	CO/NC14-1	46.96053	-123.97877	-38.7	-44.0	2.0	2.0
	CO/NC14-2	46.96091	-123.97749	-38.6	-44.0	2.0	2.0
	CO/NC14-3	46.96128	-123.97535	-38.2	-44.0	2.0	2.0
	CO/NC14-4	46.96075	-123.97681	-34.5	-44.0	2.0	2.0
	CO/NC14-5	46.96051	-123.97791	-35.3	-44.0	2.0	2.0
	CO/NC14-6	46.96002	-123.97900	-32.1	-44.0	2.0	2.0
	CO/NC14-7	46.95971	-123.97993	-33.1	-44.0	2.0	2.0

Table 4. Sampling Data

DMMU	Station	Latitude	Longitude	Mudline Elevation (ft, MLLW)	Acquisition Depth (ft, MLLW)	Sample Length Acquired (ft)	Z-sample Length Acquired (ft)
NC15	NC15-1	46.96167	-123.97214	-39.2	-43.7	2.0	1.7
	NC15-2	46.96204	-123.96944	-40.6	-44.0	2.0	2.0
	NC15-3	46.96241	-123.96743	-39.9	-44.0	2.0	2.0
	NC15-4	46.96205	-123.96655	-36.6	-44.0	2.0	2.0
	NC15-5	46.96197	-123.96848	-38.8	-44.0	2.0	2.0
	NC15-6	46.96158	-123.97023	-34.5	-44.0	2.0	2.0
	NC15-7	46.96111	-123.97398	-32.5	-44.0	2.0	2.0
NC16	NC16-1	46.96292	-123.96440	-38.9	-44.0	2.0	2.0
	NC16-2	46.96321	-123.96199	-38.4	-44.0	2.0	2.0
	NC16-3	46.96347	-123.96018	-37.6	-43.6	2.0	1.6
	NC16-4	46.96285	-123.96034	-38.0	-44.0	2.0	2.0
	NC16-5	46.96258	-123.96180	-35.7	-44.0	2.0	2.0
	NC16-6	46.96266	-123.96333	-37.5	-44.0	2.0	2.0
	NC16-7	46.96226	-123.96506	-36.0	-44.0	2.0	2.0
NC17	NC17-1	46.96361	-123.95863	-38.3	-44.0	2.0	2.0
	NC17-2	46.96385	-123.95659	-38.0	-44.0	2.0	2.0
	NC17-3	46.96393	-123.95487	-39.7	-44.0	2.0	2.0
	NC17-4	46.96450	-123.95283	-37.5	-43.7	2.0	1.7
	NC17-5	46.96464	-123.95160	-37.6	-44.0	2.0	2.0
	NC17-6	46.96317	-123.95707	-39.1	-44.0	2.0	2.0
	NC17-7	46.96303	-123.95896	-39.1	-44.0	2.0	2.0
NC18	NC18-1	46.96490	-123.95046	-34.6	-43.0	2.0	1.0
	NC18-2	46.96492	-123.94892	-38.8	-44.0	2.0	2.0
	NC18-3	46.96538	-123.94796	-35.9	-44.0	2.0	2.0
	NC18-4	46.96527	-123.94672	-38.9	-44.0	2.0	2.0
	NC18-5	46.96578	-123.94570	-34.5	-44.0	2.0	2.0
	NC18-6	46.96600	-123.94439	-35.2	-44.0	2.0	2.0
	NC18-7	46.96536	-123.94443	-39.0	-44.0	2.0	2.0
NC19	NC19-1	46.96590	-123.94310	-38.7	-44.0	2.0	2.0
	NC19-2	46.96665	-123.94087	-36.2	-44.0	2.0	2.0
	NC19-3	46.96704	-123.93850	-38.2	-44.0	2.0	2.0
	NC19-4	46.96644	-123.93822	-38.8	-44.0	2.0	2.0
	NC19-5	46.96629	-123.93990	-39.4	-44.0	2.0	2.0
	NC19-6	46.96580	-123.94145	-38.3	-44.0	2.0	2.0
NC20	NC20-1	46.96874	-123.92895	-39.1	-44.0	2.0	2.0
	NC20-2	46.96837	-123.92877	-38.3	-44.0	2.0	2.0
	NC20-3	46.96812	-123.93018	-32.0	-44.0	2.0	2.0
	NC20-4	46.96775	-123.93135	-31.2	-43.9	2.0	1.9
	NC20-5	46.96730	-123.93328	-37.2	-44.0	2.0	2.0
	NC20-6	46.96682	-123.93665	-38.9	-44.0	2.0	2.0
NC21	NC21-1	46.96899	-123.92736	-37.7	-44.0	2.0	2.0
	NC21-2	46.96952	-123.92425	-38.2	-44.0	2.0	2.0
	NC21-3	46.96903	-123.92368	-38.1	-44.0	2.0	2.0
	NC21-4	46.96882	-123.92498	-39.1	-44.0	2.0	2.0
	NC21-5	46.96885	-123.92590	-39.3	-44.0	2.0	2.0
	NC21-6	46.96860	-123.92723	-38.5	-44.7	2.0	2.0

Table 4. Sampling Data

DMMU	Station	Latitude	Longitude	Mudline Elevation (ft, MLLW)	Acquisition Depth (ft, MLLW)	Sample Length Acquired (ft)	Z-sample Length Acquired (ft)
NC22	NC22-1	46.96955	-123.92179	-39.8	-44.0	2.0	2.0
	HC22-2	46.96942	-123.92052	-38.5	-44.0	2.0	2.0
	HC22-3	46.96928	-123.91896	-37.8	-44.0	2.0	2.0
	HC22-4	46.96892	-123.91912	-33.8	-44.0	2.0	2.0
	HC22-5	46.96907	-123.92050	-34.1	-44.0	2.0	2.0
	HC22-6	46.96914	-123.92266	-34.4	-44.0	2.0	2.0
HC23	HC23-1	46.96921	-123.91653	-38.1	-44.0	2.0	2.0
	HC23-2	46.96940	-123.91547	-39.2	-44.0	2.0	2.0
	HC23-3	46.96863	-123.91234	-38.8	-44.0	2.0	2.0
	HC23-4	46.96865	-123.91350	-38.5	-44.0	2.0	2.0
	HC23-5	46.96874	-123.91492	-38.0	-44.0	2.0	2.0
	HC23-6	46.96887	-123.91742	-36.1	-44.0	2.0	2.0
HC24	HC24-1	46.96914	-123.90955	-38.4	-44.0	2.0	2.0
	HC24-2	46.96907	-123.90838	-38.3	-44.0	2.0	2.0
	HC24-3	46.96895	-123.90653	-35.2	-44.0	2.0	2.0
	HC24-4	46.96843	-123.90788	-39.2	-44.0	2.0	2.0
	HC24-5	46.96840	-123.90981	-37.4	-44.0	2.0	2.0
	HC24-6	46.96855	-123.91120	-38.0	-44.0	2.0	2.0
HC25	HC25-1	46.96888	-123.90533	-33.8	-44.0	2.0	2.0
	HC25-2	46.96878	-123.90426	-34.5	-44.0	2.0	2.0
	HC25-3	46.96873	-123.90326	-34.1	-44.0	2.0	2.0
	HC25-4	46.96870	-123.90225	-32.4	-44.0	2.0	2.0
	HC25-5	46.96864	-123.90108	-32.1	-44.0	2.0	2.0
	HC25-6	46.96805	-123.90289	-38.0	-44.0	2.0	2.0
HC26	HC26-1	46.96859	-123.89969	-31.6	-44.0	2.0	2.0
	HC26-2	46.96838	-123.89775	-34.1	-44.0	2.0	2.0
	HC26-3	46.96833	-123.89684	-34.3	-44.0	2.0	2.0
	HC26-4	46.96789	-123.89619	-38.3	-43.3	2.0	1.3
	HC26-5	46.96779	-123.89748	-38.2	-43.4	2.0	1.4
	HC26-6	46.96806	-123.89907	-37.8	-44.0	2.0	2.0
HC27	HC27-1	46.96827	-123.89418	-38.5	-44.0	2.0	2.0
	HC27-2	46.96830	-123.89315	-38.9	-44.0	2.0	2.0
	HC27-3	46.96829	-123.89201	-38.6	-44.0	2.0	2.0
	HC27-4	46.96792	-123.89092	-38.9	-44.0	2.0	2.0
	HC27-5	46.96774	-123.89280	-39.0	-44.0	2.0	2.0
	HC27-6	46.96781	-123.89466	-38.3	-44.0	2.0	2.0
HC28	HC28-1	46.96835	-123.88894	-38.1	-44.0	2.0	2.0
	HC28-2	46.96841	-123.88754	-38.0	-44.0	2.0	2.0
	HC28-3	46.96789	-123.88021	-41.0	-44.0	2.0	2.0
	HC28-4	46.96776	-123.88107	-39.6	-44.0	2.0	2.0
	HC28-5	46.96779	-123.88673	-40.4	-44.0	2.0	2.0
	HC28-6	46.96791	-123.88807	-39.6	-44.0	2.0	2.0
HC/CP29	HC/CP29-1	46.96791	-123.87834	-35.3	-44.0	2.0	2.0
	HC/CP29-2	46.96799	-123.87647	-38.6	-44.0	2.0	2.0
	HC/CP29-3	46.96775	-123.87487	-39.0	-44.0	2.0	2.0
	HC/CP29-4	46.96696	-123.86855	-40.6	-44.0	2.0	2.0
	HC/CP29-5	46.96570	-123.86155	-38.0	-44.0	2.0	2.0
	HC/CP29-6	46.96542	-123.86075	-38.6	-44.0	2.0	2.0

Table 4. Sampling Data

DMMU	Station	Latitude	Longitude	Mudline Elevation (ft, MLLW)	Acquisition Depth (ft, MLLW)	Sample Length Acquired (ft)	Z-sample Length Acquired (ft)
CP30	CP30-1	46.96468	-123.85753	-36.7	-44.0	2.0	2.0
	CP30-2	46.96414	-123.85628	-39.1	-44.0	2.0	2.0
	CP30-3	46.96373	-123.85615	-38.1	-43.9	2.0	1.9
	CP30-4	46.96414	-123.85731	-37.0	-44.0	2.0	2.0
	CP30-5	46.96445	-123.85835	-37.7	-44.0	2.0	2.0
	CP30-6	46.96494	-123.85946	-39.1	-44.0	2.0	2.0
CP31	CP31-1	46.96336	-123.85411	-37.5	-43.8	2.0	1.8
	CP31-2	46.96278	-123.85259	-37.8	-44.0	2.0	2.0
	CP31-3	46.96144	-123.85147	-38.9	-44.0	2.0	2.0
	CP31-4	46.96208	-123.85247	-39.2	-44.0	2.0	2.0
	CP31-5	46.96266	-123.85369	-37.2	-44.0	2.0	2.0
	CP31-6	46.96330	-123.85512	-37.5	-44.0	2.0	2.0
CP32	CP32-1	46.96132	-123.84924	-38.6	-44.0	2.0	2.0
	CP32-2	46.96137	-123.84873	-39.7	-44.0	2.0	2.0
	CP32-3	46.96029	-123.84952	-39.2	-44.0	2.0	2.0
	CP32-4	46.95992	-123.84992	-35.7	-44.0	2.0	2.0
	CP32-5	46.96023	-123.85055	-37.6	-44.0	2.0	2.0
	CP32-6	46.96095	-123.85027	-39.7	-44.0	2.0	2.0
CP33	CP33-1	46.96086	-123.84764	-37.6	-44.0	2.0	2.0
	CP33-2	46.95967	-123.84778	-38.8	-43.8	2.0	1.8
	CP33-3	46.95938	-123.84834	-39.7	-44.0	2.0	2.0
	CP33-4	46.95904	-123.84886	-38.6	-44.0	2.0	2.0
	CP33-5	46.95946	-123.84924	-37.4	-44.0	2.0	2.0
	CP33-6	46.96008	-123.84879	-38.5	-44.0	2.0	2.0
CP34	CP34-1	46.96046	-123.84660	-37.8	-44.0	2.0	2.0
	CP34-2	46.96042	-123.84562	-35.2	-44.0	2.0	2.0
	CP34-3	46.96043	-123.84465	-32.4	-42.6	2.0	0.6
	CP34-4	---	---	---	---	---	---
	CP34-5	46.95993	-123.84487	-38.9	-44.0	2.0	2.0
	CP34-6	46.95992	-123.84586	-40.2	-44.0	2.0	2.0
CP35	CP35-1	46.96021	-123.84353	-32.1	-43.1	2.0	1.1
	CP35-2	46.96021	-123.84183	-31.6	-44.0	2.0	2.0
	CP35-3	46.96032	-123.84099	-32.8	-42.2	2.0	0.2
	CP35-4	46.95965	-123.84103	-36.5	-42.5	2.0	0.5
	CP35-5	46.95964	-123.84229	-37.1	-41.7	1.7	none
	CP35-6	46.95975	-123.84355	-37.5	-43.5	2.0	1.5
CP36	CP36-1	46.96033	-123.84000	-32.2	-42.2	2.0	0.2
	CP36-2	46.96031	-123.83864	-33.3	-44.0	2.0	2.0
	CP36-3	46.96019	-123.83772	-32.2	-41.6	1.6	none
	CP36-4	46.95957	-123.83750	-35.9	-42.1	2.0	0.1
	CP36-5	46.95952	-123.83876	-37.2	-44.0	2.0	2.0
	CP36-6	46.95958	-123.84005	-36.3	-42.8	2.0	0.8

Table 5-1. Analytical Results for South Reach: DMMUs 1 - 4 (from SEE, 2013)

Compound	SL	BT	ML	SR-1		SR-2		SR-3		SR-4	
				Value	Q	Value	Q	Value	Q	Value	Q
Conventionals											
Total Solids (%)	—	—	—	89.00		85.20		90.20		74.90	
Total Volatile Solids (%)	—	—	—	1.51		1.35		1.33		2.37	
N-Ammonia (mg-N/kg)	—	—	—	6.73		11.60		3.90		19.80	
Sulfide (mg/kg)	—	—	—	71.00		135.00		2.49	J	51.10	J
Total Organic Carbon (%)	—	—	—	2.68		0.31		0.98		1.17	
Gravel (%)	—	—	—	0.60		0.20		0.20		0.10	
Sand (%)	—	—	—	97.30		97.30		99.50		85.10	
Silt (%)	—	—	—	2.00	U	2.50	U	0.30		9.70	
Clay (%)	—	—	—	0.00		0.00		0.00		5.10	
Fines (%)	—	—	—	2.00	U	2.50	U	0.30		14.80	
Metals (mg/kg dw)											
Antimony	150	—	200	6.00	U	n.a.	n.a.	5.00	U	7.00	U
Arsenic	57	507.1	700	6.00	U	n.a.	n.a.	5.00	U	7.00	U
Cadmium	5.1	11.3	14	0.20	U	n.a.	n.a.	0.20	U	0.30	U
Chromium	260	260	—	17.40		n.a.	n.a.	17.50		23.80	
Copper	390	1,027	1,300	7.00		n.a.	n.a.	7.30		15.70	
Lead	450	975	1,200	2.00	U	n.a.	n.a.	2.00	U	3.00	
Mercury	0.41	1.5	2.3	0.02	U	0.02	U	0.02	U	0.03	U
Selenium	—	3	—	0.60	U	n.a.	n.a.	0.50	U	0.60	U
Silver	6.1	6.1	8.4	0.40	U	n.a.	n.a.	0.30	U	0.40	U
Zinc	410	2,783	3,800	33.00		n.a.	n.a.	34.00		46.00	
PAHs (µg/kg dw)											
Naphthalene	2,100	—	2,400	18.00	U	n.a.	n.a.	20.00	U	19.00	U
2-Methylnaphthalene [1]	670	—	1,900	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Acenaphthylene	560	—	1,300	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Acenaphthene	500	—	2,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Fluorene	540	—	3,600	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Phenanthrene	1,500	—	21,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Anthracene	960	—	13,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Total LPAH	5,200	—	29,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Fluoranthene	1,700	4,600	30,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Pyrene	2,600	11,980	16,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Benzo(a)anthracene	1,300	—	5,100	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Chrysene	1,400	—	21,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Total HPAH	12,000	—	69,000	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Chlorinated Hydrocarbons (µg/kg dw)											
1,4-Dichlorobenzene	110	—	120	18.00	U	n.a.	n.a.	20.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	18.00	U	n.a.	n.a.	20.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Hexachlorobenzene	22	168	230	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Phthalates (µg/kg dw)											
Dimethylphthalate	71	—	1,400	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Diethylphthalate	200	—	1,200	46.00	U	n.a.	n.a.	49.00	U	47.00	U
Di-n-Butylphthalate	1,400	—	5,100	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Butylbenzylphthalate	63	—	970	18.00	U	n.a.	n.a.	20.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	23.00	U	n.a.	n.a.	25.00	U	24.00	U
Di-n-Octyl phthalate	6,200	—	6,200	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Phenols (µg/kg dw)											
Phenol	420	—	1,200	18.00	U	n.a.	n.a.	20.00	U	41.00	
2-Methylphenol	63	—	77	18.00	U	n.a.	n.a.	20.00	U	19.00	U
4-Methylphenol	670	—	3,600	37.00	U	n.a.	n.a.	39.00	U	38.00	U
2,4-Dimethylphenol	29	—	210	17.00	U	n.a.	n.a.	20.00	U	19.00	U
Pentachlorophenol	400	504	690	180.00	U	n.a.	n.a.	200.00	U	190.00	U

Table 5-1. Analytical Results for South Reach: DMMUs 1 - 4 (from SEE, 2013)

Compound	SL	BT	ML	SR-1		SR-2		SR-3		SR-4	
				Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)											
Benzyl Alcohol	57	—	870	18.00	U	n.a.	n.a.	20.00	UJ	19.00	U
Benzoic Acid	650	—	760	370.00	U	n.a.	n.a.	390.00	U	380.00	U
Dibenzofuran	540	—	1,700	18.00	U	n.a.	n.a.	20.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	18.00	U	n.a.	n.a.	20.00	U	19.00	U
Heptachlor	1.5	—	—	0.46	U	n.a.	n.a.	0.48	U	1.80	U
Hexachlorobutadiene	11	—	270	0.46	U	n.a.	n.a.	0.48	U	0.48	U
Pesticides and PCBs (µg/kg dw)											
Aldrin	9.5	—	—	0.46	U	n.a.	n.a.	0.48	U	3.10	U
Dieldrin	1.9	—	—	0.92	U	n.a.	n.a.	0.96	U	0.96	U
4,4 -DDE	16	—	—	0.92	U	n.a.	n.a.	0.96	U	0.96	U
4,4 -DDD	9	—	—	0.92	U	n.a.	n.a.	0.96	U	0.96	U
4,4 -DDT	12	—	—	0.92	U	n.a.	n.a.	0.96	U	0.96	U
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.92	U	n.a.	n.a.	0.96	U	0.96	U
trans-Chlordane	—	—	—	0.46	U	n.a.	n.a.	0.48	U	1.80	U
cis-Chlordane	—	—	—	0.46	U	n.a.	n.a.	0.48	U	2.00	U
oxy Chlordane	—	—	—	1.80	U	n.a.	n.a.	1.90	U	2.60	U
cis-Nonachlor	—	—	—	1.80	U	n.a.	n.a.	1.90	U	1.90	U
trans-Nonachlor	—	—	—	1.80	U	n.a.	n.a.	1.90	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	1.80	U	n.a.	n.a.	1.90	U	2.60	U
Aroclor 1016	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1242	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1248	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1254	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1260	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1221	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1232	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1262	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Aroclor 1268	—	—	—	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Total PCBs	130	38 (2)	3,100	9.10	U	n.a.	n.a.	9.00	U	9.20	U
Dioxins and Furans (ng/kg) [3]											
2,3,7,8-TCDD	—	—	—	0.138	U	n.a.	n.a.	0.197	U	0.436	U
1,2,3,7,8-PeCDD	—	—	—	0.153	U	n.a.	n.a.	0.189	J	0.523	J
1,2,3,4,7,8-HxCDD	—	—	—	0.192	U	n.a.	n.a.	0.272	U	0.601	U
1,2,3,6,7,8-HxCDD	—	—	—	0.099	J	n.a.	n.a.	0.059	U	0.305	U
1,2,3,7,8,9-HxCDD	—	—	—	0.214	U	n.a.	n.a.	0.253	J	1.150	J
1,2,3,4,6,7,8-HpCDD	—	—	—	1.510	J	n.a.	n.a.	0.804	U	4.860	
OCDD	—	—	—	8.980		n.a.	n.a.	7.010		25.700	
2,3,7,8-TCDF	—	—	—	0.195	J	n.a.	n.a.	0.081	J	0.163	J
1,2,3,7,8-PeCDF	—	—	—	0.212	U	n.a.	n.a.	0.055	U	0.069	J
2,3,4,7,8-PeCDF	—	—	—	0.150	U	n.a.	n.a.	0.048	J	0.131	U
1,2,3,4,7,8-HxCDF	—	—	—	0.182	U	n.a.	n.a.	0.167	U	0.058	U
1,2,3,6,7,8-HxCDF	—	—	—	0.027	J	n.a.	n.a.	0.154	U	0.044	U
2,3,4,6,7,8-HxCDF	—	—	—	0.191	U	n.a.	n.a.	0.020	U	0.072	U
1,2,3,7,8,9-HxCDF	—	—	—	0.121	U	n.a.	n.a.	0.095	U	0.134	U
1,2,3,4,6,7,8-HpCDF	—	—	—	0.291	U	n.a.	n.a.	0.208	J	1.280	U
1,2,3,4,7,8,9-HpCDF	—	—	—	0.236	U	n.a.	n.a.	0.119	U	0.385	U
OCDF	—	—	—	0.541	U	n.a.	n.a.	0.145	U	1.680	U

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

n.a. - not analyzed

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

Table 5-2. Analytical Results for Crossover Reach: DMMUs 5 - 13 (from SEE, 2013)

Compound	SL	BT	ML	CO-5		CO-55 (CO5 Dup)		CO-6		CO-7		CO-8	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Conventionals													
Total Solids (%)	—	—	—	68.90		68.4		68.10		65.70		72.40	
Total Volatile Solids (%)	—	—	—	3.55		3.62		4.15		4.65		3.18	
N-Ammonia (mg-N/kg)	—	—	—	75.50		84.7		89.50		102.00		33.50	
Sulfide (mg/kg)	—	—	—	840.00	J	23.9		557.00	J	638.00	J	455.00	
Total Organic Carbon (%)	—	—	—	1.30		0.729		1.20		1.30		1.06	
Gravel (%)	—	—	—	0.20		0.3		0.20		0.10	U	0.60	
Sand (%)	—	—	—	73.40		73		73.60		64.90		78.50	
Silt (%)	—	—	—	18.50		18.2		17.60		24.90		14.40	
Clay (%)	—	—	—	7.80		8.3		8.60		10.50		6.40	
Fines (%)	—	—	—	26.30		26.50		26.20		35.40		20.80	
Metals (mg/kg dw)													
Antimony	150	—	200	7.00	UJ	7.00	UJ	7.00	UJ	7.00	UJ	7.00	UJ
Arsenic	57	507.1	700	7.00	U	7.00	U	7.00	U	7.00	U	7.00	U
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.30	U	0.30	U	0.30	U
Chromium	260	260	—	25.40		23.90		26.00		29.40		26.10	
Copper	390	1,027	1,300	20.60		20.70		21.90		25.70		21.30	
Lead	450	975	1,200	4.00		3.00		4.00		4.00		3.00	U
Mercury	0.41	1.5	2.3	0.03		0.03	U	0.03	U	0.04		0.03	U
Selenium	—	3	—	0.70	U	0.70	U	0.70	U	0.70	U	0.60	U
Silver	6.1	6.1	8.4	0.40	U	0.40	U	0.40	U	0.40	U	0.40	U
Zinc	410	2,783	3,800	50.00		46.00		52.00		58.00		49.00	
PAHs (µg/kg dw)													
Naphthalene	2,100	—	2,400	26.00		19.00	U	12.00	J	18.00	J	19.00	U
2-Methylnaphthalene [1]	670	—	1,900	24.00		19.00	U	19.00	U	19.00	U	19.00	U
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Fluorene	540	—	3,600	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phenanthrene	1,500	—	21,000	12.00	J	19.00	U	17.00	J	16.00	J	10.00	J
Anthracene	960	—	13,000	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Total LPAH	5,200	—	29,000	38.00		19.00	U	29.00		34.00		10.00	
Fluoranthene	1,700	4,600	30,000	19.00	U	19.00	U	13.00	J	13.00	J	10.00	J
Pyrene	2,600	11,980	16,000	11.00	J	19.00	U	13.00	J	14.00	J	12.00	J
Benzo(a)anthracene	1,300	—	5,100	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Chrysene	1,400	—	21,000	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Total HPAH	12,000	—	69,000	11.00		19.00	U	26.00		27.00		22.00	
Chlorinated Hydrocarbons (µg/kg dw)													
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Hexachlorobenzene	22	168	230	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phthalates (µg/kg dw)													
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Diethylphthalate	200	—	1,200	48.00	U	48.00	U	48.00	U	47.00	U	48.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	15.00	J	15.00	J	23.00	U	24.00	U
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phenols (µg/kg dw)													
Phenol	420	—	1,200	17.00	J	16.00	J	19.00	U	19.00		24.00	
2-Methylphenol	63	—	77	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
4-Methylphenol	670	—	3,600	33.00	J	18.00	J	20.00	J	48.00		38.00	U
2,4-Dimethylphenol	29	—	210	19.00	UJ	19.00	UJ	19.00	UJ	19.00	UJ	19.00	UJ
Pentachlorophenol	400	504	690	190.00	UJ	190.00	UJ	190.00	UJ	190.00	UJ	190.00	UJ

Table 5-2. Analytical Results for Crossover Reach: DMMUs 5 - 13 (from SEE, 2013)

Compound	SL	BT	ML	CO-5		CO-55 (CO5 Dup)		CO-6		CO-7		CO-8	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)													
Benzyl Alcohol	57	—	870	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Benzoic Acid	650	—	760	390.00	U	380.00	U	380.00	U	370.00	U	380.00	U
Dibenzofuran	540	—	1,700	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Heptachlor	1.5	—	—	0.47	UJ	0.47	UJ	0.48	UJ	0.49	UJ	0.46	UJ
Hexachlorobutadiene	11	—	270	0.47	U	0.47	U	0.48	U	0.49	U	0.46	U
Pesticides and PCBs (µg/kg dw)													
Aldrin	9.5	—	—	0.47	U	0.47	UJ	0.48	U	0.49	U	0.46	U
Dieldrin	1.9	—	—	0.95	U	0.95	U	0.97	U	0.98	U	0.93	U
4,4 -DDE	16	—	—	0.95	U	0.95	U	0.97	U	0.98	J	0.93	U
4,4 -DDD	9	—	—	0.95	U	0.95	U	0.97	U	0.98	U	0.93	U
4,4 -DDT	12	—	—	0.95	U	0.95	U	0.97	U	7.40	J	0.93	U
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.95	U	0.95	U	0.97	U	7.40		0.93	U
trans-Chlordane	—	—	—	0.47	U	0.47	U	0.48	U	0.49	U	0.46	U
cis-Chlordane	—	—	—	0.47	U	0.47	U	0.48	U	0.49	U	0.46	U
oxy Chlordane	—	—	—	1.90	U	1.90	U	1.90	U	2.00	U	1.80	U
cis-Nonachlor	—	—	—	1.90	U	1.90	U	1.90	U	3.40	U	1.80	U
trans-Nonachlor	—	—	—	1.90	U	1.90	U	1.90	U	2.00	U	1.80	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	1.90	U	1.90	U	1.90	U	*3.40*	*U*	1.80	U
Aroclor 1016	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1242	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1248	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1254	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1260	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1221	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1232	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1262	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Aroclor 1268	—	—	—	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Total PCBs	130	38 (2)	3,100	9.50	U	9.40	U	9.70	U	9.90	U	9.30	U
Dioxins and Furans (pg/g) [3]													
2,3,7,8-TCDD	—	—	—	0.689	U	0.642	U	0.588	U	0.853	U	0.521	U
1,2,3,7,8-PeCDD	—	—	—	0.931	J	0.961	J	0.944	J	1.150	J	0.600	U
1,2,3,4,7,8-HxCDD	—	—	—	2.100		2.070		1.820	J	2.900		1.650	J
1,2,3,6,7,8-HxCDD	—	—	—	1.000	J	1.100	J	0.818	J	1.100	J	0.604	J
1,2,3,7,8,9-HxCDD	—	—	—	0.302	J	0.303	J	0.242	J	0.315	J	0.206	J
1,2,3,4,6,7,8-HpCDD	—	—	—	14.000		14.000		10.200		14.500		7.640	
OCDD	—	—	—	75.900		84.600		59.100		84.200		45.100	
2,3,7,8-TCDF	—	—	—	0.839	J	0.794	J	0.521	J	0.774	J	0.350	J
1,2,3,7,8-PeCDF	—	—	—	0.168	J	0.135	U	0.132	J	0.186	J	0.085	J
2,3,4,7,8-PeCDF	—	—	—	0.219	U	0.308	J	0.248	U	0.291	J	0.152	J
1,2,3,4,7,8-HxCDF	—	—	—	0.037	U	0.143	U	0.079	U	0.139	U	0.077	U
1,2,3,6,7,8-HxCDF	—	—	—	0.042	U	0.046	U	0.029	U	0.047	U	0.024	U
2,3,4,6,7,8-HxCDF	—	—	—	0.154	J	0.168	J	0.146	J	0.257	J	0.108	U
1,2,3,7,8,9-HxCDF	—	—	—	0.265	J	0.220	U	0.230	U	0.268	J	0.121	U
1,2,3,4,6,7,8-HpCDF	—	—	—	0.117	U	0.177	U	0.134	U	0.129	U	0.059	U
1,2,3,4,7,8,9-HpCDF	—	—	—	4.860		4.820		4.150		5.520		2.600	
OCDF	—	—	—	5.810		5.980		4.720	J	6.610		2.600	U

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.
2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.
3. *Value exceeds the DMMP screening level*

Table 5-2. Analytical Results for Crossover Reach: DMMUs 5 - 13 (from SEE, 2013)

Compound	SL	BT	ML	CO-9		CO-10		CO-11		CO-12		CO-13	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Conventionals													
Total Solids (%)	—	—	—	71.70		71.8		62.9		70.3		65.1	
Total Volatile Solids (%)	—	—	—	3.28		3.7		5.0		3.3		5.0	
N-Ammonia (mg-N/kg)	—	—	—	54.60		58.0		113.0		91.3		68.2	
Sulfide (mg/kg)	—	—	—	398.00		4.6		791.0		23.9		238.0	J
Total Organic Carbon (%)	—	—	—	0.56		1.1		1.6		1.1		1.6	
Gravel (%)	—	—	—	4.80		0.2		0.1		0.1	U	0.1	
Sand (%)	—	—	—	68.70		71.0		63.0		70.3		65.2	
Silt (%)	—	—	—	19.00		18.8		24.5		19.8		23.7	
Clay (%)	—	—	—	7.40		10.1		12.3		9.8		11.0	
Fines (%)	—	—	—	26.40		28.90		36.80		29.60		34.70	
Metals (mg/kg dw)													
Antimony	150	—	200	6.00	UJ	7.00	UJ	7.00	UJ	7.00	UJ	7.00	UJ
Arsenic	57	507.1	700	6.00		7.00	U	7.00	U	7.00	U	8.00	
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.30	U	0.30	U	0.30	U
Chromium	260	260	—	28.70		25.40		30.00		26.80		30.40	
Copper	390	1,027	1,300	24.90		22.60		28.70		24.30		30.00	
Lead	450	975	1,200	3.00	U	3.00		4.00		3.00		4.00	
Mercury	0.41	1.5	2.3	0.03	U	0.03		0.04		0.03		0.04	
Selenium	—	3	—	0.60	U	0.70	U	0.80	U	0.70	U	0.70	U
Silver	6.1	6.1	8.4	0.40	U	0.40	U	0.40	U	0.40	U	0.40	U
Zinc	410	2,783	3,800	52.00		50.00		58.00		53.00		60.00	
PAHs (µg/kg dw)													
Naphthalene	2,100	—	2,400	20.00	U	11.00	J	16.00	J	18.00	U	27.00	
2-Methylnaphthalene [1]	670	—	1,900	20.00	U	19.00	U	11.00	J	18.00	U	14.00	J
Acenaphthylene	560	—	1,300	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Acenaphthene	500	—	2,000	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Fluorene	540	—	3,600	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Phenanthrene	1,500	—	21,000	20.00	U	19.00	U	15.00	J	18.00	U	20.00	
Anthracene	960	—	13,000	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Total LPAH	5,200	—	29,000	20.00	U	11.00		31.00		18.00	U	47.00	
Fluoranthene	1,700	4,600	30,000	11.00	J	19.00	U	12.00	J	18.00	U	18.00	J
Pyrene	2,600	11,980	16,000	9.80	J	19.00	U	14.00	J	18.00	U	19.00	
Benzo(a)anthracene	1,300	—	5,100	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Chrysene	1,400	—	21,000	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	20.00	U	19.00	U	19.00	U	18.00	U	11.00	J
Total HPAH	12,000	—	69,000	20.80		19.00	U	26.00		18.00	U	48.00	
Chlorinated Hydrocarbons (µg/kg dw)													
1,4-Dichlorobenzene	110	—	120	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Hexachlorobenzene	22	168	230	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Phthalates (µg/kg dw)													
Dimethylphthalate	71	—	1,400	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Diethylphthalate	200	—	1,200	49.00	U	48.00	U	48.00	U	46.00	U	47.00	U
Di-n-Butylphthalate	1,400	—	5,100	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Butylbenzylphthalate	63	—	970	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	24.00	U	24.00	U	23.00	U	23.00	U
Di-n-Octyl phthalate	6,200	—	6,200	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Phenols (µg/kg dw)													
Phenol	420	—	1,200	20.00	U	19.00	U	47.00		18.00	U	23.00	
2-Methylphenol	63	—	77	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
4-Methylphenol	670	—	3,600	39.00	U	39.00	U	41.00		37.00	U	80.00	
2,4-Dimethylphenol	29	—	210	20.00	UJ	19.00	UJ	19.00	UJ	18.00	UJ	19.00	UJ
Pentachlorophenol	400	504	690	200.00	UJ	190.00	UJ	190.00	UJ	180.00	UJ	190.00	U

Table 5-2. Analytical Results for Crossover Reach: DMMUs 5 - 13 (from SEE, 2013)

Compound	SL	BT	ML	CO-9		CO-10		CO-11		CO-12		CO-13	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)													
Benzyl Alcohol	57	—	870	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Benzoic Acid	650	—	760	390.00	U	390.00	U	380.00	U	370.00	U	380.00	U
Dibenzofuran	540	—	1,700	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	20.00	U	19.00	U	19.00	U	18.00	U	19.00	U
Heptachlor	1.5	—	—	0.48	UJ	0.48	UJ	0.48	UJ	0.48	UJ	0.50	UJ
Hexachlorobutadiene	11	—	270	0.48	U	0.48	U	0.48	U	0.48	U	0.50	U
Pesticides and PCBs (µg/kg dw)													
Aldrin	9.5	—	—	0.48	U	0.48	U	0.48	U	0.48	U	0.50	U
Dieldrin	1.9	—	—	0.95	U	0.96	U	0.96	U	0.96	U	1.00	U
4,4 -DDE	16	—	—	0.95	U	0.96	U	0.96	U	0.96	U	1.00	U
4,4 -DDD	9	—	—	0.95	U	0.96	U	0.96	U	0.96	U	1.00	U
4,4 -DDT	12	—	—	0.95	U	0.96	U	0.96	U	0.96	U	1.00	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.95	U	0.96	U	0.96	U	0.96	U	1.00	UJ
trans-Chlordane	—	—	—	0.48	U	0.48	U	0.48	U	0.48	U	0.70	U
cis-Chlordane	—	—	—	0.48	U	0.48	U	0.48	U	0.48	U	0.50	U
oxy Chlordane	—	—	—	1.90	U	1.90	U	1.90	U	1.90	U	2.00	U
cis-Nonachlor	—	—	—	1.90	U	1.90	U	1.90	U	1.90	U	2.00	U
trans-Nonachlor	—	—	—	1.90	U	1.90	U	1.90	U	1.90	U	2.00	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	1.90	U	1.90	U	1.90	U	1.90	U	2.00	U
Aroclor 1016	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1242	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1248	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1254	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1260	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1221	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1232	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1262	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Aroclor 1268	—	—	—	9.50	U	9.50	U	9.60	U	9.70	U	9.70	U
Total PCBs	130	38 (2)	3,100	9.50	U	9.50	U	9.60	U	9.70	U		
Dioxins and Furans (pg/g) [3]													
2,3,7,8-TCDD	—	—	—	0.611	J	0.790	J	0.896	U	0.857	J	0.983	U
1,2,3,7,8-PeCDD	—	—	—	0.742	J	0.941	J	1.280	J	1.080	J	1.470	
1,2,3,4,7,8-HxCDD	—	—	—	1.690	J	2.150		3.010		2.200		0.356	J
1,2,3,6,7,8-HxCDD	—	—	—	0.631	J	0.886	J	1.260	J	0.974	J	1.320	J
1,2,3,7,8,9-HxCDD	—	—	—	0.205	J	0.291	J	0.340	J	0.258	J	3.740	
1,2,3,4,6,7,8-HpCDD	—	—	—	7.550		12.000		14.000		10.500		15.100	J
OCDD	—	—	—	43.300		78.000		80.400		63.600		89.100	J
2,3,7,8-TCDF	—	—	—	0.295	J	0.464	J	0.658	J	0.475	J	0.542	J
1,2,3,7,8-PeCDF	—	—	—	0.065	J	0.119	J	0.147	J	0.117	U	0.069	U
2,3,4,7,8-PeCDF	—	—	—	0.084	U	0.243	J	0.123	U	0.139	J	0.115	U
1,2,3,4,7,8-HxCDF	—	—	—	0.051	U	0.109	U	0.140	U	0.081	U	0.275	J
1,2,3,6,7,8-HxCDF	—	—	—	0.025	U	0.060	U	0.047	U	0.028	U	0.192	U
2,3,4,6,7,8-HxCDF	—	—	—	0.084	U	0.151	U	0.200	U	0.168	J	0.170	U
1,2,3,7,8,9-HxCDF	—	—	—	0.143	U	0.197	U	0.251	U	0.200	J	0.050	U
1,2,3,4,6,7,8-HpCDF	—	—	—	0.052	U	0.056	U	0.181	J	0.143	U	5.330	
1,2,3,4,7,8,9-HpCDF	—	—	—	2.150		3.860		5.000		3.910		0.138	U
OCDF	—	—	—	2.540	J	5.980		5.960		3.790	U	7.230	

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

Table 5-3. Analytical Results for North Channel: DMMUs 14 - 21 (from SEE, 2013)

Compound	SL	BT	ML	CO/NC-14		NC-15		NC-16		NC-17	
				Value	Q	Value	Q	Value	Q	Value	Q
Conventionals											
Total Solids (%)	—	—	—	60.60		62.80		60.10		68.70	
Total Volatile Solids (%)	—	—	—	4.77		5.16		4.99		3.26	
N-Ammonia (mg-N/kg)	—	—	—	81.00		120.00		117.00		58.40	
Sulfide (mg/kg)	—	—	—	262.00		220.00		572.00		32.90	
Total Organic Carbon (%)	—	—	—	1.20		2.24		1.65		1.18	
Gravel (%)	—	—	—	0.10		0.10		0.70		0.50	
Sand (%)	—	—	—	62.30		46.50		53.90		72.60	
Silt (%)	—	—	—	25.80		37.50		31.70		18.60	
Clay (%)	—	—	—	11.80		15.90		13.60		8.30	
Fines (%)	—	—	—	37.60		53.40		45.30		26.90	
Metals (mg/kg dw)											
Antimony	150	—	200	8.00	UJ	8.00	UJ	8.00	UJ	7.00	UJ
Arsenic	57	507.1	700	8.00	U	8.00	U	8.00	U	7.00	U
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.30	U	0.30	U
Chromium	260	260	—	31.80		33.50		31.50		27.20	
Copper	390	1,027	1,300	34.70		38.40		36.70		27.30	
Lead	450	975	1,200	4.00		4.00		4.00		3.00	
Mercury	0.41	1.5	2.3	0.04		0.04		0.04		0.03	U
Selenium	—	3	—	0.80	U	0.80	U	0.80	U	0.70	U
Silver	6.1	6.1	8.4	0.50	U	0.50	U	0.50	U	0.40	U
Zinc	410	2,783	3,800	63.00		64.00		62.00		55.00	
PAHs (µg/kg dw)											
Naphthalene	2,100	—	2,400	12.00	J	15.00	J	17.00	J	19.00	U
2-Methylnaphthalene [1]	670	—	1,900	20.00	U	18.00	U	10.00	J	19.00	U
Acenaphthylene	560	—	1,300	20.00	U	18.00	U	19.00	U	19.00	U
Acenaphthene	500	—	2,000	20.00	U	18.00	U	19.00	U	19.00	U
Fluorene	540	—	3,600	20.00	U	18.00	U	19.00	U	19.00	U
Phenanthrene	1,500	—	21,000	12.00	J	15.00	J	26.00		19.00	U
Anthracene	960	—	13,000	20.00	U	18.00	U	19.00	U	19.00	U
Total LPAH	5,200	—	29,000	24.00		30.00		43.00		19.00	U
Fluoranthene	1,700	4,600	30,000	11.00	J	14.00	J	20.00		19.00	U
Pyrene	2,600	11,980	16,000	11.00	J	15.00	J	19.00		19.00	U
Benzo(a)anthracene	1,300	—	5,100	20.00	U	18.00	U	19.00	U	19.00	U
Chrysene	1,400	—	21,000	20.00	U	18.00	U	19.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	20.00	U	18.00	U	19.00	U	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	20.00	U	18.00	U	19.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	20.00	U	18.00	U	19.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	20.00	U	18.00	U	19.00	U	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	20.00	U	18.00	U	19.00	U	19.00	U
Total HPAH	12,000	—	69,000	22.00		29.00		39.00		19.00	U
Chlorinated Hydrocarbons (µg/kg dw)											
1,4-Dichlorobenzene	110	—	120	20.00	U	18.00	U	19.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	20.00	U	18.00	U	19.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	20.00	U	18.00	U	19.00	U	19.00	U
Hexachlorobenzene	22	168	230	20.00	U	18.00	U	19.00	U	19.00	U
Phthalates (µg/kg dw)											
Dimethylphthalate	71	—	1,400	20.00	U	18.00	U	19.00	U	19.00	U
Diethylphthalate	200	—	1,200	50.00	U	46.00	U	47.00	U	47.00	U
Di-n-Butylphthalate	1,400	—	5,100	20.00	U	18.00	U	19.00	U	19.00	U
Butylbenzylphthalate	63	—	970	20.00	U	18.00	U	19.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	25.00	U	23.00	U	24.00	U	24.00	U
Di-n-Octyl phthalate	6,200	—	6,200	20.00	U	18.00	U	19.00	U	19.00	U
Phenols (µg/kg dw)											
Phenol	420	—	1,200	20.00	U	38.00		19.00		20.00	
2-Methylphenol	63	—	77	20.00	U	18.00	U	19.00	U	19.00	U
4-Methylphenol	670	—	3,600	79.00		16.00	J	36.00	J	38.00	U
2,4-Dimethylphenol	29	—	210	20.00	UJ	18.00	UJ	18.00	UJ	19.00	UJ
Pentachlorophenol	400	504	690	200.00	U	180.00	U	190.00	U	190.00	UJ

Table 5-3. Analytical Results for North Channel: DMMUs 14 - 21 (from SEE, 2013)

Compound	SL	BT	ML	CO/NC-14		NC-15		NC-16		NC-17	
				Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)											
Benzyl Alcohol	57	—	870	20.00	U	18.00	U	19.00	U	19.00	U
Benzoic Acid	650	—	760	400.00	U	370.00	U	380.00	U	380.00	U
Dibenzofuran	540	—	1,700	20.00	U	18.00	U	19.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	20.00	U	18.00	U	19.00	U	19.00	U
Heptachlor	1.5	—	—	0.49	UJ	0.46	UJ	0.47	UJ	0.48	UJ
Hexachlorobutadiene	11	—	270	0.49	U	0.46	U	0.47	U	0.48	U
Pesticides and PCBs (µg/kg dw)											
Aldrin	9.5	—	—	0.49	U	0.46	U	0.47	U	0.48	U
Dieldrin	1.9	—	—	0.99	U	0.93	U	0.93	U	0.97	U
4,4 -DDE	16	—	—	0.99	U	0.93	U	0.93	U	0.97	U
4,4 -DDD	9	—	—	0.99	U	0.93	U	0.93	U	0.97	U
4,4 -DDT	12	—	—	0.99	UJ	0.93	UJ	0.93	UJ	0.97	U
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.99	U	0.93	U	0.93	U	0.97	U
trans-Chlordane	—	—	—	1.40	U	0.46	U	0.83	U	0.48	U
cis-Chlordane	—	—	—	0.49	U	0.46	U	0.47	U	0.48	U
oxy Chlordane	—	—	—	2.00	U	1.80	U	1.90	U	1.90	U
cis-Nonachlor	—	—	—	2.00	U	1.80	U	1.90	U	1.90	U
trans-Nonachlor	—	—	—	2.00	U	1.80	U	1.90	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	2.00	U	1.80	U	1.90	U	1.90	U
Aroclor 1016	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1242	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1248	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1254	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1260	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1221	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1232	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1262	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Aroclor 1268	—	—	—	9.80	U	9.20	U	9.40	U	9.80	U
Total PCBs	130	38 (2)	3,100	9.80	U	9.20	U	9.40	U	9.80	U
Dioxins and Furans (pg/g) [3]											
2,3,7,8-TCDD	—	—	—	1.540		1.230	U	1.680		0.947	J
1,2,3,7,8-PeCDD	—	—	—	1.970		1.660		2.140		1.080	J
1,2,3,4,7,8-HxCDD	—	—	—	0.404	J	0.332	J	0.484	J	2.620	
1,2,3,6,7,8-HxCDD	—	—	—	1.480	J	1.280	J	1.620	J	0.882	J
1,2,3,7,8,9-HxCDD	—	—	—	4.610		4.840		5.420		0.280	J
1,2,3,4,6,7,8-HpCDD	—	—	—	15.900	J	12.300	J	16.400	J	10.300	
OCDD	—	—	—	86.400	J	64.500	J	84.700	J	60.400	
2,3,7,8-TCDF	—	—	—	0.533	J	0.318	J	0.440	J	0.407	J
1,2,3,7,8-PeCDF	—	—	—	0.109	J	0.017	U	0.132	U	0.113	J
2,3,4,7,8-PeCDF	—	—	—	0.193	J	0.068	U	0.140	U	0.156	J
1,2,3,4,7,8-HxCDF	—	—	—	0.305	J	0.152	J	0.310	J	0.088	U
1,2,3,6,7,8-HxCDF	—	—	—	0.219	J	0.023	U	0.138	U	0.048	U
2,3,4,6,7,8-HxCDF	—	—	—	0.176	J	0.190	J	0.152	J	0.148	U
1,2,3,7,8,9-HxCDF	—	—	—	0.066	U	0.010	U	0.090	U	0.194	J
1,2,3,4,6,7,8-HpCDF	—	—	—	4.980		3.330		7.320		0.125	U
1,2,3,4,7,8,9-HpCDF	—	—	—	0.260	J	0.106	U	0.168	U	3.540	
OCDF	—	—	—	6.900		4.080	J	7.510		4.270	J

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

Table 5-3. Analytical Results for North Channel: DMMUs 14 - 21 (from SEE, 2013)

Compound	SL	BT	ML	NC-18		NC-19		NC-20		NC-21	
				Value	Q	Value	Q	Value	Q	Value	Q
Conventionals											
Total Solids (%)	—	—	—	70.00		57.20		64.80		58.40	
Total Volatile Solids (%)	—	—	—	3.30		5.53		4.22		6.10	
N-Ammonia (mg-N/kg)	—	—	—	96.80		153.00		137.00		171.00	
Sulfide (mg/kg)	—	—	—	73.40		927.00		166.00		512.00	
Total Organic Carbon (%)	—	—	—	0.84		1.26		1.09		1.61	
Gravel (%)	—	—	—	0.10		0.10		0.10		0.10	
Sand (%)	—	—	—	66.80		37.80		58.00		36.20	
Silt (%)	—	—	—	23.70		44.40		30.70		46.40	
Clay (%)	—	—	—	9.40		17.90		11.20		17.20	
Fines (%)	—	—	—	33.10		62.30		41.90		63.60	
Metals (mg/kg dw)											
Antimony	150	—	200	7.00	UJ	8.00	UJ	7.00	UJ	8.00	UJ
Arsenic	57	507.1	700	7.00	U	8.00	U	7.00	U	8.00	U
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.30	U	0.30	U
Chromium	260	260	—	28.40		36.10		32.20		36.90	
Copper	390	1,027	1,300	28.70		53.90		40.10		50.00	
Lead	450	975	1,200	3.00		5.00		4.00		5.00	
Mercury	0.41	1.5	2.3	0.03	U	0.04		0.03		0.05	
Selenium	—	3	—	0.60	U	0.90	U	0.70	U	0.80	U
Silver	6.1	6.1	8.4	0.40	U	0.50	U	0.40	U	0.50	U
Zinc	410	2,783	3,800	54.00		73.00		63.00		74.00	
PAHs (µg/kg dw)											
Naphthalene	2,100	—	2,400	19.00	U	23.00		20.00	U	70.00	
2-Methylnaphthalene [1]	670	—	1,900	19.00	U	19.00	U	20.00	U	15.00	J
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	20.00	U	18.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	20.00	U	18.00	U
Fluorene	540	—	3,600	19.00	U	19.00	U	20.00	U	18.00	U
Phenanthrene	1,500	—	21,000	19.00	U	23.00		20.00	U	28.00	
Anthracene	960	—	13,000	19.00	U	19.00	U	20.00	U	18.00	U
Total LPAH	5,200	—	29,000	19.00	U	46.00		20.00	U	98.00	
Fluoranthene	1,700	4,600	30,000	19.00	U	26.00		9.90	J	33.00	
Pyrene	2,600	11,980	16,000	19.00	U	22.00		9.90	J	30.00	
Benzo(a)anthracene	1,300	—	5,100	19.00	U	19.00	U	20.00	U	18.00	U
Chrysene	1,400	—	21,000	19.00	U	19.00	U	20.00	U	12.00	J
Benzo(a)pyrene	1,600	—	3,600	19.00	U	19.00	U	20.00	U	18.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	19.00	U	20.00	U	18.00	U
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	20.00	U	18.00	U
Benzo(g,h,i)perylene	670	—	3,200	19.00	U	19.00	U	20.00	U	18.00	U
Total Benzofluoranthenes	3,200	—	9,900	19.00	U	12.00	J	20.00	U	18.00	U
Total HPAH	12,000	—	69,000	19.00	U	60.00		19.80		75.00	
Chlorinated Hydrocarbons (µg/kg dw)											
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	20.00	U	18.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	20.00	U	18.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	20.00	U	18.00	U
Hexachlorobenzene	22	168	230	19.00	U	19.00	U	20.00	U	18.00	U
Phthalates (µg/kg dw)											
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	20.00	U	18.00	U
Diethylphthalate	200	—	1,200	47.00	U	48.00	U	50.00	U	46.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	20.00	U	18.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	20.00	U	18.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	24.00	U	25.00	U	23.00	U
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	20.00	U	18.00	U
Phenols (µg/kg dw)											
Phenol	420	—	1,200	19.00	U	25.00		20.00	U	80.00	
2-Methylphenol	63	—	77	19.00	U	19.00	U	20.00	U	18.00	U
4-Methylphenol	670	—	3,600	38.00	U	20.00	J	13.00	J	28.00	J
2,4-Dimethylphenol	29	—	210	19.00	UJ	18.00	UJ	20.00	UJ	18.00	UJ
Pentachlorophenol	400	504	690	190.00	UJ	190.00	U	200.00	U	180.00	U

Table 5-3. Analytical Results for North Channel: DMMUs 14 - 21 (from SEE, 2013)

Compound	SL	BT	ML	NC-18		NC-19		NC-20		NC-21	
				Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)											
Benzyl Alcohol	57	—	870	19.00	U	15.00	J	20.00	U	18.00	U
Benzoic Acid	650	—	760	380.00	U	380.00	U	400.00	U	110.00	J
Dibenzofuran	540	—	1,700	19.00	U	19.00	U	20.00	U	9.20	J
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	20.00	U	18.00	U
Heptachlor	1.5	—	—	0.49	UJ	0.49	UJ	0.48	UJ	0.48	UJ
Hexachlorobutadiene	11	—	270	0.49	U	0.49	U	0.48	U	0.48	U
Pesticides and PCBs (µg/kg dw)											
Aldrin	9.5	—	—	0.49	U	0.49	U	0.48	U	0.48	U
Dieldrin	1.9	—	—	0.98	U	0.98	U	0.96	U	0.96	U
4,4 -DDE	16	—	—	0.98	U	0.98	U	0.96	U	0.96	U
4,4 -DDD	9	—	—	0.98	U	0.98	U	0.96	U	0.96	U
4,4 -DDT	12	—	—	0.98	U	0.98	U	0.96	UJ	0.96	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.98	U	0.98	U	0.96	U	0.96	U
trans-Chlordane	—	—	—	0.49	U	0.49	U	0.48	U	1.20	U
cis-Chlordane	—	—	—	0.49	U	0.49	U	0.48	U	0.48	U
oxy Chlordane	—	—	—	2.00	U	2.00	U	1.90	U	1.90	U
cis-Nonachlor	—	—	—	2.00	U	2.00	U	1.90	U	1.90	U
trans-Nonachlor	—	—	—	2.00	U	2.00	U	1.90	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	2.00	U	2.00	U	1.90	U	1.90	U
Aroclor 1016	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1242	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1248	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1254	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1260	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1221	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1232	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1262	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Aroclor 1268	—	—	—	9.70	U	9.80	U	9.50	U	9.50	U
Total PCBs	130	38 (2)	3,100	9.70	U	9.80	U	9.50	U	9.50	U
Dioxins and Furans (pg/g) [3]											
2,3,7,8-TCDD	—	—	—	0.892	U	0.404	U	1.360		0.274	U
1,2,3,7,8-PeCDD	—	—	—	1.050	U	0.557	J	1.450		0.364	J
1,2,3,4,7,8-HxCDD	—	—	—	2.740		0.109	U	0.298	J	0.051	U
1,2,3,6,7,8-HxCDD	—	—	—	0.883	J	0.443	J	0.945	J	0.233	U
1,2,3,7,8,9-HxCDD	—	—	—	0.250	J	1.500	J	3.930		0.757	J
1,2,3,4,6,7,8-HpCDD	—	—	—	10.700		5.350	J	10.800	J	2.490	J
OCDD	—	—	—	62.200		30.500	J	56.000	J	14.200	J
2,3,7,8-TCDF	—	—	—	0.263	J	0.189	J	0.312	J	0.088	U
1,2,3,7,8-PeCDF	—	—	—	0.078	U	0.024	U	0.041	U	0.016	U
2,3,4,7,8-PeCDF	—	—	—	0.130	J	0.044	U	0.079	J	0.039	U
1,2,3,4,7,8-HxCDF	—	—	—	0.083	U	0.078	U	0.124	J	0.037	U
1,2,3,6,7,8-HxCDF	—	—	—	0.021	U	0.030	U	0.089	J	0.027	J
2,3,4,6,7,8-HxCDF	—	—	—	0.100	U	0.070	U	0.043	U	0.049	J
1,2,3,7,8,9-HxCDF	—	—	—	0.137	U	0.020	U	0.032	U	0.006	U
1,2,3,4,6,7,8-HpCDF	—	—	—	0.093	U	1.300	J	2.150		0.815	J
1,2,3,4,7,8,9-HpCDF	—	—	—	2.620		0.052	U	0.089	J	0.008	U
OCDF	—	—	—	3.760	J	1.990	J	3.180	J	1.090	J

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

Table 5-4. Analytical Results for Hoquiam Reach: DMMUs 22-29 (from SEE, 2013)

Compound	SL	BT	ML	HC-22		HC-23		HC-73 (HC23 Dup)		HC-24		HC-25	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Conventionals													
Total Solids (%)	—	—	—	64.20		65.00		64.90		69.50		58.70	
Total Volatile Solids (%)	—	—	—	4.44		4.31		4.46		3.51		7.39	
N-Ammonia (mg-N/kg)	—	—	—	127.00		95.70		111.00		81.80		165.00	
Sulfide (mg/kg)	—	—	—	585.00		478.00		n.v. [5]		107.00	J	656.00	
Total Organic Carbon (%)	—	—	—	1.29		1.21		1.09		1.09		1.72	
Gravel (%)	—	—	—	0.10		0.10	U	0.10		0.10		0.10	U
Sand (%)	—	—	—	58.60		57.50		57.30		74.40		42.90	
Silt (%)	—	—	—	29.50		30.20		30.60		18.20		42.50	
Clay (%)	—	—	—	12.00		12.40		12.00		7.30		14.70	
Fines (%)	—	—	—	41.50		42.60		42.60		25.50		57.20	
Metals (mg/kg dw)													
Antimony	150	—	200	8.00	UJ	8.00	UJ	7.00	UJ	20.00	UJ	8.00	UJ
Arsenic	57	507.1	700	8.00	U	8.00	U	7.00	U	20.00	U	8.00	U
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.30	U	0.70	U	0.30	U
Chromium	260	260	—	33.00		30.60		30.80		37.00		40.00	
Copper	390	1,027	1,300	40.30		38.00		38.50		46.40		57.30	
Lead	450	975	1,200	4.00		4.00		4.00		7.00	U	5.00	
Mercury	0.41	1.5	2.3	0.04		0.04		0.03		0.03	U	0.05	
Selenium	—	3	—	0.70	U	0.70	U	0.80	U	0.70	U	0.80	U
Silver	6.1	6.1	8.4	0.50	U	0.50	U	0.40	U	1.00	U	0.50	U
Zinc	410	2,783	3,800	67.00		63.00		63.00		72.00		76.00	
PAHs (µg/kg dw)													
Naphthalene	2,100	—	2,400	18.00	J	19.00	U	19.00	U	19.00	U	18.00	J
2-Methylnaphthalene [1]	670	—	1,900	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Fluorene	540	—	3,600	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phenanthrene	1,500	—	21,000	20.00		19.00	U	19.00	U	19.00	U	16.00	J
Anthracene	960	—	13,000	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Total LPAH	5,200	—	29,000	38.00		19.00	U	19.00	U	19.00	U	34.00	
Fluoranthene	1,700	4,600	30,000	25.00		13.00	J	11.00	J	19.00	U	26.00	
Pyrene	2,600	11,980	16,000	22.00		12.00	J	11.00	J	19.00	U	21.00	
Benzo(a)anthracene	1,300	—	5,100	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Chrysene	1,400	—	21,000	10.00	J	19.00	U	19.00	U	19.00	U	10.00	J
Benzo(a)pyrene	1,600	—	3,600	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	15.00	J	19.00	U	19.00	U	19.00	U	17.00	J
Total HPAH	12,000	—	69,000	72.00		25.00		22.00		19.00	U	74.00	
Chlorinated Hydrocarbons (µg/kg dw)													
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Hexachlorobenzene	22	168	230	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phthalates (µg/kg dw)													
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Diethylphthalate	200	—	1,200	48.00	U	47.00	U	48.00	U	47.00	U	48.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	23.00	U	24.00	U	15.00	J	15.00	J
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phenols (µg/kg dw)													
Phenol	420.00	—	1200.00	48.00		13.00	J	30.00		19.00	U	20.00	
2-Methylphenol	63.00	—	77.00	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
4-Methylphenol	670.00	—	3600.00	19.00	J	16.00	J	13.00	J	38.00	U	30.00	J
2,4-Dimethylphenol	29.00	—	210.00	19.00	UJ	19.00	UJ	19.00	UJ	19.00	UJ	19.00	UJ
Pentachlorophenol	400.00	504.00	690.00	190.00	U	190.00	UJ	190.00	UJ	190.00	UJ	190.00	UJ

Table 5-4. Analytical Results for Hoquiam Reach: DMMUs 22-29 (from SEE, 2013)

Compound	SL	BT	ML	HC-22		HC-23		HC-73 (HC23 Dup)		HC-24		HC-25	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)													
Benzyl Alcohol	57	—	870	19.00	U	19.00	U	19.00	U	19.00	U	16.00	J
Benzoic Acid	650	—	760	380.00	U	380.00	U	390.00	U	380.00	U	380.00	U
Dibenzofuran	540	—	1,700	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Heptachlor	1.5	—	—	0.49	UJ	0.50	UJ	0.49	UJ	0.49	UJ	0.48	UJ
Hexachlorobutadiene	11	—	270	0.49	U	0.50	U	0.49	U	0.49	U	0.48	U
Pesticides and PCBs (µg/kg dw)													
Aldrin	9.5	—	—	0.49	U	0.50	U	0.49	U	0.49	U	0.48	U
Dieldrin	1.9	—	—	0.98	U	0.99	U	0.98	U	0.98	U	0.96	U
4,4 -DDE	16	—	—	0.98	U	0.99	U	0.98	U	0.98	U	0.96	U
4,4 -DDD	9	—	—	0.98	U	0.99	U	0.98	U	0.98	U	0.96	U
4,4 -DDT	12	—	—	0.98	UJ	0.99	U	0.98	U	0.98	U	0.96	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.98	UJ	0.99	U	0.98	U	0.98	U	0.96	UJ
trans-Chlordane	—	—	—	1.10	U	0.50	U	0.49	U	0.49	U	0.86	U
cis-Chlordane	—	—	—	0.49	U	0.50	U	0.49	U	0.49	U	0.48	U
oxy Chlordane	—	—	—	2.00	U	2.00	U	2.00	U	2.00	U	1.90	U
cis-Nonachlor	—	—	—	2.00	U	2.00	U	2.00	U	2.00	U	1.90	U
trans-Nonachlor	—	—	—	2.00	U	2.00	U	2.00	U	2.00	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	2.00	U	2.00	U	2.00	U	2.00	U	1.90	U
Aroclor 1016	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1242	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1248	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1254	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1260	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1221	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1232	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1262	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Aroclor 1268	—	—	—	9.50	U	9.90	U	9.90	U	9.80	U	9.60	U
Total PCBs	130	38 (2)	3,100	9.50	U	9.90	U	9.90	U	9.80	U	9.6	U
Dioxins and Furans (pg/g) 3													
2,3,7,8-TCDD	—	—	—	1.710		1.300	U	1.540		1.000		2.000	
1,2,3,7,8-PeCDD	—	—	—	2.130		1.840	J	1.930	J	1.210	J	2.900	J
1,2,3,4,7,8-HxCDD	—	—	—	0.492	J	4.560		4.560		2.960		7.400	
1,2,3,6,7,8-HxCDD	—	—	—	1.840	J	1.310	U	1.530	J	0.913	J	2.290	
1,2,3,7,8,9-HxCDD	—	—	—	5.200		0.305	U	0.317	U	0.300	J	0.747	J
1,2,3,4,6,7,8-HpCDD	—	—	—	20.800	J	17.100		18.000		11.200		27.400	
OCDD	—	—	—	121.000	J	97.800		105.000		62.000		154.000	
2,3,7,8-TCDF	—	—	—	0.766	J	0.592	U	0.665	J	0.211	U	0.599	J
1,2,3,7,8-PeCDF	—	—	—	0.163	U	0.144	U	0.179	U	0.082	U	0.180	U
2,3,4,7,8-PeCDF	—	—	—	0.238	J	0.292	J	0.325	J	0.172	U	0.255	U
1,2,3,4,7,8-HxCDF	—	—	—	0.335	J	0.149	U	0.153	U	0.085	U	0.163	U
1,2,3,6,7,8-HxCDF	—	—	—	0.226	U	0.051	J	0.049	U	0.041	U	0.142	J
2,3,4,6,7,8-HxCDF	—	—	—	0.232	U	0.211	J	0.205	J	0.085	U	0.234	J
1,2,3,7,8,9-HxCDF	—	—	—	0.081	J	0.267	J	0.291	J	0.111	U	0.360	J
1,2,3,4,6,7,8-HpCDF	—	—	—	5.880		0.161	U	0.232	J	0.100	U	0.252	U
1,2,3,4,7,8,9-HpCDF	—	—	—	0.278	J	5.280		5.700		2.760		6.790	
OCDF	—	—	—	8.630		6.820		7.220		3.300	U	12.200	

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

4. nv = no value. Sulfides were not taken for blind field replicates

Table 5-4. Analytical Results for Hoquiam Reach: DMMUs 22-29 (from SEE, 2013)

Compound	SL	BT	ML	HC-26		HC-27		HC-57 (HC27 Dup)		HC-28		HC/CP-29	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Conventionals													
Total Solids (%)	—	—	—	59.80		61.90		60.00		60.70		56.90	
Total Volatile Solids (%)	—	—	—	5.14		5.76		6.63		4.75		5.90	
N-Ammonia (mg-N/kg)	—	—	—	148.00		74.90		74.70		82.40		113.00	
Sulfide (mg/kg)	—	—	—	441.00		874.00		n.v. [5]		735.00		1390.00	
Total Organic Carbon (%)	—	—	—	1.81		1.51		1.59		1.53		1.68	
Gravel (%)	—	—	—	0.20		0.40		0.40		0.30		0.60	
Sand (%)	—	—	—	49.90		60.30		59.30		59.40		43.40	
Silt (%)	—	—	—	36.80		27.20		27.60		29.10		40.00	
Clay (%)	—	—	—	13.00		12.30		12.80		11.10		16.10	
Fines (%)	—	—	—	49.80		39.50		40.40		40.20		56.10	
Metals (mg/kg dw)													
Antimony	150	—	200	8.00	UJ	8.00	UJ	8.00	UJ	20.00	UJ	8.00	UJ
Arsenic	57	507.1	700	8.00	U	8.00	U	8.00	U	20.00	U	8.00	U
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.30	U	0.80	U	0.30	U
Chromium	260	260	—	36.70		37.10		36.40		38.00		33.00	
Copper	390	1,027	1,300	51.60		49.00		51.20		51.60		40.30	
Lead	450	975	1,200	5.00		5.00		5.00		8.00	U	4.00	
Mercury	0.41	1.5	2.3	0.05		0.04		0.03	U	0.04		0.04	
Selenium	—	3	—	0.80	U	0.80	U	0.80	U	0.80	U	0.70	U
Silver	6.1	6.1	8.4	0.50	U	0.50	U	0.50	U	1.00	U	0.50	U
Zinc	410	2,783	3,800	76.00		72.00		75.00		79.00		67.00	
PAHs (µg/kg dw)													
Naphthalene	2,100	—	2,400	15.00	J	30.00		22.00		15.00	J	22.00	
2-Methylnaphthalene [1]	670	—	1,900	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	12.00	J	19.00	U	19.00	U
Fluorene	540	—	3,600	19.00	U	19.00	U	9.40	J	19.00	U	19.00	U
Phenanthrene	1,500	—	21,000	12.00	J	49.00		20.00		17.00	J	16.00	J
Anthracene	960	—	13,000	19.00	U	19.00	U	13.00	J	19.00	U	19.00	U
Total LPAH	5,200	—	29,000	27.00		79.00		76.40		32.00		38.00	
Fluoranthene	1,700	4,600	30,000	18.00	J	76.00	J	23.00	J	23.00		24.00	
Pyrene	2,600	11,980	16,000	15.00	J	63.00	J	22.00	J	22.00		23.00	
Benzo(a)anthracene	1,300	—	5,100	19.00	U	41.00	J	19.00	UJ	19.00	U	19.00	U
Chrysene	1,400	—	21,000	19.00	U	41.00	J	19.00	UJ	19.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	19.00	U	34.00		19.00	U	19.00	U	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	16.00	J	19.00	U	19.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	19.00	U	16.00	J	19.00	U	19.00	U	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	19.00	U	72.00	J	10.00	J	19.00	U	12.00	J
Total HPAH	12,000	—	69,000	33.00		359.00		55.00		45.00		59.00	
Chlorinated Hydrocarbons (µg/kg dw)													
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Hexachlorobenzene	22	168	230	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phthalates (µg/kg dw)													
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Diethylphthalate	200	—	1,200	47.00	U	48.00	U	47.00	U	47.00	U	48.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	17.00	J	24.00	U	24.00	U	23.00	U	24.00	U
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Phenols (µg/kg dw)													
Phenol	420.00	—	1200.00	18.00	J	24.00		33.00		52.00		36.00	
2-Methylphenol	63.00	—	77.00	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
4-Methylphenol	670.00	—	3600.00	15.00	J	39.00		67.00		37.00		18.00	J
2,4-Dimethylphenol	29.00	—	210.00	19.00	UJ	19.00	UJ	19.00	UJ	19.00	UJ	19.00	UJ
Pentachlorophenol	400.00	504.00	690.00	190.00	UJ	190.00	U	190.00	U	190.00	U	190.00	U

Table 5-4. Analytical Results for Hoquiam Reach: DMMUs 22-29 (from SEE, 2013)

Compound	SL	BT	ML	HC-26		HC-27		HC-57 (HC27 Dup)		HC-28		HC/CP-29	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)													
Benzyl Alcohol	57	—	870	14.00	J	19.00	U	24.00		12.00	J	11.00	J
Benzoic Acid	650	—	760	380.00	U	390.00	U	380.00	U	370.00	U	380.00	U
Dibenzofuran	540	—	1,700	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	19.00	U	19.00	U	19.00	U
Heptachlor	1.5	—	—	0.48	UJ	0.50	UJ	0.49	UJ	0.46	UJ	0.48	UJ
Hexachlorobutadiene	11	—	270	0.48	U	0.50	U	0.49	U	0.46	U	0.48	U
Pesticides and PCBs (µg/kg dw)													
Aldrin	9.5	—	—	0.48	U	0.50	U	0.49	U	0.46	U	0.48	U
Dieldrin	1.9	—	—	0.97	U	0.99	U	0.98	U	0.92	U	0.96	U
4,4 -DDE	16	—	—	0.97	U	0.99	U	0.98	U	0.92	U	0.96	U
4,4 -DDD	9	—	—	0.97	U	0.99	U	0.98	U	0.92	U	0.96	U
4,4 -DDT	12	—	—	0.97	U	1.50	UJ	0.98	UJ	0.92	UJ	0.96	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.97	U	1.50	UJ	0.98	UJ	0.92	UJ	0.96	UJ
trans-Chlordane	—	—	—	0.90	U	0.50	U	0.49	U	0.99	U	1.50	U
cis-Chlordane	—	—	—	0.48	U	0.50	U	0.49	U	0.46	U	0.48	U
oxy Chlordane	—	—	—	1.90	U	2.00	U	2.00	U	1.80	U	1.90	U
cis-Nonachlor	—	—	—	1.90	U	2.00	U	2.00	U	1.80	U	1.90	U
trans-Nonachlor	—	—	—	1.90	U	2.00	U	2.00	U	1.80	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	1.90	U	2.00	U	2.00	U	1.80	U	1.90	U
Aroclor 1016	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1242	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1248	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1254	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1260	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1221	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1232	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1262	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Aroclor 1268	—	—	—	9.60	U	9.60	U	9.60	U	9.50	U	9.90	U
Total PCBs	130	38 (2)	3,100	9.6	U	9.6	U	9.6	U	9.5	U	9.9	U
Dioxins and Furans (pg/g) [3]													
2,3,7,8-TCDD	—	—	—	1.210	U	3.240		1.370		1.770		0.993	U
1,2,3,7,8-PeCDD	—	—	—	1.730	J	4.440		1.690		2.220		1.280	
1,2,3,4,7,8-HxCDD	—	—	—	3.760		0.866	J	0.287	U	0.548	U	0.264	U
1,2,3,6,7,8-HxCDD	—	—	—	1.280	J	3.370		1.380	J	1.940	J	1.120	J
1,2,3,7,8,9-HxCDD	—	—	—	0.407	J	11.300	J	3.970	J	5.270		3.120	
1,2,3,4,6,7,8-HpCDD	—	—	—	15.700		40.000	J	16.900	J	19.400	J	10.800	J
OCDD	—	—	—	102.000		233.000	J	111.000	J	108.000	J	63.100	J
2,3,7,8-TCDF	—	—	—	0.368	J	0.800	J	0.547	J	0.508	J	0.260	J
1,2,3,7,8-PeCDF	—	—	—	0.131	U	0.199	U	0.020	U	0.125	J	0.097	U
2,3,4,7,8-PeCDF	—	—	—	0.228	U	0.270	J	0.157	J	0.155	U	0.107	U
1,2,3,4,7,8-HxCDF	—	—	—	0.091	U	0.495	J	0.270	U	0.225	U	0.311	J
1,2,3,6,7,8-HxCDF	—	—	—	0.084	J	0.371	J	0.215	J	0.191	J	0.180	J
2,3,4,6,7,8-HxCDF	—	—	—	0.211	J	0.232	U	0.276	J	0.247	U	0.111	U
1,2,3,7,8,9-HxCDF	—	—	—	0.261	J	0.099	U	0.022	U	0.036	U	0.083	J
1,2,3,4,6,7,8-HpCDF	—	—	—	0.201	U	9.210		7.050		4.520		3.370	
1,2,3,4,7,8,9-HpCDF	—	—	—	4.680		0.411	J	0.138	U	0.233	J	0.155	U
OCDF	—	—	—	7.980		16.700		8.700		7.580		5.930	

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

4. nv = no value. Sulfides were not taken for blind field replicates

Table 5-5. Analytical Results for Cow Point: DMMUs 30 - 36 (from SEE, 2013)

Compound	SL	BT	ML	CP-30		CP-31		CP-32		CP-33	
				Value	Q	Value	Q	Value	Q	Value	Q
Conventionals											
Total Solids (%)	—	—	—	57.6		54.4		52.2		47.8	
Total Volatile Solids (%)	—	—	—	6.9		7.0		7.9		8.4	
N-Ammonia (mg-N/kg)	—	—	—	179.0		157.0		210.0		115.0	
Sulfide (mg/kg)	—	—	—	501.0		920.0		509.0		70.2	
Total Organic Carbon (%)	—	—	—	1.6		1.9		2.0		2.4	
Gravel (%)	—	—	—	0.1		0.1		0.6		5.9	
Sand (%)	—	—	—	23.8		19.7		25.5		15.3	
Silt (%)	—	—	—	51.7		57.0		49.6		48.2	
Clay (%)	—	—	—	24.5		23.4		24.2		30.6	
Fines (%)	—	—	—	76.2		80.4		73.8		78.8	
Metals (mg/kg dw)											
Antimony	150	—	200	8.00	UJ	9.00	UJ	10.00	UJ	10.00	UJ
Arsenic	57	507.1	700	8.00	U	9.00	U	10.00	U	10.00	U
Cadmium	5.1	11.3	14	0.30	U	0.30	U	0.40	U	0.40	U
Chromium	260	260	—	38.40		40.10		44.00		48.00	
Copper	390	1,027	1,300	61.90		65.00		71.60		82.80	
Lead	450	975	1,200	6.00		6.00		6.00		7.00	
Mercury	0.41	1.5	2.3	0.05		0.06		0.05		0.06	
Selenium	—	3	—	0.80	U	0.90	U	0.90	U	1.00	U
Silver	6.1	6.1	8.4	0.50	U	0.50	U	0.60	U	0.60	U
Zinc	410	2,783	3,800	77.00		83.00		86.00		93.00	
PAHs (µg/kg dw)											
Naphthalene	2,100	—	2,400	19.00		32.00		30.00		49.00	
2-Methylnaphthalene [1]	670	—	1,900	19.00	U	10.00	J	12.00	J	13.00	J
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	19.00	U	18.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	19.00	U	18.00	U
Fluorene	540	—	3,600	19.00	U	9.40	J	14.00	J	18.00	U
Phenanthrene	1,500	—	21,000	23.00		28.00		30.00		27.00	
Anthracene	960	—	13,000	19.00	U	19.00	U	19.00	U	18.00	U
Total LPAH	5,200	—	29,000	42.00		60.00		60.00		76.00	
Fluoranthene	1,700	4,600	30,000	32.00		35.00		33.00		30.00	
Pyrene	2,600	11,980	16,000	28.00		33.00		27.00		28.00	
Benzo(a)anthracene	1,300	—	5,100	10.00	J	19.00	U	19.00	U	18.00	U
Chrysene	1,400	—	21,000	12.00	J	13.00	J	13.00	J	13.00	J
Benzo(a)pyrene	1,600	—	3,600	19.00	U	19.00	U	19.00	U	18.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	19.00	U	19.00	U	18.00	U
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	19.00	U	18.00	U
Benzo(g,h,i)perylene	670	—	3,200	19.00	U	19.00	U	11.00	J	18.00	U
Total Benzofluoranthenes	3,200	—	9,900	20.00		24.00		20.00		21.00	
Total HPAH	12,000	—	69,000	122.00		105.00		104.00		92.00	
Chlorinated Hydrocarbons (µg/kg dw)											
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	16.00	J	18.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	19.00	U	18.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	19.00	U	18.00	U
Hexachlorobenzene	22	168	230	19.00	U	19.00	U	19.00	U	18.00	U
Phthalates (µg/kg dw)											
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	19.00	U	18.00	U
Diethylphthalate	200	—	1,200	47.00	U	47.00	U	47.00	U	46.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	19.00	U	18.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	19.00	U	10.00	J
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	24.00	U	24.00	U	23.00	U
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	19.00	U	18.00	U
Phenols (µg/kg dw)											
Phenol	420	—	1,200	130.00		120.00		56.00		100.00	
2-Methylphenol	63	—	77	19.00	U	19.00	U	11.00	J	18.00	U
4-Methylphenol	670	—	3,600	26.00	J	30.00	J	42.00		66.00	
2,4-Dimethylphenol	29	—	210	19.00	UJ	19.00	UJ	19.00	UJ	18.00	UJ
Pentachlorophenol	400	504	690	190.00	U	190.00	U	190.00	U	180.00	U

Table 5-5. Analytical Results for Cow Point: DMMUs 30 - 36 (from SEE, 2013)

Compound	SL	BT	ML	CP-30		CP-31		CP-32		CP-33	
				Value	Q	Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)											
Benzyl Alcohol	57	—	870	26.00		35.00		*100.00*		*110.00*	
Benzoic Acid	650	—	760	110.00	J	150.00	J	210.00	J	380.00	
Dibenzofuran	540	—	1,700	19.00	U	19.00	U	19.00	U	18.00	U
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	19.00	U	18.00	U
Heptachlor	1.5	—	—	0.47	UJ	0.48	UJ	0.47	UJ	0.49	UJ
Hexachlorobutadiene	11	—	270	0.47	U	0.48	U	0.47	U	0.49	U
Pesticides and PCBs (µg/kg dw)											
Aldrin	9.5	—	—	0.47	U	0.48	U	0.47	U	0.49	U
Dieldrin	1.9	—	—	0.95	U	0.97	U	0.94	U	0.97	U
4,4 -DDE	16	—	—	0.95	U	0.97	U	0.94	U	0.97	U
4,4 -DDD	9	—	—	0.95	U	0.97	U	0.94	U	0.97	U
4,4 -DDT	12	—	—	0.95	UJ	0.97	UJ	0.94	UJ	0.97	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.95	UJ	0.97	UJ	0.94	UJ	0.97	UJ
trans-Chlordane	—	—	—	1.60	U	1.20	U	1.50	U	1.90	U
cis-Chlordane	—	—	—	0.47	U	0.48	U	0.47	U	0.49	U
oxy Chlordane	—	—	—	1.90	U	1.90	U	1.90	U	1.90	U
cis-Nonachlor	—	—	—	1.90	U	1.90	U	1.90	U	1.90	U
trans-Nonachlor	—	—	—	1.90	U	1.90	U	1.90	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	1.90	U	1.90	U	1.90	U	1.90	U
Aroclor 1016	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1242	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1248	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1254	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1260	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1221	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1232	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1262	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Aroclor 1268	—	—	—	9.40	U	9.90	U	9.30	U	9.60	U
Total PCBs	130	38 (2)	3,100	9.40	U	9.90	U	9.30	U	9.60	U
Dioxins and Furans (pg/g) [3]											
2,3,7,8-TCDD	—	—	—	0.321	U	2.710		2.680		0.415	U
1,2,3,7,8-PeCDD	—	—	—	0.376	U	3.930		3.560		0.532	U
1,2,3,4,7,8-HxCDD	—	—	—	0.016	U	0.655	U	0.707	J	0.140	J
1,2,3,6,7,8-HxCDD	—	—	—	0.422	J	2.950		2.520		0.463	J
1,2,3,7,8,9-HxCDD	—	—	—	1.010	J	9.830		7.890		1.240	J
1,2,3,4,6,7,8-HpCDD	—	—	—	7.490	J	35.000	J	25.500	J	5.760	J
OCDD	—	—	—	55.800	J	210.000	J	129.000	J	34.600	J
2,3,7,8-TCDF	—	—	—	0.111	U	0.804	J	0.839	J	0.158	J
1,2,3,7,8-PeCDF	—	—	—	0.011	U	0.166	J	0.221	U	0.011	U
2,3,4,7,8-PeCDF	—	—	—	0.018	U	0.267	U	0.301	J	0.066	J
1,2,3,4,7,8-HxCDF	—	—	—	0.109	J	0.507	J	0.476	J	0.050	U
1,2,3,6,7,8-HxCDF	—	—	—	0.059	U	0.370	U	0.353	J	0.050	J
2,3,4,6,7,8-HxCDF	—	—	—	0.052	U	0.529	J	0.287	J	0.040	U
1,2,3,7,8,9-HxCDF	—	—	—	0.018	U	0.105	J	0.127	J	0.017	U
1,2,3,4,6,7,8-HpCDF	—	—	—	2.650		9.610		6.920		1.740	J
1,2,3,4,7,8,9-HpCDF	—	—	—	0.020	U	0.396	J	0.285	U	0.064	U
OCDF	—	—	—	4.940		18.000		11.900		3.220	J

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.
2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.
3. *Value exceeds the DMMP screening level*

Table 5-5. Analytical Results for Cow Point: DMMUs 30 - 36 (from SEE, 2013)

Compound	SL	BT	ML	CP-34		CP-35		CP-36	
				Value	Q	Value	Q	Value	Q
Conventionals									
Total Solids (%)	—	—	—	53.9		56.1		54.4	
Total Volatile Solids (%)	—	—	—	7.3		7.1		7.8	
N-Ammonia (mg-N/kg)	—	—	—	102.0		150.0		82.2	
Sulfide (mg/kg)	—	—	—	247.0		879.0		797.0	
Total Organic Carbon (%)	—	—	—	2.0		1.5		2.2	
Gravel (%)	—	—	—	5.1		32.5		42.5	
Sand (%)	—	—	—	32.2		20.9		16.5	
Silt (%)	—	—	—	46.0		31.2		27.4	
Clay (%)	—	—	—	16.8		15.3		13.6	
Fines (%)	—	—	—	62.8		46.5		41.0	
Metals (mg/kg dw)									
Antimony	150	—	200	9.00	UJ	20.00	UJ	9.00	UJ
Arsenic	57	507.1	700	9.00	U	20.00	U	9.00	U
Cadmium	5.1	11.3	14	0.40	U	0.90	U	0.30	U
Chromium	260	260	—	41.80		42.00		39.90	
Copper	390	1,027	1,300	66.90		61.90		62.40	
Lead	450	975	1,200	6.00		9.00	U	6.00	
Mercury	0.41	1.5	2.3	0.06		0.06		0.06	
Selenium	—	3	—	0.90	U	0.90	U	0.90	U
Silver	6.1	6.1	8.4	0.60	U	1.00	U	0.50	U
Zinc	410	2,783	3,800	82.00		83.00		80.00	
PAHs (µg/kg dw)									
Naphthalene	2,100	—	2,400	23.00		17.00	J	20.00	
2-Methylnaphthalene [1]	670	—	1,900	9.60	J	19.00	U	19.00	U
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	19.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	19.00	U
Fluorene	540	—	3,600	19.00	U	19.00	U	19.00	U
Phenanthrene	1,500	—	21,000	25.00		22.00		50.00	
Anthracene	960	—	13,000	19.00	U	19.00	U	9.60	J
Total LPAH	5,200	—	29,000	48.00		39.00		79.60	
Fluoranthene	1,700	4,600	30,000	31.00		30.00		58.00	
Pyrene	2,600	11,980	16,000	26.00		26.00		63.00	
Benzo(a)anthracene	1,300	—	5,100	19.00	U	19.00	U	24.00	
Chrysene	1,400	—	21,000	12.00	J	19.00	U	24.00	
Benzo(a)pyrene	1,600	—	3,600	19.00	U	19.00	U	23.00	
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	19.00	U	9.60	J
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	19.00	U	19.00	U	13.00	J
Total Benzofluoranthenes	3,200	—	9,900	18.00	J	13.00	J	30.00	
Total HPAH	12,000	—	69,000	87.00		69.00		244.60	
Chlorinated Hydrocarbons (µg/kg dw)									
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	19.00	U
Hexachlorobenzene	22	168	230	19.00	U	19.00	U	19.00	U
Phthalates (µg/kg dw)									
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	19.00	U
Diethylphthalate	200	—	1,200	48.00	U	47.00	U	48.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	19.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	19.00	J	16.00	J
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	19.00	U
Phenols (µg/kg dw)									
Phenol	420	—	1,200	40.00		22.00		23.00	
2-Methylphenol	63	—	77	19.00	U	19.00	U	19.00	U
4-Methylphenol	670	—	3,600	110.00		20.00	J	24.00	J
2,4-Dimethylphenol	29	—	210	19.00	UJ	19.00	UJ	19.00	UJ
Pentachlorophenol	400	504	690	190.00	U	190.00	UJ	190.00	UJ

Table 5-5. Analytical Results for Cow Point: DMMUs 30 - 36 (from SEE, 2013)

Compound	SL	BT	ML	CP-34		CP-35		CP-36	
				Value	Q	Value	Q	Value	Q
Miscellaneous Extractables (µg/kg dw)									
Benzyl Alcohol	57	—	870	53.00		24.00		32.00	
Benzoic Acid	650	—	760	280.00	J	380.00	U	150.00	J
Dibenzofuran	540	—	1,700	19.00	U	19.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	19.00	U
Heptachlor	1.5	—	—	0.47	UJ	0.49	UJ	3.80	UJ
Hexachlorobutadiene	11	—	270	0.47	U	0.49	U	0.48	U
Pesticides and PCBs (µg/kg dw)									
Aldrin	9.5	—	—	0.47	U	0.49	U	0.48	U
Dieldrin	1.9	—	—	0.93	U	0.98	U	0.95	U
4,4 -DDE	16	—	—	0.93	U	0.98	U	1.40	U
4,4 -DDD	9	—	—	0.93	U	0.98	U	0.95	U
4,4 -DDT	12	—	—	0.93	UJ	0.98	U	0.95	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.93	UJ	0.98	U	0.95	UJ
trans-Chlordane	—	—	—	1.10	U	1.00	U	0.99	U
cis-Chlordane	—	—	—	0.47	U	0.49	U	0.48	U
oxy Chlordane	—	—	—	1.90	U	2.00	U	1.90	U
cis-Nonachlor	—	—	—	1.90	U	2.00	U	1.90	U
trans-Nonachlor	—	—	—	1.90	U	2.00	U	1.90	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	1.90	U	2.00	U	1.90	U
Aroclor 1016	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1242	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1248	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1254	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1260	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1221	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1232	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1262	—	—	—	9.40	U	9.70	U	9.60	U
Aroclor 1268	—	—	—	9.40	U	9.70	U	9.60	U
Total PCBs	130	38 (2)	3,100	9.40	U	9.70	U	9.60	U
Dioxins and Furans (pg/g) [3]									
2,3,7,8-TCDD	—	—	—	0.859	U	1.960		2.450	
1,2,3,7,8-PeCDD	—	—	—	1.030		2.710	J	3.430	J
1,2,3,4,7,8-HxCDD	—	—	—	0.165	U	6.830		7.760	
1,2,3,6,7,8-HxCDD	—	—	—	0.784	J	2.500		2.760	
1,2,3,7,8,9-HxCDD	—	—	—	2.430		0.664	J	0.827	J
1,2,3,4,6,7,8-HpCDD	—	—	—	9.570	J	31.900		36.800	
OCDD	—	—	—	58.000	J	197.000		227.000	
2,3,7,8-TCDF	—	—	—	0.177	U	0.709	J	0.728	J
1,2,3,7,8-PeCDF	—	—	—	0.031	U	0.202	U	0.262	J
2,3,4,7,8-PeCDF	—	—	—	0.058	U	0.461	U	0.565	U
1,2,3,4,7,8-HxCDF	—	—	—	0.147	J	0.208	J	0.180	U
1,2,3,6,7,8-HxCDF	—	—	—	0.089	U	0.136	U	0.087	U
2,3,4,6,7,8-HxCDF	—	—	—	0.068	U	0.289	U	0.345	U
1,2,3,7,8,9-HxCDF	—	—	—	0.009	U	0.456	J	0.436	U
1,2,3,4,6,7,8-HpCDF	—	—	—	2.660		0.372	U	0.411	U
1,2,3,4,7,8,9-HpCDF	—	—	—	0.082	U	10.700		11.500	
OCDF	—	—	—	4.920		16.900		21.500	

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.

2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

3. *Value exceeds the DMMP screening level*

Table 5-6. Analytical Results for North Bay Reference Sediments (from SEE, 2013)

Compound	SL	BT	ML	NB 040712 01		NB 040712 02	
				Value	Q	Value	Q
Conventionals							
Total Solids (%)	—	—	—	73		58.70	
Total Volatile Solids (%)	—	—	—	2.36		4.14	
N-Ammonia (mg-N/kg)	—	—	—	11.4		9.56	
Sulfide (mg/kg)	—	—	—	10.7	J	112.00	J
Total Organic Carbon (%)	—	—	—	1.15		0.79	
Gravel (%)	—	—	—	0.1	U	0.20	
Sand (%)	—	—	—	91.3		60.00	
Silt (%)	—	—	—	5.5		28.20	
Clay (%)	—	—	—	3.1		11.60	
Fines (%)	—	—	—	8.6		39.80	
Dioxins and Furans (ng/kg)							
2,3,7,8-TCDD	—	—	—	0.146	U	0.415	U
1,2,3,7,8-PeCDD	—	—	—	0.236	U	0.702	J
1,2,3,4,7,8-HxCDD	—	—	—	0.111	J	1.230	U
1,2,3,6,7,8-HxCDD	—	—	—	0.201	U	0.722	J
1,2,3,7,8,9-HxCDD	—	—	—	0.449	U	0.214	U
1,2,3,4,6,7,8-HpCDD	—	—	—	3.510		9.470	
OCDD	—	—	—	22.100		54.600	
2,3,7,8-TCDF	—	—	—	0.195	J	0.380	J
1,2,3,7,8-PeCDF	—	—	—	0.054	U	0.110	U
2,3,4,7,8-PeCDF	—	—	—	0.042	U	0.244	J
1,2,3,4,7,8-HxCDF	—	—	—	0.065	U	0.087	U
1,2,3,6,7,8-HxCDF	—	—	—	0.044	U	0.023	U
2,3,4,6,7,8-HxCDF	—	—	—	0.043	U	0.136	J
1,2,3,7,8,9-HxCDF	—	—	—	0.129	U	0.171	J
1,2,3,4,6,7,8-HpCDF	—	—	—	0.971	U	0.104	J
1,2,3,4,7,8,9-HpCDF	—	—	—	0.303	U	3.250	
OCDF	—	—	—	1.340	J	3.500	U

J - The analyte was detected above the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

Table 6. Toxic Equivalency Factors (TEFs) for PCDDs and PCDFs[1]

	CONGENERS	TOXIC EQUIVALENCY FACTOR (TEF)
Dioxins	2,3,7,8-TCDD	1
	1,2,3,7,8-PeCDD	1
	1,2,3,4,7,8-HxCDD	0.1
	1,2,3,6,7,8-HxCCD	0.1
	1,2,3,7,8,9-HxCDD	0.1
	1,2,3,4,6,7,8-HpCDD	0.01
	OCDD	0.0003
Furans	2,3,7,8-TCDF	0.1
	1,2,3,7,8-PeCDF	0.03
	2,3,4,7,8-PeCDF	0.3
	1,2,3,4,7,8-HxCDF	0.1
	1,2,3,6,7,8-HxCDF	0.1
	2,3,4,6,7,8-HxCDF	0.1
	1,2,3.7,8,9-HxCDF	0.1
	1,2,3,4,6,7,8-HpCDF	0.01
	1,2,3,4,7,8,9-HpCDF	0.01
	OCDF	0.0003

[1] World Health Organization Human and Mammalian TEFs, from van den Berg et al. (2006)

PCDD = polychlorinated dibenzo-p-dioxins
PCDF = polychlorinated dibenzofurans
T = tetra
Pe = penta
Hx = hexa
Hp = hepta
O = octa

Table 7. Dioxin/Furan Toxic Equivalents (TEQs)

Reach	DMMU	Sample ID	TEQ[1]	Units
South Reach	1	GHNIP SR1-P	0.3	ng/kg
South Reach	3	GHNIP SR3-P	0.4	ng/kg
South Reach	4	GHNIP SR4-P	1.0	ng/kg
Crossover	5	GHNIP CO5-P	2.0	ng/kg
Crossover	6	GHNIP CO6-P	1.8	ng/kg
Crossover	7	GHNIP CO7-P	2.5	ng/kg
Crossover	8	GHNIP C08-P	1.0	ng/kg
Crossover	9	GHNIP C09-P	1.8	ng/kg
Crossover	10	GHNIP CO10-P	2.4	ng/kg
Crossover	11	GHNIP CO11-P	2.5	ng/kg
Crossover	12	GHNIP CO12P	2.6	ng/kg
Crossover	13	GHNIP CO13P	2.9	ng/kg
CO/NC	14	GHNIP CO/NC14P	4.6	ng/kg
North Channel	15	GHNIP NC15-P	3.2	ng/kg
North Channel	16	GHNIP NC16P	5.0	ng/kg
North Channel	17	GHNIP NC17P	2.7	ng/kg
North Channel	18	GHNIP NC18P	1.6	ng/kg
North Channel	19	GHNIP NC19-P	1.1	ng/kg
North Channel	20	GHNIP NC20 P	3.6	ng/kg
North Channel	21	GHNIP NC21 P	0.6	ng/kg
Hoquiam Channel	22	GHNIP HC22 P	5.1	ng/kg
Hoquiam Channel	23	GHNIP HC23 P	3.5	ng/kg
Hoquiam Channel	24	GHNIP HC24 P	2.8	ng/kg
Hoquiam Channel	25	GHNIP HC25 P	6.5	ng/kg
Hoquiam Channel	26	GHNIP HC26 P	3.3	ng/kg
Hoquiam Channel	27	GHNIP HC27-P	10.1	ng/kg
Hoquiam Channel	28	GHNIP HC28-P	5.1	ng/kg
HC/CP	29	GHNIP HC/CP29-P	2.5	ng/kg
Cow Point	30	GHNIP CP30-P	0.6	ng/kg
Cow Point	31	GHNIP CP31-P	8.7	ng/kg
Cow Point	32	GHNIP CP32-P	8.0	ng/kg
Cow Point	33	GHNIP CP33P	0.8	ng/kg
Cow Point	34	GHNIP CP34P	2.0	ng/kg
Cow Point	35	GHNIP CP35P	6.4	ng/kg
Cow Point	36	GHNIP CP36P	7.8	ng/kg
North Bay Ref 1	---	GHNIP NB 040712 01	0.3	ng/kg
North Bay Ref 2	---	GHNIP NB 040712 02	1.3	ng/kg

Blind Field Splits

Reach	DMMU	Sample_ID	TEQ[1]	Units
Crossover	5	GHNIP CO5-P	2.0	ng/kg
Crossover	5	GHNIP CO55-P	2.0	ng/kg
Hoquiam Channel	23	GHNIP HC23 P	3.4	ng/kg
Hoquiam Channel	23	GHNIP HC73 P	4.6	ng/kg
Hoquiam Channel	27	GHNIP HC27-P	10.1	ng/kg
Hoquiam Channel	27	GHNIP HC57-P	4.1	ng/kg

ng/kg = nanograms/kilograms (parts per trillion)

[1]TEQs calculated with u = 1/2 detection limit

Table 8. DMMP Solid Phase Bioassay Performance Standards and Evaluation Guidelines.

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Dispersive Disposal Site Interpretation Guidelines		Nondispersive Disposal Site Interpretation Guidelines	
			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$	$M_T - M_C > 20\%$ and M_T vs. M_R SS (p=.05) and		$M_T - M_C > 20\%$ and M_T vs. M_R SS (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Larval	$N_C \div I \geq 0.70$	$N_R \div N_C \geq 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs. N_R/N_C SS (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs. N_R/N_C SS (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C \leq 10\%$ and $MIG_C \geq 0.38$	$M_R \leq 20\%$ and $MIG_R \div MIG_C \geq 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs. MIG_R SS (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs. MIG_R SS (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normal larvae, I = initial count, MIG = mean individual growth rate mg/individual/day)
SS = statistically significant, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

Table 9. Round 1 Amphipod Results - Original

	Sample ID	Replicate	Initial Count	Survivors	Percent Survival	Percent Mortality	Mean Percent Mortality	Hit/No Hit
Batch 1	CP32	1	20	9	45	55	40	XX
	CP32	2	20	10	50	50		
	CP32	3	20	11	55	45		
	CP32	4	20	13	65	35		
	CP32	5	20	17	85	15		
	CP33	1	20	18	90	10	25	XX
	CP33	2	20	11	55	45		
	CP33	3	20	13	65	35		
	CP33	4	20	18	90	10		
	CP33	5	20	15	75	25		
	NB 02	1	20	20	100	0	8	---
	NB 02	2	20	19	95	5		
	NB 02	3	20	18	90	10		
	NB 02	4	20	20	100	0		
	NB 02	5	20	15	75	25		
	control	1	20	19	95	5	1	---
	control	2	20	20	100	0		
	control	3	20	20	100	0		
	control	4	20	20	100	0		
	control	5	20	20	100	0		
Batch 2	SR1	1	20	20	100	0	1	No Hit
	SR1	2	20	20	100	0		
	SR1	3	20	20	100	0		
	SR1	4	20	19	95	5		
	SR1	5	20	20	100	0		
	SR3	1	20	19	95	5	4	No Hit
	SR3	2	20	19	95	5		
	SR3	3	20	18	90	10		
	SR3	4	20	20	100	0		
	SR3	5	20	20	100	0		
	SR4	1	20	19	95	5	3	No Hit
	SR4	2	20	20	100	0		
	SR4	3	20	20	100	0		
	SR4	4	20	19	95	5		
	SR4	5	20	19	95	5		
	CO7	1	20	20	100	0	14	No Hit
	CO7	2	20	14	70	30		
	CO7	3	20	17	85	15		
	CO7	4	20	15	75	25		
	CO7	5	20	20	100	0		
	NB 01	1	20	19	95	5	2	---
	NB 01	2	20	20	100	0		
	NB 01	3	20	19	95	5		
	NB 01	4	20	20	100	0		
	NB 01	5	20	20	100	0		
	control	1	20	20	100	0	1	---
	control	2	20	20	100	0		
	control	3	20	20	100	0		
	control	4	20	19	95	5		
	control	5	20	20	100	0		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 10. Round 1 Amphipod Results - Retest of CP32/CP33

	Sample ID	Replicate	Initial Count	Survivors	Percent Survival	Percent Mortality	Mean Percent Mortality	Hit/No Hit
Eohaustorius estuarius	CP32	1	20	15	75	25	15	No Hit
	CP32	2	20	19	95	5		
	CP32	3	20	18	90	10		
	CP32	4	20	16	80	20		
	CP32	5	20	17	85	15		
	CP33	1	20	19	95	5	21	No Hit
	CP33	2	20	14	70	30		
	CP33	3	20	14	70	30		
	CP33	4	20	17	85	15		
	CP33	5	20	15	75	25		
	NB 02	1	20	19	95	5	12	---
	NB 02	2	20	16	80	20		
	NB 02	3	20	19	95	5		
	NB 02	4	20	16	80	20		
	NB 02	5	20	18	90	10		
	control	1	20	18	90	10	6	---
	control	2	20	18	90	10		
	control	3	20	19	95	5		
	control	4	20	20	100	0		
	control	5	20	19	95	5		
Ampelisca abdita	CP32	1	20	16	80	20	23	No Hit
	CP32	2	20	12	60	40		
	CP32	3	20	18	90	10		
	CP32	4	20	17	85	15		
	CP32	5	20	14	70	30		
	CP33	1	20	18	90	10	7	No Hit
	CP33	2	20	17	85	15		
	CP33	3	20	20	100	0		
	CP33	4	20	20	100	0		
	CP33	5	20	18	90	10		
	NB 02	1	20	19	95	5	2	---
	NB 02	2	20	19	95	5		
	NB 02	3	20	20	100	0		
	NB 02	4	20	20	100	0		
	NB 02	5	20	20	100	0		
	control	1	20	20	100	0	4	---
	control	2	20	19	95	5		
	control	3	20	19	95	5		
	control	4	20	18	90	10		
	control	5	20	20	100	0		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 11. Round 1 Larval Results - Standard Termination Protocol

	Sample ID	Replicate	Initial Count	Normal Survivors	Combined Mortality and Abnormality	NMCA	Mean NCMA	Hit/No Hit
Batch 1	CP32	1	265	198	67	21.1	21.3	X
	CP32	2	265	195	70	22.2		
	CP32	3	265	200	65	20.3		
	CP32	4	265	214	51	14.7		
	CP32	5	265	180	85	28.2		
	CP33	1	265	195	70	22.2	18.5	No Hit
	CP33	2	265	204	61	18.7		
	CP33	3	265	201	64	19.9		
	CP33	4	265	216	49	13.9		
	CP33	5	265	206	59	17.9		
	NB 02	1	265	244	21	2.7	10.0	---
	NB 02	2	265	235	30	6.3		
	NB 02	3	265	188	77	25.0		
	NB 02	4	265	244	21	2.7		
	NB 02	5	265	217	48	13.5		
	swcontrol	1	265	248	17	1.1	0.0	---
	swcontrol	2	265	256	9	-2.1		
	swcontrol	3	265	249	16	0.7		
	swcontrol	4	265	255	10	-1.7		
	swcontrol	5	265	246	19	1.9		
Batch 2	SR1	1	245	196	49	13.7	13.5	No Hit
	SR1	2	245	190	55	16.4		
	SR1	3	245	173	72	23.9		
	SR1	4	245	228	17	-0.4		
	SR1	5	245	196	49	13.7		
	SR3	1	245	221	24	2.7	6.3	No Hit
	SR3	2	245	249	-4	-9.6		
	SR3	3	245	212	33	6.7		
	SR3	4	245	196	49	13.7		
	SR3	5	245	186	59	18.1		
	SR4	1	245	160	85	29.6	27.8	XX
	SR4	2	245	174	71	23.4		
	SR4	3	245	159	86	30.0		
	SR4	4	245	168	77	26.1		
	SR4	5	245	159	86	30.0		
	CO7	1	245	157	88	30.9	35.3	XX
	CO7	2	245	135	110	40.6		
	CO7	3	245	157	88	30.9		
	CO7	4	245	148	97	34.9		
	CO7	5	245	138	107	39.3		
	NB 01	1	245	204	41	10.2	12.3	---
	NB 01	2	245	189	56	16.8		
	NB 01	3	245	191	54	15.9		
	NB 01	4	245	218	27	4.0		
	NB 01	5	245	194	51	14.6		
	swcontrol	1	245	200	45	12.0	0.0	---
	swcontrol	2	245	220	25	3.2		
	swcontrol	3	245	233	12	-2.6		
	swcontrol	4	245	242	3	-6.5		
	swcontrol	5	245	241	4	-6.1		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NCMA=normalized combined percent mortality and abnormality=100(1-(# of normals/NS))
where NS=average of normal larvae counted in seawater controls

Table 12. Round 1 Larval Results - Resuspension Protocol

	Sample ID	Replicate	Initial Count	Normal Survivors	Combined Mortality and Abnormality	NMCA	Mean NCMA	Hit/No Hit
Batch 1	CP32	1	265	238	27	2.1	9.5	No Hit
	CP32	2	265	212	53	12.8		
	CP32	3	265	240	25	1.3		
	CP32	4	265	203	62	16.5		
	CP32	5	265	208	57	14.5		
	CP33	1	265	189	76	22.3	12.7	No Hit
	CP33	2	265	228	37	6.3		
	CP33	3	265	226	39	7.1		
	CP33	4	265	215	50	11.6		
	CP33	5	265	204	61	16.1		
	NB 02	1	265	236	29	3.0	-0.7	---
	NB 02	2	265	229	36	5.8		
	NB 02	3	265	232	33	4.6		
	NB 02	4	265	281	-16	-15.5		
	NB 02	5	265	247	18	-1.6		
	swcontrol	1	265	259	6	-6.5	0.0	---
	swcontrol	2	265	243	22	0.1		
	swcontrol	3	265	238	27	2.1		
	swcontrol	4	265	239	26	1.7		
	swcontrol	5	265	237	28	2.5		
Batch 2	SR1	1	245	242	3	-8.0	13.7	No Hit
	SR1	2	245	201	44	10.3		
	SR1	3	245	165	80	26.3		
	SR1	4	245	206	39	8.0		
	SR1	5	245	153	92	31.7		
	SR3	1	245	177	68	21.0	10.5	No Hit
	SR3	2	245	224	21	0.0		
	SR3	3	245	206	39	8.0		
	SR3	4	245	212	33	5.4		
	SR3	5	245	183	62	18.3		
	SR4	1	245	183	62	18.3	18.9	No Hit
	SR4	2	245	210	35	6.3		
	SR4	3	245	147	98	34.4		
	SR4	4	245	185	60	17.4		
	SR4	5	245	183	62	18.3		
	CO7	1	245	150	95	33.0	28.8	XX
	CO7	2	245	190	55	15.2		
	CO7	3	245	146	99	34.8		
	CO7	4	245	169	76	24.6		
	CO7	5	245	142	103	36.6		
	NB 01	1	245	197	48	12.1	6.0	---
	NB 01	2	245	198	47	11.6		
	NB 01	3	245	222	23	0.9		
	NB 01	4	245	221	24	1.3		
	NB 01	5	245	215	30	4.0		
	swcontrol	1	245	245	0	-9.4	0.0	---
	swcontrol	2	245	220	25	1.8		
	swcontrol	3	245	238	7	-6.3		
	swcontrol	4	245	228	17	-1.8		
	swcontrol	5	245	189	56	15.6		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NCMA=normalized combined percent mortality and abnormality=100(1-(# of normals/NS))
where NS=average of normal larvae counted in seawater controls

Table 13. Round 1 Neanthes Results - Ash-Free Dry-Weight Endpoint

	Sample ID	Replicate	Initial Count	Survivors	Growth Rate (mg/individual/day)	Mean Growth Rate	Hit/No Hit
Batch 1	CP32	1	5	5	0.59	0.62	No Hit
	CP32	2	5	5	0.71		
	CP32	3	5	5	0.61		
	CP32	4	5	5	0.62		
	CP32	5	5	5	0.56		
	CP33	1	5	5	0.58	0.61	No Hit
	CP33	2	5	5	0.62		
	CP33	3	5	5	0.56		
	CP33	4	5	5	0.66		
	CP33	5	5	5	0.63		
	NB 02	1	5	5	0.79	0.80	---
	NB 02	2	5	5	0.88		
	NB 02	3	5	5	0.76		
	NB 02	4	5	5	0.88		
	NB 02	5	5	5	0.70		
	control	1	5	5	0.69	0.69	---
	control	2	5	5	0.71		
	control	3	5	5	0.76		
	control	4	5	5	0.75		
	control	5	5	5	0.53		
Batch 2	SR1	1	5	5	0.88	0.84	No Hit
	SR1	2	5	5	0.96		
	SR1	3	5	5	0.80		
	SR1	4	5	5	0.74		
	SR1	5	5	5	0.81		
	SR3	1	5	5	0.84	0.76	No Hit
	SR3	2	5	5	0.67		
	SR3	3	5	5	0.88		
	SR3	4	5	5	0.77		
	SR3	5	5	5	0.65		
	SR4	1	5	5	0.60	0.79	No Hit
	SR4	2	5	5	0.56		
	SR4	3	5	5	0.86		
	SR4	4	5	3	1.26		
	SR4	5	5	5	0.65		
	CO7	1	5	5	0.41	0.68	No Hit
	CO7	2	5	5	0.68		
	CO7	3	5	5	0.76		
	CO7	4	5	5	0.77		
	CO7	5	5	5	0.76		
	NB 01	1	5	5	0.97	0.84	---
	NB 01	2	5	5	0.84		
	NB 01	3	5	5	0.72		
	NB 01	4	5	5	0.80		
	NB 01	5	5	5	0.86		
	swcontrol	1	5	5	0.58	0.70	---
	swcontrol	2	5	5	0.62		
	swcontrol	3	5	5	0.76		
	swcontrol	4	5	5	0.79		
	swcontrol	5	5	5	0.74		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 14. Interpretation of Bioassay Results - Round 1, Batch 1

original amphipod (Eohaustorius estuarius):

	mean % mortality	M_T - M_C	M_T - M_C > 20?	transformation	statistically greater than reference?	M_T - M_R	M_T - M_R > 15?	interpretation
CP32	40	39	yes	arcsin sq root	yes	32	yes	XX
CP33	25	24	yes	arcsin sq root	yes	17	yes	XX
NB02	8	---	---	---	---	---	---	---
Control	1	---	---	---	---	---	---	---

amphipod retest (Eohaustorius estuarius):

	mean % mortality	M_T - M_C	M_T - M_C > 20?	transformation	statistically greater than reference?	M_T - M_R	M_T - M_R > 15?	interpretation
CP32	15	9	no	NA	NA	NA	NA	no hit
CP33	21	15	no	NA	NA	NA	NA	no hit
NB02	12	---	---	---	---	---	---	---
Control	6	---	---	---	---	---	---	---

amphipod retest (Ampelisca abdita):

	mean % mortality	M_T - M_C	M_T - M_C > 20?	transformation	statistically greater than reference?	M_T - M_R	M_T - M_R > 15?	interpretation
CP32	23	19	no	NA	NA	NA	NA	no hit
CP33	7	3	no	NA	NA	NA	NA	no hit
NB02	2	---	---	---	---	---	---	---
Control	4	---	---	---	---	---	---	---

standard larval protocol (Mytilus galloprovincialis):

	mean normal count	N_T/N_C	N_T/N_C < 0.80?	transformation	statistically less than reference?	N_R/N_C - N_T/N_C	N_R/N_C - N_T/N_C > 0.15?	interpretation
CP32	197.4	0.785	yes	none needed	yes	0.115	no	X
CP33	204.4	0.813	no	NA	NA	NA	NA	no hit
NB02	226.0	---	---	---	---	---	---	---
Control	251.0	---	---	---	---	---	---	---

resuspension larval protocol (Mytilus galloprovincialis):

	mean normal count	N_T/N_C	N_T/N_C < 0.80?	transformation	statistically less than reference?	N_R/N_C - N_T/N_C	N_R/N_C - N_T/N_C > 0.15?	interpretation
CP32	220.2	0.905	no	NA	NA	NA	NA	no hit
CP33	212.4	0.872	no	NA	NA	NA	NA	no hit
NB02	245.0	---	---	---	---	---	---	---
Control	243.2	---	---	---	---	---	---	---

Neanthes growth - AFDW endpoint:

	mean individual growth rate	MIG_T/MIG_C	MIG_T/MIG_C < 0.80?	transformation	statistically less than reference?	MIG_T/MIG_R	MIG_T/MIG_R < 0.70?	interpretation
CP32	0.620	0.904	no	NA	NA	NA	NA	no hit
CP33	0.610	0.889	no	NA	NA	NA	NA	no hit
NB02	0.800	---	---	---	---	---	---	---
Control	0.686	---	---	---	---	---	---	---

M = mortality, N = normal larvae, MIG = mean individual growth rate mg/individual/day)
Subscripts: R = reference sediment, C = negative control, T = test sediment
NA = not applicable

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 15. Interpretation of Bioassay Results - Round 1, Batch 2

amphipod (Eohaustorius estuarius):

	mean % mortality	M_T - M_C	M_T - M_C > 20?	transformation	statistically greater than reference?	M_T - M_R	M_T - M_R > 15?	interpretation
SR1-P	1	0	no	NA	NA	NA	NA	no hit
SR3-P	4	3	no	NA	NA	NA	NA	no hit
SR4-P	3	2	no	NA	NA	NA	NA	no hit
CO7-P	14	13	no	NA	NA	NA	NA	no hit
NB01	2	---	---	---	---	---	---	---
Control	1	---	---	---	---	---	---	---

standard larval protocol (Mytilus galloprovincialis):

	mean normal count	N_T/N_C	N_T/N_C < 0.80?	transformation	statistically less than reference?	N_R/N_C - N_T/N_C	N_R/N_C - N_T/N_C > 0.15?	interpretation
SR1-P	196.6	0.865	no	NA	NA	NA	NA	no hit
SR3-P	212.8	0.937	no	NA	NA	NA	NA	no hit
SR4-P	164.0	0.722	yes	log 10	yes	0.155	yes	XX
CO7-P	147.0	0.647	yes	log 10	yes	0.230	yes	XX
NB01	199.2	---	---	---	---	---	---	---
Control	227.2	---	---	---	---	---	---	---

resuspension larval protocol (Mytilus galloprovincialis):

	mean normal count	N_T/N_C	N_T/N_C < 0.80?	transformation	statistically less than reference?	N_R/N_C - N_T/N_C	N_R/N_C - N_T/N_C > 0.15?	interpretation
SR1-P	193.4	0.863	no	NA	NA	NA	NA	no hit
SR3-P	200.4	0.895	no	NA	NA	NA	NA	no hit
SR4-P	181.6	0.811	no	NA	NA	NA	NA	no hit
CO7-P	159.4	0.712	yes	none needed	yes	0.229	yes	XX
NB01	210.6	---	---	---	---	---	---	---
Control	224.0	---	---	---	---	---	---	---

Neanthes growth - AFDW endpoint:

	mean individual growth rate	MIG_T/MIG_C	MIG_T/MIG_C < 0.80?	transformation	statistically less than reference?	MIG_T/MIG_R	MIG_T/MIG_R < 0.70?	interpretation
SR1-P	0.840	1.200	no	NA	NA	NA	NA	no hit
SR3-P	0.760	1.086	no	NA	NA	NA	NA	no hit
SR4-P	0.790	1.129	no	NA	NA	NA	NA	no hit
CO7-P	0.680	0.971	no	NA	NA	NA	NA	no hit
NB01	0.840	---	---	---	---	---	---	---
Control	0.700	---	---	---	---	---	---	---

M = mortality, N = normal larvae, MIG = mean individual growth rate mg/individual/day)
Subscripts: R = reference sediment, C = negative control, T = test sediment
NA = not applicable

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 16-1. Summary of data for Round 1/Batch 1: CP32 and CP33

Parameter/Bioassay	CP32	CP33	NB02	
% clay	24.2	30.6	11.6	initial results
% fines	74.0	78.8	38.7	
bulk ammonia (mg/kg)	210	115	9.6	
bulk sulfides (mg/kg)	509	70.2	10.7	
benzyl alcohol (ug/kg) (SL = 57)	100	110	---	
amphipod (*E. estuarius*)	XX	XX	NA	
larval - standard protocol	X	no hit	NA	
larval - resuspension protocol	no hit	no hit	NA	
Neanthes - AFDW endpoint	no hit	no hit	NA	
% clay	28.5	32.2	13.8	amphipod retest
% fines	77.8	85.4	42.9	
bulk ammonia (mg/kg)	151	93	7.6	
bulk sulfides (mg/kg)	233	377	348	
benzyl alcohol (ug/kg)	57	140	---	
amphipod (*E. estuarius*)	no hit	no hit	NA	
amphipod (*A. abdita*)	no hit	no hit	NA	
overall interpretation/outcome	**split and resample**	**pass**	NA	

Table 16-2. Summary of data for Round 1/Batch 2: SR1, SR3, SR4 and CO7

Parameter/Bioassay	SR-1	SR-3	SR-4	CO-7	NB01
% clay	2	0.3	2.2	4.5	1.5
% fines	2.0	0.3	14.7	35.2	9.5
% TOC	2.3	1.0	1.2	1.3	1.2
bulk ammonia (mg/kg)	6.7	3.9	19.8	102	11.4
bulk sulfides (mg/kg)	71	2.49	51.1	638	0.7
number of SL exceedances:	0	0	0	1[1]	---
cis-nonachlor (ug/kg); SL = 2.8	---	---	---	3.4 U	---
dioxin TEQ (ng/kg)	0.3	0.4	1.0	2.5	0.3
amphipod	no hit	no hit	no hit	no hit	---
larval - standard protocol	no hit	no hit	XX	XX	---
larval - resuspension protocol	no hit	no hit	no hit	XX	---
Neanthes - AFDW endpoint	no hit	no hit	no hit	no hit	---
overall interpretation/outcome	**pass**	**pass**	**pass**	**split and resample**	**---**

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NA = not applicable

[1]Cis-nonachlor was originally reported as a probable detect, hence the decision to conduct bioassays. After reviewing the data in more depth and doing some follow-up analysis, the analytical laboratory didn't think this was an actual hit, but there was not enough evidence to bring the reporting limit down below the SL.

Table 17. Round 2 Sampling Data

DMMU	Station	Latitude	Longitude	Mudline Elevation (ft, MLLW)	Acquisition Depth (ft, MLLW)	Sample Length Acquired (ft)	Z-sample Length Acquired (ft)
C07a	CO7a-1	46.93860	-124.00928	-34.3	-44.0	2.0	2.0
	CO7a-2	46.93917	-124.00841	-35.4	-44.0	2.0	2.0
	CO7a-3	46.93993	-124.00766	-35.2	-44.0	2.0	2.0
	CO7a-4	46.93809	-124.00900	-38.2	-44.0	2.0	2.0
	CO7a-5	46.93888	-124.00788	-38.4	-44.0	2.0	2.0
	CO7a-6	46.93960	-124.00699	-38.4	-44.0	2.0	2.0
CO7b	CO7b-1	46.94036	-124.00721	-34.0	-44.0	2.0	2.0
	CO7b-2	46.94114	-124.00599	-35.9	-44.0	2.0	2.0
	CO7b-3	46.94186	-124.00513	-35.8	-44.0	2.0	2.0
	CO7b-4	46.94144	-124.00467	-38.2	-44.0	2.0	2.0
	CO7b-5	46.94084	-124.00536	-38.5	-44.0	2.0	2.0
	CO7b-6	46.94027	-124.00617	-38.4	-44.0	2.0	2.0
CP32a	CP32a-1	46.96138	-123.84872	-35.6	-44.0	2.0	2.0
	CP32a-2	46.96132	-123.84923	-38.5	-44.0	2.0	2.0
	CP32a-3	46.96084	-123.84919	-38.7	-44.0	2.0	2.0
	CP32a-4	46.96130	-123.84988	-39.1	-44.0	2.0	2.0
	CP32a-5	46.96142	-123.85073	-39.2	-44.0	2.0	2.0
	CP32a-6	46.96142	-123.85073	-39.1	-44.0	2.0	2.0
CP32b	CP32b-1	46.95999	-123.84997	-33.0	-44.0	2.0	2.0
	CP32b-2	46.96028	-123.84953	-36.6	-44.0	2.0	2.0
	CP32b-3	46.96029	-123.85047	-33.9	-44.0	2.0	2.0
	CP32b-4	46.96093	-123.85026	-38.3	-44.0	2.0	2.0
	CP32b-5	46.96111	-123.85105	-35.7	-44.0	2.0	2.0
	CP32b-6	46.96071	-123.85108	-34.1	-44.0	2.0	2.0

Table 18-1. Analytical Results for Round 2 (from SEE, 2013)

Compound	SL	BT	ML	CO7a-P		CO7a-Z		CO7b-P		CO7b-Z	
				Value	Q	Value	Q	Value	Q	Value	Q
Conventionals											
Total Solids (%)	—	—	—	68.4		68.4		69.5		73.7	
Total Volatile Solids (%)	—	—	—	3.6		3.8		3.7		2.3	
N-Ammonia (mg-N/kg)	—	—	—	60.4		55.5		76.2		90.0	
Sulfide (mg/kg)	—	—	—	268.0		262.0		208.0		41.0	
Total Organic Carbon (%)	—	—	—	1.3		1.4		1.0		0.7	
Gravel (%)	—	—	—	0.4		0.1		1.0		0.1	
Sand (%)	—	—	—	65.9		52.7		57.5		75.0	
Silt (%)	—	—	—	23.7		33.4		31.0		17.8	
Clay (%)	—	—	—	10.0		13.8		10.6		7.3	
Fines (%)	—	—	—	33.7		47.2		41.6		25.1	
PAHs (µg/kg dw)											
Naphthalene	2,100	—	2,400	19.00	J	20.00	U	15.00	J	19.00	U
2-Methylnaphthalene [1]	670	—	1,900	20.00	U	20.00	U	19.00	U	19.00	U
Acenaphthylene	560	—	1,300	20.00	U	20.00	U	19.00	U	19.00	U
Acenaphthene	500	—	2,000	20.00	U	20.00	U	19.00	U	19.00	U
Fluorene	540	—	3,600	20.00	U	20.00	U	19.00	U	19.00	U
Phenanthrene	1,500	—	21,000	19.00	U	13.00	J	17.00	J	19.00	U
Anthracene	960	—	13,000	20.00	U	20.00	U	19.00	U	19.00	U
Total LPAH	5,200	—	29,000	19.00		13.00		15.00		19.00	
Benzo(a)anthracene	1,300	—	5,100	20.00	U	20.00	U	19.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	20.00	U	20.00	U	19.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	20.00	U	20.00	U	19.00	U	19.00	U
Chrysene	1,400	—	21,000	20.00	U	20.00	U	19.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	20.00	U	20.00	U	19.00	U	19.00	U
Fluoranthene	1,700	4,600	30,000	13.00	J	20.00	U	11.00	J	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	20.00	U	20.00	U	19.00	U	19.00	U
Pyrene	2,600	11,980	16,000	14.00	J	20.00	U	15.00	J	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	39.00	U	40.00	U	37.00	U	38.00	U
Total HPAH	12,000	—	69,000	27.00		40.00		26.00		38.00	U
Chlorinated Hydrocarbons (µg/kg dw)											
1,4-Dichlorobenzene	110	—	120	20.00	U	20.00	U	19.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	20.00	U	20.00	U	19.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	20.00	U	20.00	U	19.00	U	19.00	U
Hexachlorobenzene	22	168	230	20.00	UJ	20.00	UJ	19.00	UJ	19.00	UJ
Phthalates (µg/kg dw)											
Dimethylphthalate	71	—	1,400	20.00	U	20.00	U	19.00	U	19.00	U
Diethylphthalate	200	—	1,200	48	U	53		46.00	U	48.00	U
Di-n-Butylphthalate	1,400	—	5,100	20.00	U	20.00	U	19.00	U	19.00	U
Butylbenzylphthalate	63	—	970	20.00	U	20.00	U	19.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	29.00	U	25.00	U	23.00	U	24.00	U
Di-n-Octyl phthalate	6,200	—	6,200	20.00	U	20.00	U	19.00	U	19.00	U
Phenols (µg/kg dw)											
Phenol	420	—	1,200	24.00		26.00		10.00	J	19.00	U
2-Methylphenol	63	—	77	20.00	U	20.00	U	19.00	U	19.00	U
4-Methylphenol	670	—	3,600	16.00	J	40.00	U	25.00	J	38.00	U
2,4-Dimethylphenol	29	—	210	20.00	UJ	20.00	UJ	19.00	UJ	19.00	UJ
Pentachlorophenol	400	504	690	200.00	UJ	200.00	UJ	190.00	UJ	190.00	UJ
Miscellaneous Extractables (µg/kg dw)											
Benzyl Alcohol	57	—	870	20.00	UJ	20.00	UJ	19.00	UJ	19.00	UJ
Benzoic Acid	650	—	760	390.00	U	400.00	U	370.00	U	380.00	U
Dibenzofuran	540	—	1,700	20.00	U	20.00	U	19.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	20.00	U	20.00	U	19.00	U	19.00	U
Heptachlor	1.5	—	—	0.48	U	0.47	U	0.46	U	0.48	UJ
Hexachlorobutadiene	11	—	270	0.96	UJ	0.94	UJ	0.93	UJ	0.97	UJ

Table 18-1. Analytical Results for Round 2 (from SEE, 2013)

Compound	SL	BT	ML	CO7a-P		CO7a-Z		CO7b-P		CO7b-Z	
				Value	Q	Value	Q	Value	Q	Value	Q
Pesticides and PCBs (µg/kg dw)											
Aldrin	9.5	—	—	0.48	U	0.47	U	0.46	U	0.48	U
Dieldrin	1.9	—	—	0.96	U	0.94	U	0.93	U	0.97	U
4,4 -DDE	16	—	—	0.96	U	0.94	U	0.93	U	0.97	U
4,4 -DDD	9	—	—	0.96	U	0.94	U	0.93	U	0.97	U
4,4 -DDT	12	—	—	0.96	U	0.94	U	0.93	U	0.97	UJ
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.96	U	0.94	U	0.93	U	0.97	UJ
trans-Chlordane	—	—	—	0.48	U	0.47	U	0.46	U	0.48	U
cis-Chlordane	—	—	—	0.48	U	0.47	U	0.46	U	0.48	U
oxy Chlordane	—	—	—	0.96	U	0.94	U	0.93	U	0.97	U
cis-Nonachlor	—	—	—	0.96	U	0.94	U	0.93	U	0.97	U
trans-Nonachlor	—	—	—	0.96	U	0.94	U	0.93	U	0.97	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	0.96	U	0.94	U	0.93	U	0.97	U

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.
2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

Table 18-1. Analytical Results for Round 2 (from SEE, 2013)

Compound	SL	BT	ML	CP32a-P		CP32a-Z		CP32b-P		CP32b-Z	
				Value	Q	Value	Q	Value	Q	Value	Q
Conventionals											
Total Solids (%)	—	—	—	57.2		63.8		65.7		67.6	
Total Volatile Solids (%)	—	—	—	6.1		4.4		4.3		3.8	
N-Ammonia (mg-N/kg)	—	—	—	174.0		283.0		184.0		188.0	
Sulfide (mg/kg)	—	—	—	579.0		290.0		364.0		142.0	
Total Organic Carbon (%)	—	—	—	1.6		1.0		1.7		1.1	
Gravel (%)	—	—	—	0.4		0.1		0.1	U	0.1	U
Sand (%)	—	—	—	38.1		31.9		47.8		42.3	
Silt (%)	—	—	—	42.8		58.1		36.5		43.0	
Clay (%)	—	—	—	18.7		9.9		15.9		14.7	
Fines (%)	—	—	—	61.5		68.0		52.4		57.7	
PAHs (µg/kg dw)											
Naphthalene	2,100	—	2,400	22.00		19.00	U	18.00	U	19.00	U
2-Methylnaphthalene [1]	670	—	1,900	18.00	J	19.00	U	18.00	U	19.00	U
Acenaphthylene	560	—	1,300	19.00	U	19.00	U	18.00	U	19.00	U
Acenaphthene	500	—	2,000	19.00	U	19.00	U	18.00	U	19.00	U
Fluorene	540	—	3,600	12.00	J	19.00	U	18.00	U	19.00	U
Phenanthrene	1,500	—	21,000	27.00		11.00	J	14.00	J	12.00	J
Anthracene	960	—	13,000	19.00	U	19.00	U	18.00	U	19.00	U
Total LPAH	5,200	—	29,000	49.00		11.00		14.00		12.00	
Benzo(a)anthracene	1,300	—	5,100	19.00	U	19.00	U	18.00	U	19.00	U
Benzo(a)pyrene	1,600	—	3,600	19.00	U	19.00	U	18.00	U	19.00	U
Benzo(g,h,i)perylene	670	—	3,200	14.00	J	19.00	U	18.00	U	19.00	U
Chrysene	1,400	—	21,000	10.00	J	19.00	U	18.00	U	19.00	U
Dibenz(a,h)anthracene	230	—	1,900	19.00	U	19.00	U	18.00	U	19.00	U
Fluoranthene	1,700	4,600	30,000	23.00		19.00	U	11.00	J	19.00	U
Indeno(1,2,3-cd)pyrene	600	—	4,400	19.00	U	19.00	U	18.00	U	19.00	U
Pyrene	2,600	11,980	16,000	22.00		19.00	U	11.00	J	19.00	U
Total Benzofluoranthenes	3,200	—	9,900	15.00	J	38.00	U	36.00	U	38.00	U
Total HPAH	12,000	—	69,000	84.00		38.00		22.00		38.00	
Chlorinated Hydrocarbons (µg/kg dw)											
1,4-Dichlorobenzene	110	—	120	19.00	U	19.00	U	18.00	U	19.00	U
1,2-Dichlorobenzene	35	—	110	19.00	U	19.00	U	18.00	U	19.00	U
1,2,4-Trichlorobenzene	31	—	64	19.00	U	19.00	U	18.00	U	19.00	U
Hexachlorobenzene	22	168	230	19.00	UJ	19.00	UJ	18.00	UJ	19.00	UJ
Phthalates (µg/kg dw)											
Dimethylphthalate	71	—	1,400	19.00	U	19.00	U	18.00	U	19.00	U
Diethylphthalate	200	—	1,200	48.00	U	47.00	U	45.00	U	48.00	U
Di-n-Butylphthalate	1,400	—	5,100	19.00	U	19.00	U	18.00	U	19.00	U
Butylbenzylphthalate	63	—	970	19.00	U	19.00	U	18.00	U	19.00	U
bis(2-Ethylhexyl)phthalate	1,300	—	8,300	24.00	U	24.00	U	22.00	U	24.00	U
Di-n-Octyl phthalate	6,200	—	6,200	19.00	U	19.00	U	18.00	U	19.00	U
Phenols (µg/kg dw)											
Phenol	420	—	1,200	32.00		12.00	J	36.00		9.50	J
2-Methylphenol	63	—	77	19.00	U	19.00	U	18.00	U	19.00	U
4-Methylphenol	670	—	3,600	24.00	J	38.00	U	36.00	U	38.00	U
2,4-Dimethylphenol	29	—	210	19.00	UJ	19.00	UJ	18.00	UJ	19.00	UJ
Pentachlorophenol	400	504	690	190.00	UJ	190.00	UJ	180.00	UJ	190.00	UJ
Miscellaneous Extractables (µg/kg dw)											
Benzyl Alcohol	57	—	870	19.00	UJ	19.00	UJ	18.00	UJ	19.00	UJ
Benzoic Acid	650	—	760	140.00	J	380.00	U	360.00	U	380.00	U
Dibenzofuran	540	—	1,700	14.00	J	19.00	U	18.00	U	19.00	U
N-Nitrosodiphenylamine	28	—	130	19.00	U	19.00	U	18.00	U	19.00	U
Heptachlor	1.5	—	—	0.49	U	0.48	U	0.49	U	0.48	U
Hexachlorobutadiene	11	—	270	0.98	UJ	0.96	UJ	0.98	UJ	0.95	UJ

Table 18-1. Analytical Results for Round 2 (from SEE, 2013)

Compound	SL	BT	ML	CP32a-P		CP32a-Z		CP32b-P		CP32b-Z	
				Value	Q	Value	Q	Value	Q	Value	Q
Pesticides and PCBs (µg/kg dw)											
Aldrin	9.5	—	—	0.49	U	0.48	U	0.49	U	0.48	U
Dieldrin	1.9	—	—	0.98	U	0.96	U	0.98	U	0.95	U
4,4 -DDE	16	—	—	0.98	U	0.96	U	0.98	U	0.95	U
4,4 -DDD	9	—	—	0.98	U	0.96	U	0.98	U	0.95	U
4,4 -DDT	12	—	—	0.98	U	0.96	U	0.98	U	0.95	U
sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT	—	50	69	0.98	U	0.96	U	0.98	U	0.95	U
trans-Chlordane	—	—	—	0.49	U	0.48	U	0.49	U	0.48	U
cis-Chlordane	—	—	—	0.49	U	0.48	U	0.49	U	0.48	U
oxy Chlordane	—	—	—	0.98	U	0.96	U	0.98	U	0.95	U
cis-Nonachlor	—	—	—	0.98	U	0.96	U	0.98	U	0.95	U
trans-Nonachlor	—	—	—	0.98	U	0.96	U	0.98	U	0.95	U
Total Chlordane (sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane)	2.8	37	—	0.98	U	0.96	U	0.98	U	0.95	U

J - The analyte was detected below the reported quantitation limit, and the reported concentration was an estimated value.

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Notes:

1. 2-Methylnaphthalene is not included in the summation for total LPAH.
2. This value is normalized to total organic carbon, and is expressed in mg/kg carbon.

Table 18-2. Analytical Results for North Bay Reference Sediments - Round 2 (from SEE, 2013)

Compound	SL	BT	ML	NB13		NB15	
				Value	Q	Value	Q
Conventionals							
Total Solids (%)	—	—	—	67.7		71.4	
Total Volatile Solids (%)	—	—	—	3.4		2.2	
N-Ammonia (mg-N/kg)	—	—	—	5.1		6.9	
Sulfide (mg/kg)	—	—	—	169.0		359.0	
Total Organic Carbon (%)	—	—	—	1.1		1.1	
Gravel (%)	—	—	—	0.1	U	0.1	U
Sand (%)	—	—	—	71.7		88.8	
Silt (%)	—	—	—	19.3		5.9	
Clay (%)	—	—	—	8.9		5.2	
Fines (%)	—	—	—	28.2		11.1	

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

Table 19. Round 2 Amphipod Results

Sample ID	Replicate	Initial Count	Survivors	Percent Survival	Percent Mortality	Mean Percent Mortality	Hit/No Hit[1]
CO7a-P	1	20	13	65	35		
CO7a-P	2	20	12	60	40		
CO7a-P	3	20	12	60	40	32	---
CO7a-P	4	20	16	80	20		
CO7a-P	5	20	15	75	25		
CO7a-Z	1	20	14	70	30		
CO7a-Z	2	20	18	90	10		
CO7a-Z	3	20	11	55	45	28	---
CO7a-Z	4	20	16	80	20		
CO7a-Z	5	20	13	65	35		
CO7b-P	1	20	17	85	15		
CO7b-P	2	20	15	75	25		
CO7b-P	3	20	13	65	35	37	---
CO7b-P	4	20	8	40	60		
CO7b-P	5	20	10	50	50		
CO7b-Z	1	20	16	80	20		
CO7b-Z	2	20	12	60	40		
CO7b-Z	3	20	7	35	65	31	---
CO7b-Z	4	20	15	75	25		
CO7b-Z	5	20	19	95	5		
CP32a-P	1	20	9	45	55		
CP32a-P	2	20	7	35	65		
CP32a-P	3	20	9	45	55	60	---
CP32a-P	4	20	7	35	65		
CP32a-P	5	20	8	40	60		
CP32a-Z	1	20	3	15	85		
CP32a-Z	2	20	0	0	100		
CP32a-Z	3	20	1	5	95	93	---
CP32a-Z	4	20	2	10	90		
CP32a-Z	5	20	1	5	95		
CP32b-P	1	20	5	25	75		
CP32b-P	2	20	2	10	90		
CP32b-P	3	20	9	45	55	73	---
CP32b-P	4	20	8	40	60		
CP32b-P	5	20	3	15	85		
CP32b-Z	1	20	2	10	90		
CP32b-Z	2	20	1	5	95		
CP32b-Z	3	20	2	10	90	93	---
CP32b-Z	4	20	2	10	90		
CP32b-Z	5	20	0	0	100		
NB 13	1	20	18	90	10		
NB 13	2	20	15	75	25		
NB 13	3	20	20	100	0	16	---
NB 13	4	20	14	70	30		
NB 13	5	20	17	85	15		
NB 15	1	20	18	90	10		
NB 15	2	20	16	80	20		
NB 15	3	20	18	90	10	15	---
NB 15	4	20	15	75	25		
NB 15	5	20	18	90	10		
control	1	20	19	95	5		
control	2	20	19	95	5		
control	3	20	18	90	10	7	---
control	4	20	17	85	15		
control	5	20	20	100	0		

[1]High ammonia concentrations resulted in the data being rejected by the DMMP agencies

Table 20. Ammonia Concentrations in Round 2 Amphipod Bioassay

Compound	CO7a-P	CO7a-Z	CO7b-P	CO7b-Z	CP32a-P	CP32a-Z	CP32b-P	CP32b-Z	NB13	NB15	control
	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Bulk sediment ammonia (mg-N/kg)	60.4	55.5	76.2	90.0	174.0	283.0	184.0	188.0	5.1	6.9	---
Day 0 overlying total ammonia (mg-N/L)	4.37	5.10	5.56	5.89	8.60	15.39	12.23	16.31	0.46	0.65	3.21
Day 10 overlying total ammonia (mg-N/L)	6.52	9.82	10.79	12.94	18.54	33.37	27.81	33.37	0.28	0.00	0.22
Day 0 interstitial total ammonia (mg-N/L)	*27.01*	*28.73*	*30.64*	*44.38*	*40.32*	*76.35*	*66.81*	*71.58*	3.87	4.72	14.13
Day 10 interstitial total ammonia (mg-N/L)	12.03	*17.34*	*18.97*	*20.09*	*26.81*	*60.61*	*44.06*	*51.28*	2.42	2.10	3.26
Day 0 overlying unionized ammonia (mg-NH3/L)	0.325	0.312	0.420	0.440	0.425	0.948	0.756	0.812	0.028	0.039	0.195
Day 10 overlying unionized ammonia (mg-NH3/L)	0.578	0.882	0.969	1.162	1.087	1.937	1.625	1.526	0.025	0.000	0.013
Day 0 interstitial unionized ammonia (mg-NH3/L)	*0.334*	*0.446*	*0.475*	*1.720*	0.166	*0.632*	*0.695*	*0.756*	0.024	0.029	0.109
Day 10 interstitial unionized ammonia (mg-NH3/L)	0.188	*0.340*	*0.463*	*0.773*	0.135	*0.481*	*0.347*	*0.638*	0.030	0.041	0.032
Amphipod Mortality	32	28	37	31	60	93	73	93	16	15	7

Bold italized text: Exceeds DMMP interstitial threshold (DMMP, 2002 - Table 1) for total ammonia (mg/L N) for *Ampelisca abdita* = 15 mg/L.

Bold italized and shaded text: Exceeds DMMP interstitial threshold (DMMP, 2002 - Table 1) for unionized ammonia (mg/L N) for *Ampelisca abdita* = 0.2 mg/L.

Table 21. Round 2 Larval Results - Standard Termination Protocol

Sample ID	Replicate	Initial Count	Normal Survivors	Combined Mortality and Abnormality	NMCA	Mean NCMA	Hit/No Hit
CO7a-P	1	269	197	72	23.5		
CO7a-P	2	269	211	58	18.1		
CO7a-P	3	269	190	79	26.2	21.0	X
CO7a-P	4	269	215	54	16.5		
CO7a-P	5	269	204	65	20.8		
CO7a-Z	1	269	210	59	18.5		
CO7a-Z	2	269	187	82	27.4		
CO7a-Z	3	269	224	45	13.0	19.4	No Hit
CO7a-Z	4	269	206	63	20.0		
CO7a-Z	5	269	211	58	18.1		
CO7b-P	1	269	221	48	14.2		
CO7b-P	2	269	185	84	28.2		
CO7b-P	3	269	220	49	14.6	22.2	X
CO7b-P	4	269	224	45	13.0		
CO7b-P	5	269	152	117	41.0		
CO7b-Z	1	269	205	64	20.4		
CO7b-Z	2	269	211	58	18.1		
CO7b-Z	3	269	194	75	24.7	22.4	X
CO7b-Z	4	269	192	77	25.5		
CO7b-Z	5	269	198	71	23.1		
CP32a-P	1	269	200	69	22.4		
CP32a-P	2	269	226	43	12.3		
CP32a-P	3	269	214	55	16.9	21.6	X
CP32a-P	4	269	170	99	34.0		
CP32a-P	5	269	200	69	22.4		
CP32a-Z	1	269	195	74	24.3		
CP32a-Z	2	269	183	86	29.0		
CP32a-Z	3	269	193	76	25.1	25.2	XX
CP32a-Z	4	269	189	80	26.6		
CP32a-Z	5	269	204	65	20.8		
CP32b-P	1	269	205	64	20.4		
CP32b-P	2	269	204	65	20.8		
CP32b-P	3	269	182	87	29.3	21.7	X
CP32b-P	4	269	209	60	18.9		
CP32b-P	5	269	209	60	18.9		
CP32b-Z	1	269	147	122	42.9		
CP32b-Z	2	269	205	64	20.4		
CP32b-Z	3	269	176	93	31.7	33.0	XX
CP32b-Z	4	269	159	110	38.3		
CP32b-Z	5	269	176	93	31.7		
NB 13	1	269	237	32	8.0		
NB 13	2	269	232	37	9.9		
NB 13	3	269	257	12	0.2	7.7	---
NB 13	4	269	243	26	5.7		
NB 13	5	269	220	49	14.6		
NB 15	1	269	243	26	5.7		
NB 15	2	269	238	31	7.6		
NB 15	3	269	238	31	7.6	10.8	---
NB 15	4	269	230	39	10.7		
NB 15	5	269	200	69	22.4		
swcontrol	1	269	288	-19	-11.8		
swcontrol	2	269	253	16	1.8		
swcontrol	3	269	271	-2	-5.2	0.0	---
swcontrol	4	269	234	35	9.2		
swcontrol	5	269	242	27	6.1		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NCMA=normalized combined percent mortality and abnormality=100(1-(# of normals/NS))
where NS=average of normal larvae counted in seawater controls

Table 22. Round 2 Larval Results - Resuspension Termination Protocol

Sample ID	Replicate	Initial Count	Normal Survivors	Combined Mortality and Abnormality	NMCA	Mean NCMA	Hit/No Hit
CO7a-P	1	269	224	45	8.9		
CO7a-P	2	269	225	44	8.5		
CO7a-P	3	269	233	36	5.3	4.7	No Hit
CO7a-P	4	269	258	11	-4.9		
CO7a-P	5	269	232	37	5.7		
CO7a-Z	1	269	179	90	27.2		
CO7a-Z	2	269	222	47	9.8		
CO7a-Z	3	269	218	51	11.4	13.7	No Hit
CO7a-Z	4	269	238	31	3.3		
CO7a-Z	5	269	205	64	16.7		
CO7b-P	1	269	215	54	12.6		
CO7b-P	2	269	175	94	28.9		
CO7b-P	3	269	203	66	17.5	19.4	No Hit
CO7b-P	4	269	221	48	10.2		
CO7b-P	5	269	177	92	28.0		
CO7b-Z	1	269	179	90	27.2		
CO7b-Z	2	269	202	67	17.9		
CO7b-Z	3	269	225	44	8.5	15.8	No Hit
CO7b-Z	4	269	207	62	15.9		
CO7b-Z	5	269	223	46	9.3		
CP32a-P	1	269	205	64	16.7		
CP32a-P	2	269	165	104	32.9		
CP32a-P	3	269	198	71	19.5	20.3	XX
CP32a-P	4	269	201	68	18.3		
CP32a-P	5	269	211	58	14.2		
CP32a-Z	1	269	202	67	17.9		
CP32a-Z	2	269	204	65	17.1		
CP32a-Z	3	269	146	123	40.7	23.3	XX
CP32a-Z	4	269	207	62	15.9		
CP32a-Z	5	269	185	84	24.8		
CP32b-P	1	269	194	75	21.1		
CP32b-P	2	269	196	73	20.3		
CP32b-P	3	269	192	77	22.0	17.8	X
CP32b-P	4	269	196	73	20.3		
CP32b-P	5	269	233	36	5.3		
CP32b-Z	1	269	125	144	49.2		
CP32b-Z	2	269	196	73	20.3		
CP32b-Z	3	269	207	62	15.9	24.6	XX
CP32b-Z	4	269	196	73	20.3		
CP32b-Z	5	269	204	65	17.1		
NB 13	1	269	253	16	-2.8		
NB 13	2	269	229	40	6.9		
NB 13	3	269	240	29	2.4	5.0	---
NB 13	4	269	237	32	3.7		
NB 13	5	269	209	60	15.0		
NB 15	1	269	252	17	-2.4		
NB 15	2	269	248	21	-0.8		
NB 15	3	269	256	13	-4.1	1.4	---
NB 15	4	269	218	51	11.4		
NB 15	5	269	239	30	2.8		
swcontrol	1	269	237	32	3.7		
swcontrol	2	269	262	7	-6.5		
swcontrol	3	269	238	31	3.3	0.0	---
swcontrol	4	269	241	28	2.0		
swcontrol	5	269	252	17	-2.4		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NCMA=normalized combined percent mortality and abnormality=100(1-(# of normals/NS))
where NS=average of normal larvae counted in seawater controls

Table 23. Round 2 Neanthes Results - Ash-Free Dry-Weight Endpoint

Sample ID	Replicate	Initial Count	Survivors	Growth Rate (mg/individual/day)	Mean Growth Rate	Hit/No Hit
CO7a-P	1	5	5	0.64		
CO7a-P	2	5	5	0.74		
CO7a-P	3	5	5	0.66	0.71	No Hit
CO7a-P	4	5	5	0.63		
CO7a-P	5	5	5	0.89		
CO7a-Z	1	5	5	0.57		
CO7a-Z	2	5	5	0.63		
CO7a-Z	3	5	5	0.63	0.65	No Hit
CO7a-Z	4	5	5	0.63		
CO7a-Z	5	5	5	0.78		
CO7b-P	1	5	5	0.68		
CO7b-P	2	5	5	0.87		
CO7b-P	3	5	5	0.68	0.70	No Hit
CO7b-P	4	5	5	0.64		
CO7b-P	5	5	4	0.64		
CO7b-Z	1	5	5	0.76		
CO7b-Z	2	5	5	0.55		
CO7b-Z	3	5	5	0.58	0.64	No Hit
CO7b-Z	4	5	5	0.67		
CO7b-Z	5	5	5	0.65		
CP32a-P	1	5	5	0.64		
CP32a-P	2	5	5	0.57		
CP32a-P	3	5	5	0.58	0.62	No Hit
CP32a-P	4	5	5	0.76		
CP32a-P	5	5	5	0.58		
CP32a-Z	1	5	5	0.65		
CP32a-Z	2	5	5	0.63		
CP32a-Z	3	5	5	0.53	0.62	No Hit
CP32a-Z	4	5	5	0.68		
CP32a-Z	5	5	5	0.60		
CP32b-P	1	5	5	0.67		
CP32b-P	2	5	5	0.64		
CP32b-P	3	5	5	0.65	0.67	No Hit
CP32b-P	4	5	5	0.63		
CP32b-P	5	5	5	0.79		
CP32b-Z	1	5	5	0.85		
CP32b-Z	2	5	5	0.57		
CP32b-Z	3	5	5	0.63	0.72	No Hit
CP32b-Z	4	5	5	0.68		
CP32b-Z	5	5	5	0.86		
NB 13	1	5	5	0.68		
NB 13	2	5	5	0.72		
NB 13	3	5	5	0.74	0.70	---
NB 13	4	5	5	0.65		
NB 13	5	5	5	0.72		
NB 15	1	5	5	0.77		
NB 15	2	5	5	0.71		
NB 15	3	5	5	0.69	0.72	---
NB 15	4	5	4	0.81		
NB 15	5	5	5	0.63		
swcontrol	1	5	5	0.39		
swcontrol	2	5	5	0.64		
swcontrol	3	5	5	0.62	0.60	---
swcontrol	4	5	5	0.69		
swcontrol	5	5	5	0.63		

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 24. Interpretation of Bioassay Results - Round 2

amphipod (Ampelisca abdita):

data rejected due to high concentrations of ammonia

standard larval protocol (Mytilus galloprovincialis):

	mean normal count	N_T/N_C	$N_T/N_C < 0.80$?	transformation	statistically less than reference?	$N_R/N_C - N_T/N_C$	$N_R/N_C - N_T/N_C > 0.15$?	interpretation
CO7a-P	203.4	0.790	yes	none needed	yes	0.134	no	X
CO7a-Z	207.6	0.806	no	NA	NA	NA	NA	no hit
CO7b-P	200.4	0.778	yes	none needed	yes	0.145	no	X
CO7b-Z	200.0	0.776	yes	none needed	yes	0.147	no	X
CP32a-P	202.0	0.784	yes	none needed	yes	0.139	no	X
CP32a-Z	192.8	0.748	yes	none needed	yes	0.175	yes	XX
CP32b-P	201.8	0.783	yes	none needed	yes	0.140	no	X
CP32b-Z	172.6	0.670	yes	none needed	yes	0.253	yes	XX
NB13	237.8	---	---	---	---	---	---	---
NB15	229.8	---	---	---	---	---	---	---
Control	257.6	---	---	---	---	---	---	---

resuspension larval protocol (Mytilus galloprovincialis):

	mean normal count	N_T/N_C	$N_T/N_C < 0.80$?	transformation	statistically less than reference?	$N_R/N_C - N_T/N_C$	$N_R/N_C - N_T/N_C > 0.15$?	interpretation
CO7a-P	234.4	0.953	no	NA	NA	NA	NA	no hit
CO7a-Z	212.4	0.863	no	NA	NA	NA	NA	no hit
CO7b-P	198.2	0.806	no	NA	NA	NA	NA	no hit
CO7b-Z	207.2	0.842	no	NA	NA	NA	NA	no hit
CP32a-P	196.0	0.797	yes	none needed	yes	0.153	yes	XX
CP32a-Z	188.8	0.767	yes	none needed	yes	0.182	yes	XX
CP32b-P	202.2	0.822	no	NA	NA	NA	NA	no hit
CP32b-Z	185.6	0.754	yes	none needed	yes	0.195	yes	XX
NB13	233.6	---	---	---	---	---	---	---
NB15	242.6	---	---	---	---	---	---	---
Control	246.0	---	---	---	---	---	---	---

Neanthes growth - AFDW endpoint:

	mean individual growth rate	MIG_T/MIG_C	$MIG_T/MIG_C < 0.80$?	transformation	statistically less than reference?	MIG_T/MIG_R	$MIG_T/MIG_R < 0.70$?	interpretation
CO7a-P	0.712	1.197	no	NA	NA	NA	NA	no hit
CO7a-Z	0.646	1.085	no	NA	NA	NA	NA	no hit
CO7b-P	0.699	1.175	no	NA	NA	NA	NA	no hit
CO7b-Z	0.641	1.077	no	NA	NA	NA	NA	no hit
CP32a-P	0.625	1.050	no	NA	NA	NA	NA	no hit
CP32a-Z	0.620	1.041	no	NA	NA	NA	NA	no hit
CP32b-P	0.675	1.134	no	NA	NA	NA	NA	no hit
CP32b-Z	0.717	1.204	no	NA	NA	NA	NA	no hit
NB13	0.704	---	---	---	---	---	---	---
NB15	0.721	---	---	---	---	---	---	---
Control	0.595	---	---	---	---	---	---	---

M = mortality, N = normal larvae, MIG = mean individual growth rate mg/individual/day)
Subscripts: R = reference sediment, C = negative control, T = test sediment
NA = not applicable

X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)

Table 25. Literature Values for the Effects of Ammonia on Amphipods and Mussels

	Reference	NOEC	EC50/LC50	Species
Mussels	Phillips, 2005	0.09 mg/L unionized	EC50 = 0.120 to 0.231 mg/L unionized	Mytilus galloprovincialis
	Batley, 2009	0.044 mg/l unionized	---	Mytilus galloprovincialis
		2.190 mg/l total		
	Gardiner, 1996	---	EC50 = 0.7 mg/L unioinized	Mytilus galloprovincialis
	Batley, 2009	---	LC50 = 0.156 mg/L unionized	Lampsilis cardium
			LC50 = 3.050 mg/L total	
Amphipods	Kohn, 1994	---	LC50 = 0.83 mg/L unioinized	Ampelisca abdita
			LC50 = 49.8 mg/L total	
	Burgess, 2003	---	LC50[1]= 0.60 to 1.90 mg/L unioinized	Ampelisca abdita
			LC50[1] = 59.9 to 164 mg/L total	

[1]95% confidence interval

Table 26-1. Summary of chemistry and bioassay data for CO7

	Round 1	Round 2			
	CO7	CO7a-P	CO7a-Z	CO7b-P	CO7b-Z
COCs > SL	chlordane DL	none[1]	none[1]	none	none
amphipod (E. estuarius)	no hit	---	---	---	---
amphipod (*A. abdita*)	---	ammonia[2]	ammonia[2]	ammonia[2]	ammonia[2]
larval - standard protocol	XX	X	no hit	X	X
larval - resuspension protocol	XX	no hit	no hit	no hit	no hit
Neanthes - AFDW endpoint	no hit	no hit	no hit	no hit	no hit

P = primary sample (i.e. the -40 to -42 foot dredged material sample)
Z = z-sample (i.e. the -42 to -44 foot sample from the material that will be exposed by dredging)
X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NA = not applicable

[1]Diethyl phthalate was detected at concentrations above the screening level, but not detected in a subsequent retest. The data validator determined that the initial detection was likely an artifact and not an actual screening level exceedance.

[2]Results from this bioassay were set aside due to nontreatment effects from high ammonia concentrations.

Table 26-2. Summary of chemistry and bioassay data for CP32

	Round 1		Round 2			
	CP32	amphipod retest	CP32a-P	CP32a-Z	CP32b-P	CP32b-Z
COCs > SL	benzyl alcohol	none[1]	none	none	none	none
amphipod (E. estuarius)	XX	no hit	NT	NT	NT	NT
amphipod (*A. abdita*)	NT	no hit	ammonia[2]	ammonia[2]	ammonia[2]	ammonia[2]
larval - standard protocol	X	NT	X	XX	X	XX
larval - resuspension protocol	no hit	NT	XX	XX	no hit	XX
Neanthes - AFDW endpoint	no hit	NT	no hit	no hit	no hit	no hit

P = primary sample (i.e. the -40 to -42 foot dredged material sample)
Z = z-sample (i.e. the -42 to -44 foot sample from the material that will be exposed by dredging)
X = hit under the 2-hit rule (minor hit)
XX = hit under the 1-hit rule (major hit)
NT = no test; this test was not run

[1]CP33 was also subjected to the amphipod retest. Despite having a higher concentration of benzyl alcohol than in the original test (both concentrations were > SL), it too had no hits in the retest.

[2]Results from this bioassay were set aside due to nontreatment effects from high ammonia concentrations.

CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD May 2, 2013

SUBJECT: APPLICABILITY OF THE DMMP SUITABILITY DETERMINATION FOR THE GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT, DATED FEBRUARY 5, 2013, TO THE REALIGNED FEDERAL NAVIGATION CHANNEL.

A. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the applicability of the suitability determination for the Grays Harbor Navigation Improvement Project to the realigned federal navigation channel.

B. Grays Harbor Navigation Improvement Project (GHNIP). The Corps of Engineers is in the process of evaluating the economic costs and benefits associated with deepening the inner harbor reaches from the current maintenance depth of -36 feet mean lower low water (MLLW) to the full authorized depth of -38 feet (plus 2 feet of advanced maintenance and two feet of overdepth for a maximum dredging depth of -42 feet MLLW). The inner harbor reaches covered by the study include South Reach, Crossover Reach, North Channel, Hoquiam Channel and Cow Point Reach. As part of the study, the sediment that would be dredged in deepening these reaches was fully characterized under the Dredged Material Management Program. The DMMP suitability determination for the deepening project was finalized on February 5, 2013 (DMMP, 2013).

C. Realignment of the Federal Navigation Channel. Independent of the GHNIP, the Corps evaluated the benefits of realigning the federal navigation channel to take advantage of deeper water along portions of the waterway (USACE, 2013). Realignment would reduce the annual maintenance costs for the channel by reducing the volume of material requiring dredging. The reaches affected by the realignment include South Reach, Crossover Reach and North Channel.

D. Applicability of the GHNIP Suitability Determination to the Realigned Channel. The DMMP agencies evaluated potential impacts of the proposed channel realignment on the GHNIP suitability determination by reviewing an overlay of the realigned channel on the boundaries of the GHNIP dredged material management units (DMMUs) and associated sampling locations (see attached figures). The agencies concluded that the sampling conducted for the GHNIP is sufficiently representative of the realigned channel and no additional sampling or testing will be required. The following factors were considered in reaching this conclusion:

- The changes to the channel alignment are relatively minor. There is no reason to believe that the sediment within the realigned channels is any different than that in the present channel.
- Less material will need to be dredged to deepen the realigned channel so the sampling requirements calculated for the original alignment are more than adequate to cover this lesser volume.

- At least one of the GHNIP sampling stations in each DMMU falls within the realigned channel.
- All the DMMUs falling within the area of realignment were found suitable for open-water disposal. The only GHNIP material found unsuitable for open-water disposal is located in Cow Point Reach, which is not affected by the realignment.

E. References.

DMMP, 2013. *Determination Regarding the Suitability of Dredged Material from the Grays Harbor Navigation Improvement Project, Evaluated under Section 404 of the Clean Water Act, for Open-Water Disposal at the South Jetty or Point Chehalis Dispersive Sites, or for Beneficial Use.* Prepared by David Fox (Corps) for the DMMP agencies. February 5, 2013.

USACE, 2013. *Conceptual Design for Federal Deep Draft Channel Realignment in South Reach to Hoquiam Reach, Grays Harbor, Washington.* Memorandum for Record prepared by David Michalsen, P.E., March 3, 2013.

Coordination with regard to this determination was coordinated with Laura Inouye (Ecology), Erika Hoffman (EPA) and Celia Barton (DNR) by the undersigned.

5/2/13 David Fox

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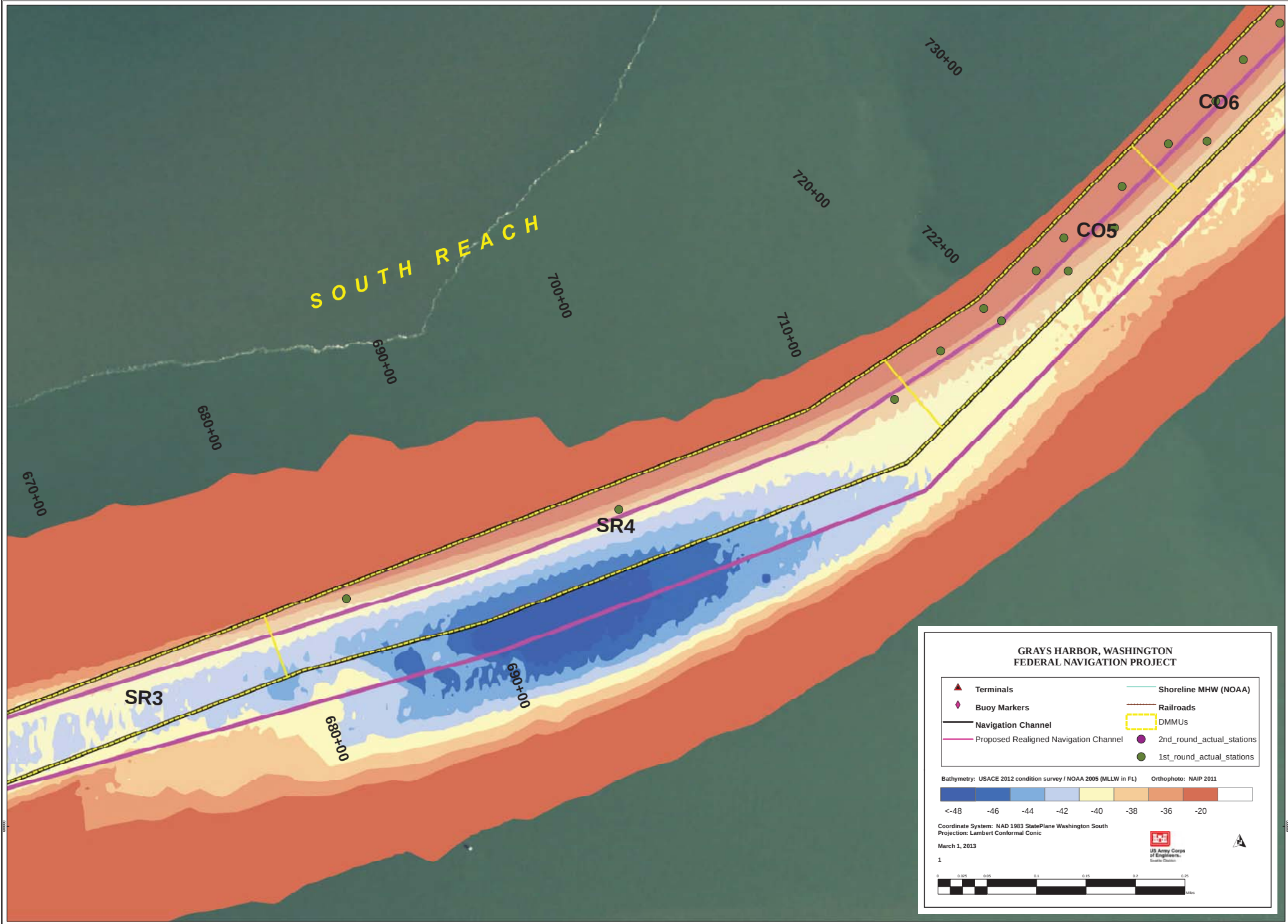
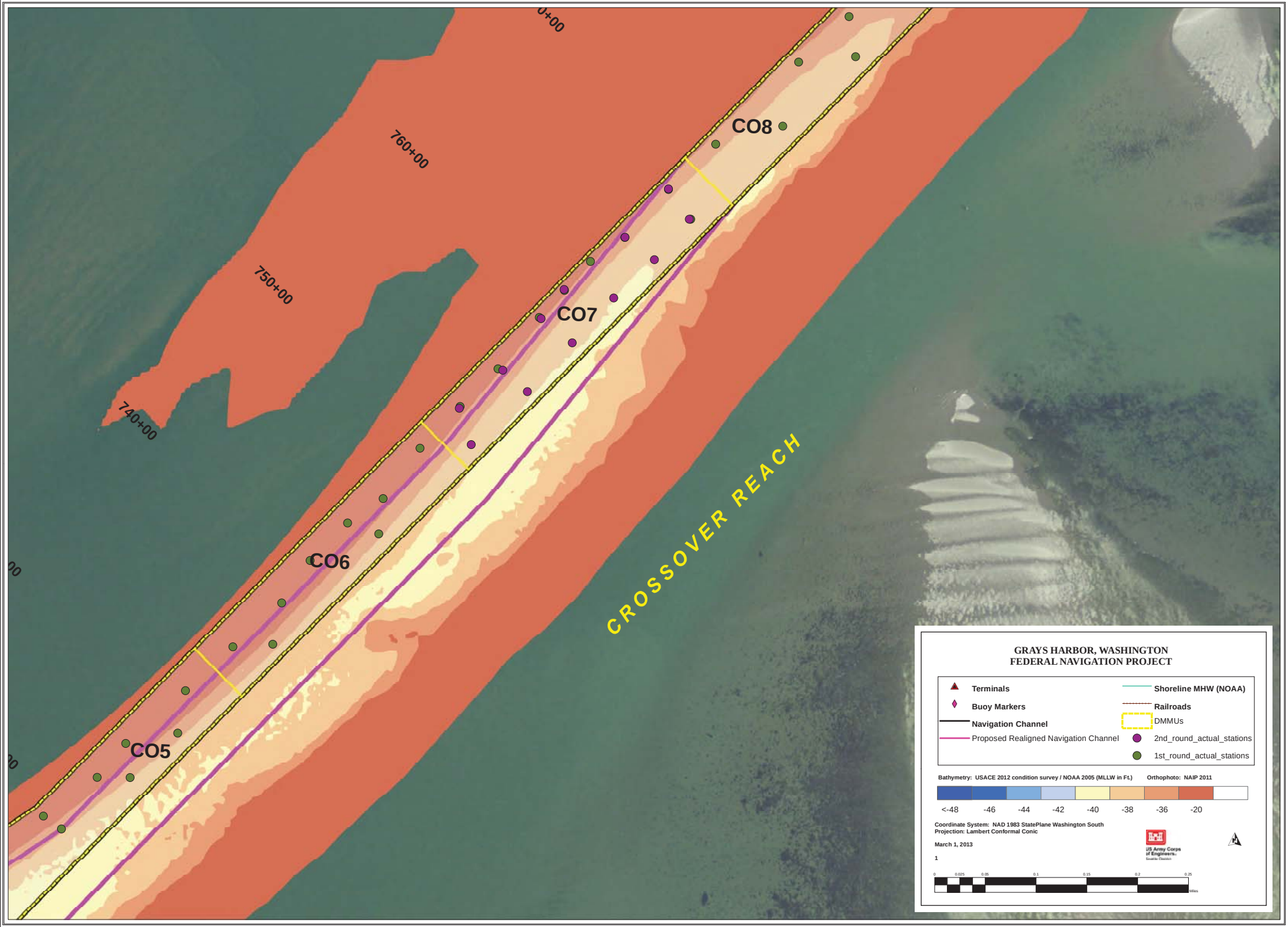
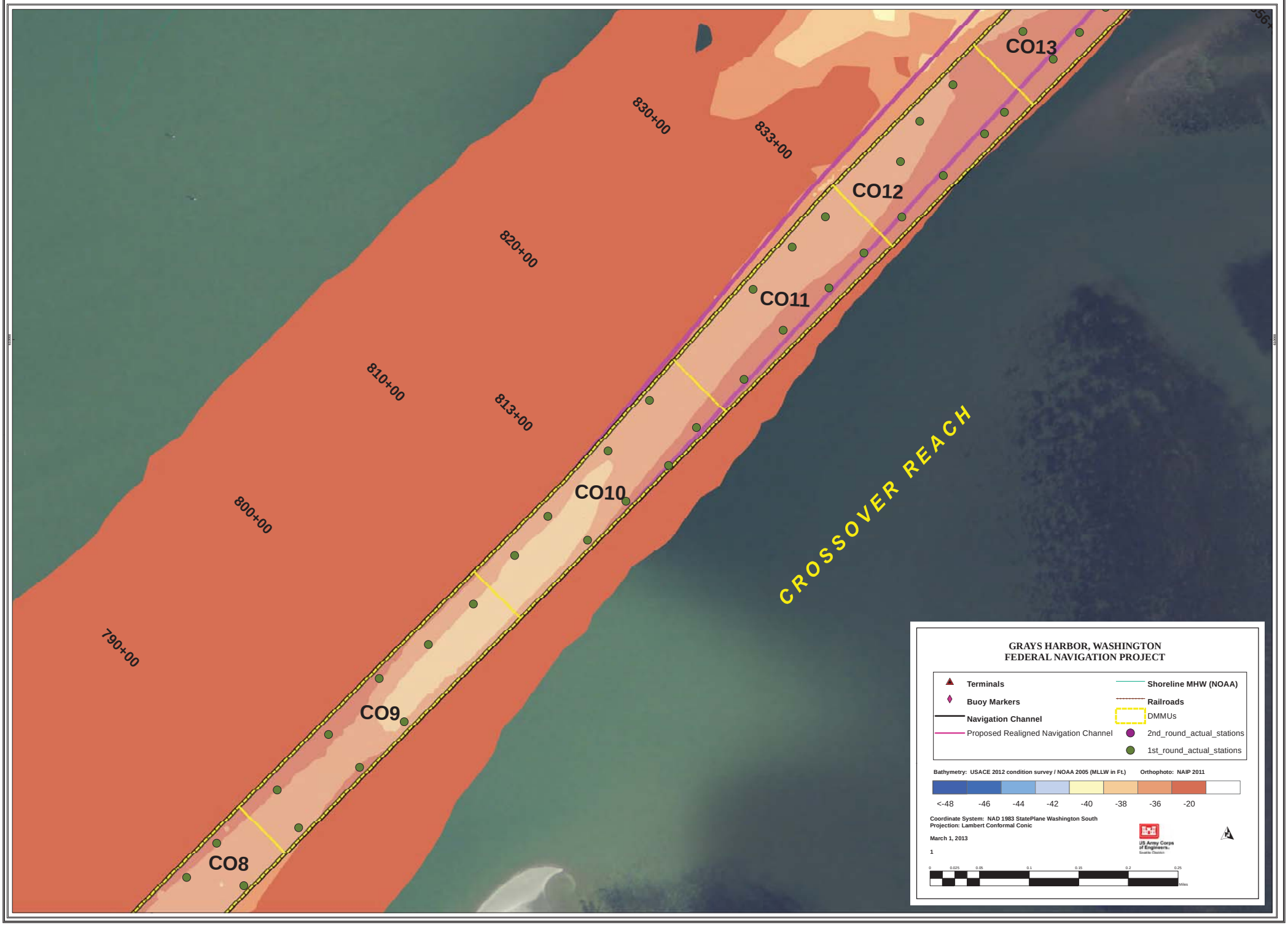
Grays Harbor Navigation Channel - Proposed Channel Realignment



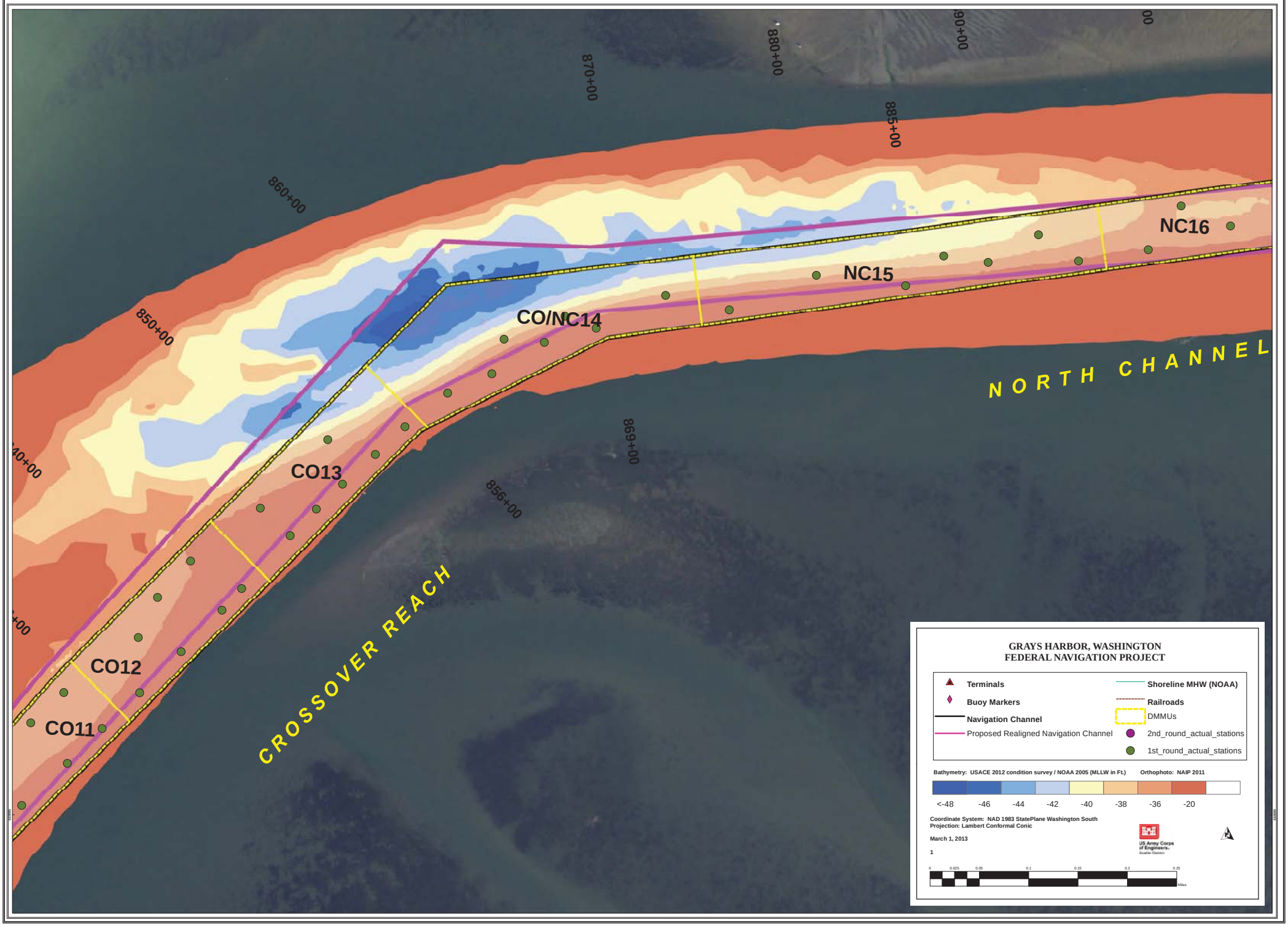
Grays Harbor Navigation Channel - Proposed Channel Realignment



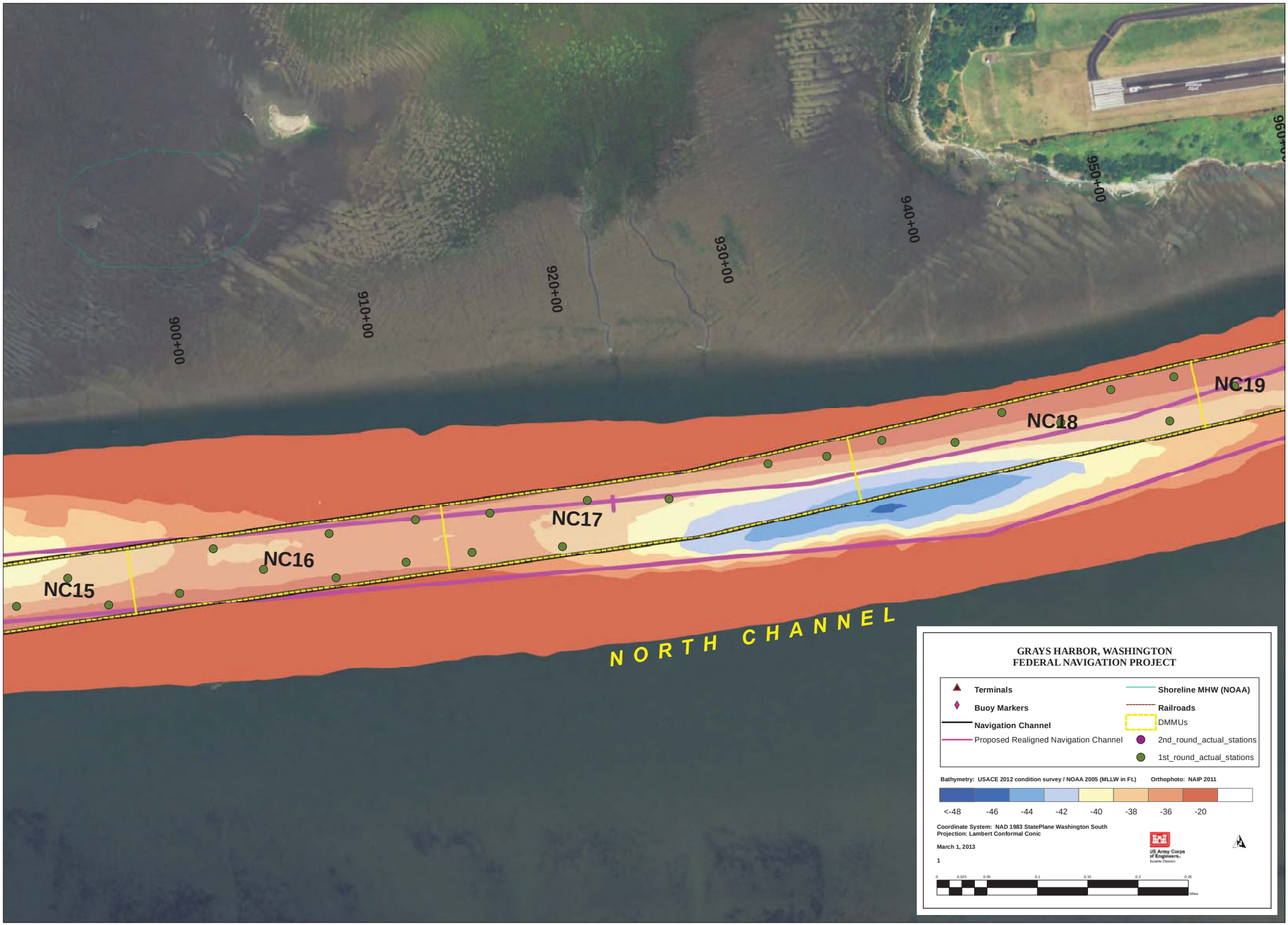
Grays Harbor Navigation Channel - Proposed Channel Realignment



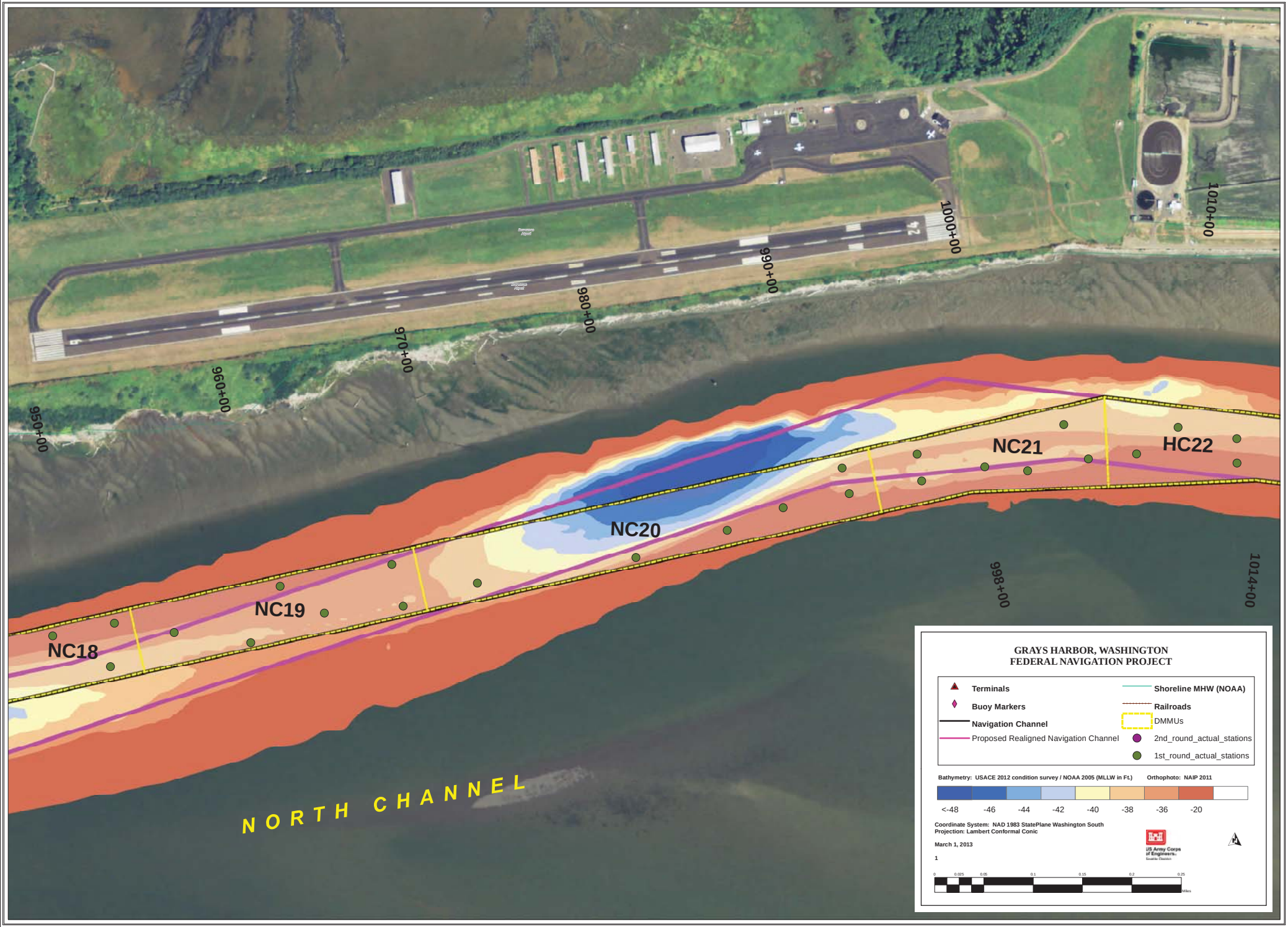
Grays Harbor Navigation Channel - Proposed Channel Realignment



Grays Harbor Navigation Channel - Proposed Channel Realignment



Grays Harbor Navigation Channel - Proposed Channel Realignment



CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD January 3, 2014

SUBJECT: APPLICABILITY OF THE DMMP SUITABILITY DETERMINATION FOR THE GRAYS HARBOR NAVIGATION CHANNEL OPERATION AND MAINTENANCE PROJECT, DATED FEBRUARY 9, 2012, TO THE REALIGNED FEDERAL NAVIGATION CHANNEL AND POST-DEEPENING CONDITIONS.

A. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the applicability of the suitability determination for the Grays Harbor Navigation Channel Operation and Maintenance Project (GH O&M) to the realigned federal navigation channel and post-deepening conditions.

The GH O&M project is periodically evaluated by the DMMP agencies for sediment quality. The most recent evaluation occurred in 2011/2012 (DMMP, 2012). Twenty-eight dredged material management units from Crossover Reach, North Channel, Hoquiam Reach, Cow Point Reach, Aberdeen Reach and South Aberdeen Reach were evaluated and found suitable for open-water disposal or beneficial use.

B. Realignment of the Federal Navigation Channel. The Corps evaluated the benefits of realigning the federal navigation channel to take advantage of deeper water along portions of the waterway (USACE, 2013). Realignment would reduce the annual maintenance costs for the channel by reducing the volume of material requiring dredging. The reaches affected by the realignment include South Reach, Crossover Reach and North Channel.

C. Applicability of the 2012 GH O&M Suitability Determination to the Realigned Channel. The DMMP agencies first evaluated the applicability of the 2012 GH O&M suitability determination to the realigned channel by reviewing an overlay of the realignment on the boundaries of the 2012 GH O&M dredged material management units (DMMUs) and associated sampling locations (see attached figures). The majority of the sampling stations fall outside the realigned channel, so from a geospatial perspective would not be considered representative of the realignment. The agencies next considered other factors, including the following:

- The changes to the channel alignment are relatively minor. There is no reason to believe that the sediment now residing in the realigned channel is any different than that found in the present channel. There is also no reason to believe that sediment accreting in the future in the realigned channel will be any different than that which would accrete in the channel without realignment.
- The DMMUs falling within the area of realignment have consistently been found suitable for open-water disposal in past O&M testing cycles.
- Less material will need to be dredged to deepen the realigned channel so the sampling requirements calculated for the original alignment are more than adequate to cover this lesser volume.

After consideration of all factors, the agencies concluded that the 2012 GH O&M characterization is sufficiently representative of the realigned channel and no additional sampling or testing will be required until the expiration of the recency/frequency period for the O&M project in November 2018.

D. Applicability of the 2012 GH O&M Suitability Determination to a Deepened Channel. The Corps of Engineers is in the process of evaluating the environmental impacts and economics associated with deepening the inner harbor reaches from the current maintenance depth of -36 feet mean lower low water (MLLW) to the full authorized depth of -38 feet (plus 2 feet of advanced maintenance and two feet of overdepth for a maximum dredging depth of -42 feet MLLW). The inner harbor reaches covered by the Grays Harbor Navigation Improvement Project (GHNIP) include South Reach, Crossover Reach, North Channel, Hoquiam Channel and Cow Point Reach. The sediment that would be dredged in deepening these reaches was fully characterized under the Dredged Material Management Program (DMMP, 2013). Approximately 99% of the material was found suitable for open-water placement. Only 22,400 cubic yards, in one DMMU in Cow Point Reach, was found unsuitable for open-water placement.

The DMMP agencies evaluated the applicability of the 2012 GH O&M suitability determination to the maintenance material that would be dredged in the years following deepening. As with the realignment discussed in the previous section, there is no reason to believe that sediment accreting within a slightly deeper channel would be any different than the sediment that would accrete in the absence of the deepening project. From that perspective, the 2012 GH O&M evaluation is completely applicable to post-deepening maintenance dredging.

The only concern is in regard to the unsuitable DMMU (CP32a). If CP32a were to be completely removed (with upland disposal) during the deepening project, then the agencies would have no concern about material dredged in this area during future maintenance dredging. However, since the completeness of removal will not be known until a post-deepening bathymetric survey is completed, the DMMP agencies reserve the right to require additional sampling and testing within the CP32a footprint prior to the first maintenance dredging cycle following deepening. A determination whether or not to trigger this requirement will be made by the agencies after review of the post-deepening bathymetry.

E. References.

DMMP, 2013. *Determination Regarding the Suitability of Dredged Material from the Grays Harbor Navigation Improvement Project, Evaluated under Section 404 of the Clean Water Act, for Open-Water Disposal at the South Jetty or Point Chehalis Dispersive Sites, or for Beneficial Use.* Prepared by David Fox (Corps) for the DMMP agencies. February 5, 2013.

USACE, 2013. *Conceptual Design for Federal Deep Draft Channel Realignment in South Reach to Hoquiam Reach, Grays Harbor, Washington*. Memorandum for Record prepared by David Michalsen, P.E., March 3, 2013.

This memorandum was coordinated with Laura Inouye (Ecology), Erika Hoffman (EPA) and Celia Barton (DNR) by the undersigned.

1/3/14 David Fox

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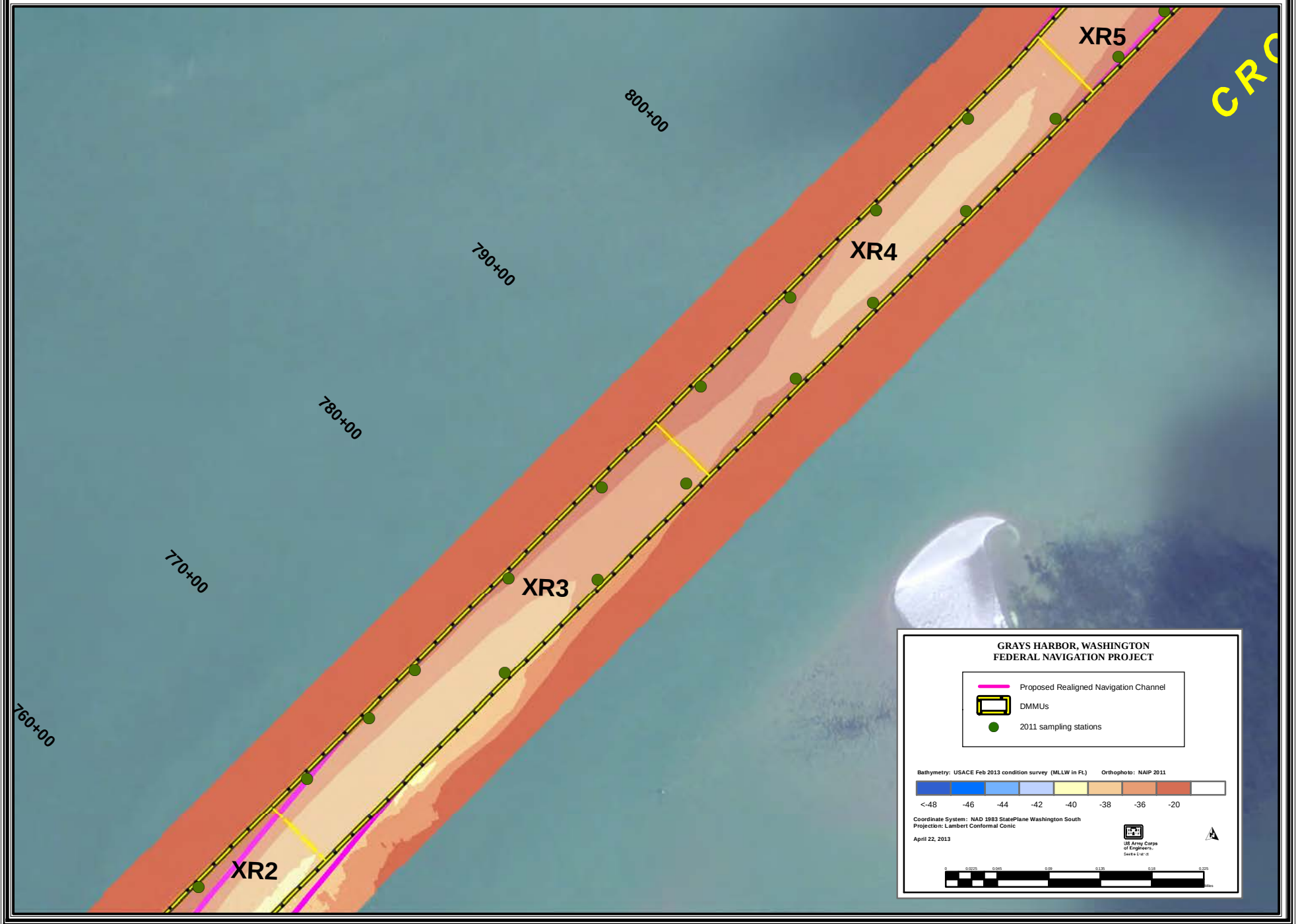
Grays Harbor Navigation Channel - Proposed Channel Realignment

Grays Harbor Navigation Channel - Proposed Channel Realignment



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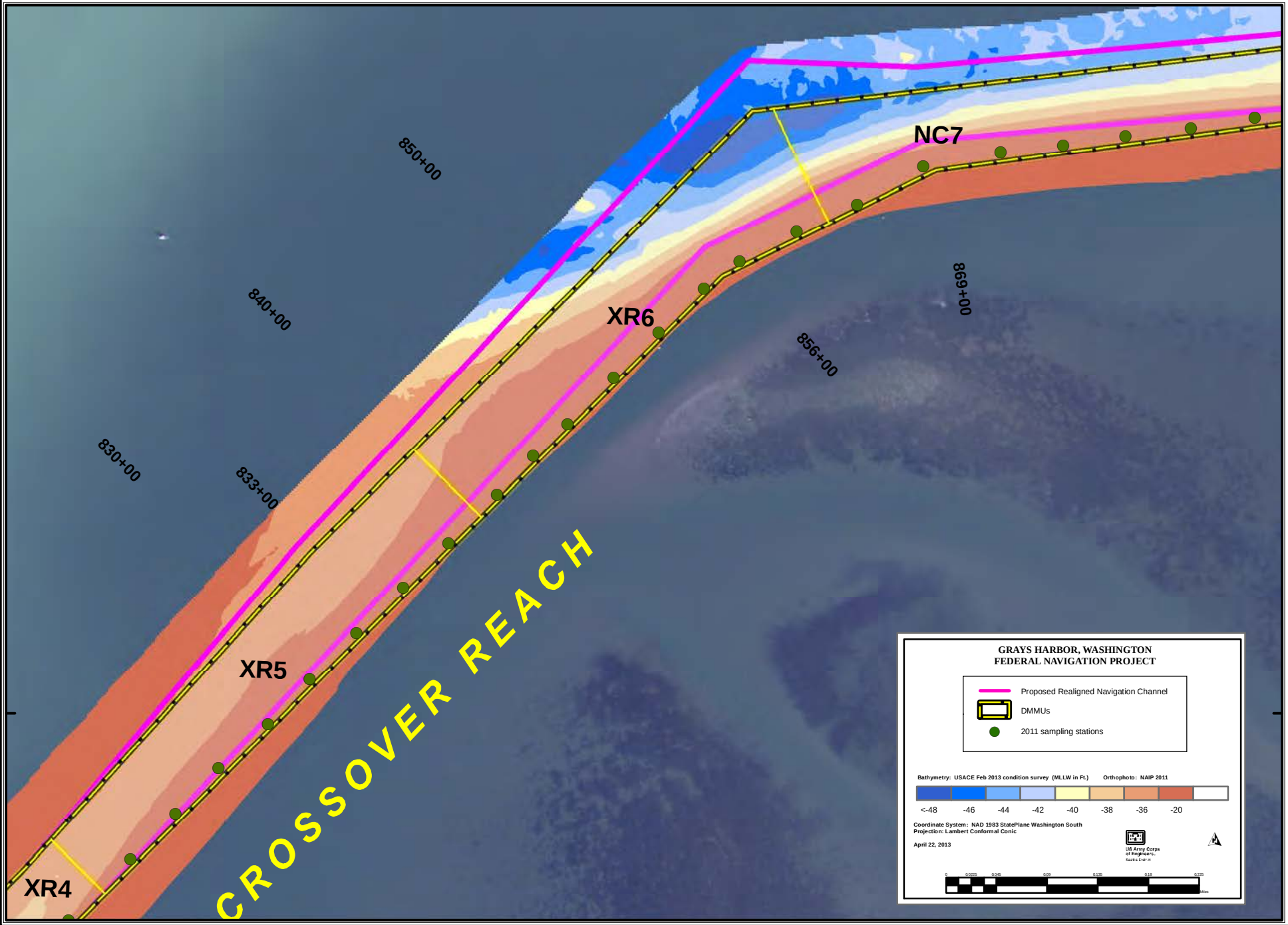

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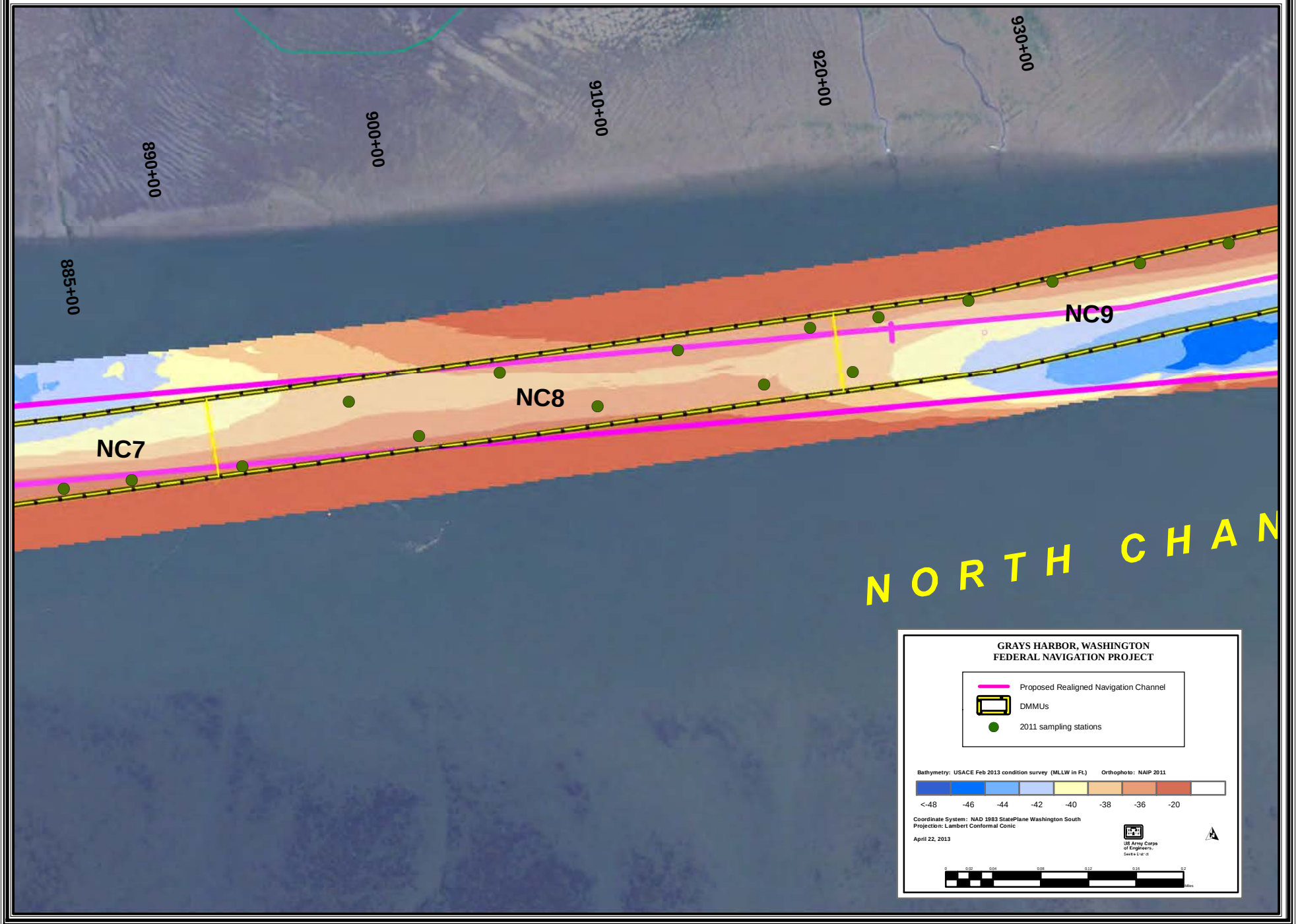

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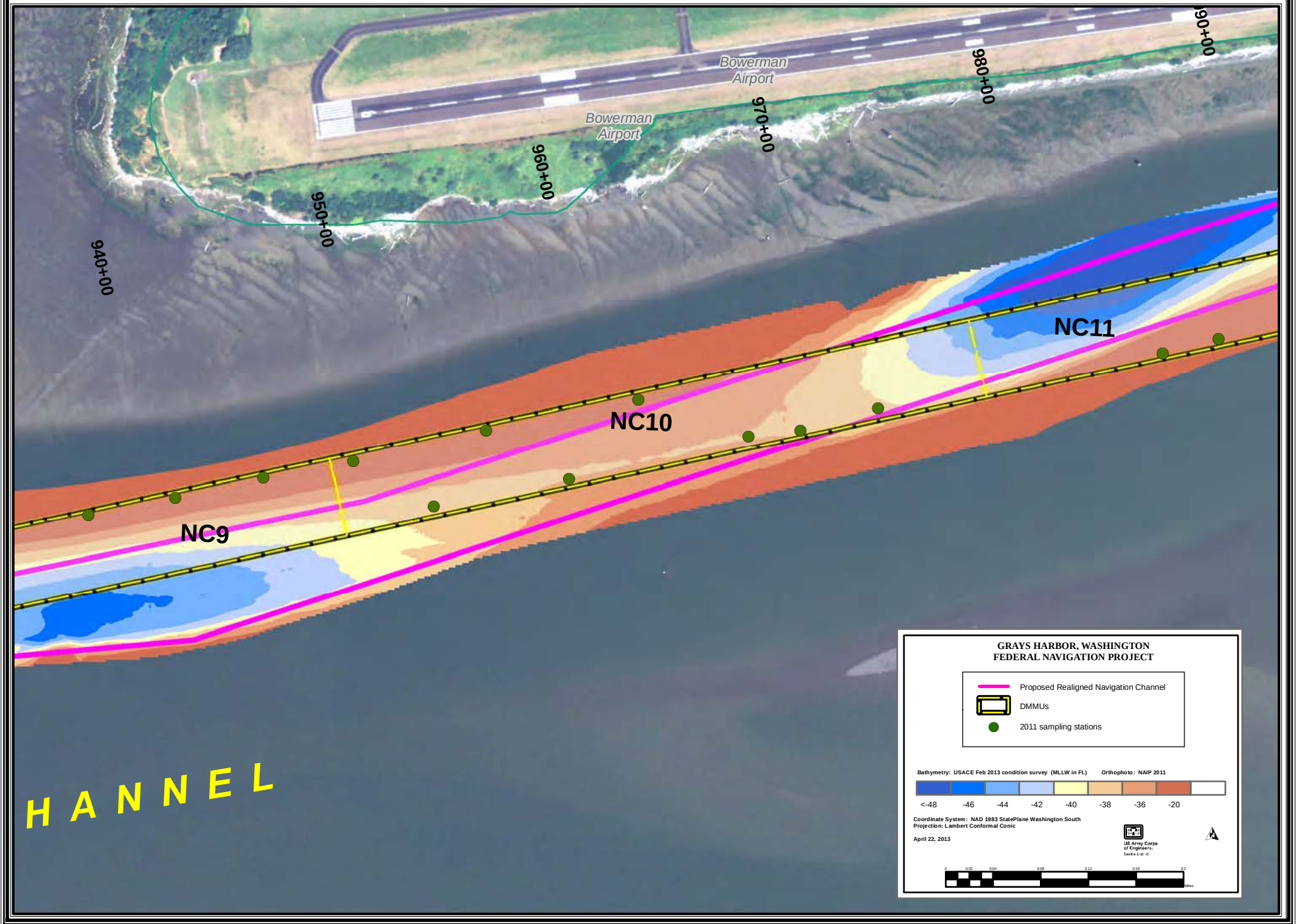
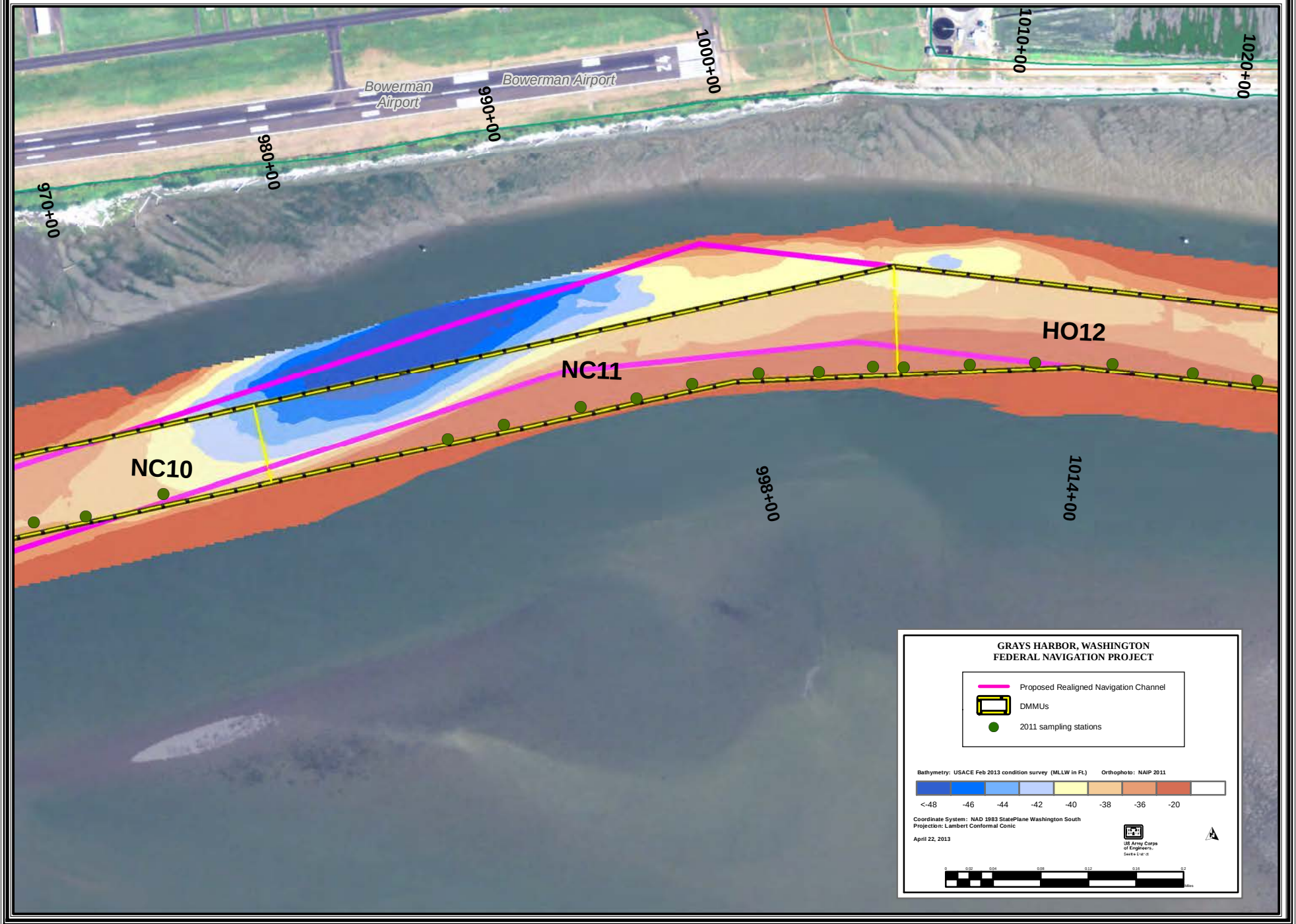


Grays Harbor Navigation Channel - Proposed Channel Realignment



CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD February 9, 2012

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATION AND MAINTENANCE DREDGED MATERIAL FROM GRAYS HARBOR, WASHINGTON (PN: CENWS-OD-TS-NS-38) EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT, FOR OPEN-WATER DISPOSAL AT THE SOUTH JETTY AND POINT CHEHALIS DISPERSIVE DISPOSAL SITES, AND AT THE SOUTH BEACH AND HALF MOON BAY BENEFICIAL USE SITES.

1. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) on the suitability of routine operations and maintenance dredged material from Grays Harbor, Washington (Figure 1) for unconfined open-water disposal and beneficial use.

Table 1. Project DMMP Tracking Details

PUBLIC NOTICE:	CENWS-OD-TS-NS-38
SAP submitted:	October 24, 2011
SAP approved	November 2, 2011 (verbal authorization)
Sampling dates: VanVeen Grab	November 4-19, 2011 (28-DMMUs, 223 stations)
Data characterization report submitted:	February 8, 2012
Recency Determination: Low Concern (7 years)	November 2018
DAIS reference number:	GRAYS-1-B-F-319

Table 2. Project Synopsis

Time of Proposed Dredging	Annually, 16 July through 14 February except during fish windows
Proposed Disposal Sites	Point Chehalis and South Jetty open-water dispersive sites; Half Moon Bay (HMB) and South Beach nearshore beneficial use sites, and HMB direct beach nourishment, as needed and approved
Sediment Ranking	Low
Project last dredged	Annually

2. Background. Maintenance dredging of the federal navigation channel is performed annually. However, sediment characterization is only done on a periodic basis. In June 1995, the Grays Harbor Dredged Material Management (Interagency) Study Group prepared a manual entitled *Dredged Material Evaluation Procedures and Disposal Site Management Manual, Grays Harbor and Willapa Bay, Washington* (GHDMEP), which provided guidance for federal maintenance dredging and other dredging projects in Grays Harbor and Willapa Bay. The federal navigation channel was ranked as a “low” concern for sediment contamination. A low-ranked project requires testing every 5 to 7 years under the GHDMEP frequency guidelines. Rather than conduct sediment characterization for the entire maintenance project every 5 to 7 years, the GHDMEP included provisions to allow sampling and testing of a portion of the federal project every other year. In this way federal expenditures for sediment characterization could be spread more evenly over multiple years, resulting in more uniform funding requirements from year to year.

3. From 1996 to 2010, the federal navigation channel was divided into three subareas, with rotating characterization. Every other year, approximately 500,000 to 600,000 cubic yards of sediment from approximately one-third of the navigation channel was fully characterized. The Corps of Engineers prepared a programmatic sampling and analysis plan (PSAP) every six years to cover the rotating sediment characterization within that time span. A PSAP was last prepared in 2006, covering the years 2006 through 2011. A PSAP addendum (PSAPA) was prepared every two years, containing details of the sampling and analysis plan for that particular sediment characterization rotation. The last required testing rotation under the 2006-2011 PSAP occurred in the summer of 2010.

4. While the rotating sediment characterization approach was successful in spreading federal expenditures more evenly over multiple years, the overall cost of characterization was higher due to repeated mobilization and contracting costs. The rotating characterization also forced more frequent updates of environmental documentation with attendant cost implications. Therefore, the Corps of Engineers has decided to alter the previous testing paradigm and characterize the entire federal project from Crossover Reach to the South Aberdeen Reach in the same year. This would also extend the recency from six to seven years, which is the recency period for Low ranked projects.

5. Testing results from previous sediment quality characterizations can be found in suitability determinations for dredging years (DY) 1993, 1994, 1996, 1999, 2001, 2005, 2008, 2009, and 2011. During that period, all material was found suitable for estuarine open-water disposal at the Point Chehalis and South Jetty sites, and for beneficial use at the Half Moon Bay and the South Beach beneficial use sites, and for HMB direct beach placement. These suitability determinations can be found on the Corps' Dredged Material Management Office website at:

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/USACE-GH-O&M-DY93-SDM.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/USACE-Grays-Harbor-DY94-SDM.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/USACE-Grays-Harbor-DY96-SDM.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/USACE-Grays-Harbor-DY99-SDM.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/USACE-Grays-Harbor-DY01-SDM.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/GHO&M-05-sdm.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/GH-DY08-Outer_Harbor_Exclusionary_Determination.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/2008-GH_O&M.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/USACE_Grays_Harbor_SDM_DY09.pdf

http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/2011-GH_SDM_final.pdf

6. Sampling and Analysis Plan. The sampling and analysis plan (SAP) was submitted for DMMP review on October 24, 2011, and was verbally approved on November 2, 2011 with minor revisions.

7. DMMU Allocation. Based on historical dredging records, average annual dredging volumes range between 1.5 to 1.8 million cubic yards (mcy)/year, with an average volume around 1.65 mcy/year. Previously, the federal project was evaluated by characterizing approximately 1/3rd of the federal

project every two years, so that the entire project was characterized every six years. Using this methodology, approximately nine dredged material management units (DMMUs) were characterized every two years from 1996 to 2010. This year, in order to characterize the entire project, 28 DMMUs of approximately equal length (~0.5 miles) were distributed within the federal channel from Crossover Reach to South Aberdeen Reach (See Table 3 and Figure 1). The purpose of using equal-length rather than equal-volume DMMUs is to facilitate the analysis of sediment quality trends (e.g., dioxin) over time throughout the federal channel from Crossover Reach to South Aberdeen Reach. It is envisioned that the same DMMU boundaries will be used in future characterization efforts.

8. Specifically, the 28 DMMUs (all composites) were divided among the reaches along the 13.5 mile inner harbor navigation channel as indicated below. Eight grab samples were collected and composited from each of the 28 DMMUs, for a total of 224 sampling locations. The most recent bathymetric survey data were used to locate representative sampling stations within each DMMU.

   Crossover Reach (Stations: 715+93 to 862+49): 6 DMMUs (C1-C6)
   North Channel Reach (Stations: 862+49 to 1005+71): 5 DMMUs (C7-C11)
   Hoquiam Reach (Stations: 1005+71 to 1156+02): 6 DMMUs (C12-C17)
   Cow Point Reach (Stations: 1156+02 to 1227+99): 3 DMMUs (C18-C20)
   Aberdeen Reach (Stations: 1227+99 to 1315+86): 3 DMMUs (C21-C23)
   South Aberdeen Reach (Stations: 1315+86 to 1448+04): 5 DMMUs (C24-C28)

Table 3. DMMU Allocation for DY 2012 Grays Harbor Maintenance Dredging

Channel Reach	Channel Width (feet)	Channel Depth (ft) (without advanced maintenance or overdepth)	Channel Length (miles)	# of DMMUs
Bar*	1000	46	1.0	NA
Entrance/Point Chehalis*	600 – 1000	28 – 46	4.0	NA
South*	350	36	4.3	NA
Crossover	350	36	2.8	6
North Channel	350	36	2.7	5
Hoquiam	350	36	2.8	6
Cow Point	350	36	1.4	3
Aberdeen	200	30	1.5	3
South Aberdeen	200	30	2.3	5
Totals (non-exclusionary):			13.5	28
Totals (exclusionary + non-exclusionary):			22.8	
Average DMMU channel length in miles:				0.48

*No Test (exclusionary); NA = not applicable

9. Sampling. The sampling commenced on November 4, 2011 and was concluded on November 19, 2011 after encountering several weather days precluding sample collections. Sampling with a VanVeen grab sampler was accomplished at 223 of the 224 stations, and composited into 28 DMMUs (8 samples/DMMU composite, except DMMU-AB-C23, which had 7 samples). Difficulties in finding a suitable replacement station for AB-C23 not already at -40 ft MLLW prevented locating the eighth sample for this DMMU. This deviation from the SAP was coordinated with the DMMO/DMMP and verbally approved, Appendix 1(a-c) and Figures 2-7 provide background information regarding estimated dredging per reach and station keeping sampling and depth data and locations for each station and DMMU. The data characterization report was submitted to the DMMP

quality assurance/control review on February 8, 2012. The DMMP agencies concluded, after reviewing the data validation report, that the data were acceptable for decision-making using best professional judgment.

10. Standard Chemicals of Concern Testing Summary. The Agencies' approved sampling and analysis plan was followed and quality assurance/quality control guidelines specified by PSEP and DMMP were generally complied with. A summary of standard list of CoCs analysis results is provided in Table 4, and demonstrates that all chemicals were quantitated as either detected or undetected below DMMP SL guidelines.

11. SMS Guidelines Comparison. Data from all twenty-eight DMMUs were carbon-normalized as appropriate and compared with Sediment Management Standards (SMS) Sediment Quality Standards (SQS) guidelines, to assess suitability for beneficial uses Table 4. All the materials evaluated were quantitated (detected and undetected) below SQS guidelines. Therefore, all the material evaluated was found to be suitable for beneficial use relative to SMS guidelines. However, SMS does not include guidelines for dioxins. Thus, the DMMP has modified the beneficial use finding, based on best professional judgment, in the Suitability section below (paragraph 20).

12. Dioxin Testing Results Summary. Table 5 provides the results of the validated dioxin/furan testing results for the twenty-eight DMMUs, which depicted concentrations ranging from 0.68 pptr-TEQ (NC-C7) to a high of 11.8-pptr-TEQ (HO-C16) (U = ½ detection limit) with an average concentration of 3.62 pptr-TEQ. Analysis of dioxin concentrations in the reference sample (GH-S7) depicted a concentration of 4.03 pptr-TEQ (U = ½ detection limit).

13. Dioxin Interim Interpretative Framework. The existing DMMP dioxin guideline in place for Coastal Washington is 15 pptr-TEQ for interpreting dioxin data. The twenty-eight DMMUs evaluated were all quantitated below the existing guideline of 15.0- pptr-TEQ, and all the maintenance dredged material within the Federal channel in Grays Harbor is suitable for open-water disposal at either of the Estuarine Dispersive sites, and for use at an appropriate beneficial use site (see paragraph 20 below) based on these dioxin testing results.

14. Confirmatory Biological Testing. The standard suite of three bioassay tests (amphipod toxicity, bivalve larval mortality/abnormality, and juvenile polychaete growth) was performed on sediments chosen for confirmatory testing. All biological testing was performed by Northwest Aquatic Science (NAS), of Newport, Oregon, in compliance with standard bioassay protocols (PSEP 1995). The DMMP agencies selected two confirmatory biological testing DMMUs, one within North Channel Reach, and the second within Aberdeen Reach after reviewing the previous testing history within each of the reaches (Table 6). No toxicity has been observed during previous confirmatory testing of Grays Harbor O&M material. The DMMP agencies selected two stations from two reaches subjected to the lowest frequency of confirmatory toxicity testing. The two stations selected were North Channel: DMMU-NC-C10 (39.2 % fines) and Aberdeen: DMMU-AB-C21 (60.3 % fines). Subsequently, a reference sample was collected at reference area station GH-S7 (Figure 8) based on wet sieving results from the twenty-eight DMMUs (Appendix 1c). The reference sample was ultimately quantitated at 87.5 % fines, which differs markedly from the two confirmatory testing DMMUs. The disparity was not realized until after testing was completed. The testing results below were compared with both reference sediments and negative controls to evaluate the suitability of these two DMMUs relative to dispersive interpretation guidelines. Comparison with negative control provides a more conservative interpretation, and the higher fines fraction in the reference sediment coupled with the negative control comparison provides a more conservative evaluation.

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			XR-C1			XR-C2			XR-C3			XR-C4			XR-C5			XR-C6			NC-C7		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
								DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Metals								dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm	
Antimony	mg/kg dw	150	200	-		--	--	7.0		U	7.0		U	7.0		U	7.0		U	7.0		U	9.0		U	7.0		U
Arsenic	mg/kg dw	57	700	507.1	mg/kg	57	93	7.0		U	7.0		U	7.0		U	7.0		U	7.0		U	9.0		U	7.0		U
Cadmium	mg/kg dw	5.1	14	11.3	mg/kg	5.1	6.7	0.3		U	**0.3**			0.3		U	0.3		U	0.3		U	0.3		U	0.3		U
Chromium	mg/kg dw	-	-	267	mg/kg	260	270	**21.5**			**21.3**			**20.3**			**19.4**			**20.9**		U	**29.0**			**19.9**		
Copper	mg/kg dw	390	1300	1027	mg/kg	390	390	**13.5**			**13.6**			**15.1**			**13.1**			**14.5**			**29.5**			**9.8**		
Lead	mg/kg dw	450	1200	975	mg/kg	450	530	**3.0**			**3.0**			3.0		U	3.0		U	3.0			**4.0**			3.0		U
Mercury	mg/kg dw	0.41	2.3	1.5	mg/kg	0.41	0.59	0.03		U	**0.03**			0.03		U	0.03		U	0.04			**0.04**			0.03		U
Selenium	mg/kg dw	-	-	3	mg/kg	--	--	0.70		U	**0.70**			0.70		U	0.7		U	0.70		U	0.8		U	0.7		U
Silver	mg/kg dw	6.1	8.4	6.1	mg/kg	6.1	6.1	0.40		U	**0.40**			0.40		U	0.4		U	0.40		U	0.5		U	0.4		U
Zinc	mg/kg dw	410	3800	2783	mg/kg	410	960	**47.0**			**47.0**			**42.0**			**41.0**			**46.0**		U	**60.0**			**41.0**		
PAHs																												
Naphthalene	µg/kg dw	2100	2400	-	mg/kg-OC	99	170	20.0	0.40	U	14.00	0.16	U	19.00	1.33	U	20.00	0.99	U	**9.40**	0.64		**19.0**	**1.58**		19.0	2.38	U
2-Methylnaphthalene	µg/kg dw	670	1900	-	mg/kg-OC	38	64	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	**J**	**13.0**	**1.08**	J	19.0	2.38	U
Acenaphthylene	µg/kg dw	560	1300	-	mg/kg-OC	66	66	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Acenaphthene	µg/kg dw	500	2000	-	mg/kg-OC	16	57	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Fluorene	µg/kg dw	540	3600	-	mg/kg-OC	23	79	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Phenanthrene	µg/kg dw	1500	21000	-	mg/kg-OC	100	480	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	**20.0**	**1.67**		19.0	2.38	U
Anthracene	µg/kg dw	960	13000	-	mg/kg-OC	220	1200	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Total LPAHs	µg/kg dw	5200	29000	-	mg/kg-OC	370	780	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	**9.40**	**0.64**	U	**52.0**	**4.33**	J	19.0	2.38	U
Fluoranthene	µg/kg dw	1700	30000	4600	mg/kg-OC	160	1200	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	J	**18.0**	1.50	J	19.0	2.38	U
Pyrene	µg/kg dw	2600	16000	11980	mg/kg-OC	1000	1400	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	**9.40**	**0.64**	U	**18.0**	1.50	J	19.0	2.38	U
Benzo(a)anthracene	µg/kg dw	1300	5100	-	mg/kg-OC	110	270	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	**J**	19.0	1.58	U	19.0	2.38	U
Chrysene	µg/kg dw	1400	21000	-	mg/kg-OC	110	460	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Benzo(a)pyrene	µg/kg dw	1600	3600	-	mg/kg-OC	99	210	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	-	mg/kg-OC	34	88	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	-	mg/kg-OC	12	33	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Benzo(g,h,i)perylene	µg/kg dw	670	3200	-	mg/kg-OC	31	78	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Total Benzofluoranthenes	µg/kg dw	3200	9900	-	mg/kg/OC	230	450	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Total HPAHs	µg/kg dw	12000	69000	-	mg/kg-OC	960	5300	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	**9.40**	**0.64**	U	**36.0**	**3.00**	**J**	19.0	2.38	U
1,4-Dichlorobenzene	µg/kg dw	110	120	-	mg/kg-OC	3.1	9	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	J	19.0	1.58	U	19.0	2.38	U
1,2-Dichlorobenzene	µg/kg dw	35	110	-	mg/kg-OC	2.3	2.3	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
1,2,4-Trichlorobenzene	µg/kg dw	31	64	-	mg/kg-OC	0.81	1.8	20.0	0.40	U	**20.00**	**0.23**	J	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Hexachlorobenzene	µg/kg dw	22	230	168	mg/kg-OC	0.38	2.3	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Dimethyl phthalate	µg/kg dw	71	1400	-	mg/kg-OC	53	53	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Diethyl phthalate	µg/kg dw	200	1200	-	mg/kg-OC	61	110	49.0	0.98	U	50.00	0.57	U	48.00	3.36	U	50.00	2.46	U	47.00	3.18	U	49.0	4.08	U	47.0	5.88	U
Di-n-butyl phthalate	µg/kg dw	-	-	-	mg/kg-OC	220	1700	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Butyl benzyl phthalate	µg/kg dw	63	970	-	mg/kg-OC	4.9	64	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Bis(2-ethylhexyl) phthalate	µg/kg dw	1300	8300	-	mg/kg-OC	47	78	24.0	0.48	U	25.00	0.29	U	24.00	1.68	U	25.00	1.23	U	24.00	1.62	U	**32.0**	**2.67**		**23.0**	**2.88**	J
Di-n-octyl phthalate	µg/kg dw	6200	6200	-	mg/kg-OC	58	4500	20.0	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Phenol	µg/kg dw	420	1200		ug/kg	420	1200	**16.0**		J	36.00		U	19.00		U	20.00		U	**13.00**		U	19.0		U	100.0		
2-Methylphenol	µg/kg dw	63	77	-	ug/kg	63	63	20.0		U	20.00		U	19.00		U	20.00		U	19.00		J	19.0		U	19.0		U
4-Methylphenol	µg/kg dw	670	3600	-	ug/kg	670	670	39.0		U	40.00		UJ	38.00		U	40.00		U	38.00		U	**69.0**			38.0		U
2,4-Dimethylphenol	µg/kg dw	29	210	-	ug/kg	29	29	19.0		UJ	20.00		U	19.00		UJ	19.00		UJ	19.00		U	19.0		UJ	19.0		UJ
Pentachlorophenol	µg/kg dw	400	690	504	ug/kg	360	690	200.0		U	200.00		U	190.00		U	200.00		U	190.00		UJ	190.0		U	190.0		U
Benzyl Alcohol	µg/kg dw	57	870	-	ug/kg	57	73	20.0		U	20.00		U	19.00		U	20.00		U	19.00		U	19.0		U	19.0		U
Benzoic Acid	µg/kg dw	650	760	-	ug/kg	650	650	390.0		U	400.00		U	380.00		U	400.00		U	380.00		U	390.0		U	380.0		U
Dibenzofuran	µg/kg dw	540	1700	-	mg/kg-OC	15	58	20	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
N-Nitrosodiphenylamine	µg/kg dw	28	130	-	mg/kg-OC	11	11	20	0.40	U	20.00	0.23	U	19.00	1.33	U	20.00	0.99	U	19.00	1.28	U	19.0	1.58	U	19.0	2.38	U
Hexachlorobutadiene	µg/kg dw	29	270	-	mg/kg-OC	3.9	6.2	0.49	0.010	U	0.48	0.005	U	0.48	0.03	U	0.49	0.02	U	0.48	0.03	U	0.5	0.04	U	0.5	0.06	U
Heptachlor	µg/kg dw	1.5	-	-		--	--	0.49		U	0.48		U	0.48		U	0.49		U	0.48		U	0.5		U	0.5		U
Aldrin	µg/kg dw	9.5	-	-		--	--	1.2		Y	0.48		U	0.48		U	0.49		U	0.48		U	0.5		U	0.5		U
Dieldrin	µg/kg dw	1.9	-	-		--	--	0.99		U	0.96		U	0.96		U	0.98		U	0.95		U	1.0		U	1.0		U
4,4'-DDE	µg/kg dw	16	-	-		--	--	0.99		U	0.96		U	0.96		U	0.98		U	0.95		U	1.0		U	1.0		U
4,4'-DDD	µg/kg dw	9	-	-		--	--	0.99		U	0.96		U	0.96		U	0.98		U	0.95		U	1.0		U	1.0		U
4,4'-DDT	µg/kg dw	12	-	-		--	--	0.99		U	0.96		U	0.96		U	0.98		U	0.95		U	1.0		U	1.0		U
Total DDT(sum of 4,4'-DDD, 4,4'-DDE & 4,4'-DDT)	µg/kg dw		69	50		--	--	0.99		U	0.96		U	0.96		U	0.98		U	0.95		U	1.0		U	1.0		U
trans-Chlordane	µg/kg dw	-	-	-		--	--	1.3		Y	0.48		U	0.48		U	0.49		U	0.48		U	0.5		U	0.5		U
cis-Chlordane	µg/kg dw	-	-	-		--	--	0.49		U	0.48		U	0.48		U	0.49		U	0.48		U	0.5		U	0.5		U
oxy Chlordane	µg/kg dw							2.0		U	1.90		U	1.90		U	2.00		U	1.90		U	1.9		U	2.0		U
cis-Nonachlor	µg/kg dw							2.0		U	1.90		U	1.90		U	2.00		U	1.90		U	1.9		U	2.0		U
trans-Nonachlor	µg/kg dw							2.0		U	1.90		U	1.90		U	2.00		U	1.90		U	1.9		U	2.0		U
Total chlordane	µg/kg dw	2.8	-	37		--	--	2.0		U	1.90		U	1.90		U	2.00		U	1.90		U	1.9		U	2.0		U

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			XR-C1			XR-C2			XR-C3			XR-C4			XR-C5			XR-C6			NC-C7		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
Aroclor 1016	µg/kg dw	-	-	-		--	--	9.90		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1242	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1248	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1254	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1260	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1221	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1232	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1262	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Aroclor 1268	µg/kg dw	-	-	-		--	--	9.9		U	9.70		U	9.60		U	9.80		U	9.60		U	9.5		U	9.9		U
Total PCBs	µg/kg dw	130	3100	-	mg/kg/OC	**12**	**65**	9.9	0.20	U	9.70	0.11	U	9.60	0.67	U	9.80	0.48	U	9.60	0.65	U	9.5	0.79	U	9.9	1.24	U
Total PCBs	mg/kg OC	-	-	38				0.20			0.11			0.67			0.48			0.65		U	0.79			1.24		
Dioxin (TEQ: see Table 4 for congener specific results)	**ng/kg**							**0.95**			**0.80**			**1.53**			**1.06**			**1.36**			**3.64**			**0.68**		
Total Solids	%							67.3			68.4			69.6			70.9			65.2			55.1			70.5		
Total Volatile Solids	%							61.2			67.6			68.6			49.1			65.6			5.0			2.0		
Total Organic Carbon	%							5.01			8.77			1.43			2.03			1.48			1.2			0.8		
Total Ammonia	mg/kg							2.72			2.63			2.4			2.15			2.79			15.4			4.1		
Total Sulfides	mg/kg							13.7			12.6			7.82			5.78			12.0			2.2			1.4		U
Gravel	%							0.1			0.1			0.1			0.1			0.1			0.1			0.1		
Sand	%							89.1			87.3			84.4			89.1			82.6			62.6			94.8		
Silt	%							6.5			7.6			9.8			6.6			11.0			24.8			2.6		
Clay	%							4.3			5			5.9			4.3			6.5			12.6			2.6		
Fines (percent silt + clay)	%							10.8			12.6			15.7			10.9			17.5			37.4			5.2		
Eohaustorius estuarius hits: (NH, 2H, 1H)																												
Mytilus galloprovincialis hits: (NH, 2H, 1H)																												
Neanthes arenaceodentata hits: (NH, 2H, 1H)																												
Bioassay Determination: (Pass/Fail)								NA			NA			NA			NA			NA			NA			NA		
BTs exceeded: Y/N								N			N			N			N			N			N			N		
Bioaccumulation conducted: Y/N								N			N			N			N			N			N			N		
Bioaccumulation Determination: (P/F)								NA			NA			NA			NA			NA			NA			NA		
ML Rule exceeded: Y/N								N			N			N			N			N			N			N		
PSDDA Determination: (Suitable/Unsuitable)								**Suitable**	**BU**		**Suitable**	**BU**		**Suitable**	**BU**		**Suitable**	**BU**		**Suitable**	**BU**		**Suitable**			**Suitable**		
DMMU Volume:	cy							60,000			60,000			60,000			60,000			60,000			60,000			60,000		
Rank (Low = L, Moderate = M, Low-Moderate =LM, High = H)								L			L			L			L			L			L			L		
Mean Grab sampling depth (cm)	cm							10			10			10			10			10			10			10		
DMMU ID:								**XR-C1**			**XR-C2**			**XR-C3**			**XR-C4**			**XR-C5**			**XR-C6**			**NC-C7**		

Legend:
VQ = Validation Qualifier
U = undetected at reporting limit
J = Estimated value, less than reporting limit, and/or QC parameter out of Control limits
NA = not analyzed
SL = screening level
BT = bioaccumulation trigger
ML = maximum level
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
DMMP = dredged material management program
DMMU = dredged material management unit
dw = dry weight
ww = wet weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
OC = organic carbon normalized
PCBs = polychlorinated biphenyls
RL = reporting limit
SVOCs = semi-volatile organic compounds
NH = No Hit; 2H = Two Hit Failure; 1H = One Hit Failure
BU = Suitable for Beneficial Use
Denotes DMMUs subject to Confirmatory Bioassay testing

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			NC-C8			NC-C9			NC-C10			NC-C11			HO-C12			HO-C13			HO-C14		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
								DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Metals								dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm	
Antimony	mg/kg dw	150	200	-		--	--	7.0		U	8.0		U	8.0		U	7.0		U	7.0		U	8.0		U	9.0		U
Arsenic	mg/kg dw	57	700	507.1	mg/kg	57	93	8.0			8.0		U	**8.0**			**7.0**			7.0		U	8.0		U	9.0		U
Cadmium	mg/kg dw	5.1	14	11.3	mg/kg	5.1	6.7	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U
Chromium	mg/kg dw	-	-	267	mg/kg	260	270	**29.0**			**26.4**			**34.6**			**26.6**			**28.4**			**32.5**			**32.9**		
Copper	mg/kg dw	390	1300	1027	mg/kg	390	390	**30.6**			**25.4**			**44.1**			**23.3**			**29.4**			**42.2**			**38.8**		
Lead	mg/kg dw	450	1200	975	mg/kg	450	530	**4.0**			**3.0**			**4.0**			**3.0**		U	**3.0**			**4.0**			**4.0**		
Mercury	mg/kg dw	0.41	2.3	1.5	mg/kg	0.41	0.59	0.03		U	0.03		U	0.04		U	0.03		U	0.03		U	0.04		U	**0.04**		
Selenium	mg/kg dw	-	-	3	mg/kg	--	--	0.7		U	0.8		U	0.8		U	0.7		U	0.7		U	0.8		U	0.9		U
Silver	mg/kg dw	6.1	8.4	6.1	mg/kg	6.1	6.1	0.4		U	0.5		U	0.5		U	0.4		U	0.4		U	0.5		U	0.5		U
Zinc	mg/kg dw	410	3800	2783	mg/kg	410	960	**59.0**			**54.0**			**69.0**			**55.0**			**60.0**			**72.0**			**68.0**		
PAHs																												
Naphthalene	µg/kg dw	2100	2400	-	mg/kg-OC	99	170	19.0	1.06	U	19.0	1.19	U	**25.0**	**1.47**		18.0	1.50	U	**10.0**	**0.77**	J	**11.0**	0.73	J	19.0	1.06	U
2-Methylnaphthalene	µg/kg dw	670	1900	-	mg/kg-OC	38	64	19.0	1.06	U	19.0	1.19	U	**11.0**	**0.65**	J	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Acenaphthylene	µg/kg dw	560	1300	-	mg/kg-OC	66	66	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Acenaphthene	µg/kg dw	500	2000	-	mg/kg-OC	16	57	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Fluorene	µg/kg dw	540	3600	-	mg/kg-OC	23	79	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Phenanthrene	µg/kg dw	1500	21000	-	mg/kg-OC	100	480	19.0	1.06	U	19.0	1.19	U	**17.0**	**1.00**	J	**10.0**	**0.83**	J	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Anthracene	µg/kg dw	960	13000	-	mg/kg-OC	220	1200	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Total LPAHs	µg/kg dw	5200	29000	-	mg/kg-OC	370	780	19.0	1.06	U	19.0	1.19	U	**53.0**	**3.12**	J	**10.0**	**0.83**	J	**10.0**	**0.77**	J	**11.0**	0.73	J	19.0	1.06	U
Fluoranthene	µg/kg dw	1700	30000	4600	mg/kg-OC	160	1200	19.0	1.06	U	**9.6**	**0.60**	J	**17.0**	**1.00**	J	**9.2**	**0.77**	J	19.0	1.46	U	**9.6**	0.64	J	**12.0**	**0.67**	J
Pyrene	µg/kg dw	2600	16000	11980	mg/kg-OC	1000	1400	19.0	1.06	U	19.0	1.19	U	**21.0**	**1.24**		**10.0**	**0.83**	JQ	19.0	1.46	U	**12.0**	0.80	J	**12.0**	**0.67**	J
Benzo(a)anthracene	µg/kg dw	1300	5100	-	mg/kg-OC	110	270	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Chrysene	µg/kg dw	1400	21000	-	mg/kg-OC	110	460	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Benzo(a)pyrene	µg/kg dw	1600	3600	-	mg/kg-OC	99	210	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	-	mg/kg-OC	34	88	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	-	mg/kg-OC	12	33	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Benzo(g,h,i)perylene	µg/kg dw	670	3200	-	mg/kg-OC	31	78	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Total Benzofluoranthenes	µg/kg dw	3200	9900	-	mg/kg/OC	230	450	19.0	1.06	U	19.0	1.19	U	**12.0**	**0.71**	J	18.0	1.50	U	19.0	1.46	U	**9.6**	0.64	J	19.0	1.06	U
Total HPAHs	µg/kg dw	12000	69000	-	mg/kg-OC	960	5300	19.0	1.06	U	**9.6**	**0.60**	J	**50.0**	**2.94**	J	18.0	1.50	U	19.0	1.46	U	**31.2**	2.08	J	**24.0**	**1.33**	J
1,4-Dichlorobenzene	µg/kg dw	110	120	-	mg/kg-OC	3.1	9	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
1,2-Dichlorobenzene	µg/kg dw	35	110	-	mg/kg-OC	2.3	2.3	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
1,2,4-Trichlorobenzene	µg/kg dw	31	64	-	mg/kg-OC	0.81	1.8	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Hexachlorobenzene	µg/kg dw	22	230	168	mg/kg-OC	0.38	2.3	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Dimethyl phthalate	µg/kg dw	71	1400	-	mg/kg-OC	53	53	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Diethyl phthalate	µg/kg dw	200	1200	-	mg/kg-OC	61	110	48.0	2.67	U	48.0	3.00	U	48.0	2.82	U	46.0	3.83	U	47.0	3.62	U	48.0	3.20	U	48.0	2.67	U
Di-n-butyl phthalate	µg/kg dw	-	-	-	mg/kg-OC	220	1700	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Butyl benzyl phthalate	µg/kg dw	63	970	-	mg/kg-OC	4.9	64	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Bis(2-ethylhexyl) phthalate	µg/kg dw	1300	8300	-	mg/kg-OC	47	78	**20.0**	**1.11**	J	**22.0**	1.38	J	**29.0**	1.71		23.0	1.92	U	**25.0**	1.92	B	24.0	1.60	U	24.0	1.33	U
Di-n-octyl phthalate	µg/kg dw	6200	6200	-	mg/kg-OC	58	4500	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Phenol	µg/kg dw	420	1200		ug/kg	420	1200	19.0		U	13.0		J	**18.0**		J	**11.0**		J	19.0		U	19.0		U	**9.7**		J
2-Methylphenol	µg/kg dw	63	77	-	ug/kg	63	63	19.0		U	19.0		U	19.0		U	18.0		U	19.0		U	19.0		U	19.0		U
4-Methylphenol	µg/kg dw	670	3600	-	ug/kg	670	670	38.0		U	**12.0**		J	**26.0**		J	37.0		U	**11.0**		J	**20.0**		J	**67.0**		
2,4-Dimethylphenol	µg/kg dw	29	210	-	ug/kg	29	29	19.0		UJ	19.0		UJ	19.0		UJ	18.0		UJ	38.0		U	19.0		U	39.0		U
Pentachlorophenol	µg/kg dw	400	690	504	ug/kg	360	690	190.0		U	190.0		U	190.0		U	180.0		U	190.0		U	190.0		U	190.0		U
Benzyl Alcohol	µg/kg dw	57	870	-	ug/kg	57	73	19.0		U	19.0		U	19.0		U	18.0		U	19.0		U	19.0		U	19.0		U
Benzoic Acid	µg/kg dw	650	760	-	ug/kg	650	650	380.0		U	380.0		U	390.0		U	370.0		U	380.0		U	380.0		U	390.0		U
Dibenzofuran	µg/kg dw	540	1700	-	mg/kg-OC	15	58	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
N-Nitrosodiphenylamine	µg/kg dw	28	130	-	mg/kg-OC	11	11	19.0	1.06	U	19.0	1.19	U	19.0	1.12	U	18.0	1.50	U	19.0	1.46	U	19.0	1.27	U	19.0	1.06	U
Hexachlorobutadiene	µg/kg dw	29	270	-	mg/kg-OC	3.9	6.2	0.5	0.03	U	0.5	0.03	U	0.5	0.03	U	0.5	0.04	U	0.5	0.04	U	0.5	0.03	U	0.5	0.03	U
Heptachlor	µg/kg dw	1.5	-	-		--	--	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U
Aldrin	µg/kg dw	9.5	-	-		--	--	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U
Dieldrin	µg/kg dw	1.9	-	-		--	--	1.0		U	0.9		U	0.9		U	1.0		U	1.0		U	0.9		U	1.0		U
4,4'-DDE	µg/kg dw	16	-	-		--	--	1.0		U	0.9		U	0.9		U	1.0		U	1.0		U	0.9		U	1.0		U
4,4'-DDD	µg/kg dw	9	-	-		--	--	1.0		U	0.9		U	0.9		U	1.0		U	1.0		U	0.9		U	1.0		U
4,4'-DDT	µg/kg dw	12	-	-		--	--	1.0		U	0.9		U	0.9		U	1.0		U	1.0		U	0.9		U	1.0		U
Total DDT(sum of 4,4'-DDD, 4,4'-DDE & 4,4'-DDT)	µg/kg dw		69	50		--	--	1.0		U	0.9		U	0.9		U	1.0		U	1.0		U	0.9		U	1.0		U
trans-Chlordane	µg/kg dw	-	-	-		--	--	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U
cis-Chlordane	µg/kg dw	-	-	-		--	--	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U
oxy Chlordane	µg/kg dw							1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U
cis-Nonachlor	µg/kg dw							1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U
trans-Nonachlor	µg/kg dw							1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U
Total chlordane	µg/kg dw	2.8	-	37		--	--	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			NC-C8			NC-C9			NC-C10			NC-C11			HO-C12			HO-C13			HO-C14		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
Aroclor 1016	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1242	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1248	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1254	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1260	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1221	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1232	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1262	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Aroclor 1268	µg/kg dw	-	-	-		--	--	9.7		U	9.5		U	9.5		U	9.4		U	9.6		U	9.6		U	9.7		U
Total PCBs	µg/kg dw	130	3100	-	mg/kg/OC	**12**	**65**	9.7	0.54	U	9.5	0.59	U	9.5	0.56	U	9.4	0.78	U	9.6	0.74	U	9.6	0.64	U	9.7	0.54	U
Total PCBs	mg/kg OC	-	-	38				0.54			0.59			0.56			0.78			0.74			0.64			0.54		
Dioxin (TEQ: see Table 4 for congener specific results)	**ng/kg**							**3.57**			**2.87**			**4.5**			**2.4**			**1.57**			**3.61**			**4.24**		
Total Solids	%							65.4			58.2			57.4			66.9			65.3			60.4			50.3		
Total Volatile Solids	%							3.5			4.0			5.0			3.0			3.3			4.4			5.2		
Total Organic Carbon	%							1.8			1.6			1.7			1.2			1.3			1.5			1.8		
Total Ammonia	mg/kg							8.5			7.5			11.2			11.4			13.1			13.5			20.4		
Total Sulfides	mg/kg							1.8			1.5		U	325			1.6		U	23.6			1.8		U	9.3		
Gravel	%							0.1			0.1			0.2			0.1			0.1			1.0			0.2		
Sand	%							76.3			74.9			60.4			85.2			82.3			64.4			55.3		
Silt	%							15.6			15.3			25.4			9.0			11.3			23.9			33.5		
Clay	%							8.0			9.8			13.8			5.7			6.1			10.6			11.1		
Fines (percent silt + clay)	%							23.6			25.1			39.2			14.7			17.4			34.5			44.6		
Eohaustorius estuarius hits: (NH, 2H, 1H)														NH														
Mytilus galloprovincialis hits: (NH, 2H, 1H)														NH														
Neanthes arenaceodentata hits: (NH, 2H, 1H)														NH														
Bioassay Determination: (Pass/Fail)								NA			NA			**PASS**			NA			NA			NA			NA		
BTs exceeded: Y/N																												
Bioaccumulation conducted: Y/N								N			N			N			N			N			N			N		
Bioaccumulation Determination: (P/F)								NA			NA			NA			NA			NA			NA			NA		
ML Rule exceeded: Y/N								N			N			N			N			N			N			N		
PSDDA Determination: (Suitable/Unsuitable)								**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**		
DMMU Volume:	cy							60,000			60,000			60,000			60,000			60,000			60,000			60,000		
Rank (Low = L, Moderate = M, Low-Moderate =LM, High = H)								L			L			L			L			L			L			L		
Mean Grab sampling depth (cm)	cm							10			10			10			10			10			10			10		
DMMU ID:								**NC-C8**			**NC-C9**			**NC-C10**			**NC-C11**			**HO-C12**			**HO-C13**			**HO-C14**		

Legend:
VQ = Validation Qualifier
U = undetected at reporting limit
J = Estimated value, less than reporting limit, and/or QC parameter out of Control limits
NA = not analyzed
SL = screening level
BT = bioaccumulation trigger
ML = maximum level
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
DMMP = dredged material management program
DMMU = dredged material management unit
dw = dry weight
ww = wet weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
OC = organic carbon normalized
PCBs = polychlorinated biphenyls
RL = reporting limit
SVOCs = semi-volatile organic compounds
NH = No Hit; 2H = Two Hit Failure; 1H = One Hit Failure
BU = Suitable for Beneficial Use
Denotes DMMUs subject to Confirmatory Bioassay testing

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			HO-C15			HO-C16			HO-C17			CP-C18			CP-C19			CP-C20			AB-C21		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
								DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Metals								dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm	
Antimony	mg/kg dw	150	200	-		--	--	8.0		U	10.0		U	10.0		U	10.00		U	10.00		U	10.00		U	10.00		U
Arsenic	mg/kg dw	57	700	507.1	mg/kg	57	93	8.0		U	10.0		U	10.0		U	10.00		U	10.00		U	10.00		U	10.00		U
Cadmium	mg/kg dw	5.1	14	11.3	mg/kg	5.1	6.7	0.3		U	0.4		U	0.5		U	0.40		U	0.50		U	0.60		U	0.40		U
Chromium	mg/kg dw	-	-	267	mg/kg	260	270	**31.9**			**40.0**			**40.0**			**36.00**			**41.00**			**42.00**			**37.00**		
Copper	mg/kg dw	390	1300	1027	mg/kg	390	390	**36.1**			**69.3**			**64.6**			**49.10**			**55.30**			**57.90**			**52.10**		
Lead	mg/kg dw	450	1200	975	mg/kg	450	530	**4.0**			**6.0**			**6.0**			**5.00**			**7.00**			**8.00**			**6.00**		
Mercury	mg/kg dw	0.41	2.3	1.5	mg/kg	0.41	0.59	**0.03**			**0.05**			**0.06**			**0.04**			**0.06**			**0.07**			**0.04**		
Selenium	mg/kg dw	-	-	3	mg/kg	--	--	0.8		U	1.0		U	1.0		U	1.00		U	1.00		U	1.00		U	1.00		U
Silver	mg/kg dw	6.1	8.4	6.1	mg/kg	6.1	6.1	0.5		U	0.7		U	0.7		U	0.60		U	0.80		U	0.80		U	0.60		U
Zinc	mg/kg dw	410	3800	2783	mg/kg	410	960	**66.0**			**83.0**			**82.0**			**76.00**			**85.00**			**87.00**			**79.00**		
PAHs																												
Naphthalene	µg/kg dw	2100	2400	-	mg/kg-OC	99	170	**11.0**	0.79	J	19.0	0.79	U	**20.0**	0.74		**23.00**	**1.25**		**15.00**	**0.60**	J	**20.00**	**0.71**		**24.00**	**1.04**	
2-Methylnaphthalene	µg/kg dw	670	1900	-	mg/kg-OC	38	64	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	**15.00**	**0.82**	J	20.00	0.80	U	20.00	0.71	U	**11.00**	0.48	J
Acenaphthylene	µg/kg dw	560	1300	-	mg/kg-OC	66	66	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Acenaphthene	µg/kg dw	500	2000	-	mg/kg-OC	16	57	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Fluorene	µg/kg dw	540	3600	-	mg/kg-OC	23	79	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Phenanthrene	µg/kg dw	1500	21000	-	mg/kg-OC	100	480	**9.5**	0.68	J	19.0	0.79	U	**29.0**	1.07		**22.00**	**1.20**		**27.00**	**1.08**		**22.00**	**0.79**		**41.00**	**1.78**	
Anthracene	µg/kg dw	960	13000	-	mg/kg-OC	220	1200	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Total LPAHs	µg/kg dw	5200	29000	-	mg/kg-OC	370	780	**20.5**	1.46	J	19.0	0.79	U	**49.0**	1.81		**60.00**	**3.26**	J	**42.00**	**1.69**	J	**42.00**	**1.50**	J	**76.00**	**3.30**	J
Fluoranthene	µg/kg dw	1700	30000	4600	mg/kg-OC	160	1200	19.0	1.36	U	19.0	0.79	U	**26.0**	0.96		**16.00**	**0.87**	J	**23.00**	**0.92**		**21.00**	**0.75**		**41.00**	**1.78**	
Pyrene	µg/kg dw	2600	16000	11980	mg/kg-OC	1000	1400	19.0	1.36	U	19.0	0.79	U	24.0	0.89	Q	**18.00**	**0.98**	JQ	31.00	1.24	Q	22.00	0.79	Q	38.00	1.65	Q
Benzo(a)anthracene	µg/kg dw	1300	5100	-	mg/kg-OC	110	270	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	**11.00**	**0.44**	J	20.00	0.71	U	**14.00**	**0.61**	J
Chrysene	µg/kg dw	1400	21000	-	mg/kg-OC	110	460	19.0	1.36	U	19.0	0.79	U	**9.6**	0.36	J	**11.00**	**0.60**	J	**16.00**	**0.64**	J	**11.00**	0.39	J	**18.00**	**0.78**	J
Benzo(a)pyrene	µg/kg dw	1600	3600	-	mg/kg-OC	99	210	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	**15.00**	**0.60**	J	20.00	0.71	U	20.00	0.87	U
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	-	mg/kg-OC	34	88	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	-	mg/kg-OC	12	33	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Benzo(g,h,i)perylene	µg/kg dw	670	3200	-	mg/kg-OC	31	78	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Total Benzofluoranthenes	µg/kg dw	3200	9900	-	mg/kg/OC	230	450	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	**24.00**	**0.96**		20.00	0.71	U	**24.00**	**1.04**	
Total HPAHs	µg/kg dw	12000	69000	-	mg/kg-OC	960	5300	19.0	1.36	U	19.0	0.79	U	**35.6**	1.32	J	**45.0**	**2.45**	J	**66.0**	**2.65**	J	**32.0**	**1.14**	J	**214.0**	**9.30**	J
1,4-Dichlorobenzene	µg/kg dw	110	120	-	mg/kg-OC	3.1	9	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
1,2-Dichlorobenzene	µg/kg dw	35	110	-	mg/kg-OC	2.3	2.3	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
1,2,4-Trichlorobenzene	µg/kg dw	31	64	-	mg/kg-OC	0.81	1.8	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Hexachlorobenzene	µg/kg dw	22	230	168	mg/kg-OC	0.38	2.3	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Dimethyl phthalate	µg/kg dw	71	1400	-	mg/kg-OC	53	53	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Diethyl phthalate	µg/kg dw	200	1200	-	mg/kg-OC	61	110	47.0	3.36	U	48.0	2.00	U	48.0	1.78	U	49.00	2.66	U	50.00	2.01	U	50.00	1.79	U	49.00	2.13	U
Di-n-butyl phthalate	µg/kg dw	-	-	-	mg/kg-OC	220	1700	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Butyl benzyl phthalate	µg/kg dw	63	970	-	mg/kg-OC	4.9	64	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Bis(2-ethylhexyl) phthalate	µg/kg dw	1300	8300	-	mg/kg-OC	47	78	24.0	1.71	U	24.0	1.00	U	24.0	0.89	U	**35.00**	**1.90**	B	**31.00**	**1.24**	B	**31.00**	**1.11**	B	**60.00**	**2.61**	B
Di-n-octyl phthalate	µg/kg dw	6200	6200	-	mg/kg-OC	58	4500	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Phenol	µg/kg dw	420	1200		ug/kg	420	1200	19.0		U	**13.0**		J	**13.0**		J	**20.00**			**23.00**			**32.00**			**22.00**		
2-Methylphenol	µg/kg dw	63	77	-	ug/kg	63	63	19.0		U	19.0		U	19.0		U	20.00		U	20.00		U	20.00		U	20.00		U
4-Methylphenol	µg/kg dw	670	3600	-	ug/kg	670	670	**22.0**		J	**15.0**		J	**24.0**		J	**35.00**		J	**42.00**			**37.00**		J	**29.00**		J
2,4-Dimethylphenol	µg/kg dw	29	210	-	ug/kg	29	29	38.0		U	38.0		U	19.0		UJ	19.00		UJ	20.00		UJ	20.00		UJ	20.00		UJ
Pentachlorophenol	µg/kg dw	400	690	504	ug/kg	360	690	190.0		U	190.0		U	190.0		U	200.00		U	200.00		U	200.00		U	200.00		U
Benzyl Alcohol	µg/kg dw	57	870	-	ug/kg	57	73	19.0		U	**21.0**			**12.0**		J	20.00		U	**15.00**		J	**27.00**			**11.00**		J
Benzoic Acid	µg/kg dw	650	760	-	ug/kg	650	650	380.0		U	380.0		U	380.0		U	390.00		U	400.00		U	400.00		U	390.00		U
Dibenzofuran	µg/kg dw	540	1700	-	mg/kg-OC	15	58	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
N-Nitrosodiphenylamine	µg/kg dw	28	130	-	mg/kg-OC	11	11	19.0	1.36	U	19.0	0.79	U	19.0	0.70	U	20.00	1.09	U	20.00	0.80	U	20.00	0.71	U	20.00	0.87	U
Hexachlorobutadiene	µg/kg dw	29	270	-	mg/kg-OC	3.9	6.2	0.5	0.03	U	0.5	0.02	U	0.5	0.02	U	0.48	0.03	U	0.49	0.02	U	0.50	0.02	U	0.48	0.02	U
Heptachlor	µg/kg dw	1.5	-	-		--	--	0.5		U	0.5		U	0.5		U	0.48		U	0.49		U	0.50		U	0.48		U
Aldrin	µg/kg dw	9.5	-	-		--	--	0.5		U	0.5		U	0.5		U	0.48		U	0.49		U	0.50		U	0.48		U
Dieldrin	µg/kg dw	1.9	-	-		--	--	0.9		U	1.0		U	1.0		U	0.97		U	0.98		U	0.99		U	0.97		U
4,4'-DDE	µg/kg dw	16	-	-		--	--	0.9		U	1.0		U	1.0		U	0.97		U	0.98		U	0.99		U	0.97		U
4,4'-DDD	µg/kg dw	9	-	-		--	--	0.9		U	1.0		U	1.0		U	0.97		U	0.98		U	0.99		U	0.97		U
4,4'-DDT	µg/kg dw	12	-	-		--	--	0.9		U	1.0		U	1.0		U	0.97		U	0.98		U	0.99		U	0.97		U
Total DDT(sum of 4,4'-DDD, 4,4'-DDE & 4,4'-DDT)	µg/kg dw		69	50		--	--	0.9		U	1.0		U	1.0		U	0.97		U	0.98		U	0.99		U	0.97		U
trans-Chlordane	µg/kg dw	-	-	-		--	--	0.5		U	0.5		U	1.2		Y	0.48		U	0.49		U	0.50		U	0.51		
cis-Chlordane	µg/kg dw	-	-	-		--	--	0.5		U	0.5		U	0.5		U	0.48		U	0.49		U	0.50		U	0.48		U
oxy Chlordane	µg/kg dw							1.9		U	2.0		U	1.9		U	1.90		U	2.00		U	2.00		U	1.90		U
cis-Nonachlor	µg/kg dw							1.9		U	2.0		U	1.9		U	1.90		U	2.00		U	2.00		U	1.90		U
trans-Nonachlor	µg/kg dw							1.9		U	2.0		U	1.9		U	1.90		U	2.00		U	2.00		U	1.90		U
Total chlordane	µg/kg dw	2.8	-	37		--	--	1.9		U	2.0		U	1.9		U	1.90		U	2.00		U	2.00		U	1.90		U

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			HO-C15			HO-C16			HO-C17			CP-C18			CP-C19			CP-C20			AB-C21		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
Aroclor 1016	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	9.70		U	9.80		U	9.70		U	9.60		U
Aroclor 1242	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	9.70		U	9.80		U	9.70		U	9.60		U
Aroclor 1248	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	19.00		Y	9.80		U	9.70		U	9.60		U
Aroclor 1254	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	19.00		Y	9.80		U	9.70		U	9.60		U
Aroclor 1260	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	9.70		U	9.80		U	9.70		U	9.60		U
Aroclor 1221	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	9.70		U	9.80		U	9.70		U	9.60		U
Aroclor 1232	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	9.70		U	9.80		U	9.70		U	9.60		U
Aroclor 1262	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	**35.00**			9.80		U	9.70		U	9.60		U
Aroclor 1268	µg/kg dw	-	-	-		--	--	9.6		U	9.6		U	9.8		U	9.70		U	9.80		U	9.70		U	9.60		U
Total PCBs	µg/kg dw	130	3100	-	mg/kg/OC	**12**	**65**	9.6	0.69	U	9.6	0.40	U	9.8	0.36	U	**35.00**	**1.90**		9.80	0.39	U	9.70	0.35	U	9.60	0.42	U
Total PCBs	mg/kg OC	-	-	38				0.69			0.40			0.36			**1.90**			0.39			0.35			0.42		
Dioxin (TEQ: see Table 4 for congener specific results)	**ng/kg**							**3.22**			**11.83**			**3.86**			**6.34**			**10.48**			**10.6**			**7.23**		
Total Solids	%							63.4			45.6			40.4			45.2			34.8			32.8			43.5		
Total Volatile Solids	%							4.4			7			7.7			6.62			8.61			9.2			6.84		
Total Organic Carbon	%							1.4			2.4			2.7			1.84			2.49			2.8			2.23		
Total Ammonia	mg/kg							12.8			56.8			57.7			17.4			25			11.3			18.9		
Total Sulfides	mg/kg							2.2			22.6			571			368			5.32			3.46			8.33		
Gravel	%							0.1			0.1			0.1			0.2			0.1			0.1			0.4		
Sand	%							67.1			22.8			16.8			42.4			14.2			8.7			39.6		
Silt	%							22.8			53.5			57.5			40.5			59.3			63.9			42.7		
Clay	%							10.2			23.5			25.7			16.9			26.2			27.4			17.6		
Fines (percent silt + clay)	%							33.0			77.0			83.2			57.4			85.5			91.3			60.3		
Eohaustorius estuarius hits: (NH, 2H, 1H)																										NH		
Mytilus galloprovincialis hits: (NH, 2H, 1H)																										NH		
Neanthes arenaceodentata hits: (NH, 2H, 1H)																										NH		
Bioassay Determination: (Pass/Fail)								NA			NA			NA			NA			NA			NA			**PASS**		
BTs exceeded: Y/N											N			N			N			N			N			N		
Bioaccumulation conducted: Y/N								N			N			N			N			N			N			N		
Bioaccumulation Determination: (P/F)								NA			NA			NA			NA			NA			NA			NA		
ML Rule exceeded: Y/N								N			N			N			N			N			N			N		
PSDDA Determination: (Suitable/Unsuitable)								**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**		
DMMU Volume:	cy							60,000			60,000			60,000			60,000			60,000			60,000			60,000		
Rank (Low = L, Moderate = M, Low-Moderate =LM, High = H)								L			L			L			L			L			L			L		
Mean Grab sampling depth (cm)	cm							10			10			10			10			10			10			10		
DMMU ID:								**HO-C15**			**HO-C16**			**HO-C17**			**CP-C18**			**CP-C19**			**CP-C20**			**AB-C21**		

Legend:
VQ = Validation Qualifier
U = undetected at reporting limit
J = Estimated value, less than reporting limit, and/or QC parameter out of Control limits
NA = not analyzed
SL = screening level
BT = bioaccumulation trigger
ML = maximum level
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
DMMP = dredged material management program
DMMU = dredged material management unit
dw = dry weight
ww = wet weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
OC = organic carbon normalized
PCBs = polychlorinated biphenyls
RL = reporting limit
SVOCs = semi-volatile organic compounds
NH = No Hit; 2H = Two Hit Failure; 1H = One Hit Failure
BU = Suitable for Beneficial Use
Denotes DMMUs subject to Confirmatory Bioassay testing

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			AB-C22			AB-C23			SA-C24			SA-C25			SA-C26			SA-C27			SA-C28			Reference: GH-S7		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
								DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Metals								dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm		dry wgt	mg-oc-norm	
Antimony	mg/kg dw	150	200	-		--	--	20.00		U	**20.00**			10.00		U	20.00		U	10.0		U	20.0		U	20.0		U			
Arsenic	mg/kg dw	57	700	507.1	mg/kg	57	93	20.00		U	20.00		U	10.00		U	20.00		U	10.0		U	20.0		U	20.0		U			
Cadmium	mg/kg dw	5.1	14	11.3	mg/kg	5.1	6.7	0.60		U	0.60		U	0.60		U	**0.60**			0.4		U	0.7		U	0.7		U			
Chromium	mg/kg dw	-	-	267	mg/kg	260	270	**36.00**			29.00		U	**35.00**			**35.00**			**38.0**			**33.0**			**35.0**					
Copper	mg/kg dw	390	1300	1027	mg/kg	390	390	**51.40**			**42.30**			**47.00**			54.60		U	**57.9**			**48.7**			**48.8**					
Lead	mg/kg dw	450	1200	975	mg/kg	450	530	6.00		U	**6.00**			6.00		U	6.00		U	**6.0**			7.0		U	7.0		U			
Mercury	mg/kg dw	0.41	2.3	1.5	mg/kg	0.41	0.59	0.03		U	0.03		U	0.03		U	**0.02**			**0.06**			0.03		U	0.03		U			
Selenium	mg/kg dw	-	-	3	mg/kg	--	--	0.60		U	**0.60**			0.60		U	0.70		U	1.0		U	0.7		U	0.7		U			
Silver	mg/kg dw	6.1	8.4	6.1	mg/kg	6.1	6.1	1.00		U	1.00		U	0.90		U	**1.00**			0.7		U	1.0		U	1.0		U			
Zinc	mg/kg dw	410	3800	2783	mg/kg	410	960	**77.00**			64.00		U	**71.00**			**73.00**			**82.0**			**73.0**			**75.0**					
PAHs																															
Naphthalene	µg/kg dw	2100	2400	-	mg/kg-OC	99	170	19.00	1.30	U	**20.00**	**2.02**		19.00	1.79	U	19.00	0.67	UJ	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
2-Methylnaphthalene	µg/kg dw	670	1900	-	mg/kg-OC	38	64	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Acenaphthylene	µg/kg dw	560	1300	-	mg/kg-OC	66	66	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Acenaphthene	µg/kg dw	500	2000	-	mg/kg-OC	16	57	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Fluorene	µg/kg dw	540	3600	-	mg/kg-OC	23	79	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Phenanthrene	µg/kg dw	1500	21000	-	mg/kg-OC	100	480	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	**11.0**	**0.39**	J	**9.3**	**0.55**	J	19.0	1.27	U			
Anthracene	µg/kg dw	960	13000	-	mg/kg-OC	220	1200	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Total LPAHs	µg/kg dw	5200	29000	-	mg/kg-OC	370	780	19.00	1.30	U	**20.00**	**2.02**	J	19.00	1.79	U	19.00	0.67	U	**11.0**	**0.39**	J	**9.3**	**0.55**	J	19.0	1.27	U			
Fluoranthene	µg/kg dw	1700	30000	4600	mg/kg-OC	160	1200	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	**12.0**	**0.43**	J	**9.3**	**0.55**	J	19.0	1.27	U			
Pyrene	µg/kg dw	2600	16000	11980	mg/kg-OC	1000	1400	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	**12.0**	**0.43**	J	19.0	1.12	U	19.0	1.27	U			
Benzo(a)anthracene	µg/kg dw	1300	5100	-	mg/kg-OC	110	270	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	**19.00**	**0.67**	B	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Chrysene	µg/kg dw	1400	21000	-	mg/kg-OC	110	460	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Benzo(a)pyrene	µg/kg dw	1600	3600	-	mg/kg-OC	99	210	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Indeno(1,2,3-cd)pyrene	µg/kg dw	600	4400	-	mg/kg-OC	34	88	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Dibenzo(a,h)anthracene	µg/kg dw	230	1900	-	mg/kg-OC	12	33	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Benzo(g,h,i)perylene	µg/kg dw	670	3200	-	mg/kg-OC	31	78	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Total Benzofluoranthenes	µg/kg dw	3200	9900	-	mg/kg/OC	230	450	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	**19.00**	**0.67**	BJ	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Total HPAHs	µg/kg dw	12000	69000	-	mg/kg-OC	960	5300	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	**38.0**	**1.34**	BJ	**24.0**	**0.86**	J	19.0	1.12	U	19.0	1.27	U			
1,4-Dichlorobenzene	µg/kg dw	110	120	-	mg/kg-OC	3.1	9	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
1,2-Dichlorobenzene	µg/kg dw	35	110	-	mg/kg-OC	2.3	2.3	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
1,2,4-Trichlorobenzene	µg/kg dw	31	64	-	mg/kg-OC	0.81	1.8	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Hexachlorobenzene	µg/kg dw	22	230	168	mg/kg-OC	0.38	2.3	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Dimethyl phthalate	µg/kg dw	71	1400	-	mg/kg-OC	53	53	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Diethyl phthalate	µg/kg dw	200	1200	-	mg/kg-OC	61	110	48.00	3.29	U	49.00	4.95	U	46.00	4.34	U	46.00	1.62	U	48.0	1.71	U	47.0	2.76	U	48.0	3.20	U			
Di-n-butyl phthalate	µg/kg dw	-	-	-	mg/kg-OC	220	1700	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Butyl benzyl phthalate	µg/kg dw	63	970	-	mg/kg-OC	4.9	64	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Bis(2-ethylhexyl) phthalate	µg/kg dw	1300	8300	-	mg/kg-OC	47	78	24.00	1.64	U	26.00	2.63	U	23.00	2.17	U	27.00	0.95	U	**36.0**	**1.29**	B	23.0	1.35	U	**24.0**	**1.60**	B			
Di-n-octyl phthalate	µg/kg dw	6200	6200	-	mg/kg-OC	58	4500	19.00	1.30	U	**20.00**	**2.02**	B	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Phenol	µg/kg dw	420	1200		ug/kg	420	1200	19.00		U	20.00		U	19.00		U	19.00		U	**14.0**		J	19.0		U	19.0		U			
2-Methylphenol	µg/kg dw	63	77	-	ug/kg	63	63	19.00		U	20.00		U	19.00		U	19.00		U	19.0		U	19.0		U	19.0		U			
4-Methylphenol	µg/kg dw	670	3600	-	ug/kg	670	670	38.00		U	39.00		U	37.00		U	37.00		U	**14.0**		J	37.0		U	38.0		U			
2,4-Dimethylphenol	µg/kg dw	29	210	-	ug/kg	29	29	19.00		UJ	20.00		U	19.00		UJ				38.0		U	37.0		U	38.0		U			
Pentachlorophenol	µg/kg dw	400	690	504	ug/kg	360	690	190.00		U	200.00		UJ	190.00		U	190.00		U	190.0		U	190.0		U	190.0		U			
Benzyl Alcohol	µg/kg dw	57	870	-	ug/kg	57	73	19.00		U	20.00		U	19.00		U	19.00		U	**9.6**		J	19.0		U	19.0		U			
Benzoic Acid	µg/kg dw	650	760	-	ug/kg	650	650	380.00		U	390.00		U	370.00		U	370.00		U	380.0		U	370.0		U	380.0		U			
Dibenzofuran	µg/kg dw	540	1700	-	mg/kg-OC	15	58	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
N-Nitrosodiphenylamine	µg/kg dw	28	130	-	mg/kg-OC	11	11	19.00	1.30	U	20.00	2.02	U	19.00	1.79	U	19.00	0.67	U	19.0	0.68	U	19.0	1.12	U	19.0	1.27	U			
Hexachlorobutadiene	µg/kg dw	29	270	-	mg/kg-OC	3.9	6.2	0.47	0.03	U	0.48	0.05	U	0.48	0.05	U	0.48	0.02	U	0.5	0.02	U	0.5	0.03	U	0.5	0.03	U			
Heptachlor	µg/kg dw	1.5	-	-		--	--	0.47		U	0.48		U	0.48		U	0.48		U	0.5		U	0.5		U	0.5		U			
Aldrin	µg/kg dw	9.5	-	-		--	--	0.47		U	0.48		U	0.48		U	0.48		U	0.5		U	0.5		U	0.5		U			
Dieldrin	µg/kg dw	1.9	-	-		--	--	0.94		U	0.95		U	0.96		U	0.97		U	1.0		U	0.9		U	1.0		U			
4,4'-DDE	µg/kg dw	16	-	-		--	--	0.94		U	0.95		U	0.96		U	0.97		U	1.0		U	0.9		U	1.0		U			
4,4'-DDD	µg/kg dw	9	-	-		--	--	0.94		U	0.95		U	0.96		U	0.97		U	1.0		U	0.9		U	1.0		U			
4,4'-DDT	µg/kg dw	12	-	-		--	--	0.94		U	0.95		U	0.96		U	0.97		U	1.0		U	0.9		U	1.0		U			
Total DDT(sum of 4,4'-DDD, 4,4'-DDE & 4,4'-DDT)	µg/kg dw		69	50		--	--	0.94		U	0.95		U	0.96		U	0.97		U	1.0		U	0.9		U	1.0		U			
trans-Chlordane	µg/kg dw	-	-	-		--	--	0.47		U	0.48		U	0.48		U	0.48		U	0.5		U	0.5		U	0.5		U			
cis-Chlordane	µg/kg dw	-	-	-		--	--	0.47		U	0.48		U	0.48		U	0.48		U	0.5		U	0.5		U	0.5		U			
oxy Chlordane	µg/kg dw							1.90		U	1.90		U	1.90		U	1.90		U	1.9		U	1.8		U	1.9		U			
cis-Nonachlor	µg/kg dw							1.90		U	1.90		U	1.90		U	1.90		U	1.9		U	1.8		U	1.9		U			
trans-Nonachlor	µg/kg dw							1.90		U	1.90		U	1.90		U	1.90		U	1.9		U	1.8		U	1.9		U			
Total chlordane	µg/kg dw	2.8	-	37		--	--	1.90		U	1.90		U	1.90		U	1.90		U	1.9		U	1.8		U	1.9		U			

Table 4. DMMP Characterization Results Summary for USACE Grays Harbor Navigation Project - DY2012 Characterization

Chemical Name	DMMP Guidelines				SMS Guidelines			AB-C22			AB-C23			SA-C24			SA-C25			SA-C26			SA-C27			SA-C28			Reference: GH-S7		
	Unit	SL	ML	BT	Unit	SQS	CSL	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ	Result	Result	VQ
Aroclor 1016	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1242	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1248	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1254	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1260	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1221	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1232	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1262	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Aroclor 1268	µg/kg dw	-	-	-		--	--	9.50		U	9.50		U	9.60		U	9.60		U	9.9		U	9.8		U	9.6		U			
Total PCBs	µg/kg dw	130	3100	-	mg/kg/OC	**12**	**65**	9.50	0.65	U	9.50	0.96	U	9.60	0.91	U	9.60	0.34	U	9.9	0.35	U	9.8	0.58	U	9.6	0.64	U			
Total PCBs	mg/kg OC	-	-	38				0.65			0.96			0.91			0.34			0.35			0.58			0.64					
Dioxin (TEQ: see Table 4 for congener specific results)	**ng/kg**							**1.58**			**0.84**			**1.37**			**1.35**			**7.76**			**1.21**			**1.26**			**4.03**		
Total Solids	%							76			71.3			77.9			71.7			42.5			67.6			71.1			38.8		
Total Volatile Solids	%							2.99			2.41			3.51			3.05			6.5			3			2.7			8.12		
Total Organic Carbon	%							1.46			0.99			1.06			2.84			2.8			1.7			1.5			2.26		
Total Ammonia	mg/kg							2.47			1.05			1.58			2.67			18.6			5.9			2.5			65.2		
Total Sulfides	mg/kg							55.3			1.27			1.32			2.92			3.6			1.5			1.6			2270		
Gravel	%							3.5			9.6			25.3			38.3			0.1			0.6			4.8			0.2		
Sand	%							88.2			86.5			70.0			49.2			40.2			87.1			89.2			12.3		
Silt	%							4.9			15.2			2.5			8.0			40.5			7.3			3.4			60.2		
Clay	%							3.5			11.4			2.2			4.5			19.0			4.9			2.6			27.4		
Fines (percent silt + clay)	%							8.4			26.6			4.7			12.5			59.5			12.2			6.0			87.5		
Eohaustorius estuarius hits: (NH, 2H, 1H)																															
Mytilus galloprovincialis hits: (NH, 2H, 1H)																															
Neanthes arenaceodentata hits: (NH, 2H, 1H)																															
Bioassay Determination: (Pass/Fail)								NA			NA			NA			NA			NA			NA			NA					
BTs exceeded: Y/N											N			N			N			N			N			N					
Bioaccumulation conducted: Y/N								N			N			N			N			N			N			N					
Bioaccumulation Determination: (P/F)								NA			NA			NA			NA			NA			NA			NA					
ML Rule exceeded: Y/N								N			N			N			N			N			N			N					
PSDDA Determination: (Suitable/Unsuitable)								**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**			**Suitable**					
DMMU Volume:	cy							60,000			60,000			60,000			60,000			60,000			60,000			60,000					
Rank (Low = L, Moderate = M, Low-Moderate =LM, High = H)								L			L			L			L			L			L			L			L		
Mean Grab sampling depth (cm)	cm							10			10			10			10			10			10			10			10		
DMMU ID:								**AB-C22**			**AB-C23**			**SA-C24**			**SA-C25**			**SA-C26**			**SA-C27**			**SA-C28**			**Reference: GH-S7**		

Legend:
VQ = Validation Qualifier
U = undetected at reporting limit
J = Estimated value, less than reporting limit, and/or QC parameter out of Control limits
NA = not analyzed
SL = screening level
BT = bioaccumulation trigger
ML = maximum level
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
DMMP = dredged material management program
DMMU = dredged material management unit
dw = dry weight
ww = wet weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
OC = organic carbon normalized
PCBs = polychlorinated biphenyls
RL = reporting limit
SVOCs = semi-volatile organic compounds
NH = No Hit; 2H = Two Hit Failure; 1H = One Hit Failure
BU = Suitable for Beneficial Use
Denotes DMMUs subject to Confirmatory Bioassay testing

Table 5. Dioxin/furan Summary for USACE Grays Harbor Navigation DY2012 DMMP Characterization

Analyte	WHO (05) TEF	XR-C1			XR-C2			XR-C3			XR-C4			XR-C5			XR-C6			NC-C7			NC-C8		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.33	U	0.165	0.43	U	0.215	0.618	U	0.309	0.443	U	0.2215	0.487	U	0.2435	1.23	J	1.23	0.301	U	0.1505	1.29		1.29
1,2,3,7,8-PeCDD	1	0.44	J	0.44	0.51	U	0.255	0.814	J	0.814	0.536	J	0.536	0.691	J	0.691	1.5	J	1.5	0.354	J	0.354	1.57		1.57
1,2,3,4,7,8-HxCDD	0.1	0.15	U	0.0075	0.18	U	0.009	0.149	U	0.00745	0.116	U	0.0058	0.125	U	0.00625	0.313	U	0.01565	0.0899	U	0.00070347	0.334	J	0.0334
1,2,3,6,7,8-HxCDD	0.1	0.55	J	0.055	0.56	J	0.056	0.562	U	0.0281	0.444	J	0.0444	0.651	J	0.0651	1.37	J	0.137	0.342	J	0.0342	1.14	J	0.114
1,2,3,7,8,9-HxCDD	0.1	1.15	J	0.115	1.22	J	0.122	1.84	J	0.184	1.19	J	0.119	1.29	J	0.129	3.11	J	0.311	0.688	J	0.0688	3.45		0.345
1,2,3,4,6,7,8-HpCDD	0.01	6.4		0.064	6.34		0.0634	7.72		0.0772	5.24		0.0524	8.1		0.081	15.3	J	0.153	3.24		0.0324	11		0.11
OCDD	0.0003	33.3		0.00999	37.6		0.01128	52		0.0156	30.6		0.00918	46.8		0.01404	94.6	J	0.02838	19.9		0.00597	59.6		0.01788
2,3,7,8-TCDF	0.1	0.25	U	0.0125	0.26	U	0.013	0.194	J	0.0194	0.251	J	0.0251	0.293	J	0.0293	0.513	J	0.0513	0.176	U	0.0045144	0.187	U	0.00935
1,2,3,7,8-PeCDF	0.03	0.06	U	0.0009	0.04	U	0.0006	0.0514	U	0.000771	0.0252	U	0.000378	0.067	J	0.00201	0.0978	U	0.001467	0.0156	U	1.1443E-05	0.0398	U	0.000597
2,3,4,7,8-PeCDF	0.3	0.11	U	0.0165	0.09	U	0.0135	0.0968	U	0.01452	0.0839	U	0.012585	0.131	U	0.01965	0.222	U	0.0333	0.0762	U	0.00126873	0.0815	U	0.012225
1,2,3,4,7,8-HxCDF	0.1	0.15	J	0.015	0.08	U	0.004	0.124	U	0.0062	0.0964	U	0.00482	0.158	J	0.0158	0.337	J	0.0337	0.0411	U	0.00069254	0.133	J	0.0133
1,2,3,6,7,8-HxCDF	0.1	0.12	J	0.012	0.08	U	0.004	0.112	J	0.0112	0.0813	U	0.004065	0.12	U	0.006	0.25	J	0.025	0.043	U	0.0005375	0.0915	U	0.004575
2,3,4,6,7,8-HxCDF	0.1	0.13	J	0.013	0.07	U	0.0035	0.0964	J	0.00964	0.0829	U	0.004145	0.161	J	0.0161	0.405	J	0.0405	0.0841	J	0.00841	0.177	J	0.0177
1,2,3,7,8,9-HxCDF	0.1	0.04	U	0.002	0.04	U	0.002	0.0397	U	0.001985	0.0477	U	0.002385	0.0463	U	0.002315	0.0898	U	0.00449	0.0395	U	8.8678E-05	0.0517	J	0.00517
1,2,3,4,6,7,8-HpCDF	0.01	2.17		0.0217	2.55		0.0255	2.58		0.0258	1.89	J	0.0189	3.69		0.0369	7.01	J	0.0701	1.54	J	0.0154	2.97		0.0297
1,2,3,4,7,8,9-HpCDF	0.01	0.06	U	0.0003	0.09	J	0.0009	0.0865	U	0.0004325	0.0678	U	0.000339	0.0759	U	0.0003795	0.18	U	0.0009	0.0332	U	0.00001494	0.109	U	0.000545
OCDF	0.0003	2.24	J	0.000672	2.59	J	0.000777	4.36	J	0.001308	2.49	J	0.000747	4.02	J	0.001206	7.73	J	0.002319	1.42	J	0.000426	4.83	J	0.001449
Total TEQ (u = 1/2):				0.95			0.80			1.53			1.06			1.36			3.64			0.68			3.57
Total TEQ (u=0):				0.75			0.28			1.16			0.81			1.08			3.58			0.52			3.55
TOC (%)				5.0			8.8			1.4			2.0			1.5			1.2			0.8			1.8

Legend:
LQ = laboratory qualifier
U = undetected at reporting limit
J = Estimated value, less than reporting limit, and/or QC parameter out of Control limits
XR = Crossover Reach
NC = North Channel
HO = Hoquium Channel
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SA = South Aberdeen

Table 5. Dioxin/furan Summary for USACE Grays Harbor Navigation DY2012 DMMP Characterization

Analyte	WHO (05) TEF	NC-C9			NC-C10			NC-C11			HO-C12			HO-C13			HO-C14			HO-C15			HO-C16		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	1.06		1.06	1.63		1.63	0.97	J	0.97	0.96	U	0.48	1.35	U	0.675	1.48	U	0.74	1.07		1.07	4.14		4.14
1,2,3,7,8-PeCDD	1	1.2		1.2	1.89		1.89	0.928	J	0.928	1.05	U	0.525	1.81		1.81	1.98		1.98	1.21		1.21	5.34		5.34
1,2,3,4,7,8-HxCDD	0.1	0.302	J	0.0302	0.555	J	0.0555	0.173	U	0.00865	0.3	U	0.015	0.48	J	0.048	0.71	J	0.071	0.405	U	0.02025	1.01	J	0.101
1,2,3,6,7,8-HxCDD	0.1	0.899	J	0.0899	1.47	U	0.0735	0.807	J	0.0807	0.91	U	0.0455	1.82	J	0.182	2.29		0.229	1.47	J	0.147	3.37		0.337
1,2,3,7,8,9-HxCDD	0.1	2.4		0.24	4.93		0.493	2.02		0.202	2.54		0.254	4.03		0.403	5.51		0.551	3.35		0.335	12.8		1.28
1,2,3,4,6,7,8-HpCDD	0.01	10.8		0.108	17		0.17	8.19		0.0819	10.4		0.104	18.7		0.187	26.7		0.267	15.7		0.157	34.9		0.349
OCDD	0.0003	66.8		0.02004	96.8		0.02904	49.7		0.01491	61.7		0.01851	114		0.0342	196		0.0588	96.9		0.02907	214		0.0642
2,3,7,8-TCDF	0.1	0.29	J	0.029	0.335	J	0.0335	0.227	U	0.01135	0.34	J	0.034	0.33	U	0.0165	0.68	J	0.068	0.464	J	0.0464	0.388	J	0.0388
1,2,3,7,8-PeCDF	0.03	0.112	J	0.00336	0.0912	U	0.001368	0.112	U	0.00168	0.07	U	0.00105	0.11	U	0.00165	0.15	U	0.00225	0.103	J	0.00309	0.134	U	0.00201
2,3,4,7,8-PeCDF	0.3	0.0519	U	0.007785	0.168	U	0.0252	0.129	U	0.01935	0.13	J	0.039	0.21	U	0.0315	0.25	J	0.075	0.178	J	0.0534	0.226	J	0.0678
1,2,3,4,7,8-HxCDF	0.1	0.144	U	0.0072	0.234	U	0.0117	0.189	U	0.00945	0.13	U	0.0065	0.3	U	0.015	0.42	U	0.021	0.318	J	0.0318	0.284	U	0.0142
1,2,3,6,7,8-HxCDF	0.1	0.152	U	0.0076	0.174	U	0.0087	0.151	J	0.0151	0.12	U	0.006	0.28	J	0.028	0.33	U	0.0165	0.259	J	0.0259	0.202	U	0.0101
2,3,4,6,7,8-HxCDF	0.1	0.226	J	0.0226	0.299	U	0.01495	0.175	J	0.0175	0.05	U	0.0025	0.33	J	0.033	0.49	J	0.049	0.338	U	0.0169	0.0795	U	0.003975
1,2,3,7,8,9-HxCDF	0.1	0.0751	U	0.003755	0.0278	U	0.00139	0.0526	U	0.00263	0.05	U	0.0025	0.09	U	0.0045	0.06	U	0.003	0.053	U	0.00265	0.0574	U	0.00287
1,2,3,4,6,7,8-HpCDF	0.01	4.14		0.0414	5.54		0.0554	3.54		0.0354	3.9		0.039	13.3		0.133	9.83		0.0983	6.93		0.0693	7.11		0.0711
1,2,3,4,7,8,9-HpCDF	0.01	0.182	U	0.00091	0.208	J	0.00208	0.0996	U	0.000498	0.07	U	0.00035	0.33	U	0.00165	0.35	U	0.00175	0.259	J	0.00259	0.412	J	0.00412
OCDF	0.0003	5.51		0.001653	7.45		0.002235	3.83	J	0.001149	4.95	U	0.0007425	12.2		0.00366	14.2		0.00426	8.7		0.00261	22.3		0.00669
Total TEQ (u = 1/2):				2.87			4.50			2.40			1.57			3.61			4.24			3.22			11.83
Total TEQ (u=0):				2.85			4.36			2.35			0.49			2.86			3.45			3.18			11.80
TOC (%)				1.6			1.7			1.2			1.3			1.5			1.8			1.4			2.4

Legend:
LQ = laboratory qualifier
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XR = Crossover Reach
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Table 5. Dioxin/furan Summary for USACE Grays Harbor Navigation DY2012 DMMP Characterization

Analyte	WHO (05) TEF	HO-C17			CP-C18			CP-C19			CP-C20			AB-C21			AB-C22			AB-C23		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	1.23		1.23	1.89		1.89	3.13		3.13	3.03		3.03	2.22		2.22	0.63	U	0.315	0.33	U	0.165
1,2,3,7,8-PeCDD	1	1.58		1.58	2.59		2.59	4.07		4.07	4.15		4.15	2.82		2.82	0.8		0.8	0.42	J	0.42
1,2,3,4,7,8-HxCDD	0.1	0.442	J	0.0442	0.64	U	0.032	1.33	J	0.133	1.25	J	0.125	0.94	J	0.094	0.27	U	0.0135	0.14	U	0.007
1,2,3,6,7,8-HxCDD	0.1	1.62	J	0.162	2.74		0.274	4.56		0.456	4.74		0.474	2.95		0.295	0.66	J	0.066	0.48	U	0.024
1,2,3,7,8,9-HxCDD	0.1	3.73		0.373	6.31		0.631	10.1		1.01	10.5		1.05	7.36		0.736	1.68	J	0.168	0.95	J	0.095
1,2,3,4,6,7,8-HpCDD	0.01	17.8		0.178	34.5		0.345	63.3		0.633	64.9		0.649	38.2		0.382	6.34		0.0634	6.64		0.0664
OCDD	0.0003	117		0.0351	224		0.0672	469		0.1407	428		0.1284	245		0.0735	36.7		0.01101	36.2		0.01086
2,3,7,8-TCDF	0.1	0.577	J	0.0577	0.8	J	0.08	1.49		0.149	1.54		0.154	0.92	J	0.092	0.18	J	0.018	0.08	J	0.008
1,2,3,7,8-PeCDF	0.03	0.12	J	0.0036	0.23	J	0.0069	0.36	J	0.0108	0.4	U	0.006	0.26	U	0.0039	0.17	J	0.0051	0.05	U	0.00075
2,3,4,7,8-PeCDF	0.3	0.198	U	0.0297	0.31	J	0.093	0.52	J	0.156	0.61	J	0.183	0.349	J	0.1047	0.16	U	0.024	0.05	U	0.0075
1,2,3,4,7,8-HxCDF	0.1	0.374	J	0.0374	0.6	J	0.06	0.99	J	0.099	1.31	J	0.131	0.72	J	0.072	0.21	J	0.021	0.13	J	0.013
1,2,3,6,7,8-HxCDF	0.1	0.29	J	0.029	0.45	J	0.045	0.88	J	0.088	0.89	J	0.089	0.58	J	0.058	0.22	J	0.022	0.04	U	0.002
2,3,4,6,7,8-HxCDF	0.1	0.37	U	0.0185	0.67	J	0.067	1.15	J	0.115	1.27	J	0.127	0.79	J	0.079	0.22	U	0.011	0.05	U	0.0025
1,2,3,7,8,9-HxCDF	0.1	0.102	U	0.0051	0.14	U	0.007	0.26	U	0.013	0.36	U	0.018	0.341	J	0.0341	0.18	J	0.018	0.03	J	0.003
1,2,3,4,6,7,8-HpCDF	0.01	7.65		0.0765	13.7		0.137	25.7		0.257	26.2		0.262	14.8		0.148	2.02		0.0202	1.15	J	0.0115
1,2,3,4,7,8,9-HpCDF	0.01	0.3	U	0.0015	0.56	J	0.0056	0.96	J	0.0096	1.02	J	0.0102	0.73	J	0.0073	0.3	J	0.003	0.07	J	0.007
OCDF	0.0003	8.39		0.002517	21		0.0063	42.2		0.01266	37.8		0.01134	20.8		0.00624	3.96	J	0.001188	1.01	U	0.0001515
Total TEQ (u = 1/2):				3.86			6.34			10.48			10.60			7.23			1.58			0.84
Total TEQ (u=0):				3.81			6.30			10.47			10.57			7.22			1.22			0.63
TOC (%)				2.7			1.8			2.5			2.8			2.2			1.5			1.0

Legend:
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Table 5. Dioxin/furan Summary for USACE Grays Harbor Navigation DY2012 DMMP Characterization

Analyte	WHO (05) TEF	SA-C24			SA-C25			SA-C26			SA-C27			SA-C28			Reference: GH-S7		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	**0.489**	J	**0.489**	0.478	U	0.239	**2.67**		**2.67**	0.657	U	0.3285	0.509	U	0.2545	**1.01**		**1.01**
1,2,3,7,8-PeCDD	1	**0.58**	J	**0.58**	**0.71**	J	**0.71**	**3.04**		**3.04**	0.77	U	0.385	**0.747**	J	**0.747**	**1.72**		**1.72**
1,2,3,4,7,8-HxCDD	0.1	**0.12**	J	**0.012**	**0.18**	J	**0.018**	**0.804**	J	**0.0804**	**0.247**	J	**0.0247**	0.092	U	0.0046	0.634	U	0.0317
1,2,3,6,7,8-HxCDD	0.1	**0.48**	J	**0.048**	**0.6**	J	**0.06**	**2.8**		**0.28**	**0.788**	J	**0.0788**	0.461	U	0.02305	**1.81**	J	**0.181**
1,2,3,7,8,9-HxCDD	0.1	**1.27**	J	**0.127**	**1.56**	J	**0.156**	**7.18**		**0.718**	**2.1**		**0.21**	**1.24**	J	**0.124**	**3.62**		**0.362**
1,2,3,4,6,7,8-HpCDD	0.01	**4.47**		**0.0447**	**6.75**		**0.0675**	**35.3**		**0.353**	**7.79**		**0.0779**	**4.97**		**0.0497**	**21**		**0.21**
OCDD	0.0003	**26.2**		**0.00786**	**39.1**		**0.01173**	**240**		**0.072**	**44**		**0.0132**	**28.2**	J	**0.00846**	**115**		**0.0345**
2,3,7,8-TCDF	0.1	0.139	U	0.00695	**0.162**	J	**0.0162**	**0.774**	J	**0.0774**	0.189	U	0.00945	0.119	U	0.00595	**0.836**	J	**0.0836**
1,2,3,7,8-PeCDF	0.03	0.0451	U	0.0006765	0.0526	U	0.000789	**0.242**	J	**0.00726**	0.0498	U	0.000747	0.0614	U	0.000921	0.442	U	0.0001989
2,3,4,7,8-PeCDF	0.3	**0.0824**	J	**0.02472**	**0.09**	U	0.0135	**0.354**	J	**0.1062**	0.119	U	0.01785	0.0475	U	0.007125	**0.466**	J	**0.1398**
1,2,3,4,7,8-HxCDF	0.1	**0.0726**	J	**0.00726**	**0.121**	J	**0.0121**	**0.672**	J	**0.0672**	**0.111**	J	**0.0111**	0.103	U	0.00515	**0.588**	J	**0.0588**
1,2,3,6,7,8-HxCDF	0.1	**0.0608**	J	**0.00608**	0.0877	U	0.004385	**0.488**	J	**0.0488**	**0.0915**	J	**0.00915**	0.098	U	0.0049	**0.499**	J	**0.0499**
2,3,4,6,7,8-HxCDF	0.1	0.0707	U	0.003535	**0.17**	J	**0.017**	**0.706**	J	**0.0706**	**0.135**	J	**0.0135**	0.104	U	0.0052	**0.607**	J	**0.0607**
1,2,3,7,8,9-HxCDF	0.1	0.03	U	0.0015	0.0448	U	0.00224	**0.226**	J	**0.0226**	0.0378	U	0.00189	0.138	U	0.0069	0.266	U	0.0133
1,2,3,4,6,7,8-HpCDF	0.01	**1.3**	J	**0.013**	**2.08**	J	**0.0208**	**13.3**		**0.133**	**2.47**		**0.0247**	**1.37**	J	**0.0137**	**7.27**		**0.0727**
1,2,3,4,7,8,9-HpCDF	0.01	0.06	U	0.0003	**0.0955**	J	**0.000955**	**0.49**	J	**0.0049**	0.14	U	0.0007	0.0934	U	0.000467	**0.374**	J	**0.00374**
OCDF	0.0003	**1.68**	J	**0.000504**	**2.65**		**0.000795**	**19.7**		**0.00591**	**3.05**	J	**0.000915**	1.9	U	0.000285	**8.76**		**0.002628**
Total TEQ (u = 1/2):				**1.37**			**1.35**			**7.76**			**1.21**			**1.26**			**4.03**
Total TEQ (u=0):				**1.36**			**1.09**			**7.76**			**0.46**			**0.94**			**3.99**
TOC (%)				**1.1**			**2.8**			**2.8**			**1.7**			**1.5**			**2.26**

Mean (U = 1/2): 3.63
Mean (U = 0): 3.39

Legend:
LQ = laboratory qualifier
U = undetected at reporting limit
J = Estimated value, less than reporting limit, and/o
XR = Crossover Reach
NC = North Channel
HO = Hoquium Channel
CP = Cow Point Reach
AB = Aberdeen Reach
SA = South Aberdeen

Table 6. Biological (confirmatory testing) History – Grays Harbor O&M.

Date	Crossover	North Channel	Hoquiam	Cow Point	Aberdeen	S. Aberdeen
1992				2		
1994			2			
1996				2		
1998	1					1
2001				1		1
2005				1	1	
2008		1	1			
2009					1	1
2011			1	1		
2012*		1			1	
Totals:	**1**	**2**	**4**	**7**	**3**	**3**

*Current characterization

15. Grays Harbor disposal sites are dispersive sites, which under DMMP guidelines require more conservative bioassay data interpretation than non-dispersive sites, due to the inability to monitor disposed dredged material over time.

16. Protocol Adjustments. The Corps chose to evaluate protocol adjustments to the sediment larval bioassay and the *Neanthes* growth bioassay by running side-by-side tests with project sediments. The DMMP recommended this step to evaluate methods to reduce false positive responses. Protocol adjustments (SMARM 2010) were:

    Bivalve Larval Development test: The sediment larval bioassay was terminated by two different methods, with data from both methods being reported. The first method was the usual PSEP termination procedure of decanting and subsampling the overlying test water with no agitation. The second termination procedure ("resuspension") specifies agitation of overlying water and sediment, with subsequent settling for approximately 24 hours prior to decanting and subsampling the overlying test water.

    Neanthes Growth test: The *Neanthes* growth bioassay breakdown procedure was modified as follows: after recording dry weight of worms at the end of the test period, the dried material was subjected to oxidation in a muffle oven to determine the ash free dry weight (AFDW). Both dry weight and AFDW were reported in the final report.

17. Bioassay Test Performance. Negative control and reference sediments met DMMP performance criteria for both the larval and amphipod tests (Table 7). For the *Neanthes* growth test, the mortality performance standard was met for both the control and reference sediments, as was the mean individual growth (MIG) rate performance standard for the negative control. The reference sample failed to meet the mean individual growth rate standard relative to control with the standard protocol, but met the standard with the AFDW protocol adjustment. The DMMP agencies accepted the AFDW protocol adjustment as valid for evaluating the *Neanthes* reference sediment performance using best professional judgment (BPJ).

Table 7. Bioassay Test Performance Summary

Bioassay		Negative Control Performance	Reference Sediment Performance
Amphipod Mortality: (*Eohaustorius estuarius*)	Standard	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$
	Actual	$M_C = 0\%$	$M_R - M_C = 1.8\%$
Bivalve Larval: (*Mytilus galloprovincialis*)	Standard	$M_R - M_C \geq 70\%$	$N_R/N_C \geq 0.65\%$
	Actual	$M_R - M_C = 91.7\%$	$N_R/N_C = 0.926\%$
Juvenile Neanthes Growth: (*Neanthes arenaceodenta*)	Standard	$M_C \leq 10\%$; $MIG_C \geq 0.38$	$M_R < 20\%$ & $MIG_R/MIG_C > 0.80\%$
	Actual	$M_C = 0\%$; $MIG_C = 0.66$	$M_R = 0\%$; $MIG_R/MIG_C = 0.72\%$ AFDW = 0.91%

M = mortality, N = normal larvae, MIG = mean individual growth rate mg/individual/day), AFDW = ash free dry weight
Subscripts: R = reference sediment, C = negative control

Table 8. Amphipod 10-day Mortality Bioassay*.

Station	% Fines	% Clay	Amphipod (*E. estuarius*) Mortality (%)		DMMP Pass/Fail (dispersive guidelines)
			Mean	sd	
Control	--	--	**0.0**	**0**	**n/a**
Reference: GH-S7	**87.5**	**27.4**	**1.8**	**0.8**	**n/a**
NC10	**39.2**	**13.8**	**1.0**	**1.2**	**Pass**
AB21	**60.3**	**17.6**	**0.0**	**0**	**Pass**

***$M_T - M_C > 20\%$;** and **M_T vs N_RSS ($p = 0.05$)**, and **$M_T - M_R > 10\%$**
n/a = not applicable, R = reference sediment, C = negative control sediment, T = test sediment;
SS = statistically significant

Reference toxicant: Ammonium Chloride, 96 hr survival (EC/LC50): 183 mg NH_3-N/L;
Lab Historical Control Range (Mean ± 2SD): 44.9 – 297 mg NH_3-N/L

Table 9. Bivalve Larval Bioassay Results Summary*

Station	% Fines	% Clay	Sediment Larval (*M. galloprovincialis*) NCMA (%)		Re-suspension (*M. galloprovincialis*) NCMA (%)		DMMP Pass/Fail*
			Mean	sd	Mean	sd	
Control	--	--	**0.0**	**8.9**	**0.0**	**4.5**	**n/a**
Reference: GHS7	**87.5**	**27.4**	**7.4**	**5.4**	**8.2**	**4.6**	**n/a**
NC10	**39.2**	**13.8**	**1.2**	**8.8**	**2.6**	**4.6**	**Pass**
AB21	**60.3**	**17.6**	**0.6**	**6.2**	**8.3**	**5.7**	**Pass**

* **$N_T \div N_C < 0.80$**, and **N_T/N_C vs. N_R/N_C SS ($p = 0.10$)**, and **$N_R/N_C - N_T/N_C > 0.15$**
Dispersive Guidelines; NCMA =normalized combined percent mortality; n/a = not applicable,
R = reference sediment, C = negative control, T = test sediment, N = normal larvae,
SS = statistically significant

Reference toxicant: Copper Sulfate Normality (EC/LC50): 10.8 µg/L;
Lab Historical Control Range (mean ± 2SD): 9.42 – 12.3 µg/L

Table 10. *Neanthes* Juvenile Growth Bioassay Summary*.

Station	% Fines	% Clay	% Mortality	Conventional Protocol (Dry weight)				Test Protocol (Ash-Free-Dry Wgt.)				DMMP Pass/Fail*
				MIG (mg/ind/day)		MIG % of Cont.	MIG % of Ref.	MIG (mg/ind/day)		MIG % of Cont.	MIG % of Ref.	
				Mean	Sd			Mean	Sd			
Control	--	--	0	0.99	0.11	--	--	0.66	0.08	--	--	n/a
Reference: GHS7	87.5	27.4	0	0.71	0.11	0.72	--	0.60	0.09	0.91	--	n/a
NC10	39.2	13.8	0	0.68	0.12	0.69	0.96	0.56	0.11	0.85	0.93	Pass
AB21	60.3	17.6	0	0.62	0.09	0.63	0.87	0.53	0.07	0.80	0.88	Pass

* $MIG_T \div MIG_C < 0.80$, and MIG_T vs. MIG_R SS ($p = 0.05$), and $MIG_T/MIG_R < 0.70$
Dispersive Guidelines; n/a = not applicable, MIG = mean individual growth rate (mg/ind/day), R = reference sediment, C = negative control, T = test sediment, SS = statistically significant

Reference toxicant: Ammonium Chloride, 96 hr survival (EC/LC_{50}): 242 mg NH_3-N/L; Lab Historical Control Range (mean ± 2SD): 137-273 mg NH_3-N/L

18. Bioassay Testing Results. The amphipod (Table 8) and bivalve larval (Table 9) bioassays both passed dispersive guidelines with no hits in comparison to reference sediment and negative control. The resuspension protocol for the bivalve larval test did not appreciably alter the test results, and both sets of results passed DMMP dispersive guidelines. The *Neanthes* results are displayed in Table 10. Comparison of test results with reference sediment using the AFDW protocol adjustment indicate the *Neanthes* results pass the DMMP dispersive guidelines compared to both reference sediments and control sediments.

19. Past problems with the *Neanthes* reference sediment not meeting performance standards using the standard protocol has been an issue over multiple years of testing of material for the federal project in Grays Harbor. Application of the AFDW protocol adjustment appears to remedy the reference performance problem, which is the result of differential retention of control and reference sediments in the guts of exposed worms. In this case, the control sediment generally contained much coarser grain sizes compared to the reference sediment.

20. Suitability for Unconfined Open-Water Disposal and Beneficial Use. In summary, the testing results for the 28 DMMUs (including all DMMP COCs and dioxins/furans), and after comparison to DMMP and SMS guidelines, and confirmatory toxicity testing of two DMMUs, indicate that all 1.65 million cubic yards of material characterized is suitable for open-water disposal at the South Jetty and Point Chehalis dispersive sites. Based on agency best professional judgment regarding acceptable dioxin concentrations in beneficial use material, only exclusionary material from the Outer Reaches (including Bar, Entrance, Point Chehalis, and South Reaches), and material from the first five DMMU's from Crossover Reach (XR-C1 through XR-C5) may be used at approved beneficial use (nearshore and onshore) sites.

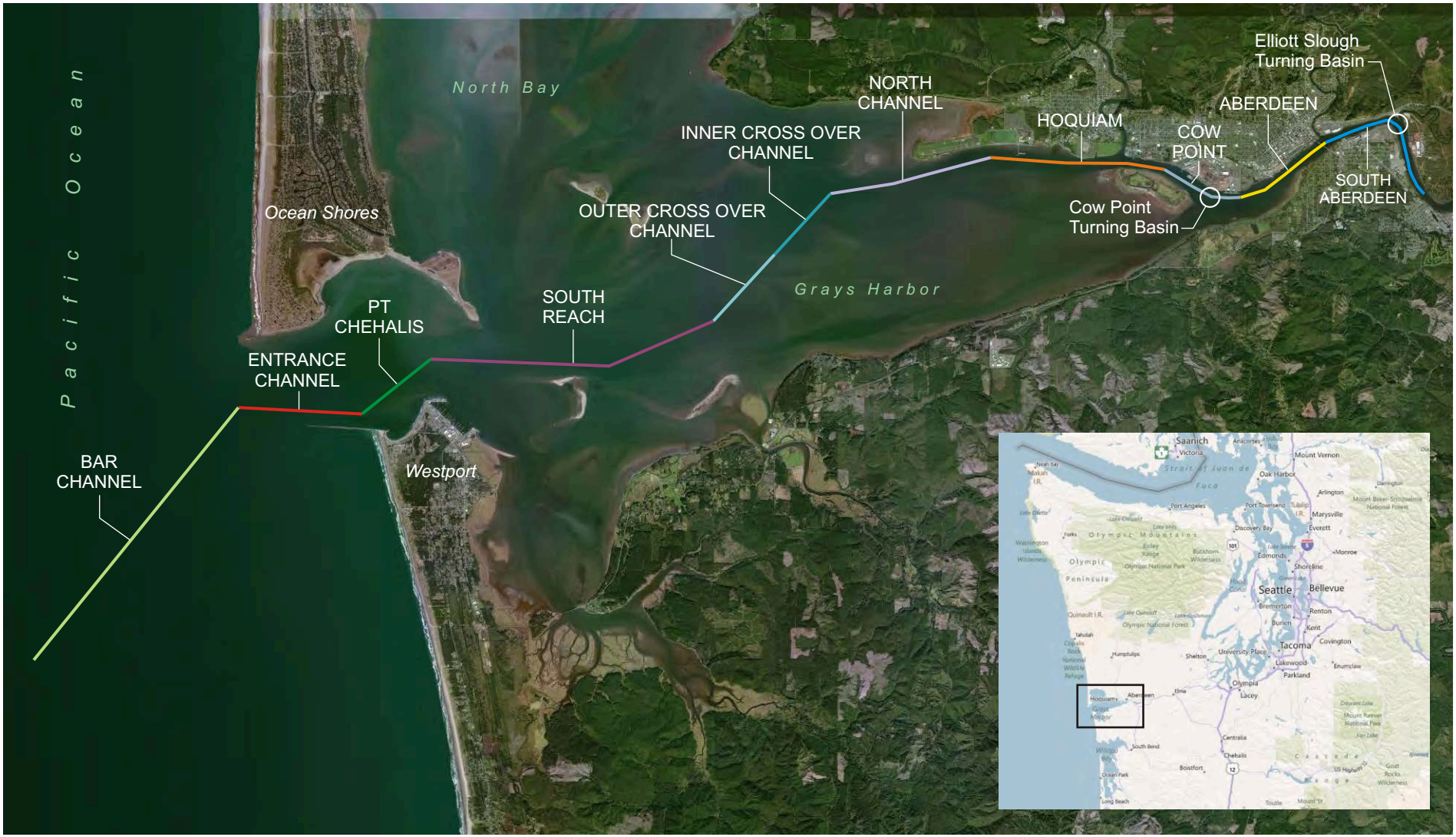
21. This memorandum documents the suitability determination for the characterized dredged material at the Grays Harbor O&M project for unconfined open-water disposal at Grays Harbor dispersive disposal sites and at appropriate beneficial use locations. However, this suitability determination does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under Section 404(b)(1) of the Clean Water Act.

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATION AND MAINTENANCE DREDGED MATERIAL FROM GRAYS HARBOR, WASHINGTON (PN: CENWS-OD-TS-NS-38) EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT, FOR OPEN-WATER DISPOSAL AT THE SOUTH JETTY AND POINT CHEHALIS DISPERSIVE DISPOSAL SITES, AND AT THE SOUTH BEACH AND HALF MOON BAY BENEFICIAL USE SITES.

Concur: Signed SDM on file in DMMO project file

Date	David R. Kendall, Ph.D., Seattle District Corps of Engineers
Date	Justine Barton, Environmental Protection Agency
Date	Laura Inouye, Ph.D., Washington Department of Ecology
Date	Celia Barton, Washington Department of Natural Resources

Copied furnished:
John Hicks, Chief of Navigation
Elizabeth Chien, Navigation Project Manager
Justine Barton, EPA
Laura Inouye, Ph.D. Department of Ecology
Celia Barton, DNR
DMMO file



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Grays Harbor Maintenance Dredging Characterization

Figure 1. Grays Harbor Federal Navigation Channel Reaches

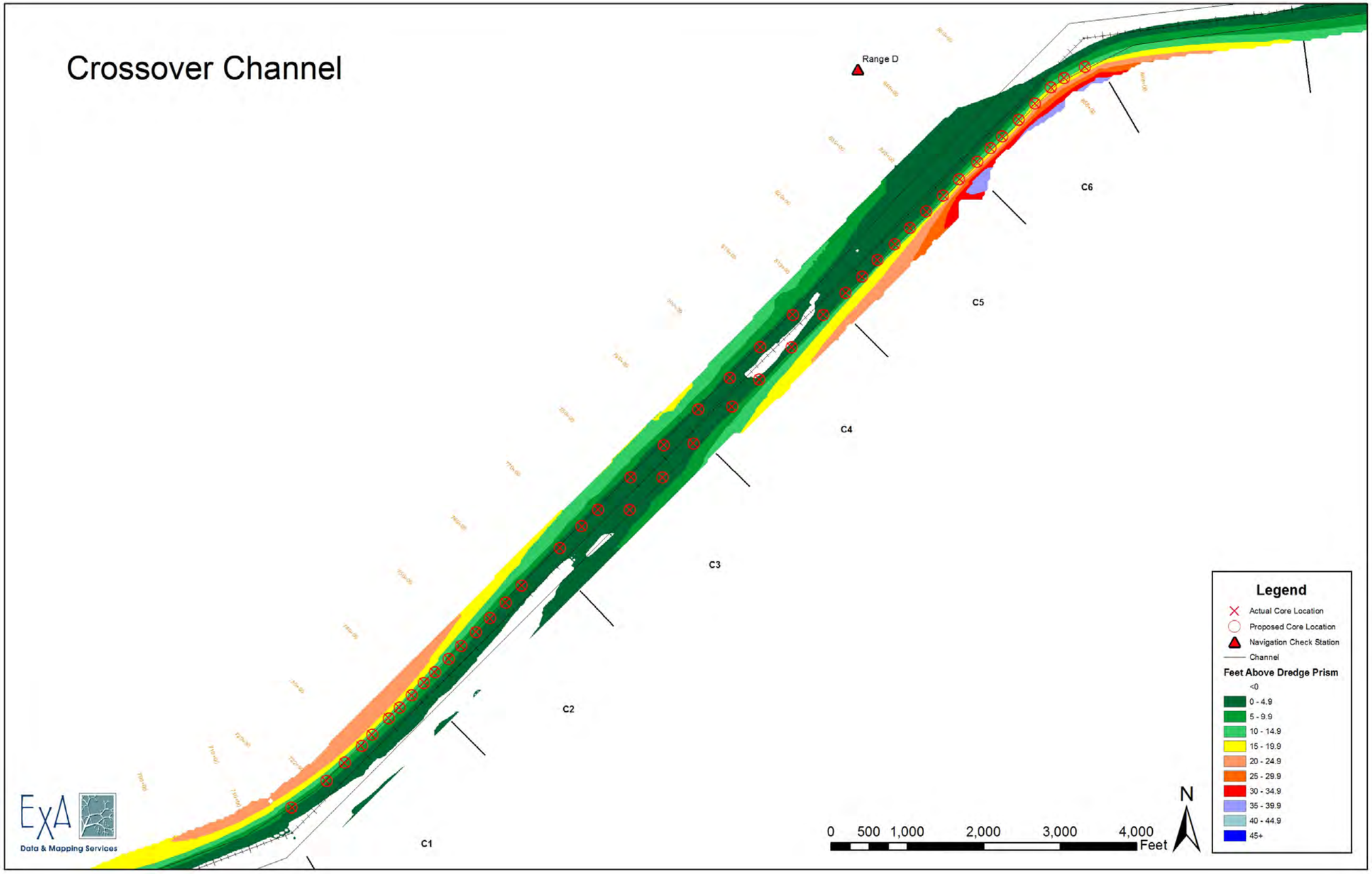

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Figure 2. . Crossover Reach Dredged Material Management Units. Planned and Actual Sampling Locations

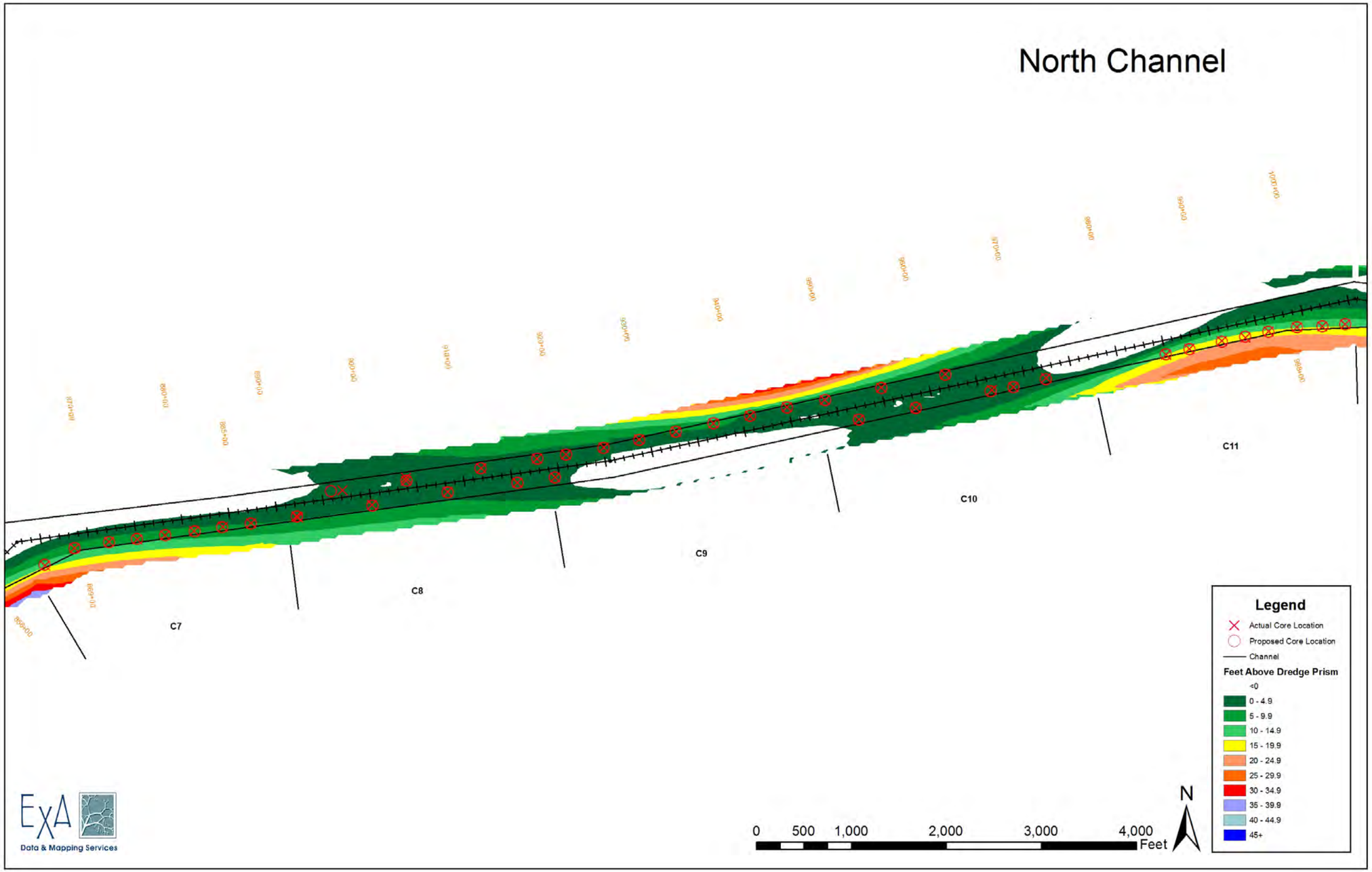

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Figure 3. North Channel ReachDredged Material Management Units. Planned and Actual Sampling Locations

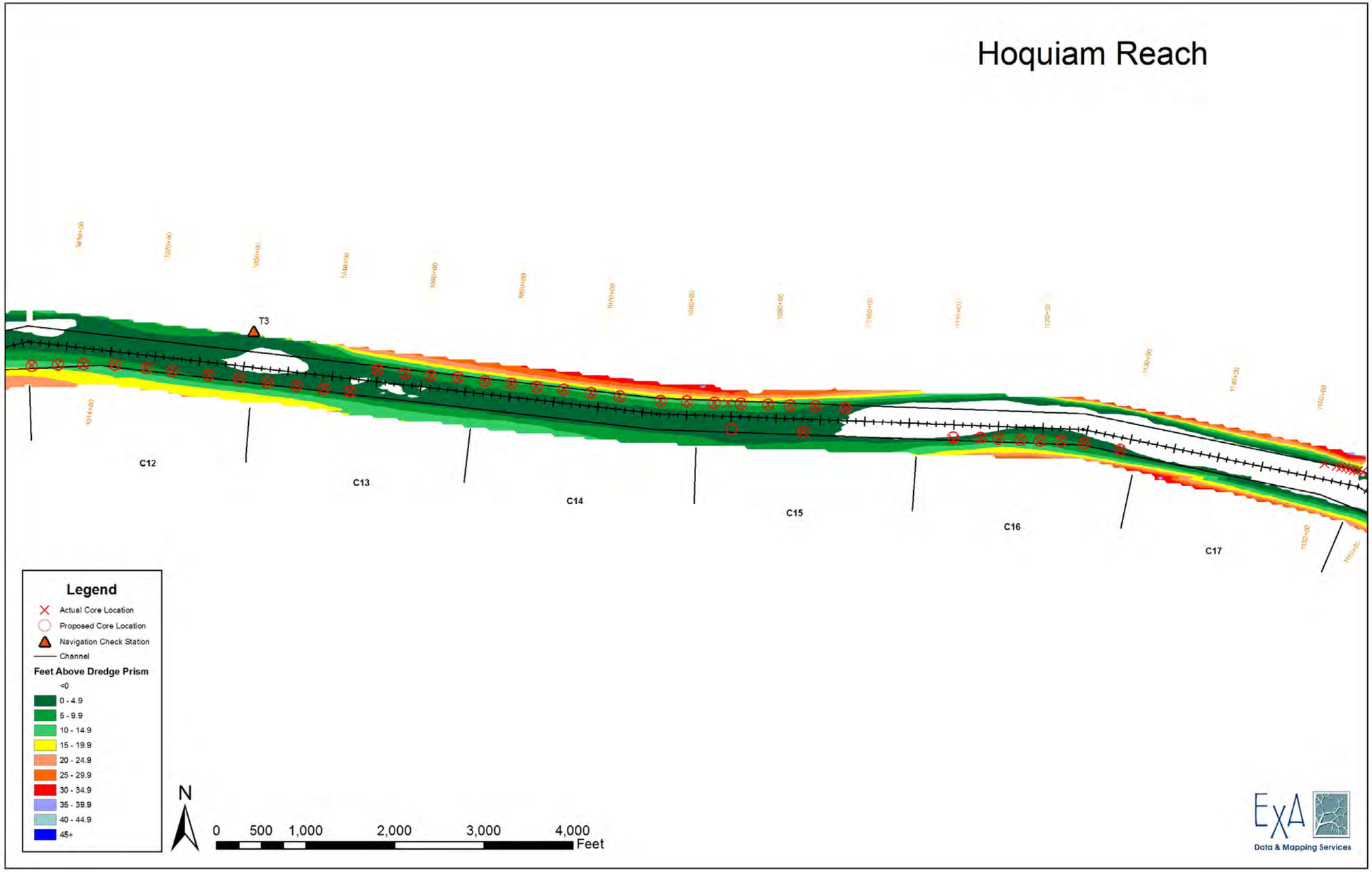

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Figure 4. . Hoquiam Reach Dredged Material Management Units. Planned and Actual Sampling Locations

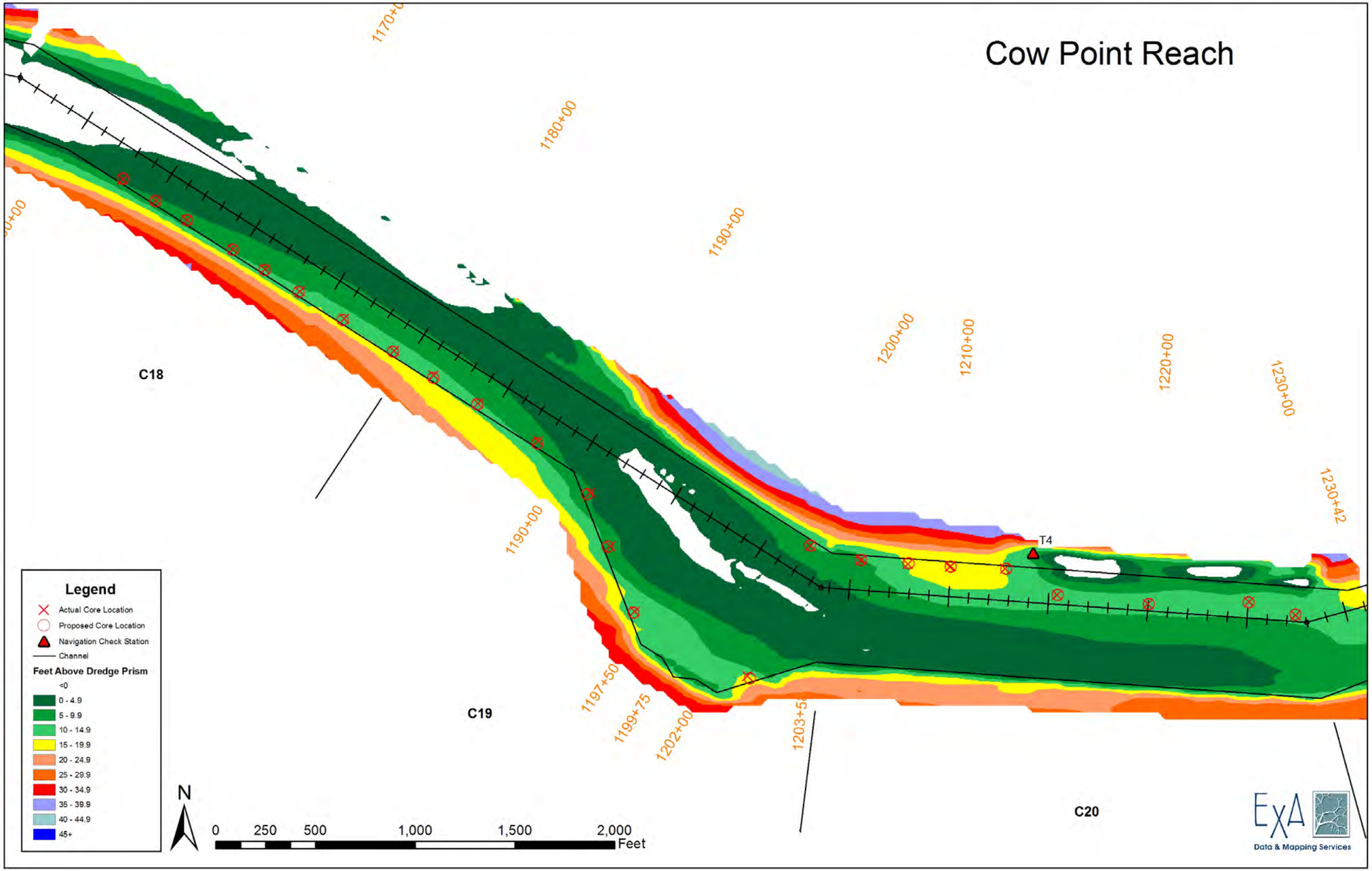

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Figure 5. . Cow Point Reach Dredged Material Management Units. Planned and Actual Sampling Locations

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Figure 6. Aberdeen Reach Dredged Material Management Units. Planned and Actual Sampling Locations

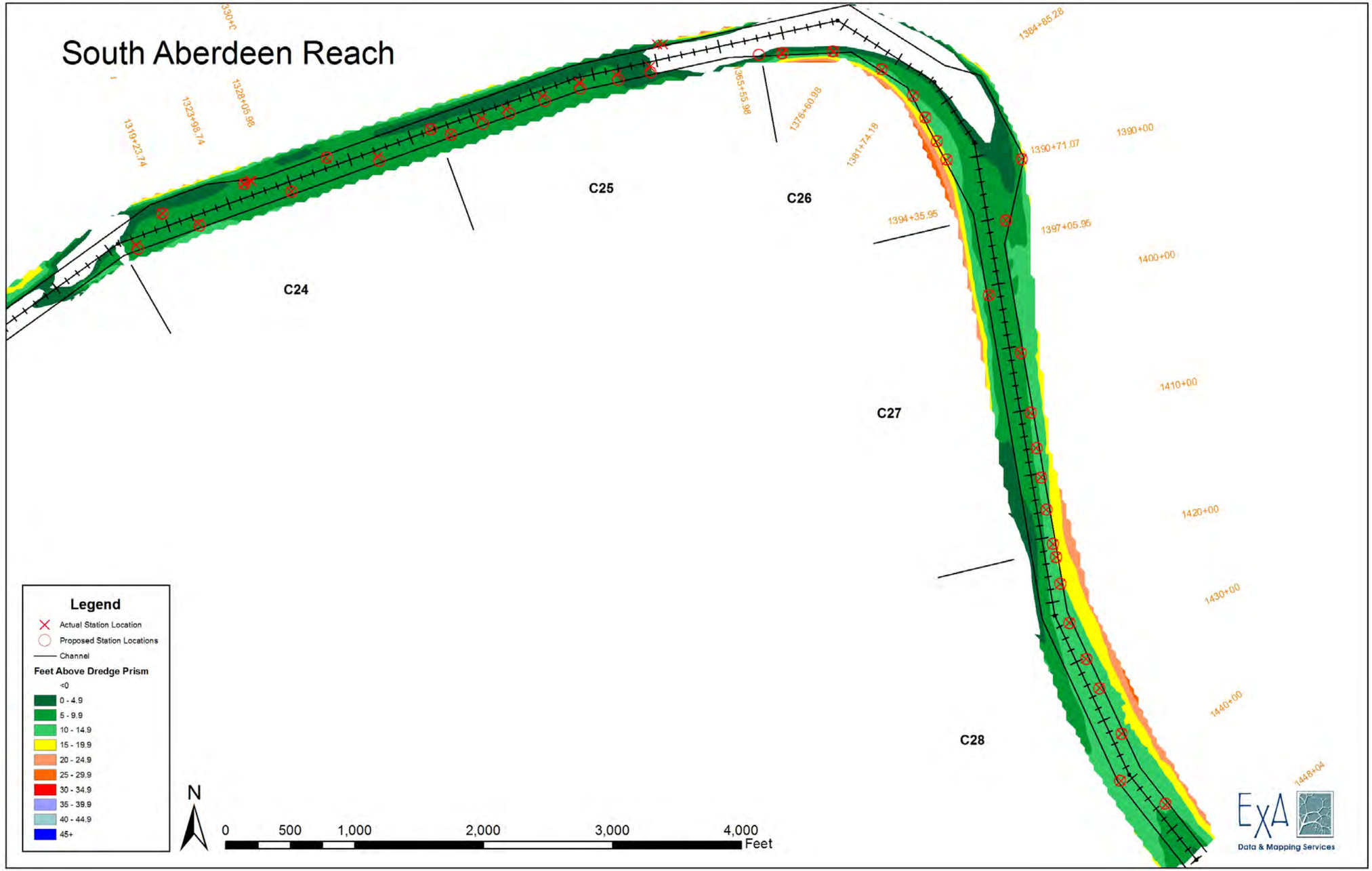

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Figure 7. . South Aberdeen Reach Dredged Material Management Units. Planned and Actual Sampling Locations

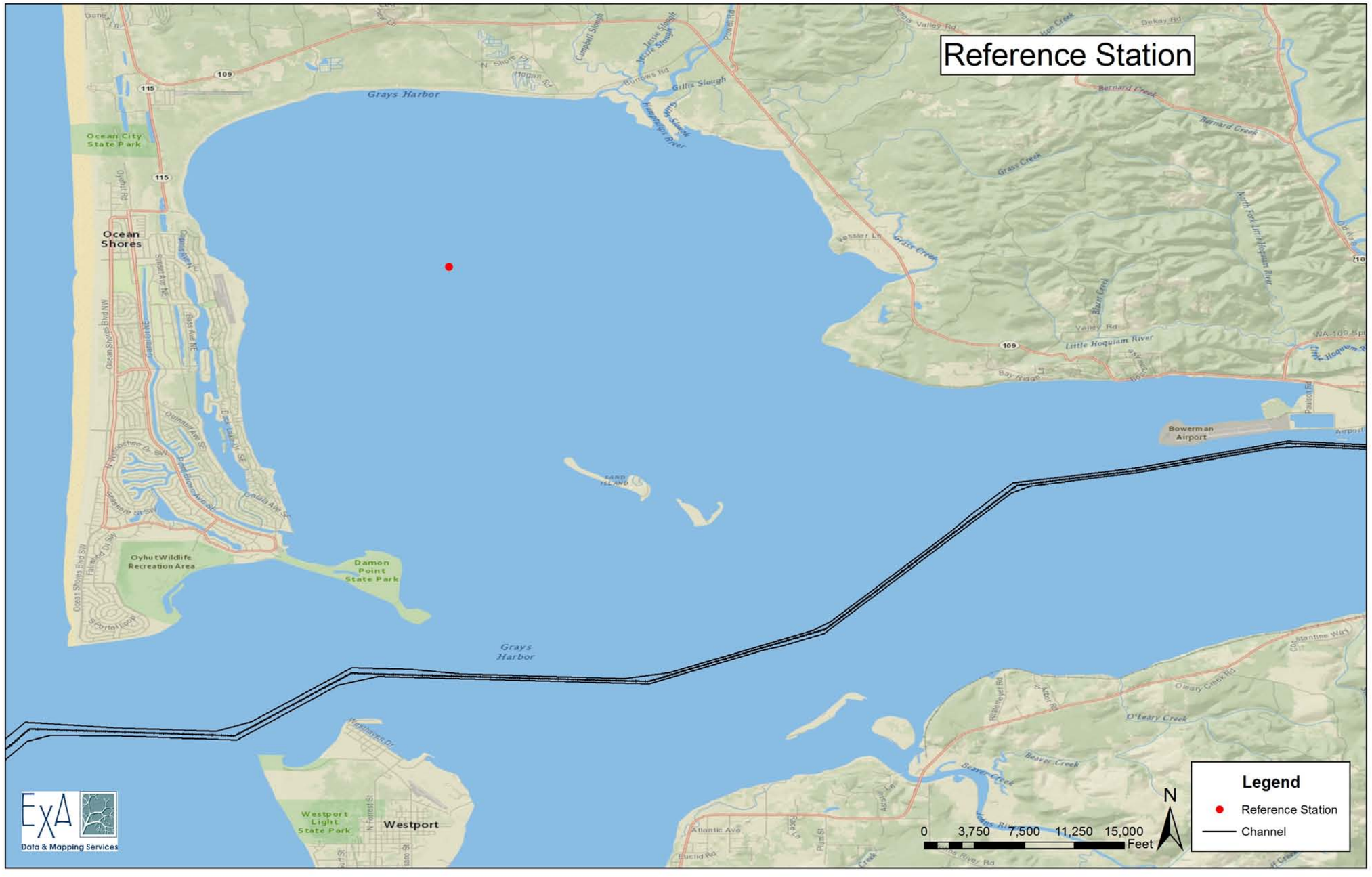

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Figure 8. Grays Harbor Reference Station GHS7 Sampling Location in North Bay

Table 1-3 Estimated FY11 and into Future Years Maintenance Dredging Program by Reach

Reach	Volume (cubic yards)[1]	Sediment Type	Dredge Type	Channel Dimensions[2]	Disposal Area(s)	Work Closures	Work Scheduled
S. Aberdeen	~55,000 Semi-decadal	silt / sand	Clamshell	-32 ft MLLW 200-300 ft wide	South Jetty or Point Chehalis[3]	15 Feb to 15 July	16 July to 14 Feb
Elliott Slough Turning Basin/S. Aberdeen	~60,000 biennially	silt / sand	Clamshell	-32 ft MLLW 350-550 ft wide	South Jetty or Point Chehalis[3]	15 Feb to 15 July	16 July to 14 Feb
Cow Point/Aberdeen	~750,000 annually	sandy silt	Clamshell	-36 ft MLLW 350-550 ft wide	South Jetty or Point Chehalis[3]	15 Feb to 15 July	16 July to 14 Feb
Cow Point Turning Basin	~215,000 annually	sandy silt	Clamshell	-36 ft MLLW 350-950 ft wide	South Jetty or Point Chehalis[3]	15 Feb to 15 July	16 July to 14 Feb
Hoquiam	~150,000 annually	sandy silt	Clamshell	-36 ft MLLW 350 ft wide	South Jetty or Point Chehalis[3]	15 Feb to 15 July	16 July to 14 Feb
North Channel	~175,000 annually	silty sand	Clamshell	-36 ft MLLW 350 ft wide	Point Chehalis	None	August to 14 Feb
Inner Crossover	~375,000 annually	silty sand	Clamshell	-36 ft MLLW 350-450 ft wide	Point Chehalis	None	August to 14 Feb
Outer Crossover	~235,000 annually	silty sand	Hopper[4]	-36 ft MLLW 350 ft wide	Point Chehalis	No hopper after 31 May	April and May
South Reach	~190,000 annually	sand	Hopper[4]	-36 ft MLLW 350-450 ft wide	Point Chehalis or Half Moon Bay	No hopper after 30 June	April to June
Entrance/ Point Chehalis	~685,000 annually	sand	Hopper	-40 ft to -46 ft MLLW 600-900 ft wide	South Jetty or Half Moon Bay or Point Chehalis	No hopper after 31 May	April and May
Bar Channel	~260,000 as needed	sand	Hopper	-46 ft MLLW 900 ft wide	South Beach or South Jetty or 3.9-mile ocean site	No hopper after 31 May	April and May

Notes:

[1] Volumes are averages, plus one standard deviation, computed on the last 10 years' dredging records, thus the actual volumes dredged may differ from those in the table.

[2] Depths shown are authorized depths and do not include 2-ft advanced maintenance or 2-ft overdepth tolerance. Exceptions: South Aberdeen Reach has 0-ft advance maintenance and 1-ft over-depth tolerance. Elliott Slough Turning Basin has 3-ft advance maintenance for half of the channel (inside bend). Widths shown are those of the channel bottom, and do not include extra width at channel bends.

[3] Adverse weather/wave relief site.

[4] Clamshell required after May 31 (Outer Crossover) and June 30 (South Reach).

ft = feet; MMLW = Mean Lower Low Water

Table 2-2 Actual Sampling Locations

Crossover Reach																
	Station Location															
	1		2		3		4		5		6		7		8	
DMMU	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
XR-C1	46 55.92084 N	124 01.13178 W	46 55.98146 N	124 01.02887 W	46 56.02189 N	124 00.97304 W	46 56.05980 N	124 00.92395 W	46 56.08484 N	124 00.89120 W	46 56.12217 N	124 00.84198 W	46 56.14596 N	124 00.80933 W	46 56.17305 N	124 00.77245 W
XR-C2	46 56.20119 N	124 00.73509 W	46 56.22518 N	124 00.70271 W	46 56.25460 N	124 00.66078 W	46 56.28405 N	124 00.62423 W	46 56.31510 N	124 00.57982 W	46 56.34572 N	124 00.53777 W	46 56.38097 N	124 00.49109 W	46 56.41887 N	124 00.44257 W
XR-C3	46 56.50423 N	124 00.32801 W	46 56.55197 N	124 00.26227 W	46 56.58999 N	124 00.21401 W	46 56.59144 N	124 00.11472 W	46 56.66284 N	124 00.11501 W	46 56.66448 N	124 00.01640 W	46 56.73451 N	124 00.01657 W	46 56.74060 N	123 59.92343 W
XR-C4	46 56.81442 N	123 59.91201 W	46 56.82354 N	123 59.80748 W	46 56.88500 N	123 59.81789 W	46 56.88377 N	123 59.72590 W	46 56.95359 N	123 59.72698 W	46 56.95625 N	123 59.62762 W	46 57.02597 N	123 59.63003 W	46 57.02881 N	123 59.53312 W
XR-C5	46 57.07778 N	123 59.46680 W	46 57.11421 N	123 59.41801 W	46 57.15125 N	123 59.37208 W	46 57.18704 N	123 59.31836 W	46 57.22310 N	123 59.27368 W	46 57.26010 N	123 59.22335 W	46 57.29634 N	123 59.17249 W	46 57.33277 N	123 59.12383 W
XR-C6	46 57.37195 N	123 59.07182 W	46 57.40325 N	123 59.03285 W	46 57.42849 N	123 58.99557 W	46 57.46646 N	123 58.94617 W	46 57.50227 N	123 58.89715 W	46 57.53803 N	123 58.84865 W	46 57.56027 N	123 58.80990 W	46 57.58550 N	123 58.74667 W
North Channel Reach																
	Station Location															
	1		2		3		4		5		6		7		8	
DMMU	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
NC-C7	46 57.60802 N	123 58.68006 W	46 57.64037 N	123 58.60760 W	46 57.65339 N	123 58.52092 W	46 57.66047 N	123 58.45045 W	46 57.66976 N	123 58.38078 W	46 57.67855 N	123 58.30746 W	46 57.68857 N	123 58.23601 W	46 57.69685 N	123 58.16410 W
NC-C8	46 57.71029 N	123 58.04689 W	46 57.76095 N	123 57.93687 W	46 57.73802 N	123 57.86067 W	46 57.78705 N	123 57.77762 W	46 57.76552 N	123 57.67178 W	46 57.80907 N	123 57.58903 W	46 57.78660 N	123 57.4957 W	46 57.82978 N	123 57.44919 W
NC-C9	46 57.79886 N	123 57.40164 W	46 57.83971 N	123 57.37661 W	46 57.85447 N	123 57.28169 W	46 57.87110 N	123 57.19307 W	46 57.88719 N	123 57.10103 W	46 57.90464 N	123 57.00735 W	46 57.91998 N	123 56.91546 W	46 57.93785 N	123 56.82287 W
NC-C10	46 57.95283 N	123 56.72792 W	46 57.92228 N	123 56.63969 W	46 57.97880 N	123 56.58735 W	46 57.94645 N	123 56.49714 W	46 58.00643 N	123 56.42732 W	46 57.98299 N	123 56.30788 W	46 57.98938 N	123 56.25309 W	46 58.00810 N	123 56.17122 W
NC-C11	46 58.05720 N	123 55.87097 W	46 58.06932 N	123 55.81213 W	46 58.08482 N	123 55.73093 W	46 58.09297 N	123 55.67222 W	46 58.10513 N	123 55.61330 W	46 58.11477 N	123 55.54296 W	46 58.11778 N	123 55.47914 W	46 58.12351 N	123 55.42151 W
Hoquiam Reach																
	Station Location															
	1		2		3		4		5		6		7		8	
DMMU	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
HO-C12	46 58.12402 N	123 55.38881 W	46 58.12790 N	123 55.31861 W	46 58.13110 N	123 55.24913 W	46 58.13296 N	123 55.16663 W	46 58.12865 N	123 55.08068 W	46 58.12541 N	123 55.01163 W	46 58.12050 N	123 54.91241 W	46 58.11716 N	123 54.82906 W
HO-C13	46 58.11164 N	123 54.75173 W	46 58.10844 N	123 54.67406 W	46 58.10472 N	123 54.60019 W	46 58.10133 N	123 54.52976 W	46 58.14407 N	123 54.45762 W	46 58.14036 N	123 54.38275 W	46 58.13741 N	123 54.31268 W	46 58.13643 N	123 54.23947 W
HO-C14	46 58.13136 N	123 54.16644 W	46 58.12883 N	123 54.09533 W	46 58.12563 N	123 54.02566 W	46 58.12256 N	123 53.95275 W	46 58.11821 N	123 53.87907 W	46 58.11385 N	123 53.80150 W	46 58.10932 N	123 53.69127 W	46 58.11123 N	123 53.62076 W
HO-C15	46 58.11012 N	123 53.54590 W	46 58.11019 N	123 53.50968 W	46 58.11123 N	123 53.47397 W	46 58.11092 N	123 53.40082 W	46 58.11098 N	123 53.34118 W	46 58.06347 N	123 53.30467 W	46 58.11206 N	123 53.27336 W	46 58.11112 N	123 53.19217 W
HO-C16	46 58.06115 N	123 52.89749 W	46 58.06633 N	123 52.82406 W	46 58.06661 N	123 52.77624 W	46 58.06588 N	123 52.71727 W	46 58.06508 N	123 52.66469 W	46 58.06792 N	123 52.60823 W	46 58.06458 N	123 52.54507 W	46 58.05524 N	123 52.44744 W
HO-C17	46 58.04008 N	123 51.83763 W	46 58.03628 N	123 51.81574 W	46 58.03582 N	123 51.80366 W	46 58.04104 N	123 51.84959 W	46 58.04617 N	123 51.89535 W	46 58.04251 N	123 51.86261 W	46 58.03821 N	123 51.82638 W	46 58.03397 N	123 51.79095 W
Cow Point Reach																
	Station Location															
	1		2		3		4		5		6		7		8	
DMMU	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
CP-C18	46 58.37352 N	123 48.43653 W	46 58.41552 N	123 48.38972 W	46 58.40425 N	123 48.32210 W	46 58.46204 N	123 48.22951 W	46 58.45024 N	123 48.15165 W	46 58.49501 N	123 48.08978 W	46 58.49901 N	123 47.99404 W	46 58.53704 N	123 47.89880 W
CP-C19	46 58.53092 N	123 47.86050 W	46 58.55335 N	123 47.80465 W	46 58.56622 N	123 47.75834 W	46 58.58533 N	123 47.69130 W	46 58.60362 N	123 47.62358 W	46 58.61625 N	123 47.55540 W	46 58.62794 N	123 47.49393 W	46 58.65699 N	123 47.48240 W
CP-C20	46 58.65319 N	123 47.24964 W	46 58.65696 N	123 47.15365 W	46 58.63674 N	123 47.06134 W	46 58.60482 N	123 47.00185 W	46 58.57830 N	123 46.97733 W	46 58.54871 N	123 46.95375 W	46 58.52531 N	123 46.93355 W	46 58.53045 N	123 46.79483 W

Table 2-2 Actual Sampling Locations

Aberdeen Reach																
DMMU	Station Location															
	1		2		3		4		5		6		7		8	
	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
AB-C21	46 57.63338 N	123 50.16070 W	46 57.64376 N	123 50.11127 W	46 57.65486 N	123 50.05839 W	46 57.66718 N	123 50.00039 W	46 57.68292 N	123 49.92848 W	46 57.70400 N	123 49.84232 W	46 57.73848 N	123 49.75397 W	46 57.73540 N	123 49.63015 W
AB-C22	46 57.79600 N	123 49.59880 W	46 57.77958 N	123 49.54342 W	46 57.83989 N	123 49.49504 W	46 57.85988 N	123 49.39593 W	46 57.92349 N	123 49.33927 W	46 57.94464 N	123 49.23790 W	46 58.01129 N	123 49.17568 W	46 58.04048 N	123 49.06230 W
AB-C23	46 58.08920 N	123 49.03269 W	46 58.08957 N	123 48.96916 W	46 58.13515 N	123 48.94786 W	46 58.13847 N	123 48.88034 W	46 58.18803 N	123 48.84780 W	46 58.18868 N	123 48.78763 W	No sample collected. See text		46 58.35280 N	123 48.48332 W
South Aberdeen Reach																
DMMU	Station Location															
	1		2		3		4		5		6		7		8	
	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
SA-C24	46 58.37352 N	123 48.43653 W	46 58.41552 N	123 48.38972 W	46 58.40425 N	123 48.32210 W	46 58.46204 N	123 48.22951 W	46 58.45024 N	123 48.15165 W	46 58.49501 N	123 48.08978 W	46 58.49901 N	123 47.99404 W	46 58.53704 N	123 47.89880 W
SA-C25	46 58.53092 N	123 47.86050 W	46 58.55335 N	123 47.80465 W	46 58.56622 N	123 47.75834 W	46 58.58533 N	123 47.69130 W	46 58.60362 N	123 47.62358 W	46 58.61625 N	123 47.55540 W	46 58.62794 N	123 47.49393 W	46 58.65699 N	123 47.48240 W
SA-C26	46 58.65319 N	123 47.24964 W	46 58.65696 N	123 47.15365 W	46 58.63674 N	123 47.06134 W	46 58.60482 N	123 47.00185 W	46 58.57830 N	123 46.97733 W	46 58.54871 N	123 46.95375 W	46 58.52531 N	123 46.93355 W	46 58.53045 N	123 46.79483 W
SA-C27	46 58.45175 N	123 46.81939 W	46 58.35569 N	123 46.84526 W	46 58.28389 N	123 46.78112 W	46 58.20799 N	123 46.75812 W	46 58.16310 N	123 46.74560 W	46 58.12635 N	123 46.73397 W	46 58.08558 N	123 46.72216 W	46 58.04214 N	123 46.70653 W
SA-C28	46 58.02563 N	123 46.70009 W	46 57.99167 N	123 46.69009 W	46 57.94272 N	123 46.67031 W	46 57.89768 N	123 46.63615 W	46 57.86133 N	123 46.60883 W	46 57.80458 N	123 46.56408 W	46 57.74472 N	123 46.56221 W	46 57.71651 N	123 46.47682 W
Reference Station																
GH S7	47 00.34937 N	124 05.79166 W	---	---	---	---	---	---	---	---	---	---	---	---	---	GH S7

Table 2-5 Depths of Collected Grab Samples (MLLW)

DMMU	Depth of Sampling Location (-ft MLLW)							
	1	2	3	4	5	6	7	8
Crossover Reach								
XR-C1	32.70	30.20	25.40	23.81	23.41	22.51	22.75	23.71
XR-C2	24.60	25.50	26.90	28.37	29.90	31.60	33.28	34.00
XR-C3	36.24	35.86	35.82	39.02	35.00	36.58	34.80	37.04
XR-C4	37.66	37.92	36.20	38.36	36.82	38.59	36.30	37.87
XR-C5	36.85	36.23	35.44	34.37	34.53	34.95	30.17	27.66
XR-C6	28.87	30.01	30.47	30.02	26.76	26.97	29.37	28.07
North Channel Reach								
NC-C7	24.86	32.63	32.03	32.15	31.67	33.25	33.83	35.21
NC-C8	35.55	38.37	36.05	38.70	38.75	37.76	38.50	36.75
NC-C9	39.90	37.90	37.98	36.28	33.76	30.89	33.10	35.50
NC-C10	34.37	46.20	34.89	36.29	36.60	39.50	39.40	39.51
NC-C11	27.19	24.73	26.15	21.56	24.11	26.52	26.27	28.37
Hoquiam Reach								
HO-C12	26.99	28.15	30.32	31.88	32.85	34.51	36.17	36.83
HO-C13	35.70	36.30	36.29	37.72	33.66	33.23	32.35	30.28
HO-C14	31.75	30.14	31.55	30.06	30.56	29.98	28.94	28.02
HO-C15	29.86	29.78	28.38	28.67	31.26	38.57	33.80	37.20
HO-C16	34.88	36.53	32.17	31.11	31.16	33.76	35.40	38.17
HO-C17	36.61	37.12	36.70	36.46	35.99	37.47	36.57	33.91
Cow Point Reach								
CP-C18	36.80	34.00	32.60	30.80	29.60	28.60	28.30	31.60
CP-C19	29.40	30.40	33.00	35.70	34.10	27.30	31.60	33.20
CP-C20	30.20	21.30	19.60	20.00	25.60	27.90	28.40	29.20
Aberdeen Reach								
AB-C21	22.80	21.10	20.50	21.80	22.70	25.05	27.30	30.70
AB-C22	27.70	30.30	31.90	30.20	32.00	31.50	36.10	32.20
AB-C23	33.43	32.69	32.28	32.78	32.37	33.67	see text	33.97
South Aberdeen Reach								
SA-C24	33.14	36.38	31.74	32.60	33.50	34.35	32.42	33.93
SA-C25	33.91	33.78	33.58	33.60	33.92	34.44	38.27	35.13
SA-C26	32.50	29.46	29.17	26.17	23.65	20.62	21.69	30.63
SA-C27	32.60	31.33	31.83	29.96	29.78	29.92	28.66	26.40
SA-C28	35.80	36.20	27.56	27.38	24.44	26.69	27.56	29.14
Reference Station								
GH S7	15.50	—	—	—	—	—	—	—

Table 2-6 Results of Field Grain Size Estimates

DMMU	Field Grain Size Estimate	
	Percent Sand	Percent Fines
Crossover Reach		
XR-C1	82	18
XR-C2	83	17
XR-C3	82	18
XR-C4	80	20
XR-C5	74	26
XR-C6	53	47
North Channel Reach		
NC-C7	92	8
NC-C8	64	36
NC-C9	59	41
NC-C10	46	54
NC-C11	81	19
Hoquiam Reach		
HO-C12	81	19
HO-C13	54	46
HO-C14	48	52
HO-C15	64	36
HO-C16	21	79
HO-C17	19	81

DMMU	Field Grain Size Estimate	
	Percent Sand	Percent Fines
Cow Point Reach		
CP-C18	18	82
CP-C19	20	80
CP-C20	10	90
Aberdeen Reach		
AB-C21	31	69
AB-C22	88	12
AB-C23	98	2
South Aberdeen Reach		
SA-C24	90	10
SA-C25	75	25
SA-C26	16	84
SA-C27	80	20
SA-C28	89	11
Reference Station		
S7	29	71

US Army Corps of Engineers
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix B: Audubon Society List of Birds Sighted in Grays Harbor

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

KEY : BLUE =Common; GREEN =Uncommon; YELLOW =Harder to find, usually seen annually; ORANGE =Rare, 5+records; RED =Less than 5 records; BLACK =extirpated; GRAY =Introduced; LAVENDER =Hypothetical.	2009 AOU 50 order	Grays Harbor	Date first seen	Observers	Location	Other notes
Total County birds		385				
Pecentage seen		62.34%				
COMMON NAME(below)		**240**				
Fulvous Whistling-Duck	1					
Taiga Bean-Goose	2					
Greater White-fronted Goose	3	1	2/28/10	Charlie Wright and his dad	Ocean Shores STP	24 geese
Emperor Goose	4					
Snow Goose	5	1	1/11/10	Mike Marsh	Brady/Wenzel Loop area, Elma	
Ross's Goose	6					
Brant	7	1	3/13/10	John & Vesta Letos	in bay south of Bill's Spit, O.S.	
Cackling Goose	8	1	1/1/10	Dianna Moore	golf course, O.S.	
Canada Goose	9	1	1/1/10	Dianna Moore	golf course, O.S.	
Mute Swan	10					
Trumpeter Swan	11	1	1/1/10	Dianna Moore	Quinault Resort property	
Tundra Swan	12	1	3/14/10	Grace & Ollie Oliver	Monte-Brady Rd	2 birds
Whooper Swan	13					
Wood Duck	14	1	4/25/10	Ruth Sullivan	Acosta-Third, across from Bottle Beach SP	breeding pair
Gadwall	15	1	3/20/10	Matt Bartels	Hoquiam STP	
Falcated Duck	16					
Eurasian Wigeon	17	1	1/31/10	Vicki Schmidt	in bay south of Bill's Spit, O.S.	
American Wigeon	18	1	1/1/10	Dianna Moore	Perkin's Pond, O.S.	
American Black Duck	19					
Mallard	20	1	1/1/10	Dianna Moore	my yard	OK…I feed them corn in my driveway
Blue-winged Teal	21	1	4/30/10	Tim O'Brien, Bruce LaBar, Alan Richards, etc	Ocosta-Third, across from Bottle Beach SP	GH Shorebird Festival field trip, Tokeland/Grayland/Westport
Cinnamon Teal	22	1	4/25/10	Ruth Sullivan	north of Brady	1 duck
Northern Shoveler	23	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Northern Pintail	24	1	3/20/10	Bill & Charlotte Byers	off O.S. North Jetty	
Garganey	25					
Baikal Teal	26					
Green-winged Teal	27	1	1/1/10	Dianna Moore	Quinault Resort property	
Canvasback	28	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Redhead	29	1	12/29/10	Ruth Sullivan, Jim Pruske, Lonnie Somer	inside Hoquiam STP fence	
Ring-necked Duck	30	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Tufted Duck	31	1	4/30/10	Bob Stallcop, Dave Richardson	Hoquiam STP	1 female
Greater Scaup	32	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Lesser Scaup	33	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Steller's Eider	34					
King Eider	35	1	2/28/10	Charlie Wright and his dad	in bay behind O.S. STP	Since 7/2/2009; also seen on CBC 12/29/2010.
Common Eider	36					
Harlequin Duck	37	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Oyehut Game Range, O.S.	
Surf Scoter	38	1	1/1/10	Dianna Moore	North Jetty, O.S.	
White-winged Scoter	39	1	1/1/10	Dianna Moore	North Jetty, O.S.	
Black Scoter	40	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Oyehut Game Range, O.S.	
Long-tailed Duck	41	1	2/28/10	Charlie Wright and his dad	in bay off the Ocean Shores STP	3 ducks
Bufflehead	42	1	1/1/10	Dianna Moore	Marina area, O.S.	
Common Goldeneye	43	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Barrow's Goldeneye	44					
Smew	45					
Hooded Merganser	46	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Common Merganser	47	1	1/1/10	Dianna Moore	Outflow area nr Discovery Inn, O.S.	
Red-breasted Merganser	48	1	1/1/10	Dianna Moore	Outflow area nr Discovery Inn, O.S.	
Ruddy Duck	49	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Mountain Quail	50	1	10/30/10	Khanh Tran	Above Newman Crk Rd, N/O Elma	2 groups
Scaled Quail	51					
California Quail	52					
Northern Bobwhite	53					
Chukar	54					
Gray Partridge	55					
Ring-necked Pheasant	56	1	3/7/10	Lonnie Somer & Jim Pruske	in water just east of O.S. STP	1 bird
Ruffed Grouse	57	1	1/12/10	Linda Orgel & R.D. Grunbaum	their property, O'Leary Creek off Hwy 105	
Greater Sage-Grouse	58					
Spruce Grouse	59					
White-tailed Ptarmigan	60					
Dusky Grouse	61					
Sooty Grouse	62	1	3/27/10	Dianna Moore	along the Moclips Hwy btwn Hwy 109 & Hwy 101	3 birds in separate places on the shoulder
Sharp-tailed Grouse	63					
Wild Turkey	64					
Red-throated Loon	65	1	3/20/10	Matt Bartels	Oyehut Game Range, O.S.	
Arctic Loon	66					
Pacific Loon	67	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Oyehut Game Range, O.S.	
Common Loon	68	1	1/1/10	Dianna Moore	Oyehut Game Range, O.S.	
Yellow-billed Loon	69					

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Pied-billed Grebe	70	1	1/1/10	Dianna Moore	Outflow area nr Discovery Inn, O.S.	
Horned Grebe	71	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Oyehut Game Range, O.S.	
Red-necked Grebe	72	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Westport Marina	
Eared Grebe	73	1	12/29/10	Bill Tweit's group	Westport	GH CBC
Western Grebe	74	1	1/1/10	Dianna Moore	North Jetty, O.S.	
Clark's Grebe	75	1	10/30/10	Ruth Sullivan	Ocean Shores Marina	
Shy Albatross	76					
Laysan Albatross	77	1	8/28/10	Ryan Shaw, Michael Donohue, Bruce LaBar	Westport Pelagic trip	1 bird
Black-footed Albatross	78	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	47 birds
Short-tailed Albatross	79	1	7/31/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	1 bird
Northern Fulmar	80	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	3 birds in separate places on the shoulder
Murphy's Petrel	81					
Mottled Petrel	82					
Hawaiian Petrel	83					
Cook's Petrel	84					
Pink-footed Shearwater	85	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	25 birds
Flesh-footed Shearwater	86	1	8/21/10	Bill Tweit, Scott Mills, Bill Shelmerdine	Westport Pelagic trip	5 birds
Greater Shearwater	87					
Wedge-tailed Shearwater	88					
Buller's Shearwater	89	1	8/21/10	Bill Tweit, Scott Mills, Bill Shelmerdine	Westport Pelagic trip	2 birds
Sooty Shearwater	90	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	1957 birds
Short-tailed Shearwater	91	1	9/11/10	Pelagic trip-goers (no names given)	Westport Pelagic trip	
Manx Shearwater	92	1	8/28/10	Ryan Shaw, Michael Donohue, Bruce LaBar	Westport Pelagic trip	1 bird
Wilson's Storm-Petrel	93					
Fork-tailed Storm-Petrel	94	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	6 birds
Leach's Storm-Petrel	95	1	6/26/10	Bill Shelmerdine & Westport Seabirds Pelagic trip	Westport Pelagic trip	22 birds
Ashy Storm-Petrel	96					
Red-billed Tropicbird	97					
Blue-footed Booby	98					
Brown Booby	99					
American White Pelican	100	1	6/7/10	John & Vesta Letos	btwn Bill's Spit and the Marina off O.S.	15 birds at dusk
Brown Pelican	101	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Westport Marina	
Brandt's Cormorant	102	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip
Double-crested Cormorant	103	1	1/1/10	Dianna Moore	North Jetty, O.S.	
Red-faced Cormorant	104					
Pelagic Cormorant	105	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	North Jetty, O.S.	
Magnificent Frigatebird	106					
American Bittern	107					
Great Blue Heron	108	1	1/1/10	Dianna Moore	irrigation ditch nr my home, O.S.	
Great Egret	109					
Snowy Egret	110					
Little Blue Heron	111					
Cattle Egret	112					
Green Heron	113	1	4/24/10	Dianna Moore	under the boardwalk at the "secondary" marina,. O.S.	
Black-crowned Night-Heron	114					
Yellow-crowned Night-Heron	115					
White Ibis	116					
Glossy Ibis	117					
White-faced Ibis	118					
Turkey Vulture	119	1	3/20/10	Bill Shelmerdine	Montesano area	8 birds
California Condor	120					
Osprey	121	1	4/6/10	Dianna Moore	cell tower behind O.S. City Yard, Ocean Lake Wy.	returning to a nest; 4th yr I think; Hoquiam STP osprey seen same day for 1st time of the season
White-tailed Kite	122					
Bald Eagle	123	1	1/1/10	Dianna Moore	Oyehut Game Range, O.S.	
Northern Harrier	124	1	1/1/10	Dianna Moore	over dunes, Taurus access, O.S.	
Sharp-shinned Hawk	125	1	1/1/10	Dianna Moore	my yard	
Cooper's Hawk	126	1	2/10/10	Dianna Moore	my yard	
Northern Goshawk	127	1	8/11/10	Bill Shelmerdine	east fork of the Humptulips River	"adult, probably male"
Red-shouldered Hawk	128					
Broad-winged Hawk	129					
Swainson's Hawk	130					
Red-tailed Hawk	131	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	
Ferruginous Hawk	132					
Rough-legged Hawk	133	1	1/11/10	Mike Marsh	east entrance to Brady Loop, Elma	
Golden Eagle	134					
Crested Caracara	135					
Eurasian Kestrel	136					
American Kestrel	137	1	2/28/10	Dianna Moore	Satsop Bulb Farm	being mobbed by crows
Merlin	138	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	downtown Aberdeen	
Eurasian Hobby	139					
Gyrfalcon	140	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Hoquiam STP	Banded #8 by Dan Varland & party, 3/3/2006
Peregrine Falcon	141	1	1/1/10	Dianna Moore	Oyehut Game Range, O.S.	
Prairie Falcon	142	1	11/13/10	Tim O'Brien, Jeff Jendro, Russ Koppendrayer	SE end of Brady Loop Rd.	adult bird

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Yellow Rail	143					
Virginia Rail	144	1	3/20/10	Matt Bartels	Burrows Rd, Hoquiam	
Sora	145	1	4/17/10	Mary Breece	Brady Loop	
Common Moorhen	146					
American Coot	147	1	1/1/10	Dianna Moore	Perkin's Pond, O.S.	
Sandhill Crane	148	1	4/14/10	Arnie Martin, Jude Armstrong	over their house on Chenault Ave, Hoquiam	100 birds flying north
Black-bellied Plover	149	1	1/1/10	Dianna Moore	Oyehut Game Range, O.S.	
American Golden-Plover	150	1	8/11/10	Jordan Gunn	Oyehut Game Range, O.S.	seen by several people later that week
Pacific Golden-Plover	151	1	5/10/10	Dan Reiff	golf course, Ocean Shores	in breeding plumage
Lesser Sand-Plover	152	1	8/26/10	Bob Sundstron, Tom Aversa, Ryan Merrill	Oyehut Game Range	adult male…first record in the state!
Snowy Plover	152	1	11/6/10	MaryFrances Mathis	at the base of Cranberry Beach Rd, Grayland	2 wandered across the road into Grays Harbor County
Common Ringed Plover	153					
Semipalmated Plover	154	1	4/17/10	Mary Breece	Bottle Beach SP	4 birds
Piping Plover	155					
Killdeer	156	1	1/1/10	Dianna Moore	Pacific Park, next block over frm my house, O.S.	
Mountain Plover	157					
Eurasian Dotterel	158					
Black Oystercatcher	159	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip, 2 birds
Black-necked Stilt	160					
American Avocet	161					
Spotted Sandpiper	162	1	1/10/10	Dianna Moore	Hoquiam River, behind Hoquiam Farmer's Mkt	
Solitary Sandpiper	163					
Gray-tailed Tattler	164					
Wandering Tattler	165	1	4/30/10	Tim O'Brien and field trip group	Westport	GH Shorebird Festival field trip, Tokeland/Grayland/Westport
Greater Yellowlegs	166	1	4/17/10	Mary Breece	Brady Loop	several scattered about
Willet	167	1	5/15/10	Blair Bernson	Bottle Beach SP	1 bird
Lesser Yellowlegs	168	1	7/26/10	Ruth Sullivan, Carol Riddell	Oyehut Game Range, O.S.	
Upland Sandpiper	169					
Little Curlew	170					
Whimbrel	171	1	4/27/10	Dan Varland, Dianna Moore, Sandra Miller	on beach north of Quinault Beach Resort	
Bristle-thighed Curlew	172					
Long-billed Curlew	173					
Hudsonian Godwit	174	1	8/8/10	Ruth Sullivan & Carol Riddell	Oyehut Game Range pond	also seen 8/9 by Tom Schooley & Dianna Moore-many took photos that week
Bar-tailed Godwit	175	1	9/25/10	Dennis Duffy & his wife	Westport Marina	flying with MAGO's
Marbled Godwit	176	1	3/1/10	Gregg Thompson	Westport Marina	1 bird
Ruddy Turnstone	177	1	5/12/10	Michael Fleming	Bottle Beach SP	
Black Turnstone	178	1	1/1/10	Dianna Moore	North Jetty, O.S.	
Surfbird	179	1	1/18/10	Matt Pike	Westport Marina	
Great Knot	180					
Red Knot	181	1	4/30/10	Tim O'Brien and field trip group	Bottle Beach SP	GH Shorebird Festival field trip, Tokeland/Grayland/Westport
Sanderling	182	1	1/1/10	Dianna Moore	on beach, Taurus Ave access	
Semipalmated Sandpiper	183	1	5/15/10	Ruth Sullivan	Oyehut Game Range, O.S.	
Western Sandpiper	184	1	1/1/10	Dianna Moore	on beach, Taurus Ave access	
Red-necked Stint	185					
Little Stint	186					
Temminck's Stint	187					
Least Sandpiper	188	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Oyehut Game Range, O.S.	
White-rumped Sandpiper	189					
Baird's Sandpiper	190	1	8/10/10	Dan Reiff	Oyehut Game Range, O.S.	
Pectoral Sandpiper	191	1	8/10/10	Dan Reiff	Oyehut Game Range, O.S.	
Sharp-tailed Sandpiper	192					
Rock Sandpiper	193	1	1/18/10	Matt Pike	Westport Marina	
Dunlin	194	1	1/1/10	Dianna Moore	Oyehut Game Range, O.S.	
Curlew Sandpiper	195					
Stilt Sandpiper	196	1	8/13/10	Evan Houston, Khanh Tran	Oyehut Game Range, O.S.	seen by several people later that day
Buff-breasted Sandpiper	197	1	9/11/10	Igor Uhrovic	Oyehut Game Range, O.S.	
Ruff	198	1	9/2/10	Wilson Cady, Barry Woodruff	Oyehut Game Range	juvenile
Short-billed Dowitcher	199	1	4/17/10	Mary Breece	Brady Loop and Ocean Shores at park nr golf course	4 birds
Long-billed Dowitcher	200	1	4/30/10	Tim O'Brien and field trip group	Bottle Beach SP	
Jack Snipe	201					
Wilson's Snipe	202	1	1/1/10	Dianna Moore	center divider, Ocean Shores Bl at Pacific Ave., O.S.	
Wilson's Phalarope	203					
Red-necked Phalarope	204	1	5/15/10	Ruth Sullivan	beach in front (south) of Oyehut Game Range, O.S.	75 birds!
Red Phalarope	205	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	2 birds
Black-legged Kittiwake	206	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Westport Marina	
Red-legged Kittiwake	207					
Ivory Gull	208					
Sabine's Gull	209	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	56 birds
Bonaparte's Gull	210	1	5/2/10	Mary O'Neil, Cecilia Pinkal	Westport	
Black-headed Gull	211					
Little Gull	212					
Ross's Gull	213					
Laughing Gull	214					

KEY : BLUE =Common; GREEN =Uncommon; YELLOW =Harder to find, usually seen annually; ORANGE =Rare, 5+records; RED =Less than 5 records; BLACK =extirpated; GRAY =Introduced; LAVENDER =Hypothetical.	2009 AOU 50 order	Grays Harbor	Date first seen	Observers	Location	Other notes
Franklin's Gull	215					
Black-tailed Gull	216					
Heermann's Gull	217	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Westport Marina	
Mew Gull	218	1	1/18/10	Matt Pike	Westport Marina	
Ring-billed Gull	219	1	4/13/10	Dianna Moore	beach at Ocean Lake Way access, O.S.	
Western Gull	220	1	1/1/10	Dianna Moore	power pole nr my house, O.S.	
California Gull	221	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip
Herring Gull	222	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Westport Marina	
Thayer's Gull	223	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	Westport Marina	
Iceland Gull	224					
Lesser Black-backed Gull	225	1	8/19/10	Mike & MerryLynn Denny	Grayland Beach	photos on Flickr site
Slaty-backed Gull	226					
Glaucous-winged Gull	227	1	1/1/10	Dianna Moore	Pacific Park, next block over frm my house, O.S.	
Glaucous Gull	228	1	1/18/10	Matt Pike	Westport Marina	1st cycle bird
Great Black-backed Gull	229					
Least Tern	230					
Caspian Tern	231	1	4/17/10	Marv Breece	Bottle Beach SP	
Black Tern	232					
Common Tern	233	1	6/26/10	Scott Mills, Bill Shelmerdine, Mike Donohue	Westport Pelagic trip	1 bird
Arctic Tern	234	1	7/10/10	Bruce LaBar, Bill Shelmerdine, etc.	Westport Pelagic trip	2 birds
Forster's Tern	235					
Elegant Tern	236					
South Polar Skua	237	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	1 bird
Pomarine Jaeger	238	1	7/31/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	2 birds
Parasitic Jaeger	239	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	1 bird
Long-tailed Jaeger	240	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	2 birds
Common Murre	241	1	4/27/10	Dianna Moore, Sandra Miller	North Jetty, O.S.	1 flying
Thick-billed Murre	242					
Pigeon Guillemot	243	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip
Long-billed Murrelet	244					
Marbled Murrelet	245	1	6/26/10	Scott Mills, Bill Shelmerdine, Mike Donohue	Westport Pelagic trip	
Kittlitz's Murrelet	246					
Xantus's Murrelet	247					
Ancient Murrelet	248					
Cassin's Auklet	249	1	5/22/10	Bill Tweit, Scott Mills, Ryan Shaw	Westport Pelagic trip	6 birds
Parakeet Auklet	250					
Whiskered Auklet	251					
Rhinoceros Auklet	252	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip
Horned Puffin	253	1	6/26/10	**Scott Mills, Bill Shelmerdine, Mike Donohue**	Westport Pelagic trip	
Tufted Puffin	254	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip
Rock Pigeon	255	1	1/3/10	Marv Breece, MaryFrances Mathis, Matt Bartels	downtown Aberdeen	
Band-tailed Pigeon	256	1	1/1/10	Dianna Moore	woods next to Ocean Shores Interpretive Center	
Eurasian Collared-Dove	257	1	1/1/10	Dianna Moore	my yard, O.S.	
White-winged Dove	258					
Mourning Dove	259	1	4/14/10	Dianna Moore	Satsop Bulb Farm, Satsop	2 in a tree
Yellow-billed Cuckoo	260					
Black-billed Cuckoo	261					
Barn Owl	262	1	1/7/10	Steve Hallstrom, Cecilia Boulais	Their farm/barn near the Chehalis River off S. Fork Rd.	Resident
Flammulated Owl	263					
Western Screech-Owl	264	1	12/21/10	Roger Moyer, Jerry Swena	Elma Gate Rd. just west of Oakville	
Great Horned Owl	265	1	2/19/10	Dianna Moore	in woods behind O.S. Interpretive Center	being mobbed by crows
Snowy Owl	266					
Northern Hawk Owl	267					
Northern Pygmy-Owl	268	1	10/30/10	Khanh Tran	Above Newman Crk Rd, N/O Elma	
Burrowing Owl	269					
Spotted Owl	270					
Barred Owl	271	1	1/7/10	Dianna Moore	my yard, O.S.	
Great Gray Owl	272					
Long-eared Owl	273					
Short-eared Owl	274	1	10/30/10	Khanh Tran	Brady Loop Rd	
Boreal Owl	275					
Northern Saw-whet Owl	276	1	12/21/10	Roger Moyer, Jerry Swena	Elma Gate Rd., just west of Oakville	
Common Nighthawk	277					
Common Poorwill	278					
Black Swift	279					
Vaux's Swift	280	1	4/30/10	Tim O'Brien and field trip group	Grays Harbor NWR headquarters parking lot	several birds flying over buildings and STP
White-throated Swift	281					
Ruby-throated Hummingbird	282					
Black-chinned Hummingbird	283					
Anna's Hummingbird	284	1	1/1/10	Dianna Moore	feeders in my yard, O.S.	
Costa's Hummingbird	285					
Calliope Hummingbird	286					
Broad-tailed Hummingbird	287					

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Rufous Hummingbird	288	1	3/1/10	Kathleen Wolgemuth	her back porch feeder, O.S.	a male
Allen's Hummingbird	289					
Belted Kingfisher	290	1	3/9/10	Dianna Moore	on power line, Grass Creek NW of Hoquiam	
Lewis's Woodpecker	291					
Acorn Woodpecker	292					
Williamson's Sapsucker	293					
Yellow-bellied Sapsucker	294					
Red-naped Sapsucker	295					
Red-breasted Sapsucker	296	1	3/20/10	Matt Bartels	south of Elma	
Downy Woodpecker	297	1	1/19/10	Dianna Moore	in yard behind O.S. Animal Hospital	
Hairy Woodpecker	298	1	12/29/10	Ruth Sullivan	right side of boardwalk at GHNWR	GH CBC
White-headed Woodpecker	299					
Am. Three-toed Woodpecker	300					
Black-backed Woodpecker	301					
Northern Flicker	302	1	2/12/10	Dianna Moore	my yard, O.S.	
Pileated Woodpecker	303	1	3/20/10	Matt Bartels	county line, Cloquallum Rd, Elma	
Olive-sided Flycatcher	304	1	5/15/10	Dianna Moore	power line in front of my house, O.S.	
Western Wood-Pewee	305	1	5/28/10	Dianna Moore	in willows in lot next door to me, O.S.	
Yellow-bellied Flycatcher	306					
Alder Flycatcher	307					
Willow Flycatcher	308					
Least Flycatcher	309					
Hammond's Flycatcher	310					
Gray Flycatcher	311					
Dusky Flycatcher	312					
Pacific-slope Flycatcher	313	1	5/23/10	Tom Schooley, Sheila McCartan, Dianna Moore	The Weatherwax Property, O.S.	
Cordilleran Flycatcher	314					
Black Phoebe	315					
Eastern Phoebe	316					
Say's Phoebe	317	1	8/16/10	Paul Hicks	behind STP, western side of Oyehut Game Range, O.S.	immature bird
Vermilion Flycatcher	318					
Ash-throated Flycatcher	319					
Variegated Flycatcher	320					
Tropical Kingbird	321	1	10/9/10	Bill Shelmerdine	Westport marina	
Western Kingbird	322					
Eastern Kingbird	323					
Scissor-tailed Flycatcher	324					
Fork-tailed Flycatcher	325					
Loggerhead Shrike	326					
Northern Shrike	327	1	3/20/10	Bill Shelmerdine	east end, Wenzel Slough Rd. Elma	1 adult bird
White-eyed Vireo	328					
Bell's Vireo	329					
Yellow-throated Vireo	330					
Cassin's Vireo	331	1	8/11/10	Bill Shelmerdine	Humptulips Ridge	in a flock of migrating passerines
Blue-headed Vireo	332					
Hutton's Vireo	333	1	3/20/10	Matt Bartels	Burrows Rd, Hoquiam	
Warbling Vireo	334					
Philadelphia Vireo	335					
Red-eyed Vireo	336					
Gray Jay	337					
Steller's Jay	338	1	1/1/10	Dianna Moore	my yard, O.S.	
Blue Jay	339					
Western Scrub-Jay	340	1	1/10/10	Dianna Moore	downtown Hoquiam	
Pinyon Jay	341					
Clark's Nutcracker	342					
Black-billed Magpie	343					
American Crow	344	1	1/1/10	Dianna Moore	my yard, O.S.	
Northwestern Crow	345					
Common Raven	346	1	1/1/10	Dianna Moore	flying over my house, O.S.	
Sky Lark	347					
Horned Lark	348	1	2/6/10	Knut Hansen, Tommy Pedersen	Westport	5 birds
Purple Martin	349	1	4/29/10	Tim O'Brien	8th & Levee St, Hoquiam	
Tree Swallow	350	1	2/19/10	Dianna Moore	O.S. Marina	
Violet-green Swallow	351	1	3/20/10	Bill Shelmerdine	Wenzel Slough Rd area, Elma	
N. Rough-winged Swallow	352	1	4/17/10	Mary Breece	Brady Loop	
Bank Swallow	353					
Cliff Swallow	354	1	4/17/10	Mary Breece	Brady Loop	
Barn Swallow	355	1	4/17/10	Mary Breece	Brady Loop	
Black-capped Chickadee	356	1	1/1/10	Dianna Moore	my yard, O.S.	
Mountain Chickadee	357					
Chestnut-backed Chickadee	358	1	1/1/10	Dianna Moore	my yard, O.S.	
Boreal Chickadee	359					
Bushtit	360	1	1/28/10	Dianna Moore	along Duck Lake Dr, O.S.	

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Red-breasted Nuthatch	361	1	1/6/10	Dianna Moore	my yard, O.S.	
White-breasted Nuthatch	362					
Pygmy Nuthatch	363					
Brown Creeper	364	1	12/29/10	Arnie Martin, Mary O'Neill	North Hoquiam	GH CBC; also seen on Satsop CBC 12/27 but don't know where in Area 3
Rock Wren	365					
Canyon Wren	366					
Bewick's Wren	367	1	1/1/10	Dianna Moore	my yard, O.S.	
House Wren	368					
Winter Wren	369	1	2/11/10	Dianna Moore	my yard, O.S.	
Marsh Wren	370	1	3/12/10	Dianna Moore	across street from my house, O.S.	Spring song
American Dipper	371	1	5/1/10	Mary O'Neil, Diane Schwickerath	Lake Quinault trail	Field trip participants and guides during GH Shorebird Festival
Golden-crowned Kinglet	372	1	1/1/10	Dianna Moore	my yard, O.S.	
Ruby-crowned Kinglet	373	1	3/24/10	Dianna Moore	my yard, O.S.	
Blue-gray Gnatcatcher	374					
Northern Wheatear	375					
Western Bluebird	376					
Mountain Bluebird	377	1	3/20/10	Bill & Charlotte Byers	O.S. STP	1 male
Townsend's Solitaire	378	1	5/1/10	Mary O'Neil, Diane Schwickerath	Quinault South Shore field trip	shorebird festival field trip
Veery	379					
Gray-cheeked Thrush	380					
Swainson's Thrush	381	1	5/1/10	Mary O'Neil, Diane Schwickerath	Quinault South Shore field trip	shorebird festival field trip
Hermit Thrush	382	1	1/1/19	Dianna Moore	my yard, O.S.	
Dusky Thrush	383					
Redwing	384					
American Robin	385	1	1/1/10	Dianna Moore	my yard, O.S.	
Varied Thrush	386	1	1/1/10	Dianna Moore	my yard, O.S.	
Gray Catbird	387					
Northern Mockingbird	388					
Sage Thrasher	389					
Brown Thrasher	390					
European Starling	391	1	1/1/10	Dianna Moore	Pacific Park, next block over frm my house, O.S.	
Siberian Accentor	392					
Eastern Yellow Wagtail	393					
White Wagtail	394					
Red-throated Pipit	395					
American Pipit	396	1	4/17/10	Mary Breece	Brady Loop	too many to count
Bohemian Waxwing	397	1	11/29/10	Keith Brady	West Fork Satsop River	approx 12 birds
Cedar Waxwing	398	1	5/29/10	Dianna Moore	across from North Bay Park, O.S.	this bird was foraging on the ground!
Phainopepla	399					
Blue-winged Warbler	400					
Golden-winged Warbler	401					
Tennessee Warbler	402					
Orange-crowned Warbler	403	1	1/1/10	Dianna Moore	behind McDonald's, O.S.	
Nashville Warbler	404					
Northern Parula	405					
Yellow Warbler	406	1	5/11/10	Michael Fleming	in willows along Paulson Rd, Hoquiam	
Chestnut-sided Warbler	407					
Magnolia Warbler	408					
Cape May Warbler	409					
Black-throated Blue Warbler	410					
Yellow-rumped Warbler	411	1	1/1/10	Dianna Moore	my yard, O.S.	
Black-throated Gray Warbler	412	1	5/1/10	Marcus Roening, Faye McAdams-Hands, Diane Yorgeson-Quinn	Point Grenville	GH Shorebird Festival field trip
Black-throated Green Warbler	413					
Townsend's Warbler	414	1	2/7/10	Drew Wheelan	along Marine View Dr. O.S.	
Hermit Warbler	415					
Blackburnian Warbler	416					
Yellow-throated Warbler	417					
Prairie Warbler	418					
Palm Warbler	419	1	9/18/10	Ruth Sullivan	Damon Point campground, O.S.	
Bay-breasted Warbler	420					
Blackpoll Warbler	421					
Black-and-white Warbler	422					
American Redstart	423					
Prothonotary Warbler	424					
Ovenbird	425					
Northern Waterthrush	426					
Kentucky Warbler	427					
Mourning Warbler	428					
MacGillivray's Warbler	429	1	4/29/10	Tim O'Brien	Elma Satsop Foothills	
Common Yellowthroat	430	1	4/17/10	Mary Breece	Brady Loop	
Hooded Warbler	431					
Wilson's Warbler	432	1	5/1/10	Mary O'Neil, Diane Schwickerath	Quinault South Shore field trip	shorebird festival field trip, also seen on the Point Grenville field trip same day (4 birds)
Yellow-breasted Chat	433					

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Green-tailed Towhee	434					
Spotted Towhee	435	1	1/1/10	Dianna Moore	my yard, O.S.	
American Tree Sparrow	436					
Chipping Sparrow	437					
Clay-colored Sparrow	438					
Brewer's Sparrow	439					
Vesper Sparrow	440					
Lark Sparrow	441					
Black-throated Sparrow	442					
Sage Sparrow	443					
Lark Bunting	444					
Savannah Sparrow	445	1	4/11/10	Dianna Moore	Marine View Dr at Greenview Ave, O.S.	
Grasshopper Sparrow	446					
Le Conte's Sparrow	447					
Nelson's Sparrow	448					
Fox Sparrow	449	1	1/1/10	Dianna Moore	my yard, O.S.	
Song Sparrow	450	1	1/1/10	Dianna Moore	my yard, O.S.	
Lincoln's Sparrow	451	1	4/25/10	Ruth Sullivan	Hiram Rd., Brady	
Swamp Sparrow	452					
White-throated Sparrow	453					
Harris's Sparrow	454					
White-crowned Sparrow	455	1	1/1/10	Dianna Moore	my yard, O.S.	
Golden-crowned Sparrow	456	1	1/1/10	Dianna Moore	my yard, O.S.	
Dark-eyed Junco	457	1	1/1/10	Dianna Moore	my yard, O.S.	
Lapland Longspur	458	1	9/17/10	Terry Little	Oyehut Game Range, O.S.	I flew overhead
Smith's Longspur	459					
Chestnut-collared Longspur	460					
Rustic Bunting	461					
Snow Bunting	462					
McKay's Bunting	463					
Summer Tanager	464					
Scarlet Tanager	465					
Western Tanager	466	1	6/8/10	Dianna Moore	The Point on The Weatherwax Property, O.S.	male
Rose-breasted Grosbeak	467					
Black-headed Grosbeak	468	1	5/25/10	Dianna Moore	my yard, O.S.	male in breeding plumage at a feeder (female showed up 5/30)
Lazuli Bunting	469	1	4/27/10	Deborah McConnell/USFS Biologist	South Shore Rd, Lake Quinault	verified by Bill Shelmerdine; seen by members of field trip to Lake Quinault on 5/1.
Indigo Bunting	470					
Painted Bunting	471					
Dickcissel	472					
Bobolink	473					
Red-winged Blackbird	474	1	1/1/10	Dianna Moore	my yard, O.S.	
Tricolored Blackbird	475					
Western Meadowlark	476	1	1/3/10	Mary Breece, MaryFrances Mathis, Matt Bartels	Oyehut Game Range, O.S.	
Yellow-headed Blackbird	477					
Rusty Blackbird	478					
Brewer's Blackbird	479					
Common Grackle	480					
Great-tailed Grackle	481					
Brown-headed Cowbird	482	1	5/18/10	Dianna Moore	my yard, O.S.	
Orchard Oriole	483					
Hooded Oriole	484					
Bullock's Oriole	485					
Baltimore Oriole	486					
Scott's Oriole	487					
Brambling	488					
Gray-crowned Rosy-Finch	489					
Pine Grosbeak	490					
Purple Finch	491	1	1/1/10	Dianna Moore	my yard, O.S.	
Cassin's Finch	492					
House Finch	493	1	1/1/10	Dianna Moore	my yard, O.S.	
Red Crossbill	494	1	8/26/10	Tom Aversa, Ryan Merrill	Burrows Rd, Hoquiam	
White-winged Crossbill	495					
Common Redpoll	496					
Hoary Redpoll	497					
Pine Siskin	498	1	5/1/10	Mary O'Neil, Diane Schwickerath	Quinault South Shore field trip	shorebird festival field trip, 15 birds
Lesser Goldfinch	499					
American Goldfinch	500	1	3/20/10	Matt Bartels	south of Elma	
Evening Grosbeak	501	1	4/17/10	Mary Breece	Brady Loop	large flock
House Sparrow	502	1	1/1/10	Dianna Moore	McDonald's parking lot, O.S.	
County list last updated:						

US Army Corps of Engineers
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix C: Coastal Zone Management Act Consistency Determination

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

Coastal Zone Management Act Consistency Determination

Grays Harbor Navigation Improvement Project Supplemental Environmental Impact Statement, Grays Harbor County, Washington

June 2014

1. Introduction

Pursuant to the Coastal Zone Management Act (CZMA), 16 United States Code (USC) 1451 *et seq*., Federal agencies' activities are required to be carried out in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved state Coastal Zone Management Programs. The Shoreline Management Act (SMA) of 1972 (Revised Code of Washington [RCW] 90.58) is the core of authority of Washington's Coastal Zone Management Program. Primary responsibility for the implementation of the SMA is assigned to local government.

The proposed action is to deepen the federal navigation channel in Grays Harbor from the channel's currently maintained depth of −36 feet mean lower low water (MLLW) to its legislatively authorized depth of −38 feet MLLW and to place the excavated dredged material at the South Jetty aquatic dispersive site and the South Beach and Half Moon Bay nearshore nourishment sites via bottom-dump barge; direct placement at the Point Chehalis Revetment Extension mitigation site would be accomplished by hydraulically pumping the dredged material via a floating/submerged pipeline. The existing Point Chehalis aquatic dispersive site would be temporarily shifted 1,000 feet to the north northwest. This shift produces less sedimentation in the navigation channel and less accumulation above authorized channel depths over the course of dredged material placement. This placement site shift would not increase the size of the site and would be a temporary one-time shift intended to take advantage of deeper water and more dispersive hydrodynamics. Material determined to be unsuitable for unconfined aquatic disposal (approximately 22,400 cubic yards) would be mechanically dredged and transported for upland placement at the former Hoquiam waste water treatment lagoon. The proposed action also includes subsequent annual maintenance of the deepened channel for a period of 50 years. Prior to subsequent maintenance dredging cycles, the Corps would contact the DMMP agencies to determine whether additional sediment testing in Cow Point Reach Dredged Material Management subunit 32a is required. The proposed action would employ similar methods to those used under baseline conditions (maintain the navigation channel at -36 feet MLLW), and these methods would be employed on the same schedule and at the same intensity (i.e. number of work hours per day) as occurs under baseline conditions. The entire 6 month work window would likely be used in the inner harbor reaches. Equipment would be the same except that a long reach excavator may be used in hardpack areas of Cow Point and a hopper dredge with pump ashore capability would be used to place material at the upland Point Chehalis Revetment Extension mitigation site (when feasible). An additional clamshell dredge would be utilized.

The background and authorization of the proposed action originated over a century ago. Congress

initially authorized construction and maintenance of the navigation channel principally through the River and Harbor Act of June 3, 1896 (29 Stat. 202, Ch. 314) and through the River and Harbor Act of August 30, 1935 (49 Stat. 409, Ch. 831); as subsequently amended, among others, by the River and Harbor Act of March 2, 1945 (Public Law 79-14) and the River and Harbor Act of September 3, 1954 (Public Law 83-780).

Dredging of the navigation channel to a depth of −38 feet MLLW was originally authorized as the Navigation Improvement Project by Congress in Section 202 of the Water Resources Development Act of 1986 (Public Law 99-662) in November 1986. The Corps' *General Design Memorandum for the Grays Harbor Navigation Improvement Project* documented detailed post-authorization engineering, environmental, and economic studies, which found justification for dredging to a depth of −36 feet MLLW at that time. The economic analysis in the 1989 General Design Memorandum was based on the timber industry and log vessels that, at that time, did not need depths of −38 feet MLLW.

In 1990, the Corps completed the deepening of 3.8 miles of upstream channel (Aberdeen Reach), and the widening of the Cow Point Turning Basin to 950 feet. In 1991, the Corps completed the deepening of 19.7 miles of downstream channel (Bar Channel to Cow Point Reach), and the widening of the Cow Point Turning Basin to 900 feet. The accompanying Letter Reevaluation Report has reached a recommendation that deepening the channel to its legislatively authorized depth of -38 feet MLLW is economically and environmentally justified.

2. State of Washington Shoreline Management Program

Primary responsibility for implementation of the SMA has been assigned to local governments. The determination of this action's consistency with the CZMA is based on review of Washington's Coastal Zone Management Program (Washington State Department of Ecology 2001), the Washington Administrative Code (WAC) SMA Titles, and the policies and standards of the adopted Grays Harbor County Shoreline Management Master Program, City of Westport Shoreline Management Master Program, and the Grays Harbor Estuary Management Plan. Applicable sections of each plan are presented below, with the Corps' consistency indicated in ***bold italics***.

3. Grays Harbor County Shoreline Management Master Program

Grays Harbor County implemented the SMA through the preparation of a SMP, adopted on June 3, 1974 (Resolution #7419) and updated on 5 April 2002. Dredging and open-water placement of dredged materials are addressed in the plan. The applicable portions of this SMP are addressed below.

Chapter 2. Shoreline Management Policies, Activity Policies, 6. Dredging:

(a) Dredging should minimize damage to existing ecological values, natural resources and the river system of both the area to be dredged and the area for deposit of dredged materials and shall also minimize water quality degradation.

Consistent. Ongoing coordination with public agencies, Tribal Nations, and the public has resulted in dredging timing and methods and dredged material placement locations that minimize ecological and environmental impacts. Seasonal work restrictions and

established work windows and gear type (clamshell dredging only in the inner channel reaches) would continue to be utilized. Evaluation of aquatically placed dredged material for suitability of unconfined aquatic disposal under the Dredged Material Management Program (DMMP) ensures that State water quality standards will not be degraded; unsuitable materials will be placed in a confined upland location as outlined in the Grays Harbor Navigation Improvement Project Supplemental Environmental Impact Statement.

(b) Spoil deposit sites in water areas should be identified in cooperation with the Washington State Department of Natural Resources (DNR) and Washington Department of Fish and Wildlife (WDFW). Depositing of dredge material in water areas should be allowed only for habitat improvements, to correct problems of material distribution affecting adversely fish and shellfish resources, or where the alternative of depositing material on land is more detrimental to shoreline resources than depositing dredge material in water areas.

Consistent. The Point Chehalis and South Jetty placement sites are DNR-managed, public, multiuser unconfined open water dredged material placement sites. The temporary Point Chehalis site shift was coordinated through the multi-agency Dredge Material Management Program (DMMP).

The upland site chosen for the 22,400 cubic yards of unsuitable material is a portion of the former Hoquiam waste water treatment lagoon. Placement of dredged material on land could be more detrimental to shoreline resources. The minimum volume of dredged material will be removed from the littoral system for upland placement: only that material found unsuitable for aquatic disposal. All remaining dredged material will be returned to the littoral system and either placed at dispersive locations or in nearshore or immediate upland locations for beach nourishment and shoreline stabilization.

Placement of the dredged materials would correct problems of material distribution associated with the South Jetty and Half Moon Bay. Dredged material from the outer channel reaches would be placed at the Half Moon Bay nearshore nourishment site as needed to offset erosion of the shoreline, protect the beach from winter erosion, and to maintain existing beach and shoreline profile. Half Moon Bay is a high-energy environment subject to erosion. The nearshore nourishment site is used for placement as bathymetric conditions permit (i.e., when the bay is deep enough for the hopper dredge to navigate). Since spring 2002, Half Moon Bay has been deep enough to allow access for placement. Approximately 2 million cubic yards of material has been placed in this site since spring 2002. An average of 187,554 cubic yards of material has been placed at the Half Moon Bay Nearshore nourishment site annually since 2000. Of the material that cannot be accommodated at the upland mitigation site or the nearshore nourishment beneficial reuse sites, the maximum volume of aquatically deposited material will be placed in the South Jetty site, in order to help stabilize the jetty toe. The remainder of material will be placed in the shifted Point Chehalis aquatic site, which is a dispersive location. The purpose of the Half Moon Bay nearshore nourishment site is to maintain a stable beach profile west of the Point Chehalis revetment extension and to ensure that the armor stone toe of the revetment extension is not exposed. Also, sandy material from the outer harbor is placed on the revetment extension (i.e. direct upland nourishment), in accordance with the requirements

for stable beach slope and revetment toe burial of the Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement (U.S. Army Corps of Engineers 1998).

This upland Point Chehalis Revetment Extension mitigation site is located above the mean higher high water (MHHW) elevation (+9 feet at this location), but sand is subsequently expected to erode from the site into Half Moon Bay through natural processes.

(c). Dredging of bottom materials for the single purpose of obtaining fill material should be discouraged.

Consistent. The purpose of the proposed action is not to obtain fill material. The purpose of the proposed action is to deepen the navigation channel to its authorized depth of –38 feet MLLW to improve the efficiency and reliability of marine navigation.

(d). Ship channels, turning and moorage basins should be identified and no new such areas should be prepared or used without sufficient evidence that existing channels and basins are inadequate.

Consistent. Only the existing navigation channel and turning basin areas would be dredged. No new areas would be created. The dredging would better accommodate current vessel traffic for existing Port tenants and commodities and would alleviate tidal delays and light loading which occurs due to the existing insufficient channel depths at all stages of the tidal cycle.

(e). The use of dredge spoils for purposes other than landfill is encouraged.

Consistent. Dredged materials would not be used as landfill. Dredged materials would replenish the littoral drift cells and be used beneficially for beach nourishment. The 22,400 cubic yards determined unsuitable for open water placement would be placed upland in the former Hoquiam waste water treatment lagoon. The purpose of this upland placement is to permanently remove it from the aquatic environment.

Chapter 2. Shoreline Management Policies, Natural System Policies, 3. Estuary:

(a) Because of poor flushing action in the upper harbor during summer low flows, any necessary dredging, spoiling, and filling should be scheduled during high flow seasons.

Consistent. The proposed action would not occur in the upper harbor. The furthest upstream reach to be dredged under the proposed action is the Aberdeen Reach. To avoid dredging during times of the year when migrating salmonids are present in the upper harbor and to comply with regulatory fish windows, dredging would sometimes occur during the low-flow summer months.

Chapter 2. Shoreline Management Policies, Natural System Policies, 8. General:

Excavation, including dredging of channels and marinas, removal of sand or gravel for construction of roads or fills, excavation of drainage ditches and grading should be controlled to minimize

removal of vegetation and cemented surface soil layers; release of sediment into water; removal of fertile soils, deepening of water where this would have adverse impacts on habitat; breaking the seal of an aquifer; change or blockage of current; smothering of underwater habitat; reduction of tidal flushing action or reduction of water depth where this would be adverse to production of desirable plant and animal life, or would stimulate undesirable forms; undesirable changes in shoreline configuration; reduction of floodwater capacity of a riverine floodplain; elimination of fertile marsh habitat or creation of navigational hazards.

Consistent. No vegetation would be removed during dredging and placement operations, as only existing navigation channel and placement areas would be disturbed. Dredging and placement operations would result in temporary, localized increases in turbidity; however, timing restrictions would minimize the potential for impacts to federally listed and commercially important species. The proposed action would only occur in the existing navigation channel, designated aquatic placement sites, or the shifted Point Chehalis aquatic site discussed previously, so baseline habitat, river current, and tidal flushing conditions would not be significantly changed by deepening the channel by 2 feet.

Direct beach and nearshore nourishment placement would not result in undesirable changes in shoreline configuration but rather help maintain a stable beach profile west of the Point Chehalis revetment extension and ensure that the armor stone toe of the revetment extension is not exposed. Dredged material placement at the Half Moon Bay Nearshore Nourishment site also helps maintain the existing beach profile waterward of the Point Chehalis revetment extension. Annual monitoring of Point Chehalis Revetment Extension mitigation site would help determine when that site might receive dredged materials. No wetland or marsh habitat would be affected by the proposed action. Navigational hazards would be reduced by the proposed action.

Chapter 2. Shoreline Management Policies, Amenity Policies, 3. Archeological Areas and Historic Sites:

(a) Where possible local government should consult professional archeologists to identify areas containing potentially valuable archaeological data, and to establish procedures for salvaging the data.

Consistent. Professional archaeologists provided technical advice during the planning phases of the Grays Harbor Navigation Improvement Project. Beginning in 1976, the Corps conducted cultural resource and environmental review of Grays Harbor navigation channel and dredged material placement sites in support of the 1982 Grays Harbor Navigation Improvement Project Environmental Impact Statement (EIS). The Corps also conducted an overview of Native American use of Grays Harbor during this period. The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and the 1989 supplement to the 1982 EIS. Those studies included a literature search for underwater shipwrecks in the navigation channel. In 1988, a side-scan sonar investigation was conducted in the navigation channel; no shipwrecks or other underwater cultural resources were identified (Larson et. al.1989).

Other cultural resource investigations that were conducted within 1 mile of the navigation channel include a reconnaissance survey for a Corps gravel and cobble placement project at Half Moon Bay, an assessment for a proposed resort, an investigation for the City of Westport's wastewater treatment facility, a reanalysis of the Newskah Creek Fish Trap, an assessment of the Port of Grays Harbor Industrial Road Improvement Project, and an investigation for the Washington State Department of Transportation State Route 520 Pontoon Construction Project. Six archeological sites have been identified either within 1 mile of the Area of Potential Effect (APE) for the proposed action or during previous Corps cultural investigations for other elements of the Grays Harbor and Chehalis River Navigation Project.

Based on the previously conducted cultural resources investigations, the Corps has determined that the prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE. On May 16, 2013, the Corps sent a Determination of Effects letter with a finding of no historic properties affected to the Washington State Historic Preservation Officer (SHPO). The SHPO responded on May 22, 2013 only agreeing with the project's APE. On May 24, 2013 the Corps re-sent the Determination of Effects letter. The SHPO responded on May 28, 2013 agreeing with the Corps determination of no historic properties affected.

(d) The National Historic Preservation Act of 1966 and Chapter 43.51 RCW are hereby adopted as policies of this Master Program and their administration and enforcement is encouraged.

Consistent. The Corps has determined that the proposed work complies with the National Historic Preservation Act. Based on the previous cultural resources investigations that have been conducted, the Corps has determined that the prior research and field investigations were adequate to identify historic properties.

No archaeological sites or other cultural resources have been identified within the APE. On May 16, 2013, the Corps sent a Determination of Effects letter with a finding of no historic properties affected to the SHPO. The SHPO responded on May 28, 2013 agreeing with the Corps determination of no historic properties affected.

Chapter 4. Shoreline Environment Designation Map, Activity Policies, 2. Channel Strip:

The Urban Strip running through the Harbor is intended to follow existing channel lines. The purpose is to allow channel dredging and maintenance.

Consistent. The navigation channel is designated as an Urban Environment area, and dredging is a permitted use (Chapter 20 of the SMA, Urban Environment Regulations).

Chapter 22. Conservancy Environment Regulations, 3. Conditional Uses

Consistent. The Point Chehalis, South Jetty, and Half Moon Bay nearshore placement sites are located within areas designated as Conservancy Environment. Dredged material placement is not listed as an approved use in the Conservancy Environment. However, Chapter 22 of the

Shoreline Management Plan identifies dredging as a permitted conditional use subject to other provisions.

4. Westport Shoreline Management Master Program

The City of Westport implemented the SMA through preparation of a SMP (Title 17- Westport Zoning Ordinance, Chapter 17.32), adopted April 28, 1998. The Half Moon Bay nearshore and direct beach placement sites and the South Beach placement site fall under the jurisdiction of this plan.

The beach along Half Moon Bay is designated as Urban Shoreline (Recreation and Parks use Zone). The South Beach placement site falls with the Conservancy Shoreline Environment. Landfill, defined as replacement of shoreland areas removed by wave action or the normal erosive processes of nature, is a conditional use on an urban shoreline [17.32.055 (8)(D)]. Bankline erosion control, shoreline protective structures, and landfills are conditional uses in the Conservancy Environment [17.32.050(2)(F)].

Relevant Landfill Guidelines [17.32.055 (8)(D)]

(1) Shoreline fills or cuts should be designed and located so that significant damage to existing ecological values or natural resources, or alteration of local currents will not occur, creating a hazard to adjacent life, property, and natural resources systems.

Consistent. The potential for adverse impacts on salmonids, forage fish, and Dungeness crab associated with dredged material placement at the Half Moon Bay site would be reduced and/or avoided through implementation of timing restrictions. The Corps would avoid placement at the Point Chehalis Revetment Extension mitigation and Half Moon Bay nearshore sites during times of the year when these areas are extensively used by these species. The 22,400 cubic yards determined unsuitable for open water placement would be placed upland in the former Hoquiam waste water treatment lagoon, permanently removing it from the aquatic environment.

(2) All perimeters of fills should be provided with vegetation, retaining walls, or other mechanisms for erosion prevention.

Consistent. The sands placed on the beach at the Point Chehalis Revetment Extension mitigation site are erodible by design. The erosion of this material maintains a stable beach profile west of the Point Chehalis revetment extension and ensures that the armor stone toe of the revetment extension is not exposed, thereby maintaining fish and wildlife habitat in Half Moon Bay. The 22,400 cubic yards determined unsuitable for open water placement would be placed upland in the former Hoquiam waste water treatment lagoon, permanently removing it from the aquatic environment. The lagoon is fully bermed.

(3) Fill materials should be of such quality that it will not cause problems of water quality. Shoreline areas are not to be considered for sanitary landfills or the placement of solid waste.

Consistent. The origin of the clean sands placed at the nearshore and Point Chehalis Revetment Extension mitigation sites is the outer reaches of the navigation channel. Placement and erosion of this material would not degrade water quality.

(4) Priority should be given to landfills for water-dependent uses and for public uses. In evaluating fill projects and in designating areas appropriate for fill, such factors as total water surface reduction, navigation restriction, impediment to water flow and circulation, reduction of water quality, and destruction of habitat should be considered.

Consistent. The project will not place materials in upland locations for the primary purpose of fill. The dredging and placement of dredged materials supports safe and efficient water dependent use of the navigation channel and the Port of Grays Harbor. Direct upland beach nourishment would not degrade recreational use of Half Moon Bay nor limit public access to the beach. Water-related activities in Half Moon Bay are not expected to be degraded as a result of direct upland beach nourishment. The purpose of beach nourishment is to keep the revetment extension buried under sand, while maintaining a stable, gently sloping adjacent beach.

Dredging is discussed in section 17.32.055 (8)(E):

2. Use of dredge spoils for protective areas and to restore areas of high erosion is appropriate. Depositing of dredge material in water areas should be allowed only for habitat improvement, to correct problems of material distribution adversely affecting fish and shellfish resources, or where the alternatives of depositing material on land is more detrimental to shoreline resources than depositing it in water areas.

Consistent. The South Beach and Half Moon Bay Nearshore Placement sites are beneficial use sites intended to keep high-quality sands in the littoral system to ameliorate the effects of ongoing erosion along South Beach and in Half Moon Bay.

Dredged material from the outer channel reaches would be placed at the Half Moon Bay nearshore nourishment site as needed to offset erosion of the shoreline, protect the beach from winter erosion, and to maintain a stable beach and shoreline profile. Half Moon Bay is a high-energy environment subject to erosion. The nearshore nourishment site is used for placement as bathymetric conditions permit (i.e., when the bay is deep enough for the hopper dredge to navigate). Since spring 2002, Half Moon Bay has been deep enough to allow access for placement. Approximately 2 million cubic yards of material has been placed in this site since spring 2002. An average of 187,554 cubic yards of material has been placed at the Half Moon Bay Nearshore nourishment site annually since 2000. Of the material that cannot be accommodated at the upland mitigation site or the nearshore nourishment beneficial reuse sites, the maximum volume of aquatically deposited material will be placed in the South Jetty site, in order to help stabilize the jetty toe. The remainder of material will be placed in the shifted Point Chehalis aquatic site, which is a dispersive location. The purpose of the Half Moon Bay nearshore nourishment site is to maintain a stable beach profile west of the Point Chehalis revetment extension and to ensure that the armor stone toe of the revetment extension is not exposed. Also, sandy material from the outer harbor is placed on the revetment extension (direct upland nourishment), in

accordance with the requirements for stable beach slope and revetment toe burial of the Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement (U.S. Army Corps of Engineers 1998).

This upland Point Chehalis Revetment Extension mitigation site is located above the MHHW elevation (+9 feet at this location), but sand is subsequently expected to erode from the site into Half Moon Bay through natural processes.

Placement of dredged material on land would be more detrimental to shoreline resources. The minimum volume of dredged material will be removed from the littoral system for upland placement: only that material found unsuitable for aquatic disposal. All remaining dredged material will be returned to the littoral system and either placed at dispersive locations or in nearshore or immediate upland locations for beach nourishment and shoreline stabilization.

5. Grays Harbor Estuary Management Plan

The Grays Harbor Estuary Management Plan is a coordinated regional comprehensive plan designed to guide land and water use activities in the Grays Harbor estuary and the surrounding shoreline. It was approved in January 1986 and is implemented through the Grays Harbor County SMP, the master programs of local jurisdictions, and the Washington State SMA. Dredging, open water placement and direct/nearshore nourishment at Half Moon Bay are under jurisdiction of the Grays Harbor Estuary Management Plan.

The federal navigation channel, open water placement sites, and the Half Moon Bay Nearshore Nourishment placement site are located in Management Unit 44, a special unit that included all the water area not included within any other designated management unit. The management objective for the Unit 44 Planning Area is to protect areas for purposes that directly use or depend on natural systems (p. 112). Activities that occur in these areas should be compatible with natural systems in order to maintain the carrying capacity and biological productivity of the bay. Special conditions are imposed on Unit 44 to ensure that activities are carried out in a manner that does not reduce or degrade these estuarine resources.

Relevant Special Conditions

1. Activities in Unit 44 will be compatible with the natural system. For example, areas of significant fish and wildlife habitat will be managed to ensure continued biological productivity. Where consistent with resource capabilities, high-intensity water-dependent recreation, dredging, and other water-dependent uses will be allowed. Thus, those uses that depend on the water area (e.g., shipping and fishing) and the activities that support those uses (maintenance dredging, navigation aids, etc.) are considered appropriate to the Management Unit.

Consistent. Dredging is considered an allowed use in this special management unit. The proposed action would improve the efficiency and safety of water dependent uses in the Grays Harbor estuary.

8. EPA-authorized in-water dredged material placement sites are allowable in this management unit consistent with meeting all designation criteria.

   Consistent. The Point Chehalis and South Jetty placement sites are DNR-managed, public, multiuser unconfined open water dredged material placement sites. The shifted Point Chehalis aquatic site has been evaluated pursuant to CWA section 404(b)(1) for use as an aquatic disposal site for dredged material, and its use has been coordinated with the DMMP, of which the EPA is a member.

The Point Chehalis Revetment Extension mitigation site is located in Management Unit 40, which is an area designated as Conservancy Managed. Unit 40 is intended for public recreational uses (p. 108).

Consistent. Direct beach nourishment would not degrade public recreational use of Half Moon Bay nor limit public access to the beach. The purpose of beach nourishment at this site is to keep the revetment extension buried under sand, while maintaining a stable, gently sloping adjacent beach. Water related activities in Half Moon Bay are not expected to be degraded as a result of beach nourishment.

Bankline erosion control, defined as a type of fill designed to preserve the existing bankline or to protect the bankline from erosion (page 15), is an allowable use in Management Unit 40. Relevant general policies for bankline erosion control (page 24) include:

1. Materials to be used shall be of non-erodible quality that will allow long-term stability and minimize maintenance. Some erodible materials may be used when it can be demonstrated that fish and wildlife uses will be enhanced.

   Consistent. The sands placed on the beach at the Point Chehalis Revetment Extension mitigation site are erodible by design. The erosion of this material maintains a stable beach profile west of the Point Chehalis revetment extension and ensures that the armor stone toe of the revetment extension is not exposed, thereby maintaining fish and wildlife habitat in Half Moon Bay.

2. Riprap/bank stabilization procedures shall be confined to those areas where active erosion is occurring or new development or redevelopment requires protection from maintaining the integrity of upland structures or facilities.

   Consistent. No riprap placement is part of the proposed action. Sandy dredged material would be placed in this area only.

3. Only clean materials may be used. Materials which could create water quality problems or which will rapidly deteriorate are not permitted.

Consistent. Only clean oceanic sands would be placed on the beach. Erosion of this material would mimic natural erosion processes and would not degrade water quality.

4. Minor modifications of the bankline may be allowed on a case-by-case basis. These alterations shall be for the purpose of stabilizing the bankline, not for the purpose of developing new upland areas.

   Consistent. Sands would be placed to maintain the current shoreline configuration; no new upland areas would be developed.

5. Under no circumstances shall bankline erosion control be initiated for the purpose of gaining developable uplands from existing water areas.

   Consistent. Sands would be placed to maintain the current shoreline configuration; no new upland areas would be developed.

6. All projects shall be constructed in a manner to minimize turbidity in adjacent waters.

Consistent. Temporary, localized increases in turbidity may result from placement of dredged materials for nearshore nourishment in Half Moon Bay; however, placement at this site has been designed in a manner that would minimize and/or avoid the potential for adverse effects on salmonids, forage fish, and Dungeness crabs. Implementation of timing restrictions avoids placement of materials during times of the year when Half Moon Bay is used extensively by these species. The Corps was issued a 50 year Clean Water Act Section 401 Water Quality Certification/Modification (WQC) from Ecology for the Point Chehalis Revetment Extension Project in August 1999 (WQC- Order #TB-98-02) which implemented the Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement, dated October 1998. This included upland dredged material placement at the buried revetment extension mitigation site. In accordance with that WQC, the Corps would allow the hydraulically placed dredged material to dewater, and would control the discharge of effluent from the Point Chehalis Revetment Extension mitigation site in order to minimize the amount of suspended sediment released into Half Moon Bay.

In addition, the Corps was issued a Clean Water Act Section 401 water quality certification (WQC) from Ecology for continued maintenance dredging and disposal in February 2012 (WQC-Order #8992) for the current maintenance dredging program. The WQC included water quality monitoring with a mixing zone of 600 feet downstream/down current from in-water activity.

9. The outer slope of the bankline after completion of the erosion control will not exceed a slope of 2:1.

   Consistent. The purpose of nearshore and direct upland beach nourishment in Half Moon Bay is to maintain a stable beach profile of 60H:1V.

10. Use of vegetation for bankline stability is required where technically applicable and should be in conjunction with structural forms of erosion control. Vegetation shall be self-sustaining and soil stabilizing and compatible with natural shoreline vegetation.

    Consistent. The sands placed on the beach would be erodible by design. The erosion of this material would maintain a stable beach profile thereby maintaining fish and wildlife habitat in Half Moon Bay. Natural colonization by Dunegrass may occur after placement, depending on the rate of subsequent erosion.

6. Conclusion

Based on the preceding evaluation, the Corps has determined that the proposed project complies with the policies, general conditions, and general activities specified in the Grays Harbor County SMP, City of Westport SMP, and the Grays Harbor Estuary Management Plan. The proposed action is consistent to the maximum extent practicable with the State of Washington Shoreline Management Program.

7. References

Larson, L., L. Hunter, J. Cox, C. Coomes, R. Sylwester, and D. Johnson. 1989. The Identification and Evaluation of Potential Historic Properties in the Grays Harbor Navigation Improvement Project. US Army Corps of Engineers.

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Washington State Department of Ecology. 2001. *Managing Washington's Coast: Washington State's Coastal Zone Management Program* Publication 00-06-029. February.

US Army Corps of Engineers
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix D: Substantive Compliance for Clean Water Act, Section 404(b)(1) Evaluation

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

CLEAN WATER ACT SECTION 404(b)(1) EVALUATION
GRAYS HARBOR NAVIGATION IMPROVEMENT DREDGED MATERIAL DISPOSAL
GRAYS HARBOR COUNTY, WASHINGTON
June 2014

1. Introduction. The purpose of this document is to record the Corps' evaluation and findings regarding this project pursuant to Section 404 of the Clean Water Act (CWA). This document covers disposal of dredged material at the following locations within the waters of the U.S. as part of the Grays Harbor Navigation Channel deepening to -38 feet below Mean Lower Low Water (MLLW):

- South Jetty Dispersive Site
- South Beach Beneficial Use Site
- Half Moon Bay Beneficial Use Site
- Point Chehalis Revetment Extension Mitigation Site
- Point Chehalis Dispersive Site – Shifted Location

The information contained in this document reflects the findings of the project record. Specific sources of information included the following:
a. *Grays Harbor, Chehalis and Hoquiam Rivers, Washington Channel Improvements for Navigation Interim Feasibility Report and Final EIS*, dated September 1982.
b. *Grays Harbor, Washington, Navigation Improvement Project Final EIS Supplement*, dated February 1989.
c. *Dredged Material Evaluation and Disposal Procedures User Manual*, dated July 2013.
d. *Revised Crab Mitigation Strategy Agreement Evaluation Report and Environmental Assessment*, dated September 1998.
e. *Point Chehalis Revetment Extension and Half Moon Bay Inter-Agency Mitigation Agreement*, dated October 1998.
f. *South Jetty Breach Fill Maintenance Final Environmental Assessment*, dated February 2004, and as supplemented in December 2004 and November 2005.
g. *Supplemental Environmental Assessment and Biological Evaluation for the South Jetty Breach Fill Maintenance, dated August 2010, and as supplemented in August 2012.*
h. *Fiscal Years 2012 through 2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project*, dated September 2011, and as supplemented in November 2013.
i. 404(b)(1) Evaluation (see below)
j. Public Interest Review (see below)

This document addresses the substantive compliance issues of the Clean Water Act 404(b)(1) Guidelines [40 CFR §230.12(a)] and Public Interest Factors [33 CFR §320.4 as reference].

2. Description of Proposed Discharge.

Placement of the material dredged from the navigation channel typically occurs only at designated placement sites; however, this project will involve a previously unused area immediately adjacent to the Point Chehalis Site. Typical disposal is as follows: Two Washington State Department of Natural Resources (DNR) public, multi-user, unconfined open-water dredged material placement sites are located directly adjacent to the navigation channel. These are the South Jetty and the Point Chehalis dispersive sites. Both sites are located on state-owned aquatic lands and managed by Washington DNR. In addition, material dredged from the sandy outer harbor reaches of the channel is periodically used for

direct upland placement (when feasible) at the Point Chehalis Revetment Extension Mitigation Site, nearshore nourishment at the Half Moon Bay Beneficial Use site, and nearshore nourishment at the South Beach Beneficial Use site.

The Evaluation assesses placement volumes associated with deepening the channel, over and above those volumes assessed in the 404(b)(1) Evaluation dated September 2011 and appended to the FY 2012-18 Maintenance Dredging EA; this Evaluation also assesses incremental volumes to be dredged during maintenance episodes over a post-construction period of 50 years.

The determination of which placement site is used during the course of maintenance dredging is based on a variety of factors. For both the inner and outer harbor reaches, placement is determined based on the source of the dredged material, the depth of each aquatic placement site, the amount of material already present at the placement sites, and weather/wave conditions at the time of placement (see Figure 1 for reaches and placement sites). For the inner harbor reaches, material is typically deposited at the South Jetty Dispersive site, unless there are adverse weather/wave conditions or the South Jetty site is full, in which case placement typically occurs at the Point Chehalis open water (dispersive) placement site. For the outer harbor reaches, some of the dredged materials may be placed at three beneficial use sites: Half Moon Bay Beneficial Use nearshore nourishment site (offshore of Half Moon Bay), Point Chehalis Revetment Extension (upland) mitigation site, and South Beach Beneficial Use nearshore nourishment site. Remaining material is typically placed in the South Jetty or Point Chehalis sites. Factors that determine which placement sites are used for the outer harbor reaches include the presence of commercial crab pots in a placement site and/or access lane (for South Beach), the amount of material present (for Half Moon Bay), as surveyed annually, and results of pre-disposal Dungeness crab surveys (for both Half Moon Bay and South Beach).

The one difference in material placement proposed for this Federal action, compared to the O&M dredging program, is to shift the Point Chehalis placement site by 1,000 feet to better accommodate the volumes that would be placed for regular maintenance dredging and the deepening all occurring in the same year. This shift is needed to meet the total capacity required for material placement. The total quantity of dredged material that will be produced during channel deepening is 1,972,000 cubic yards. Adding this to the 2,090,000 cubic yards of material from O&M dredging from those same reaches from South Reach to Cow Point comes to approximately 4.06 million cubic yards, placement of which would be required in the available dredged material placement sites in the channel deepening construction year. In addition, a volume increment of 107,000 cubic yards would need to be dredged and placed with each subsequent annual maintenance episode, over and above the volumes assessed in the 404(b)(1) Evaluation of September 2011.

3. Project Purpose and Need.

The purpose of the proposed action is to improve efficiency and reliability, and reduce navigation transportation costs of deep-draft vessel navigation in Grays Harbor within the parameters of the existing legislatively authorized channel, which will be accomplished by deepening approximately 14.5 miles of the 27.5-mile navigation channel. Deep-draft ocean-going vessels transit the navigation channel to safely reach and leave the Port. The inner harbor reaches of the navigation channel are limited by depth and cannot accommodate large vessels with drafts exceeding −36 feet MLLW at all tidal stages. The Port has requested deepening the channel up to the legislatively authorized depth (an additional 2 feet deeper than present conditions) to better accommodate existing vessel traffic for Port tenants and commodities.

The purpose of the material disposal component of the project varies by location. Some sites provide for beneficial re-use of material, and others are dispersive sites that allow sediment to be removed from the navigation channel yet remain within the local nearshore littoral ecosystem. Disposal locations must be strategically selected to meet the need for disposal of material resulting from channel deepening as well

as all O&M dredged material within a single dredging year. These purposes are used in the analysis of impact avoidance and minimization.

4. <u>Availability of Less Environmentally Damaging Practicable Alternatives to Meet the Project Purpose.</u> The Supplemental Environmental Impact Statement discusses three alternatives that the Corps analyzed for the proposed dredging action. These are as follows:

<u>Alternative 1 (No Action): Continue Channel Maintenance of −36 Feet MLLW</u>: The No Action Alternative provides the baseline conditions for comparing the potential effects of the two action alternatives. Under Alternative 1, the Corps would continue routine maintenance dredging of the navigation channel to a depth of −36 feet MLLW within the South, Outer Cross-over, Inner Cross-over, North Channel, Hoquiam, and Cow Point Reaches and the Cow Point turning basin, and placement of the dredged materials at two open-water placement sites, two beneficial beach nourishment sites, and the Point Chehalis revetment extension mitigation site (when feasible). The upland Point Chehalis Revetment Extension mitigation site was filled in 2002 with sand from the navigation channel as described in the 2011 EA. A hydraulic pipeline is typically used when placing outer harbor materials at the upland Point Chehalis Revetment Extension mitigation site. A hopper dredge full of a sand and water slurry docks at the existing rock dock at Firecracker Point and pumps the slurry through a pipeline to the stockpile site. Firecracker Point is a jetty extension located on the southeastern side of the southeastern entrance to the Westport Marina. Booster pumps are required to pump the slurry 1.7 miles across-town. The temporary pipeline was installed in 1994, and is buried along the road that generally crosses the Westport peninsula from Firecracker Point to Half Moon Bay. The slurry of sand and water is discharged to the area in front of the buried revetment. A sand berm/perimeter dike separates the discharge area from Half Moon Bay. The slurry of water and sand temporarily ponds in the placement site, and water is conveyed via effluent pipe into Grays Harbor at the exposed rock revetment near Groin A. A water quality monitoring plan implemented in accordance with an approved Water Quality Certification issued by Ecology (WQC# TB-98-02). The material placed at the Point Chehalis Revetment Extension Mitigation Site would be expected to subsequently erode through natural processes, with a portion of the material entering the intertidal zone and thus the littoral system. Alternative 1 does not meet the proposed action's purpose and need of improving navigational efficiency and reliability, and reducing navigation costs.

<u>Alternative 2: Deepen Channel to −37 Feet MLLW</u>: Alternative 2 would involve deepening the navigation channel one foot to -37 feet MLLW, requiring dredging 1,031,000 cubic yards of sediment in addition to routine maintenance quantities. Because the deepening proposal assumes the channel is at -36 feet MLLW prior to any deepening work, annual maintenance dredging would be required in the same year as the deepening dredging. Maintenance dredging volume in the reaches proposed for deepening is 2,090,000 cubic yards. Thus, total volumes dredged for both maintenance and deepening to -37 feet MLLW in the construction year requires an estimated 3,121,000 cubic yards (volumes from maintenance work plus the additional incremental volume for Alternative 2). Annual maintenance dredging requirements would increase following construction by an estimated 50,000 cubic yards. An excavator may be used in hardpack areas of Cow Point Reach to break up the hardened material in place. The hardpack material is expected to break into large pieces and remain in place for removal by a clamshell dredge. The Corps would modify methods for dredged material placement and placement sites to address material determined unsuitable for open water placement, and would temporarily shift the Point Chehalis placement site to better accommodate the greater quantity of material. A small quantity of material (13,500 cubic yards) is unsuitable for open-water disposal due to toxicity expressed in the sediment larval bioassay. This material would require upland disposal (slated for the former Hoquiam wastewater treatment lagoon). Dredging for Alternative 2 would occur over approximately six months for the inner harbor reaches, approximately 1.5 months longer than routine maintenance dredging, and would occur within the same seven-month dredge window as routine dredging. The duration of

dredging for the outer harbor reaches would be approximately one month, the same duration as routine maintenance.

Alternative 3: Deepen Channel to −38 Feet MLLW: Alternative 3 would involve deepening the navigation channel two feet to -38 feet MLLW, requiring dredging 1.972 million cubic yards of sediment in addition to routine maintenance quantities. As with Alternative 2, annual maintenance dredging would be required in the same year as the deepening dredging. The total volumes dredged for both annual maintenance and deepening to -38 feet MLLW in the construction year require an estimated 4,062,000 cubic yards. Annual maintenance dredging requirements would increase following construction by an estimated 107,000 cubic yards. The Corps is proposing the same material placement modification for Alternative 3 as for Alternative 2 – primarily the temporary shift of the Point Chehalis placement site. An excavator may be used in hardpack areas of Cow Point Reach to break up the hardened material in place. The hardpack material is expected to break into large pieces and remain in place for removal by a clamshell dredge. A slightly larger quantity of material (22,400 cubic yards) than in Alternative 2 is unsuitable for open-water disposal due to toxicity expressed in the sediment larval bioassay. This material would require upland disposal (at the former Hoquiam wastewater treatment lagoon). Dredging for Alternative 3 would involve a second dredge working simultaneously, would occur over approximately six months for the inner harbor reaches (the same as Alternative 2), approximately 1.5 months longer than maintenance dredging under baseline conditions (Alternative 1), and would occur within the same seven-month dredge window as routine maintenance dredging. The duration of dredging for the outer harbor reaches would be approximately one month, the same as under Alternatives 1 and 2.

Findings. The Corps rejected Alternative 1 because it would not meet the project purpose and need to improve navigational efficiency and reliability, and reduce transportation costs of deep-draft vessel navigation. Alternative 2 was not preferred because it would not maximize the economic efficiency of safe transit of the deepest draft vessels that presently transit the Grays Harbor Navigation Channel. Alternative 3 (dredging down to –38 feet MLLW) best accommodates existing vessel traffic for Port tenants and commodities, alleviates large-vessel restrictions imposed by insufficient channel depths, and enables maximum improvement in efficiency for large vessels with drafts exceeding −36 feet MLLW, within the parameters of the existing legislative authorization. Alternative 3 would generate additional dredged material, which would be placed at the same placement sites used during maintenance dredging, plus a temporary shift in location of the Point Chehalis Dispersive Site. While the placement of dredged material under Alternative 3 would cause temporary degradation in the aquatic environment, it is the only practicable alternative that maximizes economic improvement within the parameters of the project purpose and need.

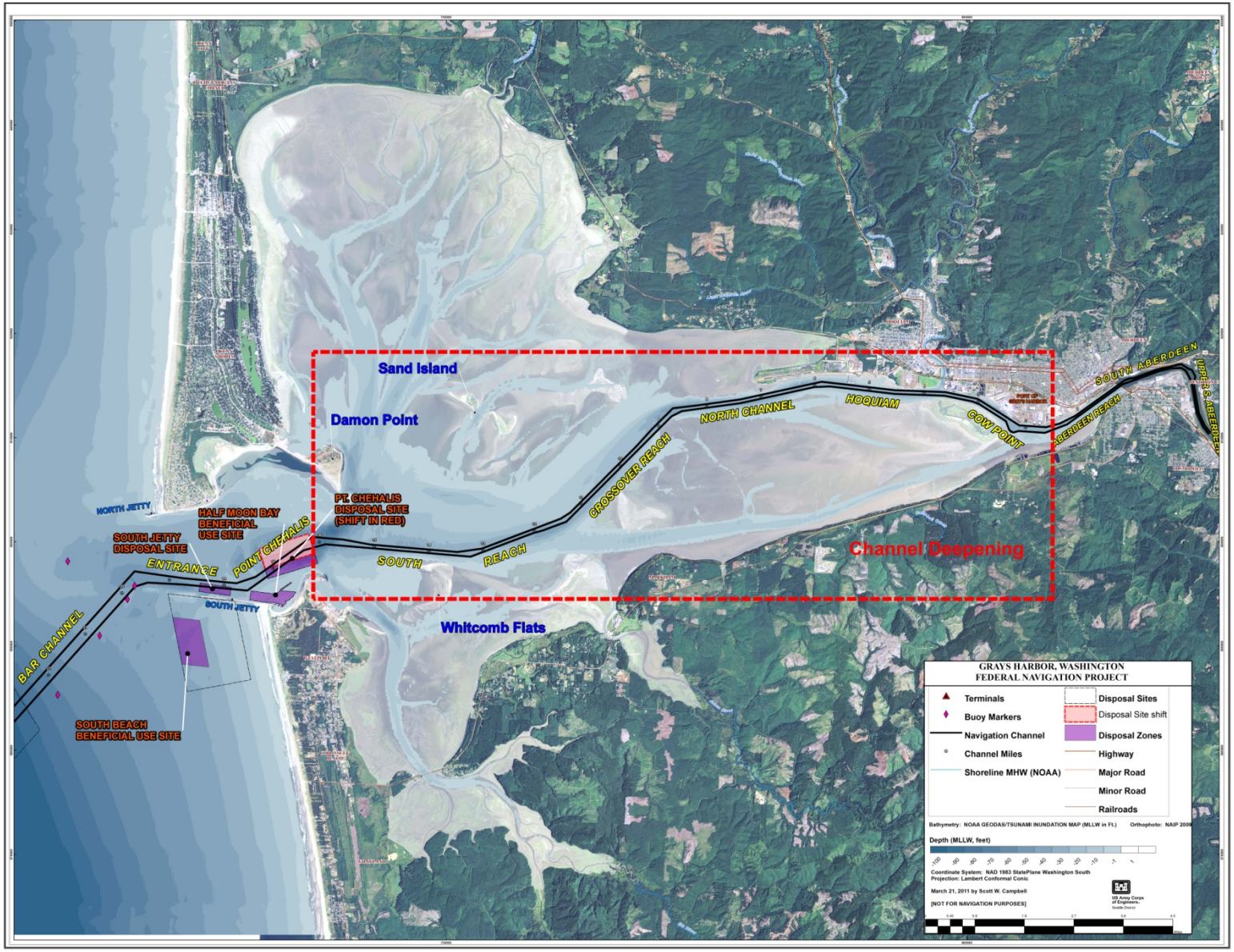

Figure 1. Grays Harbor Navigation Channel maintained reaches, segments proposed for deepening, and material placement sites.

5. <u>Significant Degradation, Either Individually or Cumulatively, To the Aquatic Environment</u>

a. Impacts on Ecosystem Function. Dredged material placement will disturb habitat at the Grays Harbor navigation channel designated placement sites. The dredged material placement will be localized to previously disturbed areas except for the shifted location of the Point Chehalis site. The new area of placement is immediately adjacent to the previously used site and has all of the same physical and biological characteristics that make the standard site a viable material placement site, which includes the depth and relatively high rate of dispersive hydrodynamics. The disturbance period will be of short duration at each location (where and when the dredge is operating for a temporary impact at each site). Relatively quiet underwater noise levels associated with placement will be well below disturbance thresholds used by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) to identify potential adverse effects on fish, diving birds, and marine mammals. Low-mobility aquatic invertebrates common to Grays Harbor can typically recolonize areas of disturbance; these disturbance episodes will not coincide with high-use habitat areas used by juvenile salmonids and sturgeon. Impacts of placement operations on salmonids, forage fish, and Dungeness crabs will be reduced and/or avoided through implementation of timing restrictions. Due to these measures, impacts on these economically important resources will not be significant either individually or cumulatively.

b. Impacts on Recreational, Aesthetic, and Economic Values. No significant adverse effects on recreation, aesthetics, or the economy are anticipated from the channel-deepening proposal, nor have these types of effects occurred during previous routine dredging operations.

Findings. The Corps has determined that there would be no significant adverse effects to aquatic ecosystem functions and values. The proposed action will not cause significant degradation, either individually or cumulatively to the aquatic environment.

<u>6. Appropriate and Practicable Measures to Minimize Potential Harm to the Aquatic Ecosystem.</u>

a. Impact Avoidance Measures.

To avoid impacts to the aquatic ecosystem, the Corps has recently instituted a minor channel re-alignment from South Reach to Hoquiam Reach, to take advantage of greater scour from river and tidal currents. The scour is expected to reduce the volume of material accumulating and is expected to significantly reduce dredging and material placement needs from this portion of the navigation channel. The location of the re-alignment would reduce dredging in Dungeness crab habitat and would thus avoid and reduce impacts on crab.

For another means to avoid aquatic impacts, the Corps investigated opportunities for upland disposal. The total quantity of material that will be placed by implementing the preferred alternative is 4,062,000 cubic yards. Placing material upland at the Point Chehalis Revetment Extension mitigation site would only provide disposition for an additional 200,000 cubic yards. This alternative is not a practicable solution for disposal of the vastly larger volumes that would be aquatically placed, as the capacity is only 5% of the total quantity of material that will be dredged and placed in the construction year. Furthermore, placement at the mitigation site would come at significant additional expense compared to open water placement. For example, at Willapa Bay, a recent contract averaged a unit cost of $14 per cubic yard to pump material from an offshore borrow site to an upland placement site. Comparatively, the contract unit cost for placement at the existing open water sites averages approximately $5 per cubic yard. No other upland opportunities appear to be available as placement locations for the dredged material to avoid aquatic disposal. No shoreside real estate at the Port of Grays Harbor is available, and no entities have expressed need for marine-derived sediments in upland applications. Additionally, upland alternatives are infeasible from a comparative cost perspective because upland sites are further from the source of the material, would involve mechanical dredging and pumping to a shoreline location, with likelihood for a need for double-handling the material to transport to an offsite location away from the shoreline. Under even more expensive scenarios, entirely distinct and separate dredge and pipeline equipment would need to be mobilized.

Implementation of timing restrictions avoids potential impacts of dredged material placement to juvenile salmonids. No inner harbor dredging will occur during the outmigration period, March 1 through June 14. For the protection of bull trout (*Salvelinus confluentus*), a species listed as threatened under the Endangered Species Act, the Corps does not dredge the Elliot Slough, South Aberdeen, Cow Point, and Hoquiam reaches between February 15 through July 15. This timing restriction, designated by USFWS, is protective of bull trout foraging in the lower portion of the Chehalis River watershed (subadults and adults moving into and out of the estuary).

b. Impact Minimization Measures.

Minimizing impacts in dredge material placement can occur through beneficial reuse of material. For beneficial re-use opportunities, material dredged from the sandy outer reaches of the channel would be used for direct upland beach and nearshore nourishment at Half Moon Bay, and nearshore nourishment at South Beach. The present capacity at the South Beach Beneficial Use Site is approximately 2.5 million cubic yards. However, there are logistical and operational constraints, which limit the amount of sediment that can be placed at South Beach. Typically, the only dredges that can safely place material at South Beach due to that site's exposed location are large class hopper dredges such as the *Essayons*. The *Yaquina* is a small class hopper dredge that is more sensitive to weather, and would lose significant dredge production to transit time by placing material at South Beach. Finally, the contract bottom dump scows that transport dredge material from the inner harbor typically operate in the harshest weather window (i.e. from October to February) and will not cross the bar to place material at South Beach. As the *Essayons*'s time is shared among all West Coast Districts, the dredging at Grays Harbor is typically performed in April and May, which can be subject to adverse weather limiting use of the South Beach site. In 2013, the *Essayons* was able to place approximately 478,000 cubic yards at South Beach, or roughly 53% of the total volume dredged from the Outer Harbor Reaches by the *Essayons* and *Yaquina*. On average, outer harbor dredging has totaled 1.1 million cubic yards per year. Thus it is assumed South Beach could practicably receive this amount in one dredge year, barring adverse weather and sea state conditions. This means that the balance of the material would have to be placed at South Jetty, Point Chehalis, Half Moon Bay, and the Point Chehalis Revetment Extension mitigation site. Even if the Corps used the Point Chehalis revetment extension site, this site would reach capacity with a one-time placement of 200,000; the Half Moon Bay nearshore site has capacity limitations as well. Through maximizing the use of identified and implemented beneficial reuse opportunities, the Corps is minimizing disturbance of aquatic habitat.

Among the aquatic placement options, to avoid impacting new areas that have never received placement of dredged material, placement would continue to occur at the designated placement sites (Figure 1). According to the 1982 EIS for channel deepening, disposal sites were carefully selected to minimize environmental impacts as much as possible given the project's economic criteria (U.S. Army Corps of Engineers 1982).Two Washington State Department of Natural Resources (DNR) public, multi-user, unconfined open-water dredged material placement sites are located directly adjacent to the navigation channel. These are the South Jetty and Point Chehalis placement sites, located on state-owned aquatic lands and managed by DNR. Use of these dispersive sites ensures that the material remains in the longshore drift cell. The South Jetty site can pose a navigation hazard in heavy seas due to its proximity to the rock jetty and prevailing wind and waves. The site is used unless there are adverse weather/wave conditions or the site is full, then the Point Chehalis site is used. The Point Chehalis aquatic site is important because it is relatively protected and deep enough to allow for placement when adverse weather conditions can preclude the use of the other sites. Unless site conditions were ideal throughout the dredging process, the shifted Point Chehalis aquatic site or another relatively protected site would be needed to potentially accommodate the entire construction year dredged material (4.06 million cubic yards).

The Corps recently completed a dredged material placement site capacity analysis for the Point Chehalis placement site to estimate short-term and long-term fate of channel deepening sediments and subsequent annual maintenance sediments that could be deposited at this site (Hayter et al. 2012). Based on sediment transport modeling and Sedflume analysis conducted (Demirbilek et al. 2010; Hayter et al. 2012) it was determined that placing all dredged material within the current Point Chehalis Site boundaries may pose an adverse risk to navigation and O&M dredging costs. The unique grain size and other characteristics of dredged material derived from channel deepening make those sediments likely to accumulate within the placement sites at a faster rate than recently accrued material derived from maintenance dredging, based on historical trends of O&M material (Hayter et al. 2012). The federal navigation channel passes through the site and mounding of material can result in loss of channel depth and width without proper site management. Through wave and hydrodynamic modeling, as well as sediment transport modeling, the Corps' conclusion from these analyses is that the most strategic placement of dredged material is to shift the Point Chehalis Disposal Site by 1,000 feet to the north-northwest, without increasing the total area of placement (Figure 2). This shift produces less sedimentation in the navigation channel and less accumulation above authorized channel depths over the course of dredged material placement (Hayter et al. 2012). As a result of the site capacity analysis, the Corps would place dredged material at the Point Chehalis placement site per this recommended shift. This placement site shift would not increase the size of the Point Chehalis Site and would be a one-time shift to take advantage of deeper water and more dispersive hydrodynamics. The 1982 analysis found that the South Jetty and Point Chehalis sites were determined to be the most effectively dispersive sites available for material disposal (U.S. Army Corps of Engineers 1982). Additionally, Hayter et al. (2012) modeling showed that the shifted footprint of the Point Chehalis site would be the most dispersive location for material placement. While there may be opportunity to place 200,000 cubic yards of material at the Point Chehalis Revetment Extension, this is not guaranteed. Therefore, given that no practicable upland alternative exists for the remaining 3.86 to 4.06 million cubic yards, there is no remaining aquatic beneficial use capacity, and the designated sites at South Jetty and South Beach, and Half Moon Bay nearshore will first be utilized as practicable to their full capacity, then aquatic disposal at the shifted, highly dispersive Point Chehalis site (with material remaining in the longshore drift cell) is the least costly and most practicable discharge site that is consistent with engineering and environmental requirements for placement of material dredged under Alternative 3 during the construction year.

Impacts of dredged material placement through hydraulic transport at the Point Chehalis Revetment Extension mitigation site include confining initial placement to above the high tide line, and control of return water to Half Moon Bay to ensure minimization of discharge of suspended dredged material.

c. Compensatory Mitigation Measures.

The Corps has placed oyster shell in crab rearing areas as compensatory mitigation for Dungeness crabs entrained and killed by hopper dredges used in Grays Harbor, based on quantification of the Dredge Impacts Model, and has been participating in the Crab Mitigation Work Group (Work Group) initially convened for the channel deepening that occurred in 1990. The agencies of this Work Group include the Washington State Department of Ecology, the Washington State Department of Fish and Wildlife, the U.S. Environmental Protection Agency, Quinault Indian Nation, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service. The Corps reconvened the Work Group in July 2012, and continues to pursue an adaptive management approach to manage impacts due to dredging operations in Grays Harbor. The primary concern lies with the use of hopper dredges; effects to crabs from dredged material placement has had very few direct studies, but is assumed not as detrimental as entrainment due to crab ability to mobilize away from disturbance and their ability to endure burial, although maximum depth and duration of burial survival have not been definitively determined. Mitigation for Dungeness

crab impacts will be coordinated with the Working Group in order to better define actual population impacts and appropriate, cost-effective, and productive measures of mitigation.

The beach nourishment program is considered a net benefit to the nearshore structure and function and does not require compensatory mitigation.

Findings. The Corps has determined that all appropriate and practicable measures, including impact avoidance, minimization, and mitigation, have been taken to minimize potential harm to the aquatic ecosystem. There are no practicably available placement alternatives that would be less costly and still be consistent with engineering and environmental requirements while meeting the project need for disposition of dredged material.

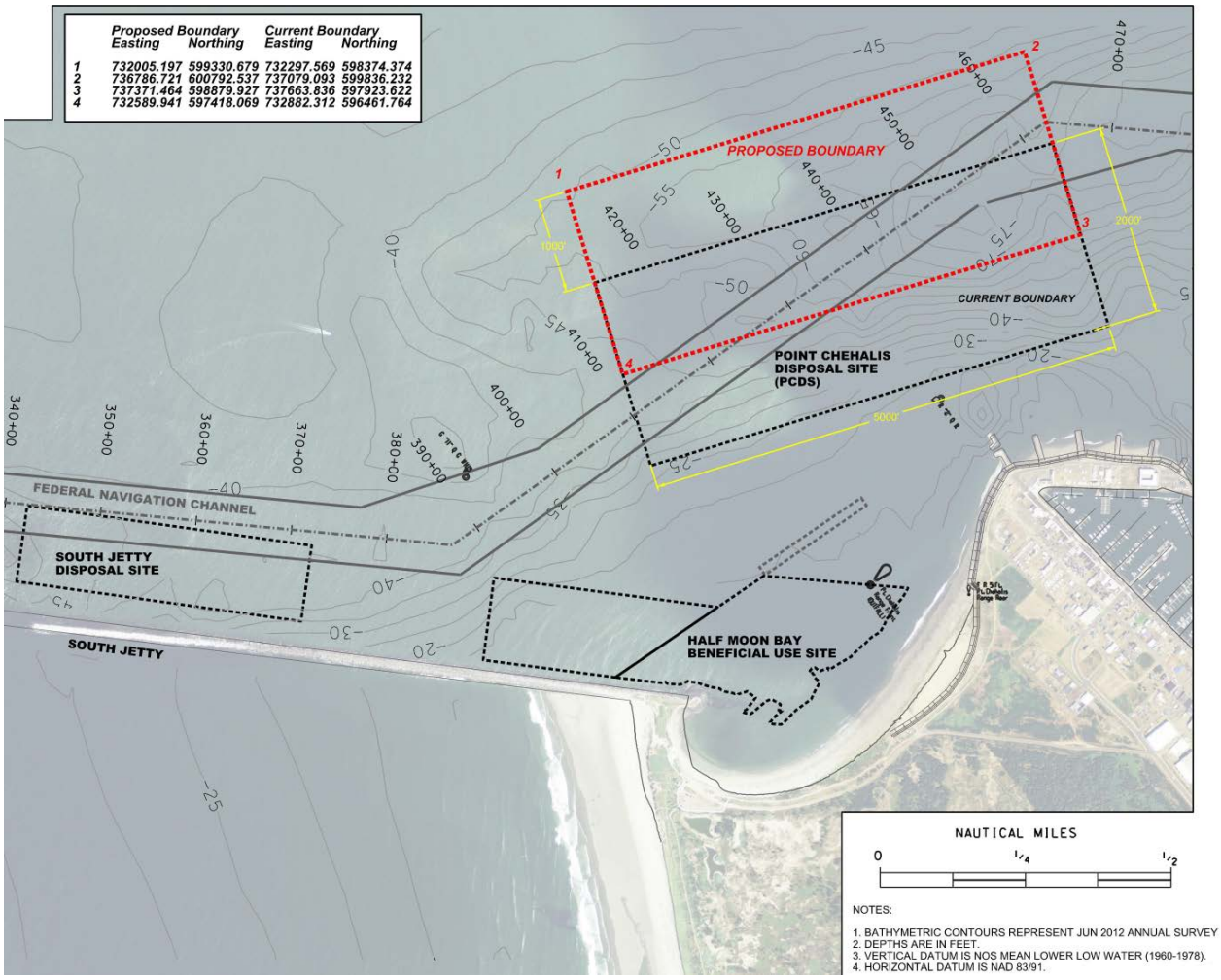

Figure 2. Proposed shift 1,000 feet north-northwest of Point Chehalis Dispersive Site.

7. Other Factors in the Public Interest.

a. Fish and Wildlife. The Corps has coordinated with State and Federal agencies, as well as the Quinault Indian Nation, to assure careful consideration of fish and wildlife resources. The Corps will assure full compliance with the Endangered Species Act prior to project implementation.

b. Water Quality. The most recent Washington Department of Ecology Water Quality Certification for maintenance dredging and material placement was valid through June 2019. The Corps obtained a Water Quality Certification for the proposed action on June 13, 2014. The Corps will abide by the

conditions in the Water Quality Certification to ensure compliance with state water quality standards when conducting activities involving the discharge of dredged material into waters of the United States.

c. Historic and Cultural Resources. Based on the previous cultural resources investigations, the Corps has determined that the prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the area of potential effect of the project. On May 28, 2013, the State's Historic Preservation Office (SHPO) agreed with the Corps determination of no historic properties affected. Since the proposed dredging is confined to the removal of sediments within the previously dredged channel boundaries, no submerged cultural resources are anticipated to be affected by the proposed action.

d. Activities Affecting Coastal Zones. The Corps has determined that this work is consistent to the maximum extent practicable with the enforceable policies of the State of Washington under the Coastal Zone Management Act and has prepared a Coastal Zone Management Act consistency determination for the proposed action for review by the Washington Department of Ecology.

e. Environmental Benefits. Clean, sandy material dredged from the outer reaches will be used beneficially to maintain a stable beach profile in Half Moon Bay and to minimize shoreline erosion along South Beach, when and if necessary.

f. Navigation. A minor, temporary disruption of navigation traffic may result from dredging and placement operations. The Corps will ask the U.S. Coast Guard to issue a Notice to Mariners before dredging and placement operations are initiated. The proposed dredging will deepen the channel to improve efficiency of use and safe navigation by the existing deep-draft navigation vessels that frequent the terminals of the Port.

Findings. The Corps has determined that the proposed action is within the public interest based on review of the public interest factors.

8. Conclusions. Based on the analyses presented in project NEPA and ESA documents, as well as the following 404(b)(1) Evaluation and General Policies for the Evaluation of Permit Applications analysis, the Corps finds that this project complies with the substantive elements of Section 404 of the Clean Water Act.

Potential Impacts on Physical and Chemical Characteristics (Subpart C)

1. Substrate [230.20] Substrate at the open water and beneficial use placement sites consists of fine to medium sized sand grains of marine origin. Materials placed at the beneficial use and nearshore nourishment sites are of similar particle size and shape. Finer river-borne silts from the inner harbor are disposed of at the South Jetty and Point Chehalis placement sites. Bathymetric surveys indicate that most of the material placed at these sites is rapidly transported seaward along the South Jetty. Most dredged material placed at these sites, as well as material placed at the direct beach and nearshore nourishment sites, will enter the longshore drift system. The Cow Point Reach contains a relatively small area of hardpack material that will be broken up in place for removal with a clamshell dredge.

2. Suspended Particulate/Turbidity [230.21] Discharge of dredged material at the open water and direct beach and nearshore nourishment placement sites will cause a temporary increase in turbidity and suspended particulate levels in the water column, particularly in near-bottom water. Sand and most silt sink rapidly to the bottom, while a small percentage of finer material is expected to remain in suspension. Increases in turbidity associated with placement operations will be minimal (confined to the areas in the immediate vicinity of the active dredging and the placement sites during sediment placement) and of short duration (i.e., currents disperse any suspended material within hours of placement (Simenstad 1988; Nightingale and Simenstad 2001). An excavator, as discussed in Section 2.3 and elsewhere in the SEIS, may be used in hardpack areas of Cow Point Reach to break up the hardened material in place. The hardpack material is expected to break into large pieces and remain in place. Sediments that have settled on top of this hardpack material are not expected to migrate a significant distance or cause a turbidity plume because currents in this reach are generally less than 0.5 knots. Material removal is expected to be accomplished with a clamshell bucket, so water quality impacts are projected to be very similar to those described for the clamshell bucket utilized in the inner harbor reaches. Removal with a clamshell dredge is assumed to cause less turbidity than removal with an excavator due to less material overflow from the shape of the clamshell bucket and fewer lifts because the clamshell bucket has more than twice the capacity of the excavator bucket.

3. Water Quality [230.22] No significant water quality effects are anticipated (see number 2 above). Since placement operations consist of a series of instantaneous, discrete discharges over the dredging schedule, any water quality impacts should be short lived (hours) and localized (immediate vicinity). Choker Research measured DO levels within dredge-related turbidity plumes at points ranging from 100 to 150 meters from a dredge operating in the inner harbor reaches. They found DO levels comparable to ambient conditions (Phipps et al. 1992). The differential between DO levels in the dredge plumes and ambient areas were within 1 to 2 mg/L of each other with most readings above 6 mg/L (Phipps et al. 1992), which is considered the threshold for excellent marine water quality (WAC 173-201A-210). The sediments to be dredged have been tested and approved for open water placement, except for one subunit in the Cow Point Reach (CP32a), under the guidelines of the Dredged Material Management Program (DMMP) administered by the Corps, EPA, Ecology, and DNR (Appendix A of the SEIS). This material will be placed at an upland location.

4. Current Patterns and Water Circulation [230.23] The placement of dredged materials will not obstruct flow, change the direction or velocity of water flow/circulation, or otherwise change the dimensions of the receiving water body. The beach nourishment material will slowly enter the longshore drift system as it erodes off the beach over several years. Material placed at the dispersive sites will move along the South Jetty.

5. Normal Water Fluctuations [230.24] The placement of dredged material from the Grays Harbor navigation channel will not impede normal tidal fluctuations. South Jetty and Point Chehalis are dispersive placement sites, meaning that rapid seaward erosion of placed material occurs.

6. Salinity Gradients [230.25] The placement of dredged material from the Grays Harbor navigation channel will not divert or restrict tidal flows and thus will not appreciably affect salt wedge or salinity gradients.

Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)

1. Threatened and Endangered Species [230.30] Pursuant to Section 7 of the Endangered Species Act, the Corps prepared a biological evaluation in 2011 for continued routine maintenance dredging of the navigation channel through 2026. The Corps also prepared a biological evaluation specifically for the proposed channel deepening and subsequent annual maintenance of the deepened channel. The biological evaluation concluded that the proposed action was *not likely to adversely affect* bull trout (*Salvelinus confluentus*); lower Columbia River Chinook salmon (*Onchorhynchus tshawytscha);*Upper Willamette River Chinook salmon (*O. tshawytscha*); Columbia River chum salmon (*O. keta*); eulachon (*Thaleichthys pacificus*); southern green sturgeon (*Acipenser medirostris*); western snowy plover (*Charadrius alexandrius nivosus*); marbled murrelet (*Brachyramphus marmoratus*); southern resident killer whale (*Orcinus orca*); eastern stock Steller sea lion (*Eumetopias jubatus*); and humpback whale (*Megaptera novaeangliae*); and would have *no effect* on the short-tailed albatross (*Phoebastria* albatross), streaked-horned lark (*Eremophila alpestris strigata*), Oregon silver spot butterfly (*Speyeria zerene hippolyta*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), Sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Mexican nesting green sea turtle (*Chelonia mydas*), and Mexican nesting Olive Ridley sea turtle (*Lepidochelys olivacea*).

2. Aquatic Food Web [230.31] Turbidity associated with placement operations may interfere with feeding and respiratory mechanisms of benthic, epibenthic, and planktonic invertebrates. Some sessile invertebrates in the navigation channel and at the dredged material placement sites will suffer mortality from dredge operations. Benthic and epibenthic species characteristic of these sites are typically opportunistic species, often small, tube-dwelling, surface-deposit feeders that exhibit patchy distribution patterns in space and time. Several studies have found that benthic fauna recolonize placement sites quickly (several months), but that the sites may never reach 'mature equilibrium' because of the frequent dredging (Simenstad 1988; Nightingale and Simenstad 2001). More mobile epibenthic organisms are expected to escape the immediate impact area without significant injury. The results of testing conducted in accordance with Grays Harbor/Willapa Bay Dredged Material Evaluation Procedures has demonstrated that populations of fish, crustaceans, mollusks, or other food web organisms will not be significantly affected by exposure to chemical contaminants (Simenstad 1988; Nightingale and Simenstad 2001).

Potential impacts of material placement on salmonids, forage fish, and Dungeness crabs will be reduced and/or avoided through implementation of timing restrictions and restrictions on the type of dredge equipment (i.e., only clamshell dredging in the inner harbor reaches). The Corps is investigating alternative crab impact compensation methods that would be self-sustaining and less costly than the current shell placement and monitoring program, and will coordinate with the Crab Working Group under the RCMSA.

3. Wildlife [230.32] Proposed dredging of the navigation channel would have minimal impact on waterfowl, seabirds, shorebirds, and other bird species that may forage or loaf in the vicinity, especially when considering the total amount of habitat available in Grays Harbor relative to the amount and type of open water habitat affected by placement of dredged material. Birds may forage or loaf in open water areas around the navigation channel, or use intertidal mudflats exposed during low tide conditions that are within the limits of measurable noise effects. Although these birds may be exposed to in-air and underwater noise from dredging activity that exceeds ambient conditions, noise from

maintenance dredging (i.e., baseline conditions) has not been found sufficient to cause injury or behavioral alteration. Analysis of noise levels produced by dredging activity indicates that associated in-air and underwater noise levels are below the disturbance thresholds used by USFWS to establish harassment/injury levels for bird species, including federally threatened and endangered species such as marbled murrelets and spotted owls. Because dredging would occur in the navigation channel and placement predominately occurs at open water dispersive sites, nesting habitat is not affected. WDFW has identified five nesting colonies of seabirds within Grays Harbor. One of these colonies, a small pigeon guillemot colony located on the Point Chehalis Jetty, lies near the navigation channel and Point Chehalis open water placement site. The noise levels produced by dredging are below disturbance thresholds that could cause injury or behavioral alteration in bird species, even at a distance of 50 feet from the source. Consequently, the pigeon guillemot colony and other birds nesting in upland sites near the upland placement areas are not affected by dredging and placement activities.

The presence of dredge vessels and the level of activity and turbidity effects associated with dredging may temporarily displace foraging seabirds and waterfowl from feeding habitats in the open water of the navigation channel. Considering the annual frequency of maintenance dredging and that dredges generally move slowly and the footprint of associated disturbance and noise effects is limited in size, some habituation to boat traffic and disturbance likely occurs. Increases in turbidity during dredging and consequent reduced visibility or foraging success for diving birds in the immediate vicinity of the dredge activities, is localized and dissipates rapidly upon completion of the dredging and/or material placement activities. Any such displacement is of short duration and affects an insignificant amount of foraging habitat relative to the amount available in Grays Harbor and nearby coastal habitats.

Noise generated by dredged material placement at the South Beach and Point Chehalis open water sites may affect marine mammals such as seals, sea lions, dolphins, and porpoises that may be present in the deeper waters of Grays Harbor or near south jetty/Pacific Ocean shoreline. While noise measurements of dredging activities are somewhat rare in the literature, dredging is considered to be a low impact activity for marine mammals, producing non-pulsed sound and being substantially quieter in terms of acoustic energy output than sources such as seismic airguns and impact piledriving (FR 78, 100 30875). Noise produced by dredging has been compared to that produced by a commercial vessel travelling a modest speed (Robinson et al. 2011, as cited in FR 78, 100 30875). The NMFS has generally considered the effects of dredging on marine mammals to remain below the level of a take (FR78, 100 30875). Underwater noise levels produced by maintenance dredging would attenuate to ambient levels within a distance of no more than approximately 600 feet. The species that would encounter dredges in the deeper channel waters are expected to be accustomed to marine traffic and capable of readily avoiding the dredges. Therefore, underwater noise impacts of dredging operations at Grays Harbor are expected to be minor.

<u>Potential Impacts to Special Aquatic Sites (Subpart E)</u>

1. Sanctuaries and Refuges [230.40] The proposed action will not adversely affect any designated sanctuary or refuge area. Bowerman Basin, a wildlife refuge operated by USFWS; two State of Washington Wildlife Recreation areas, Oyhut and Johns River; and three DNR Natural Area Preserves: Sand Island, Goose Island, North Bay, and Chehalis River Surge Plain are located in Grays Harbor but are not in proximity to the navigation channel or dredged material placement sites. No effect to these areas is expected to result from the proposed dredging and aquatic placement operations located in waters of the U.S. One preserve, Whitcomb Flats, is located south of the South Reach of the navigation channel. The proposed action is not expected to have more than a negligible impact on Whitcomb Flats because the migration of Whitcomb Flats is attributed to large-scale morphological changes.

2. Wetlands [230.41] Dredged material will not be placed in wetland areas. Use of the designated open water, beneficial use, and beach nourishment placement sites will not alter the inundation patterns of any wetlands in the project vicinity.

3. Mudflats [230.42] Dredged material will not be placed on mudflat areas. Use of the designated placement sites will not alter the inundation patterns of nearby mudflats.
4. Vegetated Shallows [230.43] Dredged material will not be placed onto or directly adjacent to vegetated shallows.
5. Coral Reefs [230.44] Not applicable.
6. Riffle and Pool Complexes [230.45] Not applicable.

Potential Effects on Human Use Characteristics (Subpart F)
1. Municipal and Private Water Supplies [230.50] Not applicable.
2. Recreational and Commercial Fisheries [230.51] Commercial and sport fishing grounds are located near both the navigation channel and the dredged material placement sites. Dredging and material placement is timed to avoid critical migration periods for salmonids. Oysters are raised commercially on portions of Whitcomb Flats, approximately 3 miles east of the placement areas. The proposed action is not expected to affect these oyster operations. Recreational, commercial, and tribal fishing vessels are required to avoid the immediate area of dredging and placement equipment for safety reasons. The U.S. Coast Guard issues a Notice to Mariners announcing the locations and duration of dredging. The extent of placement of material is small and highly localized at any one time and can be easily avoided, particularly relative to the extent and area of the navigation channel and relative to the size of Grays Harbor available for vessels (particularly at high tide).
3. Water-Related Recreation [230.52] Water-related recreation would benefit from direct beach and nearshore placement at Half Moon Bay. Nourishment of the Half Moon Bay beach changes the areal extent of the various elevation ranges in the bay, with an increase in the shallower profiles. Nourishment will cause waves to break further from the beach, providing a higher quality wave for surfers as waves will break smoother and over a longer distance. The area available for passive recreation activities such as birding, beach combing, and walking will be maintained for such activities and as dune habitat for plant and animal species by this beneficial use placement. Westhaven State Park is the closest recreational area to the dredged material placement sites, located adjacent to the Half Moon Bay placement site and within 1 mile of the South Jetty and Point Chehalis open-water placement sites. The dredged material placed at these sites contains clean silt and sand, and does not cause negative effects to the park. Additionally, placement of dredged material at these sites slows erosion in these areas, which helps to maintain their use for recreational activities.
4. Aesthetics [230.53] Dredging and dredged material placement operations will not change the appearance of the navigation channel or vicinity of the placement sites. Annual maintenance dredging is a regular occurrence for many months of the year in Grays Harbor; work to deepen the channel will only slightly lengthen the total duration of dredging and disposal in the single construction year. A second clamshell dredge and barge would be used as well. The temporary presence of two clamshell dredges working in the channel would represent localized, temporary increases in vessels on the water, as well as temporary and localized increases in noise, and turbidity while equipment is operating, but are expected to be minimal. The temporary presence of barges and dredges on an active shipping channel would represent a minor effect on aesthetics.
5. Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves [230.54] Westhaven State Park is located adjacent to the Half Moon Bay and South Beach placement sites. Placement of clean sands at these sites will slow erosion in these areas, which is considered a beneficial effect. Grays Harbor hosts other wildlife and recreation areas, but these are at a great enough distance from the project to remain undisturbed.

Evaluation and Testing (Subpart G)
1. General Evaluation of Dredged or Fill Material [230.60] The dredged material is predominantly sand and silt. Sediment from the outer reaches required verification that it meets exclusionary criteria specified in 40 CFR 230.60 and is acceptable for open-water placement. The inner reaches required full

sediment characterization, including testing for chemical contamination because the sediments in these reaches contain larger fractions of fine-grained sediment and are closer to historical sources of contamination.

2. Chemical, Biological, and Physical Evaluation and Testing [230.61] Sediments were tested according to Dredged Material Management Program (DMMP) protocol and results were submitted for approval for unconfined open water disposal. The results of this testing are detailed in the DMMP suitability determination for the proposed action (Appendix A of the SEIS). The 2012 suitability determination concluded that all sediment that would be dredged under the proposed action (including in the South Reach), with the exception of the 22,400 cubic yards of material from the Cow Point 32a subunit, is suitable for open-water placement. This material will be permanently removed from the aquatic environment to an upland placement site.

Action to Minimize Adverse Effects (Subpart H)

1. Actions Concerning the Location of the Discharge [230.70] The effects of the discharge would be minimized by using the designated dredged material placement sites that are used for annual maintenance dredging of the navigation channel, along with the shifted Point Chehalis Site. The Point Chehalis and South Jetty sites are open water, dispersive placement sites. The discharge of dredged material at these sites will not disrupt tidal flows, and material will remain in the longshore drift cell. The substrate at the Half Moon Bay and South Beach beneficial use/beach nourishment placement sites is similar to that being discharged (i.e., coarse marine sands). The beach nourishment will not disrupt tidal flows, nor create standing bodies of water. The location and timing of the discharge have been planned to minimize effects to marine organisms.

2. Actions Concerning the Material to be Discharged [230.71] No treatment substances nor chemical flocculates will be added to the materials before placement. The Corps has implemented a minor channel re-alignment from South Reach to Hoquiam Reach to take advantage of greater scour from river and tidal currents to reduce the volume of material that must be dredged annually.

3. Actions Controlling the Material after Discharge [230.72] Methods for reducing the potential for erosion, slumping, or leaching will not be employed, as the intent of the action is to keep material in littoral transport along the project area. The timing of placement will occur within environmentally protective work windows. The Point Chehalis Revetment Extension Mitigation Site consists of berms and dewatering as necessary to control immediate runoff and associated loss of material deposited above the high tide line, but placed material is expected to subsequently erode through natural processes.

4. Actions Affecting the Method of Dispersion [230.73] The placement sites have been selected to make use of currents and circulation patterns to disperse the dredged material. At the beneficial use sites, material will be distributed widely in a thin layer to maintain natural substrate contours. As part of the Corps' beneficial use of dredged materials, dredged materials are used to facilitate a stable beach profile along Half Moon Bay. Initial dredged material placement at the upland Point Chehalis revetment extension mitigation site is restricted to 9 feet above MLLW (the mean higher high water line at this location), pursuant to the Point Chehalis Revetment Extension Mitigation Agreement (U.S. Army Corps of Engineers 1998) to facilitate a more stable beach profile and to avoid nearshore and wetland impacts from material placement at this site.

5. Actions Related to Technology [230.74] Appropriate machinery and methods of transport of the material for discharge will be employed. All machinery will be properly maintained and operated. Ballast management plans have been developed for both government hopper dredges operated by the Corps' Portland District (i.e., the Essayons and Yaquina), which have annual assignments to Grays Harbor. They use both water and partial loads of sand as ballast. The management plans were written to ensure that operation of the dredges complies with federal and state ballast management laws and regulations. When contractor dredges are used, contract specifications require compliance with the Washington Ballast Water Management Act (Revised Code of Washington [RCW] 77.120) and federal ballast water management regulations (33 CFR 151.2000 *et seq*.).

6. Actions Affecting Plant and Animal Populations [230.75] The timing of the proposed discharge operations will minimize the potential for adverse effects to animal populations, particularly Dungeness crab and juvenile salmonids. To avoid impacts on bull trout and out-migrating juvenile salmon, the Corps does not dredge the Aberdeen Reach, Cow Point Reach, Hoquiam Reach, and turning basins between February 15 and July 15. No timing restrictions related to salmonids apply downstream of Hoquiam Reach because the estuary is wider downstream of Hoquiam Reach, so a smaller proportion of the migratory pathway is affected by sediment plumes. Additionally, the relative distance between dredging activities and the shallow subtidal habitat where juvenile foraging occurs is greater**.**

7. Actions Affecting Human Use [230.76] The placement will not damage aesthetically pleasing features of the aquatic landscape. The placement will not increase incompatible human activity in remote fish and wildlife areas. Potential impacts on Native American fishing rights, specifically those of the Quinault Indian Nation, are minimized mainly by timing and gear restrictions aimed at reducing impacts on the target species important to the Tribe (e.g., Dungeness crabs). Impacts on salmon and Dungeness crab are minimized by avoiding times when juvenile salmonids and Dungeness crab are heavily using the inner harbor and restricting equipment to clamshell dredges in the inner harbor reaches.

8. Other Actions [230.77] Not applicable.

<u>Application by Analogy of the General Policies for the Evaluation of Public Interest [33 CFR §320.4 for reference]</u>

1. Public Interest Review [320.4(a)] The Corps finds these actions to be in compliance with the 404(b)(1) guidelines and not contrary to the public interest.

2. Effects on Wetlands [320.4(b)] No wetlands will be altered by the proposed dredging and placement work.

3. Fish and Wildlife [320.4(c)] The Corps consulted the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to ensure that direct and indirect loss and damage to fish and wildlife resources attributable to the proposed work will be minimized.

4. Water Quality [320.4(d)] Through incorporation of the previously implemented minor channel re-alignment, the Corps has reduced the volume of material that needs to be dredged, which will reduce the potential for water quality impacts. Timing of dredging and material placement will help reduce potential temporary local impacts on fish and wildlife due to water quality. The Corps will abide by the conditions of the Section 401 Water Quality Certification issued by Ecology to ensure compliance with Washington water quality standards when conducting activities involving the discharge of dredged material into waters of the United States.

5. Historic, Cultural, Scenic, and Recreational Values [320.4(e)] No wild and scenic rivers, historic properties, National Landmarks, National Rivers, National Wilderness Areas, National Seashores, National Recreation Areas, National Lakeshores, National Parks, National Monuments, estuarine and marine sanctuaries, or archaeological resources will be adversely affected by the proposed work.

6. Effects on Limits of the Territorial Sea [320.4(f)] The proposed work will not alter the coastline or baseline from which the territorial sea is measured for the purposes of the Submerged Lands Act and international law.

7. Consideration of Property Ownership [320.4(g)] Aquatic dredged material placement is subject to the Federal navigation servitude.

8. Activities Affecting Coastal Zones [320.4(h)] The proposed action is consistent to the maximum extent practicable with the policies, general conditions, and general activities specified in the Grays Harbor County Shoreline Management Master Plan, the City of Westport Shoreline Management Master Plan, and the Grays Harbor Estuary Management Plan.

9. Activities in Marine Sanctuaries [320.4(i)] Not applicable.

10. Other Federal, State, or Local Requirements [320.4(j)] The Corps has analyzed the proposed action under all applicable Federal, State, and local requirements and documented this compliance in the Supplemental Environmental Impact Statement.
11. Safety of Impoundment Structures [320.4(k)] Not applicable.
12. Floodplain Management [320.4(l)] The proposed work will not alter any floodplain areas.
13. Water Supply and Conservation [320.4(m)] Not applicable.
14. Energy Conservation and Development [320.4(n)] Not applicable.
15. Navigation [320.4(o)] Placement operations are a necessary part of deepening the navigation channel for use by deep draft ocean going vessels as stated in the purpose and need for the proposed action.
16. Environmental Benefits [320.4(p)] Clean, sandy material dredged from the outer reaches will be used beneficially to maintain a stable beach profile in Half Moon Bay and to minimize shoreline erosion along South Beach.
17. Economics [320.4(q)] The economic benefits of the Grays Harbor Navigation Improvement Project are important to the economy of the local community through improvements in efficiency and safe navigation within the navigation channel for import and export through the Port of Grays Harbor. The Corps finds this project is economically justified.
18. Mitigation [320.49(r)] Potential impacts of dredging and placement operations on salmonids will be avoided through implementation of timing restrictions. To avoid impacts on bull trout and out-migrating juvenile salmon, the Corps does not dredge the South Aberdeen Reach, Cow Point Reach, Hoquiam Reach, and turning basins between February 15 and July 15.

To reduce the volume of material that needs to be dredged from the navigation channel, the Corps has implemented a minor channel alignment modification from South Reach to Hoquiam Reach to take advantage of greater scour from river and tidal currents to reduce the volume of material accumulating in these portions of the navigation channel.

To reduce the potential for damage to crab pots, placement of dredged materials at the Point Chehalis revetment extension mitigation site and the South Beach placement site is coordinated with commercial and tribal crab fishers.

As part of the Corps' beneficial use of dredged materials, dredged materials are used to facilitate a stable beach profile along Half Moon Bay. Initial dredged material placement at the upland Point Chehalis Revetment Extension mitigation site is restricted to 9 feet above MLLW (the mean higher high water line at this location), pursuant to the Point Chehalis Revetment Extension Project Interagency Mitigation Agreement (U.S. Army Corps of Engineers 1998) to facilitate a more stable beach profile and to avoid nearshore and wetland impacts from material placement at this site.

The Corps participates in a Crab Mitigation Work Group (Work Group) to evaluate crab impacts and mitigation. The purpose of the Work Group is to review the Dungeness crab mitigation plan developed for the 1990 deepening project, evaluate crab mitigation efforts to date, and devise a strategy for future mitigation efforts. The agreement limits dredging to only the minimal amount necessary for navigation needs, regardless of government hopper dredge schedules. The agreement also established credit for avoiding impacts on crabs through use of specific dredging methods (i.e., clamshell dredging). The Corps last placed oyster shell in the mitigation sites in 2006 and these mitigation efforts through 2011 have shown to have produced more adult (harvestable age 2+) crabs (as calculated by the DIM) than have been impacted by the deepening and subsequent maintenance dredging (Visser 2012). The oyster shell habitat has been shown to be effective in increasing the density of young of the year crabs (Armstrong et al. 1987; Visser 2012) but this may or may not translate into an increase in age 2+ (harvestable crabs). Creation of additional intertidal habitat for age 1+ crabs in Grays Harbor could provide a much greater

benefit to crab populations than oyster shell. The Work Group continues to meet regularly to discuss this and additional ways to positively influence mitigation efforts, as needed, in Grays Harbor.

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US Army Corps of Engineers®
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix E: 1998 Revised Crab Mitigation Strategy Agreement

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

REVISED CRAB MITIGATION STRATEGY AGREEMENT

US Army Corps of Engineers
US Fish and Wildlife Service
Washington Department of Ecology
Washington Department of Fish and Wildlife
Quinault Indian Nation
National Marine Fisheries Service
US Environmental Protection Agency

Grays Harbor Navigation Improvement Project
Grays Harbor, Washington

September 1998

REVISED CRAB MITIGATION STRATEGY AGREEMENT

for the

GRAYS HARBOR CRAB MITIGATION PROGRAM

Grays Harbor Navigation Improvement Project
Grays Harbor, Washington

September 1998

1. INTRODUCTION

The purpose of this Revised Crab Mitigation Strategy Agreement is to establish a long term agreement among the agencies for further implementation of the crab mitigation effort in Grays Harbor (described below). The Grays Harbor Crab Mitigation work group members, representing their respective agencies, developed this revised crab mitigation strategy to document the mutually agreed-to revised procedures to attain the long-term goals initially established for crab mitigation.

The agreement has been prepared, reviewed and accepted by all members of the Grays Harbor Crab Mitigation Work Group. The agencies, by signing this agreement, concur with and accept this revised crab mitigation strategy.

Nothing in this Agreement alters any state or federal law or regulation. This Agreement merely updates the crab mitigation requirements for the Grays Harbor Navigation Improvement Project from those previously described or practiced, in a manner consistent with the National Environmental Protection Act (NEPA).

2. BACKGROUND

Construction of the Grays Harbor Navigation Improvement Project (GHNIP) by the U.S. Army Corps of Engineers was initiated in 1990. The project construction included deepening and widening 23.5 miles of the existing Grays Harbor channel, enlarging existing turning basins, and deepening existing ship berths. The deepened and widened channel (completed except for the last four upstream miles) is now dredged annually to maintain project depths. The Environmental Impact Statement Supplement (EISS) completed in 1989 for this project recognized significant impacts to Dungeness crab. Mitigation measures were implemented to offset losses to the crab resource.

The crab avoidance and mitigation programs, as described in the EISS, were based on several years of research in Grays Harbor. They were, however, not based on actual dredging or full-scale mitigation experience. In the years since project construction, much has transpired: assumptions basic to the original mitigation calculations and costs have proven incorrect,

dredging amounts and impacts have varied from those expected, and demand for sediment for beneficial uses (erosion control) has altered maintenance dredging practices. This revised crab mitigation strategy is intended to update the Dungeness crab avoidance and mitigation measures presented in the EISS in order to keep the program relevant to current Corps, sponsor and agency concerns and to protect and perpetuate the crab resources of Grays Harbor.

The revised strategy was developed by a work group that met several times from 1995 to 1998. The work group consisted of agency representatives from the Washington Department of Ecology, Washington Department offish and Wildlife, US Environmental Protection Agency, Quinault Indian Nation, US Fish and Wildlife Service, National Marine Fisheries Service, and the Seattle District Corps of Engineers. The purpose of this work group was to review the Dungeness crab mitigation plan developed for the Grays Harbor Navigation Improvement Project, evaluate crab mitigation efforts to date, and devise a revised strategy that could be used for future mitigation efforts.

3. STRATEGY ELEMENTS

The strategy developed was an attempt to balance the cost of Grays Harbor maintenance dredging and mitigation with the associated risk to the Dungeness crab resource. Maximizing avoidance of crab impacts during maintenance dredging and minimizing oyster shell mitigation to replace lost crabs were major objectives of the strategy. Though new methods of mitigation were considered by the work group, no suitable alternatives were identified. The resulting strategy refines avoidance and mitigation methods used in the past in light of six years of biological monitoring, shell placement and dredging experience.

3.1 Impact Avoidance

These strategy elements address maintenance dredging of the Grays Harbor Channel.

1. *Credit for Dredging Method Avoidance.* In accordance with the 1989 EISS, only crabs lost to maintenance of the widened and deepened portion ("incremental maintenance") of the Grays Harbor Channel are subject to mitigation. Thus, crabs lost during dredging of historic ("non-incremental") maintenance amounts are not replaced. Non-incremental amounts are calculated as the mean number of cubic yards (cy) dredged in a given reach from 1981 to 1989. Any changes in dredging equipment that avoid crab in the incremental portion also avoid large numbers of crabs usually lost to non-incremental maintenance. To this end, it is agreed that all crabs "saved" in the non-incremental yardage by use of a clamshell dredge (instead of a hopper dredge) in Crossover and South Reaches would be credited against past and present maintenance impacts. This credit will thus lower the amount of oyster shell mitigation required for the overall project's incremental impact.

2. *Upstream Clamshell Dredging.* All maintenance dredging from upper Crossover Reach (see Figure 1) upstream will be dredged by clamshell dredge.

3. *Downstream Dredge Timing Avoidance Measures.* Dredging in South and Lower Crossover Reaches may be done by any method from the beginning of the calendar year until 31 May. From 1 June to the end of the calendar year, South and Lower Crossover Reaches will be dredged only by clamshell dredge. Bar and Entrance Channel dredging will also be completed by 31 May. Dredge timing may be reconsidered based on future crab population monitoring.

4. *Minimal Dredging.* Only the minimal amount necessary for navigation needs will be dredged, regardless of government hopper schedules.

5. *Emergency Dredging.* Dredging designated as an emergency by the District Engineer will be considered on a case by case basis, following the Code of Federal Regulations (33 CFR 337.7) approval and coordination procedures. Shell mitigation for impacts caused by emergency dredging will follow the same guidelines as impacts caused by non-emergency dredging.

3.2 Oyster Shell Mitigation

These strategy elements apply to mitigation for past and future impacts, both from GHNIP construction and incremental maintenance.

6. *Mitigation Commitment.* Shell placement will be done for impacts remaining from past dredging, and for any future impacts.

7. *Mitigation Plot Assessment.* The production model produced by the University of Washington (Armstrong *et al.* 1996) will be used to calculate future mitigation production. Young-of-the-year crab will be considered "produced" by the shell plots when they reach approximately 15.5 to 19 mm, or the J4 molt (fourth molt after settlement). The same model and production unit will be used to recalculate all past mitigation production.

3.3 Ongoing Efforts

These elements are needed to promote further avoidance measures, and to keep the crab mitigation effort current.

8. *Continued Excluder Development.* As a possible Corps-wide measure to reduce crab impacts, development of a crab excluder device for hopper dredges will continue until it is either 1) considered adequate for use and deployed in Grays Harbor, or 2) considered to be inadequate for sufficient crab avoidance, and not worthy of further development. A work plan will be provided to the crab working group each year that outlines the specific studies and objectives that will be completed during the year. Credit for successful crab avoidance will be based on field trials and determined by the crab work group.

9. *Crab Population Monitoring.* Trawl surveys for population monitoring of crab abundance began in September 1996 and will take place for at least three years. Population density information will be compared with assumptions made in the Dredge Impact Model (DIM), and may be used to reconsider dredge timing (Element 3). The crab working group will review the monitoring information after three years to decide if additional monitoring is necessary.

10. *Continued Re-evaluation.* The crab working group will continue to meet at least semi-annually to reevaluate and/or refine this strategy. Additions and/or modifications to this agreement may be made by the working group via Strategy Implementation Reports attached to updated project EA's.

4. AGENCY CONCURRENCE AND ACCEPTANCE

The following agency officials agree that this revised crab mitigation strategy documents the mutually agreed to revised procedures to attain the long-term goals initially established for crab mitigation in the Grays Harbor Navigation Improvement Project.

SEATTLE DISTRICT CORPS OF ENGINEERS

25 Sep 98
Date

By James M. Rigby
Title Seattle District Engineer

WASHINGTON DEPARTMENT OF ECOLOGY

11-22-98
Date

By Tom Fitzsimmons
Title Director

U.S. FISH AND WILDLIFE SERVICE

12/1/98
Date

By Lynn P. Childers
Title Acting Supervisor

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

11/9/98
Date

By Sara LaBorde
Title Regional Director

AGENCY CONCURRENCE AND ACCEPTANCE, continued

U.S. ENVIRONMENTAL PROTECTION AGENCY

11-19-98
Date

By Chuck Clarke

Title EPA

QUINAULT INDIAN NATION

Date

By

Title

NATIONAL MARINE FISHERIES SERVICE

Date

By

Title

PORT OF GRAYS HARBOR

SEPT. 29-98
Date

By Donald F. Clay

Title EXECUTIVE DIRECTOR

GRAYS HARBOR CRAB MITIGATION PROGRAM

EVALUATION REPORT

US Army Corps of Engineers
US Fish and Wildlife Service
Washington Department of Ecology
Washington Department of Fish and Wildlife
Quinault Indian Nation
National Marine Fisheries Service
US Environmental Protection Agency

Grays Harbor Navigation Improvement Project
Grays Harbor, Washington

September 1998

1. INTRODUCTION

The US Army Corps of Engineers constructed the Grays Harbor Navigation Improvement Project (GHNIP) in 1990. Project construction included deepening and widening 23.5 miles of the existing Grays Harbor channel (Figure 1), creating larger turning basins and deepening existing ship berths. The Environmental Impact Statement Supplement (EISS) completed in 1989 recognized significant impacts to Dungeness crab *(Cancer magister)* due to hopper and pipeline dredging. It also described a plan for minimizing crab impacts and replacing those crab actually lost.

The crab mitigation program, as described in the EISS, was based on several years of research in Grays Harbor. It was not, however, based on actual dredging or full-scale mitigation experience. In the several years since project construction, much has transpired: assumptions basic to original mitigation calculations have proven incorrect; costs used to justify oyster shell placement have risen significantly; dredging amounts and impacts have varied from those expected; and demand for sediment for beneficial uses has altered maintenance practices. All these factors together contributed to a large deficit in the crab mitigation program, with crab impacts rising higher than expected, and crab replacement falling further and further behind.

To address these disparities, representatives from the Seattle District Corps of Engineers, Washington Department of Ecology, Washington Department of Fish and Wildlife, US Environmental Protection Agency, Quinault Indian Nation, US Fish and Wildlife Service, and the National Marine Fisheries Service convened a Crab Mitigation Work Group to evaluate the mitigation program. The purpose of this work group was to review the Dungeness crab mitigation plan developed for the GHNIP, evaluate crab mitigation efforts to date, and devise a strategy that could be used for future mitigation efforts. This Evaluation Report (ER) and Revised Crab Mitigation Strategy Agreement (RCMSA) are the initial products of this work group. They are intended to update the Dungeness crab avoidance and mitigation measures in light of several years of experience, in order to keep the program relevant to current Corps, sponsor and agency concerns and to protect and perpetuate the crab resources of Grays Harbor.

2. BACKGROUND

2.1 Project Construction

Widening and deepening of the twenty miles of downstream reach, from the ocean bar to Port of Grays Harbor Terminal 4 at Cow Point, was started in April 1990 and completed in February 1991. Over 8 million cubic yards (cy) of sediment were removed. The four miles of upstream reach (from Cow Point upstream to 900 feet above the Weyerhaeuser terminal) have not yet been deepened. Recent charges to the upstream portion of the project have reduced the amount of upstream dredging planned from approximately 2.1 million cubic yards to approximately 52,000 cubic yards. This dredging is presently scheduled for 1999 or 2000, depending on the availability of Federal construction funds. Because Dungeness crab are not regularly found in the upstream reaches of Grays Harbor, no additional crab impacts are expected from construction of the final portion of the project.

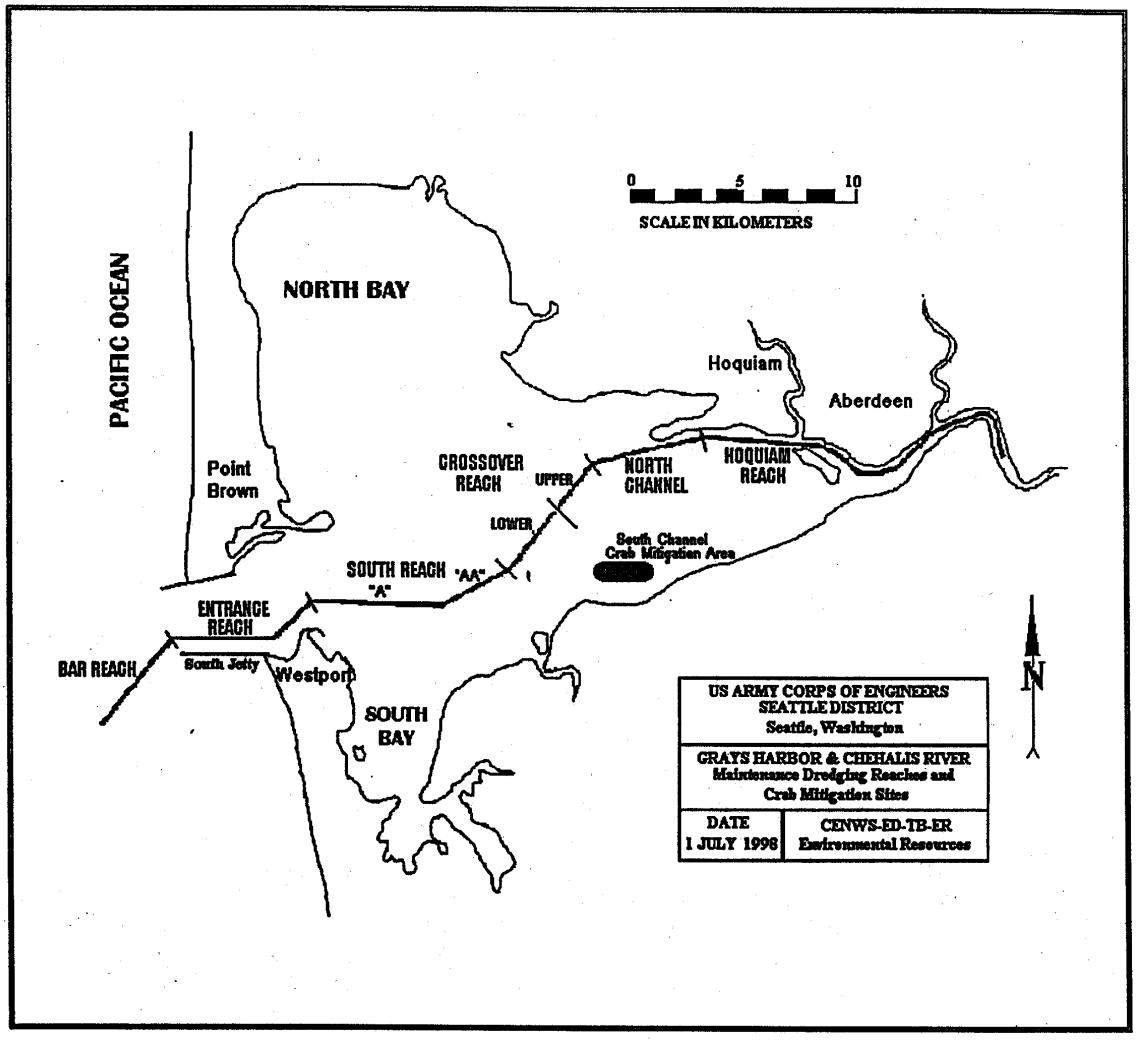

Figure 1. Map of the Grays Harbor Estuary, including dredging reaches and crab mitigation sites.

Mitigation for construction impacts is funded as part of project construction, which is cost-shared with the local sponsor (port of Grays Harbor), and which is assessed and carried out separately from impacts due to project maintenance.

2.2 Project Maintenance

The Grays Harbor Navigation Channel is dredged annually to maintain authorized project depths. The EISS made a distinction between two categories of maintenance dredging: incremental and non-incremental. Non-incremental maintenance dredging is the average yearly volume of sediment dredged from the channel prior to project construction. Incremental Maintenance (IM) is the additional amount of maintenance dredging necessary to maintain the widened and deepened portion of the channel. In the EISS, crab mitigation was required only for IM impacts and not for crabs lost to non-incremental maintenance dredging.

All maintenance dredging, including mitigation for IM crab impacts, is entirely federally funded, and is assessed and carried out separately from impacts due to project construction.

2.3 Crab Impacts

In the years before project construction, a research program conducted by the University of Washington (UW) and Battelle Marine Laboratory investigated Dungeness crab densities and life cycle in the Grays Harbor estuary and nearshore area and the impacts of dredging on crabs. With this data, the UW developed the Dredge Impact Model (DIM) to predict the number of crabs entrained and killed during project construction and maintenance (Armstrong et al. 1987). The DIM incorporates average seasonal crab densities in either upstream or downstream channel reaches with a calculated entrainment rate, natural mortality, and dredge type to estimate the number of crabs lost. During research, crab densities were found to be higher in the outer reaches of the channel (South, Entrance and Bar) than in the inner reaches (Crossover, North Channel, Hoquiam and Cow Point). Also, hopper and pipeline dredges were found to entrain and kill Dungeness crab at a much higher level than did clamshell dredges.

2.4 Crab Mitigation

The Corps addressed the effect of hopper dredging on Dungeness crab by developing both crab avoidance and replacement measures. These measures were presented in the 1989 EISS and included scheduling dredging outside the peaks of high crab abundance and placement of intertidal oyster shell habitat to produce 0+ (i.e. young-of-the-year or YOY) Dungeness crab.

The use of intertidal oyster shell to enhance habitat was based on studies that found higher juvenile crab densities in shell beds than on mudflats (Armstrong et al. 1987, 1988; Doty et al. 1989; Dumbauld and Armstrong 1987; Dumbauld et al. 1993; McGraw et al. 1988). The oyster shell serves as refuge for YOY crab, which settle in late spring and remain in the shell for 2-3 months, then leave the intertidal area for subtidal areas in the estuary or near shore (Armstrong et a1. 1989).

Full scale oyster shell mitigation for Dungeness crab mortalities due to construction dredging began during 1992. Approximately 10,000 cubic yards (cy) of clean oyster shell were spread over 8 hectares (20 acres) of intertidal area in two locations in Grays Harbor that spring. Impacts to crab due to IM dredging began in 1991, and shell plots for IM mitigation have been placed annually from 1994 to 1997. A shell plot for mitigation of additional impacts due to the 1995 Section 111 Beach Nourishment project was placed in 1998. A total of approximately 35 hectares (87 acres) have been placed for these IM crab impacts to date.

3. PROBLEMS

Many aspects of the GHNIP have changed since the 1989 EISS, and many of the original assumptions made about dredging practices and oyster shell mitigation have proved to be erroneous and/or difficult to achieve.

3.1 Dredging Impacts

Construction dredging and crab impacts were approximately what was expected in the EISS. For construction, the DIM predicted that the equivalent number of 2+ crabs lost to dredging would range from approximately 97,000 to 169,000. Actual losses, estimated using crab density data taken monthly during the construction period, were approximately 161,600 age 2+ crabs (Armstrong et al 1991).

Total incremental maintenance dredging amounts have been approximately as they were expected in the EISS, but crab impacts have been much higher (Figure 2.) For IM dredging from 1991 through 1994, the DIM predicted the equivalent loss of 48,000 age 2+ crab. But actual losses to IM dredging from 1991 through 1994 reached almost 162,000 2+ crab (Table 1).

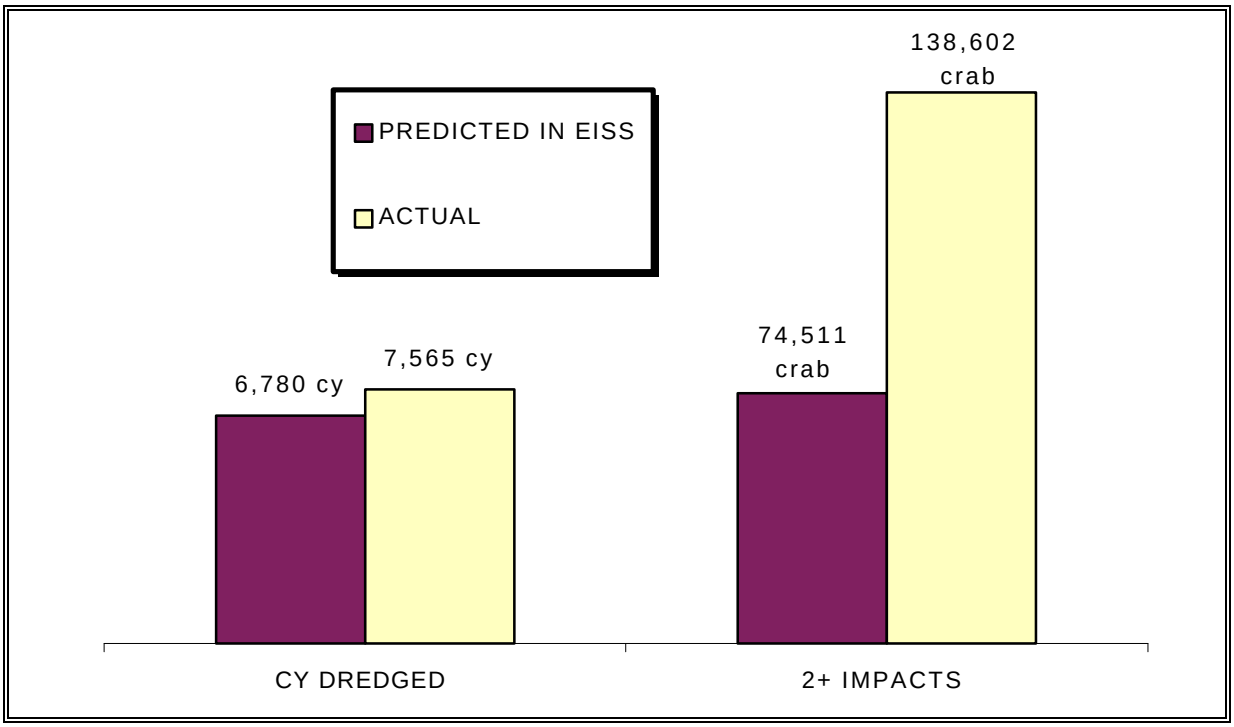

Figure 2. IM dredging impacts, 1991-1997. Although dredging amounts have been only slightly higher, impacts to crabs have been over twice as high as expected in the EISS.

Several factors have contributed to the high number of crab impacts for IM dredging. First, the entrainment rate used in the DIM was changed after the EISS was prepared but before GHNIP dredging began. The entrainment rate, or the ratio of available crabs actually picked up with sediment during dredging, is an important factor in the DIM and significantly affects results (Conquest 1989). It was changed based on collection of additional data and analysis by outside statisticians. Although the entrainment rate was increased only slightly, this change resulted in higher crab impacts per cubic yard dredged than was estimated in the EISS, and these increases have added up over time. Almost 50% of the unexpectedly high impacts can be attributed to this change.

The second major factor contributing to high IM crab impacts is the season in which outer reaches of the Grays Harbor Channel have been dredged. Based on trawl surveys done during the 1980's, crab densities--and thus crab impacts--are much higher during the summer and fall than during the spring in these reaches. In the EISS, it was assumed that all dredging in South, Entrance and Bar Reaches would be completed by the end of May, and this was one of the mitigation measures planned to reduce crab mortalities. In reality, and for many complex reasons, most dredging in those reaches has been actually accomplished during summer and fall months. These seasonal changes account for most of the remainder of the unexpectedly high impacts.

Table 1. Expected and actual IM dredging and crab impacts for maintenance dredging from 1991-1997. Crab impacts are as estimated by the DIM. Negative impacts can occur with credit given for clamshell dredging (Strategy Element 1).

		CY DREDGED (in thousands)		2+ IMPACTS	
YEAR	**PROJECT**	**PREDICTED IN EISS**	**ACTUAL**	**PREDICTED IN EISS**	**ACTUAL**
1991	O&M	1,140	1,106	13,920	41,610
1992	O&M	1,140	1,932	12,644	50,502
1993	O&M	1,140	958	11,369	31,956
1994	O&M	1,140	682	10,098	12,461
1994	Breach fill	0	600	0	24,978
1995	O&M	740	535	8,827	1,776
1995	Beach nour.	0	6	0	436
1996	O&M	740	1,061	8,827	-1,447
1997	O&M	740	685	8,827	1,744
TOTALS		**6,780**	**7,565**	**74,511**	**164,016**

Some of the dredging outside of preferred spring months was due to use of dredged material for erosion protection projects that were not anticipated during planning for the GHNIP. These projects included the South Beach and Half Moon Bay Berms, South Jetty Breach, and Westport Section 111 Beach Fill. In these cases, dredging schedules were driven by requirements of the nearshore and beach fills and not by potential crab impacts. These projects also contributed to higher impacts in other ways: they required more material than would otherwise have been dredged out of the navigation channel, and there were additional impacts due to placement equipment.

In some cases, dredge scheduling may not make much difference in the total number of crabs killed, but it can make a big difference in the amount of mitigation required. For the 1994 breach fill, much of the dredged material was taken out of the South Reach after routine maintenance had already been done for the year. The following year very little maintenance dredging was necessary, and over a two year period the amount dredged was as expected. If the dredging had

been done evenly over the two years, the amounts would have all been non-incremental maintenance, and would not have contributed to IM impacts. But by dredging the entire amount in one year, the additional amount was entirely IM dredging, and thus required mitigation.

Other reasons that have contributed to dredging during the periods of high crab abundance include problems with scheduling of the government hopper dredges, which often are used for dredging the outer reaches, and the previous belief that oyster shell placement was efficient enough to increase dredging flexibility over adhering to the timing schedule.

3.2 Shell Supply and Price

In the EISS, the shell purchase and placement cost was assumed to be $12 per cubic yard with a ready shell supply that would provide adequate competition. Since project initiation, shell prices have risen dramatically, and shell plot construction has been much more expensive the originally predicted. Cost for building the shell plots has increased by five to eight times over the predicted cost.

3.3 Shell Retention and Maintenance

The original mitigation plan assumed that the shell plots would retain a useful life of eight years, with slightly declining production each year, and with harrowing once after year three that would recover up to 75 percent of any sunken shell. Monitoring results for the shell plots have shown that much of the shell sinks into the mud within the first season, much faster than predicted by the mitigation plan. In addition, harrowing was found during early trials to be infeasible.

3.4 Crab Production on Shell Plots

Based on initial pilot studies, it was estimated in the EISS that each square meter of shell cover could produce ten 0+ crabs. Studies subsequent to the EISS but prior to the first full scale shell placement suggested that crab densities had been previously under-reported, and that densities of 0+ crabs on test plots were typically between 30 and 100 crabs per square meter (Armstrong et al. 1991). Although crab "production" was not defined in the EISS, the Corps and agencies agreed, based on Armstrong's 1991 study, to assume use by 20 crabs per square meter as the basis for deciding how much shell to place. The monitoring plan agreed to at the time of the first shell placement assumed that the total number of 0+ crab estimated to be on the mitigation sites in August of a given year would be the number of crabs produced.

Crab densities proved to be similar to what Armstrong et al. (1991) had predicted--but only during the first summer following spring placement of the oyster shell (Figure 3). Approximately 90% of all crabs produced have been produced in the first year of shell placement. In following years, not only did most of the shell either sink or become buried, the remaining shell produced much lower densities of 0+ crab. No controlled studies have been done to determine the cause for this decline in production, but observation and circumstantial evidence suggest two main reasons. First, remaining shell is often “silted in,” which may reduce the three dimensional complexity of the oyster shell and thus much of its habitat value. Second, by the year after placement, the shell has often been colonized by the green shore crab

(*Hemigrapsus oregonensis*). These crab inhabit the shell plots year round, and evidence suggests that not only do they compete with juvenile Dungeness for available habitat within the shell plots, but settling Dungeness may actually avoid areas already colonized by shore crab (Visser 1997).

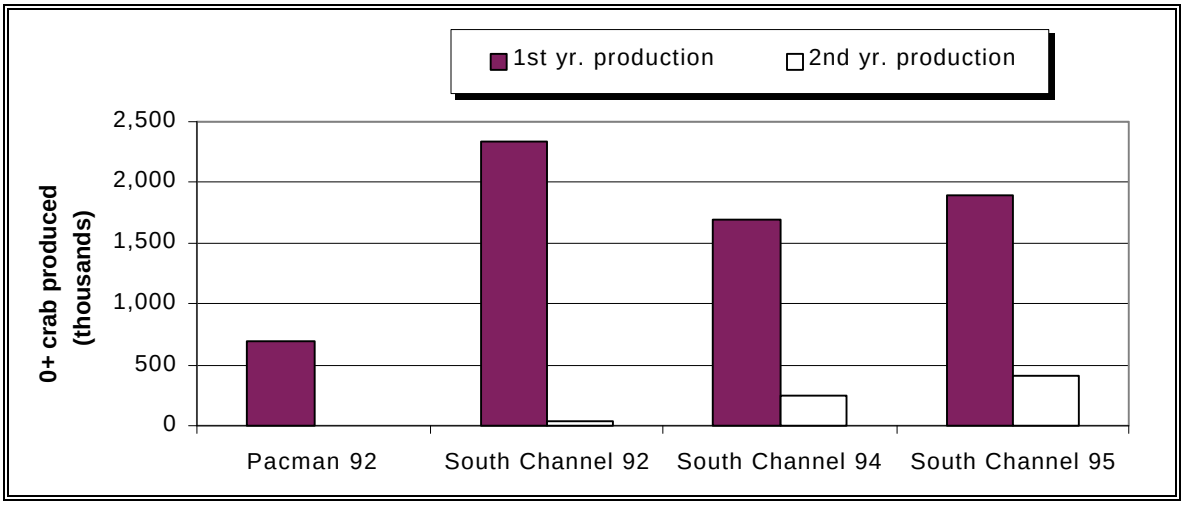

Figure 3. Production of YOY crab drops off dramatically after the shell placement year.

3.5 Land Base Issues

At project conception, it was assumed that each mitigation plot would produce crab for eight years, and then could be covered again with another layer of shell, which again would produce crab for eight years. It was also assumed that suitable land (i.e., mud flats with firm substrate, low ghost shrimp densities, and no eelgrass) would be available for any shell plots needed. With reuse of existing plots, it was initially believed that only 20 hectares of land would be needed for the life of the mitigation program.

But with impacts higher than expected, shell placements only producing crab for one year, and a hesitancy to place new shell on old plots already colonized with shore crabs, the amount of land necessary for shell placement has skyrocketed. By 1995, shell had already been placed on 25 hectares of intertidal land; by 1997 that amount has almost doubled. Because shell sank most rapidly at the North Bay Pacman site, all shell since 1992 has been placed in the vicinity of the South Channel area that was originally identified as suitable. Private ownership of lands to the west of this area preclude additional shell placement there; state lands east and north of the existing area are not easily accessible by placement barges. No other parts of the bay were originally identified as suitable for shell placement. Though there may be strategies to reuse land, or to use land not originally identified as suitable, it is clear that available land may be a limiting factor in future shell placement.

4. STRATEGY SOLUTIONS

The work group was initially formed because it was clear that the crab mitigation program as envisioned in the EISS was not working. The strategy eventually developed by the work group takes into account lessons learned to date in the shell mitigation program and dredging programs. It is an attempt to balance the cost of Grays Harbor maintenance dredging and mitigation with the associated risk to the Dungeness crab resource. Maximizing avoidance of crab impacts during maintenance dredging and minimizing oyster shell mitigation to replace lost crabs were major objectives of the strategy. Though new methods of avoidance and mitigation were considered by the work group, no suitable alternatives were identified. The strategy is based on the following principles:

1. Strategy must address the current mitigation deficit and provide an adequate assurance of minimizing future impacts to Dungeness crab.

2. Strategy must consider problems within the framework of the mitigation agreements in the 1989 EISS. These include assessing impacts with the Dredge Impact Model.

3. Dungeness crabs must be protected to at least the level provided in the 1989 EISS.

4. Economic costs must be considered in the strategy.

5. Strategy must be responsive to new scientific information and technical advances.

The strategy has ten elements that are itemized in the RCMSA. This section documents some of the lessons learned during six years of biological monitoring and shell placement and dredging experience, and describes how the strategy addresses the problems outlined above.

4.1 Dredging Impacts.

4.1.1 Strategy Elements. Because construction dredging impacts are already completed, the strategy elements that address reduction of crab impacts focus on maintenance dredging, as follows.

Element 1. ***Credit for Dredging Method Avoidance***. If a clamshell dredge is used in Crossover or South Reaches, all crabs "saved" in the non-incremental yardage by not using a hopper dredge will be credited against past and present maintenance impacts.

Element 2. ***Upstream Clamshell Dredging***. All maintenance dredging from upper Crossover Reach (see Figure 1) upstream will be dredged by clamshell dredge.

Element 3. ***Downstream Dredge Timing Avoidance Measures***. Dredging in South and Lower Crossover Reached will be done by any method from the beginning of the calendar year until 31 May. From 1 June to the end of the calendar year, South and Lower Crossover Reaches will be dredged only by clamshell dredge. Bar and Entrance Channel dredging will also be completed by 31 May. Dredge timing may be reconsidered

based on future crab population monitoring.

Element 4. ***Minimal Dredging***. Only the minimal amount necessary for navigation needs will be dredged, regardless of government hopper schedules.

Element 5. ***Emergency Dredging***. Dredging designated as an emergency by the Corp's District Engineer will be considered on a case by case basis, following the Code of Federal Regulations (33CFR337.7) approval and coordination procedures. Shell mitigation for impacts caused by emergency dredging will follow the same guidelines as impacts caused by non-emergency dredging.

4.1.2. Discussion.

Clamshell Dredging. Of the 3 million cy of maintenance material dredged annually from Grays Harbor, approximately 65 percent is non-incremental maintenance, and is thus not subject to crab mitigation. This portion of the current maintenance dredging has been responsible for two-thirds of the annual crab loss from dredging entrainment, a loss of 8 to 15 thousand adult Dungeness crab in Grays Harbor each year (US Army Corps of Engineers 1989). Hopper dredging in the South, Crossover, and North Channel Reaches caused most of these losses. A clamshell dredge entrains 95 percent fewer crabs than hopper or suction head dredges. It also kills fewer of the crab that it entrains. Depending on crab size, a hopper dredge can kill up to 86 percent of the entrained crabs, while a clamshell dredge kills about 10 percent of the entrained crabs.

Use of a clamshell dredge in the outer reaches of the channel has always been the preferred method of crab impact avoidance. However, clamshell dredging is not safe or feasible in the Bar and Entrance Reaches, where most of the IM impacts occur. Clamshell dredging is the norm for upstream reaches (Cow Point and Hoquiam) because of water quality constraints and cost. But, although clamshell dredging is theoretically feasible in Crossover and South Reaches, hopper dredging is much lower in cost due to the close proximity of the disposal areas. Also, water conditions get increasingly difficult for a clamshell dredge to perform as dredging proceeds towards the more exposed outer harbor. The "credit" concept is an attempt to offset some of the increased costs of downstream clamshell dredging while avoiding more crabs. Credit is expected to reduce but not eliminate the need to replace crabs lost by maintaining the navigation channel.

Reduced Dredging. In the last few years, the amount of dredging needed to maintain project depths in the outer reaches of the Grays Harbor Channel has declined. This is apparently due to the stabilization of the navigation improvement project side slopes and to long term coastal erosion trends, and it is anticipated that needed dredging will continue to decline. This decreased dredging will greatly reduce crab impacts. However, the clean, sandy sediment found in these reaches is in great demand for beneficial use projects--primarily near shore and on shore erosion protection for coastal communities--and in the past there has been political pressure to dredge deeper than is really needed by ship traffic to obtain these sediments. In addition, the Corps operates two hopper dredges, and Seattle District in the past has been obligated to use and pay for these dredges, whether or not the dredging is really needed for the safety of ships using the channel. Thus, Element 4 of the strategy may seem to be unnecessary, but in fact is an important commitment in the face of competing priorities.

4.2 Crab Mitigation.

4.2.1. Strategy Elements. These strategy elements address the replacement of crabs lost to dredging by oyster shell mitigation.

Element 6. ***Mitigation Commitment.*** Shell placement will be done for impacts remaining from past dredging, and for any future impacts.

Element 7. ***Mitigation Plot Assessment***. The production model produced by the University of Washington (Armstrong *et at.* 1996) will be used to calculate future mitigation production. Young-of-the-year crab will be considered "produced" by the shell plots when they reach 15.5 to 19 mm, or the J4 molt. The same model and production unit will be used to recalculate all past mitigation production.

4.2.2. Discussion.

Commitment. Prior to work group discussions, the Corps requested a re-examination of crab mitigation procedures before doing further shell mitigation, due to the unexpectedly high costs and shell and land limitations. But an analysis done by the University of Washington (Armstrong *et at.* 1996) suggested that counting crabs in August probably has underestimated crab production on the mitigation plots. They developed a model that takes into account multiple crab settlements over one season, and the assumption that crabs leave the intertidal shell plots for subtidal areas when they reach the J4 molt. When crab production was reevaluated with the UW model, it showed that the shell mitigation deficit was smaller than originally calculated. It also showed that shell mitigation for future impacts could potentially be done at a more reasonable price, and with less needed land, than originally believed. With this new understanding, the Corps was able to continue shell mitigation.

Selection of the Production Unit. During negotiations for this strategy, discussions were held to determine a "production unit" or a scientific estimate of what size/age crab were to be considered finished products of the mitigation plots. The "production unit" in this sense was to be the best estimate of the size/age that YOY crabs moved off the plots into subtidal areas. Based on data collected by both the UW and the COE, Armstrong *et al.* (1996) suggested use of either the 13 or 14 molt (the 3rd or 4th molt after YOY crab settle to the substrate). They were unable to select one molt due to discrepancies in data collection methods, and to apparent interannual variations in plot use.

Also relevant to this discussion was the size of crab that was presumed "lost" in the DIM. The group wanted to make sure that crabs replaced equaled crabs lost, at least theoretically. In other words, replacing l00 J4 crabs with 100 J3 crabs would be under mitigating, or vice versa. It was decided that the scientific evidence, as well as personal observations by several members of the group, supported the assumption that most crabs in most years did not leave the intertidal mitigation plots until the 14 molt. This assumption also corresponded with the average size used in the DIM for 0+ lost to dredging.

Production Model. The UW model is basically a simple spreadsheet. The only data needed to

calculate crab production in a given year is the number of 12 crab (9-12 mm carapace width). With a calculated mortality rate from 12 to 14, the model returns the number of crabs expected to live long enough to leave the mitigation plots. These crabs are assumed to be crabs that would not have survived without the mitigation plots, and that will survive at the same rate as other crab produced in the estuary, and are thus "produced" by the mitigation.

4.3 Ongoing Efforts.

4.3.1. Strategy Elements. These elements are needed to promote further avoidance measures, and to keep the crab mitigation effort current.

Element 8. ***Continued Excluder Development***. Development of a crab excluder device for hopper dredges will continue until it is either 1) considered adequate for use and deployed in Grays Harbor, or 2) considered to be inadequate for sufficient crab avoidance, and not worthy of further development.

Element 9. ***Crab Population Monitoring***. Trawl surveys for population monitoring of crab abundance began in September 1996 and will take place for at least three years. Population density information will be compared with assumptions made in the Dredge Impact Model (DIM), and may be used to modify this model. Resulting information may be used for reconsidering dredge timing (Element 3).

Element 10. ***Continued Re-evaluation***. The crab working group will continue to meet at least bi-annually to reevaluate and/or refine this strategy. Additions and/or modifications to this agreement may be made by the working group via Strategy Implementation Reports attached to updated project EA's.

4.3.2. Discussion.

Excluder. A draghead excluder is a modified draghead on a hopper or suction dredge that acts to exclude Dungeness crab and other marine organisms from being sucked up by the dredge. There has been strong support to develop a Corps-wide draghead design that would successfully reduce or eliminate entrainment of marine animals, and this method of avoidance was favored over other mitigation during initial GHNIP discussions. However, initial designs either did not exclude crabs, or could not withstand dredging conditions.

In recent years, the Corps' Portland District has led the development of the modified draghead. After several years of testing and modifications, a prototype excluder has been field-tested and is currently being refined. Preliminary results from field tests in 1994 and 1995 showed that the excluder may reduce crab entrainment (Shaw 1996). The 1994 data showed a reduction in sandlance and fish. The 1995 data showed that the excluder entrained a lower number of 0+ crab, fish, and shrimp. However, for an excluder to reduce crab impacts by any appreciable amount, it must exclude adult and older juvenile crabs as well as 0+ at a fairly high rate of efficiency. The next stage of excluder development is to construct and test a prototype for the largest government dredge, the *Essayons*, and to continue biological testing on that dredge.

Population Monitoring. During the 1980's, much work was done to investigate the abundance and distribution of Dungeness crab in Grays Harbor and near shore areas (Armstrong et al. 1984,1985, 1986; Dumbauld et al. 1987; Stevens and Armstrong 1984), age class distribution (Armstrong et al. 1985,1986), and seasonal movements (Armstrong et al. 1987). Some of the main conclusions from those studies include:

1. no reproduction takes place in the estuary;
2. females extrude and carry fertilized eggs entirely near shore;
3. eggs hatch and zoeal larvae and most stages of the megalopal larvae develop near shore, not in the estuary;
4. advanced stages of the megalopal larvae enter the estuary from May through June;
5. older crab immigrate into the estuary in early summer;
6. significant populations of several juvenile age classes (0+ from megalopal larvae settlement or 1 + crab immigration) use the estuary for one or two summers of growth;
7. crabs emigrate from the estuary in late summer through fall as relatively large juveniles approaching sexual maturity (> 1 +); and
8. crab larvae settle and develop to sexual maturity near shore.

This work established that the Grays Harbor estuary is used by Dungeness crab as a nursery habitat, and that crabs move between the estuary and near shore areas at different life stages. Little is known about when crabs move into and out of the estuary, whether the navigation channel acts as a corridor to concentrate crab during this movement, or if the crab move at certain times based on physical or biological factors. These studies also made it apparent that dredging during seasons of low abundance greatly reduces crab loss.

However, these studies included very few trawls from the Bar Channel, and none at all from the Entrance Channel. For the DIM, South Reach data were averaged with the limited Bar data to estimate densities in all three outer reaches. But these three reaches all have quite different habitat characteristics, and may be used quite differently by crab. Further efforts to assess crab abundance; and movements in these areas will allow hopper dredging to be scheduled more accurately at times when crab impacts could be minimized or avoided, and to make any necessary adjustments to the DIM.

For this element, crab population data is being collected for the Bar, Entrance and South Reaches for at least three years. The purpose of the monitoring is to determine the seasonal abundance of crab (0+, 1+, >1+) in these reaches more accurately throughout the year and over time. Trawls are conducted monthly except when weather and/or safety conditions prevent them. At least four trawls are taken in each reach (South, Entrance and Bar) each month; trawls are split evenly (to the extent possible) between high and low slack tides. Data from the first 2 years of population monitoring is presently being analyzed, and any adjustments found necessary will be made to the trawl program. After three years, data will again be analyzed and decisions about whether further trawl studies are necessary, and if or how to modify dredge schedules, will made by the work group

Continued Re-evaluation. Many factors contribute to the need to make this strategy dynamic. While much is known about crab abundance, distribution, and movement in Grays Harbor, our

knowledge is still far from complete. Some examples of project uncertainty that may contribute to changes in this agreement include:

- The DIM has some parameters based on professional judgment and others with large confidence intervals.
- The estuary is dynamic and may be undergoing changes that could affect Dungeness crab distribution, abundance, and biology.
- Shell prices or other placement prices could change, making mitigation measures more or less expensive.

This element proposes to make the strategy dynamic by considering and adjusting the strategy concepts over time. Issues will be discussed during biennial meetings. Any clarifications, additions, changes, or amendments will be documented via special report, and attached to an updated Environmental Assessment (EA). These reports may be prepared by any member of the work group, although each must be signed by all signatory agencies before taking effect.

5. CALCULATIONS

Many assumptions and details have gone into the calculations that form the basis for this agreement. In this section, those will be detailed to the extent possible so that all methods are available for public and agency scrutiny, and so that future calculations can remain consistent.

5.1 Dredging Impacts

The DIM assesses the number of crab of different age groups lost to dredging, and normalizes these losses to the number of 2+ crab lost. Input includes the number of cubic yards dredged, the reach dredged, and the method of dredging. Other components that are frequently modified are crab densities (when real time data is available) and mortality assumptions (when disposal is other than in open-water sites).

To calculate impacts, only incremental maintenance amounts dredged are entered into the DIM. Non-incremental maintenance amounts have been calculated by taking the average maintenance amount dredged, by reach, from 1981-1989. Incremental maintenance is the amount dredged over these thresholds, by reach, in any given year.

Because dredging can overlap seasons, a decision must be made about which season the "incremental" portion of the dredging was accomplished. In all calculations to date, incremental dredging has been spread proportionally across seasons. For example, assume 650,000 cy were dredged from Cow Point in a given year, with half dredged in winter (January-March) and half dredged in spring (April-May). The non-incremental amount allowed in Cow Point is 374,000 cy; the remaining 276,000 cy is the incremental portion and must be mitigated for. In this case, half of the incremental portion (138,000 cy) will be assigned to the winter, and half to the summer.

Dredging credits are also calculated using the DIM. The total amounts dredged by clamshell (in Crossover and South Reaches only) are entered in the model as if the dredging was actually done by hopper. Dredging is assumed to have taken place in the actual season dredged. For example,

if 250,000 cy are dredged by clamshell in South Reach in July, no losses are tallied because none of the dredging was incremental maintenance. But the 250,000 cy is entered in the DIM as if this amount was dredged by hopper in the summer, and the resulting 2+ impacts are subtracted from the total impacts. When the volume dredged in a particular reach is less than its non-incremental volume, then the actual dredge volume is used to calculate the credit. When the dredge volume is greater than the non-incremental volume then the maximum non-incremental volume is used to decide the credit. Dredging credits are then subtracted from dredging impacts.

5.2 Crab Mitigation

The goal of crab mitigation is to return an equivalent number of crab to the crab fishery as were lost to it. These "replacement crabs" are not returned to the fishery in the same year they were lost to it.

To determine the amount of oyster shell habitat required for mitigation, the following steps are followed:

1. The number of YOY crab needed to replace the adults lost to the fishery is determined by dividing adults lost by 0.017, which is the estimated natural survival from settlement to winter of the 2+ year (Armstrong *et al.* 1987).
2. The number of juveniles needed is divided by the average production to get the number of square meters of shell cover needed to produce them.
3. The resulting number of square meters is divided by the number of years of shell plot life. For 1992 and 1994 placements the life of a shell plot was assumed to be 8 years; that assumption has been reduced to one year.
4. Result is amount of area needed for oyster shell mitigation.

6. IMPLEMENTATION PLAN

The RCMSA has been implemented according to the attached plan since the beginning of Fiscal Year (FY) 1997. Status and methods are detailed below.

6.1 Construction

Although no more impacts are expected due to construction dredging, there is still a deficit of crabs killed during initial construction that have yet to be replaced with mitigation. It was estimated that approximately 9.5 million 0+ crabs would be needed to replace all crabs lost to construction. Shell was placed in 1992 to mitigate for those impacts at two sites (Pacman and South Channel) but, through fall of 1997, only about 3.65 million 0+ crabs have been produced at those sites (Table 2).

Settlement of juveniles on the shell plots varies greatly from year to year, due to a multitude of environmental factors that are difficult to predict. Since oyster shell mitigation began, production of J4 0+ has ranged from 6 crabs m^{-2} in 1997 to 65 crabs m^{-2} in 1991. On the 1992 construction mitigation plots, production was approximately 31 crabs m^{-2} on the Pacman site and 40 crabs m^{-2} on the South Channel site. But production has been much lower in recent years on the IM mitigation plots, leading to caution about assuming that a specific amount of production will

occur in any specific time frame.

Table 2. Status of construction deficits and mitigation.

0+ Impacts	0+ Produced	0+Remaining to Mitigate	Approx. ha needed (32 crabs m-2)	Approx. ha Needed (19.5 crabs m-2)
9,503,588	3,646,900	5,856,688	18.3	30.0

Because construction accounts need to be finalized within the next few years, it was necessary to determine an "endpoint" for construction mitigation prior to actual implementation, assuring that impacts are adequately mitigated while defining an end to the Corps' obligation. To this end, an initial plan and contingency plan were formulated. The Corps will initially place 20 hectares of shell over a 2-year period, which will produce the balance of crab mitigation if average crab production (32 crabs m^{-2}) or better occurs. If there is less than average crab production during the two years, shell placement on up to an additional. 10 hectares in the third year will complete the required crab mitigation, irrespective of total production. This contingency plans assumes that average crab production over the three years will be (19.5 crabs m^{-2}). Though production could conceivably fall below this target, the work group agreed that this 50% level of contingency was a reasonable compromise, and that further shell placement beyond 30 hectares would not be required. If there is higher than average crab production during the initial two years, the required mitigation will be met as soon as the necessary crab production is achieved. If more crabs are produced by this placement than are needed to eliminate the construction deficit then the “surplus” will be credited to the IM deficit. The Corps reserves the right to adjust annual placement amounts based on shell availability and other variables within the 20-30 hectare placement discussed above. This effort will complete all crab mitigation requirement for GHNIP construction.

Final crab mitigation will begin in the spring of the fiscal year in which federal construction funds become available (most likely 2000), will be accomplished with one contract, and will take up to three years to complete. After this period, the construction accounts will be closed, and no additional funding will be required for further shell mitigation or monitoring for construction impacts.

6.2 Incremental Maintenance.

6.2.1 Dredging. A two year contract for maintenance dredging was let in 1997 that requires the contractor to abide by all timing and dredging plant restrictions. All future contracts and/or agreements will also require performance in accordance with strategy agreements and objectives.

6.2.2 Mitigation. Estimated future O&M mitigation requirements are much less than in the past for three main reasons: 1) reduction in anticipated maintenance dredging in the outer reaches due to coastal erosion, 2) credit for the clamshell dredging, and 3) the UW formula for measuring mitigation success. Table 3 summarizes all maintenance dredging data collected through 1997, and projects maintenance dredging mitigation requirements until the end of the 50 year project life.

Table 3. Status of IM deficits and mitigation through 1997.

Impact Year	0+ Impacts	0+ Produced	0+ Remaining to Mitigate	Approx. ha needed (32 crabs m^{-2})
1991-1997 (actual)	9,648,000	6,086,472	3,561,528	11.1
1998-2040 (estimated)	4,023,899	0	4,023,899	12.6
Total 1991-2040	13,671,899	6,086,472	7,585,427	23.7

At a rate of approximately 10 hectares per year, IM mitigation will require another three years of shell placement. However, these placement estimates are for planning purposes only and should not be interpreted as the mitigation commitment. As always, the remaining mitigation commitment will be based on the accumulated crab impacts and the number of crab actually produced by the shell plots. Placement years will be coordinated with the work group.

6.2.3. Excluder Testing. Field testing done in 1994 and 1995 was aboard the Corps dredge *Yaquina,* the smaller of 11 the two west coast Corps dredges. But most nearshore dredging, where the majority of IM impacts occur, is done by the larger dredge *Essayons.* Since 1995, a larger prototype of the excluder was built, along with a sampling device for the deck of the *Essayons.* However, planned field sampling in 1996 and 1997 was not accomplished, because the *Essayons* was used in areas of low crab abundance. Sampling has again been scheduled for 1998 on the *Essayons,* and sampling will focus on taking enough samples to test the exclusion of older crabs.

6.2.4. Population Trawling. Monthly trawling samples in the South Reach, Entrance and Bar Channels began in September 1996, and will continue through September 1999. Data collected to date are presently being analyzed, to assure that the sampling design is appropriate for the questions asked, and to identify any early trends.

7. REFERENCES

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GRAYS HARBOR CRAB MITIGATION PROGRAM

ENVIRONMENTAL ASSESSMENT

Grays Harbor Navigation Improvement Project
Grays Harbor, Washington

September 1998

1. INTRODUCTION

The 1989 Final Environmental Impact Statement Supplement (EISS) for the Grays Harbor Navigation Improvement Project (GHNIP), is hereby incorporated by reference. That document described the placement of oyster shell for juvenile Dungeness crab *(Cancer magister)* habitat as mitigation for crab impacts due to channel dredging. It also described some methods for avoiding crab impacts during dredging. Environmental Assessments (EAs) addressing plans and coordination specific to each full scale shell placement were prepared in 1992, 1994, 1995, 1996 and 1997, and those are incorporated by reference. EAs addressing maintenance dredging plans specific to each year have been prepared annually through 1997, and those are also incorporated by reference.

Since 1995, an interagency work group has met to evaluate and update the crab mitigation program. This EA evaluates modifications made by this group to the crab mitigation program, and includes the workgroup's resulting Evaluation Report and Crab Strategy Agreement. All references are available at the Seattle District office for inspection and use in connection with this EA.

2. AUTHORITY

The original Grays Harbor navigation channel was authorized by Congress in the Rivers and Harbors Act of 3 June 1896. Planning studies for the Grays Harbor Navigation Channel Improvement Project were initiated under resolutions dated 21 October and 30 December 1957, of the U.S. Senate Committee on Public Works, and under resolution by the House of I Representatives' Committee on public Works on 16 July 1958. The final feasibility report and environmental impact statement (EIS) was completed in September 1982 and approved in May 1985 by the Chief of Engineers, with minor changes in the recommended plan. The Grays Harbor Navigation Improvement Project was authorized by Congress on 17 November 1986 in Section 202 of the Water Resources Development Act of 1986 (public Law 99-662). The Record of Decision for the final EIS was signed on 18 March 1987. The final General Design Memorandum (DGM) and EIS Supplement (EISS) was approved on 31 March 1989. Copies of the authorizing documents are on file at the Seattle District office.

3. PROPOSED ACTION

The proposed action is as described in the Revised Crab Mitigation Strategy Agreement (RCMSA) attached to this EA, and is intended to mitigate for crab impacts caused by construction and maintenance dredging of the widened and deepened portion of the Federal Navigation Channel. The RCMSA describes methods to avoid and minimize crab impacts during future maintenance dredging. It also describes how crabs not yet replaced for past construction and maintenance dredging impacts, and crabs unavoidably lost to future maintenance dredging, will be replaced. None of the actions described in the RCMSA are new to of the Grays Harbor mitigation program. The RCMSA merely refines methods used in the past in light of six years of biological monitoring, shell placement and dredging experience.

4. ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTION

The RCMSA reduces both crab impacts and oyster shell placement below previous levels, thus reducing environmental impacts of both dredging and mitigation. Environmental consequences of dredging and placing oyster shell on mud are as stated in previous environmental documentation. No impacts to threatened or endangered species will result from the oyster shell placement.

5. COORDINATION

The entire crab mitigation program was reviewed by a group of agency scientists from the Corps, Washington Department of Fish and Wildlife (WDFW), U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology (Ecology), the Quinault Indian Nation (Quinault), the Environmental Protection Agency (EPA) and the National Marine Fisheries Service (NMFS). This Crab Mitigation Working Group met several times from 1995 to 1998 to review dredging impacts and crab production on the mitigation plots, to determine whether the plan as drafted in the EISS was still the desired method of mitigation. The resulting RCMSA and Evaluation Report describe future impact avoidance and mitigation requirements consistent with the evolution of the project.

US Army Corps of Engineers®
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix F: Grays Harbor Navigation Improvement Project, Public Information Meeting Summary, December 5, 2012

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

Transmittal

Date:	December 19, 2012
To:	Joshua Jackson U.S. Army Corps of Engineers, Seattle District
Cc:	Kevin McKeag, U.S. Army Corps of Engineers, Seattle District Steve Martin, U.S. Army Corps of Engineers, Seattle District Torrey Luiting, ICF International Steve Seville, ICF International Sandra Davis, ECO Resource Group
From:	Colleen Lingappaiah Project Manager
Subject:	**Grays Harbor Navigation Improvement Project** **Public Information Meeting Summary**
Client: **Project:** **Project Number:**	U.S. Army Corps of Engineers Grays Harbor Navigation Improvement Project 00567.12
Method of Transmission:	☒ Email ☐ Overnight ☐ Courier
Purpose of Transmission:	☒ Per your request ☐ For your review ☐ For your information or use ☐ Other:
Items Being Transmitted:	Description Grays Harbor Navigation Improvement Project, Supplemental Environmental Impact Statement, Public Information Meeting Summary Attachments: • Attachment 1, Comment Form • Attachment 2, PowerPoint Presentation • Attachment 3, Poster Boards • Attachment 4, Meeting Transcript – December 5, 2012

Grays Harbor Navigation Improvement Project Supplemental Environmental Impact Statement Public Information Meeting Summary

A public information meeting on the Grays Harbor Navigation Improvement Project was held on Wednesday, December 5, 2012, at the Port of Grays Harbor. The meeting took place from 6:30 p.m. to 8:00 p.m. in the Port Commission chambers at 111 South Wooding Street, Aberdeen, Washington. Approximately 30 people were in attendance. Comment sheets were provided for the public to provide written comments, and a sign-up sheet was also available for individuals to request additional information about the project. No one provided written comments at the meeting, and only one person signed up to request additional information about the project.

The agenda for the meeting included a presentation by the U.S. Army Corps of Engineers (Corps), Seattle District project team, followed by clarifying questions and a public Open House. The Corps' project team included Joshua Jackson, Project Manager; David Michalsen, PE, Coastal Engineer; Scott Long, Economist; Kevin McKeag, Biologist; and Don Kramer, Planner. Main topics addressed during the meeting include

- Project Authority,
- Project Overview,
- Dredging and Dredged Material Placement,
- Economic Analysis, and
- Environmental Analysis.

At the end of the presentation, the meeting was opened to questions. Jessica Winkler, Chief, Civil Works Branch, responded to the few clarifying questions that were asked following the presentation. The question that elicited the greatest explanation and exchange of information pertained to the relationship between the Supplemental Environmental Impact Statement being developed for this project and the Grays Harbor Long Term Management Strategy.

Following the presentation, some members of the public remained to review the following poster boards and converse with the project team.

- Project Purpose and Need and Project Description
- National Environmental Policy Act Process and Schedule
- Grays Harbor Navigation Project Features
- Representative Cross Sections of Navigation Channel
- Photos of Dredging and Disposal Site Placement
- 5-Year Growth at Port of Grays Harbor

Copies of the public comment form (Attachment 1), PowerPoint presentation (Attachment 2), and poster boards (Attachment 3) for the meeting are included with this summary. A 21-page transcript of the meeting is also available (Attachment 4).

Attachments

- Attachment 1, Comment Form
- Attachment 2, PowerPoint Presentation
- Attachment 3, Poster Boards
- Attachment 4, Meeting Transcript – December 5, 2012

Attachment 1

Grays Harbor Navigation Improvement Project
Public Information Meeting
Comment Form

Public Comment Form

Grays Harbor Navigation Improvement Project

Supplemental Environmental Impact Statement – Public Information Meeting

Wednesday, December 5, 2012

U.S. ARMY CORPS OF ENGINEERS **BUILDING STRONG®**

What topics/issues are you most concerned about regarding deepening of the Grays Harbor Navigation Channel?

_____

_____

_____

_____

What pertinent information would you like to have considered in the analysis?

_____

_____

_____

_____

What topics would you like to see considered in the Supplemental Environmental Impact Statement (SEIS)?

_____

_____

_____

_____

Continue comments on other side.

To receive information regarding the Grays Harbor Navigation Improvement Project, please provide us with your contact information:

Name:_____

Address:_____

Email: _____

Your comments on the information presented today on the Grays Harbor Navigation Improvement Project **must be received by 5:00 PM, January 4, 2013**, in order to be considered during the development of the Draft SEIS.

Comments may be provided in the following ways:

1) Completing a comment form and depositing it in one of the comment boxes during this Public Information Meeting
2) Mailing your comments and any supporting information to Joshua Jackson at the U.S. Army Corps of Engineers, CENWS-PM-CP, Post Office Box 3755, Seattle, Washington 98124-3755
3) Emailing your comments and any supporting information to: Joshua.L.Jackson@usace.army.mil

OTHER COMMENTS:

Joshua Jackson, Project Manager
U.S. Army Corps of Engineers
CENWS-PM-CP
Post Office Box 3755
Seattle, Washington 98124-3755

Attachment 2

Grays Harbor Navigation Improvement Project
Public Information Meeting
PowerPoint Presentation

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

Public Information Meeting
Aberdeen, Washington

Joshua Jackson, Project Manager
David Michalsen, PE, Coastal Engineer
Scott Long, Economist
Kevin McKeag, Biologist
Don Kramer, Planner

5 December 2012

US Army Corps of Engineers
BUILDING STRONG®

Outline

- Project Authority
- Project Overview
- Dredging and Dredged Material Placement
- Economic Analysis
- Environmental Analysis
- Q&A

Project Authority

The Grays Harbor Navigation Channel Project, including maintenance of the Federal Navigation Channel and South Jetty, North Jetty, Point Chehalis Revetment and Groins is authorized principally by:

- River and Harbor Act of June 3rd, 1896 (29 Stat. 202, Ch. 314),
- River and Harbor Act of August 30th, 1935 (49 Stat. 409, Ch. 831, House Document 53, 73rd Congress, 1st Session),
- as further amended, among others, by the Water Resources Development Act of November 17th, 1986 (Public Law 99-662).

Project Overview

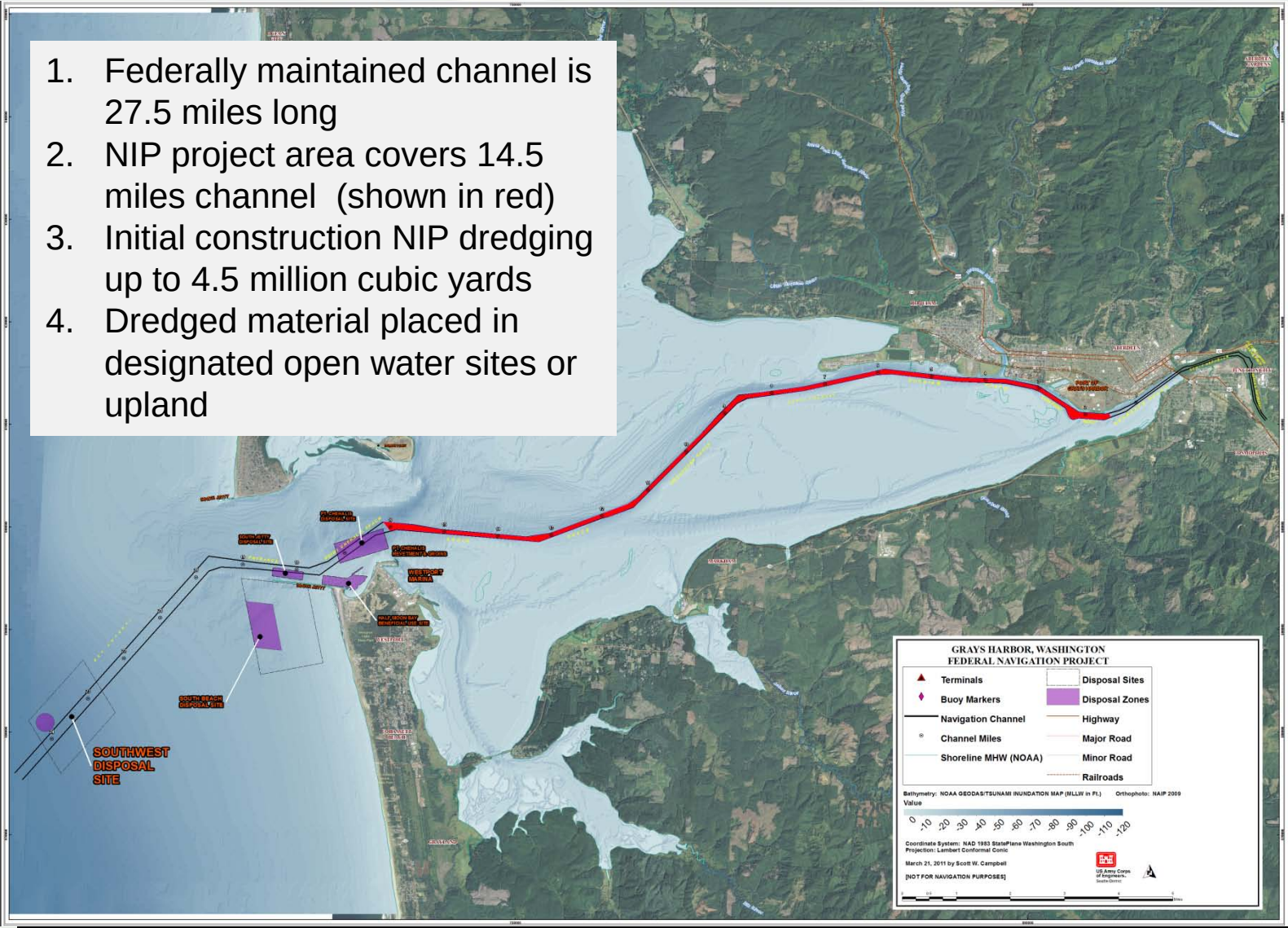
- **1982 – Feasibility Report and Environmental Impact Statement (EIS)** completed for channel improvement below -30 feet mean lower low water (MLLW)
- **1986 - Congress authorized Navigation Improvement Project** from -46 feet MLLW (Outer Harbor) to -38 feet MLLW (Inner Harbor)
- **1989 - Corps completes General Design Memorandum:** recommended deepening to full depth in Outer Harbor and to -36 feet MLLW in Inner Harbor
- **1989 – Corps Completes Supplemental Environmental Impact Statement** (SEIS)
- 1990-1991 - Phase I deepening completed

Project Overview

- **2009 - Reconnaissance 905(b) Analysis and Report:** Documented Federal interest in continuing evaluation of implementing the authorized depth of Inner Harbor to -38 feet MLLW
- **2012-2014 - Limited Reevaluation Report:** Will document analysis of current economic benefits and costs associated with depths of -37 and -38 feet MLLW
- **2012-2014 – Supplemental EIS (SEIS):** Will document the scope and purpose of the project, alternatives considered, and environmental impacts of those alternatives.

Project Overview

1. Federally maintained channel is 27.5 miles long
2. NIP project area covers 14.5 miles channel (shown in red)
3. Initial construction NIP dredging up to 4.5 million cubic yards
4. Dredged material placed in designated open water sites or upland



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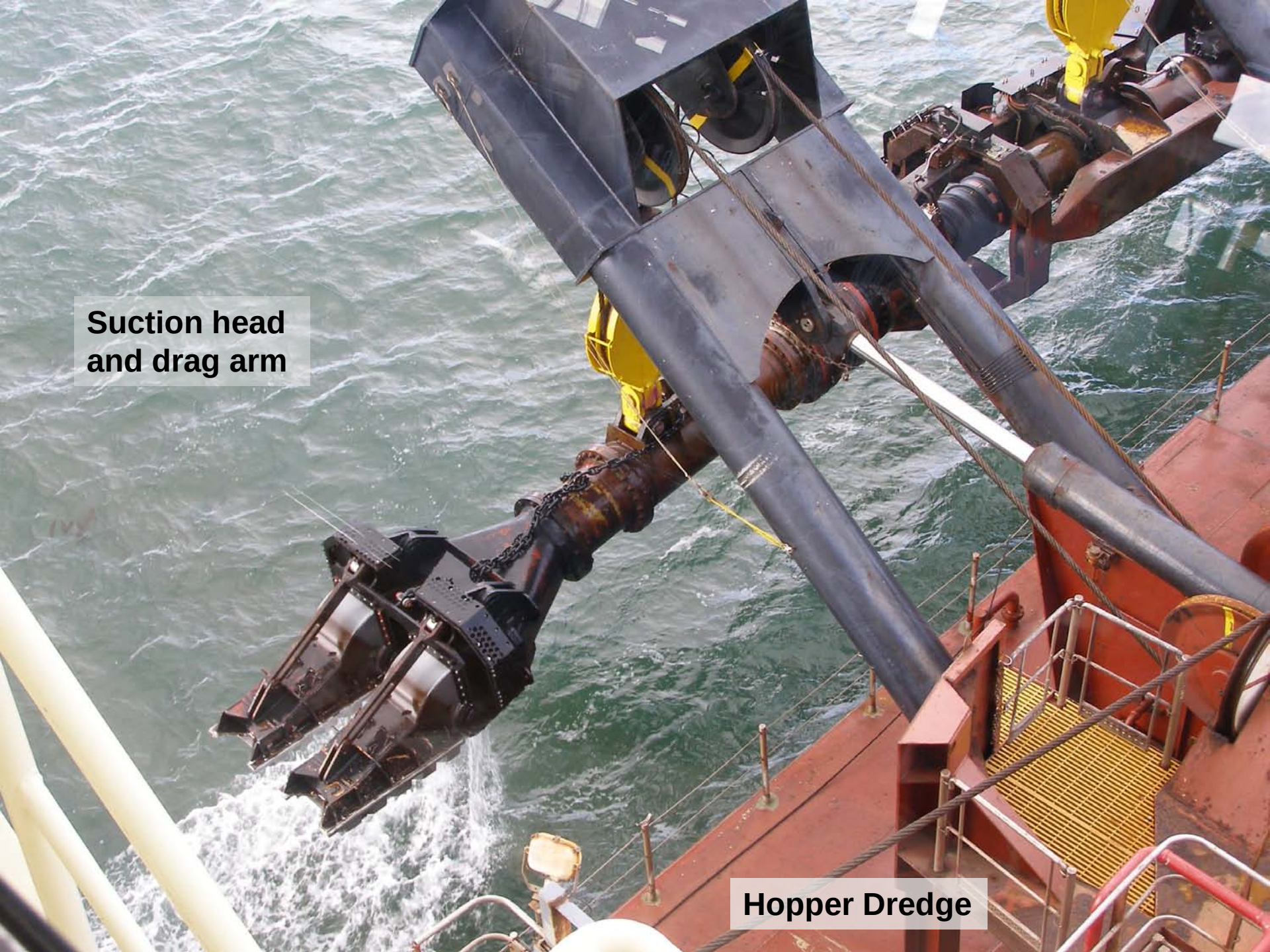
Dredging Definition

Dredge Definition:

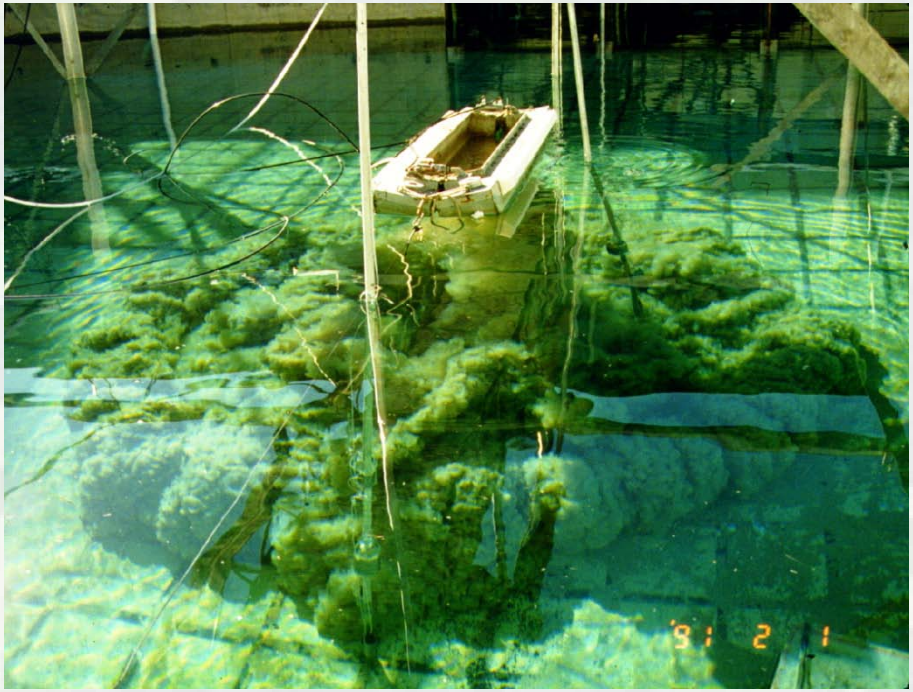
- 1. Any of various machines equipped with scooping or suction devices and used to **deepen harbors and waterways** and in **underwater mining.**
- 2. Nautical: A boat or barge equipped with a dredge.

Scow (bottom dump)
barge
Clamshell dredge
35 cubic yard bucket


Suction head
and drag arm
Hopper Dredge

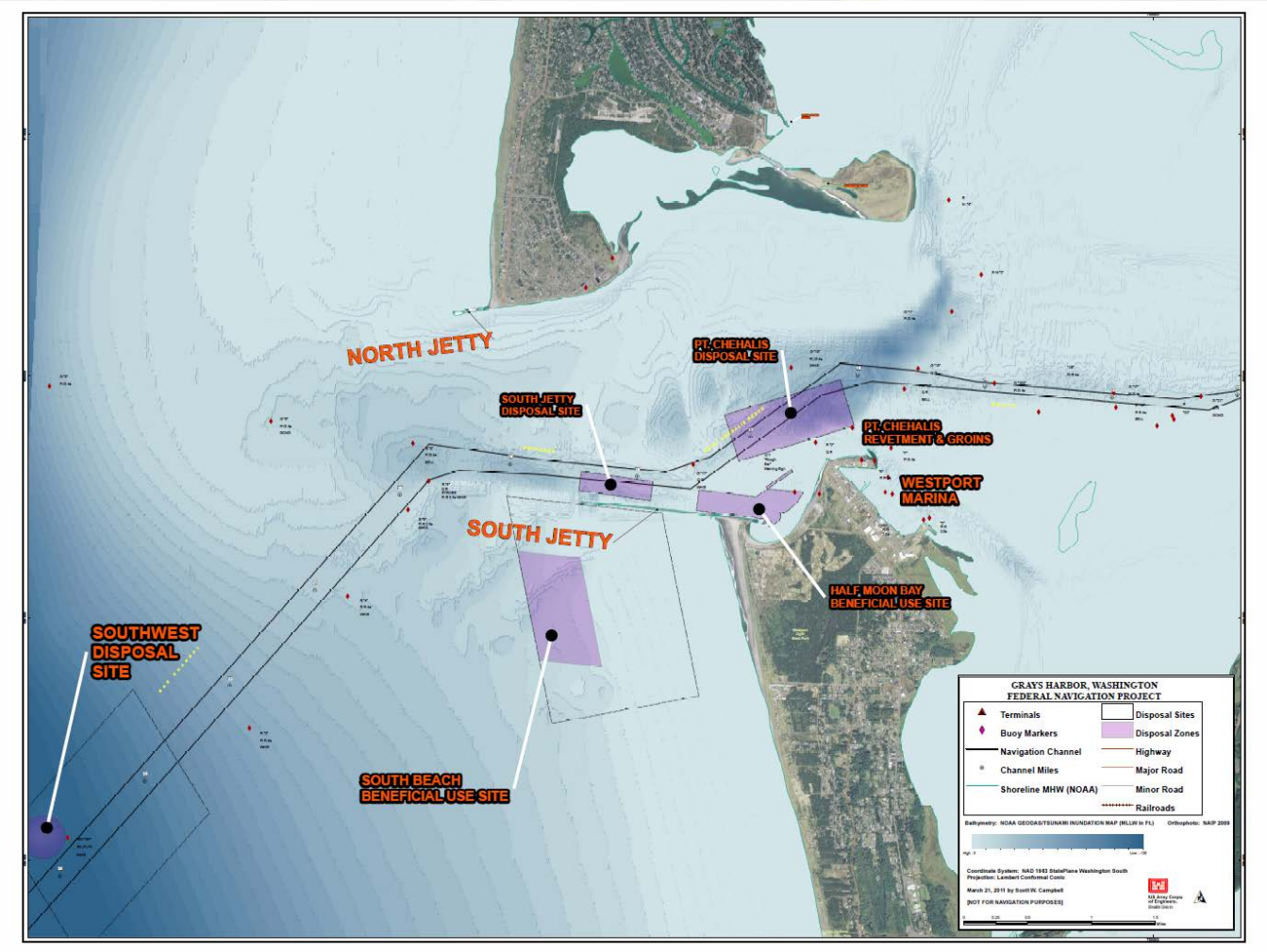
Dredged Material Placement

Open water placement via barge



Upland placement via hydraulic pipeline

Existing Open Water DM Placement Areas



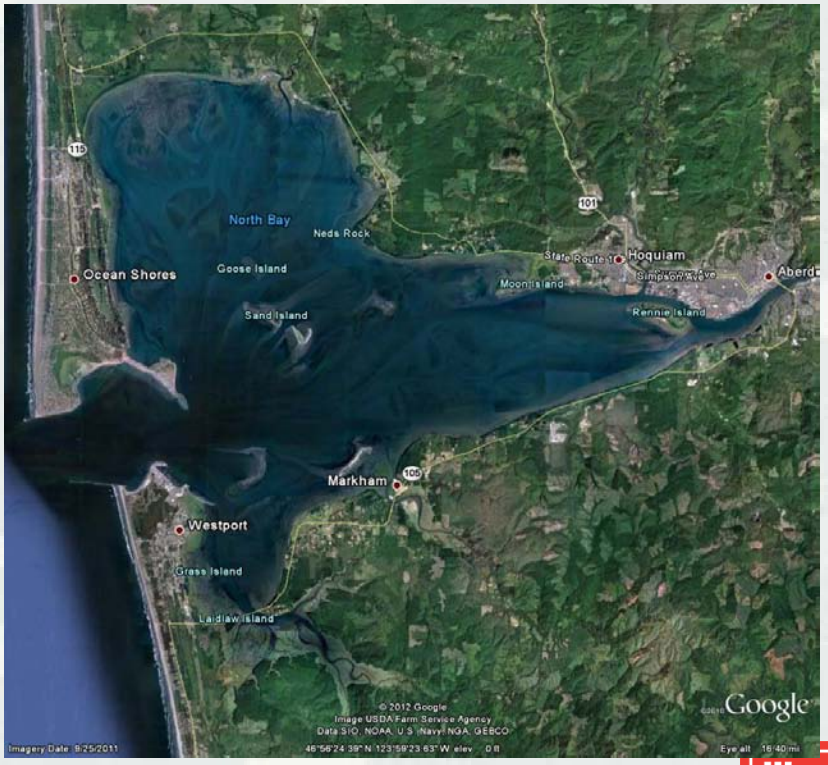
Economic Analysis

- *"The **role** of the U. S. Army Corps of Engineers with respect to navigation is to provide safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation. The Corps accomplishes this mission through a combination of capital improvements and the operation and maintenance of existing projects." -ER 1105-2-100, Planning Guidance Notebook*

Economic Analysis

Symptoms of Problems:

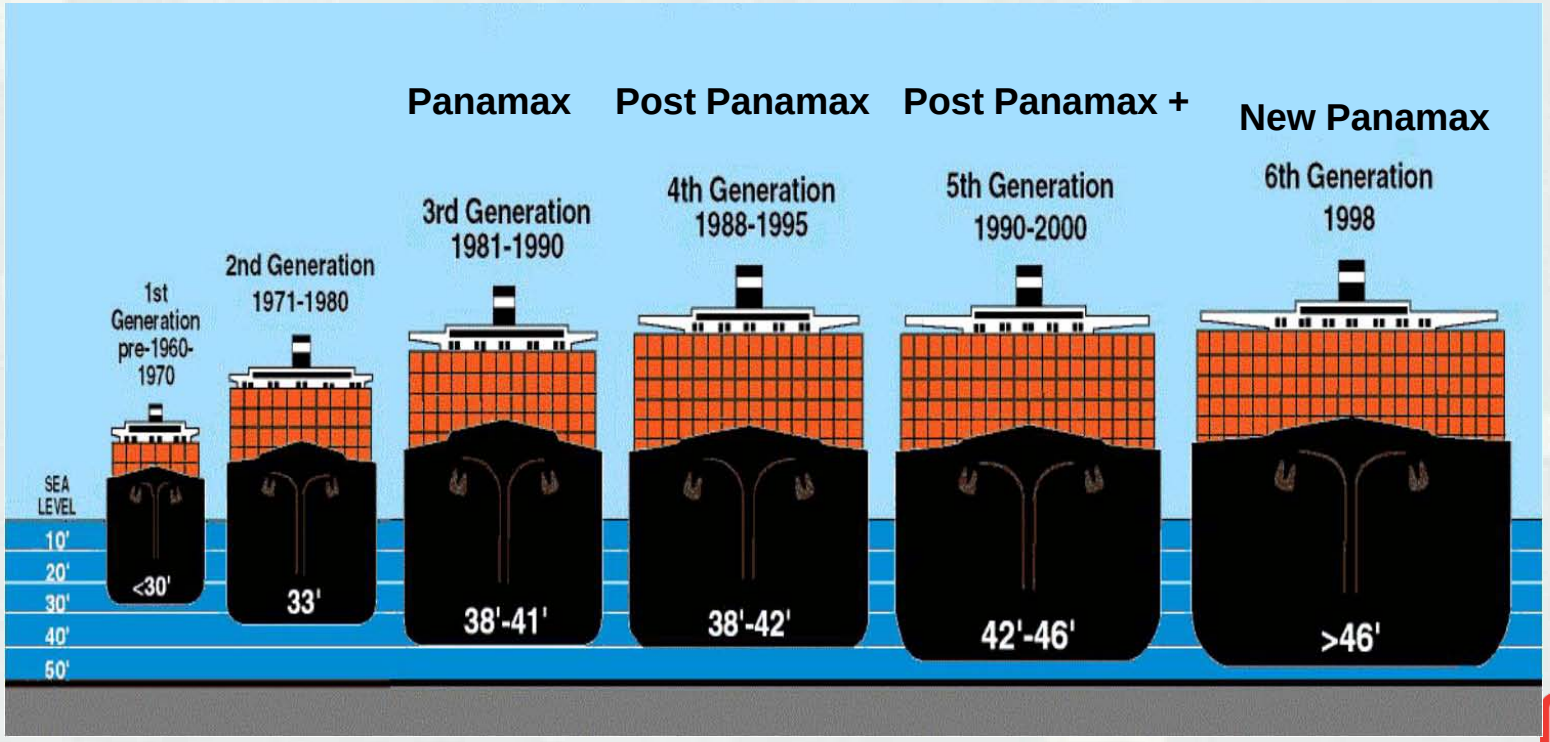
- Physical Condition
- Traffic Delays
- Light Loading
- Lightering
- Safety Issues



Economic Analysis

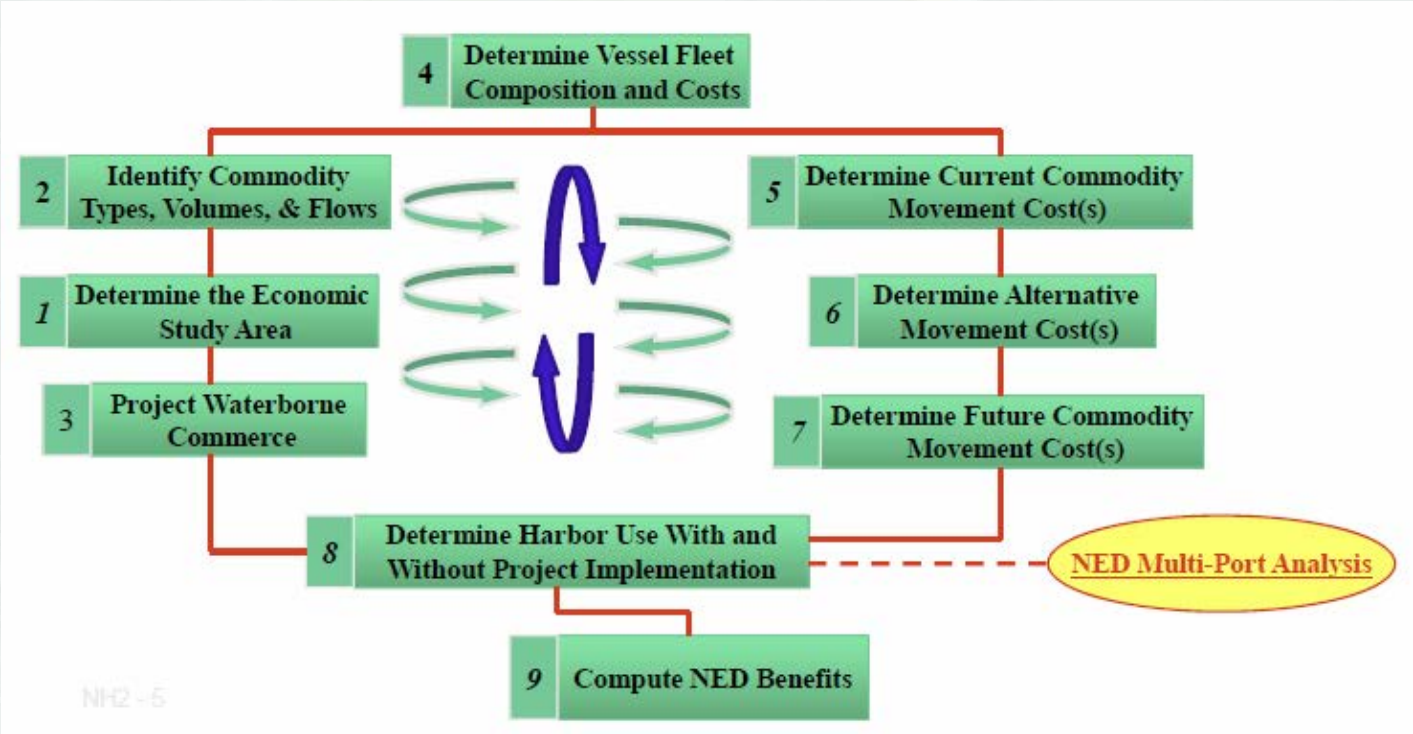
The need for deeper channels:

The Evolution of Ships



Economic Analysis

National Economic Development (NED) Benefits Procedures Deep-Draft Navigation Manual 9 Step Evaluation Process:



Economic Analysis

Information Gathering:

- Types
  - Inventory
  - Forecast
- Uses
  - Defines relevant conditions in planning area under various scenarios
    - Historic (support rapid & sustained growth)
    - Existing
    - Base year
    - Most likely future with a project
  - Identify constraints

Economic Analysis

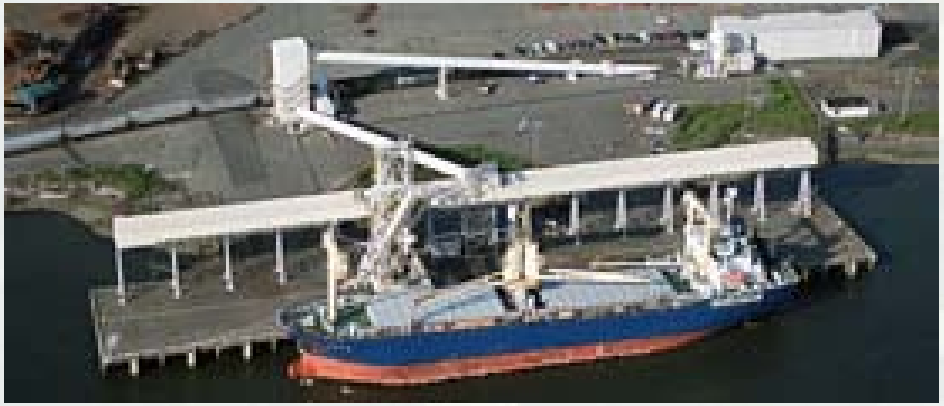
Existing Annual Transportation Costs:

- Ship operating costs
- Origin-to-destination costs
  - Transit costs
  - Delay costs
- Landside/Port costs

Economic Analysis

Port Characteristics:

- Terminals
- Berthing Depths
- Terminal Capacities
- Port Institutions
- Master Plan
- Data source - Port Series & Customs Data



Economic Analysis

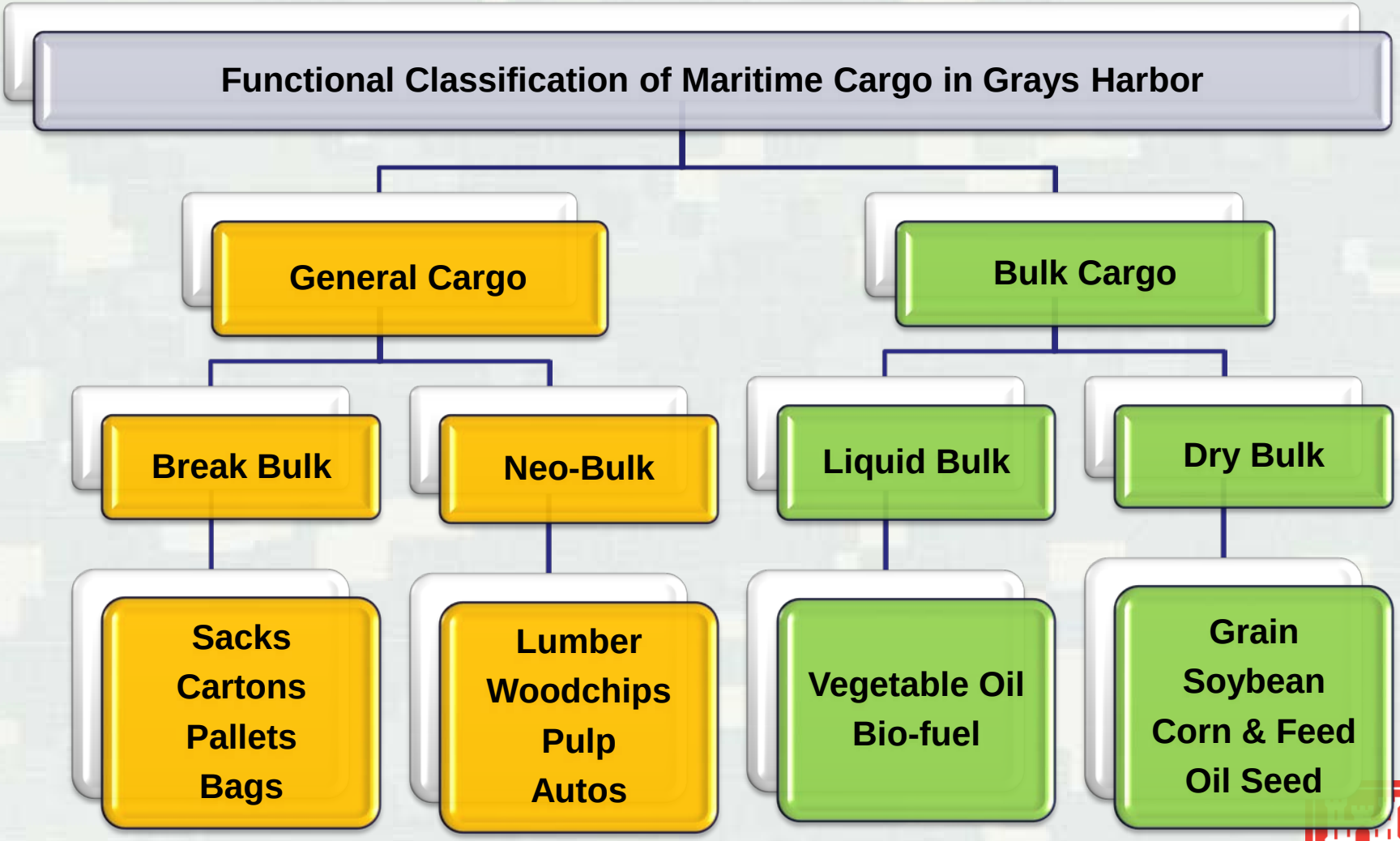
Characteristics for Commodities Affected by Delays/Capacity:

- Population
- Commodity movement
- Alternative mode information
- Trading patterns

Economic Analysis

Cargo:

Economic Analysis



Economic Analysis

Vessel Information:

- Port vessel fleet
- Vessel size data
- Vessel operating drafts
  - limited by general navigation features
  - design versus operating
- Vessel operating costs
- Vessel capacity utilization
- Vessel itinerary
- Light loading analysis

Economic Analysis

Data Inputs:

- Vessel Calls/Characteristics
- Commodity/Cargo Handling Volumes
- Origin/Destination

Economic Analysis

National Economic Development Costs:

- Construction costs (Combined Federal and non-Federal Costs)
  - General Navigation Facilities
    - Project features – tide gauges, jetties, etc.
    - Dredging and disposal
    - Real estate-upland disposal site
    - Mitigation
  - Local Service Facilities
- Operation and maintenance costs
- Interest during construction
- Associated costs

Economic Analysis

NED Benefits – Savings in Transportation Unit Costs:

- Cost Reduction Benefit (same origin-destination and same mode).
  - Reductions in costs incurred from trip delays
  - Increased loads in existing ships
  - Reduction in costs because larger or longer tows
  - Reduction in costs because of using larger ships
- Change in mode benefits
- Shift of origin-destination benefits

Economic Analysis

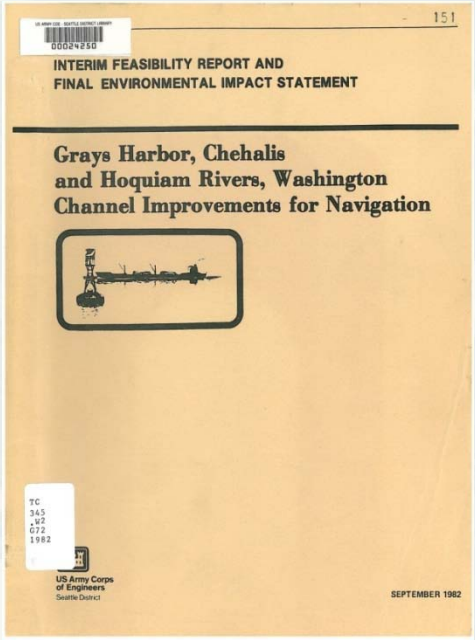
Other NED/NER Benefits (Include, but not limited to):

- Recreation
- Location or land enhancement by filling with dredged material (however, there is no Federal investment in a Corps project that is intentionally or effectively a land development project and projects generally should not use land enhancement as a large incidental benefit)
- Utilization of unemployed or underemployed labor in various markets
- National environmental restoration (NER) benefits, which are generally not monetized but appear in the form of additional acres, habitat units, fish counts, or biodiversity indices

Environmental Analysis

1982 Environmental Impact Statement (EIS) and Feasibility Report:

- ►This initial study established the need for, and environmental impacts of, improving the safety and efficiency of deep draft water in Grays Harbor



Environmental Analysis

1982 analysis included:

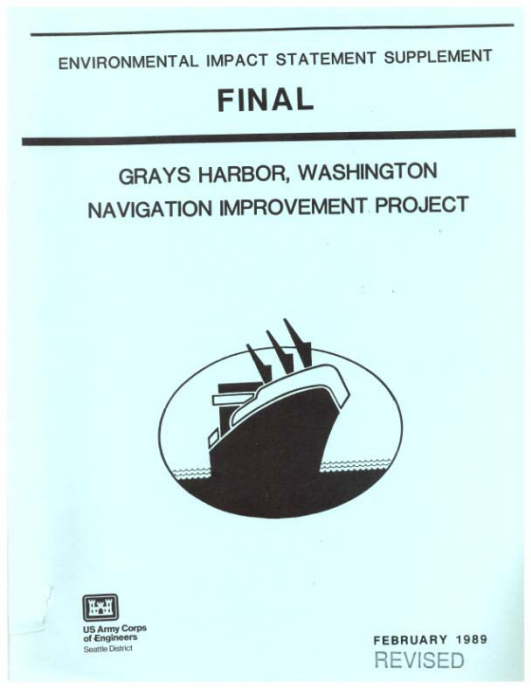
- 24.3 miles of channel improvement (-30 ft to -38 ft)
- Replacement of Union Pacific Railroad bridge
- Mitigation of 4 acres of lost shallow water fish habitat
- Mitigation through dredge modification to avoid crab mortalities from dredging

- 1982 analysis concluded that further study was warranted for crab mitigation, sediment management, and disposal site locations

Environmental Analysis

1989 Supplemental EIS (SEIS):

- Project reduced in scope and environmental impacts
- Presented new information on:
  - ► Crab ecology & mitigation strategy
  - ► Ecological considerations of ocean disposal areas
  - ► Evaluation of sediments
  - ► Native American concerns



Environmental Analysis

1989 SEIS project scope cont.:

- Proposed 23.5 miles vs. 24.3 miles, two turning basins vs. four
- 11.3M cy of dredge material vs. 17.1M in 1982
- Modification of UPRR bridge from swing to lift
- Mitigation for loss of 2 acres of sub-tidal salmon habitat by creation of 4 acres plus 18 acres of buffer zone (Junction City area)
- Placement of oyster shell to mitigate for loses to harvestable Dungeness crabs

Environmental Analysis

New Supplemental Environmental Impact Statement (SEIS):

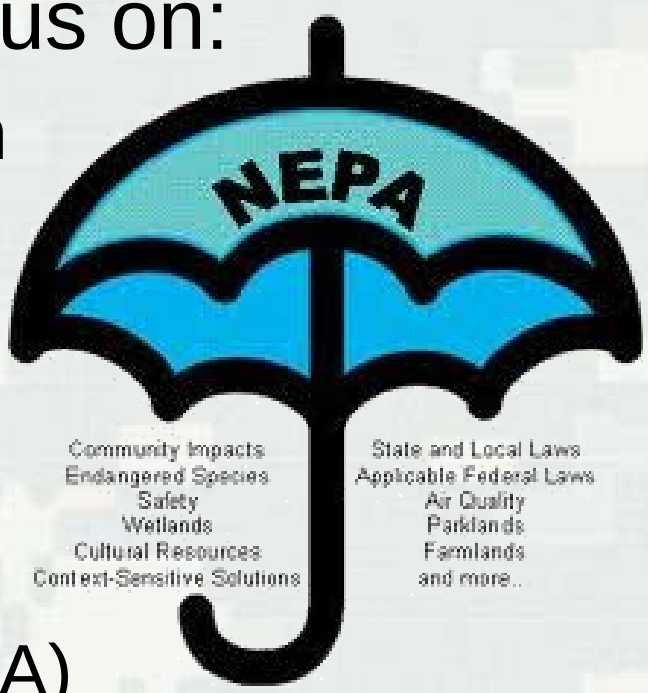
- Supplement 1982 and 1989 documents
- Focus on comparative evaluation and environmental impacts of the selected alternatives

SEIS Alternatives

- **Alternative 1:** No Action, continue maintenance of -36 ft MLLW
- **Alternative 2:** Deepen existing channel within some or all reaches to a depth greater than -36 ft MLLW and less than or equal to -37 ft MLLW
- **Alternative 3:** Deepen existing channel within some or all reaches to a depth greater than -37 ft MLLW and less than or equal to -38 ft MLLW (fully authorized depth)

Environmental Analysis

- The new analysis will incorporate new and updated information and focus on:
  - ►Dungeness crab and shellfish impacts
  - ►Dredged material disposal
  - ►Evaluation of sediments to be dredged
  - ►Native American issues (U & A)
  - ►Endangered species impacts

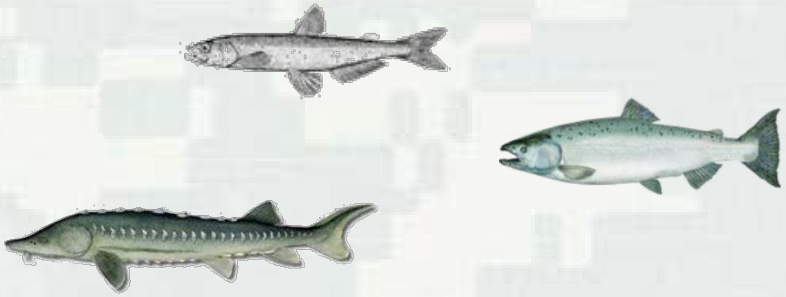


Environmental Analysis

- Opportunities for public input and comment throughout the NEPA process
- The draft SEIS is planned for release in summer 2013
- Another public forum is planned for late summer 2013

Biological Analysis

- In addition to NEPA, a separate Biological Assessment, in consultation with resources agencies, will address any project related impacts to Endangered Species Act (ESA) listed species



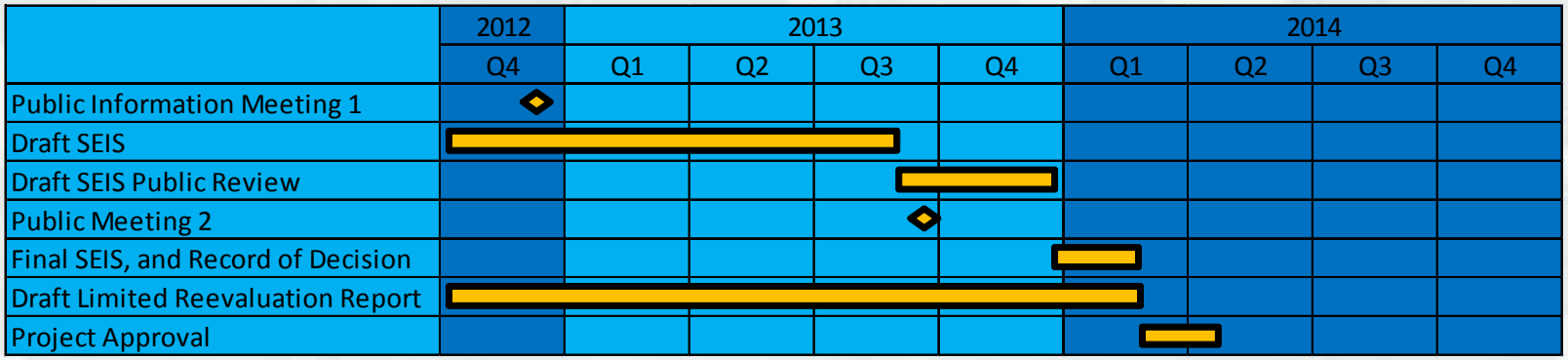
Biological Analysis

Listed Species in Grays Harbor area:

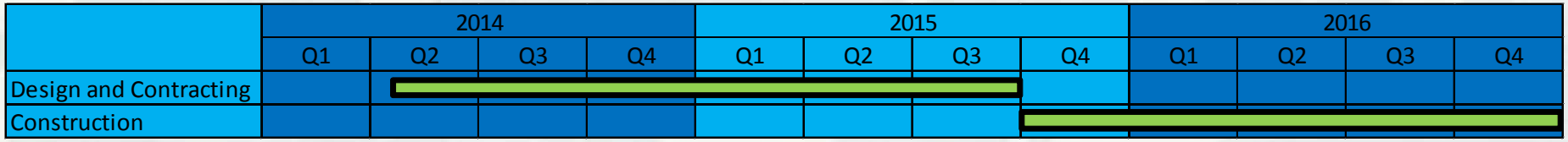
- Coastal/Puget Sound bull trout, lower Columbia River Chinook salmon, upper Willamette River Chinook salmon, Columbia River chum salmon, eulachon, southern green surgeon, western snowy plover, marbled murrelet, eastern stellar sea lion, southern resident killer whale, humpback whale, and leatherback sea turtle

Project Schedule

Feasibility Phase



Design and Implementation Phase (Dependant on Funding)



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Questions?

- Written comments/questions may be submitted to:

  Mr. Joshua Jackson, U.S. Army Corps of Engineers,
  Seattle District, Civil Works Branch
  P.O. Box 3755, Seattle, WA 98124-3755
  joshua.l.jackson@usace.army.mil

- For more information on the project visit:

  www.nws.usace.army.mil

Attachment 3

Grays Harbor Navigation Improvement Project
Public Information Meeting
Poster Boards

PROJECT PURPOSE AND NEED AND PROJECT DESCRIPTION

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

Purpose and Need Statement

The Grays Harbor Navigation Improvement Project (Proposed Project) is located 50 miles west of Olympia on the central coast of Washington. The cities of Aberdeen, Hoquiam, Ocean Shores, and Westport surround Grays Harbor. Based on a General Design Memorandum dated February 1989, the deep draft channel was deepened to -36 feet mean lower low water (MLLW), two feet less than the fully-authorized depth of -38 feet MLLW. The Port of Grays Harbor has requested deepening the channel the additional two feet to better accommodate current vessel traffic for existing Port tenants and commodities.

The purpose of the Proposed Project is to improve the efficiency of deep-draft vessel navigation in Grays Harbor. The Proposed Project is needed to alleviate large vessel restrictions imposed by the insufficient channel depths. Ship transportation in the existing upstream channel is limited by depth. Current depths are inadequate to accommodate vessels with drafts exceeding -36 feet MLLW.

Project Description

The U.S. Army Corps of Engineers (Corps) is investigating the feasibility of deepening the federal navigation deep-draft channel in Grays Harbor from the currently maintained depth of -36 feet MLLW to the fully authorized depth of -38 feet MLLW. The deepening would occur from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located. The Grays Harbor Navigation Improvement Project (Proposed Project) would deepen approximately 14.5 miles of the 27.5-mile channel.

Currently, the Corps removes an average of 1.2 million cubic yards of sediment annually from the channel. The dredged material is disposed of at various approved disposal sites, including open-water disposal at the Point Chehalis, South Beach, South Jetty, and Southwest disposal sites, as well as beneficial use for beach nourishment at Half Moon Bay. Deepening the navigation channel to -38 feet MLLW is estimated to require the initial removal of approximately 1.8 million cubic yards, and would result in removing approximately ten percent more material during annual maintenance dredging. The Corps anticipates continuing to dispose of maintenance dredged material at the same disposal sites during and after implementation of the Proposed Project.

For additional information about the Proposed Project, visit the Corps' website at http://www.nws.usace.army.mil.

Questions can be directed to Josh Jackson, Grays Harbor General Investigation Project Manager, at (206) 764-6583 or Joshua.L.Jackson@ usace.army.mil.

NEPA PROCESS AND SCHEDULE

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

The U.S. Army Corps of Engineers (Corps) will evaluate dredging the Grays Harbor Navigation Channel to the previously authorized depth of -38 feet mean lower low water (MLLW) in a General Reevaluation Report and will comply with the National Environmental Policy Act (NEPA) by developing a Supplemental Environmental Impact Statement (SEIS) that will tier from the original 1982 EIS and the 1989 SEIS.

The Corps anticipates evaluating in the SEIS three dredging alternatives. Each alternative will be analyzed assuming with implementation of the Grays Harbor Long-Term Management Strategy (LTMS) and without implementation of the LTMS.

Alternative 1 (No Action): Continue annual maintenance dredging to -36 feet MLLW

- Continue Annual Dredging to -36 feet MLLW with LTMS
- Continue Annual Dredging to -36 feet MLLW without LTMS

Alternative 2: Deepen existing navigation channel within some or all reaches to a depth greater than -36 feet MLLW and less than or equal to -37 feet MLLW

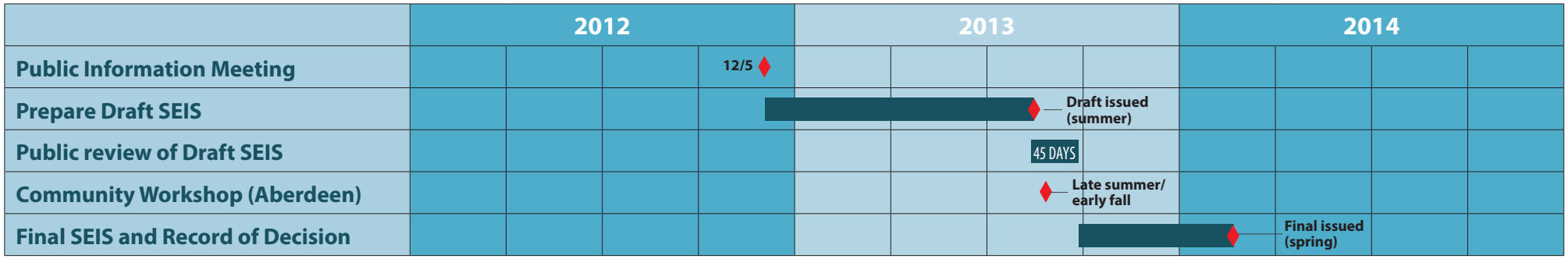
- Deepening and then Annual Maintenance Dredging to -37 feet MLLW with LTMS
- Deepening and then Annual Maintenance Dredging to -37 feet MLLW without LTMS

Alternative 3: Deepen existing navigation channel within some or all reaches to a depth greater than -37 feet MLLW and less than or equal to -38 feet MLLW

- Deepening and then Annual Maintenance Dredging to -38 feet MLLW with LTMS
- Deepening and then Annual Maintenance Dredging to -38 feet MLLW without LTMS

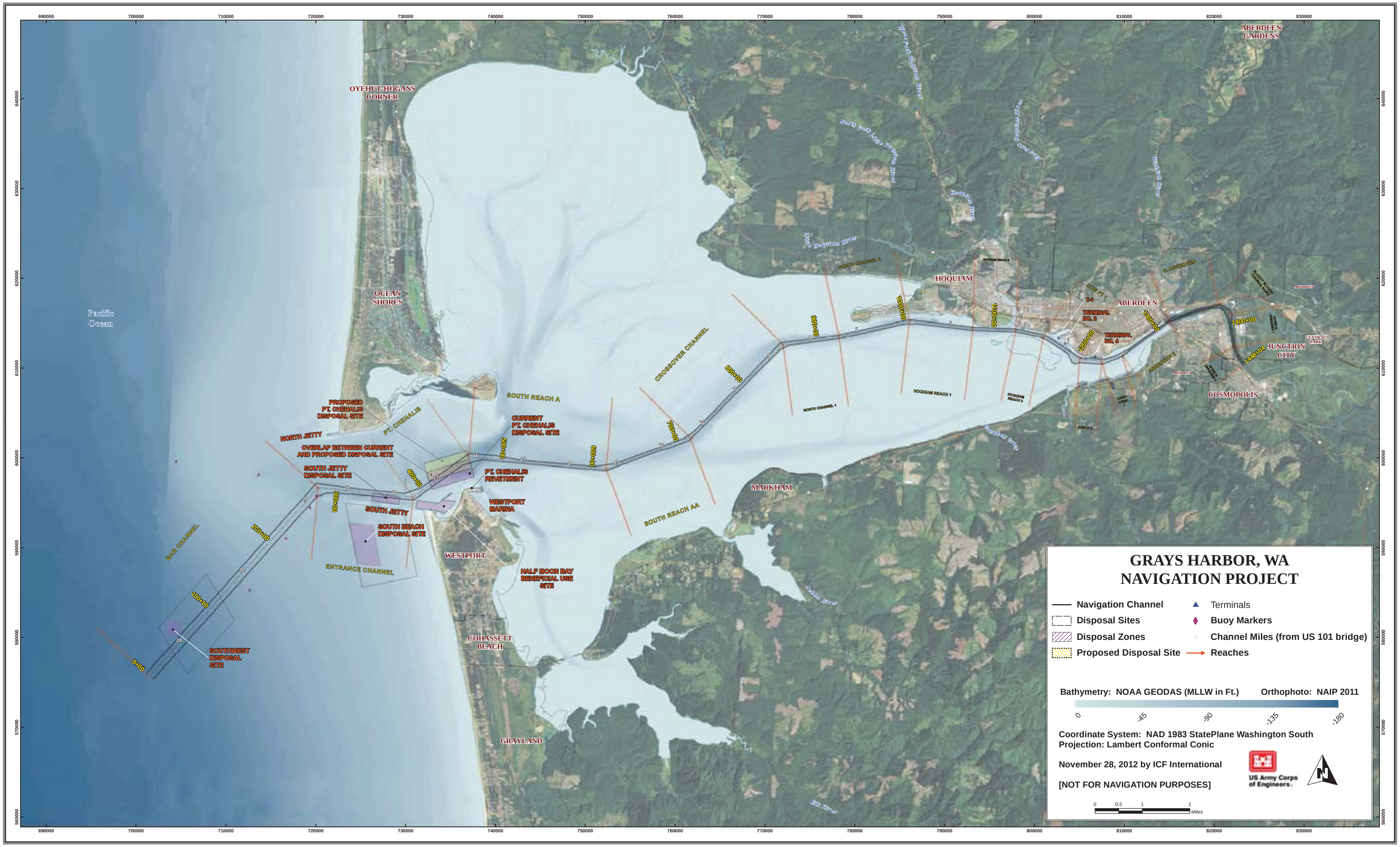
Long-Term Management Strategy: The purpose of the operations and maintenance LTMS study is to assess if a breach of the landmass adjacent to the south jetty may occur, evaluate the threat of adverse impacts on the Proposed Project resulting from a breach, and, if action is warranted, assess and recommend the most appropriate LTMS of authorized Proposed Project features. Pending consideration of comments on the draft Environmental Assessment, the preferred alternative includes initial placement of dredged sand between Half Moon Bay and South Beach to reduce risk of breaching and periodic placement of sand thereafter.

Project Schedule



GRAYS HARBOR NAVIGATION PROJECT FEATURES

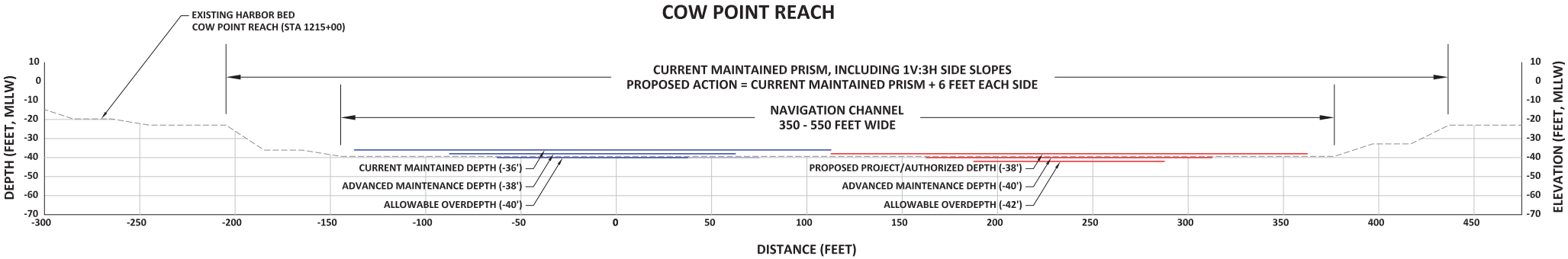
GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT



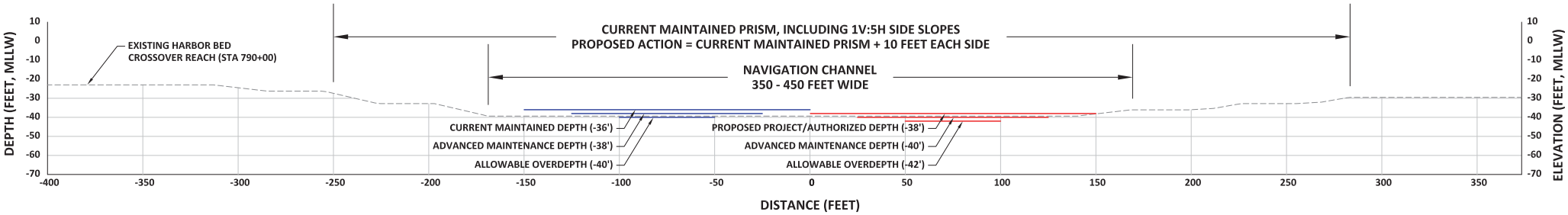
REPRESENTATIVE CROSS SECTIONS OF NAVIGATION CHANNEL

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

COW POINT REACH



CROSSOVER REACH



CURRENT MAINTENANCE DREDGING DEPTHS

PROPOSED PROJECT DREDGING DEPTHS

PHOTOS OF DREDGING AND DISPOSAL SITE PLACEMENT

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

Clamshell dredge (bucket capacity 35 cubic yards) onto bottom dump barge (4,000 cubic yard capacity) at Cow Point near Port of Grays Harbor Terminal #4 (February 2009). Bottom dump barge used for direct placement at open water disposal sites. Standard barge is used for upland stockpile/ rehandling.

The Corps hopper dredge 'Yaquina' has its own bottom dump capability. A hopper dredge with pump ashore can be used for direct upland placement for beneficial use/ rehandling.

Aerial view of hopper dredge drag arm.

Direct beach pump ashore from a hopper dredge via a floating pipeline (over North Jetty of Columbia River onto Benson Beach, 2008). Note sand berms to contain material.

5-YEAR GROWTH AT PORT OF GRAYS HARBOR

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

- Growth at the Port of Grays Harbor since 2007 includes over $200 million in private investments
- U.S. Army Corps of Engineers will consider existing ship traffic and cargo orders in its economic analysis related to the deepening of the navigation channel
- Examples of benefits associated with deepening the Grays Harbor navigation channel include:
  - Reduction in ship waiting time – A deeper channel would reduce the amount of fuel used and crew time spent waiting for the correct tide to enter or exit Grays Harbor
  - Efficiencies in loading – A deeper channel would allow ships to sail fully loaded, increasing their efficiency

Attachment 4

Grays Harbor Navigation Improvement Project
Public Information Meeting
Meeting Transcript – December 5, 2012

GRAYS HARBOR NAVIGATION IMPROVEMENT PROJECT

PUBLIC INFORMATION MEETING

Presentation By

U.S. ARMY CORPS OF ENGINEERS

December 5, 2012

6:30 p.m.

Port of Grays Harbor

111 South Wooding Street

Aberdeen, Washington

Reported By:

Connie Church, CCR #2555, RPR, CRR

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PRESENTATION BY:

Joshua Jackson, Project Manager

David Michalsen, PE, Coastal Engineer

Scott Long, Economist

Kevin McKeag, Biologist

Don Kramer, Planner

Jessica Winkler

ECO Resource Group: Sandra Davis
David Sale

1 MS. DAVIS: Thank you, everybody, for your
2 patience. I know we're starting a few minutes late but
3 we wanted to give folks a chance to come in if they were
4 slowed down a little bit because of the weather. At the
5 same time, we really want to honor your time and the fact
6 that you made it here in time for us to begin our
7 presentation.
8 AUDIENCE MEMBER: We're thinking just a few more
9 minutes still.
10 MS. DAVIS: Okay. If I could ask you for your
11 patience for a few more minutes.
12 AUDIENCE MEMBER: Just keep going. It's only
13 Randy Lewis.
14 MS. DAVIS: Okay. Right on cue.
15 AUDIENCE MEMBER: Now we can start over.
16 MS. DAVIS: So in a word, it was thank you. So
17 as we begin, there is coffee to your right there.
18 There's also some cookies. There's one variety that has
19 some walnuts in it and they have been marked as such in
20 case you have any kind of an allergy. We want to make
21 sure you stay away from them.
22 So we're here tonight - this is actually a public
23 information meeting and we're here to talk with you about
24 the navigation project. Our format for the evening is
25 going to be a slide presentation on various aspects of

1 the project followed by an open house. We'll have some
2 poster boards up around the room and ask you to take your
3 specific questions about various topics to the people who
4 will be at those particular stations afterwards.
5 As we do the presentation, we're going to work our
6 way through it. I ask you to hold your questions until
7 after the presentation is complete. And at that time,
8 I'll take clarifying questions from you regarding any
9 aspect of the presentation itself. Any questions? Oh,
10 somebody.
11 AUDIENCE MEMBER: We have to hold them to the
12 end you said.
13 MS. DAVIS: Thank you. Thanks for the reminder.
14 So I'm going to introduce you to Josh Jackson, who is the
15 Project Manager for the Corps of Engineers. And then he
16 will introduce you to the other team members. Thank you.
17 MR. JACKSON: All right, everybody. Thanks for
18 coming. Like she said, I'm Josh Jackson. I'm Project
19 Manager with the Civil Works Branch of the Army Corps of
20 Engineers. We have Dave Michalsen, who's our Coastal
21 Engineer; Scott Long, who's our economist over here; got
22 Kevin McKeag, our Biologist; and Don Kramer down there is
23 our planner.
24 AUDIENCE MEMBER: Josh, could you try to use the
25 microphone?

1 MR. JACKSON: Is that better?
2 MR. CALDWELL: Makes it easier to sing, too.
3 MR. JACKSON: You don't want that. All right.
4 All right. So tonight we'll talk about project authority
5 and overview. I'll let Dave talk a little bit about
6 dredging. Scott will get into our economic analysis.
7 And then we'll let Kevin talk about the environmental
8 part. One too many.
9 So the original navigation channel was authorized
10 over a hundred years ago, 1896. Since then we've had a
11 couple of reauthorizations, the latest one being in 1986.
12 And that was the result of the 1982 feasibility study to
13 investigate the deepening of channel. So the
14 authorization in '86 authorized the channel down to -38.
15 But the '89 general design memorandum only found
16 justification for going to -36, so that's what the
17 channel is maintained at today.
18 So about eight years ago the Port came back to the
19 Corps of Engineers and said, "Hey, we'd like to look at
20 deepening the channel the remaining two feet to the fully
21 authorized -38."
22 So we looked at that and said, "Yeah. That looks
23 like something that we could do."
24 So this is where we are now, working on the limited
25 reevaluation report, which is essentially the economic

analysis to determine justification and the supplemental EIS on those. So what we're looking at is only the inner harbor from South Reach here to Cow Point. So that's the reach we're looking at deepening to -38. And then this is the outer harbor. We'd be looking at using existing disposal sites as well as possible upland disposal.

Dave.

MR. MICHALSEN: Okay. So hopefully everyone knows what dredging means. But just in case you don't, there's two ways, either scooping or hydraulically sucking the sandy treasure, as John likes to put it. This is a picture just right off the T4 here at the port harbor of a clamshell dredge 35-yard bucket and a scow bottom dump barge to the left. This is mechanical dredging.

Here is a hopper dredge. This is our Essayons hopper dredge. Hydraulic suction head right here and drag arm which basically extends down to the sea floor and vacuums off sand off the seabed.

As far as where the material would be placed, there's two options that are currently on the table. One is open water placement via scow barge or hopper barge with the bottom dump bins. This is just a laboratory picture of a scow opening up and the sand going down to the bottom here.

1 Here is upland placement on a beach for beach
2 nourishment. There may be options to use dredge material
3 beneficially so we're looking into this as well as other
4 areas for mitigation as part of this project. And this
5 just shows a hydraulic pipeline here pumping the sand
6 onto the beach.
7 Right here, this is our current open water dredge
8 material placement sites. We don't like to use the word
9 disposal anymore because it's actually a sandy treasure
10 so . . . But here we have Point Chehalis open water
11 placement site, South Jetty placement site, and then we
12 have two beneficial placement sites at Half Moon Bay and
13 South Beach.
14 For this project, we're - we'd be using primarily
15 inner harbor sediment, which would be coming in the scow
16 barge so we'd primarily be using this Point Chehalis site
17 and South Jetty site because the scow barges can't get
18 out to the South Beach disposal site - sorry - dredge
19 material placement site. However, for this project, we
20 would be looking at using material from the outer harbor
21 and placing more of the material in this site to get
22 increased capacity for inner harbor sediment at the
23 estuarine sites.
24 Okay. Scott, you're going to go over the economic
25 analysis. Thanks.

1 MR. LONG: See if I can get this thing back in.
2 I'm pretty loud so I shouldn't have to carry that around.
3 Plus I have lots of slides with lots of notes on it.
4 Like he said, my name is Scott Long with the Army Corps
5 of Engineers. And I'm going to be doing the economic
6 analysis for this project. And today I'm just going to
7 give you a brief overview of how we do our core analysis.
8 Right now you can see up there our economic
9 analysis. This is the basis. One of our key missions or
10 the role for the Army Corps of Engineers is navigation.
11 And that is to provide reliable and efficient waterborne
12 transportation for the nation.
13 So what happens is a sponsor comes to us and says,
14 "We have some kind of problem," whether that be a
15 physical conditions, traffic delays, some light loading,
16 maybe some debris, things of that nature. And they ask
17 us for some help. And we try to provide that.
18 This isn't necessarily a problem but this is one of
19 the things that plays hand in hand with a lot of these
20 deep draft navigation studies is there's a history of
21 deep draft vessels. There's a trend for those to get
22 bigger and more efficient over time. So what's happening
23 is the ships are getting bigger but the channels are
24 staying the same, and some may be getting smaller.
25 Depends on how much O & M is actually taking place;

1 right?
2 So this is the nine-step process that I'm going to
3 be using or going through with the Corps of Engineers.
4 And it's actually very iterative. And there's not a
5 single step that is more important than the others. But
6 some may take a little more time than the others.
7 And as you see, the National Economic Development,
8 NED, when we talk about NED, what I'm talking about is
9 the benefits and contributions to the nation that
10 increase the value of the national output of goods and
11 services. Another way of putting that is benefit - it's
12 the benefits that accrue to the nation by facilitating
13 commerce.
14 So this is one of the nine-step processes that I'm
15 going to go through. And that's information gathering as
16 it relates to quite a few of the things that are going on
17 at the port. So what I'm going to do is look at the
18 inventory and the forecast and see what's actually
19 happening historically, existing conditions, the base
20 year, and most likely future without conditions. And
21 then I'm going to try to identify some of the constraints
22 that's going on, what the problems are that are happening
23 there.
24 So another thing that we're going to look at is the
25 annual transportation costs as it relates to the vessels,

1 the origin to destination cost, how much it's going to
2 cost for a ship that goes from the Port of Grays Harbor
3 to maybe China or wherever they go to. And that's
4 another part of the analysis is figuring out where those
5 vessels are moving to and from, what their drafts - what
6 they're actually moving, what commodities, which will be
7 talked about here shortly.
8 I also look at the port characteristics, the
9 terminals, the berthing depths, the actual capacities,
10 what the master plan of the port is, looking at maybe the
11 10-year plan for the port, figure out what's coming,
12 what's going, what the leases are, what they look like.
13 Some of the data sources that I'm going to be
14 drawing from will be the customs data and we also have
15 our own waterborne statistics center with the Corps of
16 Engineers. A lot of that data is actually generally
17 about two years old. So I look to the pilots here at the
18 Port of Grays Harbor to provide a lot of pertinent and
19 valuable information as the study progresses.
20 So the characteristics and commodities, I'm going to
21 be looking at where those commodities are going, the
22 population that's going to be applicable, and then
23 actually look at the actual commodities which I mentioned
24 earlier and determine the types and flows of those.
25 And then what's not listed on here is also the

1 projection that I'll have to do for projecting the
2 waterborne commerce at the port for the foreseeable
3 future. This should be sensible. But I'll also - I'll
4 use whatever data that's available to me to come up with
5 a reasonable and basically look at the future commerce
6 that's going to be happening. That also goes with the
7 10-year plan or whatever the port has as far as contracts
8 and leases, things of that nature. I'll also look at the
9 macroeconomic trends and the trends to the nation also
10 globally.
11 From this picture, these are just some of the
12 commodities that are applicable to Grays Harbor. You see
13 that they're moving a lot of Chrysler Jeeps. There's
14 lumber. There's soy bean. There's feed, a lot of paper
15 products. So this is just to give you a general overview
16 of what - the types of cargo that are moving. There's
17 general cargo and there's bulk cargo. And this just
18 breaks it down, how we're going to view it as break bulk.
19 This is how I would break it down for economic analysis,
20 neo-bulk, liquid bulk, dry bulk. These are things that I
21 mentioned earlier. They're also moving vegetable oil,
22 the bio-fuel, grain and oil seed. I neglected to mention
23 those in the last slide.
24 Again, some more information that I'm going to be
25 gathering will be the vessel information. I'll need to

1 know what - the port fleet, the existing fleet, determine
2 what that consists of, what the costs are to move those
3 ships and how they would benefit from a deeper channel.
4 Along with this, I'll look at the actual operating drafts
5 that the ships are moving in and out with and the actual
6 vessel capacity, if they're using their full capacity or
7 not, see if they're light loading. I'll look at their
8 vessel itinerary.
9 All this is just a big process of data gathering so
10 that I can put the econ together and then run the net
11 benefit cost analysis.
12 This is the summary of some of the key data inputs
13 that I'll be looking for and I've just previously
14 mentioned in the slides before this, where the vessels -
15 what their characteristics are, the commodities they're
16 moving, their volumes, and the origin to destination of
17 those.
18 So for the economic development costs, I will be
19 looking at any and all construction costs that are going
20 to go and be a part of this project, to include tide
21 gauges, jetties, any and all dredging, maybe some real
22 estate you may or may not have to acquire. I don't think
23 that's applicable to this. Some of this isn't
24 applicable. But I try to make this - these slides as
25 applicable to Grays Harbor as possible. We also have to

1 take into account the cost of mitigation and any and all
2 O & M costs over the 50-year life of the project.
3 So some of the benefits - this is the good stuff;
4 right - mostly going to be looking at the savings to
5 transportation by using more efficient vessels, more
6 efficient fleet, wouldn't be light loading. Try to take
7 advantage of that one or two additional feet that's - so
8 that the ships could go to full capacity if possible. I
9 would also be looking at the change in road benefits,
10 which is the commodities travel, possibly another route
11 that would be a little less costly. And then I would
12 look at the shift in origin to destination benefits,
13 which is the increase to net revenue for just the
14 commodity producers.
15 Some other economic benefits that are applicable -
16 that may be applicable to this project are recreation
17 benefits, land enhancements, utilization of unemployed or
18 unemployed population. This is other social effects.
19 Basically we'd be doing a qualitative analysis but - for
20 the other social effects that could actually play into
21 the economic benefits. And then we'd also look at
22 anything that would be environmental like environmental
23 restoration. And that would just be a little extra icing
24 on the cake, I think.
25 There's also a possibility for the beneficial use of

1 dredge material. It's not on the slide. But some of
2 that dredge material - which we call it the sandy spoils,
3 treasures - they can be used for construction material or
4 beach nourishment and maybe marsh creation or topsoil.
5 So I'm going to hand it over to the environmental lead on
6 this project.
7 MR. MCKEAG: Hi. I'm Kevin McKeag, the Corps
8 Biologist and Environmental Coordinator for this project.
9 Really this project got started, the planning stages
10 environmentally, in the early eighties. In '82, there
11 was an environmental impact statement published, and it
12 ran into some problems.
13 Let's see here if I know how to do this. There you
14 go. All right. The '82 analysis included 24 - just over
15 24 miles of channel improvement. And that was taking the
16 channel down to -38 - this is again looking at the
17 environmental impacts of this action - replacement of a
18 Union Pacific Railroad bridge, and the project included
19 mitigation of four acres. This was lost shallow water
20 fish habitat. I believe that was up in the turning
21 basins.
22 Mitigation, this is for Dungeness crab actually.
23 The original plan was modification of dredge methods and
24 some of the excluder head to avoid the crab completely.
25 Basically the Corps concluded that we were going to need

1 some further study on this.
2 So after several studies were conducted on crab,
3 salmon, there was some benthic studies on the disposal
4 sites, and we supplemented the '82 EIS in '89. And
5 basically the project was reduced in scope and, of
6 course, the associated environmental impacts. New
7 information from some those studies over the eighties
8 were presented and the crab ecology and mitigation, new
9 strategy was developed on that, some ecological
10 considerations of the ocean disposal areas, new
11 evaluation of the sediments, and Native American concerns
12 were brought forward.
13 So the scope of the '89 supplemental EIS then
14 proposed just over 23 miles of dredging versus the 24
15 from '82. And there would be two turning basins versus
16 four in the '82 document. This - the dredge material was
17 going to be reduced from about 17 million to just over 11
18 million cubic yards. It included the modification of the
19 Union Pacific Railroad bridge was still in there and the
20 mitigation was still in there for subtidal salmon
21 habitat. And this is where the placement of oyster shell
22 came about for - as a mitigation practice for losses to
23 the Dungeness crabs.
24 So here we are now, and we're looking at another
25 supplemental document. So this is supplementing - this

1 will supplement the '82 and the '89 documents. And the
2 focus is going to be, you know, on the impacts of several
3 selected alternatives. Basically for this, we're going
4 to look at three alternatives. The no action will be
5 evaluated, which is the continued maintenance to -36 feet
6 in the channel. Second alternative would be to deepen to
7 -37. And the third would be to go to the fully
8 authorized depth of -38.
9 And again, we're going to bring in any new
10 information from . . . You know, this has been since
11 '89. Again, there's the gap of several years again. So
12 we're going to have to focus on Dungeness crab and
13 shellfish impacts. As in '82 and '89, these again will
14 be the major issues. Dredge material disposal and again
15 the evaluation of the sediments, Native American issues
16 and, of course, endangered species impacts.
17 During this process, we're going to have several
18 opportunities for public input and comments through the
19 process. The draft document should be out and ready for
20 release next summer. And we will - we're going to
21 schedule another public forum probably down here again
22 right after that to again take comments on that document.
23 In addition to the NEPA, we're going to do a
24 biological assessment, and that'll be in conjunction with
25 the services to fulfill our Endangered Species Act

1 requirements.
2 In the project vicinity here, basically we've got 12
3 listed species. And of special concern would be the
4 green sturgeon and eulachon and all salmon, so the salmon
5 species primarily in their juvenile life stages.
6 So with that, is it Josh?
7 MR. JACKSON: Thanks, Kevin. So like Kevin
8 said, we're at the beginning stages of this. The next
9 chance for a public comment would be sometime next summer
10 we'd have another public forum. In the meantime, we'll
11 be drafting that supplemental EIS, drafting our report
12 that we have to work on. The end goal for this phase of
13 the project would be for a project approval that we
14 expect sometime kind of the middle - early to middle of
15 2014. Beyond that we'd go into a design phase and
16 construction. It's all dependent on funding, which is
17 still unknown at this point.
18 So you guys heard a lot of technical information.
19 Kind of just to wrap it up and bring back to the point is
20 that this is an incremental deepening to the authorized
21 38 feet. So it's an additional one to two feet deeper
22 than the existing maintenance work that's done to -36.
23 That maintenance is done every year. So in the economic
24 analysis, we're just looking at that increment; is the
25 cost to deepen the channel to -37 or -38, is it offset by

1 the benefits to the nation, the economic benefits. And
2 at the same time, in the environmental analysis we'll be
3 doing, we're looking at the incremental impacts above and
4 beyond what has already been identified in those previous
5 documents.
6 And with that, I think are there any clarifying
7 questions for the presentation?
8 AUDIENCE MEMBER: So will this presentation be
9 available on a website so that we could download that?
10 MS. PATRICIA GRAESSER: Yeah. I'll put it up
11 probably Friday. Maybe among. We're moving offices.
12 But definitely by Monday.
13 MR. JACKSON: Yeah. We have a project website.
14 If you go to our district's website, which is - which is
15 here, www.nws.usace.army.mil, you can find the Grays
16 Harbor Improvement Project website.
17 MS. DAVIS: It's a hot link right on the front
18 page.
19 MR. JACKSON: On that website, we have the
20 original '82 document and the '89 documents there for
21 your viewing pleasure. And we'll add in these slides
22 from tonight.
23 MS. DAVIS: Anybody else have a question? Okay.
24 Well, then hearing none, I think we'll close this part of
25 the meeting. This is the information segment. And we

1 can move into the open house. You'll see around you
2 various boards. And there will be staff there in just a
3 minute if they aren't there already, and they're happy to
4 answer any and all of your questions. Thank you for
5 coming tonight. Gary?
6 MR. NELSON: Yeah. You know, there's several -
7 there's LTMS out of Half Moon Bay. You've got several
8 other projects going on. You have the LTMS at Half Moon
9 Bay South Jetty plus the jetties and the revetments and
10 other aids to navigation. Do those get considered or
11 brought in in any way to this study?
12 MR. JACKSON: Yeah, it does. We'll be looking
13 at . . . The three alternatives that Kevin mentioned
14 actually get split into two subalternatives each. So
15 each one will be examined looking at with or without the
16 long-term management strategy project. So any changes
17 that would come with that would be taken into account.
18 MS. WINKLER: So we'd look at the -37 foot
19 alternative with the LTMS in place, but we'll also look
20 at that alternative if we were not to construct the LTMS.
21 Since we don't know at this point about funding for LTMS,
22 we would want to evaluate it under both scenarios. We'll
23 do the same for the -38 alternatives.
24 MR. NELSON: Well, they're evaluated separately
25 - separately and together.

1 MS. WINKLER: Exactly. We want to acknowledge
2 that there's the potential for either of the alternatives
3 to be constructed or not and look at both of those
4 scenarios for the purposes of this study.
5 AUDIENCE MEMBER: So are you saying that the
6 LTMS, you've decided on a project that you are actually
7 going to do for that? Or is that still in the process of
8 developing?
9 MS. WINKLER: That one's also still in the
10 process. But in order for us to be as complete as
11 possible in our analysis, we'll take any current
12 information on what that LTMS alternative would look like
13 and use that in our analysis.
14 AUDIENCE MEMBER: But there should be four
15 alternatives for the LTMS.
16 MS. WINKLER: But it's also working its way
17 through the analysis process. And we're just getting
18 started on our study. So when we're at the point of
19 fully analyzing all of our alternatives, we may have more
20 information about LTMS.
21 AUDIENCE MEMBER: Okay.
22 MS. DAVIS: Any other questions? Okay. Thank
23 you again, everyone. Good night.
24 (Presentation concluded at
7:15 p.m.)
25

1

2 C E R T I F I C A T E

3 STATE OF WASHINGTON)

) ss.

4 COUNTY OF GRAYS HARBOR)

5

6

7 I, CONNIE CHURCH, a duly authorized Court Reporter

8 in and for the State of Washington, residing at Montesano, do

9 hereby certify:

10 That the foregoing proceedings were reported by me

11 on said date and were transcribed by means of computer-aided

12 transcription.

13 I further certify that the said transcript of

14 proceedings, as above transcribed, is a full, true and

15 correct transcript of the aforementioned matter.

16 Dated and signed this 15th day of December, 2012.

17

18

19

CONNIE CHURCH

20 Certified Court Reporter

CCR #2555

21

22

23

24

25

US Army Corps of Engineers®
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix G: Point Chehalis Site Shift Description

Prepared by:
U.S. Army Corps of Engineers
Seattle District

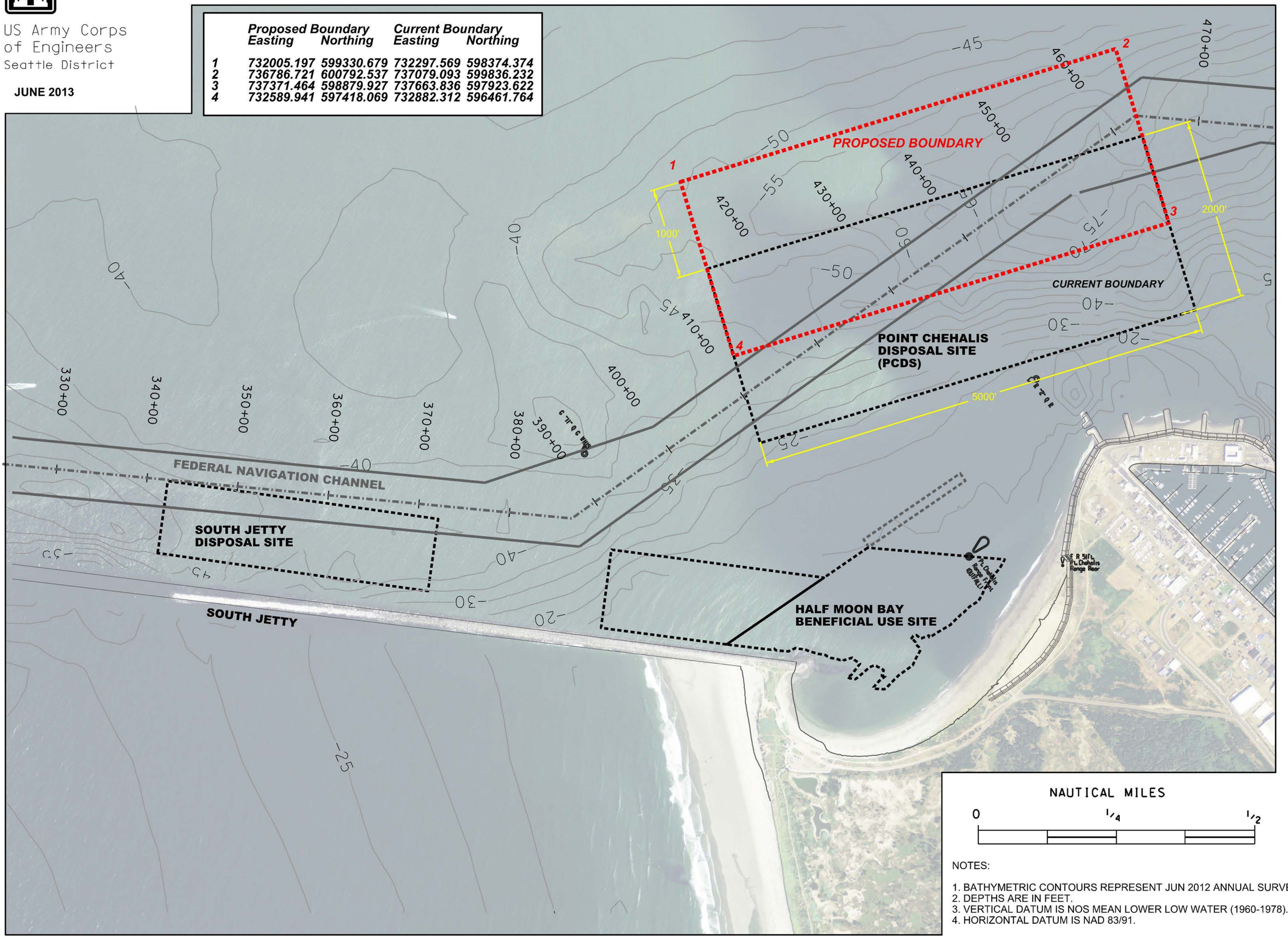
June 2014

POINT CHEHALIS DISPOSAL SITE - PROPOSED BOUNDARY MODIFICATION

US Army Corps of Engineers
Seattle District

JUNE 2013

	Proposed Boundary Easting	Proposed Boundary Northing	Current Boundary Easting	Current Boundary Northing
1	732005.197	599330.679	732297.569	598374.374
2	736786.721	600792.537	737079.093	599836.232
3	737371.464	598879.927	737663.836	597923.622
4	732589.941	597418.069	732882.312	596461.764



NOTES:

1. BATHYMETRIC CONTOURS REPRESENT JUN 2012 ANNUAL SURVEY
2. DEPTHS ARE IN FEET.
3. VERTICAL DATUM IS NOS MEAN LOWER LOW WATER (1960-1978).
4. HORIZONTAL DATUM IS NAD 83/91.

US Army Corps of Engineers®
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix H: Agency Coordination

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

Agency Coordination Documentation

This appendix contains the following documentation of agency coordination for the Grays Harbor, Washington, Navigation Improvement Project Feasibility Study, in support of the Limited Reevaluation Report and Supplemental Environmental Impact Statement.

1. Section 106 National Historic Preservation Act Coordination Documentation May 28, 2013
2. Fish and Wildlife Coordination Act- Planning Aid Letter of June 7, 2013; and Coordination Act Report May 20, 2014
3. National Marine Fisheries Service Endangered Species Act Section 7 Consultation June 5, 2014
4. US Fish And Wildlife Service Endangered Species Act Section 7 Consultation June 11, 2014
5. Washington Department of Ecology Water Quality Certification Order June 13, 2014

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DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

MAY 1 6 2013

Allyson Brooks, Ph.D.
Washington State Historic Preservation Officer
Department of Archaeology and Historic Preservation
P.O. Box 48343
Olympia, WA 98504

Subject: Section 106 Review for the Grays Harbor Navigation Improvement Project, in Grays Harbor, near Aberdeen and Hoquiam, Washington.

Dear Dr. Brooks:

The United States Army Corps of Engineers (Corps) is considering authorizing the Grays Harbor Navigation Improvement Project (GHNIP), in Grays Harbor, Washington. The Port of Grays Harbor has proposed the GHNIP which would deepen the Grays Harbor channel from the currently maintained depth of -36 feet mean lower low water (MLLW) to the fully authorized depth of -38 feet MLLW (undertaking). We are notifying you of the undertaking, but given its limited scope and potential to cause effects, propose to expedite consultation by addressing the multiple steps of 36 C.F.R § 800.3 through § 800.6 in this letter as provided at 36 C.F.R. § 800.3(g). This letter provides a description of the undertaking, documents the area of potential effect (APE), summarizes the efforts to identify historic properties, and provides agency determinations and findings. We also request your agreement with our finding that there will be *no historic properties affected.*

The Grays Harbor channel is a federal deep draft navigation channel. In 1986, Congress authorized deepening the channel to -38 feet MLLW. However, a post-authorization analysis in 1989 determined that the channel was only justified economically to a depth of -36 feet MLLW, which is the current depth of annual maintenance dredging. In 2009, the Corps determined that there is a federal interest in re-evaluating the deepening of the Grays Harbor navigation channel. The Port of Grays Harbor has requested deepening of the channel to better accommodate current and anticipated vessel traffic for existing Port tenants and commodities. The GHNIP is located within the current navigation channel in Township 17 North; Range 9 West; and Township 17 North; Range 10 West. The GHNIP would extend from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located (Figure 1) and would deepen approximately 14.5 miles of the 27.5-mile channel.

Dredging of the inner harbor (connecting the harbor proper to the Chehalis River) was first authorized by the Corps in 1892. Since that time, dredging has occurred as necessary to prevent shoals from forming and impeding ship traffic. Currently, the Corps removes an average of 1.2 million cubic yards of sediment annually from the navigation channel. The dredged material is deposited at designated areas, including the Point Chehalis and South Jetty open water placement sites, as well as nearshore placement at Half Moon Bay and South Beach for beneficial use. The Corps anticipates continuing to place maintenance dredged material at the same sites during and after implementation of the proposed project.

The Corps has reviewed existing cultural resources information available for the area and prior cultural resources studies conducted for the maintenance or improvement of the Grays Harbor navigation channel. Beginning in 1980, the Corps conducted cultural resources and environmental review of navigation channel and dredge material disposal sites in support of an Environmental Impact Statement for the Grays Harbor Navigation Project (1982). The Corps consulted with the Washington State Historic Preservation Officer (SHPO) who concurred with the Corps findings in a letter dated June 17th, 1982. The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and a supplemental EIS. Those studies included a literature search for underwater shipwrecks which may have been located in the channel. In 1988, a side-scan sonar investigation was conducted in the navigation channel. No shipwrecks or other underwater cultural resources were identified in the navigation channel. The SHPO concurred with the Corps finding that no resources were located in the area of potential effect (APE) and no historic properties would be affected in a letter dated December 12th, 1986. For the current GHNIP, the Corps has conducted a Washington Information System Architectural and Archaeological Records Data search and has determined that prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE.

The Corps has also sought information from Indian tribes regarding places to which they attach religious and cultural significance. The Corps has consulted with the following tribes about the undertaking: Confederated Tribes of the Chehalis Reservation, Hoh Indian Tribe, Quinault Indian Nation and the Shoalwater Bay Tribe. The Chehalis Tribe requested a staff-to-staff level meeting with the Corps regarding the project. Corps staff met with the natural resources, fisheries and cultural resources staff of the Chehalis Tribe regarding the GHNIP project on May 6th, 2013. Topics of discussion during the meeting included: hydrology and whether the project would cause an increase in salinity and wave action and possible effects on fish that migrate though Grays Harbor. In addition, the Chehalis Tribe cultural resources staff asked about potential effects to archaeological sites and traditional gathering areas of sweet grass used in basket making and wanted to make sure that the Corps archaeologist had reviewed and was familiar with the most recent cultural resources work done to date in the Grays Harbor area. The Corps responded that, based on the most current hydrology information, there would only be a minimal increase in wave action and salinity and there would be no affect to archaeological sites or gathering areas. The Corps assured the Tribe that the most current cultural resources information available was reviewed for the GHNIP project.

The Corps has made a reasonable and good faith effort to identify historic properties that may be affected by this undertaking. Based on the results of the literature review and our efforts to identify historic properties, consultations with your office on past activities related to the Grays Harbor navigation channel, and our consultations with Indian tribes, the Corps has found that there are no historic properties within the APE and that there will be *no historic properties affected* by the undertaking.

At this time, the Corps is requesting your review and agreement with our finding that there will be *no historic properties affected*. We appreciate your consideration of our request. If you have specific questions or we can provide any clarification, please contact Ms. Kara Kanaby (Lead Archaeologist) by telephone at (206) 764-6857 or by email at Kara.M.Kanaby@usace.army.mil. I can be reached by telephone at (206) 316-3069 or by email at rolla.l.queen@usace.army.mil.

Sincerely,

Rolla Queen, Chief
Cultural Resources Section
Environmental and Cultural Resources Branch

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

FEB 14 2013

David Burnett, Chair
Confederated Tribes of the Chehalis Reservation
P.O. Box 536
Oakville, WA 98568

Subject: Section 106 Review and Tribal Notification for the Grays Harbor Navigation Improvement Project, in Grays Harbor, near Aberdeen and Hoquiam, Washington

Dear Chairman Burnett:

The United States Army Corps of Engineers (Corps) is considering authorizing the Grays Harbor Navigation Improvement Project (GHNIP), a proposal by the Port of Grays Harbor to deepen the Grays Harbor channel from the currently maintained depth of -36 feet mean lower low water (MLLW) to the fully authorized depth of -38 feet MLLW. To assist in our review of the proposed project under Section 106 of the National Historic Preservation Act, we are notifying the Confederated Tribes of the Chehalis Tribe about the project and seeking information to identify properties which may be of religious or cultural significance to the Tribe (see 36 CFR 800.4(a)(4)).

The Grays Harbor channel is a federal deep draft navigation channel. In 1986, Congress authorized deepening the channel to -38 feet MLLW. However, a post-authorization analysis in 1989 determined that the channel was only justified economically to a depth of -36 feet MLLW, which is the current depth of annual maintenance dredging. In 2009, the Corps determined that there is a federal interest in re-evaluating the deepening of the Grays Harbor navigation channel. The Port of Grays Harbor has requested deepening of the channel to better accommodate current and anticipated vessel traffic for existing Port tenants and commodities. The GHNIP is located within the current navigation channel in Township 17 North; Range 9 West; and Township 17 North; Range 10 West. The GHNIP would extend from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located (Figure 1) and would deepen approximately 14.5 miles of the 27.5-mile channel.

Dredging of the inner harbor (connecting the harbor proper to the Chehalis River) was first authorized by the Corps in 1892. Since that time, dredging has occurred as necessary to prevent shoals from forming and impeding ship traffic. Currently, the Corps removes an average of 1.2 million cubic yards of sediment annually from the Navigation Improvement Project channel reaches. The dredged material is deposited at designated areas, including the Point Chehalis and South Jetty open water placement sites, as well as nearshore placement at Half Moon Bay and South Beach for beneficial use. The Corps anticipates continuing to place maintenance dredged material at the same sites during and after implementation of the proposed project.

The Corps has reviewed existing cultural resources information available for the area and prior cultural resources studies conducted for the maintenance or improvement of the Grays Harbor navigation channel. Beginning in 1980, the Corps conducted cultural resources and environmental review of navigation channel and dredge material disposal sites in support of an Environmental Impact Statement for the Grays Harbor Navigation Project (1982). The Corps consulted with the Washington State Historic Preservation Officer (SHPO) who concurred with the Corps findings in a letter dated June 17th, 1982. The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and a supplemental EIS. Those studies included a literature search for underwater shipwrecks which may have been located in the channel. In 1988, a side-scan sonar investigation was conducted in the navigation channel. No shipwrecks or other underwater cultural resources were identified in the navigation channel. The SHPO concurred with the Corps finding that no resources were located in the area of potential effect (APE) and no historic properties would be affected in a letter dated December 12th, 1986.

For the current GHNIP, the Corps has conducted a Washington Information System Architectural and Archaeological Records Data search and has determined that prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE. Based on the available information, the Corps anticipates submitting a finding of *no historic properties affected* to the SHPO after March 30th, 2013. If the Confederated Tribes of the Chehalis Reservation has information or concerns regarding properties that may be of religious or cultural significance to the Tribe that it believes may be affected by this project, please contact us as soon as possible so that we may consult with you and ensure consideration of the information in a timely manner.

For more information about this project, clarification about this request, or to request a formal government-to-government meeting about Section 106 or any other concerns with this project, please contact Ms. Kara Kanaby (Lead Archaeologist) by telephone at (206) 764-6857 or by email at Kara.M.Kanaby@usace.army.mil. You may also contact Ms. Lori Morris (Tribal Liaison) at (206) 764-3625 or by email at frances.morris@usace.army.mil. I can be reached by telephone at (206) 316-3069 or by email at rolla.l.queen@usace.army.mil.

Sincerely,

Rolla Queen, Chief
Cultural Resources Section
Environmental and Cultural Resources Branch

cc with enclosures

Richard, Bellon, Cultural Resources
Confederated Tribes of the Chehalis Reservation
P.O. Box 536
Oakville, WA 98568

Mark White, Natural Resources
Confederated Tribes of the Chehalis Reservation
P.O. Box 536
Oakville, WA 98568

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

FEB 14 2013

Maria Lopez, Chair
Hoh Indian Tribe
P.O. Box 2196
Forks, WA 98331

Subject: Section 106 Review and Tribal Notification for the Grays Harbor Navigation Improvement Project, in Grays Harbor, near Aberdeen and Hoquiam, Washington

Dear Chairwomen Lopez:

The United States Army Corps of Engineers (Corps) is considering authorizing the Grays Harbor Navigation Improvement Project (GHNIP), a proposal by the Port of Grays Harbor to deepen the Grays Harbor channel from the currently maintained depth of -36 feet mean lower low water (MLLW) to the fully authorized depth of -38 feet MLLW. To assist in our review of the proposed project under Section 106 of the National Historic Preservation Act, we are notifying the Hoh Indian Tribe about the project and seeking information to identify properties which may be of religious or cultural significance to the Tribe (see 36 CFR 800.4(a)(4)).

The Grays Harbor channel is a federal deep draft navigation channel. In 1986, Congress authorized deepening the channel to -38 feet MLLW. However, a post-authorization analysis in 1989 determined that the channel was only justified economically to a depth of -36 feet MLLW, which is the current depth of annual maintenance dredging. In 2009, the Corps determined that there is a federal interest in re-evaluating the deepening of the Grays Harbor navigation channel. The Port of Grays Harbor has requested deepening of the channel to better accommodate current and anticipated vessel traffic for existing Port tenants and commodities. The GHNIP is located within the current navigation channel in Township 17 North; Range 9 West; and Township 17 North; Range 10 West. The GHNIP would extend from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located (Figure 1) and would deepen approximately 14.5 miles of the 27.5-mile channel.

Dredging of the inner harbor (connecting the harbor proper to the Chehalis River) was first authorized by the Corps in 1892. Since that time, dredging has occurred as necessary to prevent shoals from forming and impeding ship traffic. Currently, the Corps removes an average of 1.2 million cubic yards of sediment annually from the Navigation Improvement Project channel reaches. The dredged material is deposited at designated areas, including the Point Chehalis and South Jetty open water placement sites, as well as nearshore placement at Half Moon Bay and South Beach for beneficial use. The Corps anticipates continuing to place maintenance dredged material at the same sites during and after implementation of the proposed project.

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For more information about this project, clarification about this request, or to request a formal government-to-government meeting about Section 106 or any other concerns with this project, please contact Ms. Kara Kanaby (Lead Archaeologist) by telephone at (206) 764-6857 or by email at Kara.M.Kanaby@usace.army.mil. You may also contact Ms. Lori Morris (Tribal Liaison) at (206) 764-3625 or by email at frances.morris@usace.army.mil. I can be reached by telephone at (206) 316-3069 or by email at rolla.l.queen@usace.army.mil.

Sincerely,

Rolla Queen, Chief
Cultural Resources Section
Environmental and Cultural Resources Branch

cc with enclosures

Walter Ward, Cultural Resources
Hoh Indian Tribe
P.O. Box 2196
Forks, WA 98331

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

Fawn Sharp, President
Quinault Indian Nation
P.O. Box 189
Taholah, WA 98587

FEB 14 2013

Subject: Section 106 Review and Tribal Notification for the Grays Harbor Navigation Improvement Project, in Grays Harbor, near Aberdeen and Hoquiam, Washington.

Dear President Sharp:

The United States Army Corps of Engineers (Corps) is considering authorizing the Grays Harbor Navigation Improvement Project (GHNIP), a proposal by the Port of Grays Harbor to deepen the Grays Harbor channel from the currently maintained depth of -36 feet mean lower low water (MLLW) to the fully authorized depth of -38 feet MLLW. To assist in our review of the proposed project under Section 106 of the National Historic Preservation Act, we are notifying the Quinault Indian Nation about the project and seeking information to identify properties which may be of religious or cultural significance to the Tribe (see 36 CFR 800.4(a)(4)).

The Grays Harbor channel is a federal deep draft navigation channel. In 1986, Congress authorized deepening the channel to -38 feet MLLW. However, a post-authorization analysis in 1989 determined that the channel was only justified economically to a depth of -36 feet MLLW, which is the current depth of annual maintenance dredging. In 2009, the Corps determined that there is a federal interest in re-evaluating the deepening of the Grays Harbor navigation channel. The Port of Grays Harbor has requested deepening of the channel to better accommodate current and anticipated vessel traffic for existing Port tenants and commodities. The GHNIP is located within the current navigation channel in Township 17 North; Range 9 West; and Township 17 North; Range 10 West. The GHNIP would extend from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located (Figure 1) and would deepen approximately 14.5 miles of the 27.5-mile channel.

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The Corps has reviewed existing cultural resources information available for the area and prior cultural resources studies conducted for the maintenance or improvement of the Grays Harbor navigation channel. Beginning in 1980, the Corps conducted cultural resources and environmental review of navigation channel and dredge material disposal sites in support of an Environmental Impact Statement for the Grays Harbor Navigation Project (1982). The Corps consulted with the Washington State Historic Preservation Officer (SHPO) who concurred with the Corps findings in a letter dated June 17th, 1982. The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and a supplemental EIS. Those studies included a literature search for underwater shipwrecks which may have been located in the channel. In 1988, a side-scan sonar investigation was conducted in the navigation channel. No shipwrecks or other underwater cultural resources were identified in the navigation channel. The SHPO concurred with the Corps finding that no resources were located in the area of potential effect (APE) and no historic properties would be affected in a letter dated December 12th, 1986.

For the current GHNIP, the Corps has conducted a Washington Information System Architectural and Archaeological Records Data search and has determined that prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE. Based on the available information, the Corps anticipates submitting a finding of *no historic properties affected* to the SHPO after March 30th, 2013. If the Quinault Indian Nation has information or concerns regarding properties that may be of religious or cultural significance to the Tribe that it believes may be affected by this project, please contact us as soon as possible so that we may consult with you and ensure consideration of the information in a timely manner.

For more information about this project, clarification about this request, or to request a formal government-to-government meeting about Section 106 or any other concerns with this project, please contact Ms. Kara Kanaby (Lead Archaeologist) by telephone at (206) 764-6857 or by email at Kara.M.Kanaby@usace.army.mil. You may also contact Ms. Lori Morris (Tribal Liaison) at (206) 764-3625 or by email at frances.morris@usace.army.mil. I can be reached by telephone at (206) 316-3069 or by email at rolla.l.queen@usace.army.mil.

Sincerely,

Rolla Queen, Chief
Cultural Resources Section
Environmental and Cultural Resources Branch

cc with enclosures

Leilani Jones-Chubby, Cultural Resources
Quinault Tribe
P.O. Box 189
Taholah, WA 98587

Justin James, Cultural Resources
Quinault Tribe
P.O. Box 189
Taholah, WA 98587

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

FEB 14 2013

Charlene Nelson, Chair
Shoalwater Bay Tribe
P.O. Box 130
Tokeland, WA 98590

Subject: Section 106 Review and Tribal Notification for the Grays Harbor Navigation Improvement Project, in Grays Harbor, near Aberdeen and Hoquiam, Washington.

Dear Chairwomen Nelson:

The United States Army Corps of Engineers (Corps) is considering authorizing the Grays Harbor Navigation Improvement Project (GHNIP), a proposal by the Port of Grays Harbor to deepen the Grays Harbor channel from the currently maintained depth of -36 feet mean lower low water (MLLW) to the fully authorized depth of -38 feet MLLW. To assist in our review of the proposed project under Section 106 of the National Historic Preservation Act, we are notifying the Shoalwater Bay Tribe about the project and seeking information to identify properties which may be of religious or cultural significance to the Tribe (see 36 CFR 800.4(a)(4)).

The Grays Harbor channel is a federal deep draft navigation channel. In 1986, Congress authorized deepening the channel to -38 feet MLLW. However, a post-authorization analysis in 1989 determined that the channel was only justified economically to a depth of -36 feet MLLW, which is the current depth of annual maintenance dredging. In 2009, the Corps determined that there is a federal interest in re-evaluating the deepening of the Grays Harbor navigation channel. The Port of Grays Harbor has requested deepening of the channel to better accommodate current and anticipated vessel traffic for existing Port tenants and commodities. The GHNIP is located within the current navigation channel in Township 17 North; Range 9 West; and Township 17 North; Range 10 West. The GHNIP would extend from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located (Figure 1) and would deepen approximately 14.5 miles of the 27.5-mile channel.

Dredging of the inner harbor (connecting the harbor proper to the Chehalis River) was first authorized by the Corps in 1892. Since that time, dredging has occurred as necessary to prevent shoals from forming and impeding ship traffic. Currently, the Corps removes an average of 1.2 million cubic yards of sediment annually from the Navigation Improvement Project channel reaches. The dredged material is deposited at designated areas, including the Point Chehalis and South Jetty open water placement sites, as well as nearshore placement at Half Moon Bay and South Beach for beneficial use. The Corps anticipates continuing to place maintenance dredged material at the same sites during and after implementation of the proposed project.

The Corps has reviewed existing cultural resources information available for the area and prior cultural resources studies conducted for the maintenance or improvement of the Grays Harbor navigation channel. Beginning in 1980, the Corps conducted cultural resources and environmental review of navigation channel and dredge material disposal sites in support of an Environmental Impact Statement for the Grays Harbor Navigation Project (1982). The Corps consulted with the Washington State Historic Preservation Officer (SHPO) who concurred with the Corps findings in a letter dated June 17th, 1982. The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and a supplemental EIS. Those studies included a literature search for underwater shipwrecks which may have been located in the channel. In 1988, a side-scan sonar investigation was conducted in the navigation channel. No shipwrecks or other underwater cultural resources were identified in the navigation channel. The SHPO concurred with the Corps finding that no resources were located in the area of potential effect (APE) and no historic properties would be affected in a letter dated December 12th, 1986.

For the current GHNIP, the Corps has conducted a Washington Information System Architectural and Archaeological Records Data search and has determined that prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE. Based on the available information, the Corps anticipates submitting a finding of *no historic properties affected* to the SHPO after March 30th, 2013. If the Shoalwater Bay Tribe has information or concerns regarding properties that may be of religious or cultural significance to the Tribe that it believes may be affected by this project, please contact us as soon as possible so that we may consult with you and ensure consideration of the information in a timely manner.

For more information about this project, clarification about this request, or to request a formal government-to-government meeting about Section 106 or any other concerns with this project, please contact Ms. Kara Kanaby (Lead Archaeologist) by telephone at (206) 764-6857 or by email at Kara.M.Kanaby@usace.army.mil. You may also contact Ms. Lori Morris (Tribal Liaison) at (206) 764-3625 or by email at frances.morris@usace.army.mil. I can be reached by telephone at (206) 316-3069 or by email at rolla.l.queen@usace.army.mil.

Sincerely,

Rolla Queen, Chief
Cultural Resources Section
Environmental and Cultural Resources Branch

cc with enclosures

Earl Davis, Cultural Resources
Shoalwater Bay Tribe
P.O. Box 130
Tokeland, WA 98590

DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past, Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

May 22, 2013

Mr. Rolla L. Queen
Environmental Resources Section
Corps of Engineers – Seattle District
PO Box 3755
Seattle, Washington 98124-3755

Re: Grays Harbor Navigation Improvement Project
Log No.: 052213-01-COE-S

Dear Mr. Queen:

Thank you for contacting our department. We have reviewed the materials you provided for the Area of Potential Effect (APE) for the proposed Grays Harbor Navigation Improvement Project, Grays Harbor County, Washington.

We concur with your definition of the Area of Potential Effect (APE).

We look forward to receiving the report of the results of your identification efforts, your review, the results of tribal consultation, and the Determination of Effect.

We would also appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in compliance with the Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800.4. Should additional information become available, our assessment may be revised.

Thank you for the opportunity to comment and we look forward to receiving the report on the results of your efforts.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: *rob.whitlam@dahp.wa.gov*

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

MAY 24 2013

Allyson Brooks, Ph.D.
Washington State Historic Preservation Officer
Department of Archaeology and Historic Preservation
P.O. Box 48343
Olympia, WA 98504

Subject: Section 106 Review for the Grays Harbor Navigation Improvement Project, in Grays Harbor, near Aberdeen and Hoquiam, Washington. Log No.: 052213-01-COE-S.

Dear Dr. Brooks:

The United States Army Corps of Engineers (Corps) is continuing consultation on the Grays Harbor Navigation Improvement Project (GHNIP), in Grays Harbor, Washington. The Port of Grays Harbor has proposed the GHNIP which would deepen the Grays Harbor channel from the currently maintained depth of -36 feet mean lower low water (MLLW) to the fully authorized depth of -38 feet MLLW (undertaking). The Corps previously notified your office and consulted on the area of potential affect (APE) and our findings in a letter dated May 16, 2013. Your office agreed with our APE in a letter dated May 22nd, 2013. The purpose of this letter is to present the results of the identification efforts and re-submit the Corps' determinations and findings for this undertaking. This letter provides a brief project description, summarizing the efforts to identify historic properties, and provide agency determinations and findings. We also request your agreement with our finding that there will be *no historic properties affected.*

The Grays Harbor channel is a federal deep draft navigation channel. In 1986, Congress authorized deepening the channel to -38 feet MLLW. However, a post-authorization analysis in 1989 determined that the channel was only justified economically to a depth of -36 feet MLLW, which is the current depth of annual maintenance dredging. In 2009, the Corps determined that there is a federal interest in re-evaluating the deepening of the Grays Harbor navigation channel. The Port of Grays Harbor has requested deepening of the channel to better accommodate current and anticipated vessel traffic for existing Port tenants and commodities. The GHNIP is located within the current navigation channel in Township 17 North; Range 9 West; and Township 17 North; Range 10 West. The GHNIP would extend from the South Reach upstream to Cow Point Reach where the Port of Grays Harbor Terminal 4 is located (Figure 1) and would deepen approximately 14.5 miles of the 27.5-mile channel.

Dredging of the inner harbor (connecting the harbor proper to the Chehalis River) was first authorized by the Corps in 1892. Since that time, dredging has occurred as necessary to prevent shoals from forming and impeding ship traffic. Currently, the Corps removes an average of 1.2

million cubic yards of sediment annually from the navigation channel. The dredged material is deposited at designated areas, including the Point Chehalis and South Jetty open water placement sites, as well as nearshore placement at Half Moon Bay and South Beach for beneficial use. The Corps anticipates continuing to place maintenance dredged material at the same sites during and after implementation of the proposed project.

The Corps has reviewed existing cultural resources information available for the area and prior cultural resources studies conducted for the maintenance or improvement of the Grays Harbor navigation channel. Beginning in 1980, the Corps conducted cultural resources and environmental review of navigation channel and dredge material disposal sites in support of an Environmental Impact Statement for the Grays Harbor Navigation Project (1982). The Corps consulted with the Washington State Historic Preservation Officer (SHPO) who concurred with the Corps findings in a letter dated June 17th, 1982. The Corps conducted additional cultural resources studies in 1989 in support of Section 106 review and a supplemental EIS. Those studies included a literature search for underwater shipwrecks which may have been located in the channel. In 1988, a side-scan sonar investigation was conducted in the navigation channel. No shipwrecks or other underwater cultural resources were identified in the navigation channel. The SHPO concurred with the Corps finding that no resources were located in the area of potential effect (APE) and no historic properties would be affected in a letter dated December 12th, 1986. For the current GHNIP, the Corps has conducted a Washington Information System Architectural and Archaeological Records Data search and has determined that prior research and field investigations were adequate to identify historic properties. No archaeological sites or other cultural resources have been identified within the APE.

The Corps has also sought information from Indian tribes regarding places to which they attach religious and cultural significance. The Corps has consulted with the following tribes about the undertaking: Confederated Tribes of the Chehalis Reservation, Hoh Indian Tribe, Quinault Indian Nation and the Shoalwater Bay Tribe. In a letter to the Tribes dated February 14th, 2013, the Corps described the undertaking and the results of our identification efforts, asked the Tribe to identify any concerns with effects to historic properties including properties to which the Tribe attaches religious or cultural significance, and informed the Tribes that the Corps proposed to submit a finding of *no historic properties affected* to the SHPO based on the information developed at that time. Following the receipt of the tribal letters, the Chehalis Tribe requested a staff-to-staff level meeting with the Corps regarding the project. Corps staff met with the natural resources, fisheries and cultural resources staff of the Chehalis Tribe regarding the GHNIP project on May 6th, 2013. Topics of discussion during the meeting included: hydrology and whether the project would cause an increase in salinity and wave action and possible effects on fish that migrate though Grays Harbor. In addition, the Chehalis Tribe cultural resources staff asked about potential effects to archaeological sites and traditional gathering areas of sweet grass used in basket making and wanted to make sure that the Corps archaeologist had reviewed and was familiar with the most recent cultural resources work done to date in the Grays Harbor area. The Corps responded that, based on the most current hydrology information, there would only be a minimal increase in wave action and salinity and

there would be no affect to archaeological sites or gathering areas. The Corps assured the Tribe that the most current cultural resources information available was reviewed for the GHNIP project.

The Corps has made a reasonable and good faith effort to identify historic properties that may be affected by this undertaking. Based on the results of the literature review and our efforts to identify historic properties, consultations with your office on past activities related to the Grays Harbor navigation channel, and our consultations with Indian tribes, the Corps has found that there are no historic properties within the APE and that there will be *no historic properties affected* by the undertaking.

At this time, the Corps is requesting your review and agreement with our finding that there will be *no historic properties affected.* We appreciate your consideration of our request. If you have specific questions or we can provide any clarification, please contact Ms. Kara Kanaby (Lead Archaeologist) by telephone at (206) 764-6857 or by email at Kara.M.Kanaby@usace.army.mil. I can be reached by telephone at (206) 316-3069 or by email at rolla.l.queen@usace.army.mil.

Sincerely,

Rolla Queen, Chief
Cultural Resources Section
Environmental and Cultural Resources Branch

DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past, Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

May 28, 2013

Ms. Rolla Queen
Environmental & Cultural Resources Branch
Seattle District, Corps of Engineers
PO Box 3755
Seattle, Washington 98124-3755

Re: Grays Harbor Navigation Improvement Project
Log No: 052213-01-COE-S

Dear Ms. Queen:

Thank you for contacting our department. We have reviewed material you provided for the proposed Grays Harbor Navigation Improvement Project, Grays Harbor County, Washington.

We concur with your Determination of No Historic Properties.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the concerned tribes and this department notified.

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: *rob.whitlam@dahp.wa.gov*

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

MAY 20 2014

In Reply Refer To:
01EWFW00-2013-CPA-0120

Evan Lewis
Seattle District, U.S. Army Corps of Engineers
ATTN: Civil Works Branch
Post Office Box 3755
Seattle, Washington 98124-3755

Marc Horton
Director of Environment and Engineering Services
Port of Grays Harbor
111 South Wooding Street
Aberdeen, Washington 98520

Gentlemen:

Subject: Grays Harbor Navigation Improvement Project, Grays Harbor, Washington
Fish and Wildlife Coordination Act Report (May 2014)

Under authorities established by Public Law 85-624 (72 Stat. 563; August 12, 1958), and as subsequently amended by Public Law 89-72 (79 Stat. 213; July 9, 1965), the Fish and Wildlife Coordination Act (FWCA; 16 U.S.C. 661 *et seq.*) provides for the equal and integrated consideration of fish and wildlife conservation needs, and requires coordinated planning with other features of Federal water resource development proposals.

The U.S. Army Corps of Engineers – Seattle District (Corps) and Port of Grays Harbor (Port) have been investigating the feasibility of deepening the federal navigation deep-draft channel in Grays Harbor, Washington; from the currently maintained depth of -36 feet mean lower low water (MLLW), to the fully authorized depth of -38 feet MLLW. The Corps and Port have prepared a General Investigation Feasibility Study (GI), Draft Limited Reevaluation Report, and a Supplemental Environmental Impact Statement (EIS).

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The GI Report and Supplemental EIS (January 2014) identify your preferred alternative. According to your findings, the preferred alternative is technically feasible, cost effective, environmentally sound, and economically justified. The Corps has determined that the preferred alternative meets the stated purpose and need better and more completely than the other alternatives under consideration, Alternative 1 (No Action) and Alternative 2 (Channel Deepening to -37 feet MLLW).

Since mid-2012 the U.S. Fish and Wildlife Service – Washington Fish and Wildlife Office (Service) has been meeting with the Corps, U.S. Environmental Protection Agency, National Marine Fisheries Service, the Washington State Department of Fish and Wildlife, the Quinault Indian Nation, and other interested stakeholders, to discuss resource issues related to the GI. In support of furthering the purposes of the FWCA, the Service prepared a Planning Aid Letter addressing the GI and proposed action (signed June 7, 2013). The enclosed document, our May 2014 Fish and Wildlife Coordination Act Report (Report), is based on better and more complete information, and constitutes the final report of the Secretary of the Interior as required under Section 2(b) of the FWCA. Earlier documentation includes a Supplemental FWCA Report (February 1989).

The enclosed Report:

- Briefly summarizes the proposed action and alternatives, and describes their relationship to the larger, surrounding water resource development context.
- Identifies important fish and wildlife resources in the action area and characterizes their current condition.
- Summarizes the Corps' and Port's description of foreseeable direct effects, indirect effects, and unavoidable impacts. And,
- Describes our current understanding of the foreseeable indirect and cumulative effects of the proposed action, including data gaps, information needs, and uncertainties.

The enclosed Report expresses our concern, and the concerns of other stakeholders, regarding the Corps' and Port's description of "future-with-project" conditions. The Report highlights potential damages and losses to fish and wildlife resources, and tribal trust resources.

While the Service is not fundamentally opposed to implementation of the Corps' and Port's preferred alternative, we do have serious concerns about the planning and communication that has occurred to date in support of the action. This Report provides a number of recommendations, regarding: planning and analysis; operational features and alternatives; impact minimization and conservation measures; and, mitigation for unavoidable impacts to fish and wildlife resources. The Service hopes and expects that the Corps and Port will give our FWCA documentation fair and full consideration before making final decisions.

If you have questions, concerns, or a request related to the content of this Report, or would like to otherwise discuss this planning effort, please call or write either Ryan McReynolds (360-753-6047; ryan_mcreynolds@fws.gov) or Bridget Moran (360-753-6044; bridget_moran@fws.gov).

Sincerely,

For Ken S. Berg, Manager
Washington Fish and Wildlife Office

Enclosure

cc:
Corps, Seattle, WA (J. Winkler)
Corps, Seattle, WA (L. Wickstrom)
Corps, Seattle, WA (M. Harrington)
Corps, Seattle, WA (K. McKeag)
USFWS, Nisqually NWR, WA (G. Nakai)
USFWS, Nisqually NWR, WA (D. Roster)
Quinault Indian Nation, Taholah, WA (K. Allston)
Quinault Indian Nation, Taholah, WA M. Mobbs)
Quinault Indian Nation, Taholah, WA (J. Schumacker)
EPA, Seattle, WA (J. Barton)
NMFS, Lacey, WA (G. Kreitman)
NMFS, Lacey, WA (J. Fisher)
WDFW, Montesano, WA (B. Burkle)
WDFW, Montesano, WA (S. Kalinowski)
WDOE, Olympia, WA (D. Butorac)
Coast Guard, Portland, OR (R. Berg)
PMSA, Seattle, WA (Capt. M. Moore)

Grays Harbor Navigation Improvement Project, Grays Harbor, Washington
Fish and Wildlife Coordination Act Report

Prepared for the U.S. Army Corps of Engineers
Seattle District, Seattle, Washington

And

Port of Grays Harbor, Aberdeen and Hoquiam, Washington

May 2014

Prepared by the U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

Introduction

The U.S. Army Corps of Engineers (Corps) – Directorate of Civil Works manages and maintains the deep-draft Grays Harbor Federal Navigation Channel (Channel), including the entrance channel, north and south jetties, Point Chehalis rock revetment, and boat basin at Westhaven Cove Marina, under authorities that include the River and Harbor Acts of 1896, 1935, and 1945, and the Water Resources Development Act of November 17, 1986 (Public Law 99-662). Management of the Channel includes a program of annual maintenance dredging, and dredged material disposal and beneficial reuse.

The Corps and Port of Grays Harbor (Port), the non-Federal sponsor, have been conducting a General Investigation Feasibility Study (GI), Limited Reevaluation, in consideration of whether to deepen the Channel to the Congressionally-authorized depth of -38 feet mean lower low water (MLLW). The Corps' and Port's recent Supplemental Environmental Impact Statement (EIS), dated January 2014, and first made available to the public during February 2014, identifies their preferred alternative. According to the findings of the GI and Supplemental EIS, the preferred alternative is technically feasible, cost effective, environmentally sound, and economically justified. The Corps and Port have determined that the preferred alternative meets the stated purpose and need better and more completely than the other alternatives under consideration, Alternative 1 (No Action) and Alternative 2 (Channel Deepening to -37 feet MLLW).

Under authorities established by Public Law 85-624 (72 Stat. 563; August 12, 1958), and as subsequently amended by Public Law 89-72 (79 Stat. 213; July 9, 1965), the Fish and Wildlife Coordination Act (FWCA; 16 U.S.C. 661 *et seq*.) provides for the equal and integrated consideration of fish and wildlife conservation needs, and requires coordinated planning with other features of Federal water resource development proposals. This planning requirement extends to actions that would construct and operate navigational features, and actions that would modify or supplement plans for previously authorized projects.

Pursuant to our authorities and shared responsibilities under the FWCA, the U.S. Fish and Wildlife Service – Washington Fish and Wildlife Office (Service) has been meeting since mid-2012 with the Corps, U.S. Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), the Washington State Department of Fish and Wildlife (WDFW), the Quinault Indian Nation (QIN), and other interested stakeholders. In support of furthering the purposes of the FWCA, the Service prepared a Planning Aid Letter addressing the GI and proposed action (signed June 7, 2013). The present document, our May 2014 Fish and Wildlife Coordination Act Report (Report), is based on better and more complete information. Earlier documentation includes a Supplemental FWCA Report (February 1989).

On March 24, 2014, the Service provided comments to the Corps and Port in response to the findings of their GI and Supplemental EIS. The Corps and Service met to discuss these comments on April 18, 2014. The Service offered, and the Corps agreed to receive and consider, our final recommendations in the form of an amendment to our previous FWCA documentation.

This Report is provided under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*), and constitutes the final report of the Secretary of the Interior required under Section 2(b) of that Act. The Report integrates our earlier comments, and expresses both our concern, and the concerns of other stakeholders, regarding the foreseeable direct, indirect, and cumulative effects of the preferred alternative and proposed action. Where deemed appropriate to the discussion of planning and resources issues, the Service has referenced and cited official correspondence sent to the Corps by other stakeholders, including the EPA and QIN. The Service hopes and expects that the Corps and Port will give these concerns fair consideration before making final decisions.

The Service is committed to implementing the goals, objectives, and policy principles outlined in our *Native American Policy* (U.S. Department of the Interior, 1994) and *Secretarial Order 3206* (U.S. Department of the Interior and U.S. Department of Commerce, 1997). The U.S. Departments of the Interior and Commerce recognize the sovereignty of Native American governments, and Federal courts have recognized the treaty-reserved rights of tribes: "The treaty right to fish is a property right of the tribes and is protected under the Fifth Amendment of the U.S. Constitution, our treaties, and the U.S. Supreme Court affirmation of this right." (Treaty Indian Tribes in Western Washington, 2011).

This Report highlights concerns regarding potential risks and damages to fish, wildlife, and tribal trust resources ("future-with-project" conditions). In the context of this and other Federal water resource development proposals, we emphasize the necessity of improving government-to-government relations and communication, and the necessity of upholding treaty fishing rights and other/related tribal trust responsibilities.

Purpose and Need: The purpose of the Grays Harbor Navigation Improvement Project (NIP) is to improve the efficiency and reliability of deep-draft vessel navigation in Grays Harbor, to reduce navigation transportation costs and improve navigation safety. Current depths are inadequate to accommodate vessels with drafts exceeding -36 feet MLLW. Some vessels have to be partially loaded or experience tidal delays due to insufficient channel depths. The action is needed to alleviate large vessel restrictions, for existing vessel fleets[1], which are imposed by insufficient channel depths.

Summary Description of the Proposed Action and Alternatives

According to the findings of the GI and Supplemental EIS, the preferred alternative (Alternative 3, Channel Deepening to -38 feet MLLW) is technically feasible, cost effective, environmentally sound, and economically justified. The Corps and Port have determined that the preferred alternative meets the stated purpose and need better and more completely than the other alternatives under consideration, Alternative 1 (No Action) and Alternative 2 (Channel Deepening to -37 feet MLLW).

The Corps and Port propose to deepen approximately 14.5 miles of the 27.5-mile Channel. No deepening is needed or proposed along the entrance/Point Chehalis reach and bar channel. Initial Channel deepening will require a dredge volume of approximately 2 million cubic yards in the year of construction. The action also includes subsequent annual maintenance dredging, to a depth of -38 feet MLLW, for a term of approximately 50 years; this represents an incremental increase of approximately 100,000 cubic yards per year. The Grays Harbor NIP would increase both Channel depths and annual maintenance quantities by approximately 5 percent.

The Corps proposes to implement all of the same conservation measures and best management practices that have been refined through years of performing annual maintenance dredging along the Channel: they will use a mechanical clamshell dredge to complete most of the deepening and annual maintenance dredging; will schedule inner harbor clamshell dredging, and outer harbor hydraulic suction or hopper dredging, to avoid and reduce impacts to out-migrating juvenile salmon and peak Dungeness crab (*Metacarcinus magister*) abundance; will coordinate with the commercial and tribal crab fisheries to reduce conflicts; will contract for, or otherwise obtain, a pump-ashore capacity to recharge the Point Chehalis Revetment Extension mitigation site; and, will obtain current and valid Site Use Authorizations from the Dredged Material Management Program (DMMP) before using open-water disposal and beneficial reuse sites.

[1] According to the Corps and Port, they do not intend with this action and, in fact, will not accommodate with this action, a change to the existing vessel fleets that navigate the Channel and make calls at the Port's marine terminals; Post Panamax, Post Panamax Plus, New Panamax, and Triple E container ships all have drafts in excess of 42 feet.

The DMMP has determined that initial construction of the deepened Channel will produce approximately 22,000 cubic yards of dredged material that is not suitable for in-water disposal or beneficial reuse. This material (Cow Point Dredge Unit 32a) failed sediment larval bioassay tests and must be disposed at an upland site. The Corps and Port propose to place this material at an approximately 20-acre, former City of Hoquiam wastewater treatment lagoon, located on Airport Way, Paulson, and Moon Island Roads, adjacent to the Port's Terminal 3, Bowerman Basin, and the Service's Grays Harbor National Wildlife Refuge.

Description of the Action Area and Baseline Environmental Conditions

The Service's previous documentation addressing improvements to the Channel includes a Supplemental FWCA Report (dated February 1989), and a Planning Aid Letter signed and transmitted to the Corps on June 7, 2013. The Supplemental FWCA Report provides a reasonably concise and still accurate, general description of the setting, and of the fish and wildlife resources that occur within the action area (USFWS 1989, pp. 8-10).

The Service has responsibility for managing or co-managing a variety of Federal trust resources, including sensitive species which are listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.)(ESA), their habitats and designated critical habitat, Federal wildlife refuges, and other fish and wildlife trust resources. Within the action area, these trust resources include:

- Species Listed Under ESA; ESA Designated Critical Habitat – Most notably, Coastal/Puget Sound bull trout (*Salvelinus confluentus*, threatened), the marbled murrelet (*Brachyramphus marmoratus*, threatened), western snowy plover (*Charadrius alexandrinus nivosus*, threatened), streaked horned lark (*Eremophila alpestris strigata*, threatened), and designated critical habitat for the bull trout, western snowy plover, and streaked horned lark (USFWS jurisdiction); also, eulachon (*Thaleichthys pacificus*, threatened), southern green sturgeon (*Acipenser medirostris*, threatened), several species of threatened and endangered marine mammals, and Essential Fish Habitat defined under the Magnuson-Stevens Fishery Conservation and Management Act for Pacific salmon, Pacific coast groundfish, and coastal pelagic species (NMFS jurisdiction).

- The Grays Harbor National Wildlife Refuge (Grays Harbor NWR), located on Bowerman Basin in Hoquiam, Washington.

- Grays Harbor shorebird, waterfowl, and migratory bird populations. And,

- Jointly managed tribal, commercial, and recreational fisheries (fin fish and shellfish).

<u>Species Listed Under ESA; ESA Designated Critical Habitat (USFWS Jurisdiction)</u>

Grays Harbor provides habitat for anadromous bull trout originating from coastal Washington core areas to the north (the Quinault, Queets, and Hoh River core areas). Current information indicates that the major tributaries to Grays Harbor do not support bull trout spawning, rearing,

or local populations. However, Grays Harbor is designated as bull trout critical habitat, and this habitat is essential to maintaining connectivity between the Olympic Peninsula Management Unit's bull trout core areas and local populations. Both historical and more current surveys indicate that bull trout are present in Grays Harbor and the lower Chehalis River from mid-February through early-July. Bull trout have been captured, or detected in the nearshore waters, infrequently and in low numbers. Most recently, during April 2014, when biologists working for the Washington State Department of Transportation reported having successfully captured and released without harm a single subadult bull trout that was entrained within their bridge pontoon casting basin in Aberdeen, Washington (Mike McDowell pers. comm., 18 April 2014).

The marbled murrelet is a wide-ranging seabird known to occur in the coastal and in-land marine waters of California, Oregon, Washington, and Canada (British Columbia). The species nests in mature coniferous forests located less than 70 miles from marine waters. The marbled murrelet faces a variety of threats, including loss of nesting habitat and forage fish resources. Populations located in Washington have experienced significant declines since the species was listed in 1992. Available summer and winter survey data for Grays Harbor document low numbers throughout the year, generally near the mouth. Available anecdotal data, including Christmas bird counts conducted from 1995 to 1999, and again in 2009, place nearly every documented occurrence of the species close to the mouth of Grays Harbor (i.e., at the "Bottle Beach," "John's River Road," or "Ocean Shores" bird count stations)(USFWS 2010).

Habitats located on Damon Point and at Oyhut State Wildlife Recreation Area (Oyhut), approximately 1.5 miles north of the Channel, are designated as critical habitat for the western snowy plover (77 FR 36805; June 19, 2012; Unit WA 2 – Damon Point). The species occupies sandy beaches, inland dune systems, salt flats, mud flats, seasonally exposed gravel bars, and dredge spoil sites. Western snowy plovers forage in the tide zone and typically nest nearby (i.e., on the upper beach). Oil spills are recognized as a threat to this species across its range (77 FR 36754; June 19, 2012).

Streaked horned larks nest and winter on Damon Point and at Oyhut, where critical habitat has been designated (78 FR 61561; October 3, 2013; Unit 3A – Damon Point/Oyhut). Low-growing vegetation and an open landscape provide the physical and biological habitat features that are essential to the species.

<u>The Grays Harbor NWR</u>

Congress authorized the establishment of the Grays Harbor NWR in 1988. Managed by the Service as part of the National Wildlife Refuge System, Grays Harbor NWR was established in 1990. The refuge encompasses approximately 1,500 acres of intertidal mudflats, salt marsh, and uplands, located on Bowerman Basin in the northeast corner of the Grays Harbor estuary. Figures 1 and 2 depict the boundaries and habitat types located on the Grays Harbor NWR.

"The Refuge only occupies two percent of the [Grays Harbor] estuary land base, but [supports] up to fifty percent of the migrating shorebirds. "The Service owns approximately 1,408 acres, and leases 64 acres from the Port of Grays Harbor." "The Refuge provides important migratory habitat for a variety of shorebirds, including: western sandpiper, dunlin, semi-palmated and

black-bellied plover, red knot, short-billed dowitcher, greater yellowlegs, and other shorebird and migratory bird species." "Common raptor [species] include osprey, bald eagle, northern harrier, red-tailed hawk, peregrine falcon, and merlin." "Unique conditions found in Bowerman Basin … make it a migratory shorebird focal feeding and resting place. This basin is … the last area to be flooded at high tide and first to be exposed as the tide recedes, affording thousands of migrating shorebirds the maximum time … to forage for food." (USFWS 2014, pp. 1-2, 1-3).

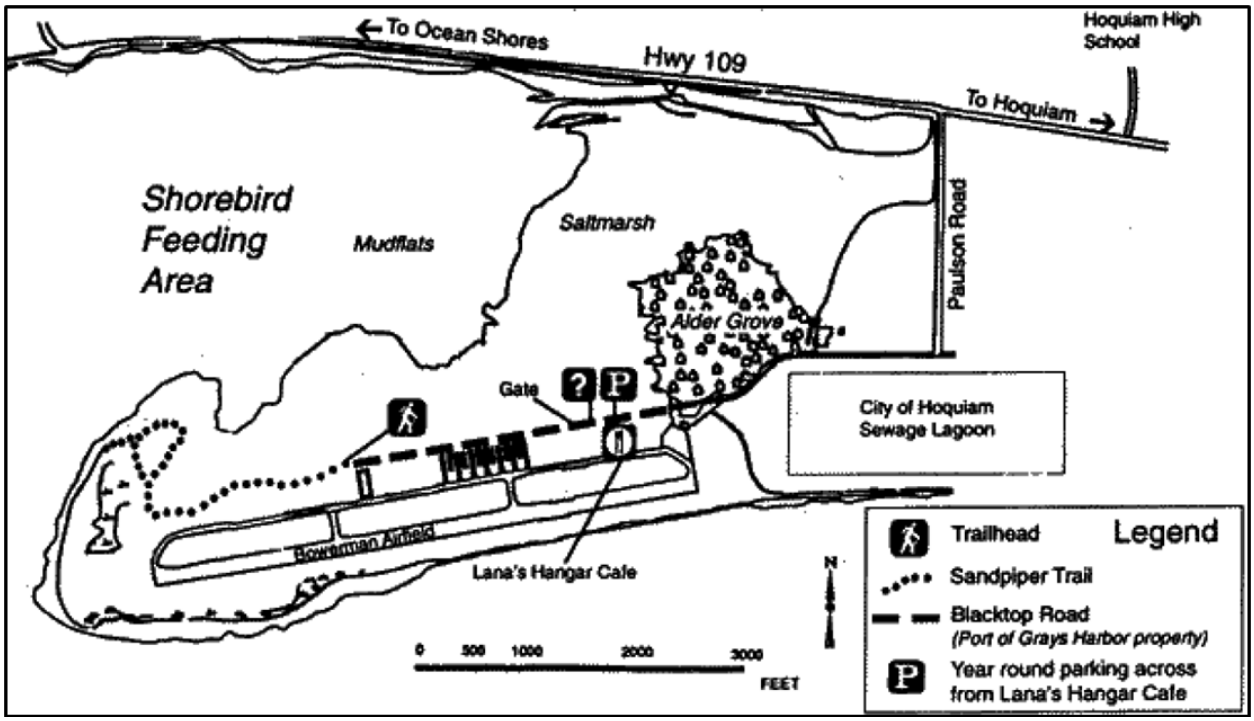

Figure 1. Grays Harbor NWR habitat types and other features.

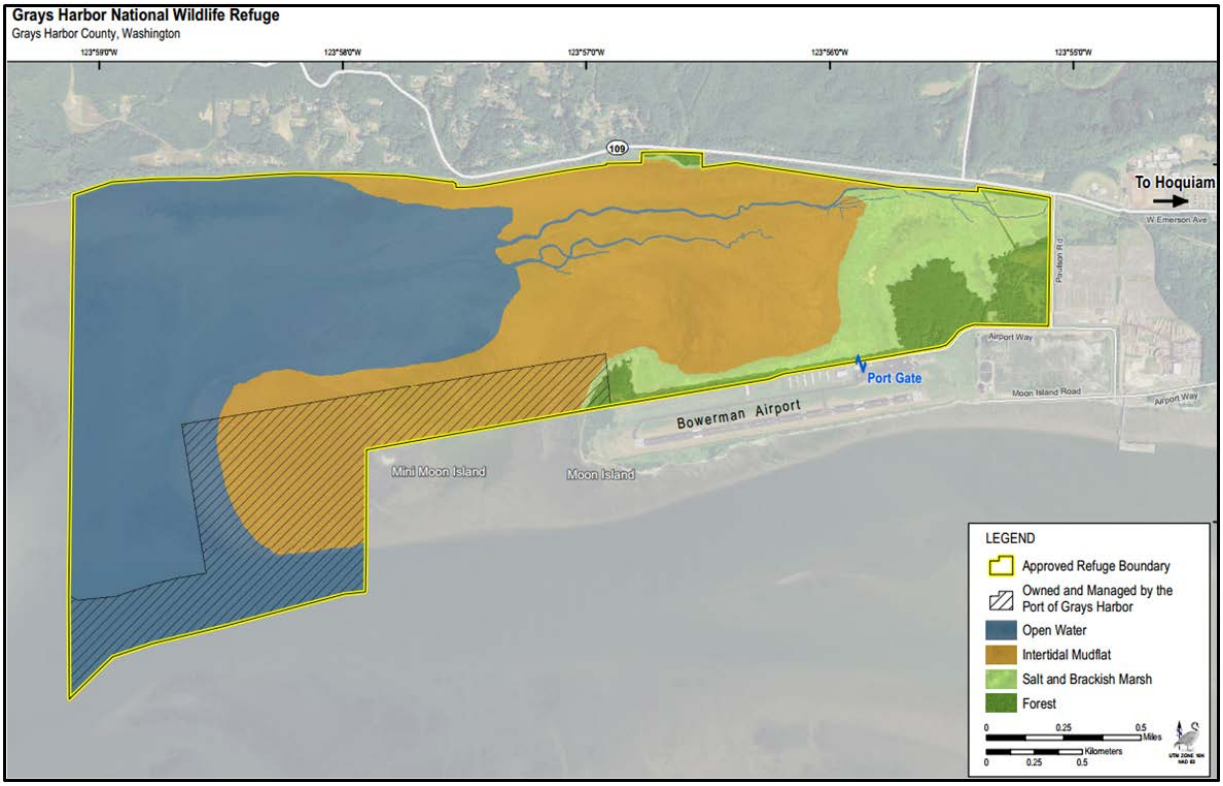

Figure 2. Grays Harbor NWR boundaries and habitat types.

"The Refuge is bordered by industrial development on the east and south, with State Route 109 and a steep upland slope to the north, and open estuary … to the west." (USFWS 2014, p. 3-1) "Directly to the east of the Refuge are upland properties, which are managed by the Port of Grays Harbor … as industrial sites … [The] log storage and shipping yard has been considered for a variety of [alternative] uses. Currently, an oil tank farm and transfer operation is being considered for development. South of the Refuge boundary, the City of Hoquiam [operates] a water treatment facility, and the Port operates Bowerman Airport … Lands not acquired within the Refuge acquisition boundary include approximately 309 acres of intertidal mudflat and open water habitat owned by the Port." (USFWS 2014, p. 3-34)

"The Refuge receives an annual visitation of approximately 13,000 [persons] … [and] Refuge staff conduct environmental education programs." (USFWS 2014, p. 1-3) The Grays Harbor NWR and City of Hoquiam host the annual Grays Harbor Shorebird Festival.

"The Refuge System is the world's largest network of public lands and waters set aside specifically for conserving wildlife and protecting ecosystems." "The needs of wildlife and their habitats come first on refuges, in contrast to other public lands that are managed for multiple uses. Refuges are guided by various federal laws and executive orders, Service policies, and

international treaties. Fundamental are the mission and goals of the National Wildlife Refuge System … and the designated purposes of the refuge unit, as described in … legislation, executive orders, or other documents establishing, authorizing, or expanding a Refuge." (USFWS 2014, p. 1-7).

The "Purposes for establishing [the] Grays Harbor NWR [include]: (1) [to] conserve fish and wildlife populations and their habitats, including but not limited to those of western sandpiper, dunlin, red knot, long-billed dowitcher, short-billed dowitcher, other shorebirds, and other migratory birds, including birds of prey; (2) to fulfill international treaty obligations of the United States with regard to fish and wildlife and their habitats; (3) to conserve those species known to be threatened with extinction; and (4) to provide an opportunity, consistent with the purposes set forth in paragraphs (1), (2), and (3), for wildlife-oriented recreation, education, and research." (USFWS 2014, p. 1-10).

The Service believes, and would argue, that the Gray Harbor NWR is an Aquatic Resource of National Importance, per the resource-based threshold factors implementing Section 404(q) of the Clean Water Act (EPA, 2011).

Grays Harbor Shorebird, Waterfowl, and Migratory Bird Populations

"The [Grays Harbor] estuary's 94 square miles of open water, saltmarshes, and mudflats provide crucial habitat for a variety of wildlife and aquatic species, including hundreds of thousands of shorebirds." The "Grays Harbor estuary is one of four major staging areas for migrating shorebirds [on the Pacific Coast of] North America, and hosts one of the largest concentrations of shorebirds … south of Alaska. In 1996, [the estuary] was designated as a Western Hemisphere Shorebird Reserve Network Site of Hemispheric Significance, and a Washington Important Bird Area." "Neotropical songbirds stopover on their north and south migrations and some are residents throughout the year." (USFWS 2014, p. 1-3)

"In 1996, the greater Grays Harbor estuary … was designated … as a Western Hemisphere Shorebird Reserve Network Site of Hemispheric Significance in the Pacific Flyway. The relatively undisturbed estuary habitats were indentified as subtidal (open water), intertidal (mudflat), rocky shore (harbor mouth), intertidal emergent (salt marsh and scrub/shrub), palustrine forested (forested wetland/willow), palustrine emergent, and palustrine emergent spoil (fill). To receive [this] designation, the site must support over 500,000 shorebirds during a year (WHSRN 2009)." "The greater estuary … provides spring and fall stopover habitat where shorebirds can forage on abundant invertebrates and rest during migration … [and] provides habitat and food for wintering shorebirds. Most of the shorebirds identified … as having primary importance within the region use the greater Grays Harbor estuary." (USFWS 2014, p. 1-27).

Jointly Managed Tribal, Commercial, and Recreational Fisheries

Grays Harbor supports large and important fisheries, both fin fish and shellfish. These fisheries are important (socially, economically, and culturally) to the citizens of Grays Harbor, the State of Washington, and to the QIN, whose usual and accustomed areas include Grays Harbor. These fisheries support traditional industries that are vital to the economy of the region and the State, including fishing, crabbing, tourism, shellfish culturing, boat building, and marine support services.

"The QIN has the right to take fish at its usual and accustomed fishing grounds, which include the Chehalis River and Grays Harbor … [These are] resources our members depend upon, now and in the future." (QIN 2014, pp. 1, 3)

Direct Effects, Indirect Effects, and Unavoidable Impacts

The Corps and Port have described the proposed action's foreseeable direct effects, indirect effects, and unavoidable impacts. The Corps' Biological Evaluation (Corps 2014a), which is prepared and provided to the Service in support of ESA consultation, also addresses the effects of any interrelated or interdependent actions (e.g., maintenance dredging conducted at the Port's marine terminal berths; placement of oyster shell within crab habitat/mitigation plots).

Dredging and disposal activities will result in measurable temporary impacts to aquatic vegetation and forage fish. More than 20 species of fish have been identified in suction dredge entrainment samples (Corps 2014a, p. 4-12). Bottom-dwelling forage fish, such as Pacific sand lance (*Ammodytes hexapterus*), staghorn sculpin (*Leptocottus armatus*), and Pacific sanddab (*Citharichthys sordidus*), appear to be most vulnerable. However, the Corps now limits the use of suction dredge equipment to only those outer harbor reaches where clamshell dredging is impracticable, and timing restrictions further reduce the risk and likely extent of entrainment.

Dredging, open-water disposal, and beneficial reuse of dredged materials will result in measurable, persistent, and long-term effects to substrates and the native benthos, mostly at depths in excess of -33 feet MLLW (excluding beneficial reuse at Half Moon Bay and South Beach). The proposed action will only modestly increase channel depths and annual maintenance quantities (i.e., by approximately 5 percent), and will otherwise maintain existing conditions along a navigation channel which has been frequently and repeatedly dredged in the past. The Corps will continue to mitigate for unavoidable impacts to Dungeness crab according to the *1998 Revised Crab Mitigation Strategy Agreement* (Corps 1998), will continue the practice of assessing impacts with the Dredge Impact Model, and will increase shell placement to mitigate for impacts resulting from both initial Channel deepening and subsequent annual maintenance dredging.

The Corps' management and maintenance of the Channel affects patterns of tidal exchange, wave energy, sediment transport, and erosion that operate on large spatial and temporal scales (Corps 2014a, pp. 1-4 through 1-6). For example, Damon Point, Whitcomb Flats, and Half Moon Bay are all dynamic geomorphological features that reflect the Channel's strong and prevailing influence (Corps 2014a, p. 4-8). However, because the proposed action will only

modestly increase channel depths and annual maintenance quantities (i.e., by approximately 5 percent), and will otherwise maintain existing conditions along a navigation channel which has been frequently and repeatedly dredged in the past, the foreseeable direct and indirect effects to shoreline features and habitat-forming processes will be insignificant.

The Corps has determined that a small increase to the number of future, deep-draft vessel transits is reasonably foreseeable and attributable to the Grays Harbor NIP; approximately 32 additional transits per year (Corps 2014a, p. 5-8). The Corps and Port have assessed resulting patterns of channel side slope and ship-wake erosion, and have concluded that the proposed action "…would have no more than a minor incremental effect on … the Grays Harbor shoreline" (Corps 2014b, PDF p. 211).

Indirect and Cumulative Effects

Here the Service has summarized our current understanding of the foreseeable indirect and cumulative effects of the proposed action. We emphasize related data gaps, information needs, and uncertainties.

The Corps and Port have acknowledged that the action will have foreseeable indirect and cumulative effects to marine traffic in Grays Harbor, the number of future deep-draft vessel port calls, resulting patterns of channel side slope and ship-wake erosion, and port operations. These foreseeable indirect and cumulative effects have significance for the future condition of the Service's trust resources, including the Grays Harbor NWR, Grays Harbor shorebird, waterfowl, and migratory bird populations, and ESA-listed species and their designated critical habitats. These foreseeable indirect and cumulative effects will also have significance for large and important tribal, commercial, and recreational fisheries, and the traditional industries that rely upon these resources (e.g., fishing, crabbing, tourism, shellfish culturing).

The Corps' and Port's description of "future-with-project" conditions is concerning to stakeholders. With our letters and official correspondence, we have emphasized the following:

> "The preferred alternative for the Grays Harbor NIP poses unacceptable risks to fish and wildlife trust resources [that are] managed and co-managed by the Service." "The … Grays Harbor NIP would facilitate, make possible, and promote or encourage selection of Grays Harbor as a destination for additional, future shipping and port operations." "A future increase to the number of deep-draft vessel port calls is foreseeable, and attributable to the Grays Harbor NIP … However, we do not have confidence that the Corps and Port have accurately or reliably projected the size of this increase." "The Corps and Port have tried, unsuccessfully, to argue that the proposed action would not change significantly the intensity of future marine traffic." And, "The Corps and Port have acknowledged, but not adequately assessed or addressed, the proposed action's significant indirect and cumulative effects … To date, the very real and significant risks that increased shipping and port operations would present to vulnerable coastal and marine ecological resources have not been adequately addressed." (USFWS 2014, pp. 2, 4, 5)

> "The Corps maintains that the feasibility and benefit-cost analysis of this project was based solely on vessel traffic increases that would occur whether the deepening was conducted or not." "However, [the] QIN takes issue with ... [the model], the results of which have been used to justify this project." "It is inconceivable that ... petroleum exports ... can be replaced over the next 50 years by products of similar tonnage and value." "The results ... make absolutely no rational sense and ... undercut ... the benefit-to-cost analysis." "The QIN believes that deepening the Grays Harbor channel will contribute to the potential for [petroleum exports]." And, "We believe that the very timing of this deepening project is suspect and that the Port of Grays Harbor's strong agenda to bring [petroleum exports] to Grays Harbor has made the [Corps] complicit ... through [a] dubious economic analysis." (QIN 2014, p. 2)
>
> "We are rating the [Supplemental EIS] Environmental Concerns - Insufficient Information (EC-2)." "We are concerned about discrepancies within the [Supplemental EIS] regarding the proposed action's contribution to indirect and cumulative effects, and disagree that the proposed action's contribution would be 'insubstantial'." "We believe that the proposed action is likely to induce shippers to increase cargo throughput at the Port ... [and] likely to result in significant adverse effects to environmental resources within Grays Harbor." "We recommend that the [Final EIS] address or resolve what appear to be important discrepancies regarding the action alternatives' contribution to additional shipping and port development." (EPA 2014, pp. 1, 2).

For the purposes of conducting an economic analysis, the Corps' and Port's descriptions of "future-with-project" and "future-without-project" conditions both assume that petroleum exports will be brought successfully, by 2015, to properties managed by the Port of Grays Harbor. When assessing the economic viability of the Grays Harbor NIP, the Corps and Port assume that petroleum will become the dominant commodity moved through the Port by 2017 (Corps 2014c, pp. 22, 24, 26, 29). "[Oil] tankers do not play a major role in the commodity movements within the Port of Grays Harbor. This is expected to change in the near (1 year) to intermediate (5 year) future … and, as such, will be part of the analysis" (p. 22) "[Petroleum] forecasts … were taken from Permits (Hoquiam 2013) and other public and private sources" (p. 24). The Corps and Port have assumed that petroleum will account for approximately 80 percent of the Port's throughput (by tonnage) by 2017, and will continue in this pattern for the foreseeable future (p. 26).

There are currently no approvals for pending Port redevelopment proposals have been granted or obtained (WA State SHB 2013); the Washington State Department of Ecology and City of Hoquiam are just now initiating the SEPA public involvement process for the first proposals (Ecology 2014); and, there is significant local community opposition to siting petroleum transport and shipping operations on the lower Chehalis River and Grays Harbor (Meeting Notes, Public Meetings, April 24 and 29, 2014). There is a strong emerging State and regional consensus that petroleum exports pose unacceptable risks, and that associated costs and damages will likely exceed the economic benefits that accrue to local communities and the State.

The Corps' and Port's economic analysis does not attempt to account for important externalities, including social and environmental risks and damages. "Cost[s] that are accumulated outside of the actual vessels entering or exiting the harbor, such as fixed cost, tug assistance cost, pilot cost, terminal fees, and externalities, are not captured by the model … Hinterland transportation costs are not included in the model … [and] External factors such as weather, emergencies, laws, or policies are not captured in the model." (Corps 2014c, p. 43) During 2013, a report evaluating the economic impacts of two pending Port redevelopment proposals was commissioned by proponents. The report clearly states and acknowledges, "The analysis … does not measure non-economic and environmental costs and benefits" (ECONorthwest 2013, p. 10). These failures to account for social and environmental risks and damages are not acceptable to the Service and other interested stakeholders, and should be addressed or analyzed as indirect or cumulative effects in the Supplemental EIS.

The Corps has indicated to us that the Grays Harbor NIP achieves favorable cost-benefit ratios, and is economically justified, even under a 'no growth' scenario or projection (Meeting Notes, April 18, 2014). This argument has not been convincing to the QIN. "As a trustee required to protect the QIN's treaty resources, the [Corps] must be held accountable for and be fully transparent about the potential for its actions to facilitate development of [petroleum exports]. We do not believe it has … The Corps cannot separate [the Grays Harbor NIP] from the ... [pending] proposals ... It is simply not realistic and not responsible … We demand full answers to our questions and a full explanation of how [the Grays Harbor NIP] was justified." (QIN 2014, p. 3) The Service believes that further information sharing, and negotiation between the Corps and QIN, is advisable. A Memorandum of Agreement may eventually be necessary, if the Corps is to obtain the QIN's consent and conditional approval for deepening the Channel.

These differences of perspective and opinion may be ideological, or inherent to the very specific methodologies and approaches that the Corps is required to apply in conducting GIs. However, our stated concerns, and the stated concerns of other interested stakeholders, are real. The Corps exercises authorities that extend beyond the current decision, to include future management and maintenance of the Channel. The authorities of the Corps' Directorate of Civil Works, and Regulatory Division, will likely both be engaged if and when the Channel requires future maintenance repair, or further modification, in response to future levels of use, marine traffic, and channel side slope and ship-wake erosion. Therefore, in our view, the Corps has both a current and future, continuing responsibility to account for and meaningfully address associated risks and damages.

In Whatcom County, Washington, where another fossil fuel export facility is being proposed (i.e., the Gateway Pacific coal terminal), the Corps has chosen to strictly limit the scope of their environmental review: "The three agencies conducting environmental reviews of a proposed coal export terminal and railroad spur at Cherry Point will produce two reports, not just one as originally planned, according to an agreement completed last week." "The U.S. Army Corps of Engineers is breaking with the [Washington] State Department of Ecology and Whatcom County to draft its own 'environmental impact statement' under federal law. Ecology and the county's separate statement will be written according to state law." "The Corps' review will be limited to local impacts such as the construction of a three-berth wharf and the filling of wetlands." (The Bellingham Herald, September 24, 2013).

Potential Damages and Losses to Fish, Wildlife, and Tribal Trust Resources

Here we highlight potential risks and damages to fish, wildlife, and tribal trust resources ("future-with-project" conditions).

The Corps' and Port's preferred alternative would cause additional impacts to Dungeness crab populations and productivity. The Corps has committed to continuing the practice of assessing impacts with the Dredge Impact Model, and will increase shell placement to mitigate for impacts resulting from both initial Channel deepening and subsequent annual maintenance dredging. The EPA has stated their concern regarding the adequacy of these measures and has posed a number of relevant questions that the Corps and Port should address (EPA 2014).

The Corps and Port intend to place dredged material that is not suitable for in-water disposal or beneficial reuse at the former City of Hoquiam wastewater treatment lagoon, located on Airport Way, Paulson, and Moon Island Roads. This interrelated action would fill, or begin to fill, an approximately 20-acre impoundment lying directly adjacent to the Service's Grays Harbor NWR. A wide variety of shorebirds and waterfowl use the impoundment and, in conjunction with the refuge and Bowerman Basin in general, the site is a popular destination for bird watchers. The Grays Harbor NWR was established with the specific intent of supporting compatible wildlife-oriented uses, including bird watching and associated educational opportunities (USFWS 2014, p. 1-10).

The Service does not support placement of unsuitable dredge material at the former City of Hoquiam municipal wastewater treatment lagoon, adjacent to the Port's Terminal 3, Bowerman Basin, and the Grays Harbor NWR. The Corps and Port have stated that alternative locations are available and may be considered (Corps 2014b, p. ES-2-22). We strongly recommend that the Corps and Port seek other locations for the placement and disposal of this dredge material. Placing contaminated dredge/fill at the former City of Hoquiam wastewater treatment lagoon would have direct impacts that are unacceptable to the Service and other stakeholders, and those impacts should be fully avoidable.

The Corps' and Port's preferred alternative would result in measurable temporary impacts to water quality, underwater and in-air sound levels, aquatic vegetation, and forage fish, and would have more persistent, long-term effects to substrates and the native benthos. However, the Service believes that most or all of these effects will be fairly limited in physical extent and duration. The proposed action will only modestly increase channel depths and annual maintenance quantities (i.e., by approximately 5 percent), and will otherwise maintain existing conditions along a navigation channel which has been frequently and repeatedly dredged in the past. Maintenance of the Channel will affect patterns of tidal exchange, wave energy, sediment transport, and erosion that operate on large spatial and temporal scales, but we expect that the foreseeable direct and indirect effects to shoreline features and habitat-forming processes will be insignificant.

The QIN has stated the following regarding potential damages and losses: "The QIN does not oppose progress or increased growth in Grays Harbor. We do oppose irresponsible development that threatens the Federally-protected treaty rights and resources our members depend upon now and in the future … We have many concerns … including a critical underestimation of increasing vessel transits." (QIN 2014, p. 3)

The EPA has stated the following regarding potential damages and losses: "Our primary concerns relate to induced shipping impacts and the lack of [information regarding] harbor-wide restoration and enhancement, discrepancies related to crab impacts and mitigation, insufficient information on how … impacts will be accounted for and mitigated, and the apparent placement of dredged materials at a … site without [the required] approval from EPA" (EPA 2014, pp. 1, 2); "We disagree that the proposed action's contribution is minor and insubstantial … We … emphasize our belief that … reasonably foreseeable … [activities] are collectively likely to result in significant adverse effects to environmental resources within Grays Harbor" (p. 2).

The NMFS has not commented directly on the Corps' and Port's preferred alternative for the Grays Harbor NIP. However, with a letter addressed to the Corps, Washington State Department of Ecology, and Cowlitz County, the NMFS has emphasized the following concerns regarding increased marine terminal exports: "Shipping-associated vessel strikes … with marine mammals and sea turtles", "prop wash", "vessel noise", and "vessel wakes" (NMFS 2013, pp. 1, 4); "Vessel wakes have been demonstrated to cause take … by stranding fish" (p. 4); "Transportation of coal also facilitates its consumption, which increases carbon emissions that contribute to … ocean acidification … [and] can liberate metals to the atmosphere" (pp. 4, 5); and, "The proposed project will have environmental effects … [that extend] beyond the footprint" (p. 5).

We agree with the Corps and Port that the possibility of a future oil spill(s), and the potential for resulting impacts, cannot be fully discounted. Accordingly, our position is that a Terminal 3 petroleum storage and transloading/shipping operation would be incompatible with the environmental conditions we seek to maintain on the Gray Harbor NWR. Furthermore, because the Channel runs the length of the Gray Harbor NWR at close proximity, we believe that any decision to site petroleum storage and transloading/shipping operations on the lower Chehalis River or Grays Harbor is likely to cause substantial and unacceptable impacts to this Aquatic Resource of National Importance, and other sensitive aquatic and terrestrial resources. Many concerned stakeholders have voiced similar and related concerns, regarding unquantified and/or unacceptable risks, associated social and environmental costs and damages, and the very limited economic benefits that might accrue to local communities and the State (Meeting Notes, Public Meetings, April 24 and 29, 2014).

Recommendations

The Service offers the following recommendations to the Corps and Port, regarding planning and analysis, operational features and alternatives, impact minimization and conservation measures, and mitigation for unavoidable impacts to fish and wildlife resources:

- (Planning and Analysis) Coordinated planning in support of this GI, the Grays Harbor NIP, and other Federal water resource development proposals could be improved with an increased commitment to transparency, and timely and complete sharing of available information with all engaged stakeholders.

- (Planning and Analysis) Failure to account for externalities, including social and environmental risks and damages, will result in findings that are skewed and incomplete. Decision-makers, and the general public, should not be presented with a distorted image of true costs and benefits. We recommend that the Corps and Port broaden their consideration of social and environmental factors where possible.

- (Operational Features and Alternatives) The Service does not support placement of unsuitable dredge material at the former City of Hoquiam municipal wastewater treatment lagoon, adjacent to the Grays Harbor NWR. We recommend that the Corps and Port reconsider their plans for wasting dredged material at this site. Placing this material at this site would have avoidable direct impacts that are unacceptable to the Service and other stakeholders.

- (Operational Features and Alternatives) The Crab Mitigation Working Group, which met on several occasions to improve information sharing, identified a number of important questions involving proper calibration and use of the Dredge Impact Model, available alternative methods for describing and quantifying potential dredge impacts, and the net effect of maintenance dredging (and related mitigation) on long-term recruitment to the adult crab population. This group also addressed the long-term success and viability of the current Corps approach to mitigation (i.e., annual placement of oyster shell and creation of refuge habitat for juvenile crab), associated costs to the Corps' operation and maintenance budget, and the feasibility and best opportunities for alternative, advance or concurrent mitigation in the form of habitat restoration and/or enhancement. Many constructive suggestions were offered by this group at the request of the Corps. We recommend that the Corps act on these suggestions if and when there is a willingness to consider an alternative approach to mitigation for dredge impacts to Dungeness crab.

- (Impact Minimization and Conservation Measures) The Corps proposes to implement all of the same conservation measures and best management practices that have been refined through years of performing annual maintenance dredging along the Channel. The Corps limits the use of suction dredge equipment to only those outer harbor reaches where clamshell dredging is impracticable, and timing restrictions further reduce the risk and likely extent of fish and crab entrainment. We commend the Corps for their good-faith efforts to identify and prioritize meaningful and effective conservation measures and best management practices.

- (Mitigation for Unavoidable Impacts to Fish and Wildlife Resources) Many constructive suggestions have been offered by participants in the Crab Mitigation Working Group. We recommend that the Corps act on these suggestions if and when there is a willingness to consider an alternative approach to mitigation for dredge impacts to Dungeness crab.

- (Mitigation for Unavoidable Impacts to Fish and Wildlife Resources) During 2012, the Service, EPA, and Washington State Department of Fish and Wildlife each provided comments critical of the Corps' proposed mitigation in support of a long-term management strategy for the south jetty (South Jetty LTMS). No official Corps response to these comments has been offered. We recommend that the Corps reengage with stakeholders on this issue before selecting a preferred alternative for the South Jetty LTMS (FWS Ref. No. 01EWFW00-2012-CPA-0202).

We offer the following recommendations to the Corps and Port, regarding the necessity of improving government-to-government relations and communication, and the necessity of upholding Federally guaranteed treaty fishing rights and the Federal government's other/related tribal trust responsibilities:

- (Improving Government-To-Government Relations and Communication) The Corps exercises authorities that extend beyond the current decision, to include future management and maintenance of the Channel. The authorities of the Corps' Directorate of Civil Works, and Regulatory Division, will likely both be engaged if and when the Channel requires future maintenance repair, or further modification, in response to future levels of use, marine traffic, and channel side slope and ship-wake erosion. In our view, the Corps has both a current and future, continuing responsibility to account for and meaningfully address associated environmental risks and damages. We recommend that the Corps fully exercise its authorities and plan for continued engagement in the public processes surrounding Port of Grays Harbor redevelopment proposals.

- (Improving Government-To-Government Relations and Communication) Several of the Corps' and Port's conclusions have been questioned, or been found unconvincing, by the QIN, EPA, and Service. The Service believes that further information sharing, and negotiation between the Corps and QIN, is advisable. A Memorandum of Agreement may eventually be necessary, if the Corps is to obtain the QIN's consent and conditional approval for deepening the Channel.

- (Improving Government-To-Government Relations and Communication) Some of the apparent differences of perspective and opinion may be ideological, or inherent to the very specific methodologies and approaches that the Corps is required to apply in conducting GIs. We recommend that the Corps redouble its efforts to communicate clearly, objectively, and with terms and concepts that are understood by stakeholders and the general public.

- (Upholding Treaty Fishing Rights and Tribal Trust Responsibilities) Tribal concerns regarding proper recognition and protection of treaty resources and rights are not unique to this action. Instead, these concerns are a common and recurring theme when large and small actions are proposed that would have foreseeable impacts to treaty-protected rights

(including access to usual and accustomed fishing grounds). We recommend that the Corps look to the history of past successes and failures, to obtain, provide internally, and refine improved guidance for conducting effective government-to-government relations. We recommend that the Corps and Port might have, and probably will have, greater success meeting long-term planning objectives, if they reconsider and adjust older modes of interactions with the tribes.

- (Upholding Treaty Fishing Rights and Tribal Trust Responsibilities) Collectively, we the agencies and departments of the Federal government, have a unique responsibility for championing and accomplishing greater recognition and protection of treaty-protected resources and rights. Where our agencies' fundamental goals and purposes are aligned with the needs and desires of tribal interests, it should be easy to develop consensus positions that aim to protect these resources and rights.

- (Upholding Treaty Fishing Rights and Tribal Trust Responsibilities) The QIN has stated that it will "...continue to vehemently oppose ... [Port redevelopment] projects proposed by Imperium, Westway, and U.S. Development." (QIN 2014, p. 2) The Service has stated, that "...a bulk fluid storage and transloading/shipping operation located at Terminal 3 would present unacceptable risks to Service trust resources", and we "...will seek every opportunity to reinforce our stated concerns" regarding each of these proposals (USFWS 2014, pp. 6, 7). We recommend that the Port and other parties with regulatory authority (City of Hoquiam, Washington State Department of Ecology, U.S. Coast Guard) should invite, initiate, and engage in inter-agency coordination before advancing proposals that would bring petroleum storage and transloading/shipping operations to the Port; carefully consider proximity to vulnerable and irreplaceable coastal and marine ecological resources, and treaty-protected resources, when making siting determinations; fairly consider any redevelopment projects and/or alternatives that would achieve the same or similar economic development objectives; and, prioritize the identification and pursuit of better, safer, and more compatible uses of the Port's facilities.

Thank you for the opportunity to engage in the planning process for the Grays Harbor NIP. We hope and expect that the Corps and Port will give our FWCA documentation fair and full consideration before making final decisions.

If you have any questions about this Report, would like to discuss our comments or recommendations, and/or meet in-person, please contact Ryan McReynolds (360-753-6047; ryan_mcreynolds@fws.gov) or Bridget Moran (360-753-6044; bridget_moran@fws.gov).

Sincerely,

For Ken S. Berg, Manager
Washington Fish and Wildlife Office

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PERSONAL COMMUNICATIONS

Mike McDowell pers. comm., 18 April 2014.

Meeting Notes, Meeting with the Corps, April 18, 2014.

Meeting Notes, Public Meetings - SEPA Scoping, Westway and Imperium Expansion Projects (Port of Grays Harbor), April 24 and 29, 2014.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, Washington 98115

NMFS Tracking No.:
WCR-2014-476

June 5, 2014

Evan Lewis
Corps of Engineers, Seattle District
Post Office Box 3755
Seattle, Washington 98124-3755

RE: Endangered Species Act Section 7 Informal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Grays Harbor/Chehalis River Navigation Project Grays Harbor County, Washington; Sixth Field HUC 170010000005-Mid WA Coast; Fifth Field HUC 1710010503-Grays Harbor).

Dear Mr. Lewis:

On March 4, 2014, the National Marine Fisheries Service (NMFS) received your request for a written concurrence the proposed action is not likely to adversely affect (NLAA) species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA). This response to your request was prepared by NMFS pursuant section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency guidance for preparation of letters of concurrence.[1]

NMFS also reviewed the proposed action for potential effects on essential fish habitat (EFH) designated under the Magnuson-Stevens Act (MSA), including conservation measures and any determination that you made regarding the potential effects of the action. This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation.[2]

This letter is in compliance with section 515 of the Treasury and General Government Appropriations Act of 2001 (Data Quality Act) (44 U.S.C. 3504 (d) (1) and 3516), and underwent pre-dissemination review using standards for utility, integrity and objectivity.

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[1] Memorandum from D. Robert Lohn, Regional Administrator, to ESA consultation biologists (guidance on informal consultation and preparation of letters of concurrence) (January 30, 2006).
[2] Memorandum from William T. Hogarth, Acting Administrator for Fisheries, to Regional Administrators (national finding for use of Endangered Species Act section 7 consultation process to complete essential fish habitat consultations) (February 28, 2001).

Consultation History

The National Marine Fisheries Service (NMFS) reviewed your March 4, 2014 request for consultation, as well as the follow-up information received between March and May, 2014. Consultation was initiated on May 12, 2014. The U.S. Army Corps of Engineers (COE) requested concurrence with its determination that the proposed action "may affect, is not likely to adversely affect" Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook salmon (*O. tshawytscha*), Columbia River (CR) chum salmon (*O. keta*), Southern Distinct Population Segment (DPS) North American green sturgeon (*Acipenser medirostris*), Southern DPS Pacific eulachon (*Thaleichthys pacificus*), Southern Resident (SR) killer whale (*Orcinus orca*), Humpback whale (*Megaptera novaeangliae*), and Eastern DPS Steller sea lion (*Eumetopias jubatus*). The COE also requested concurrence with its determination that the proposed action "may affect, is not likely to adversely affect" designated critical habitat for Southern DPS North American green sturgeon.

Critical habitat has not been designated for the Humpback whale, and the proposed action does not occur within designated critical habitat for LCR Chinook salmon, UWR Chinook salmon, or CR chum salmon, SR killer whales, Steller sea lion, or in proposed critical habitat for Southern DPS Pacific eulachon. The species addressed in this consultation are identified in Table 1 (appended), which also lists Federal Register notices for final rules that list threatened and endangered species, designate critical habitat, or apply protective regulations. This consultation is conducted under section 7(a)(2) of the ESA, and its implementing regulations, 50 CFR Part 402.

Description of the Proposed Action and Action Area

The COE proposes to deepen approximately 14.5 miles of the 23.5 mile Federally authorized deep-draft Grays Harbor and Chehalis River Navigation Channel. Dredging will occur in six channel 'reaches' and a turning basin to reach the full congressionally-authorized depth of -38 feet mean lower low water (MLLW), from its current depth of -36 ft MLLW. Approximately 1.8 million cubic yards (mcy) are dredged annually from the inner Grays Harbor navigation channel reaches and turning basins and approximately 1.4 mcy are dredged annually from the outer reaches. Deepening the channel to 38 feet will add an additional 1.97 mcy of dredged material for a total of 4.06 mcy for the construction year. After deepening is complete, annual maintenance dredging is expected to increase by approximately 107,000 cy's per year, making the total dredged material increase from approximately 3.07 mcy per year to about 3.2 mcy per year, to maintain the 38-foot depth.

The COE proposes to dredge the inner harbor in an east-to-west direction with a floating clamshell dredge during periods intended to avoid significant salmonid use. Dredging timing in the inner harbor will vary by reach and is proposed between July 16 and February 14, or August 1 and February 14, depending on the dredging reach. Outer harbor dredging with a Hopper (suction) dredge is proposed between April 1 and May 31, or April 1 and June 30, to avoid foul weather and wave conditions, and to reduce impacts to the Dungeness crab (*Cancer magister*)

fishery (again, with timing varied depending up dredging reach). Although dredging in the inner harbor is proposed through mid-February, dredging is typically completed in January.

Dredged material disposal will occur at six existing, approved, designated disposal sites:

1. The Point Chehalis Open Water Disposal Site, which varies between minus 50 to minus 80 feet Mean Lower Low Water (MLLW), is a dispersive site subject to high wave energy and strong, predominantly westward currents. On average 1.8 million cubic yards of dredged material have been placed in this area annually since 1977. Approximately 75 percent of this material erodes seaward along the South Jetty during the dredging period, and another 15 percent erodes the following winter. This is the most heavily used disposal site in Grays Harbor.

2. The South Jetty Open Water Disposal Site, which varies between minus 40 to 60 feet MLLW, is a dispersive site subject to fast tidal currents, predominantly westward, that sweep along the jetty toe. This is the preferred disposal site for inner Grays Harbor dredged material, unless foul weather conditions dictate disposal at the Point Chehalis site.

3. The Southwest (3.9 mile) Open Water Disposal Site, which varies between minus 100 to minus 120 feet MLLW, is rarely used. Material disposed at this site is unavailable for longshore transport and nourishment to northern beaches.

4. The Half Moon Bay Nearshore Nourishment and Direct Beach Nourishment Sites use dredged material from the outer reaches to maintain a stable beach profile west of the Point Chehalis revetment extension and to ensure the revetment toe is not exposed.

5. The South Beach Nearshore Nourishment Site is used to slow erosion on the south side of the South Jetty. Dredged material is generally placed between minus 35 to minus 40 feet MLLW.

Dredged material is transported to the disposal sites by either a bottom-dump hopper dredge, or by a tugboat and bottom-dump (or split-hull) barge. Approximately 800 to 6,000 cubic yards of material are transported each trip. Typically, three to five trips are made each day. Sediment sampling, testing and approval prior to dredging and disposal are conducted pursuant to the Dredged Material Management Program[3] (DMMP).

Pursuant to the Revised Crab Mitigation Strategy Agreement (1998)[4], the COE also proposes to place up to 7,500 cubic yards of oyster shell on existing Dungeness crab habitat plots (Figure 1.) The South Channel habitat plots are approximately 45 acres in size and maintained approximately every 3 years in the spring, prior to settlement of larval crabs. Prior to shell placement, surveys for eelgrass (*Zostra marina*) are conducted and marked so that shell placement does not occur on eelgrass beds.

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[3] Available online at: http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=dmmo&pagename=home.
[4] Available online at: http://www.nws.usace.army.mil/ERS/reposit/Revised_Crab_Strategy.pdf.

Conservation measures proposed by the COE include: (1) the use of clamshell dredges in the inner harbor reaches of the Federal navigation channel to avoid entrainment of fish, shrimp, and crabs; (2) water quality monitoring when Chehalis River flows drop below 1,000 cubic feet per second at Hoquiam; (3) ceasing dredging when dissolved oxygen levels fall below 4 milligrams per liter; (4) restricting disposal at Half Moon Bay nearshore disposal site to above plus 9 feet MLLW; and (5) dredging the inner harbor in an east-to-west direction to reduce potential impacts to eulachon. In addition, the COE proposes to: (1) conduct dredge operations in a manner that minimizes the disturbance or siltation of adjacent waters, and that prevents the accidental discharge of petroleum products, chemicals, or other toxic or deleterious substances; (2) conduct water quality monitoring to ensure that applicable standards are not exceeded outside of the 300-foot specified compliance zone. Dredging activity will be modified if exceedances are seen at the 300-foot zone. If exceedances occur at the 600-foot zone of compliance, work will stop and will not re-commence until water quality standards are met and all relevant actions are taken to modify the dredging to minimize the chance for future exceedances; and (3) monitor for larval eulachon for at least 2 years. Up to three additional years of sampling will occur depending upon available funding. Sampling will follow accepted protocols of the Washington State Department of Fish and Wildlife and the Cowlitz Indian Tribe (as described in NMFS 2010), and occur in the Wynoochee and Chehalis rivers in the months of January through June. A systematic sampling regime during the months of January through June is based on an assumption that run-timing in Grays Harbor is similar to that of the Columbia River, where adults can enter as early as December and spawn as late as May.

The action area for dredging and disposal includes the Federal Navigation Channel in the lower mainstem Chehalis River and Grays Harbor, and the Pacific Ocean off the mouth of Grays Harbor. The action area also encompasses a 0.75-mile radius around the project sites to account for underwater noise effects and turbidity generated by dredging and disposal. The proposed timing for the project is between April and May (or June for South Reach only) for outer harbor dredging and disposal, and between July 16 or August 1 to February 14 for inner harbor dredging and disposal.

ENDANGERED SPECIES ACT

Effects of the Action

Although there are no ESA-listed salmon or steelhead runs in the Grays Harbor Watershed, juvenile salmonids from some Columbia River stocks may enter Grays Harbor for some portion of their early marine rearing. Specifically, emigrating juveniles that have left the Columbia River estuary may feed in the nearshore oceanic environment as they move north, and may consequently find their way into Grays Harbor. Based on past review (Casillas pers comm., in NMFS 2009) juvenile salmonids from the following ESU's considered likely to utilize the action area in Grays Harbor include:

<u>Lower Columbia River Chinook Salmon, Upper Willamette River Chinook Salmon</u>
<u>Columbia River Chum Salmon</u>

The NMFS has analyzed the potential impacts of the proposed action on the above species and has determined that the effects will be insignificant and discountable for a variety of reasons as discussed below.

Peak outmigration to the Columbia River estuary for ocean type salmonids occurs from March through July, with ocean entry between August and November. Stream-type salmonids emigrate in spring of their second year as larger yearlings, with ocean entry occurring from May through June. Ocean entry is considered prerequisite for the use of Grays Harbor by Columbia river salmonid ESUs. These ocean entry periods overlap the dredge timing proposed; thus, the NMFS concludes that juvenile salmonids from the Columbia River could be in the action area during the proposed dredging and disposal activities. As summarized above, outer harbor hopper dredging and disposal is proposed to occur between April and May, or June (South Reach only), and inner harbor clamshell dredging and disposal is to occur between mid-July to mid-February. All dredging operations will be conducted in offshore waters of minus 32 feet to minus 46 feet MLLW. These depths are below the shallower nearshore depth profile preferred by juvenile salmonids. Further, with the exception of the Half Moon Bay nearshore and beach nourishment sites, all disposal areas are open water, dispersive, and at depths ranging from minus 35 feet to minus 120 feet MLLW—again, depths that are not typically utilized by juvenile salmonids. Therefore, while juvenile salmonids may be present in Grays Harbor during the proposed action, they are not likely to occur at the locations of the dredging and disposal activities and are therefore not likely to be affected by those activities.

Turbidity from the dredge and disposal operations is expected to occur, but turbidity is expected to be of short duration, and to the extent that salmonids are present in the areas affected by turbidity they are expected to be of sufficient size that they can respond by avoiding waters affected by turbidity. Several reports summarized dredged material behavior and sediment resuspension due to hopper and clamshell dredging and associated open water disposal (Palermo et al. 2009; LaSalle et al. 1991; Havis 1988; McLellan et al. 1989; Herbich and Brahme 1991; Truitt 1988). Hopper dredging creates a near-bottom turbidity plume of suspended material from the dragheads and upper water column plume from overflow of turbid water during hopper-filling operations. Suspended-sediment plumes for hopper dredges could extend up to 1,200 meters on the bottom at concentrations up to 800 milligrams per liter (Clark and Wilbur 2000). Hayes et al. (1984 in LaSalle et al. 1991) reported the near-bottom sediment plume from a hopper dredge in Grays Harbor with suspended sediment (silty clay) concentrations of up to 891 milligrams per liter. However, the sediment to be hopper-dredged is primarily coarse sand with less than 2 percent fines, which is expected to have a small turbidity plume with minimal duration and suspended sediment concentration. In support, the settling velocities for similar material dredged in the Columbia River are in the range of 0.03 to 0.06 feet per second, so sand resuspended 3 to 6 feet off of the bottom should redeposit in approximately 1 to 2 minutes. Clamshell dredging can create water column concentrations of resuspended sediment of 500 to 1,100 milligrams per liter, mainly near the bottom. These concentrations quickly return to background levels within several hundred feet of the dredge.

Phipps et al. (1992 in COE 2011) monitored water quality at 34 sites around a clamshell dredge during inner harbor maintenance dredging in 1990. Out of 600 samples, only 23 registered a value of total suspended solids (TSS) greater than 500 milligrams per liter, and seven of these

samples were measurements of ambient conditions. The highest TSS level measured was 3,000 milligrams per liter with an ambient measurement of 700 milligrams per liter. In-water disposal of source material will create a discharge field from the bottom of the ship's hull (hopper dredge or bottom-dump barge) to the bottom of the open water disposal site. However, only 1 to 5 percent of the released material will be transported within the upper water column (Truitt 1988). Tidal action, currents, and wave action relative to the dredge and/or disposal site will influence the spread of the turbidity plume. Any turbidity is anticipated to dissipate within a few hours or less.

Of all the disposal sites, disposal of dredged material in Half Moon Bay for nearshore and direct beach nourishment has the most potential to affect juvenile salmonids. Juvenile salmonids could be present within the minus 10-foot to minus 25-foot MLLW depths of the disposal site. However, the dredge material will be dumped from bottom dump barges which release dredge material a number of feet below the water's surface, avoiding that portion of the water column that is most typically occupied by juvenile salmon. Although disposal for direct beach nourishment at Half Moon Bay will involve pumping dredge material into an upland disposal site and will require mixing water with the dredge material, the water intake to the pump that adds water to the dredge material will be screened in accordance with NMFS screening criteria to prevent fish entry and entrainment. In addition, only material dredged from the outer harbor will be disposed of at Half Moon Bay. This material is composed predominantly of larger-grained sand with less than 2 percent fines, thus suspended sediment concentrations will be insignificant.

Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries, and identified a scale of ill effects based on sediment concentration and duration of exposure, or dose. Exposure to concentrations of suspended sediments expected during the proposed dredging and disposal activities could elicit behavioral effects such as a short-term reduction in feeding rate or success. However, turbidity will persist only during dredging and shortly after the operations cease. Typically a hopper dredge operates for 30 to 60 minutes before transferring the material to the disposal site. Travel to and from the disposal site typically takes 30 minutes to 3 hours. As with the hopper dredge, turbidity from clamshell dredging persists as long as dredging is in progress. Typically, 20 to 30 cycles or bucket loads are made per hour, until the bottom-dump barge is full and ready for disposal.

Studies show that salmonids are able to detect and distinguish turbidity and other water quality gradients (Quinn 1988, Simenstad 1988, Bisson and Bilby 1982), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991). Columbia River juvenile salmonids that may access habitat in the Grays Harbor action area will likely be of larger size, as they will have already outmigrated out of the mainstem Columbia into oceanic waters—a transition that correlates with the achievement of sufficient size to accommodate the rigors of the marine life history stage. To this end, Columbia River chum emigrate seaward in the spring and have been captured in the estuary in April and May (Bottom et al. 1984). They initially use nearshore coastal habitats and move offshore at 50 to 110 millimeters fork length (Irie 1985). Stream-type Chinook salmon average 73 to 134 millimeters fork length at ocean entry and move offshore relatively quickly (Healey 1991). Ocean-type Chinook salmon move slowly through the estuary, feeding and rapidly growing prior to ocean

entry. Bottom et al. (1984) captured subyearlings in the Columbia River estuary as late as October. Ocean-type Chinook salmon typically enter the ocean in late summer to late fall (LCFRB 2010). Coho leave the estuary in the late spring of their second year at a much larger size and move rapidly to deeper water upon ocean entry. Given the timing and location of dredge and disposal operations, and the larger size of juvenile salmonids that would be anticipated in the action area if present, potential sediment-related effects to LCR Chinook, UWR Chinook, or CR chum from the proposed activities would be short-term, temporary, and localized, and therefore, insignificant.

Juvenile salmonids that may be present are also likely to exhibit noise-induced avoidance behavior that causes them to avoid the dredge and transport barge and tug. Studies conducted by the COE (Clarke et al. 2002) measured sounds produced by different dredging methods, including clamshell, hydraulic cutterhead, and hopper dredges. Based on these studies, NMFS estimates that root-mean-squared sound pressure levels will exceed the threshold for adverse behavioral modification (150 dB (re: 1μPa)) at a maximum distance of 13 meters from the dredge, regardless of the type of dredge used, but will not exceed injury thresholds (187 dB cumulative SEL). Furthermore, the noise generated by dredging will be short-term, temporary, and localized. As larger juvenile salmonids are better able to avoid potentially harmful acoustic noise, and the noise radius above the avoidance threshold is conservatively projected to be highly localized, the NMFS concludes that any short-term avoidance behavior by juvenile salmonids will be insignificant, with an extremely low probability of taking LCR Chinook, UWR Chinook, or CR chum.

Based on the project timing, locations, and depths of proposed dredging and disposal, the overall potential effects of the proposed project on salmonids potentially present in the action area are expected to be insignificant. Thus, NMFS concurs with the COE's determination of "may affect, not likely to adversely affect" LCR Chinook salmon, UWR Chinook salmon, and CR chum salmon.

Southern DPS North American Green Sturgeon

The only known spawning population of Southern DPS North American green sturgeon occurs in the Sacramento River. Adults migrate into the river to spawn between April and July. Juveniles spend 1 to 4 years in freshwater before migrating to the ocean. Evidence of green sturgeon spawning in the coastal estuaries of Washington is lacking (Adams et al. 2002). Consequently, the proposed action will have no impact on Southern green sturgeon spawning or juvenile rearing. During the late summer and early fall, subadult and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast (Emmett et al. 1991; Moser and Lindley 2007) with particularly large concentrations occurring in the Columbia River estuary, Willapa Bay, and Grays Harbor (Moyle et al. 1992). Adult green sturgeon are common in the seawater and mixing zones of Grays Harbor during high salinity periods, with the highest abundance from July through early October (Monaco et al. 1990).

Although this species is likely to be present in Grays Harbor during project activities, most dredging would occur in the lower salinity reaches of the inner harbor which are less likely to be inhabited by green sturgeon. Adult or subadults that may be present in disposal areas would be

mobile enough to avoid the discharge fields and suspended sediments created. Further, the species is typically found in turbid conditions and forages in the benthos by stirring up the sediment to access benthic prey such as burrowing shrimp and is thus relatively tolerant of higher suspended sediment concentrations.

Subadult and adult green sturgeon may also be at risk of entrainment during dredging, however, that risk is also considered low. R2 Consultants (1999) reported only one white sturgeon captured in a Lower Columbia River hopper dredge entrainment study. Hopper dredging will occur in the spring prior to the period of highest species abundance, as indicated above. Although sturgeon are benthically-oriented fish, fewer than 25 confirmed instances of sturgeon entrainment by dredges operating in Gulf and Atlantic waters were reported for 1990 to 2005 (unpublished as cited in Hoover et al. 2005). Consequently, given the low likelihood of their presence in the action area, and the extreme rarity of sturgeon entrainment events, the potential for entraining subadult or adult green sturgeon is expected to be low.

Although benthic food resources are prey items for ESA-listed green sturgeon, removal of these food organisms via dredging or disposal is expected to be limited. Given the ability of invertebrates to recolonize dredge and disposal locations rapidly, and the lack of any evidence to indicate benthic food resources for green sturgeon are limited in Grays Harbor the temporary and localized loss of benthic food items is expected to be insignificant to the species (Flemer et al. 1997; Dernie et al. 2003). Changes in prey availability are unlikely to be of a magnitude or extent that would appreciably diminish forage resources in the action area.

Although present in the action area, the overall potential effects from the proposed dredging and disposal activities on green sturgeon are expected to be insignificant. Thus, NMFS concurs with the COE's determination of "may affect, not likely to adversely affect" Southern DPS North American green sturgeon.

Southern DPS Pacific Eulachon

Eulachon are endemic to the eastern Pacific Ocean and range from northern California to southwest Alaska and into the southeastern Bering Sea. The SDPS of eulachon includes populations spawning in rivers south of the Nass River in British Columbia to the Mad River in California. Eulachon primarily spawn in the Columbia River system in Washington State, although sporadic spawning runs in Grays Harbor tributaries, including the Chehalis River, have been reported (WDFW (Washington Department of Fish and Wildlife) and ODFW (Oregon Department of Fish and Wildlife) 2001). Eulachon leave saltwater to spawn in their natal streams late winter through early summer and typically spawn in the lower reaches of larger rivers fed by snowmelt, glacial runoff, or extensive spring freshets (Gustafson 2010). Spawning begins as early as December and January in the Columbia River system, peaks in February, and can continue through May. Larval outmigration occurs 30 to 40 days after spawning. After hatching, larvae are carried downstream and are widely dispersed by estuarine and ocean currents. Eulachon movements in the ocean are poorly understood.

Presuming similar run-timing as the Columbia River where adults can enter as early as December and spawn through May, adult eulachon could be present during inner harbor

dredging and disposal activities. However, adult eulachon are unlikely to be affected by clamshell dredging in the inner harbor because the dredge bucket descends through the water column in an open position and closes on impact with the substrate, and adult eulachon will be mobile enough to avoid the bucket.

While adults are unlikely to be present during spring hopper dredging in the outer harbor; hopper dredging would occur during juvenile outmigration—if juveniles are present. Thus, hopper dredging in the outer harbor could potentially entrain larval eulachon. Although some risk of larval eulachon entrainment exists, the NMFS considers the risk negligible because larval eulachon are not likely to be present in the action area during dredging operations. Eulachon prefer large river systems, such as the Columbia and Fraser rivers that are fed by snowmelt or extensive spring freshets. The WDFW and ODFW (2001) reported eulachon in "large abundance" in the Wynoochee River, a tributary of the Chehalis River, in 1993 when the run into the Columbia River was delayed, presumably due to cold water conditions. Observances over a relatively long period suggest that this was a unique occurrence and that their use of the Chehalis system is highly irregular. Deschamps et al. (1970 in Gustafson 2011; Monaco et al. 1990) and Simenstad et al. (2001 in Gustafson 2011) stated their observances of adult eulachon in the Chehalis River system were rare. Deschamps et al. further stated that a eulachon run of any consequence in the Chehalis system was unlikely, "although strays or feeding fish from other areas probably visit the upper harbor at times." Consequently, eulachon appear to utilize the Grays Harbor watershed very infrequently, which further reduces the likelihood of the species being encountered during dredge operations. Notwithstanding, the COE will visually monitor for adult eulachon during operations, and will also sample for larval eulachon in the action area. (Larval monitoring is appropriate in this instance because adult eulachon can be missed through visual monitoring). The COE is expected to notify NMFS of monitoring results if adult spawners are observed or larval eulachon are captured during sampling. Positive results from either effort will be immediately communicated to NMFS, to determine if reinitiation of consultation is warranted.

Temperature greatly influences the length of time to hatching for eulachon. In laboratory conditions at temperatures ranging from 6.5 degrees Celsius to 9 degrees Celsius, active embryo hatching began in 20-21 days and all eggs under observation hatched within 5 days of each other (Gustafson 2010). Using the Columbia River as a surrogate for Grays Harbor, hatching and the onset of outmigration on the tides and currents typically occurs 30-40 days later, with peak outmigration in April. In the Columbia River, larval eulachon are usually located in the lower reaches of the water column during outmigration; however, surveys in British Columbia coastal estuaries indicated that larvae are mostly present in the top 15 meters (49 feet) of the water column, which would increase risk of entrainment into hopper dredge water intakes. It is unlikely that larval eulachon produced in small spawning events would be entrained during hopper dredging, given the small area being dredged and the small numbers of larval eulachon potentially present in the harbor as the result of minor spawning events. The entire navigation channel represents only 3 percent of Grays Harbor, and each dredging event would be even smaller. Thus the likelihood of larval entrainment is expected to be extremely low. However, as hopper dredging essentially would overlap peak larval outmigration timing, eulachon larval sampling should extend through June.

Given the timing, location and duration of dredging and disposal operations, and the low likelihood of eulachon presence, the likelihood of effects on eulachon is insignificant. Therefore the NMFS concurs with the effects determination of "may affect, not likely to adversely affect," for Southern DPS Pacific eulachon.

Marine Mammals (Southern Resident Killer Whales, Steller Sea Lions and Humpback Whales)

The above ESA-listed marine mammal species are extremely unlikely to occur in the Grays Harbor navigation channel or the harbor proper, and therefore the proposed dredging actions, including vessel traffic, have a discountable potential to affect these species. These species may occur within nearshore habitats along the outer Washington coast at the Grays Harbor entrance, where disposal of dredge materials is proposed to occur. Therefore dredge disposal activities may have some effects on marine mammal species. These effects are likely to be insignificant, for the reasons described below.

Disturbance of Steller sea lion haulout behavior. Dredge disposal at these sites will have no effect on Steller sea lion haulout behavior because the nearest haulouts are 20 or more miles away (Split Rock area, greater than 20 miles to the north, and Columbia River South Jetty, greater than 40 miles to the south).

Disturbance of marine mammals swimming in the area. In the event marine mammals are present during disposal activities, vessel operations and dredge discharge procedures associated with the proposed action may cause temporary disturbance. Any marine mammals swimming in the vicinity of the disposal site during dredge discharge may temporarily avoid the disposal area, but such disturbance is likely to be short-term and localized, with no lasting effects, and therefore insignificant. Vessels transporting dredge material may also disturb marine mammals, but such disturbance is also likely to be short-term and localized, with no lasting effects, and therefore insignificant. Vessel strikes of marine mammals are extremely unlikely because the barge-sized vessels are slow moving, follow a predictable course, do not target marine mammals, and should be easily detected and avoided by marine mammals. Potential effects from vessel strikes are therefore discountable.

Effects on prey. The proposed action is not anticipated to affect the quantity of prey available to marine mammals (i.e., no anticipated effects on salmon or other fish species addressed above, or on small schooling fish or euphausids that are prey of humpback whales). As described in the project description above, the COE adheres to sediment quality standards for open ocean disposal. Only "clean" dredged material can be placed into the ocean under current statutes and regulations. Sediment suitability must be documented prior to disposal. Adherence to sediment quality standards for proposed dredge disposal would minimize effects on water quality such that any effects to prey quality would be insignificant.

The NMFS finds that all potential adverse effects to ESA-listed marine mammals are discountable or insignificant and concurs with the COE's determination of "may affect, not likely to adversely affect" for Southern Resident killer whales, Steller sea lions, and humpback whales.

Critical Habitat Determination

The NMFS reviews the status of critical habitat and proposed critical habitat affected by a proposed action by examining the condition and trends of primary constituent elements (PCEs) or essential features of critical habitat throughout the designated area. The PCEs and essential features are physical features essential to the conservation of the evolutionarily significant unit/DPS.

Southern DPS North American Green Sturgeon

The NMFS designated critical habitat for the Southern DPS North American green sturgeon on October 9, 2009 (74 FR 23822). The PCEs potentially found in the action area include:

1. Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages.
2. Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
3. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats.
4. Depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages.

The NMFS analyzed the potential impacts of the project on the designated PCEs of critical habitat potentially found in the action area. The impacts of the proposed dredging and disposal activities to these PCEs will be insignificant for the following reasons.

1. Dredging will increase water depth in the area, altering habitat and prey resources. However, this depth is not significantly different from the baseline due to regular maintenance dredging since 1935. The dredging will disrupt the substrate and entrain some North American green sturgeon prey items. However the area affected by the dredge operation is extremely small compared to the area of Grays Harbor. Further, the prey base will recover to pre-dredge conditions within one to two years, and the benthic prey base is not limited in Grays Harbor nor will become so as a result of the dredging. Benthic macroinvertebrate and fish prey species will continue to be available from the surrounding area. Fast currents at the deep water disposal sites prohibit significant benthic macroinvertebrate production. Consequently, the annual dredge and disposal of approximately mainly sand and gravel will not alter the food base within the action area. The effects on food resources are therefore insignificant.
2. The project will temporarily alter the water quality within the action area. The use of standard best management practices, including as described above, will minimize the release of sediment-laden water during dredging and disposal. Thus effects on the water quality of the action area are insignificant.

3. The proposed action is designed to maintain channel depths. Bathymetry and sediment movement in the estuary is dynamic and influenced by factors such as tides, currents, waves, and ocean and freshwater sources of sediment. The navigation channel represents only 3 percent of the surface area of Grays Harbor, and dredged material disposal is located in areas that will keep that material within Grays Harbor. Given the dynamic nature of sediment movement and that only 3 percent of the estuary will be dredged, the effects on the depth diversity within Grays Harbor are expected to be insignificant.
4. The migration of subadult/adult green sturgeon will not be impeded by the dredging and disposal operations. Few subadult or adult green sturgeon will be in the action area during hopper dredging. Sturgeon will be mobile enough to avoid both the hopper and clamshell dredges. The effects on the migration corridor are therefore concluded to be insignificant.

Therefore, NMFS concludes that the potential effects of the project are not likely to adversely modify the designated critical habitat of Southern DPS North American green sturgeon.

Conclusion

This summary of the NMFS interpretation of potential effects of the proposed action concludes informal consultation pursuant to the regulations implementing the ESA, 50 CFR 402.13. The COE must reinitiate this ESA consultation if: (1) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered, (2) the action is modified in a manner that causes an effect to the listed species or designated critical habitat that was not considered in this consultation, or (3) a new species is listed, or critical habitat for another species is designated that may be affected by the identified action, or (4) adult eulachon are observed during dredging, or larval eulachon are captured during monitoring. Although the BE does not have a termination date, consultation will be reinitiated in 15 years (October 2026), or if one of the above criteria occurs.

Magnuson-Stevens Fishery Conservation and Management Act

Federal agencies are required, under section 305(b)(20) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and its implementing regulations (50 CFR 600 Subpart K), to consult with NMFS regarding actions that are authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat (EFH). The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". If an action would adversely affect EFH, NMFS is required to provide the Federal action agency with EFH conservation recommendations (MSA section 305(b)(4)(A». This consultation is based, in part, on the information provided by the Federal agency and descriptions of EFH for Pacific coast groundfish, coastal pelagic species, and Pacific salmon contained in the Fishery Management Plans[5] developed by the Pacific Fishery Management Council (PMFC) and approved by the Secretary of Commerce.

[5] PFMC (1998) online: http://www.pcouncil.org/cps/cpsfmp.html; PFMC (1999) online: http://www.pcouncil.org/salmon/salfmp/a14.html; PFMC (2006) online: http://www.pcouncil.org/groundfish/gffmp.html.

The proposed action is described in the BE and supplemental information submitted by the COE. The action area includes habitat in Grays Harbor, which has been designated as EFH for various life stages of 18 species of groundfish (PMFC 2006), four coastal pelagic species (PMFC 1998), and two species of Pacific salmon (PMFC 1999) (Table 2), and is in an area where environmental effects of the proposed project may adversely affect EFH for these species.

Dredging and disposal can adversely affect EFH through: (1) direct removal/burial of benthic invertebrate populations; (2) creating temporary, short-term increases in suspended sediment; (3) alteration of benthic topography; and (4) temporarily reducing migratory habitat by disturbance.

Removal or burial of benthic invertebrate populations. Limited removal of organisms via dredging and burying of deposit feeders, suspension/deposit feeders, and suspension feeders will occur in dredged portions of the navigation channel. Because deposit feeders, suspension/deposit feeders, and suspension feeders are prey items for groundfish and coastal pelagic species, any removal of these organisms via dredging or disposal may cause short-term harm to these fish species' EFH. However, the loss of food items is limited, and will not occur in the more important, shallower habitat types. Therefore, the potential for such harm is minimal.

Dredging will result in entrainment of mobile macroinvertebrates. Entrainment by dredges likely is lethal to macroinvertebrates. Groundfish, coastal pelagic species, and Pacific salmon may feed on certain mobile macroinvertebrates, and therefore any loss of these prey items via dredging may harm these species. However, this harm is likely to be localized in areas of low importance to these species. In addition, mobile macroinvertebrates in the estuary appear to be adapted to respond relatively rapidly to disturbances and can recolonize areas following these disturbances, and benthic habitat in the channel is not considered highly productive habitat due to regular disturbance from past and ongoing dredging and ship traffic. Sedentary organisms such as tube worms will take longer to reestablish since they will need to re-colonize via settlement of early life history stages.

The dredging schedule, a result of years of coordination between resource agencies and the COE, reflects the times of year when dredging and disposal will have the least impact on important commercial fisheries (e.g. Dungeness crab fishery) and species protected under the Endangered Species Act. Clamshell dredges will be used to the maximum extent practicable to reduce entrainment impacts. Normal sea conditions prevent the safe use of clamshell equipment in the outer reaches of the navigation channel. Pursuant to the Revised Crab Mitigation Strategy Agreement (1998), to compensate for any loss of Dungeness crabs to the commercial fishery, the COE also proposes to place up to 7,500 cubic yards of oyster shell on existing Dungeness crab habitat plots in order to improve survival rates for young-of-the-year crabs.

Temporary, repeated increases in turbidity. Proposed dredging may influence suspended sediment concentrations in Grays Harbor. In areas adjacent to dredges, increases in suspended sediment concentrations may temporarily increase local water column turbidity reducing the quality of habitats adjacent to the navigation project footprint. Most of the dredging-induced suspended sediment should rapidly settle onto adjacent substrates, as elevated turbidity levels

will be temporary and rapidly dissipate once dredging is complete. Further, since the dredge operations constantly move, the effect to any one location will be temporary and short-term.

While high levels of turbidity are known to affect salmonid physiology and feeding success, the combined background and project-related turbidity concentrations are well below known salmonid impact levels (see ESA discussion above). Little is known about behavioral or physiological effects of increased turbidity on groundfish and coastal pelagic species, but elevated suspended sediment levels can elicit sublethal stress responses in fish, as well as damage gills and reduce feeding success (Servizi and Martens 1991).

Habitat and prey resources may be affected through temporary decreases in dissolved oxygen (DO). Reductions in DO will likely be short lived if they occur at all. Dredging will cease if DO levels drop below 4 milligrams per liter, which should be protective of the organisms in the area.

Contaminants associated with dredged sediments may be resuspended in the ecosystem. However, much of the material to be dredged from the navigation channel will originate from existing sand waves, a dynamic natural feature of the channel bottom, that are constantly on the move due to tidal and current action. These sand waves contain a small percentage of fine sediments and organic material, and thus only minimal amounts of contaminants are likely to become resuspended from current action or dredging and disposal. Additionally, sediments have been tested tor contaminants and approved for unconfined open water disposal under the guidelines of the DMMP.

Alteration of benthic topography. Continuing maintenance dredging in the navigation channel will likely have limited impacts to groundfish, coastal pelagic species, and Pacific salmon. Benthic productivity and structural habitat value are low due to the dynamic nature of the coarse, sandy sediments in the area and past dredging at the site.

Dredged material disposal is likely to have minor adverse effects to EFH for groundfish, coastal pelagic species, and Pacific salmon, since these locations have already been used as dredged material disposal sites. Only previously disturbed areas will be impacted by the proposed action; no new dredging or disposal sites are proposed. Project design included reducing the volume of material to be dredged to the least possible.

Productivity and habitat value of the open-water dispersive disposal sites are likely low due to prior disturbance and the erosive, dynamic nature of the seabed in these areas. Reducing the suitability of the navigation project footprint for settlement and recruitment of early life history stages will be minor because the substrate in the channel after dredging will still be predominantly sand, which will still provide substrate for settlement and recruitment of early life history stages of many of the invertebrate and vertebrate species associated with the substrate in Grays Harbor.

Temporary, repeated disturbance of migratory habitat. Disturbance of migrating fish is likely to be minor because the area in which the dredge is operating at one time is small compared to the total width of the harbor, and because the dredges operate intermittently.

Essential Fish Habitat for groundfish, coastal pelagic species, and Pacific salmon will not be adversely affected by the proposed dredging of the Grays Harbor and Chehalis River navigation channel. Maintenance dredging of the channel has occurred regularly since 1935. The most regularly used disposal site, Point Chehalis, has received over 35 million cubic yards of dredged material since 1977, at an average rate of 1.8 million cubic yards per year. Habitat quality has been severely degraded due to this historic and continuing use, and it is not likely to receive significant use by any managed fish species.

EFH Conservation Recommendations: Because the conservation measures that the COE included as part of the proposed action to address ESA concerns are also adequate to avoid, minimize, or otherwise offset potential adverse impacts to the EFH of the species in Table 2, conservation recommendations pursuant to MSA (section 305(b)(4)(A) are not necessary. Since NMFS is not providing conservation recommendations at this time, no 30-day response from COE is required (MSA section 305(b)(4)(B)).

This concludes consultation under the MSA. If the proposed action is modified in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations, the COE will need to reinitiate consultation in accordance with the implementing regulations for EFH at 50 CFR 600.920(k).

The efforts by the COE to design this project to minimize environmental impacts are appreciated. If you have any questions, please contact Scott E. Anderson, of my staff, at (360) 753-5828 or scott.anderson@noaa.gov.

Sincerely

William W. Stelle, Jr.
Regional Administrator

cc: Kevin McKeag, COE

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Table 1. Federal Register notices for final rules that list threatened and endangered species, designate critical habitats, or apply protective regulations to listed species considered in this consultation.

Species	ESU or DPS	Original Listing Notice	Listing Status Reaffirmed	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)	Lower Columbia River	3/24/99 64 FR 14308 Threatened	6/28/05 70 FR 37160 Threatened	9/02/05 70 FR 52630	6/28/05 70 FR 37160
	Upper Willamette River spring-run	3/24/99 64 FR 14308 Threatened	6/28/05 70 FR 37160 Threatened	9/02/05 70 FR 52630	6/28/05 70 FR 37160
Chum salmon (*O. keta*)	Columbia River	3/25/99 64 FR 14507 Threatened	6/28/05 70 FR 37160 Threatened	9/02/05 70 FR 52630	6/28/05 70 FR 37160
North American Green Sturgeon (*Acipenser medirostris*)	Southern DPS	4/07/06 71 FR 17757 Threatened	Not applicable	10/09/09 74 FR 52300	6/02/2010 74 FR 30714 Proposed
Pacific eulachon (*Thaleichthys pacificus*)	Southern DPS	3/18/10 75 FR 13012 Threatened	Not applicable	01/05/11 76 FR 515 Proposed	Not applicable
Steller sea lion (*Eumetopias jubatus*)	Eastern	11/26/90 55 FR 49204 Threatened	6/4/97 62 FR 24645	8/27/93 58 FR 45269	Not applicable
Killer whale (*Orcinus orca*)	Southern Resident	11/15/04 70 FR 69903 Endangered	Not applicable	11/29/06 71 FR 69054	Not applicable
Humpback whale (*Megaptera novaeangliae*)		12/02/70 35 FR 18319 Endangered	Not applicable	Not applicable	Not applicable
Leatherback sea turtle (*Dermochelys coriacea*)		06/02/1970 35 FR 8491 Endangered	Not applicable	03/23/1979 44 FR 17710 Final 01/05/2010 75 FR 319 Proposed modification	Not applicable

bc: OWC – PDF (Read File)
OWC/Lacey – File Copy
OWC/LCWC – PDF (Fisher)
OWC/LCWC – PDF (Anderson)

PDF Copies sent to the following

Kevin McKeag.COE
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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

JUN 11 2014

In Reply Refer To:
01EWFW00-2014-I-0444
XRefs: 13410-2011-I-0274/-R001/-R002
01EWFW00-2013-CPA-0120
01EWFW00-2013-I-0216

Evan Lewis
Seattle District, U.S. Army Corps of Engineers
ATTN: ECRB (M. Harrington., K. McKeag)
P.O. Box 3755
Seattle, Washington 98124-3755

Dear Mr. Lewis:

Subject: Grays Harbor Navigation Improvement Project

On February 27, 2014, the U.S. Fish and Wildlife Service – Washington Fish and Wildlife Office (Service) received from the U.S. Army Corps of Engineers – Seattle District (Corps) a Supplemental Biological Evaluation (BE) and request for informal consultation on the Grays Harbor Navigation Improvement Project (NIP) in Grays Harbor County, Washington, and its potential effects to the Coastal-Puget Sound bull trout (*Salvelinus confluentus*; threatened), marbled murrelet (*Brachyramphus marmoratus*; threatened), western snowy plover (*Charadrius alexandrinus nivosus*; threatened), streaked horned lark (*Eremophila alpestris strigata*; threatened), and their designated critical habitats. The Corps provided information in support of "may affect, not likely to adversely affect" determinations for the bull trout, marbled murrelet, western snowy plover, streaked horned lark, and designated critical habitat for the bull trout, western snowy plover, and streaked horned lark. This informal consultation has been conducted in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)(ESA).

The Corps made "no effect" determinations for additional species and critical habitat known to occur in Grays Harbor County, Washington. Your determinations that the action will have no effect on these listed species and critical habitat rest with the Federal action agency. The Service has no regulatory or statutory authority for concurring with "no effect" determinations, and no consultation with the Service is required. We recommend that the Federal action agency document their analyses, and maintain that documentation as part of their project files.

The Corps' Directorate of Civil Works manages and maintains the deep-draft Grays Harbor Federal Navigation Channel (Channel), including the entrance channel, north and south jetties, Point Chehalis rock revetment, and boat basin at Westhaven Cove Marina, under authorities that include the River and Harbor Acts of 1896, 1935, and 1945, and the Water Resources Development Act of November 17, 1986 (Public Law 99-662). Management of the Channel includes a program of annual maintenance dredging and dredged material disposal and beneficial reuse (XRef.s 13410-2011-I-0274/-R001/-R002).

Since 2012, or earlier, the Corps has been conducting a General Investigation Feasibility Study (GI), Limited Reevaluation, in consideration of whether to deepen the Channel to the Congressionally-authorized depth of -38 feet mean lower low water (MLLW). The Corps' recent Supplemental Environmental Impact Statement (SEIS), which was made available to the public during February 2014, identifies their preferred alternative.

The Corps and Port of Grays Harbor (Port), the non-Federal sponsor for the GI, propose to deepen the Channel, from the currently maintained depth of -36 feet MLLW, to the fully authorized depth of -38 feet MLLW. According to the findings of the Corps' GI and SEIS, the preferred alternative is technically feasible, cost effective, environmentally sound, and economically justified. The Corps has determined that the preferred alternative meets the action's stated purpose and need better and more completely than the other alternatives under consideration, Alternatives 1 (No Action) and 2 (Channel Deepening to -37 feet MLLW).

The purpose of the Grays Harbor NIP is to improve the efficiency and reliability of deep-draft vessel navigation in Grays Harbor, and to reduce navigation transportation costs and improve navigation safety (BE, p. 1-1). Navigation along the Channel is limited by depth. Current depths are inadequate to accommodate vessels with drafts exceeding -36 feet MLLW. Some vessels have to be partially loaded or experience tidal delays due to insufficient channel depths. The action is needed to alleviate large vessel restrictions, for existing vessel fleets, which are imposed by insufficient channel depths. The proposed action will not result in a change to the type of vessels that currently navigate the Channel and make calls at the Port's marine terminals; Post Panamax, Post Panamax Plus, New Panamax, and Triple E container ships all have drafts in excess of 42 feet.

The Corps proposes to deepen approximately 14.5 miles of the 27.5-mile Channel. This deepening would address insufficient channel depths located along South Reaches A and AA, the Crossover Reach, North Channels 1 and 2, Hoquiam Reaches 1, 2, and 3, the Turning Basin, and Cow Point reaches 1 and 2. No deepening of the Channel is needed or proposed downstream of the South Reach, including the entrance/Pt. Chehalis Reach and bar channel.

The Grays Harbor NIP includes initial channel deepening, a dredge volume of approximately 2 million cubic yards in the year of construction. The action also includes subsequent annual maintenance dredging, to a depth of -38 feet MLLW, through 2026; this represents an incremental increase of approximately 100,000 cubic yards per year over current dredge volumes. The Grays Harbor NIP would increase both Channel depths and annual maintenance quantities by approximately 5 percent. The action also includes continued use and operation of the dredged material disposal sites in close proximity, including: 1) the unconfined, open-water

disposal sites at Point Chehalis, South Jetty, and Southwest, 2) the upland Point Chehalis Revetment site, and, 3) the two beneficial reuse sites (Half Moon Bay and South Beach), where suitable dredged materials are re-introduced to the littoral drift with the goal of nourishing adjacent beaches and preventing shoreline erosion.

During 2013, the Corps considered and instituted a minor Channel alignment shift, to take advantage of naturally deeper water along the Channel (XRef. 13410-2011-I-0274-R002). The proposed action incorporates this alignment shift, and also includes a one-time shift in the location of the Point Chehalis dredged material disposal site (i.e., for construction, but not annual maintenance, of the deepened Channel).

The Corps proposes to implement all of the same conservation measures and best management practices that have been refined through years of performing annual maintenance dredging along the Channel. The Corps will:

- Use a mechanical clamshell dredge to complete most of the deepening and annual maintenance dredging;
- Schedule inner harbor clamshell dredging, and outer harbor hydraulic suction or hopper dredging, to avoid and reduce impacts to out-migrating juvenile salmon and peak crab abundance;
- Continue to coordinate with the commercial and tribal crab fisheries to reduce conflicts;
- Use equipment with pump-ashore capability to recharge the Point Chehalis Revetment Extension mitigation site; and,
- Obtain current and valid Site Use Authorizations from the Dredged Material Management Program (DMMP) before using open-water disposal and beneficial reuse sites.

The DMMP has determined that initial construction of the deepened Channel will produce approximately 22,000 cubic yards of dredged material that is not suitable for in-water disposal or beneficial reuse. This material, from the Cow Point dredge unit 32a, failed sediment larval bioassay tests and must be disposed at an upland site. The Corps proposes to place material not suitable for in-water disposal at the approximately 20-acre, former City of Hoquiam wastewater treatment lagoon located on Airport Way, Paulson, and Moon Island Roads, adjacent to the Port's Terminal 3, Bowerman Basin, and the Service's Grays Harbor National Wildlife Refuge.

The Corps has evaluated the foreseeable direct and indirect effects of the proposed action, and the effects of any interrelated or interdependent actions (e.g., maintenance dredging conducted periodically at the Port's marine terminal berths; placement of oyster shell within crab habitat/ mitigation plots). The Corps has determined that a small increase to the number of future, deep-draft vessel transits is reasonably foreseeable and attributable to the Grays Harbor NIP (approximately 32 additional transits per year; BE, p. 5-8). The Corps has consulted with the Service previously to address maintenance of the Point Chehalis rock revetment (XRef. 01EWFW00-2013-I-0216). The Service expects that the Corps will also request independent consultation once they have selected a preferred alternative for long-term management of the South Jetty (South Jetty LTMS).

The Corps has provided sufficient information to determine the effects of the proposed action to federally listed species and to conclude whether the action is likely to adversely affect those species. Our concurrence is based on information included the Corps' Supplemental BE, and full and successful implementation of the agreed-upon conservation measures. Our concurrence with your "may affect, not likely to adversely affect" determinations is based on the following rationale:

Effects of the Action

Dredging, open-water disposal, and beneficial reuse of dredged materials will result in measurable temporary impacts to water quality. However, these temporary effects will be intermittent and limited in physical extent and duration. Measurable turbidity should not extend more than approximately 600 feet down-current of the dredge (BE, p. 5-3).

Dredging and disposal activities will result in measurable temporary increases in underwater and in-air sound levels. However, these temporary effects will be intermittent and limited in physical extent and duration. Dredging and disposal activities create mostly non-impulsive sound, and associated sound (engine noise, operation of on-deck equipment, etc.) typically attenuates to background levels within 0.25 mile.

Dredging and disposal activities will result in measurable temporary impacts to aquatic vegetation and forage fish. More than 20 species of fish have been identified in suction dredge entrainment samples (BE, p. 4-12). Bottom-dwelling forage fish, such as Pacific sand lance (*Ammodytes hexapterus*), staghorn sculpin (*Leptocottus armatus*), and Pacific sanddab (*Citharichthys sordidus*), appear to be most vulnerable. However, the Corps now limits the use of suction dredge equipment to only those outer harbor reaches where clamshell dredging is impracticable, and timing restrictions further reduce the risk and extent of fish entrainment.

Dredging, open-water disposal, and beneficial reuse of dredged materials will result in measurable, persistent, and long-term effects to substrates and the native benthos, mostly at depths in excess of -33 feet MLLW (excluding beneficial reuse at Half Moon Bay and South Beach). The Corps will mitigate for unavoidable impacts to Dungeness crab (*Metacarcinus magister*) according to the *1998 Revised Crab Mitigation Strategy Agreement*, will continue the practice of assessing impacts with the Dredge Impact Model, and will increase shell placement to mitigate for impacts resulting from both initial Channel deepening and subsequent annual maintenance dredging.

The Corps' management and maintenance of the Channel affects patterns of tidal exchange, wave energy, sediment transport, and erosion that operate on large spatial and temporal scales (BE, pp. 1-4 through 1-6). For example, Damon Point, Whitcomb Flats, and Half Moon Bay are all dynamic geomorphological features that reflect the Channel's strong and prevailing influence on sediment transport and deposition (BE, p. 4-8). However, because the proposed action will only modestly increase channel depths and annual maintenance quantities (i.e., by approximately 5 percent), and will otherwise maintain existing conditions along a navigation channel which has been frequently and repeatedly dredged in the past, the Service expects that the foreseeable direct and indirect effects to shoreline features and habitat-forming processes will not be measurable.

The Corps has determined that a small increase to the number of future, deep-draft vessel transits is reasonably foreseeable and attributable to the Grays Harbor NIP; approximately 32 additional transits per year (BE, p. 5-8). The Corps and Port have assessed resulting patterns of channel side slope and ship-wake erosion, and have concluded that the proposed action "...would have no more than a minor incremental effect on ... the Grays Harbor shoreline" (SEIS, PDF p. 211). The Service expects that the related indirect effects to shoreline features and habitat-forming processes will not be measurable.

Bull Trout and Designated Critical Habitat

The action area provides seasonal, nearshore marine, foraging, migrating, and overwintering habitat for adult and subadult bull trout originating from coastal Washington core areas and local populations to the north (the Quinault, Queets, and Hoh River bull trout core areas). The best available, current information indicates that the major tributaries to Grays Harbor, including the Chehalis, Humptulips, Hoquiam, Wynochee, and Satsop Rivers, do not support bull trout spawning and rearing or local populations. The action area includes designated bull trout critical habitat and provides five of the nine primary constituent elements (PCEs) of critical habitat:

PCE #2: *Migratory habitats with minimal physical, biological, or water quality impediments.*
PCE #3: *Abundant food base.*
PCE #4: C*omplex shoreline aquatic environments and processes.*
PCE #5: *Water temperatures.*
PCE #8: *Water quality ... such that normal reproduction, growth, and survival are not inhibited.*

Foraging, migrating, and overwintering habitats are essential to maintaining connectivity between the Olympic Peninsula Management Unit's bull trout core areas and local populations. The Chehalis River is not a natal basin, but is used seasonally for foraging and overwintering. Both historical and more current surveys indicate that bull trout are present in Grays Harbor and the lower Chehalis River from mid-February through early-July. Bull trout have been captured, or detected in the nearshore marine waters, infrequently and in low numbers.

Based on location and baseline environmental conditions, we expect that the action area supports low numbers of adult and subadult bull trout during periods of prey abundance. Available documentation indicates that bull trout are most likely to occur in these waters during winter and spring. PCE #s 1 (*groundwater sources*), 6 (*suitable spawning substrates*), 7 (*a natural hydrograph*), and 9 (*low levels of nonnative predatory or competitive species*) do not occur in the action area, and/or will not be affected by the action.

The proposed action will result in measurable temporary impacts to water quality, and measurable temporary increases in underwater and in-air sound levels. These temporary effects will be intermittent and limited in physical extent and duration. Measurable turbidity will not extend more than approximately 600 feet down-current (BE, p. 5-3), and elevated, non-impulsive sound levels should attenuate to background levels within 0.25 mile. With successful implementation of the agreed-upon conservation measures, we expect that very few bull trout will be exposed to the temporary effects of the action. Based on the behavior of bull trout, distance from shore, timing, location, and depth, we conclude that entrainment when suction

dredging is extremely unlikely, and therefore considered discountable. Temporary impacts to water quality, and measurable temporary increases in sound levels, will not preclude bull trout from foraging and migrating in the action area, and will not significantly disrupt normal bull trout behaviors (i.e., the ability to successfully feed, move, and/or shelter).

The proposed action will result in measurable temporary impacts to aquatic vegetation and forage fish. However, with successful implementation of the agreed-upon conservation measures (including timing restrictions), we expect that rates of entrainment and other potential impacts to forage fish will be reduced. The proposed action will not preclude bull trout from foraging and migrating in the action area, will not significantly disrupt normal bull trout behaviors, and will have no measurable short- or long-term effect on forage fish abundance and availability at the scale of the action area. We conclude that the short- and long-term effects to bull trout prey resources will not be measurable.

The proposed action will result in measurable, persistent, and long-term effects to substrates and the native benthos. Maintenance of the Channel will also affect patterns of tidal exchange, wave energy, sediment transport, and erosion on large spatial and temporal scales. However, because the proposed action will only modestly increase channel depths and annual maintenance quantities (i.e., by approximately 5 percent), because nearly all of these activities are conducted at depths in excess of -33 feet MLLW (BE, p. 5-12), and the action will otherwise maintain existing conditions along a navigation channel which has been frequently and repeatedly dredged in the past, we conclude that the proposed action will not measurably degrade nearshore marine habitat functions that are important to bull trout or their prey. The persistent, long-term effects of the action will not measurably degrade bull trout habitat or diminish bull trout prey production, and are therefore considered insignificant.

Nearly all of the proposed dredging and disposal activities are conducted at depths in excess of -33 feet MLLW (i.e., excluding beneficial reuse at Half Moon Bay and South Beach), outside of designated bull trout critical habitat. Temporary impacts to water quality, and sound levels, will be localized and will not prevent bull trout from foraging and migrating in the action area. Impacts to aquatic vegetation, forage fish, substrates, and native benthos will not measurably degrade nearshore marine habitat functions that are important to bull trout or their prey. The proposed action will not measurably affect the function of the migratory corridor in either the short- or long-term, and will not measurably reduce prey availability or productivity at the scale of the action area. No adverse effects to marine shoreline aquatic environments and processes are foreseeable and attributable to the proposed action. The proposed action will not affect water temperatures, the availability of thermal refugia, or long-term water quality trends.

With full and successful implementation of the agreed-upon conservation measures, there are no foreseeable, adverse effects (direct or indirect) to bull trout, their habitat, or prey resources. The foreseeable, direct and indirect effects of the action will not preclude bull trout from foraging, migrating, and overwintering in the action area, will not measurably disrupt normal bull trout behaviors (i.e., the ability to successfully feed, move, and/or shelter), and are therefore considered insignificant. No measurable adverse effects are anticipated.

Based on the limited, foreseeable impacts to water quality, aquatic vegetation, forage fish, substrates, and native benthos, we conclude that the proposed action will result in insignificant effects to the PCEs of designated bull trout critical habitat. The proposed action will not prevent the PCEs of critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area.

Marbled Murrelet

The action area provides marine foraging habitat for the marbled murrelet (murrelet). Available summer and winter survey data for Grays Harbor document low numbers of murrelets throughout the year, generally near the entrance of the harbor. Available anecdotal data, including Christmas bird counts conducted from 1995 to 1999, and again in 2009, place nearly every documented occurrence of the species close to the entrance of Grays Harbor (i.e., at the "Bottle Beach," "John's River Road," or "Ocean Shores" bird count stations)(*Biological Opinion - State Route 520, Pontoon Construction Project*).

Dredging, open-water disposal, and beneficial reuse of dredged materials will not be conducted within suitable murrelet nesting habitat, and there is no suitable nesting habitat within 0.25 mile of the action area. The distance from suitable murrelet nesting habitat should preclude any adverse effects to nesting murrelets or their young.

For reasons summarized above (*see* Bull Trout), we expect that dredging, open-water disposal, and beneficial reuse of dredged materials will have only temporary and limited impacts to water quality and sound levels, and will have no measurable short- or long-term effect on forage fish abundance and availability at the scale of the action area. Because the proposed action will only modestly increase channel depths, and will otherwise maintain existing conditions, we conclude that the action will not measurably degrade marine habitat functions that are important to murrelets or their prey. The persistent, long-term effects of the action will not measurably degrade murrelet habitat or diminish murrelet prey production, and are therefore considered insignificant.

With full and successful implementation of the agreed-upon conservation measures, there are no foreseeable, adverse effects (direct or indirect) to the murrelet, their habitat, or prey resources. The foreseeable, direct and indirect effects of the action will not preclude murrelets from foraging in the action area, will not measurably disrupt normal murrelet behaviors (i.e., the ability to successfully feed, move, and/or shelter), and are therefore considered insignificant.

Western Snowy Plover, Streaked Horned Lark, and Designated Critical Habitats

Damon Point, located approximately 1.5 miles north of the Channel, is a dynamic and shifting shore form, with accreting beaches and a sand spit that extend in a southeast direction from the north shore of Grays Harbor (BE, p. 3-24). Suitable nesting and foraging habitats for the western snowy plover (plover) are present on Damon Point. Although no active nesting has been documented since 2006, the area is considered essential for the long-term survival and recovery of the species, and plovers may still nest and/or forage at Damon Point or the adjacent Oyhut State Wildlife Recreation Area (Oyhut).

Historically, plovers also nested along the beaches within Westhaven State Park (BE, p. 3-24), but these sites may have been abandoned in response to intensive public use and recreation. Grays Harbor's ephemeral sand spits and exposed intertidal zones, including the large expanses of exposed mudflat found in Bowerman Basin and in North Bay, provide suitable foraging habitats for plovers and other shorebirds (BE, p. 3-24).

The Service has designated Damon Point and Oyhut as critical habitat for the plover (77 FR 36805; June 19, 2012; Unit WA 2 – Damon Point). Plovers occupy sandy beaches, inland dune systems, salt flats, mud flats, seasonally exposed gravel bars, and dredge spoil sites. The PCEs of designated critical habitat include: (PCE #2) Shoreline habitat areas for feeding, with no or very sparse vegetation, that are between the annual low tide or low-water flow and annual high tide or high-water flow, subject to inundation but not constantly under water, that support essential food sources; and (PCE #3) Surf- or water-deposited organic debris, such as seaweed (including kelp and eelgrass) or driftwood located on open substrates, that supports and attracts food, provides cover or shelter from predators and weather, and assists in avoidance of detection for nests, chicks, and incubating adults.

Damon Point and Oyhut also support a population of the streaked horned lark (lark). The lark is a regional endemic subspecies of the horned lark, is reliant on early successional vegetative communities, and on a frequent disturbance regime that keeps vegetation sparse. Today the subspecies occupies and uses converted and degraded habitats, including agricultural lands, airfields, and industrial sites. In Washington, larks also occupy low-lying coastal beaches, dunes, and dredge spoil sites.

A nesting population of the lark is present on Damon Point and at Oyhut, where critical habitat has been designated (78 FR 61561; October 3, 2013; Unit 3A Damon Point/Oyhut). Damon Point's open landscape context and sparse, low-growing vegetation provide the physical and biological features that are essential to support nesting and wintering larks. The PCEs of designated critical habitat include: (PCE #1) areas having a minimum of 16 percent bare ground with sparse, low-stature vegetation composed primarily of grasses and forbs less than 13 inches (33 cm) in height; and (PCE #2) large (300 acre), flat (0 to 5 percent slope) areas, or smaller areas, within a landscape context that provides visual access to open water or fields.

Dredging, open-water disposal, and beneficial reuse of dredged materials will not be conducted within suitable plover or lark nesting habitat, and there is no suitable nesting habitat located within 1 mile. The distance from suitable nesting habitat should preclude any adverse effects to nesting plovers, larks, or their young. And, for reasons summarized above (*see* Bull Trout), we expect that the proposed action will have only temporary and limited impacts to water quality and sound levels. The action will result in impacts to aquatic vegetation, substrates, and native benthos, but at locations that are generally far removed from habitats where plovers and larks may be foraging or nesting.

Maintenance of the Channel will affect patterns of tidal exchange, wave energy, sediment transport, and erosion on large spatial and temporal scales. However, because the proposed action will only modestly increase channel depths and annual maintenance quantities (i.e., by approximately 5 percent), and will otherwise maintain existing conditions along a navigation

channel which has been frequently and repeatedly dredged in the past, the Service expects that the direct and indirect effects to shoreline features and habitat-forming processes will not be measurable. Damon Point, Oyhut, and the large expanses of exposed mudflat found in Bowerman Basin and in North Bay, are dynamic shore forms and will continue to shift and change. However, we expect that they will persist and continue to function as suitable plover and lark nesting and foraging habitats into the future. Because the proposed action's foreseeable direct and indirect effects will not measurably degrade shoreline habitats or habitat functions that are important to the plover or lark, these effects are considered insignificant.

With full and successful implementation of the agreed-upon conservation measures, there are no foreseeable, adverse effects (direct or indirect) to the plover, lark, their habitats, or prey resources. The foreseeable, direct and indirect effects of the action will not preclude plovers or larks from nesting, foraging, and over-wintering in the action area, will not measurably disrupt normal behaviors (i.e., the ability to successfully feed, move, and/or shelter), and are therefore considered insignificant.

Based on the limited, foreseeable impacts to water quality, aquatic vegetation, substrates, and native benthos, we conclude that the proposed action will result in insignificant effects to the PCEs of designated plover critical habitat.

PCE #1: *Sparsely vegetated areas above high tide that are relatively undisturbed.*
PCE #2: *Feeding areas that are periodically inundated and support essential food sources.*
PCE #3: *Surf- or water-deposited organic debris providing cover and shelter from predators.*

Nearly all of the proposed dredging and disposal activities are conducted at depths in excess of -33 feet MLLW (i.e., excluding beneficial reuse at Half Moon Bay and South Beach). Impacts to water quality, and sound levels, will be localized and will not prevent plovers from nesting and foraging in the action area. Impacts to aquatic vegetation, substrates, and the native benthos (including invertebrate prey resources) will have no measurable effects on the PCEs, and dredging and disposal activities will not degrade shoreline habitats or habitat functions that are important to plovers or their prey. Damon Point and Oyhut are likely to continue evolving, but we expect that they will persist and continue to function as suitable plover nesting and foraging habitat into the future.

Therefore, the action's foreseeable effects to the PCEs and designated plover critical habitat are considered insignificant. The proposed action will not prevent the PCEs of critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area.

Based on the limited, foreseeable impacts to water quality, aquatic vegetation, substrates, and native benthos, we conclude that the proposed action will result in insignificant effects to the PCEs of designated lark critical habitat. The proposed dredging and disposal activities will be conducted far away from areas currently used by larks. Dredging and disposal activities will not degrade shoreline habitats or habitat functions that are important to larks. Damon Point and Oyhut are likely to continue evolving, but we expect that they will persist and continue to function as suitable lark nesting and wintering habitat into the future.

Therefore, the action's foreseeable effects to the PCEs and designated lark critical habitat are considered insignificant. The proposed action will not prevent the PCEs of critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area.

Conservation Recommendations

Pursuant to our authorities under the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*), the Service offers the following recommendations for the Corps' consideration:

1) The Service does not support placement of unsuitable dredge material at the former City of Hoquiam municipal wastewater treatment lagoon, adjacent to the Port's Terminal 3, Bowerman Basin, and the Grays Harbor National Wildlife Refuge. A wide variety of shorebirds and waterfowl use the impoundment, and the site is a popular destination for bird watchers. The refuge was established with the specific intent of supporting compatible wildlife-oriented uses, including bird watching and associated educational opportunities. The Corps and Port have stated that alternative locations are available and may be considered (SEIS, p. ES-2-22). We strongly recommend that the Corps and Port seek other locations for the placement and disposal of this dredge material. Placing contaminated dredge/fill at the former City of Hoquiam wastewater treatment lagoon would have direct impacts that are unacceptable to the Service, and those impacts should be fully avoidable. The Corps and Port should also consider that placement of dredge material at the Port's Terminal 3 may unintentionally create habitat that is attractive to larks.

2) The Crab Mitigation Working Group, which met on several occasions to improve information sharing, identified a number of important questions involving proper calibration and use of the Dredge Impact Model, available alternative methods for describing and quantifying potential dredge impacts, and the net effect of maintenance dredging (and related mitigation) on long-term recruitment to the adult Dungeness crab population. This group also addressed the long-term success and viability of the current Corps approach to mitigation (i.e., annual placement of oyster shell and creation of refuge habitat for juvenile crab), associated costs to the Corps' operation and maintenance budget, and the feasibility and best opportunities for alternative, advance or concurrent mitigation in the form of habitat restoration and/or enhancement. Many constructive suggestions were offered by this group at the request of the Corps. We recommend that the Corps act on these suggestions if and when there is a willingness to consider an alternative approach to mitigation for dredge impacts to Dungeness crab.

The Service requests a response, via electronic correspondence (email), to indicate whether the Corps will implement these recommendations.

This concludes informal consultation pursuant to the regulations implementing the ESA (50 CFR 402.13). The action should be re-analyzed if new information reveals effects to listed species or critical habitat in a manner, or to an extent, not considered in this consultation. The action should also be re-analyzed if subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this consultation, and/or a new species is listed or critical habitat is designated that may be affected by the action.

If you have any questions about this letter or our joint responsibilities under the ESA, please contact Ryan McReynolds (ryan_mcreynolds@fws.gov; 360-753-6047), or Martha Jensen (martha_l_jensen@fws.gov; 360-753-9000).

Sincerely,

Martha L. Jensen

for Ken S. Berg, Manager
Washington Fish and Wildlife Office

cc:
NOAA-NMFS, Lacey, WA (S. Anderson)
NOAA-NMFS, Lacey, WA (G. Kreitman)
NOAA-NMFS, Lacey, WA (J. Fisher)
WDOE, Lacey, WA (K. Carroll)
USFWS, Nisqually NWR, Olympia, WA (G. Nakai)

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

June 13, 2014

Kevin J. McKeag
US Army Corps of Engineers, Seattle District
P.O. Box 3755
Seattle, WA 98124-3755

RE: Water Quality Certification Order #10742, Grays Harbor Navigation Improvement and Operations and Maintenance project in Grays Harbor County, Washington

Dear Mr. McKeag:

The above-referenced project for proposed work in waters of the state has been reviewed in accordance with all pertinent rules and regulations. On behalf of the State of Washington, we certify that the work proposed complies with applicable provisions of Sections 301, 302, 303, 306 and 307 of the Clean Water Act, as amended, and other appropriate requirements of State law. This certification is subject to the conditions contained in the enclosed Order and may be appealed by following the procedures described in the Order.

In addition, the Department of Ecology is rescinding Order # 8992 that was issued for annual maintenance dredging of the Grays Harbor and Chehalis River Federal Navigation Channel Inner Harbor.

If you have any questions concerning the content of this letter, please contact Kerry Carroll at (360) 407-7503.

Sincerely,

Brenden McFarland, Section Manager
Environmental Review and Transportation Section
Shorelands and Environmental Assistance Program

by Certified Mail 7010 2780 0000 2503 4034

Enclosures

cc: Bob Burkle, WDFW-Region 6
Rick Schwartz, DNR
Fawn R. Sharp, Quinault Indian Nation

ecc: Loree' Randall, Ecology (SEA)
DMMP@dnr.wa.gov
Rick Mraz, Ecology (SEA)
Debra Cornett, Ecology (WQ)
ecyrefedpermits@ecy.wa.gov

IN THE MATTER OF GRANTING A WATER QUALITY CERTIFICATION TO US Army Corps of Engineers, Seattle District in accordance with 33 U.S.C. 1341 (FWPCA § 401), RCW 90.48.120, RCW 90.48.260 and Chapter 173-201A WAC	)))))))	**ORDER # 10742** Deepen six of the nine reaches of the Federal Navigation Channel and annual maintenance dredging in Grays Harbor and Chehalis River in Grays Harbor County, Washington

TO: US Army Corps of Engineers, Seattle District
Attn: Kevin J. McKeag
P.O. Box 3755
Seattle, WA 98124-3755

On February 3, 2014 the US Army Corps of Engineers, Seattle District submitted a request to the Department of Ecology (Ecology) requesting a Section 401 Water Quality Certification. A public notice regarding the request was distributed by Ecology for the above-referenced project pursuant to the provisions of Chapter 173-225 WAC on May 15, 2014.

The project is proposing to deepen six of the nine maintained reaches of the Federal Navigation Channel from the maintenance depth of -36 feet mean lower low water (MLLW) to -38 MLLW, the congressionally authorized depth, with a two foot advanced maintenance and two foot over depth allowed. Up to 1,972,000 cubic yards will be dredged for the deepening and will stay within the same footprint as the current maintained channel.

The project also includes annual maintenance dredging of up to approximately 3,000,000 cubic yards of material from the five "inner harbor" reaches (South Aberdeen, Cow Point, Hoquiam, North Channel, Inner Crossover), including two turning basins within the inner harbor (Elliott Slough in the South Aberdeen reach and Cow Point in the Cow Point reach) and four "outer harbor" reaches (Outer Crossover, South, Entrance/Point Chehalis, Bar Channel) within the Grays Harbor and Chehalis River Federal navigation channel. The deepening and maintenance may be done simultaneously over the next five (5) years.

AUTHORITIES:

In exercising authority under 33 U.S.C. § 1341, RCW 90.48.120, and RCW 90.48.260, Ecology has examined this application pursuant to the following:

1. Conformance with applicable water quality-based, technology-based, and toxic or pretreatment effluent limitations as provided under 33 U.S.C. §1311, 1312, 1313, 1316, and 1317 (FWPCA § 301, 302, 303, 306 and 307);

2. Conformance with the state water quality standards contained in Chapter 173-201A WAC and authorized by 33 U.S.C. §1313 and by Chapter 90.48 RCW, and with other applicable state laws; and

3. Conformance with the provision of using all known, available and reasonable methods to prevent and control pollution of state waters as required by RCW 90.48.010.

WATER QUALITY CERTIFICATION CONDITIONS:

Through issuance of this Order, Ecology certifies that it has reasonable assurance that the activity as proposed and conditioned will be conducted in a manner that will meet the applicable water quality standards and other appropriate requirements of state law. In view of the foregoing and in accordance with 33 U.S.C. § 1341, RCW 90.48.120, RCW 90.48.260, Chapter 173-200 WAC and Chapter 173-201A WAC, water quality certification is granted to the Applicant subject to the conditions within this Order.

Certification of this proposal does not authorize the Applicant to exceed applicable state water quality standards (Chapter 173-201A WAC), ground water standards (Chapter 173-200 WAC) or sediment quality standards (Chapter 173-204 WAC). Furthermore, nothing in this certification shall absolve the Applicant from liability for contamination and any subsequent cleanup of surface waters, ground waters or sediments occurring as a result of project construction or operations.

A. General Conditions:

1. In this Order, the term "Applicant" shall mean the US Army Corps of Engineers, Seattle District (Corps) and its agents, assignees and contractors.

2. All submittals required by this Order shall be sent to Ecology's Headquarters Office, Attn: Federal Permit Coordinator, P.O. Box 47600 Olympia, WA 98504-7600 and/or Kerry Carroll. Any submittals shall reference Order 10742.

3. All notifications required by this Order shall be made via phone to Kerry Carroll, 360-407-7503, or e-mail at Kerry.Carroll@ecy.wa.gov. These notifications shall be identified with Order 10742 and include the Applicant's name, the project contact, and the contact's phone number.

4. Work authorized by this Order is limited to the work described in the Joint Aquatic Resources Permit Application (JARPA) received by Ecology on February 3, 2014 unless otherwise authorized by Ecology.

5. The Applicant shall obtain Ecology review and approval before undertaking any changes to the proposed project that might significantly and adversely affect water quality, other than those project changes required by this Order.

6. Within 30 days of receipt of the updated information, Ecology will determine if the revised project requires a new public notice and Certification or if a modification to this Order is required.

7. The Applicant shall keep copies of this Order on the job site and readily available for reference by Ecology personnel, the construction superintendent, construction managers and lead workers, and state and local government inspectors.

8. Upon Ecology personnel's request, the Applicant shall provide access to the project site, all staging areas, and mitigation sites for site inspections, monitoring, necessary data collection, and/or to ensure that conditions of this Order are being met.

9. Nothing in this Order waives Ecology's authority to issue additional orders if Ecology determines that further actions are necessary to implement the water quality laws of the state. Furthermore, Ecology retains continuing jurisdiction to make modifications hereto through supplemental order, if additional impacts due to project construction or operation are identified or if additional conditions are necessary to further protect water quality.

10. In the event of changes or amendments to the state water quality, ground water quality, or sediment standards, or changes in or amendments to the state Water Pollution Control Act (RCW 90.48), or the federal Clean Water Act, Ecology will issue an administrative order to incorporate any such changes or amendments applicable to this project.

11. The Applicant shall ensure that all appropriate project engineers and contractors at the project site have read and understand relevant conditions of this Order and all permits, approvals, and documents referenced in this Order. The Applicant shall provide Ecology a signed statement (see Attachment A for an example) from each project engineer and contractor that they have read and understand the conditions of this Order and the above-referenced permits, plans, documents and approvals. These statements shall be provided to Ecology before construction begins at the project.

12. This Order does not authorize direct, indirect, permanent, or temporary impacts to waters of the state (including wetlands) or related aquatic resources, except as specifically provided for in conditions of this Order.

13. Failure of any person or entity to comply with this Order may result in the issuance of civil penalties or other actions, whether administrative or judicial, to enforce its terms.

B. Water Quality Conditions:

1. This Order does not authorize temporary exceedances of water quality standards beyond the limits established in WAC 173-201A, except as otherwise authorized by this Order.

2. Turbidity occurring outside the turbidity mixing zone that is more than 10 nephelometric turbidity units (NTU) over background when the background is 50 NTU or less, or a 20% increase in turbidity when the background turbidity is more than 50 NTU is a violation of the turbidity water quality standard.

C. Turbidity Mixing Zone:

1. The distance granted for the temporary turbidity mixing zone is as follows:

Location	Mixing Zone Distance Downstream/Down current from In-water Activity
a. Suitable Material Areas	600 ft
b. Unsuitable Material Areas	300 ft

2. Visible turbidity anywhere beyond the point of compliance from the activity and/or disposal location shall be considered to be an exceedance of the standard.

D. Water Quality Monitoring

1. The Applicant shall submit the contractor's water quality monitoring plan to Ecology per Condition A2 at least 14 days prior to dredging. This plan shall be approved by Ecology prior to any dredging activities. The plan shall include, at a minimum, the following information:

    a. Name and contact information of the person responsible for monitoring
    b. Sample locations including background, half the distance to the point of compliance (only for suitable areas), and point of compliance at or near the surface, midway, and bottom depths. For this project the point of compliance for suitable material is a radius of 600 ft from the activity causing the turbidity exceedance and for unsuitable material it is 300 ft feet from the activity causing the turbidity exceedance
    c. Parameter(s) to be monitored: turbidity
    d. BMP's
    e. Sample method
    f. Frequency
    g. Steps to be taken and contingency measures if monitoring results indicate an exceedance has occurred
    h. Reporting procedures

2. Ecology must approve, in writing, any changes or additions to the WQMP.

3. Turbidity monitoring reports shall be sent weekly to the 401/CZM Federal Permit Coordinator (per condition A.3 above). The Permit Coordinator shall be contacted within 24 hours if an exceedance occurs.

4. If monitoring results indicate an exceedance has occurred, a report shall be sent to the Federal Permit Coordinator, per condition H.2.f.

E. Dredging and Disposal:

1. All dredging is to be done using a clam shell bucket or hopper dredge. A long arm excavator may be used in the Cow Point reach for identified areas of hard pack only. **Use of any other type of dredge requires preapproval from Ecology.**

2. All suitable dredged material will be disposed of at one of the five Department of Natural Resources aquatic disposal sites. (Point Chehalis, South Jetty, Chehalis, Half Moon Bay and South Beach). **Use of any other type of disposal method or location requires pre-approval by Ecology.**

3. For material being taken to open water disposal sites, all debris (larger than 2 feet in any dimension) shall be removed from the dredged sediment prior to disposal. Similar sized debris found floating in the dredging or disposal area shall also be removed.

4. Dredging operations shall be conducted in a manner that minimizes the disturbance or siltation of adjacent waters and prevents the accidental discharge of petroleum products, chemicals or other toxic or deleterious substances into waters of the State.
5. Dredged material shall not be stockpiled on a temporary or permanent basis below the ordinary high water line.
6. During dredging, the Applicant shall have a boat available on site at all times to retrieve debris from the water.

7. The barge shall not be overfilled to the point where dredge material overtops the sidewalls.

8. Caution shall be used when placing material from the bucket into the barge to limit splash and prevent spillage.

9. The Dredge operator shall pause the bucket at the surface, after its ascent through the water column, to minimize turbidity by allowing free water to drain from the bucket prior to swinging the bucket to the barge.

10. A pre-dredge meeting is required to be convened prior to each dredging cycle.

11. A **Dredging Plan and Transloading Plan** are required and shall be submitted to the Ecology 401/CZM Federal permit coordinator, at the address shown in Condition A2, for review and approval at least 2 weeks prior to dredging.

12. Prior to each dredging cycle, the Applicant shall contact the DMMP agencies to

determine whether additional sediment testing is required. If additional testing is required, no dredging or disposal shall be conducted until the material has been tested and a suitability determination has been issued. The recency determination extends until April 2019.

13. Impacts to Dungeness crab shall be avoided, minimized, and mitigated according to the September 1998 Revised Crab Mitigation Strategy or an alternative approach approved by Ecology.

Additional conditions for Unsuitable Material

14. All dredging in unsuitable material areas is to be done using a clamshell bucket or equivalent.

15. Dredging in unsuitable material areas shall be done at a much slower pace than for suitable material areas to limit turbidity.

16. The barge shall have filter fabric covering the scuppers and be outfitted with filter fabric wrapped hay bails to control run-off and turbidity.

17. All unsuitable dredged material will be disposed upland at an approved location.

18. The applicant shall notify Ecology of the disposal location at least 30 days prior to dredging within the unsuitable material area.

F. Timing Requirements:

1. All in-water work shall be completed within the following work windows:

   Inner Harbor Reaches
   Cow Point, Cow Point turning basin and Hoquiam - July 16-February 14
   North Channel, Inner Crossover- August 1 to February 14

   Outer Reaches
   Outer Cross-over- April 1- April 31 (hopper) or August 1-February 14 (clamshell)
   South Reach- April 1-June 30

2. The Applicant shall notify Ecology of any project changes that require new ESA Consultation.

3. This Order shall remain in effect for a period of five (5) years from date of issuance.

4. To continue maintenance dredging the Applicant shall submit either a request for an extension or a new JARPA at least twelve (12) months prior to the expiration of this Order.

G. Notification Requirements:

1. The Applicant shall provide notice to Ecology's 401/CZM Federal permit coordinator at least 7 days prior to the start of dredging each dredging season and within 14 days after completion of dredging each season.

2. Notifications shall be made using all the information required in Condition A2.

H. Emergency/Contingency Measures:

1. The Applicant shall develop a spill prevention and containment plan for this project, and shall have spill cleanup materials and an emergency call list available on site.

2. Any work that is out of compliance with the provisions of this Order, or conditions causing distressed or dying fish, or any discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, is prohibited. If these occur, the Applicant or operator shall immediately take the following actions:

    a. Cease operations that are causing the compliance problem.

    b. Assess the cause of the water quality problem and take appropriate measures to correct the problem and/or prevent further environmental damage.

    c. In the event of finding distressed or dying fish, the applicant shall collect fish specimens and water samples in the affected area within the first hour of the event. These samples shall be held in refrigeration or on ice until the applicant is instructed by Ecology on what to do with them. Ecology may require analyses of these samples before allowing the work to resume.

    d. In the event of a discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, containment and cleanup efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Cleanup shall include proper disposal of any spilled material and used cleanup materials.

    e. Immediately notify Ecology's 24-Hour Spill Response Team at 1-800-258-5990, **and** within 24 hours of spills or other events Ecology's 401/CZM Federal permit coordinator at (360) 407-7503.

    f. Submit a detailed written report to Ecology within five (5) days that describes the nature of the event, corrective action taken and/or planned, steps to be taken to prevent a recurrence, results of any samples taken, and any other pertinent information.

3. Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained and stored properly to prevent spills into state waters, including wetlands.

4. If at any time during work the proponent finds buried chemical containers, such as drums, or any unusual conditions indicating disposal of chemicals, the proponent shall immediately notify Ecology using the above phone numbers.

YOUR RIGHT TO APPEAL

You have a right to appeal this Order to the Pollution Control Hearings Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do all of the following within 30 days of the date of receipt of this Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel RD SW STE 301 Tumwater, WA 98501	**Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

CONTACT INFORMATION

Please direct all questions about this Order to:

Kerry Carroll
Department of Ecology
Headquarters
P.O. Box 47600

360-407-7503
Kerry.Carroll@ecy.wa.gov

MORE INFORMATION

Pollution Control Hearings Board Website
www.eho.wa.gov/Boards_PCHB.aspx

Chapter 43.21B RCW - Environmental and Land Use Hearings Office – Pollution Control Hearings Board
http://apps.leg.wa.gov/RCW/default.aspx?cite=43.21B

Chapter 371-08 WAC – Practice And Procedure
http://apps.leg.wa.gov/WAC/default.aspx?cite=371-08

Chapter 34.05 RCW – Administrative Procedure Act
http://apps.leg.wa.gov/RCW/default.aspx?cite=34.05

Chapter 90.48 RCW – Water Pollution Control
http://apps.leg.wa.gov/RCW/default.aspx?cite=90.48

Chapter 173.204 WAC – Sediment Management Standards
www.ecy.wa.gov/biblio/wac173204.html

Chapter 173-201A WAC – Water Quality Standards for Surface Waters of the State of Washington
www.ecy.wa.gov/biblio/wac173201A.html

SIGNATURE

Dated this 13th day of June 2014 at the Department of Ecology Lacey Washington

Brenden McFarland, Section Manager
Environmental, Review and Transportation Section
Shorelands and Environmental Assistance Program
Headquarters

US Army Corps of Engineers
Seattle District

Port of Grays Harbor
On Washington's Pacific Coast

Grays Harbor, Washington
Navigation Improvement Project
General Investigation Feasibility Study

FINAL Supplemental Environmental Impact Statement

Appendix I: October 1998 Point Chehalis Revetment Extension Project Inter-Agency Mitigation Agreement

Prepared by:
U.S. Army Corps of Engineers
Seattle District

June 2014

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

August 30, 1999

Mr. Steven Babcock, Project Manager
Civil Projects and Planning Branch
Seattle District Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124-3755

RE: Revisions to Water Quality Certification/Modification
Corps Public Notice TB-98-02
Extension of Point Chehalis Revetment.

Dear Mr. Babcock:

Revisions to the above referenced water quality certification are required as a result of the settlement of the appeal of the certification to the Pollution Control Hearings Board, Case No. 98-257. The revisions are specified in Part 3.a.(1) and (2) of the "Stipulation and Agreed Order" dated July 15, 1999. Except as revised, all other conditions of certification, contained in Order No. TB-98-02, shall remain in effect. The revisions of note are shown as bold italic font in the order enclosed with this letter.

Revision to Transmittal Letter: ***This water quality certification is granted to the Seattle District Corps of Engineers on the condition that those provisions of approval applicable to the life of the Point Chehalis Revetment Project (noted in the Order) shall remain in effect for the entire life of the project. At a minimum, project life is predicated upon an economically-derived structural life span of 50 years. In addition, certification of the project is contingent upon the full faith implementation by the Seattle District Corps of Engineers of the mitigation plan contained as Attachment A to the signed Interagency Mitigation Agreement dated October 7, 1998. The department considers this commitment to be unconditional and not subject to or contingent upon the availability of federal funding.***

If you have any questions concerning the content of the revisions to the Order, please contact Rick Vining at (360) 407-6944.

Sincerely,

Paula Ehlers

Paula Ehlers, Supervisor
Environmental Coordination Section
Shorelands and Environmental Assistance Program

cc: AG – Tanya Barnett
City of Westport
Port of Grays Harbor
Knoll Lowney, Agent for Surfrider Foundation

EXHIBIT A

DEPARTMENT of ECOLGY

In the Matter of Granting a Water Quality Certification/Modification to: Seattle District Corps of Engineers in accordance with 33 U.S.C. 1341 [FWPCA § 401], RCW 90.48.260 and WAC 173-201A	))))))	**Order No. TB-98-02** Construct a 1,900-foot extension to the Point Chehalis revetment.

TO: Mr. Steven Babcock
Seattle District Corps of Engineers
Civil Projects and Planning Branch

On June 26, 1998, a request for water quality certification from the State of Washington was submitted for the above-referenced project pursuant to the provisions of 33 U.S.C. 1341 (FWPCA § 401). The request for certification was made available for public review and comment by inclusion in Seattle Corps Public Notice No. TB-98-02.

The proposed project involves several elements:
(1) the construction of a 1,900-foot extension to the Point Chehalis revetment in an alignment that lies above mean higher high water of Half Moon Bay;
(2) the placement of revetment fill into approximately 1.4 acres of palustrine emergent (dunal) wetland situated within the proposed alignment (on the landward side);
(3) the construction of a mitigation site to compensate for the unavoidable loss of approximately 1.4 acres of palustrine dunal wetland;
(4) the nourishment of the beach at Half Moon Bay by periodic placement of clean dredged material just offshore and directly onto the beach; and
(5) the placement and maintenance of an emergency supply of sand (stockpile) at a convenient location behind the revetment.

In exercising its authority under 33 U.S.C. 1341 and RCW 90.48.260, Ecology has investigated this application pursuant to the following:

1. Conformance with the state water quality standards as provided for in Chapter 173-201A WAC authorized by 33 U.S.C. 1313 and by Chapter 90.48 RCW, and with other appropriate requirements of state law.

2. Conformance with the provision of using all known, available and reasonable methods to prevent and control pollution of state waters as required by RCW 90.48.010.

In view of the foregoing and in accordance with 33 U.S.C. 1341, 90.48.260 RCW and Chapter 173-201A WAC, certification is granted to the Seattle District Corps of Engineers subject to the following conditions:

1. **Revetment Design.** State approval of the proposed revetment extension is based, in part, on the following design features committed to by the Corps and project sponsors (City of Westport and Port of Grays Harbor):

a) The 1,900-foot extension of the revetment is to be constructed entirely landward of the ordinary high water line and kept buried by a suitable covering of sand so as to appear as a part of the Half Moon Bay dune system. ***This requirement is one of the conditions of certification that shall remain in effect for the life of the (revetment) project.***

b) Periodic or "as needed" beach nourishment is included as an integral element of the revetment project to maintain burial of the revetment and to prevent shoreline erosion that could eventually expose the lower face the revetment to marine waters. If sufficient quantities of dredged material are not available to maintain the agreed upon beach profile, the Corps and project sponsors shall be considered responsible for procuring and placing an alternate source of suitable nourishment material, such as from an upland source. ***This requirement is one of the conditions of certification that shall remain in effect for the life of the (revetment) project.***

2. **Revetment Construction.**

a) The contractor shall use all reasonable measures to minimize the impacts of construction activity on waters of the state, including the dunal wetlands situated immediately adjacent to the revetment. The alignment of the revetment extension shall be staked during a pre-construction meeting involving the Corps, the contractor and representatives from Ecology and WDFW. Construction methods and measures to minimize impacts to surface waters and wetlands will also be described and discussed at the pre-construction meeting.

b) Any turbid water generated from construction activities shall <u>not</u> be discharged directly into Half Moon Bay or the dunal wetland area. Temporary sediment control structures or traps shall be used to allow the turbid water to settle for a minimum of two hours before discharge. All planned sediment and erosion control measures shall be adjusted to meet field conditions at the time of construction. Sediment control measures shall be inspected periodically and maintained so as to be in working condition at the end of each workday.

c) Any excess excavated or construction material shall be transported and disposed of in a manner that prevents the material from entering state waters, including wetlands.

d) In the event of a spill or discharge of oil, fuel, or chemicals at the construction site, containment and cleanup efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Cleanup shall include proper disposal of any spilled material and used cleanup materials. Such spills shall be reported immediately to the Department of Ecology, Southwest Regional Office at (360) 407-6300 (24-hour phone number).

2. Beach Nourishment

a) *Certification of the revetment extension project is contingent upon the implementation of the Beach Nourishment Plan specified in Attachment A of the Interagency Mitigation Agreement dated October 7, 1998).*

b) **Sediment Quality.** The sediments to be used for beach nourishment are to come primarily from the two reaches of the Grays Harbor navigation channel designated as the Entrance and South Reach. Dredged material from these reaches, as well as from the other outer reaches of the channel, has been sampled and analyzed according to guidelines and procedures prescribed in the Grays Harbor/Willapa Bay Dredged Material Evaluation Manual and found suitable for unconfined in-water disposal. Thus the dredged material from these reaches is deemed suitable for the beneficial purpose of beach nourishment. The Manual contains Recency/Frequency guidelines that provide for the periodic reassessment of the quality of sediments dredged from the navigation channel.

c) **Emergency Stockpile.** Per Attachment A of the Mitigation agreement, the project includes the provision for an upland stockpile of sand to be used in the case of sudden catastrophic erosion to the beach immediately adjacent to the revetment. A sufficient quantity of sand should be available to restore the beach to a condition suitable to isolate the revetment from the ordinary high water line. If restoration is necessary, it particularly important that it be completed prior to the period of juvenile salmonid migration (March 1st through June 14th). The Corps/City of Westport shall take appropriate steps to insure that the stockpile is reserved for this use only and is re-supplied as necessary. ***This requirement is one of the conditions of certification that shall remain in effect for the life of the (revetment) project.***

d) **Crab Mitigation.** Dungeness crabs killed by the placement of dredged material directly onto the beach shall be mitigated for in accordance with the Grays Harbor Dungeness Crab Mitigation Strategy Agreement. ***This requirement is one of the conditions of certification that shall remain in effect for the life of the (revetment) project.***

3. **Water Quality Modification.**

a) The direct placement of dredged material on the Half Moon Bay beach may have water quality effects that will exceed the state water quality criteria specified in WAC 173-201A. Per Section 173-201A-110, the department may grant a Modification to the Standards to allow for exceedances of the criteria on a short-term basis when necessary to accommodate essential activities.

b) The project site is classified as Class AA marine waters and thus the criteria of that class apply except as specifically modified by this order. A dilution zone extending 300 feet radially from the approximate center of dredged material placement is considered to be reasonably sufficient to allow for temporary impacts resulting from direct beach nourishment. Within the

dilution zone, the standard for turbidity is waived. All other applicable water quality standards shall remain in effect within the dilution zone and all water quality standards are expected to be met outside of the authorized dilution zone.

c) **Duration.** As a result of recent changes to the water quality standards (Chapter 173-201A WAC), "modifications to the standards" may be issued for indefinite periods of time. Thus the modification allowance for direct beach nourishment at Half Moon Bay is granted for the same duration as the water quality certification, ***that being for the life of the project.***

The intent of a "modification to the standards" as a means to temporarily waive a water quality standard needs to be made clearer given the extended period of approval. The waiver of a water quality parameter (such as turbidity) within a specified dilution zone is intended only for brief periods of time (such as a few hours or a day) and is not an authorization to exceed the standard for the entire duration of construction. In no case does the waiver authorize degradation of water quality that might significantly interfere with or become injurious to characteristic water uses or cause long-term harm to the marine waters of Half Moon Bay. Also, the modification does not authorize any in-water work during closure periods specified by the Department of Fish and Wildlife.

A modification is also granted on condition that all reasonable and appropriate "best management practices" are being undertaken to reduce the impacts that may cause exceedances of the water quality standards.

4. Compensatory Mitigation for Unavoidable Wetland Fill.

a) To compensate for the loss of approximately 1.4 acres of palustrine dunal wetland, the Port of Grays Harbor has agreed to provide to the Corps of Engineers 2.8 acres of property located near Firecracker Point for the purpose of removing fill and restoring what was originally salt marsh habitat. The mitigation site is situated along the eastern edge of the large fill area located just to the south of the barge unloading facility at Firecracker Point. Included within the mitigation acreage is a fresh water wetted area that supports the only significant stand of woody vegetation on the site.

b) A more detailed Salt Marsh Restoration Plan shall be prepared for the proposed mitigation site and submitted to Ecology for review and approval prior to starting the salt marsh restoration work.

c) The primary purpose of wetland mitigation is to protect, in perpetuity, the functions and values of the wetland mitigation site, along with the rights and restrictions necessary to ensure that habitat and wetland functions and values continue. To this end, the Port of Grays Harbor (as land owner and sponsor) shall take appropriate action to insure the preservation of the salt marsh restoration site. The most common means for preserving a mitigation site involves a deed restriction or a conservation easement. PGH

An example of a deed restriction acceptable to the department is provided in Enclosure 1. Once finalized, the deed restriction or conservation easement shall be filed with (the local assessor's office) with a copy provided to the department, ATTN: Rick Vining

d) Enforcement. To monitor the successful accomplishment of restrictions placed on the deed or conservation easement for the mitigation site, the following actions may be taken by the department:

1) To enter upon the mitigation site at reasonable times and upon reasonable notification to the owner in order to monitor compliance with and otherwise enforce the terms of the deed restrictions.

2) To prevent any activity on or use of the mitigation site that is inconsistent with the deed restrictions and to require restoration of such areas or features of the site if damaged by any inconsistent activity or use.

3) To recover any costs incurred by the department in enforcing the terms of the deed restriction, including without limitation, costs of the suit and attorneys' fees and any costs of restoration necessitated by the violation of the terms of the deed restriction.

5. HPA Letter of Approval. The following referenced provisions contained in the HPA "letter of approval" submitted by the Department of Fish and Wildlife (Enclosure 2) are included as conditions of this Order: Provision Number 1, 8 through 14, 19, 20, 21, 24 through 28, and 30. Some of the other provisions have been incorporated into the main text of this certification.

6. Other Requirements.

a) Copies of this Order shall be kept on the job site and readily available for reference by the Corps of Engineers, Ecology personnel, the contractor, and other appropriate state and local government inspectors.

b) The Department of Ecology, Environmental Coordination Section retains jurisdiction to make modifications hereto through supplemental order, if it appears necessary to protect the public interest during the construction and monitoring of this project.

c) The Corps or designated contractor shall notify the department at least 14 days prior to the scheduled start of construction. The contact person is Rick Vining at (360) 407-6944.

d) This certification does not exempt and is provisional upon compliance with other statutes and codes administered by federal, state, and local agencies.

c) The permittee (Corps) shall be considered out of compliance with this certification if:

1. the project is constructed and/or operated in a manner not consistent with the project description contained in the Public Notice.

2. five years elapse between the date of the issuance of this certification and the start of construction and/or discharge for which the federal permit is being sought; however, the expiration date may be extended by the department at the request of the permittee.

3. the information contained in the Public Notice is voided by subsequent submittals to the federal agency, in which case the permittee must reapply for certification with the updated information.

7. **Penalties.** Failure to comply with this Order may result in the issuance of civil penalties or other actions, whether administrative or judicial, to enforce the terms of this Order.

8. **Appeal Process.** Any person aggrieved by this Order may obtain review thereof by appeal. The applicant can appeal up to thirty (30) days after receipt of this Order, and all others can appeal up to thirty (30) days from the postmarked date of this Order. The appeal must be sent to the Washington Pollution Control Hearings Board, PO Box 40903, Olympia WA 98504-0903. Concurrently, a copy of the appeal must be sent to the Department of Ecology, Enforcement Section, PO Box 47600, Olympia WA 98504-7600. These procedures are consistent with the provisions of Chapter 43.21B RCW and the rules and regulations adopted thereunder.

Dated 8-30-99 at Lacey, Washington

Paula Ehlers

Paula Ehlers, Supervisor
Environmental Coordination Section
Shorelands and Environmental Assistance Program
Department of Ecology

October 7, 1998

POINT CHEHALIS REVETMENT EXTENSION PROJECT
WESTPORT, WASHINGTON
INTERAGENCY MITIGATION AGREEMENT

PURPOSE. The purpose of the attached mitigation plan is to establish an interagency partnership for addressing fish and wildlife mitigation issues related to the Point Chehalis revetment extension project at Westport, Grays Harbor County, Washington.

RESPONSIBILITIES. The U.S. Army Corps of Engineers (Corps) agrees to fund the mitigation, as described in the attached mitigation plan (Attachment A) and project plans (Attachment B), or as modified by mutual agreement of the parties to this agreement. Sufficient funding is believed to be available for implementation of the wetland mitigation and replanting of upland vegetation. Funding for the other items in the mitigation agreement is anticipated to come from the Grays Harbor navigation project operations and maintenance annual budget appropriations. All the items set forth in the mitigation agreement are subject to availability of funds for this purpose.

The Washington Department of Ecology, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and Port of Grays Harbor agree to assist the Corps of Engineers in implementing project-related mitigation by participating on a technical committee which will review performance of the mitigation measures. The Port of Grays Harbor agrees to grant a right-of-entry without cost to the Corps of Engineers, to allow wetland mitigation work on Port-owned lands identified in this Agreement. The Port of Grays Harbor further agrees to preserve the salt marsh wetland mitigation site, by deed restriction, conservation easement, or other legal instrument, in perpetuity.

James M. Rigsby 19 Oct 98
James M. Rigsby (date)
Colonel, U.S. Army Corps of Engineers
District Engineer, Seattle District

Donald C. Fleming 21 OCT 98
Donald C. Fleming, Executive Director (date)
Port of Grays Harbor

Tom Fitzsimmons, Director (date)
Washington Department of Ecology

Sara LaBorde 11/9/98
Sara LaBorde, Regional Director (date)
Washington Department of Fish and Wildlife

Berkley Barker, Mayor (date)
City of Westport

for Nancy J. Gloman, Acting Supervisor 12/3/98 (date)
U.S. Fish and Wildlife Service

Exhibit 16

ATTACHMENT A

MITIGATION PLAN

Point Chehalis Revetment Extension, Westport, Washington

PURPOSE.

The mitigation plan, as described below, was developed to facilitate the resolution of fish and wildlife resource issues relating to the project by the U.S. Army Corps of Engineers (Corps) to extend the Point Chehalis revetment at Westport, Washington, to prevent further erosion of Half Moon Bay and to protect public facilities landward of the shoreline. Several resource agencies, including the Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), and U.S. Fish and Wildlife Service, requested the development of a fish and wildlife mitigation plan for the project. This mitigation plan is intended to satisfy that condition and has been jointly developed by the Corps, Port of Grays Harbor, City of Westport and the above named resource agencies.

BACKGROUND.

The Point Chehalis revetment extension project has undergone a number of refinements to improve its effectiveness and to avoid and minimize adverse fish and wildlife impacts, since it was originally proposed. The mitigation plan is based on the Corps' current design of the Point Chehalis revetment extension, as shown in the attached project and mitigation drawings (see Attachment B). Future project elements involving erosion associated with the Grays Harbor South Jetty and Half Moon Bay, including future extension or modification of the South Jetty, will require development of a separate mitigation plan or an amendment to this mitigation plan.

The project that this mitigation plan addresses includes:

1. A 1,900-foot-long rock extension of the Point Chehalis revetment; and
2. Periodic beach nourishment of the Half Moon Bay shoreline using sand dredged during maintenance dredging of the Federally authorized navigation channel.

ISSUES OF CONCERN.

The issues of concern specifically addressed in this mitigation plan are:

1. Maintenance of beach profile and exposure of buried revetment toe;
2. Wetland impacts;
3. Replanting of disturbed upland vegetation; and
4. Intertidal habitat loss at revetment intertie with existing Point Chehalis Revetment.

ENVIRONMENTAL COMPLIANCE.

The Corps does not anticipate that additional environmental compliance will be required for implementation of this mitigation plan. Periodic beach nourishment will be addressed in future Public Notices and Environmental Assessments for maintenance dredging of the Federally authorized navigation channel. In the event that further environmental compliance is necessary with regard to wetland mitigation, WDFW and Ecology agree to assist with this effort.

BEACH NOURISHMENT.

Description. The 1,900-foot extension of the Point Chehalis revetment will be constructed along the alignment shown on Figure 1. The majority of the structure is considerably landward of the foredune and beach face. The toe of the structure will be placed at elevation +4 feet mean lower low water (MLLW), with a top elevation of the structure at elevation +25 feet MLLW (see cross sections on Figure 2). An artificial dune will be constructed and maintained by backfilling and covering the revetment with excavated sand. The revetment is thus designed to become active only if the Half Moon Bay shoreline severely erodes during an extreme storm event and the revetment must serve as a "last line of defense" in the event Half Moon Bay were to experience severe erosion before periodic beach nourishment could be performed.

Periodic nourishment of the beach to maintain a stable beach profile of approximately 1 vertical on 60 horizontal (1V on 60 H) and to ensure that the toe of the revetment is not exposed is an integral part of the Point Chehalis revetment and South Jetty extension project plan. Of particular concern to the resource agencies is ensuring that the revetment toe is not exposed during the juvenile salmon out-migration period that begins on March 1 and ends on June 14. It has been agreed that periodic beach nourishment will be treated as a mitigation measure of the revetment extension project, as well as a measure to provide structural integrity to the toe of the revetment.

Mitigation. The Half Moon Bay shoreline will be periodically nourished with clean sand dredged during maintenance of the Federally authorized navigation channel. Beach nourishment will be performed so as to establish and maintain an approximate beach profile of 1V on 60 H and cover the area shown on Figure 3. The current beach slope (above elevation -10 feet MLLW) ranges from 1V on 20 H to 1V to 30 H. The primary source of nourishment material will be clean sand dredged during maintenance of the Federally authorized Entrance and South Reach channels. The anticipated schedule for periodic nourishment is shown on Table 1. The initial direct beach placement is scheduled for project year three, following construction of the revetment extension. Placement of approximately 460,000 cubic yards (CY) of maintenance dredged material on the beach and 680,000 CY of material by nearshore disposal, is scheduled over the first five years. Table 1 also shows that, after year 5, direct beach nourishment will be required at estimated four year intervals, leveling off at an estimated 100,000 CY by project year 18. By Year 16, nearshore disposal of dredged material will level off at an estimated 100,000 CY per year, as well.

Beach nourishment material will be placed on the beach above MHHW (above +9.0 feet MLLW) by hydraulic pipeline. No material will be placed between March 1 and June 14. Berms will be constructed to protect newly placed fill material from wave and tidal action, and may be constructed from existing beach material from within the fill limits. Following hydraulic placement of dredged material, the material shall be shaped to a uniform elevation and slope, generally as indicated on Figure 3.

Construction plans for maintenance dredging and hydraulic placement of dredged material on the beach shall be prepared by the Corps for each beach nourishment cycle and reflected in a Public Notice and in an Environmental Assessment prepared in conjunction with the maintenance dredging. The hydraulic pipeline will extend overland from the offloading facility located at Firecracker Point near the U.S. Coast Guard Station in Westport. The Corps has a permanent easement for the offloading facility and the pipeline right-of-way, both of which have recently been used for hydraulic placement of dredged material for beach nourishment at Half Moon Bay.

In the intervening years, maintenance dredged material will be placed in the Half Moon Bay nearshore environment by hopper dredge or bottom dump barge. The volume of material scheduled for placement in Half Moon Bay is designed to establish a sustainable beach profile of approximately 1V on 60 H so renourishment of the upper beach every fourth year will occur entirely above the mean higher high water (MHHW) contour (+9 feet MLLW) (see Figure 3). If conditions so warrant, the interval for periodic beach nourishment will be reevaluated and maintenance dredged material will be placed on the beach in a given year of need rather than placed in the Half Moon Bay nearshore environment. Extensive analysis clearly indicates that suitable material for either direct beach nourishment or nearshore disposal in Half Moon Bay will continue to be available on an annual basis in quantities that will ensure the desired beach profile and revetment toe protection can be achieved.

Beach Nourishment Stockpile. If winter storms have eroded sand from the toe of the revetment below elevation +10.0 feet MLLW, stockpiled sand will be placed against the toe of the revetment in the affected areas to correct the deficiency prior to the March 1 juvenile salmon migration period. Of particular concern to the resource agencies is erosion of beach sand along the toe of the revetment near the tie-in with the existing Point Chehalis revetment.

Sand will stockpiled behind the revetment extension, between stations 1+00 and 7+00 (see Figure 1), in the area disturbed by revetment construction. This area is presently largely unvegetated. Initially, surplus sand (estimated at between 10,000 and 30,000 CY) will be stockpiled and shaped to a uniform elevation and slope. To maintain a minimum stockpile of 20,000 CY, the stockpile will be replenished in conjunction with periodic beach nourishment.

Monitoring. Bathymetric and topographic surveys in Half Moon Bay will be conducted. Topographic surveys of the beach profile will be conducted at least every two years to monitor the beach profile. The surveys will determine any changes in the beach profile relative to the anticipated year five slope of 1V on 60 H and any deficiencies of sand covering the revetment (i.e., rock exposed below elevation +10 feet MLLW). The frequency of surveys and survey

methods will depend on storm and erosion conditions and will reflect changing technology. Visual surveys will be routinely made by both City of Westport and Corps personnel, to monitor sand coverage of the revetment side slopes and toe. Annual aerial flight monitoring of Half Moon Bay will be conducted. Topographic surveys and aerial photographic coverage will be needed for the life of the project. Survey data will be analyzed by the Corps and provided to the resource agencies for their review. Survey results and the position of the +9 foot MLLW contour shown on Figure 3 will be used in coordination with the resource agencies to aid in determining the need for periodic beach nourishment relative to the schedule shown on Table 1.

Bathymetric surveys will continue to be conducted by the Corps in conjunction with nearshore placement of maintenance dredged material in Half Moon Bay. These surveys are conducted prior to and following nearshore disposal operations, to monitor the nearshore bathymetry and distribution of sand in Half Moon Bay. The anticipated schedule for both nearshore disposal and beach nourishment is shown on Table 1.

Estimated beach nourishment cost (including stockpile maintenance): $2 million at year 3, $1 million at year 7, decreasing to $800,000 each cycle by year 15.

Estimated monitoring cost: To be performed as part of ongoing program of aerial and bathymetric surveys of Half Moon bay and the Grays Harbor navigation project.

WETLAND MITIGATION.

Description. A low-lying area within the back dunes where a portion of the proposed revetment will be constructed supports a palustrine emergent (dunal) wetland area approximately 6 acres in size (see Figure 4). The National Wetland Inventory (NWI) classification for this wetland is palustrine emergent/scrub shrub temporary tidal. Dominant plants are shore pine (*Pinus contorta*), willows (*Salix hookerana* and *S. exigua*), wax myrtle (*Myrica californica*), sedge (*Carex obnupta*), rush (*Juncus effusus*), and Pacific silverweed (*Potentilla anserina*). Elevated areas (mounds) within the wetland support Scotch broom (*Cystisus scoparius*), Himalayan blackberry (*Rubus procerus*), European dune grass (*Alymus arenarius*), rush (*J. effusus*), lovage (*Ligustichum scoticum*), and *Glehnia littoralis*. Animals observed in the wetland include deer, voles, gulls, crows, western goldfinch, and various shorebirds. The source of water supporting the wetland is believed to be a combination of rainwater and shallow groundwater, and possibly some ocean water that intrudes during high tide. The functions provided by the wetland are considered modest: some wildlife habitat use, slight stormwater detention, and groundwater recharge. Aerial photographs from early winter 1995 and in 1996 show that this area had minimal vegetation, with evidence of recent disturbance. However, vegetation at the time of the August 11, 1998 field review was relatively thick, indicating that vegetation in this area recovers in a relatively short period of time.

Construction of the revetment extension will result in the unavoidable filling of approximately 1.4 acres of this dunal wetland. Mitigation for the unavoidable loss of 1.4 acres of dunal wetland is required.

Mitigation.

1. Estuarine Emergent Wetland (Salt Marsh) Restoration. To compensate for the unavoidable loss of the 1.4 acres of dunal wetland, a previous fill will be removed from Port of Grays Harbor property located south and west of the barge unloading facility at Firecracker Point and directly south of the U.S. Coast Guard Westport Station. Portions of a former dredged material disposal containment dike will be removed, as shown on Figure 5. Dike material (estimated at 16,000 CY) will be removed to about elevation +10 feet MLLW. The excavated material will be disposed of on an adjacent upland area, as indicated on the drawing. The fill removal area is 1,200 feet long by 100 feet wide, excluding an area vegetated by trees and shrubs. The existing trees and shrubs will be preserved as part of the mitigation plan. This fill removal will restore 2.8 acres of high value estuarine emergent salt marsh in the tidal estuary. Estuarine emergent wetlands are of high value and a high priority for restoration by Ecology, WDFW, and USFWS. Concurrent with construction of the revetment extension, the Corps will develop a salt marsh restoration plan in conjunction with the resource agencies. This plan will be included as a future appendix to this agreement. As recommended by Ecology staff, implementation of the salt marsh restoration plan will be by mutual agreement of the agencies, at a time of year chosen to maximize the success of the restoration.

A right-of-entry will be obtained from the Port of Grays Harbor to perform the work. Ownership of the property will be retained by the Port, and the Port agrees to preserve the wetland mitigation site in perpetuity.

2. Preserving Hydrology of Remaining Dunal Wetland. To ensure that the revetment extension does not change the hydrology of the remaining dunal wetland, a drainage barrier (either a clay layer or heavy plastic sheeting) will be installed as shown in the cross section drawing on Figure 4.

Monitoring. The restored salt marsh and the dunal wetland area landward of the revetment extension will be monitored at years ~~1~~, ~~2~~, ~~3~~, 5, 7, and 10 following wetland restoration and revetment construction, respectively. The purpose of monitoring will be to verify that there are no adverse hydrologic effects of the project on the remaining dunal wetland, and to document the progress of restoration of the salt marsh. Monitoring will consist of a site visit by a qualified wetland biologist, a vegetation transect, and interpretation of aerial flight photographs. A memorandum will be prepared by the Corps and submitted to the resource agencies for review. If the revetment is shown to adversely change the dunal wetland's hydrology, the technical committee will consider measures to mitigate for the additional loss.

Estimated construction cost: $50,000.
Estimated monitoring cost: $21,000 ($3,500 x 6 times).

REPLANTING UPLAND VEGETATION

Description. Portions of the revetment extension construction zone are vegetated with upland vegetation. Rush (*Juncus effusus*), dune grass (*Elymus mollis*), Himalayan blackberry (*Rubus procerus*), and Scotch broom (*Cystisus scoparius*) dominate the vegetation in this upland dune area. Approximately 70 percent of the upland area that will be impacted by revetment extension and dune creation is so vegetated. The remainder of the area is heavily used for public access and is not vegetated. Mitigation for the unavoidable loss of up to 4 acres of upland vegetation is required.

Mitigation. Removal or destruction of upland vegetation will be limited to that necessary for the construction of the revetment extension. The revetment extension will result in an unavoidable loss of 4 acres of vegetated dunal upland area. This 4-acre area will be replanted, including the side slopes of the completed revetment covered by sand. Species to be planted will include both native American dune grass (*Elymus mollis*) and rush (*Juncus effusus*). A planting plan will be developed by the Corps and submitted to the resource agencies for approval prior to replanting of upland vegetation.

Monitoring. The plantings will be monitored for success, with a performance measure of 80 percent survival after the 2nd year. Monitoring will consist of a site visit by a qualified wetland biologist, vegetation transect, and interpretation of aerial flight photographs. Monitoring will be conducted in the second year following planting. A memorandum will be prepared by the Corps and submitted to the resource agencies for review.

Estimated replanting cost: $12,000.
Estimated monitoring cost: $3,000.

INTERTIDAL HABITAT LOSS.

Description. The intertie between the existing Point Chehalis revetment and the proposed revetment extension, as originally designed and as described in the Public Notice, would have resulted in a loss of 45 lineal feet (215 square feet) of intertidal habitat (habitat below MHHW -- i.e., below +9 feet MLLW) in Half Moon Bay. Intertidal habitat such as this is a valuable refuge area for juvenile salmon migrating from Grays Harbor to the Pacific Ocean. Juvenile salmon could be adversely impacted during their migration to the ocean if the beach profile in front of this portion of the revetment extension steepens or by having to migrate past additional rock face as they are forced to migrate through deeper water away from the sandy beach. Higher mortality from piscivorous, avian, or mammalian predators is the main concern.

Mitigation/Avoidance. Based upon resource agency concerns, the intertie has been redesigned to avoid the loss (see Figures 1 and 3). The revetment extension will not result in loss of intertidal habitat.

REFERENCES.

Corps of Engineers. June 1997. *Evaluation Report - Long term Maintenance of the South Jetty at Grays Harbor, Washington.* Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

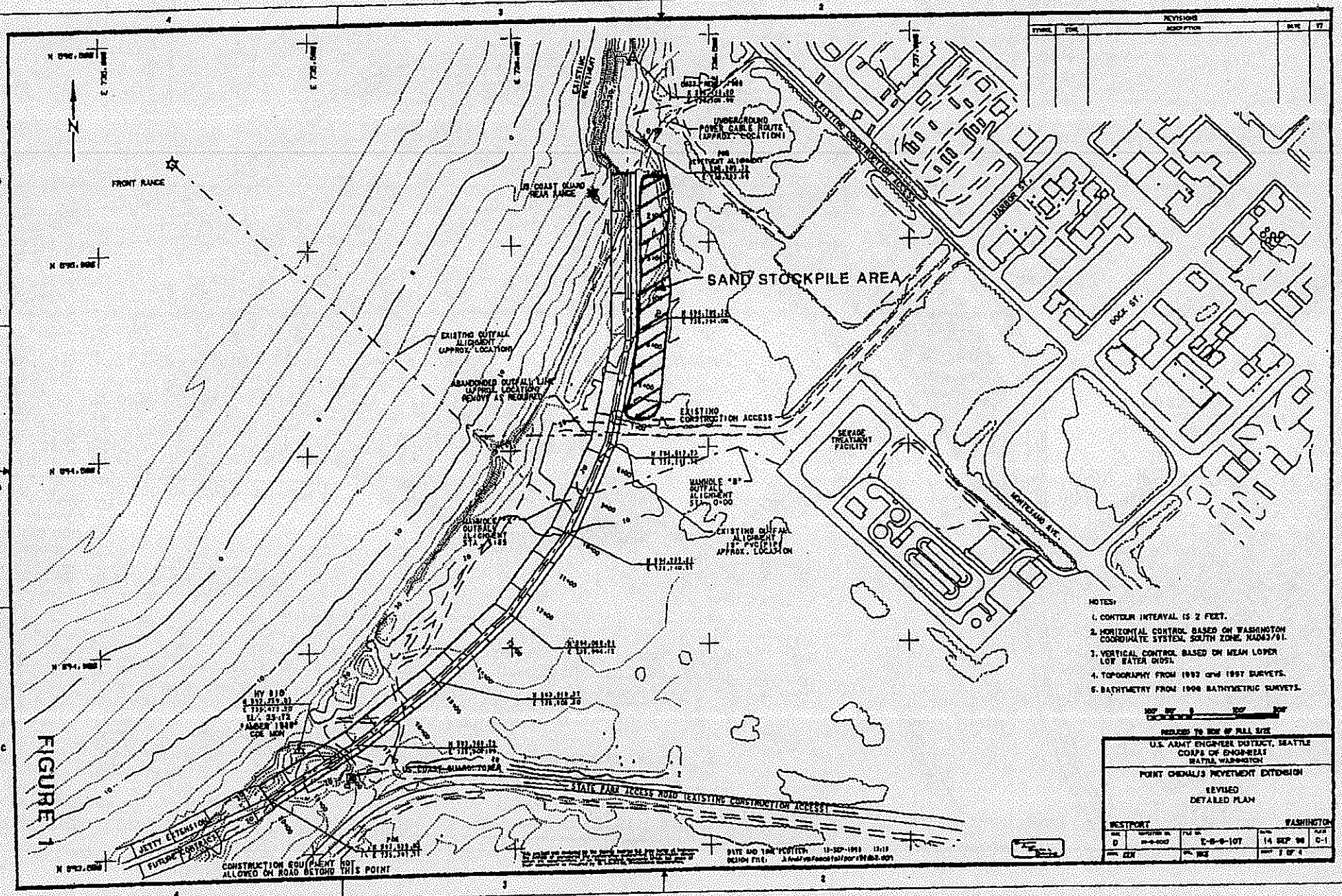
_____. September 1998. *Environmental Assessment: Extension of Point Chehalis Revetment, Grays Harbor Navigation Project, Westport, Washington.* Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

_____. August 13, 1998. Memorandum for Record: Field Review and Jurisdictional Summary for Point Chehalis O&M Revetment. Memorandum prepared by Cindy Barger, Biologist, Regulatory Branch, on the August 11, 1998 wetland delineation. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

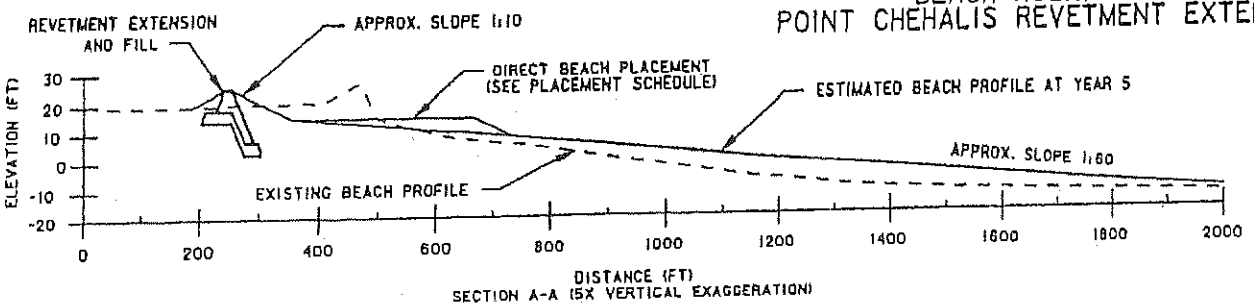
ATTACHMENT B

PROJECT PLANS
Point Chehalis Revetment Extension

Figure 1	Revised Detailed Plan
Figure 2	Revised Revetment Sections
Figure 3	Beach Nourishment
Figure 4	Palustrine Wetland Area
Figure 5	Wetland Mitigation Site
Table 1	Placement Schedule for Beach Nourishment and Nearshore Disposal


SAND STOCKPILE AREA
FRONT RANGE
REAR RANGE
EXISTING CONSTRUCTION ACCESS
EXISTING OUTFALL ALIGNMENT (APPROX. LOCATION)
ABANDONED OUTFALL LINE (APPROX. LOCATION) REMOVE AS REQUIRED
UNDERGROUND POWER CABLE ROUTE (APPROX. LOCATION)
SEWAGE TREATMENT FACILITY
MANHOLE "B" OUTFALL ALIGNMENT STA. 0+00
MANHOLE "A" OUTFALL ALIGNMENT STA. 1+48
EXISTING OUTFALL ALIGNMENT 18" PVC PIPE APPROX. LOCATION
HARBOR ST.
DOCK ST.
MONTESANO AVE.
STATE PARK ACCESS ROAD (EXISTING CONSTRUCTION ACCESS)
JETTY EXTENSION
FUTURE EXTENSION
CONSTRUCTION EQUIPMENT NOT ALLOWED ON ROAD BEYOND THIS POINT
NOTES:
1. CONTOUR INTERVAL IS 2 FEET.
2. HORIZONTAL CONTROL BASED ON WASHINGTON COORDINATE SYSTEM, SOUTH ZONE, NAD83/91.
3. VERTICAL CONTROL BASED ON MEAN LOWER LOW WATER (MLLW).
4. TOPOGRAPHY FROM 1992 and 1997 SURVEYS.
5. BATHYMETRY FROM 1996 BATHYMETRIC SURVEYS.
REDUCED TO 50% OF FULL SIZE
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
POINT CHEHALIS REVETMENT EXTENSION
REVISED
DETAILED PLAN
WESTPORT
WASHINGTON
14 SEP 98
C-1
FIGURE 1

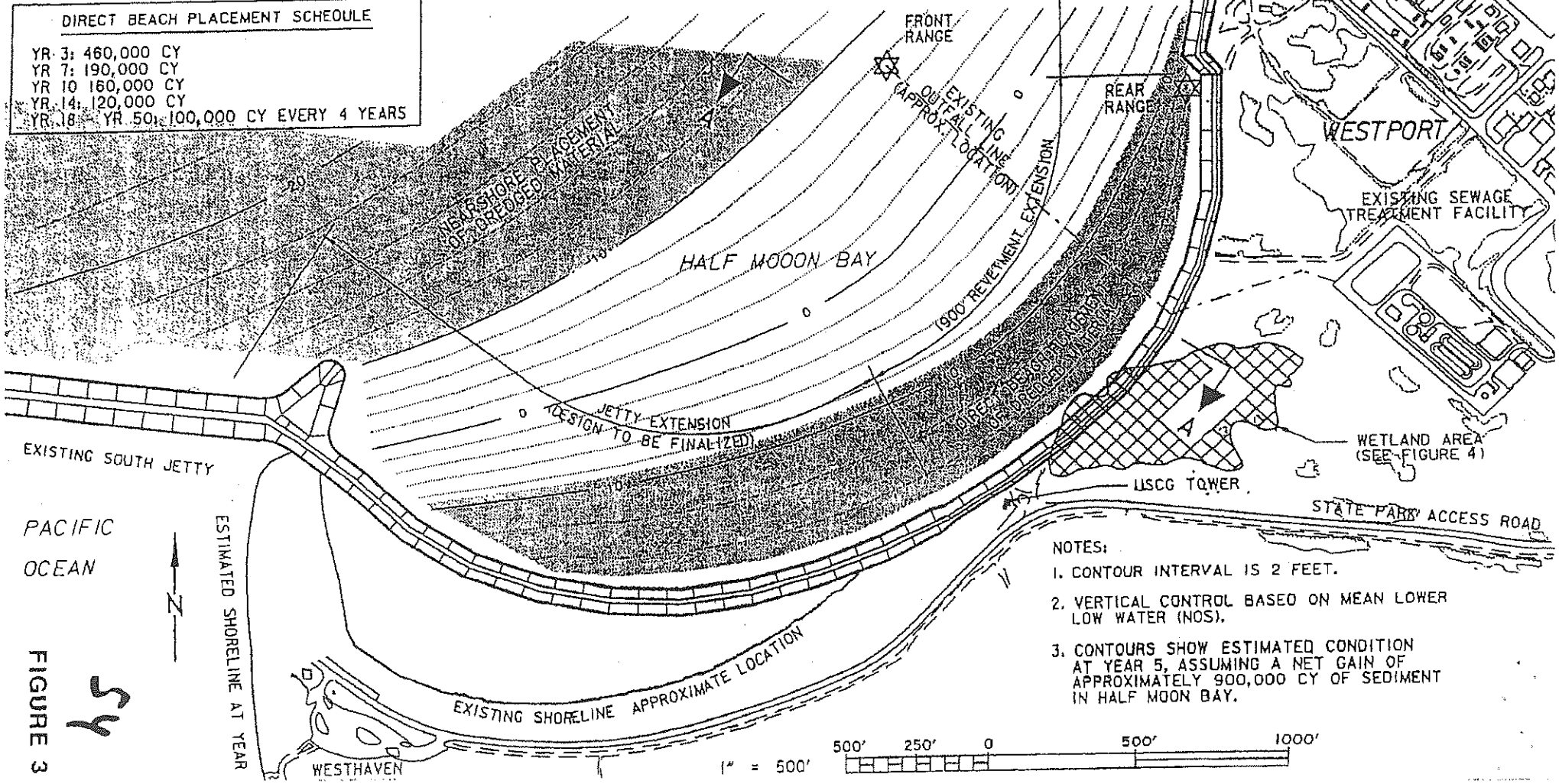
BEACH NOURISHMENT
POINT CHEHALIS REVETMENT EXTENSION



SECTION A-A (5X VERTICAL EXAGGERATION)

DIRECT BEACH PLACEMENT SCHEDULE

YR 3: 460,000 CY
YR 7: 190,000 CY
YR 10 160,000 CY
YR 14: 120,000 CY
YR 18 - YR 50: 100,000 CY EVERY 4 YEARS



NOTES:

1. CONTOUR INTERVAL IS 2 FEET.
2. VERTICAL CONTROL BASED ON MEAN LOWER LOW WATER (NOS).
3. CONTOURS SHOW ESTIMATED CONDITION AT YEAR 5, ASSUMING A NET GAIN OF APPROXIMATELY 900,000 CY OF SEDIMENT IN HALF MOON BAY.

FIGURE 3

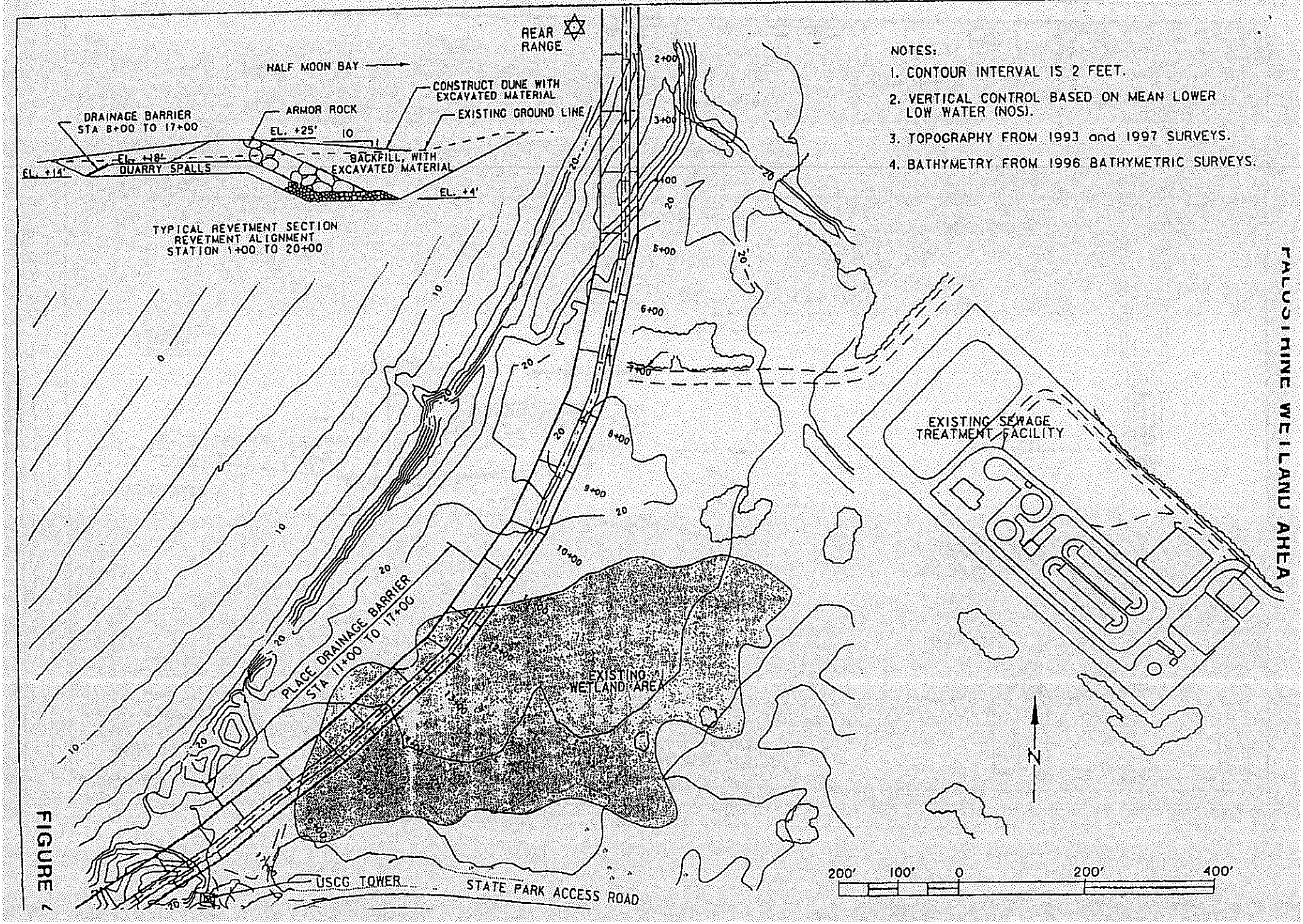
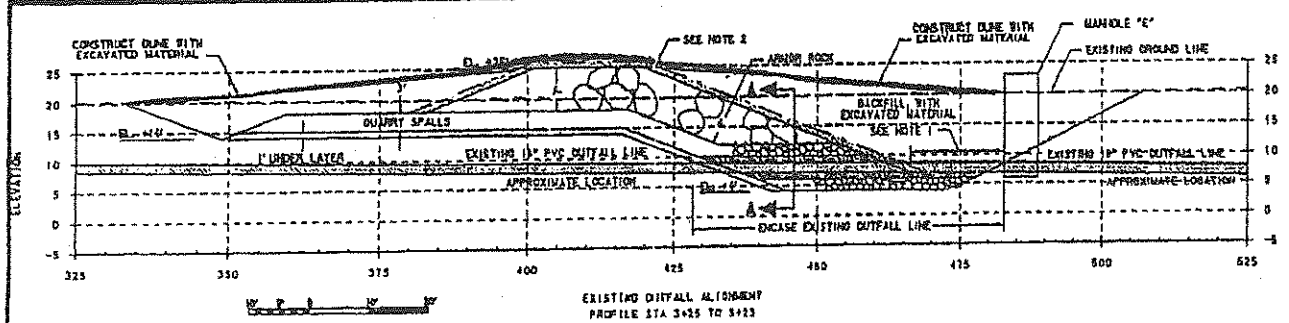
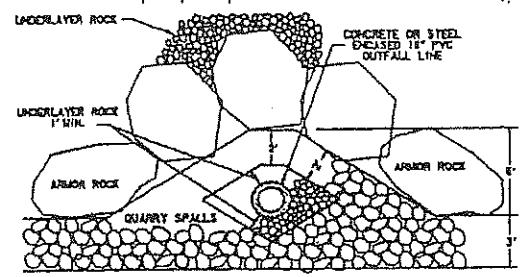


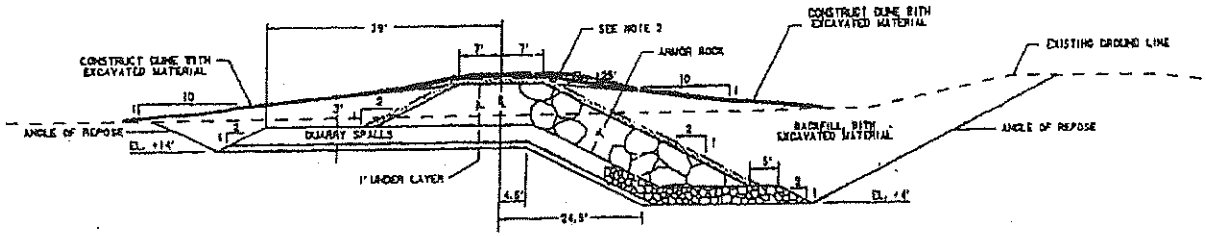
FIGURE 7

PALOS PINE WETLAND AREA

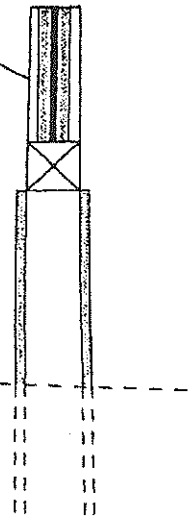


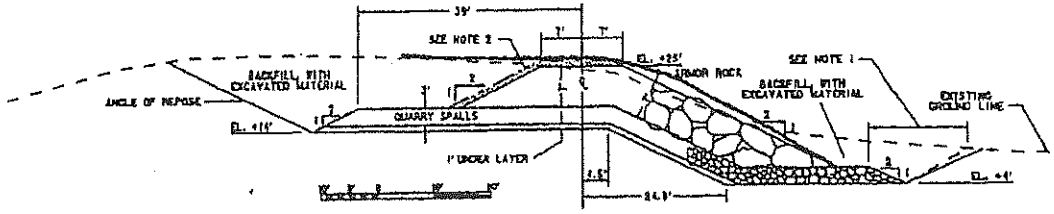


SECTION A-A

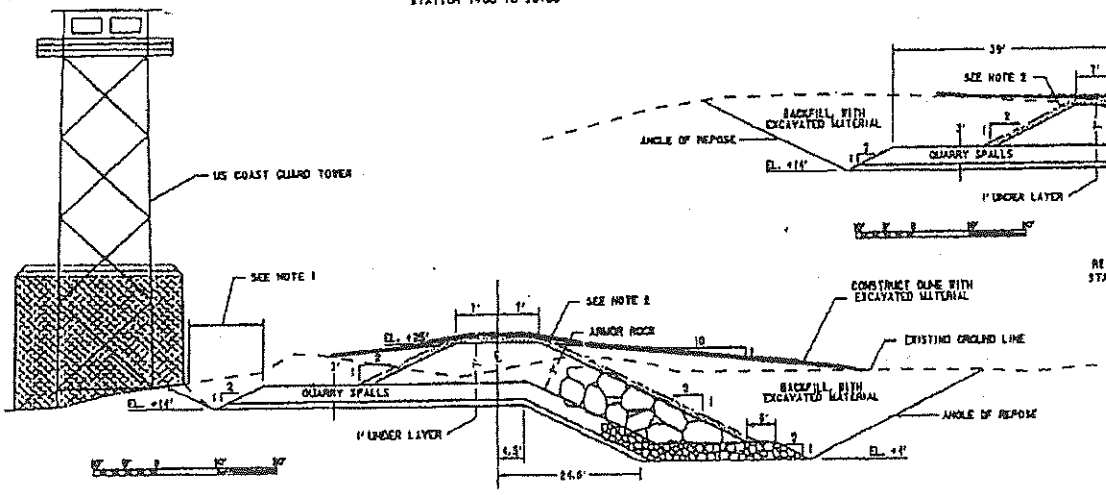


TYPICAL REVETMENT SECTION
REVETMENT ALIGNMENT
STATION 1+00 TO 30+00





REVETMENT ALIGNMENT
STATION 1+40 TO 1+55



REVETMENT ALIGNMENT
STATION 18+00

NOTES:

1. ADJUST EXCAVATION AND QUARRY SPALL PLACEMENT TO AVOID DISTURBING EXISTING STRUCTURE.
2. FILL VOIDS IN ARMOR ROCK WITH UNDERLAYER ROCK PRIOR TO PLACEMENT OF BACKFILL MATERIAL OR CONSTRUCTION OF DUNE.

REVISIONS

SYMBOL	ZONE	DESCRIPTION	DATE	BY

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE WASHINGTON

POINT CHEHALIS REVETMENT EXTENSION

REVISED
REVETMENT SECTIONS

WESTPORT WASHINGTON

SIZE	DRAWING NO.	FILE NO.	DATE	PLATE
D	96-6-0003	E-8-8-107	14 SEP 98	C-2

FIGURE 2

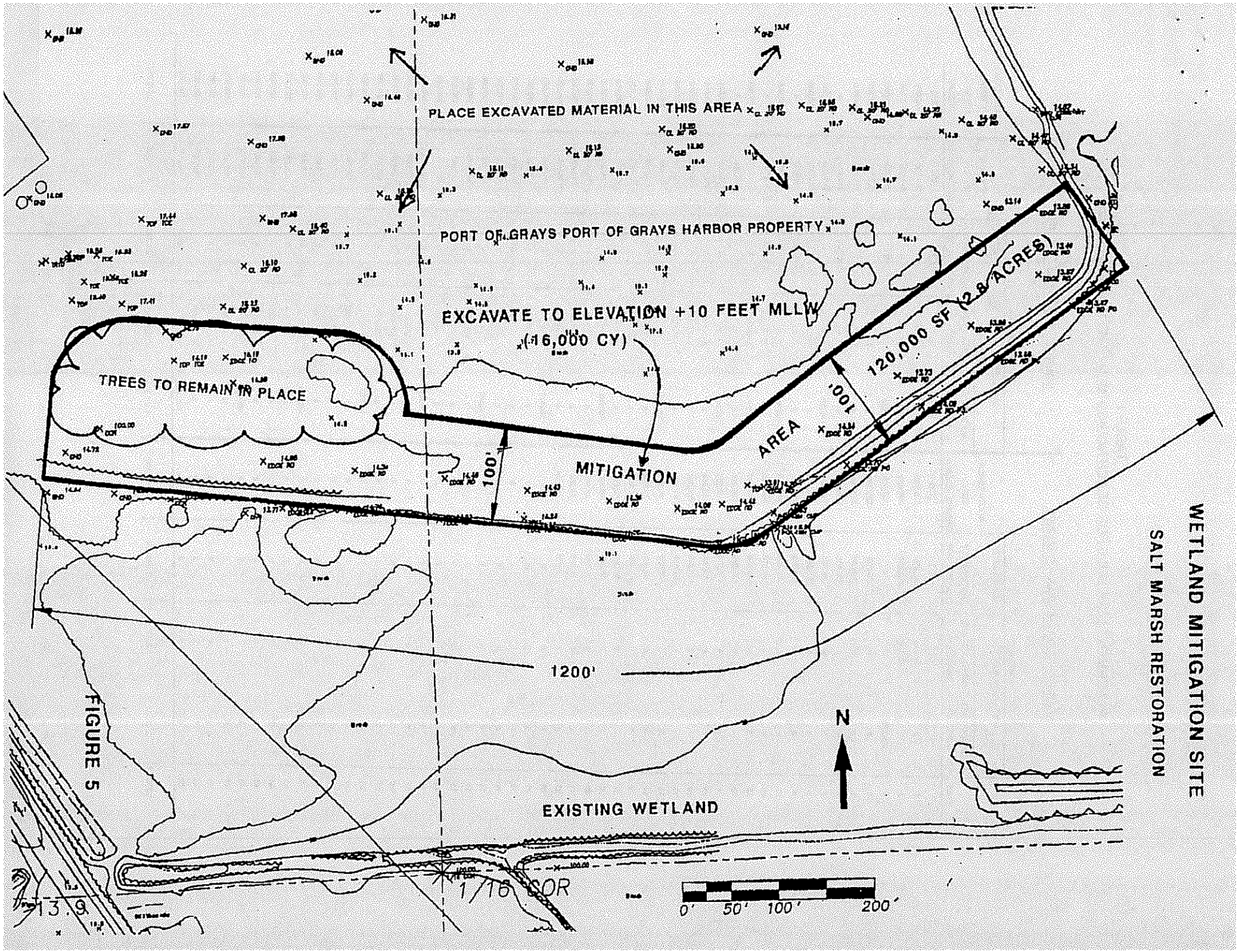


FIGURE 5

WETLAND MITIGATION SITE

SALT MARSH RESTORATION

TABLE 1
PLACEMENT SCHEDULE FOR BEACH NOURISHMENT AND NEARSHORE DISPOSAL

	SOURCE: SOUTH REACH CHANNEL				SOURCE: ENTRANCE CHANNEL				
	DESTINATION:				DESTINATION:				
	HALF MOON BAY		SOUTH JETTY		HALF MOON BAY		SOUTH JETTY		
YEAR	HALF MOON BAY DIRECT	HALF MOON BAY NEARSHORE	SOUTH JETTY DISPOSAL SITE	SOUTH REACH TOTAL DREDGE VOLUME	HALF MOON BAY DIRECT	HALF MOON BAY NEARSHORE	SOUTH JETTY DISPOSAL SITE	ENTRANCE TOTAL DREDGE VOLUME	HALF MOON BAY TOTAL PLACEMENT VOLUME
	(CY)	(CY)	(CY)	(CY)	(CY)	(CY)	(CY)	(CY)	(CY)
1	0	50,000	200,000	250,000	0	250,000	0	250,000	300,000
2	0	10,000	230,000	240,000	0	240,000	0	240,000	250,000
3	230,000	0	0	230,000	230,000	0	0	230,000	460,000
4	0	0	220,000	220,000	0	220,000	0	220,000	220,000
5	0	0	210,000	210,000	0	210,000	0	210,000	210,000
6	0	0	200,000	200,000	0	0	200,000	200,000	0
7	0	0	190,000	190,000	190,000	0	0	190,000	190,000
8	0	0	180,000	180,000	0	180,000	0	180,000	180,000
9	0	0	170,000	170,000	0	0	170,000	170,000	0
10	0	0	160,000	160,000	160,000	0	0	160,000	160,000
11	0	0	150,000	150,000	0	0	150,000	150,000	0
12	0	0	140,000	140,000	0	140,000	0	140,000	140,000
13	0	0	130,000	130,000	0	0	130,000	130,000	0
14	0	0	120,000	120,000	120,000	0	0	120,000	120,000
15	0	0	110,000	110,000	0	110,000	0	110,000	110,000
16	0	0	100,000	100,000	0	100,000	0	100,000	100,000
17	0	0	90,000	90,000	0	100,000	0	100,000	100,000
18	0	0	80,000	80,000	100,000	0	0	100,000	100,000
19	0	0	70,000	70,000	0	100,000	0	100,000	100,000
20	0	0	60,000	60,000	0	100,000	0	100,000	100,000
21	0	0	50,000	50,000	0	100,000	0	100,000	100,000
22	0	0	40,000	40,000	100,000	0	0	100,000	100,000
23	0	0	30,000	30,000	0	100,000	0	100,000	100,000
24	0	0	20,000	20,000	0	100,000	0	100,000	100,000
25	0	0	10,000	10,000	0	100,000	0	100,000	100,000
26	0	0	0	0	100,000	0	0	100,000	100,000
27	0	0	0	0	0	100,000	0	100,000	100,000
28	0	0	0	0	0	100,000	0	100,000	100,000
29	0	0	0	0	0	100,000	0	100,000	100,000
30	0	0	0	0	100,000	0	0	100,000	100,000
31	0	0	0	0	0	100,000	0	100,000	100,000
32	0	0	0	0	0	100,000	0	100,000	100,000
33	0	0	0	0	0	100,000	0	100,000	100,000
34	0	0	0	0	100,000	0	0	100,000	100,000
35	0	0	0	0	0	100,000	0	100,000	100,000
36	0	0	0	0	0	100,000	0	100,000	100,000
37	0	0	0	0	0	100,000	0	100,000	100,000
38	0	0	0	0	100,000	0	0	100,000	100,000
39	0	0	0	0	0	100,000	0	100,000	100,000
40	0	0	0	0	0	100,000	0	100,000	100,000
41	0	0	0	0	0	100,000	0	100,000	100,000
42	0	0	0	0	100,000	0	0	100,000	100,000
43	0	0	0	0	0	100,000	0	100,000	100,000
44	0	0	0	0	0	100,000	0	100,000	100,000
45	0	0	0	0	0	100,000	0	100,000	100,000
46	0	0	0	0	100,000	0	0	100,000	100,000
47	0	0	0	0	0	100,000	0	100,000	100,000
48	0	0	0	0	0	100,000	0	100,000	100,000
49	0	0	0	0	0	100,000	0	100,000	100,000
50	0	0	0	0	100,000	0	0	100,000	100,000
TOTALS	230,000	60,000	2,960,000	3,250,000	1,600,000	3,950,000	850,000	6,200,000	5,840,000

Pollution Control Hearings Board
Shorelines Hearings Board
Forest Practices Appeals Board
Hydraulics Appeals Board

(360) 459-6327
(FAX) (360) 438-7699
E-Mail: EHO@EHO.WA.GOV

STATE OF WASHINGTON

ENVIRONMENTAL HEARINGS OFFICE

4224 - 6th Avenue SE, Bldg. 2, Rowe Six
P.O. Box 40903, Lacey, WA 98504-0903

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Ecology Division

July 15, 1999

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RE: PCHB NO. 98-257
SURFRIDER FOUNDATION, WASHINGTON STATE CHAPTER v. ECOLOGY And US ARMY CORPS OF ENGINEERS

Dear Parties:

Enclosed is the Stipulation and Agreed Order of Dismissal in this matter.

If you have questions, please do not hesitate to call.

Sincerely yours,

Ann Daley

Ann Daley
Presiding

AD/jg/surfrider
Cc: Leann Ryser – Ecology
enc.

CERTIFICATION

On this day, I forwarded a true and accurate copy of the documents to which this certificate is affixed via United States Postal Service postage prepaid to the attorneys of record herein.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

DATED July 15, 99, at Lacey, WA.

Tracey S. Johnson

RECEIVED
JUL 20 1999
ATTORNEY GENERAL'S OFFICE
Ecology Division

POLLUTION CONTROL HEARINGS BOARD

SURFRIDER FOUNDATION, WASHINGTON STATE CHAPTER, Appellant, v. STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY; and UNITED STATES ARMY CORPS OF ENGINEERS, Respondents.	NO. 98-257 STIPULATION AND AGREED ORDER OF DISMISSAL

STIPULATION

The Parties to this matter hereby stipulate as follows:

1. On October 2, 1998, the State of Washington, Department of Ecology (Ecology) issued to the U.S. Army Corps of Engineers (Corps) a water quality certification under § 401 of the Clean Water Act in the form of Order No. TB-98-02. The certification pertained to the Corps' proposal to extend the Point Chehalis revetment near Westport, Washington. The Corps had submitted to Ecology a Coastal Zone Management Act (CZMA) consistency determination for the same project on August 27, 1998. Ecology took no action on the determination within the time allowed by federal law.

2. Appellant Surfrider Foundation, Washington State Chapter appealed Ecology's issuance of the § 401 certification and its failure to take action on the CZMA consistency determination to the Pollution Control Hearings Board on November 2, 1998.

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3. To avoid the costs and uncertainties of litigation, the Parties agree to resolve this appeal in the following manner:

a. By July 30, 1999, Ecology will amend Order No. TB-98-02 to:

(1) Require the Corps to comply with the Mitigation Plan for the Point Chehalis Revetment Extension, Westport, Washington, dated October 7, 1998, as a condition of the § 401 certification. The Mitigation Plan will be attached to, and incorporated by reference into, Order No. TB-98-02. Ecology will make clear that the Corps' obligation to comply with the Mitigation Plan is not contingent on its receipt of funding. This does not constitute a waiver by the Corps that its obligations under the Mitigation Plan are subject to the provisions of the Anti-Deficiency Act, 31 U.S.C. § 1341, nor does it constitute a waiver by Ecology that the Corps' obligations under the Mitigation Plan are not subject to the Anti-Deficiency Act.

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401

done

(2) Extend the duration of the Order, including the water quality modification granted in the Order, for the life of the Point Chehalis Revetment Extension project.

b. Ecology will adopt the following policy and procedure documents, each of which is attached to this Stipulation:

(1) Procedures for coordinated 401/CZM implementation (November 16, 1998) (2 pages);

(2) Procedures/Federal Consistency/General Process (November 16, 1998) (2 pages); and

(3) Procedures/Federal Consistency/Direct Federal Actions (Corps, Coast Guard, Navy, BPA etc.) (November 16, 1998) (2 pages).

c. Ecology is currently reorganizing and updating its Coastal Zone Management Program Document. No later than December 31, 1999, Ecology will provide the Surfrider Foundation, Washington State Chapter with a copy of its proposed changes to the Program Document, and an opportunity to comment on those changes. In the future, Ecology will review its Program Document to determine whether substantive changes are necessary. If it decides that

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substantive changes are necessary, Ecology will convene a workgroup to assist in making those changes, and will invite the Surfrider Foundation and other stakeholders to participate in the workgroup.

4. This Stipulation fully resolves this appeal. Therefore, the Parties request that the Board enter the attached Order of Dismissal.

DATED this 9th day of July, 1999.

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