SITE DESIGNATION OF THE OCEAN DREDGED MATERIAL DISPOSAL SITES OFFSHORE OF YAQUINA BAY, OREGON

BIOLOGICAL ASSESSMENT

FOR LISTED SPECIES INCLUDING COHO SALMON, CHINOOK SALMON, GREEN STURGEON, PACIFIC EULACHON, MARINE MAMMALS, MARINE TURTLES, MARINE AND TERRESTRIAL BIRDS, AND INVERTEBRATES

ESSENTIAL FISH HABITAT ASSESSMENT

FOR SALMON, GROUNDFISH, AND COASTAL PELAGIC SPECIES

PREPARED BY
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REGION 10, SEATTLE, WASHINGTON

December 2011

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INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is proposing final designation under the Marine Protection, Research and Sanctuaries Act of 1972, as amended, 33 U.S.C. §§ 1401 to 1445, (MPRSA), for two proposed ocean dredged material disposal (ODMD) sites located offshore of Yaquina Bay on the central Oregon coast. The proposed North ODMD site (Yaquina North site) is located 1.7 nautical miles northwest of the entrance to Yaquina Bay. The proposed South ODMD site (Yaquina South site) is located about 2 nautical miles southwest of the bay's entrance (Figure 1). Both ocean disposal sites are 4,000 feet wide by 6,500 feet long, about 597 acres, and their depths range from about 112 to 152 feet.

The primary anticipated user of the proposed Yaquina North and South sites is the U.S. Army Corps of Engineers (USACE), who anticipates using the sites for disposal of dredged material from the federally authorized Yaquina Bay and River navigation project. Persons or entities who want to use the proposed sites for disposal of suitable dredged material must seek a permit, or in the case of the USACE, meet the substantive requirements of federal laws and regulations, including EPA concurrence, before the proposed ODMD sites may be used. The EPA's proposed site designation does not authorize any disposal activity.

This Biological Assessment (BA) is being prepared pursuant to Section 7(c) of the Endangered Species Act of 1973 (ESA), as amended, 16 U.S.C. §§ 1531 to 1544, to evaluate the effects of designation of the proposed ocean disposal sites on the federally listed fish, marine mammals, marine turtles, and marine and terrestrial birds, and invertebrate species that may occur in the action area (Table 1).

Under the ESA, "action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR § 402.02). Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur (50 CFR § 402.02). For this BA, the action area includes the two ODMD sites and the water column within the disposal sites (Figure 1). Disposal of material at the two proposed ODMD sites is an indirect effect of site designation and the most likely environmental impacts of disposal (turbidity, physical disturbance, and benthic effects) would be limited to this action area.

Effects to essential fish habitat (EFH) are being assessed in the attached Essential Fish Habitat Assessment, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA) of 2006 (Public Law 109-479). EFH is designated in the action area for five coastal pelagic species, numerous groundfish species, and coho and Chinook salmon.

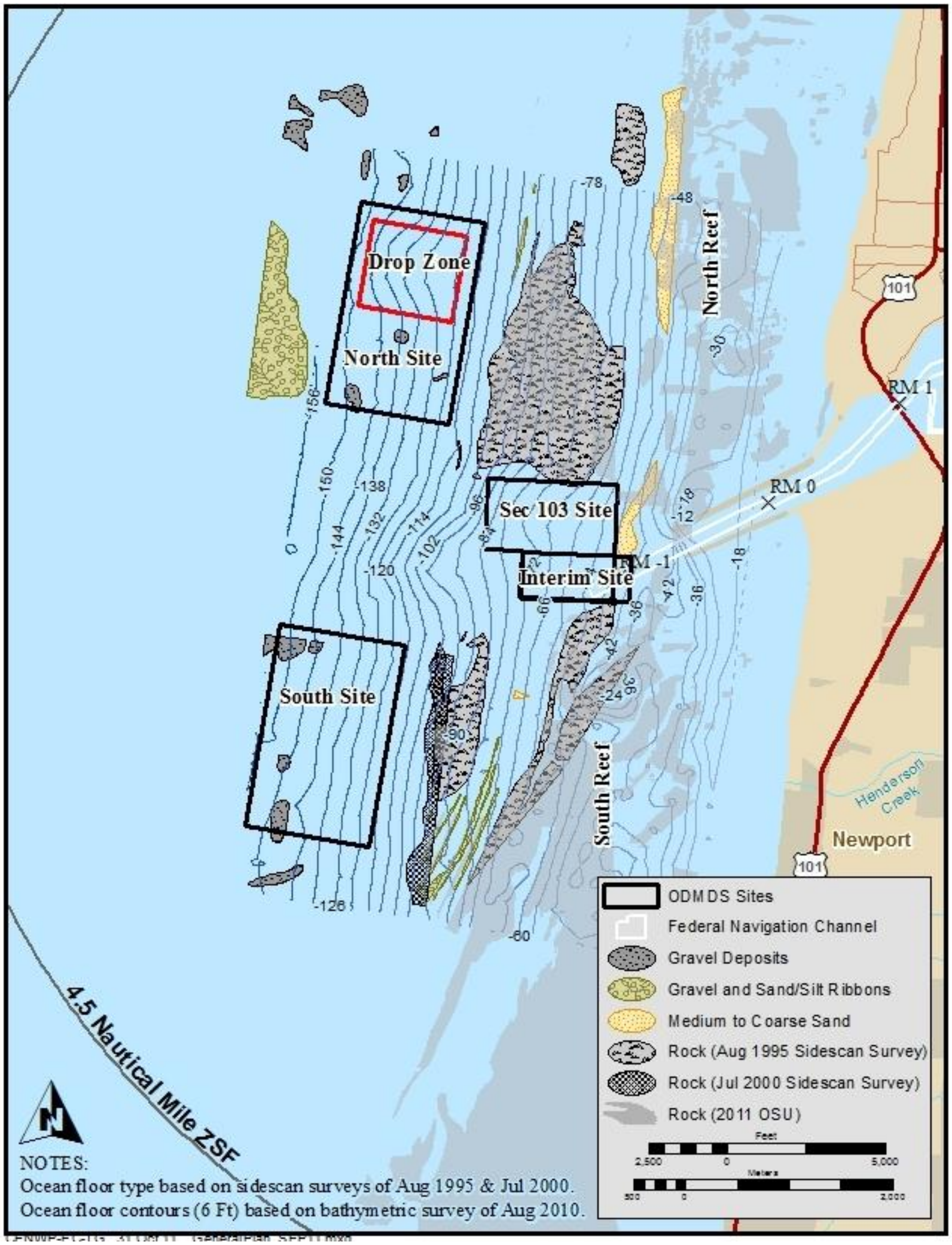
PROPOSED ACTION

The proposed action is the designation of the Yaquina North and South sites. The proposed Yaquina North site is located 1.7 nautical miles northwest of the entrance to Yaquina Bay. The proposed Yaquina South site is located about 2 nautical miles southwest of the bay's entrance. Both ocean disposal sites are 4,000 feet wide by 6,500 feet long, about 597 acres, and their depths range from 112 to 152 feet.

Table 1. ESA-listed species that may be in the action area.

Species	Listing Status	Critical Habitat
Anadromous Fish		
Oregon Coast Coho salmon (*Oncorhynchus kisutch*)	T 6/20/08; 76 FR 35755	2/11/08; 73 FR 7816
Lower Columbia River Coho Salmon (*O. kisutch)*	T 8/15/11; 76 FR 50448	Not applicable
Lower Columbia River Chinook (*O. tshawytscha)*	T 8/15/11; 76 FR 50448	70 FR 52630; 9/2/05
Upper Willamette River spring run Chinook (*O. tshawytscha)*	T 8/15/11; 76 FR 50448	70 FR 52630; 9/2/05
Snake River spring/summer run Chinook (*O. tshawytscha)*	T 8/15/11; 76 FR 50448	64 FR 57399; 10/25/99
Southern Green sturgeon *(Acipenser medirostris)*	T 4/07/06; 71 FR 17757	10/09/09; 74 FR 52300
Eulachon (*Thaleichthys pacificus*)	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324
Marine Mammals		
Eastern Steller sea lion (*Eumetopias jubatus*)	T 5/5/1997; 63 FR 24345	8/ 27/93; 58 FR 45269
Blue whale (*Balaenoptera musculus*)	E 12/02/70; 35 FR 18319	Not applicable
Sei whale (*Balaenoptera borealis*)	E 12/02/70; 35 FR 18319	
Sperm whale (*Physeter macrocephalus*)	E 12/02/70; 35 FR 18319	
Fin whale (*Balaenoptera physalus*)	E 12/02/70; 35 FR 18319	Not applicable
Humpback whale (*Megaptera novaeangliae*)	E 12/02/70; 35 FR 18319	Not applicable
Southern Resident Killer whale (*Orcinus orca*)	E 11/18/05; 70 FR 69903	11/26/06; 71 FR 69054
Marine Turtles		
Green turtle (*Chelonia mydas*) Excludes Pacific Coast of Mexico and Florida	ET 7/28/78; 43 FR 32800	9/02/98; 63 FR 46693
Leatherback turtle (*Dermochelys coriacea*)	E 6/02/70 ; 39 FR 19320 P 1/5/10; 75 FR 319	3/23/79; 44 FR 17710
Loggerhead turtle (*Caretta caretta*)	T 7/28/78; 43 FR 32800	Not applicable
Olive ridley turtle (*Lepidochelys olivacea*)	ET 7/28/78; 43 FR 32800	Not applicable
Birds		
Marbled murrelet *(Brachyramphus marmoratus)*	T 10/01/92; 57 FR 45328	61 FR 26255; 05/24/1996
Short-tailed albatross *(Phoebastria (=Diomedea) albatrus)*	E 06/02/70; 35 FR 8491	None designated
Western snowy plover *(Charadrius alexandrinus nivosus)*	T 03/05/93; 58 FR 12864	70 FR 56969; 09/29/2005
Northern spotted owl *(Strix occidentalis caurina)*	T 06/26/90; 55 FR 26114	57 FR 1796; 01/15/1992
Invertebrates		
Oregon silverspot butterfly *(Speyeria zerene hippolyta)*	T 07/02/80; 45 FR 44935	45 FR 44935; 07/02/1980

Figure 1. Proposed Yaquina Bay North and South ODMD sites, including prior disposal sites (Interim Site and Section 103 Adjusted Site). All disposals since 2001 have occured in the "drop zone", except for some material that was disposed of in the southern half of the North Site in 2009.



The proposed Yaquina ODMD sites have the following corner coordinates (NAD 83):

North ODMD site
44° 38' 17.98" N, 124° 07' 25.95" W
44° 38' 12.86" N, 124° 06' 31.10" W
44° 37' 14.33" N, 124° 07' 37.57" W
44° 37' 09.22" N, 124° 06' 42.73" W

South ODMD site
44° 36' 04.50" N, 124° 07' 52.66" W
44° 35' 59.39" N, 124° 06' 57.84" W
44° 35' 00.85" N, 124° 08' 04.27" W
44° 34' 55.75" N, 124° 07' 09.47" W

The primary use of the proposed ODMD sites would be for disposal of material dredged from maintenance of the USACE's federal navigation project in Yaquina Bay and River. USACE conducted ESA and MSA consultation for these dredging and dredged material disposal activities with the National Marine Fisheries Service (NMFS). These activities are analyzed in NMFS' 2010 Maintenance Dredging Program for the Oregon Coastal Projects Biological Opinion (May 28, 2010; NMFS Tracking No. 2009/01756). In addition to use of the sites by the USACE, the proposed sites could be used through separate section 103 permit evaluations pursuant to the MPRSA for the disposal of suitable dredged material from other dredging projects. Each specific proposal to dispose of dredged material at the proposed Yaquina sites would require a permit, or in the case of the USACE, a demonstration that substantive regulatory requirements have been met, before disposal could occur.

For disposal of dredged material to occur at the proposed Yaquina North and South sites over the long-term, the EPA must designate these sites. The primary user of the site would be the USACE, thus, their disposal of materials is considered interrelated with the proposed action. However, the EPA does not consider dredging, whether by the USACE or another entity, to be interrelated (or interdependent) with the proposed action because designation of the site does not justify, or legitimize, dredging, per se, and because dredging has utility that is independent of the proposed action.

History of Ocean Disposal Sites

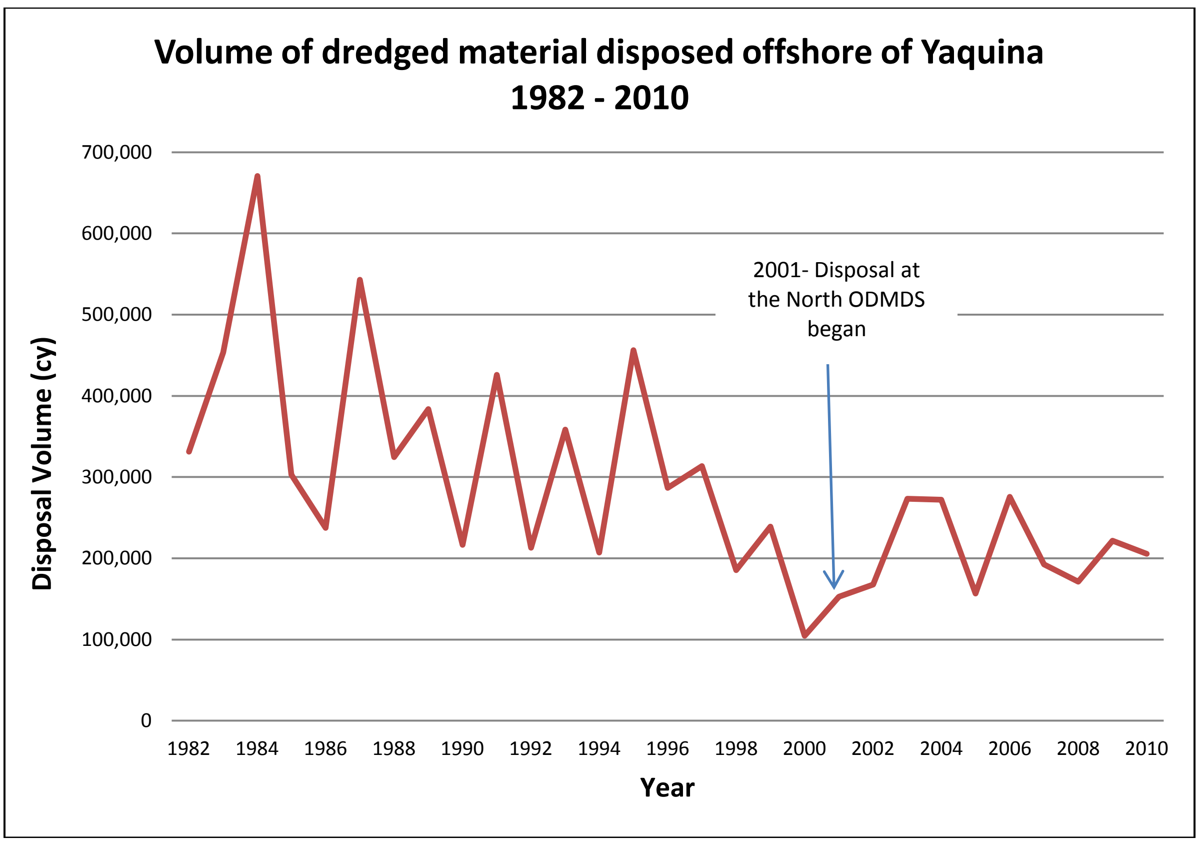
The Yaquina River enters the Pacific Ocean near Newport, Oregon, approximately 115 miles south of the Columbia River. The Yaquina River and its tributaries deposit approximately 150,000 to 350,000 cubic yards (cy) of sediment annually into the estuary shipping areas that must be dredged by the USACE to maintain the authorized Yaquina Bay and River federal navigation project. Some littoral drift also distributes sediment from the ocean into the mouth of Yaquina Bay. The need for improved navigation controls in the estuary began with the founding of a port city at Yaquina.

The USACE's navigation project maintains a navigation channel into the Yaquina River up to river mile 2.0, the South Beach marina access channel, the river channel from RM 4.0 to RM 14.0, and the turning basin in Depot Slough at Toledo.

The USACE historically used the general area offshore of Yaquina Bay for dredged material disposal. In 1977, an Interim ODMD site offshore of Yaquina received the EPA designation and was used by the USACE for dredged material disposal after 1977 and prior to 1986 (Figure 1). However, because of increased mounding in the Interim Site and its potential adverse effect on navigation safety, the USACE selected an alternate ODMD site under the authority of Section 103 of the MPRSA. The USACE began to use this "Adjusted Site" in 1986. Dredged material continued to accumulate in the Adjusted Site. In 1990, dredged material disposal was managed by restricting placement only to portions of the Adjusted Site. By 2000, the USACE had ceased disposing material at the Adjusted Site. In 2001, the USACE and the EPA completed an examination of possible new locations for ocean disposal further offshore from the entrance to the bay (USACE and EPA 2001). The recommended areas from that study are the proposed Yaquina North and South sites. These disposal sites were authorized to be used by the USACE, with the EPA concurrence, under Section 103 of the MPRSA. Since October 2000, only the Yaquina 103 North site has been used for disposal. Furthermore the southern half of the Yaquina 103 North site has been used for only one disposal season. In all other years, only the Yaquina 103 North "drop zone" was used for disposal (Figure 1). The Yaquina 103 South site has never been used for disposal of dredged material due to prevailing southwest winds. The Yaquina 103 North site has been the preferred choice for disposal by dredge operators. The use of the Yaquina 103 North site expired at the end of the 2011 dredge season and is unavailable for future dredge seasons unless designated as proposed in the EPA's current designation action.

From the USACE's navigation maintenance activities over the past 10 years which is considered a predictor for how the sites would be used in the future, the maximum dredged material disposal volume for one year was 275,800 cy (Figure 2). The average annual volume of material disposed at the Yaquina 103 North site was 208,850 cy. Since 2001, the only other user of the Yaquina 103 North site was the Port of Toledo which disposed of 3,000 cy in 2010. Material has been and would continue to be allowed to be disposed of up to 32 days per year. Disposal is likely to occur for 6 days in April or May and then from June 15 to October 31.

Figure 2. Disposal volumes offshore of Yaquina Bay from 1982 to 2010.



The USACE has and would test all dredged material for physical (grain size) and chemical (contaminants) every 5 years prior to disposing at Yaquina North and South sites. Any individual applicant would be required to conduct these same tests prior to disposal. Sediment testing is done to ensure that the material being disposed of at the Yaquina North and South sites does not pose a risk to human health or the environment. All testing is done in accordance with the Sediment Evaluation Framework (2009) Sediment Testing Manual and must be consistent with the requirements of the ocean dumping regulations. In general, a sediment and analysis plan (pre-sampling) and the results (post-sampling) are submitted to the Portland District Sediment Evaluation Team (formerly the Project Review Group). The EPA is a member of the interagency team that reviews proposed dredging and disposal projects for suitability of the material to be disposed of in-water at open disposal sites.

The location of the EPA's proposed Yaquina North and South sites and the management of those sites are intended to achieve the following goals: 1) maximize the capacity of the sites; 2) minimize the potential for mounding and associated safety concerns; and 3) minimize long-term adverse affects to the marine environment. The EPA and the USACE manage the disposal of dredged material at the ODMD sites according to the Site Management and Monitoring Plan (SMMP) (see attached). The SMMP addresses disposal operations at the sites which are determined on an annual basis.

ENVIRONMENTAL BASELINE

Physical Characteristics

The Yaquina River estuary covers about 1,780 acres and opens into the Pacific Ocean about 115 miles south of the mouth of the Columbia River. The estuary lies within the Heceta Head littoral cell, which extends for about 56 miles from Heceta Head south to Cape Arago. The estuary is fed mainly by the Yaquina River, which is about 59 miles from its mouth to headwaters and has a drainage basin of 253 square miles. The river's annual discharge is marked by a high seasonal variability, typically ranging from 100 cubic feet per second (cfs) to 2,500 cfs. Highest discharges occur from November through February due to rain runoff. Lowest flows occur from July through September.

The coastal zone of the Heceta Head littoral cell consists of a 1- to 2-mile-wide plain, covered by active and stabilized sand dunes backed by the mature upland topography of the Coast Range. The lower portion of the Yaquina River is bordered by broad alluvial flats. Between the Siuslaw River and Yaquina River estuaries, the continental shelf is at its widest along the Oregon coast, extending over 44 miles offshore forming the Heceta Bank. The Heceta Head littoral cell is the largest on the Oregon coast. Landward of the cell, the coast is primarily beach-fronting sand dunes. Headlands are located at the north and south ends of the cell.

The sea cliffs and headlands, as well as the rock underlying all the beach and nearshore sands, are many millions of years old. The beach nearshore sands are less than one million years old. Coastal rivers deposited some of these sands when sea level was lower (>6,000 years ago). Other sources include erosion from rock outcrops and bluffs as sea level rose and fell. Little, if any, sand is presently escaping from coastal estuaries. The Yaquina Bay estuary is being filled by marine sand entering from the ocean and deposition of fluvial sediment entering the estuary from upland sources. The proposed ODMD sites are at such depths that they are not being "filled" by the longshore processes described here. In the nearshore area, wave energy has removed any fine silts and clays from sediments leaving only medium-fine sand covering an area 3 to 10 miles offshore along much of the Oregon coast.

Ocean water circulation near the proposed Yaquina ODMD sites is directly influenced by large-scale regional currents and weather patterns in the northwestern Pacific Ocean. During winter, strong low-pressure systems with winds and waves predominantly from the southwest contribute to strong northward currents. During summer, high-pressure systems dominate and waves and winds are commonly from the north. Along the Oregon coast, there is a northerly wind in summer that creates a mass transport of water offshore resulting in upwelling of cold, nutrient-rich bottom water close to shoreline.

Water Quality

Water quality throughout the action area is typical for Oregon nearshore marine waters. In 2003, the EPA conducted an ecological assessment of marine waters on the continental shelf from the Mexican border to the Strait of Juan de Fuca in Washington (Nelson et al 2008). The assessment included water column characteristics, sediment quality, fish tissue contaminants, and a status of benthic communities off the central coast of Oregon. For the samples taken in closest proximity to the action area, salinity, water temperature, and chlorophyll all were within the normal range. Dissolved oxygen levels for the two stations closest to the action area were 2.56 and 2.59 mg/l. These concentrations are considered to be potentially harmful to larval recruitment; however, this was not an anomaly as the majority of results were within this range (2.3 to 4.8 mg/l). These low oxygen concentrations have been found to persist in the nearshore area, likely including the action area (Chan 2008; Grantham 2004). Oxygen concentrations less than 3 milligrams/liter (hypoxia) are likely to occur in the action area each summer. The exact extent and magnitude of these events on benthic fish offshore of Newport is currently being studied.[1]

Sediments

Testing of material prior to dredging. Physical and chemical evaluation sampling was performed by the USACE at Yaquina Bay and South Beach Marina in 1980, 1986, 1990, 1991, 1995, 2000, 2005, and 2010 (these reports are available at http://www.nwp.usace.army.mil/environment/sediment.asp). Potential sources of contaminants to the federal navigation channel are logging, wood processing, fish processing and urban runoff. Over the years, sediment studies have shown the sediment is typically below screening levels for contaminants of concern.[2] Consequently, sediment has been acceptable for in-water ocean disposal.

The latest sediment sampling effort in Yaquina Bay by the USACE occurred on July 28, 2010 (USACE 2010). The evaluation was conducted following procedures set forth in the Sediment Evaluation Framework (SEF 2009) which is consistent with the federal guidance in the Ocean Testing Manual and Inland Testing Manual. The 2009 SEF was developed jointly with regional federal and state agencies to address environmental issues associated with dredging and sediment management.

Eight box core grab samples and one gravity core sample were collected: two samples were collected from the entrance channel, four from the federal navigation channel, and three from South Beach Marina. All nine samples were submitted for physical analyses. Based upon grain size and sample location, 5 out of the 9 samples (two from the federal channel and three from the marina) were subjected to chemical analyses which included metals, total organic carbon (TOC), polychlorinated biphenyls (PCBs), chlorinated hydrocarbons, phenols, phthalates, miscellaneous extractables, low and high molecular weight polynuclear aromatic hydrocarbons (PAHs), and petroleum hydrocarbon identification. One sample was submitted for organotin (TBT) analysis because of the location inside the marina where there may be potential sources of organotins.

The overall mean grain size was 72% sand, with a mean grain size of 94% sand for the federal navigation channel (entrance to turning basin) and 45% sand within South Beach Marina. TOC averaged 2.5%, and had a range of 0.8% to 3.6%.[3] Levels of metals were consistent with historical values and did not approach the SEF screening levels (SLs). No pesticides or PCBs were detected in any samples above the laboratory method reporting limits. All method reporting limits were well below the SEF SLs.

[1] Conversation with Lorenzo Ciannelli (Oregon State University), during a trawl survey off the coast of Newport, Oregon (October 21, 2011) (discussing his investigations of the effects of hypoxic events on the benthic fish community offshore of Newport, Oregon).

[2] There are 60 contaminants of concern that fall into the following categories: metals, polynuclear aromatic hydrocarbons, chlorinated hydrocarbons, phthalates, phenols, miscellaneous extractables, pesticides, tributyltin, and total petroleum hydrocarbons. (SEF 2009).

[3] Per the SEF (2009), sediments with less than 0.5% TOC have a high probability of no adverse affects in bioassay tests.

No chlorinated hydrocarbons or miscellaneous extractables were detected above the method reporting limits in any samples. Bis(2-ethylhexyl)phthalate and phenol were detected in all samples at levels below the SEF marine SL. One sample, BC-05, contained an estimated concentration of 15 ppb 4-methyl phenol, well below the SEF marine SL of 670 ppb. All method reporting limits were well below SEF SLs. Phenanthrene, a low molecular weight PAH, was detected in very low concentrations (21-46 pbb) in samples collected from South Beach Marina (samples BC-08, 09, and 10), which was well below the SEF marine SL of 1,500 ppb. Several high molecular weight PAHs were detected in some samples. However, all detected values and method reporting limits were low and well below SEF SLs. No gasoline-, diesel-, or residual-range organics were detected in any of the samples. The one marina sample submitted for TBT analysis was found to be non-detect for butyltin ions.

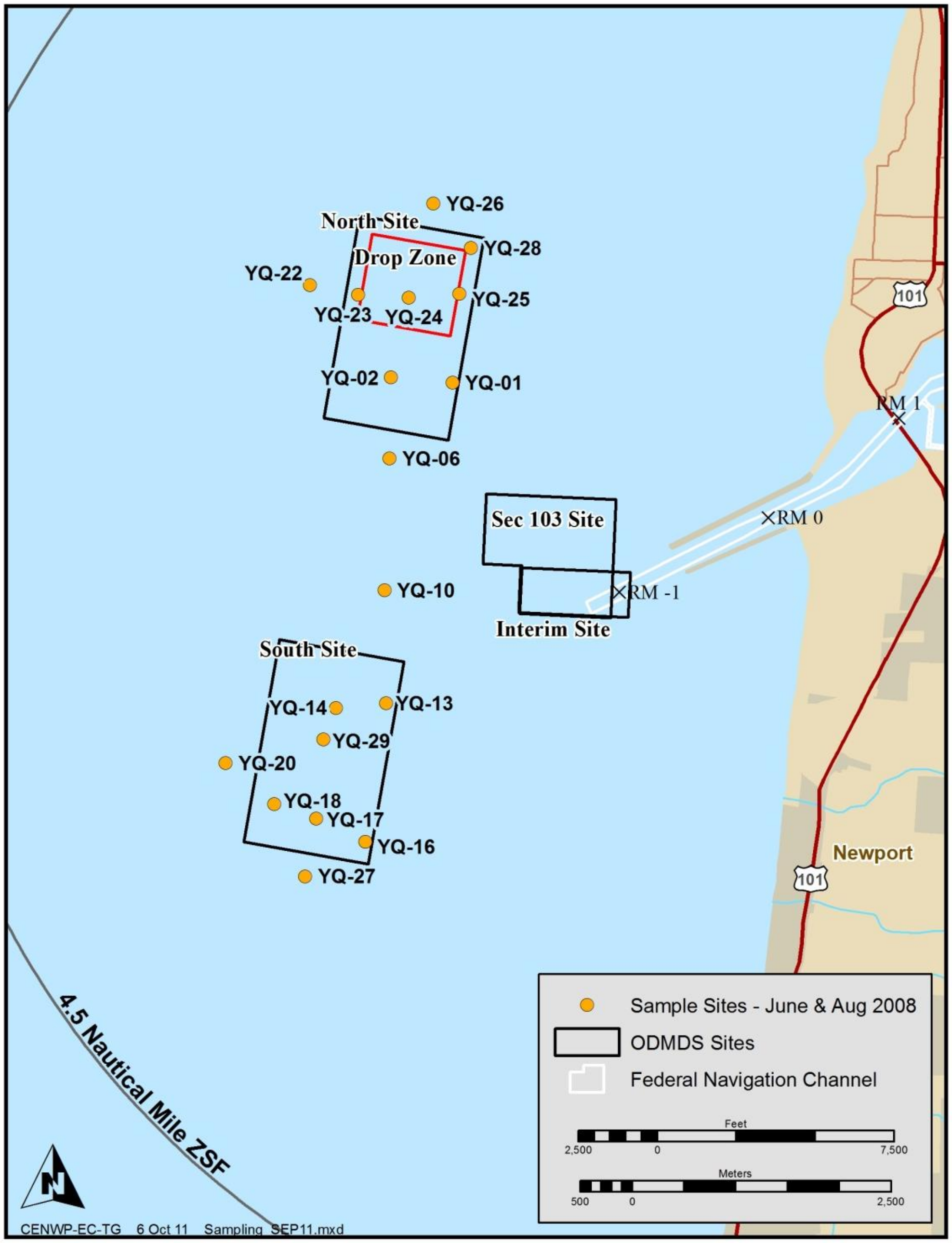
Given the lack of any exceedances of the SEF SL's, the sediment that was collected during 2010 was considered suitable for unconfined in-water placement without further characterization and is not toxic to marine organisms[4].

Testing of material at Yaquina 103 North and South sites. In June 2008, sediment samples for physical and chemical analyses were collected by the EPA using a 0.1 m^2 Young modified Van Veen grab sampler at the Yaquina 103 North and South sites (USACE and EPA 2011). The 18 samples were selected based on previous sampling efforts in 1999, 2000 and 2002 (Figure 3). The re-use of the sampling stations allows for direct comparisons both between stations and among sampling years. The 2008 survey area size was approximately 2.5 square nautical miles and the surveys were carried out in water depths of 110 to 150 feet. Samples were analyzed by the EPA's Manchester Laboratory (Port Orchard, WA) and by subcontractors for the following: grain size, total solids, TOC, metals, TBT, semivolatile organic compounds (SVOCs), PCBs, and PAHs. Tables showing all results are located in the final data report for the 2008 monitoring (USACE and EPA 2011) and can be found in Appendix C to the EA (see attachments).

Physical Analysis and TOC. The sediment collected was primarily medium sand with little variation, ranging from 98% to 100% sand-sized grains ("percent sand") at stations in the 103 North Yaquina site drop site, and from 97% to 100% sand at the background stations. There was higher percent coarse sand at YQ-22, the deepest location, and higher percent very fine sand at YQ-01, the shallowest location. The mean percent sand was essentially the same at the 103 North Yaquina drop site stations (99%) as that of the background stations (98%). The mean and median grain sizes were calculated using percentage of
grain size. The mean grain sizes at the Yaquina 103 North drop zone stations were more consistent than those at the background stations, ranging only from 0.195 millimeters (mm) to 0.213 mm at the former and from 0.171 mm to 0.308 mm at the latter. The largest grain size (0.308 mm) was collected at YQ-22, the deepest location.

[4] Pursuant to the Ocean Dumping Regulations at 40 CFR § 227.13(b), dredged material which meets the following criteria is environmentally acceptable for ocean dumping without further testing: (1) dredged material composed primarily of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larges than silt, and the material is found in areas of high current or wave energy such as streams with large bed loads, or coastal areas with shifting bars and channels; or (2) dredged material for beach nourishment or restoration and is composed primarily of sand, gravel, or shell with particle sizes compatible with material on the receiving beaches; or (3) when the material is substantially the same as the substrate at the proposed disposal site and the site from which the material is taken is far removed from known existing and historical sources of pollution such that there is a reasonable assurance that the material has not been contaminated by such pollution. The use of SEF screening levels provide additional safeguards for material that would otherwise meet the regulatory criteria for environmentally acceptable material for ocean dumping without further testing.

Figure 3. Sampling Stations at Proposed Yaquina Bay Ocean Disposal Site.



Source: USACE and EPA 2011.

The TOC was substantially lower at the Yaquina 103 North drop zone stations than at the background stations (mean 349.2 milligrams per kilogram (mg/kg) versus 513.3 mg/kg). This difference is likely due to the relatively low TOC normally found in the Oregon coast river sediments as opposed to the higher organic carbon normally found in the deeper, more productive ocean waters. TOC samples collected at the proposed Yaquina ODMD sites in 2000 (prior to any disposal) averaged 500 mg/kg.

Metals. Overall, metals concentrations were comparable between those collected in the Yaquina 103 North drop zone stations as compared to those in the background stations. Some concentrations were slightly lower at the Yaquina 103 North drop zone site stations for iron, magnesium, vanadium, and nickel, and higher for calcium and potassium. Metals concentrations detected in all samples were far below the SEF SLs (SEF 2009). The following metals were not detected at any sampling station: antimony, cadmium, cobalt, copper, mercury, selenium, and thallium.

*Organotins (including TBT)***.** In marine sediments, pore-water analysis has been shown to improve the reliability of toxicity predictions over bulk-sediment, dry-weight analysis and consequently is required in marine environments (Michelsen et al. 1996). No organotin compounds were detected at any station; however, the laboratory reporting limit was much greater than the SEF SL. For this analysis, none of the initial calibration and calibration verification, matrix spike/matrix spike duplicate, and laboratory duplicates met established laboratory/quality assurance criteria. While not noted in the laboratory results, this may have resulted in the higher reporting level, but may also be due to the small amount of pore water that can be extracted from a sediment sample consisting primarily of sand. Significant concentrations of TBT or other organotins were not expected since organotin levels in all dredged material are tested prior to disposal. Testing of the Yaquina dredge prism in 2005 and 2010 showed non-detects of TBT, and either non-detects or extremely low concentrations of other organotins.

Organic Compounds. Benzoic acid was detected at three background stations, at levels well below the SEF SLs. The only SVOCs detected above the reporting level in the Yaquina 103 North drop zone were bis(2-ethylhexyl) phthalate and di-n-butylphthalate, both of which were found only in the sample duplicate collected at station YQ-024. The detected concentrations were far below the SEF SLs. The compounds 2,4-dimethylphenol at station YQ-28 and pentachlorophenol at stations YQ-24D and YQ-25 also were identified, but each value is considered an estimate. All concentrations of SVOCs in both the 103 North drop zone and at the background stations were below SEF SLs. In a matrix made up of primarily sand-sized particles or larger, such as sediments all along the Oregon coast, any organic contamination is expected to be minimal.

The laboratory reporting limit for several compounds exceeded the SEF SLs slightly; these included 2,4-dimethylphenol, dieldrin, heptachlor, hexachlorobenzene, hexachlorobutadiene, and n-nitrosodiphenylamine. However, the reporting level was consistent for all compounds analyzed by the SVOC method. The reporting levels that were exceeded were for compounds with SLs very close to the reporting levels. Numerous other SVOCs had much higher screening levels and showed no detections. None of the compounds for which the SL was exceeded were detected in either the 2005 or 2010 sediment characterization sampling prior to dredging of the channel and harbor, and would not be expected at the ODMD sites.

Polychlorinated Biphenyls. PCBs were not detected at any of the Yaquina 103 North and South stations.

Pesticides. Pesticides were not detected at any of the Yaquina 103 North and South stations.

Benthic Organisms

Benthic Infauna

The USACE and the EPA have conducted seven studies of benthic infauna at or near the proposed ODMD sites in March 1984, May 1986, October 1989, May 1999, September 1999, June 2000 and September 2000, June and August 2008 (USACE and EPA 2001; Marine Taxonomic Services 2000, 2001). These studies included sampling at shallower stations (1984, 1986) and at stations at the same isobaths and/or within the ODMD sites (1999, 2000, 2002, and 2008). The studies consistently found the benthic community to be dominated by mobile organisms that are adapted to a sandy environment. Dominant species and groups included gammaridean amphipods, sand dollars *Dendraster eccentricus,* surface-dwelling gastropods *Olivella* spp., and various species of polychaete worms. The benthic invertebrate fauna densities and diversities collected during these studies were typical of the nearshore sandy substrate along the Oregon coast.

Summer 2008 Sampling. The EPA conducted the most recent survey of benthic infauna at the proposed ODMD sites in June and August 2008. The sampling stations were selected based on the previous sampling efforts in 1999, 2000, and 2002 (USACE and EPA 2011) (Figure 3). In 2008, the USACE disposed of dredged material at the Yaquina 103 North site before and after sampling at these locations. The USACE disposed of 135,918 cy of material at the North Yaquina drop zone over 18 days between May 20 to August 6. Disposal of material occurred 10 days prior to the June 2008 sampling[5]. For the August 2008 data, material was disposed at the site 19 days prior to sampling. The information from these sampling events provides a snapshot of the benthic communities at and around the proposed ODMD sites in the summer of 2008. The survey was not designed to provide enough data for rigorous statistical analyses of species diversity, species richness, or community dynamics. However, it does indicate which species are at these sites and the surrounding area and the relative abundance and densities of those organisms in the different survey areas.

June 2008. The June 2008 survey was composed of 20 samples (18 samples plus two duplicate samples) that generated 6,028 specimens (Marine Taxonomic Services 2009). The dominant species in the June 2008 data set included the polychaetes *Chaetozone* nr. *setosa*, *Magelona sacculata*, *Nephtys caecoides*, *Onuphis iridescens*, *Spio filicornis,* and *Spiophanes bombyx*; the crustaceans *Anchicolurus occidentalis* and *Eohaustorius estuarius*; and the miscellaneous phylum nemertinea. The number of polychaetes, specifically *Spiophanes bombyx* at a count of 3,313, far exceeded the number of other individual organisms. There were a total of 106 taxa of which 46 were polychaetes, 34 were crustacean, 18 were mollusca, 3 were echinoderms, and 5 were miscellaneous groups. No *Cancer magister* (Dungeness crab) larvae or juveniles were collected.

For this discussion, the data are broken out into 4 groups, representative of their level of impact from dredge disposal and/or location at the 103ODMD sites: 1) Yaquina North drop zone; 2) Yaquina North - no disposal; 3) Yaquina South site; 4) baseline stations. The Yaquina North drop zone is the only area used between 2001 and 2009. In 2010, the entire Yaquina North site (406 acres) was used for disposal. The latter three groups are considered baseline stations (unimpacted areas) for purposes of the June and August 2008 surveys and thus analysis was conducted combining those three groups together.

In terms of number of species and density of individuals between the Yaquina North drop zone and other areas, the Yaquina North drop zone had fewer species (M = 25) (Table 2) and a lower density (M= 1,180

[5] June 2008 benthic grabs occurred on June 4 and 5th. The August 2008 benthic grabs and trawl survey occurred on August 25.

Table 2. Number of benthic species per sampling location (June 2008).

Station	Polychaetes	Molluscs	Crustacea	Nemertina	Echinodermata	Phoronida	Misc	Spp Richness	Mean
Number of Species									
North ODMDS Drop Site									
YQ-28	7	3	11	1	1	0	0	23	25
YQ-23	9	3	11	1	1	1	0	26	
YQ-24	8	3	13	1	0	0	0	25	
YQ-24D	11	6	7	1	2	1	0	28	
YQ-25	9	2	9	1	1	1	1	24	
Background Stations – Southern part of North ODMDS									
YQ-02	13	5	11	1	0	1	0	31	34
YQ-02D	15	5	6	1	1	1	0	29	
YQ-01	12	6	20	1	2	1	0	42	
Background Stations – South ODMDS									
YQ-13	13	5	13	1	1	1	0	34	30
YQ-14	13	6	13	1	1	0	1	35	
YQ-29	14	6	10	1	1	1	0	33	
YQ-16	6	5	9	1	1	1	0	23	
YQ-17	12	6	5	1	1	1	0	26	
YQ-18	11	4	9	1	1	0	1	27	
Background Stations – Outside of Proposed ODMDSs									
YQ-26	15	4	12	1	1	1	1	35	35
YQ-22	32	6	11	1	2	1	2	55	
YQ-06	17	5	12	1	1	1	0	37	
YQ-10	11	5	11	1	0	1	0	29	
YQ-20	12	7	6	1	1	1	0	28	
YQ-27	8	6	9	1	2	1	0	27	

individuals/m^2) than at locations that had not been disposed on (M= 33 species, M= 3,466 individuals/m^2) (Table 3) (Figures 4 and 5). The species that differed the most between the Yaquina North drop zone and the baseline stations was polychaetes. Both the overall lower density of individuals and lower density of polychaetes was expected because dredged material was deposited during the week prior to the June sampling. Thus, these values can be considered to represent what occurs to the species and number of individuals immediately after a disposal event. There appears to be a decrease in the number of species and number of individuals in response to disposal.

August 2008. The August 2008 survey was composed of 19 samples (18 samples plus one duplicate) that generated 5,372 specimens (Marine Taxonomic Services 2009). The data show a high energy benthic community structure. The dominant species in the data set included the polychaetes *Magelona sacculata*, *Spio filicornis* and *Spiophanes bombyx*; the mollusca *Siliqua* sp. juvenile (razor clam); the crustacea *Anchicolurus occidentalis, Diastylopsis dawsoni* and *Photis* sp. indeterminate; and the miscellaneous phylum nemertinea. As in June, the count of *Spiophanes bombyx* exceeded the number of other individual organisms. There were a total of 98 taxa of which 45 were polychaetes, 29 were crustacea, 20 were mollusca, 2 were echinoderms, and 2 were miscellaneous groups. There were four Dungeness crab larvae or juveniles collected. Juvenile razor clams encountered during this study were too immature to identify to the species level. No adult razor clams were collected because they live deeper in the sediment than the grab sampler could penetrate.

In terms of number of species and density of individuals between the Yaquina North drop zone and other areas, the Yaquina North drop zone had fewer species (M = 26) and a lower density (M= 1,490 individuals/m^2) than at locations that had not been disposed on (M= 33 species, M= 2,947 individuals/m^2) (Tables 4 and 5) (Figures 6 and 7). The species that differed the most between the Yaquina North drop zone and the baseline stations was polychaetes. Both the overall lower density of individuals and lower density of polychaetes was expected because dredged material was deposited a few weeks prior to the August sampling.

Density of Benthic Infauna. In general, for both June and August, the density of benthic invertebrates increased from east to west (shallow to deeper waters) (Figures 8 and 9). One exception both in June and August was sample YQ-20 (furthest west sample outside the Yaquina South site), which had a lower density than the nearest sample to the east (YQ-18). Sample YQ-18 had the greatest density of benthic invertebrates in June, while YQ-22 (furthest west sample outside the Yaquina North site) had the greatest density in August. Overall, the density of benthic invertebrates was lower in the Yaquina North drop zone than at the baseline stations.

Benthic Infauna - Summary. The benthic infaunal invertebrates collected in June and August 2008 are what would be expected based on earlier studies and are comparable to earlier studies in the vicinity of the mouth of Yaquina Bay. The data show a benthic community typical of a nearshore sandy environment. The difference in the number of species and density of individuals between the Yaquina North drop zone and areas outside of the drop zone indicate a potential effect from disposal of dredged material at the location. However, the effect appears to be localized. Rehabilitation of the area can occur from vertical migration, immigration from undisturbed areas, and larval settlement. A benthic community dynamic may occur that is different from surrounding areas, but it is not likely to make a meaningful difference to higher trophic levels. Higher trophic levels are not likely to be adversely affected by this change because: 1) the area of impact is discrete; 2) the disposal area is not completely void of benthic invertebrates thus there is still a prey resource; and 3) the infaunal and epifaunal invertebrates rehabilitate the area via vertical migration.

Table 3. Number of individuals per sampling location (June 2008).

Station	Polychaetes	Molluscs	Crustacea	Nemertina	Echinodermata	Phoronida	Misc	Total # of Individuals per grab	Average # of Individuals per grab	# of Individuals/m2	Mean
Number of Individuals											
North ODMDS Drop Site											
YQ-28	39	4	24	10	3	0	0	80	118	800	1180
YQ-23	80	6	40	14	1	1	0	142		1420	
YQ-24	28	5	49	43	0	0	0	125		1250	
YQ-24D	38	16	21	65	3	1	0	144		1440	
YQ-25	41	2	29	18	1	7	1	99		990	
Background Stations – Southern part of North ODMDS											
YQ-02	438	8	41	26	0	1	0	514	388	5140	3880
YQ-02D	403	15	14	21	1	8	0	462		4620	
YQ-01	69	13	93	6	4	2	0	187		1870	
Background Stations – South ODMDS											
YQ-13	66	7	78	18	9	1	0	179	386	1790	3860
YQ-14	341	16	53	40	4	0	2	456		4560	
YQ-29	372	16	37	32	2	3	0	462		4620	
YQ-16	28	7	17	22	1	2	0	77		770	
YQ-17	250	9	9	20	1	3	0	292		2920	
YQ-18	748	41	32	25	1	0	2	849		8490	
Background Stations – Outside of Proposed ODMDSs											
YQ-26	364	17	44	16	1	2	1	445	325	4450	3250
YQ-22	312	11	52	94	2	1	1	473		4730	
YQ-06	275	11	62	14	1	5	0	368		3680	
YQ-10	72	7	25	13	0	1	0	118		1180	
YQ-20	275	25	27	7	1	1	0	336		3360	
YQ-27	132	9	16	49	3	1	0	210		2100	

Figure 4. Average number of individuals per grab by area (June 2008).

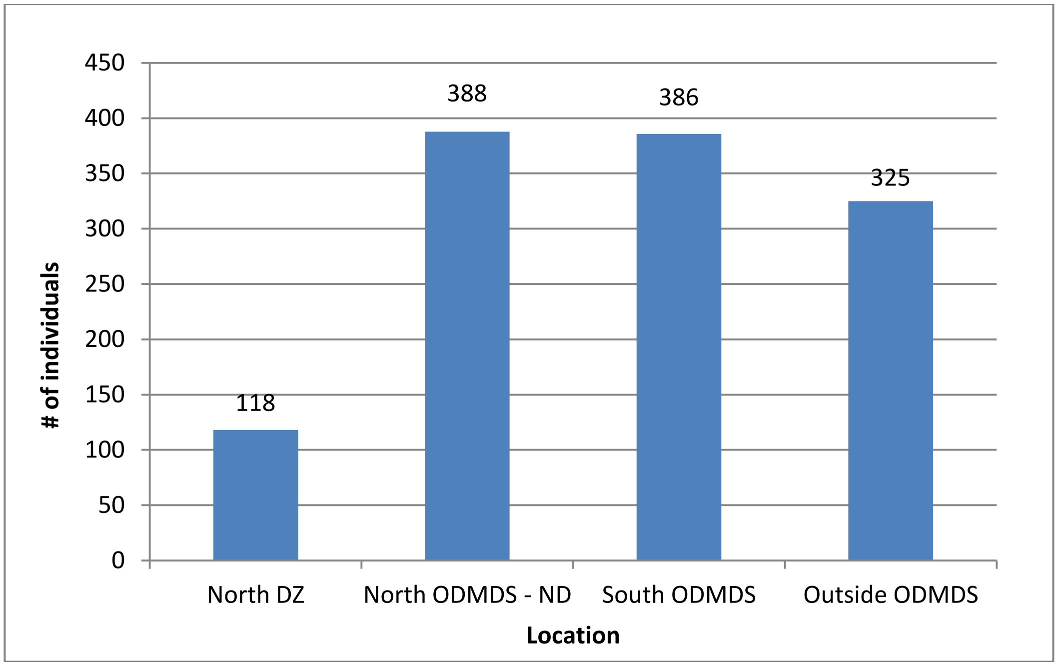


Figure 5. Average number of species per grab by area (June 2008).

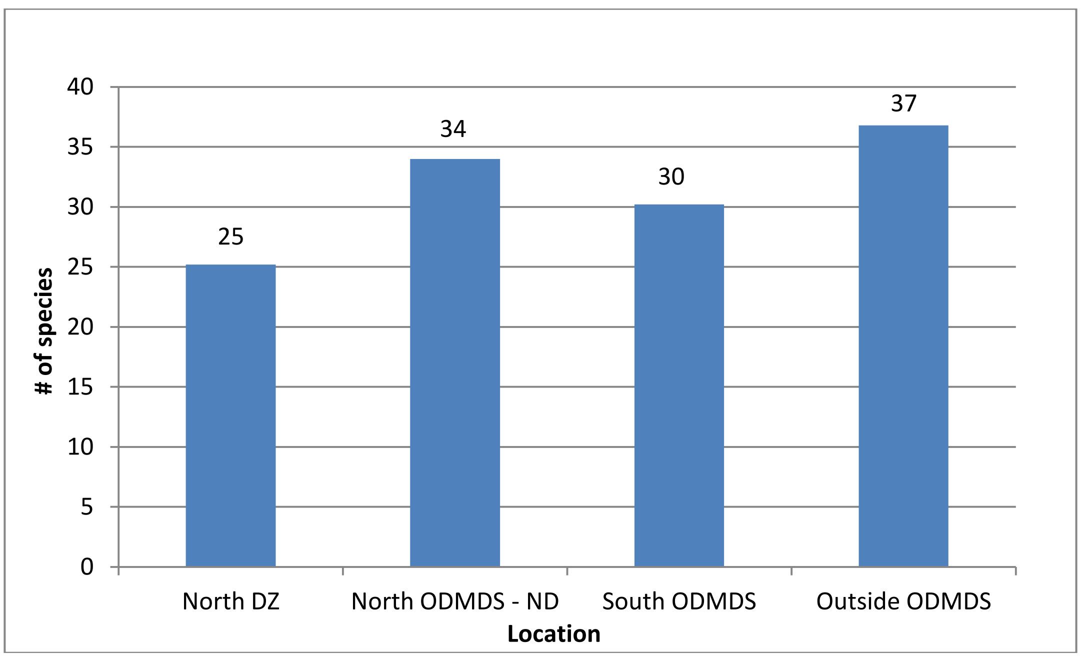


Table 4. Number of individuals per sampling location (August 2008).

Station	Polychaetes	Molluscs	Crustacea	Nemertina	Echinodermata	Phoronida	Misc	Total # of Individuals	Mean	# of Individuals per m^2	Mean
Number of Individuals											
North ODMDS Drop Site											
YQ-28	37	18	46	11	0	0	0	112	149	1120	1490
YQ-23	151	14	23	14	0	1	0	203		2030	
YQ-24	37	46	39	66	0	1	0	189		1890	
YQ-25	36	21	31	2	2	0	0	92		920	
Background Stations – Southern part of North ODMDS											
YQ-02	146	19	55	7	3	1	0	231	175	2310	1750
YQ-QC1	92	12	33	9	3	2	0	151		1510	
YQ-01	68	11	55	7	1	2	0	144		1440	
Background Stations – South ODMDS											
YQ-13	99	13	28	18	3	2	1	164	335	1640	3350
YQ-14	192	36	43	25	0	1	0	297		2970	
YQ-29	256	37	66	47	3	1	0	410		4100	
YQ-16	169	8	30	20	1	2	1	231		2310	
YQ-17	243	36	89	41	0	4	0	413		4130	
YQ-18	362	25	87	14	4	0	1	493		4930	
Background Stations – Outside of Proposed ODMDSs											
YQ-26	181	8	49	11	1	6	0	256	374	2560	3740
YQ-22	485	19	107	29	1	2	0	643		6430	
YQ-06	193	37	85	17	2	3	0	337		3370	
YQ-10	93	16	74	15	1	3	0	202		2020	
YQ-20	296	42	35	18	1	1	0	393		3930	
YQ-27	312	14	49	29	2	5	0	411		4110	

Table 5. Number of species per sampling location (August 2008).

Station	Polychaetes	Molluscs	Crustacea	Nemertina	Echinodermata	Phoronida	Misc	Spp Richness	Mean
Number of Species									
North ODMDS Drop Site									
YQ-28	7	5	8	0	1	0	0	21	26
YQ-23	10	6	8	0	1	1	0	26	
YQ-24	12	9	13	0	1	1	0	36	
YQ-25	7	4	9	1	1	0	0	22	
Background Stations – Southern part of North ODMDS									
YQ-02	16	5	10	1	1	1	0	34	34
YQ-QC1	15	5	9	1	1	1	0	32	
YQ-01	14	4	15	1	1	1	0	36	
Background Stations – South ODMDS									
YQ-13	11	3	9	1	1	1	1	27	32
YQ-14	15	4	14	0	1	1	0	35	
YQ-29	14	7	13	1	1	1	0	37	
YQ-16	10	5	7	1	1	1	1	26	
YQ-17	14	9	12	0	1	1	0	37	
YQ-18	12	5	11	2	1	0	1	32	
Background Stations – Outside of Proposed ODMDSs									
YQ-26	11	2	8	1	1	1	0	24	33
YQ-22	22	4	7	1	1	1	0	36	
YQ-06	18	6	13	1	1	1	0	40	
YQ-10	12	7	14	1	1	1	0	36	
YQ-20	15	8	5	1	1	1	0	31	
YQ-27	11	6	12	1	1	1	0	32	

Figure 6. Average number of individuals per grab by area (August 2008).

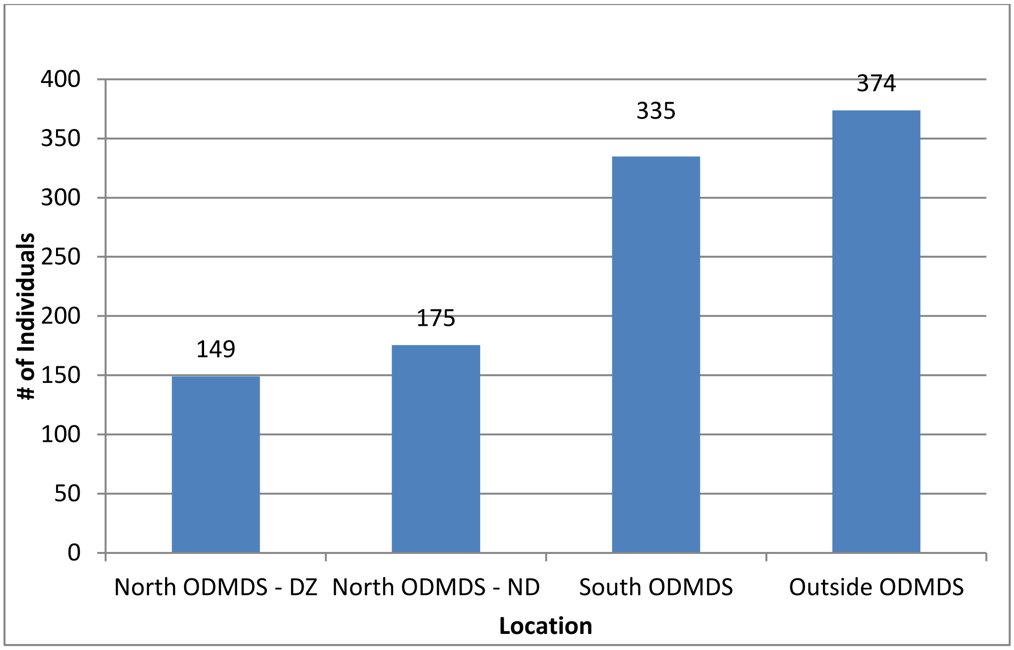


Figure 7. Average number of species per grab by area (August 2008).

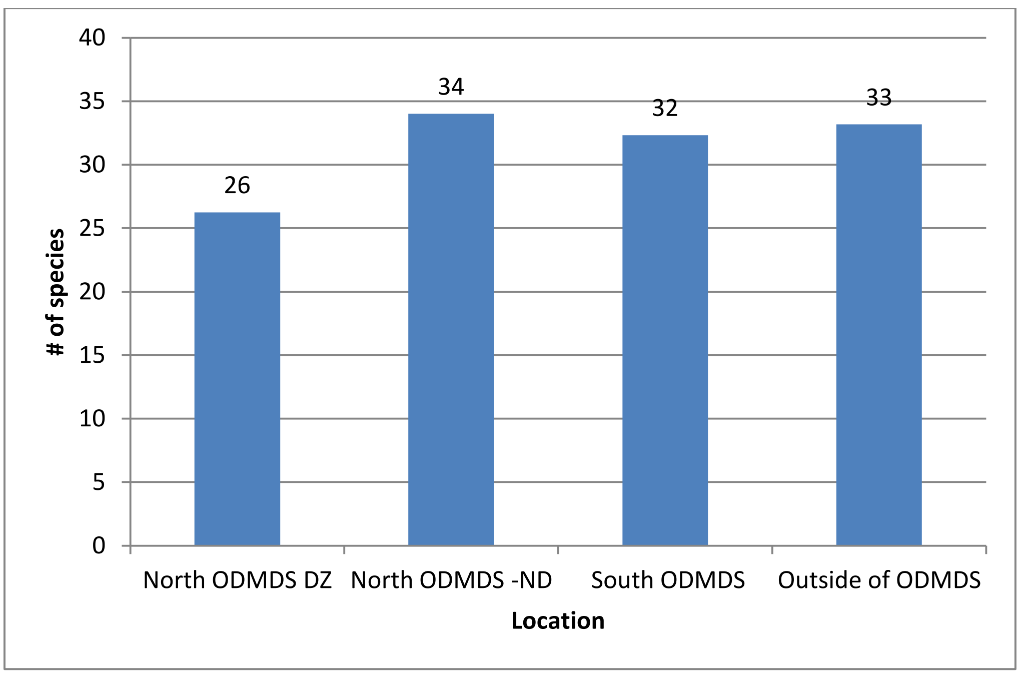


Figure 8. Density of Benthic Invertebrates in June 2008 (number per m2).

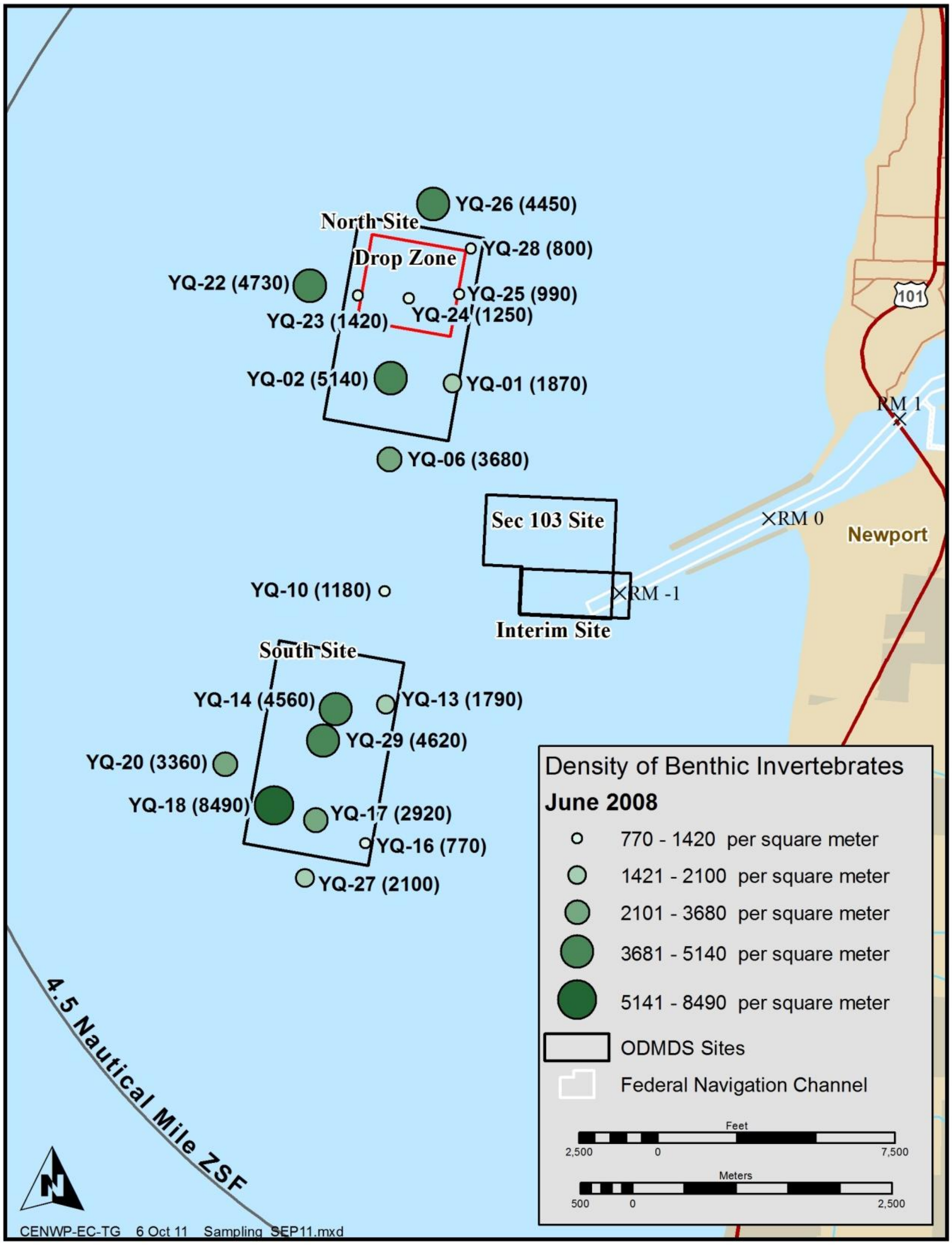
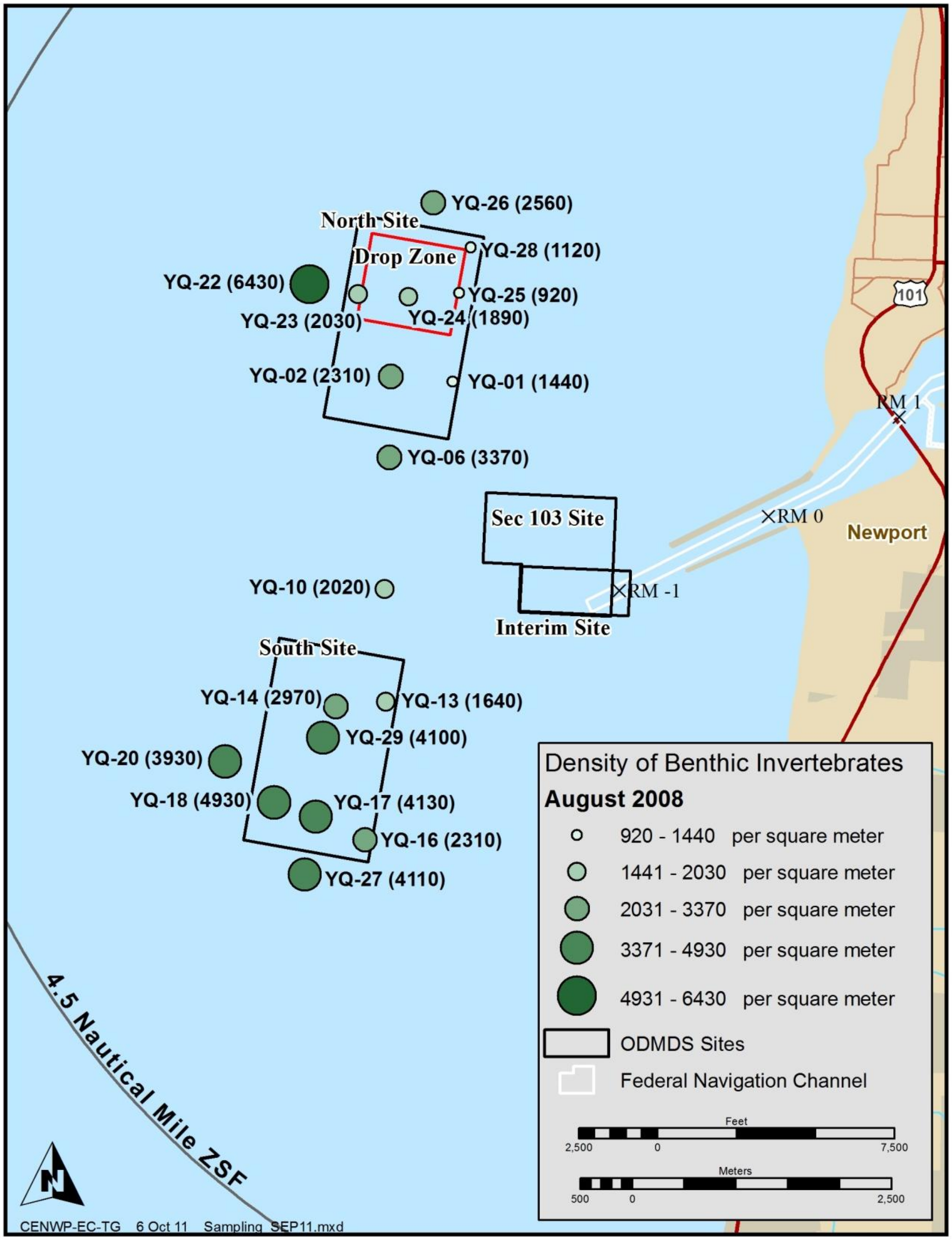


Figure 9. Density of Benthic Invertebrates in August 2008 (number per m2).



Fish and Epibenthic Species

Pelagic fish species found in the action area include anadromous salmonids such as coho salmon (*Oncorhynchus kisutch*), winter steelhead (*O. mykiss*), and spring and fall Chinook salmon (*O. tshawytscha*). Other pelagic species include the Pacific herring (*Clupea harengus pallasi*), northern anchovy (*Engraulis mordax*), and surf smelt (*Hypomesus pretiosus*).

Demersal fish species present in the action area are mostly residents and include sculpins, sea perch, and flatfish species. Flatfish include English sole (*Parophrys vetulus*), Pacific sanddab (*Citharichthys* sp.), and starry flounder (*Platichthys stellatus*) among others. English sole and starry flounder, along with the sand sole (*Psettichthys melanostictus*), spawn in the area and juveniles use this area for growth to maturity.

Dungeness crab is the primary commercially and recreationally important epibenthic invertebrate species off of Yaquina Bay. Dungeness crab adults occur on sand and muddy areas in estuaries to areas 200-feet in depth offshore. Crabs spawn in the winter in offshore areas. The larval stages of zoea and megalopes are pelagic. Once the megalope stage is completed, they settle out in shallow estuarine areas as juveniles in late summer and fall. Adult crabs (> 2 years old) may move out of the estuaries and into the ocean sandflat habitat along the Oregon coast.

***August 2008 trawl survey*.** The EPA conducted seven trawl transects in August 2008 to provide a snapshot of the fish and epibenthic invertebrates that are found at the Yaquina North site, Yaquina South site (non-disposal), and outside the proposed ODMD sites (Figure 10) (USACE and EPA 2011). The EPA conducted two trawls at the Yaquina North site, two trawls north of the Yaquina North site, and three trawls at the Yaquina South site. For the purposes of this discussion, the last trawl at the Yaquina South site is not included (Table 6). Disposal at the North Yaquina drop site occurred 18 days between May and August, with the most recent disposal being 20 days prior to the trawl survey. Information collected on each trawl include: the number and relative age of demersal fish species; number, sex and size of Dungeness crab, and the number and the species of epibenthic invertebrates collected for each of the seven trawls. In total, 840 epibenthic fish were caught, and all species were typical for nearshore habitat of the Oregon coast. The number of fish collected per trawl ranged from 95 individuals in the Yaquina North site to 177 individuals (outside of ODMD site). The number of species ranged from 8 species (Yaquina South site) to 15 species (outside of ODMD site).

With regards to average abundance of fish per trawl, trawls north of the Yaquina North site had the greatest number of individual fish collected during each trawl (158 and 177 individuals) with an average of 168 fish per trawl. These trawls also caught the greatest number of species (11 and 15 species). The trawls within the Yaquina North site averaged 121 individual fish per trawl (146 and 95 respectively). And, the trawls at the Yaquina South site averaged 130 fish per trawl (104 and 156 individuals respectively). The number of species per area did not appear to differ substantially with the range of species from 8 to 15 species (Yaquina South and north of Yaquina North site). The percent of the total catch was highest north of the Yaquina North site at 17 and 19%. The Yaquina North site trawls pulled in 16% and 10% of the total catch, while the trawls in the Yaquina South site pulled in 11% and 17% of the total catch.

Juveniles. Juvenile fish were caught in all of the trawls. Of all the identifiable fish caught, 75% were juveniles. North of the Yaquina North site, 13 of the 17 (76%) species caught had at least one juvenile individual in the catch. In the Yaquina North site, 7 of the 15 species (47%) caught had at least one juvenile individual collected in the survey. In the South Yaquina site, 9 out of the 12 species (75%) caught had a least one juvenile life history stage present. In terms of which species had the most juveniles

Figure 10. Trawl Locations at Yaquina ODMD Sites (August 2008).

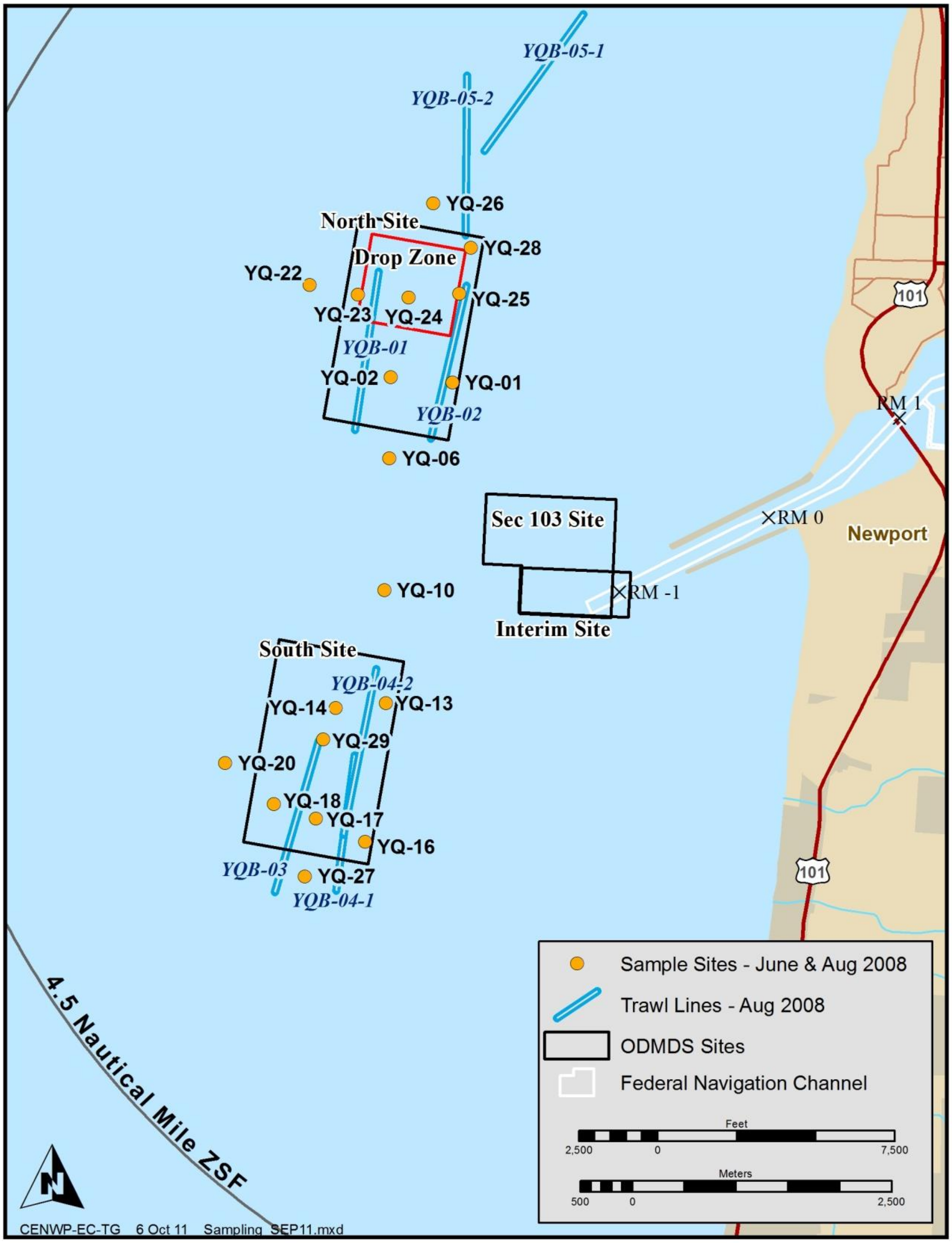


Table 6. Summary of data for each trawl area (north of North ODMDS; North ODMDS; South ODMDS).

	North of North ODMDS			North ODMDS			South ODMDS		
Common Name	**Adult**	**Juvenile**	**UD**	**Adult**	**Juvenile**	**UD**	**Adult**	**Juvenile**	**UD**
Big skate	1	4		2		1		1	
Butter sole	7	59		2	29		2	32	
Curl fin				1					
English sole	6	75		3	80		12	53	
Ling cod		1							
Pacific sanddab	6	22		27	41		59	51	
Pacific staghorn sculpin	6	2		1			2		
Pacific tomcod		91			13			4	
Petrale sole*	1			1	1			2	
Pricklebreast poacher		1							
Rock sole		1							
Sablefish		2							
Sand sole	4	25		2	19		5	22	
Showy snailfish	1			3					
Smelt - unknown sp	1		6						
Snailfish (marbled?)				1					
Speckled sanddab							7	1	
Spotted ratfish				1	1				
Starry flounder		1			1		1		
Tubenose poacher				1			4		
Warty poacher	11			9		1	6		
Unidentified sculpin		1							
Total	**44**	**285**	**6**	**54**	**185**	**2**	**98**	**166**	**0**
Total # of Individuals per Area	**335**			**241**			**264**		
% of Total Catch	**40**			**29**			**31**		

present, the butter sole and English sole were in the top three for most juveniles present in each area. The third species was either the Pacific tomcod (North of Yaquina North site) or Pacific sanddab (Yaquina North site and Yaquina South site). These numbers demonstrate the use of the site by juvenile benthic fish.

Overall, it appears that the Yaquina North site supports similar numbers of juvenile and adult fish when compared to areas that are not used for dredged material disposal.

Dungeness crab. The greatest number of crabs was collected from trawls north of the Yaquina North site with totals of 17 and 30 crabs (Table 7). The Yaquina North site trawls had 6 and 9 adult crabs per trawl while the Yaquina South site trawls collected 7 and 8 adult crabs. Only 1 female was collected in the Yaquina North and South sites. The trawls to the north of the Yaquina North site collected the most female crabs (6 and 8 females). Overall there was a total of 82 Dungeness crab collected, of which 38% were legal males. It appears that Dungeness crab were using the disposal site and non-disposal site equally, which may indicate that prey resources were not adversely affected.

Epibenthic invertebrates. The trawls collected 10 different types of epibenthic invertebrates with only Dungeness crab and short-spined pink star *(Pisaster brevispina)* collected in all trawls (Table 8). The most numerous organisms were Dungeness crab and sea nettles which were caught in the trawls north of the Yaquina North site. The average number of individuals per area that were caught puts the area north of the Yaquina North site with the most (47), followed by the Yaquina South site (24) and then the Yaquina North site (21).

Status of ESA-listed Species and Critical Habitat

Coho Salmon

Oregon Coast Coho Salmon. This species includes all naturally-spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco, and progeny of five artificial propagation programs. The Oregon Coast-Technical Recovery Team (OC-TRT) identified 56 historical populations, grouped into five major “biogeographic strata,” based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity (Lawson *et al.* 2007).

Of the 56 historical populations identified by the OC-TRT, 13 populations were identified as functionally independent, 8 as potentially independent, and 35 historical populations were identified as dependent populations. Functionally independent populations are identified as high- persistence populations whose population dynamics or extinction risk over a 100-year time frame is not substantially altered by exchanges of individuals with other populations. These populations are net “donor” populations that may provide migrants for other types of populations. Potentially independent populations are identified as high-persistence populations whose population dynamics may be substantially influenced by periodic immigration from other populations. In the event of the decline or disappearance of migrants from other populations, a potentially independent population could become a functionally independent population. Dependent populations are considered low-persistence populations that rely upon immigration from other populations. Without these inputs, dependent populations would have a lower likelihood of persisting over 100 years. Dependant populations are “receiving” populations that are dependent on sufficient immigration from surrounding populations to persist.

The OC-TRT concluded that, if recent past conditions continue into the future, OC coho salmon are moderately likely to persist over a 100-year period without artificial support, and have a low to moderate likelihood of being able to sustain their genetic legacy and long-term adaptive potential for the foreseeable future (Wainwright *et al.* 2008). The major factors limiting recovery of OC coho salmon include altered stream morphology, reduced habitat complexity, loss of overwintering habitat, excessive sediment, high water temperature, and variation in ocean conditions (Stout 2011).

Table 7. Dungeness Crab Trawl Data (August 2008).

+ Legally harvestable crabs are males greater than 5.75 inches, approximately 14.7 cm (data collected in cm).
++ Percent legal males relative to the total number of crabs.
NA = Not available

	North ODMDS						South ODMDS									Outside ODMDS						
Trawl	YQB-01 N to S in North ODMDS, Western third			YQB-02 S to N in North ODMDS, Eastern edge			YQB-03 N to S in South ODMDS, Western third			YQB-04 N to S in South ODMDS, Eastern third			YQB-04 S to N in South ODMDS, Eastern third			YQB-05 SW to NE North of North ODMDS			YQB-05 N to S North of North ODMDS			Totals
Replicate	1			1			1			1			2			1			2			
Crab Data	No.	Mean Width		No.	Mean Width		No.	Mean Width		No.	Mean Width		No.	Mean Width		No.	Mean Width			Mean Width		
		cm	in		cm	in		cm	in		cm	in		Cm	in		cm	in	No.	cm	in	
Female Crabs	0	NA	NA	1	14.5	5.7	1	15.2	6.0	0	NA	NA	0	NA	NA	6	12.4	4.9	8	12.6	4.9	
Male Crabs	6	14.3	5.6	8	14.2	5.6	6	15.8	6.2	5	15.8	6.2	8	15.9	6.2	11	14.1	5.6	22	14.9	5.9	
Total Crab Count	6			9			7			5			8			17			30			82
+ No. Legal Males	2			2			5			3			6			4			9			31
++ % Legal Males	33.3			22.2			71.4			60.0			75.0			23.5			30.0			37.8

Source: USACE and EPA 2011

Table 8. Epibenthic Invertebrate Data (August 2008).

		North of North ODMDS		North ODMDS		South ODMDS		
	Trawl	**YQB-05**		**YQB-01**	**YQB-02**	**YQB-03**	**YQB-04**	
	Replicate	**1**	**2**	**1**	**1**	**1**	**1**	**2**
Common Name	**Latin Name**							
Clear jellyfish	unknown		2		3		10	6
Crangon sp.		8	3	2			1	
Dungeness crab	*Cancer magister*	17	30	6	9	7	5	8
Flat mud star		2	1	5		1		
Short-spined pink star	*Pisaster brevispina*	4	1	5	10	4	2	10
Sunflower star	*Pycnopodia helianthoides*	1		2		3	5	3
Sand flea (adult)							1	
Luidia sp.	*Luidia sp.*						1	
Sea nettles		24				3		
Unidentified shrimp						1		
Other		2 bits of sponges						
Total Individuals per Trawl		56	37	20	21	19	25	27
Average # of Individuals per area		47		21		24		

Yaquina River Population. All coho salmon outmigration or returning to Yaquina Bay move through one or both of the disposal sites. Adult OC coho salmon return to Yaquina Bay in the fall/winter, migrating upstream to spawn, with a peak in November through December. Outmigration of juveniles to the ocean occurs from mid-February through June, with a peak from April to mid-May. The estimated number of wild adults returning to the Yaquina Bay basin since 1990 has averaged 4,182, with a range of 365 to 23,981 (Table 9). During the period from 2002 to present, these data on the number of returning adult OC coho salmon were collected using a different protocol then the previous years, and therefore, not entirely comparable. However, during the overlapping years of 2002 – 2004, the results were not extremely different, and are the best available for the purposes of this discussion.

The number of OC coho salmon juvenile out migrants from Yaquina Bay basin has not been studied to provide a reliable estimate by direct sampling. However, it can be estimated by back calculation dividing the number of returning adults by marine survival. Marine survival predictions averaged 4%, with a range of 0.5% and 11.7%, between 1970 and 1999 (PMFC 2000). The average number of out migrants estimated by this back calculation is 104,550 with a range of 9,125 to 599,525. While this extrapolation is not optimal, it is considered the best information available.

For several months before they disperse into the open ocean, coho typically stay in nearshore areas close to their natal streams (Groot and Margolis 1991). Juvenile coho from California to British Columbia typically migrate northward along the coast, generally remaining over the continental shelf within sight of land and at depths less than 90 to 150 meters (Groot and Margolis 1991). Typically, coho salmon spend two growing seasons (approximately 18 months) in the ocean before returning to their natal streams to spawn. However, precocious male 'jacks' return after 6 months.

Table 9. Estimated wild OC coho salmon spawner abundance in the Yaquina Bay basin. (http://oregonstate.edu/dept/ODFW/spawn/cohoabund.htm)

Year	Number of fish
1990	381
1991	380
1992	633
1993	549
1994	2,,448
1995	5668
1996	5,127
1997	384
1998	365
1999	2,588
2000	647
2001	3,039
2002	23,981
2003	13,254
2004	4,989
2005	3,441
2006	4,247
2007	3,158
2008	10,913
2009	11,182
2010	8,589
average	**5,046**
1998-2010 average	**6,953**

Juvenile coho salmon feed primarily on aquatic invertebrates while in freshwater, but fish become an important prey as they grow larger (Groot and Margolis 1991). In estuarine and marine environments, chum and pink salmon fry, as well as larvae of pacific crab are important prey.

NMFS designated critical habitat for OC coho salmon but it does not include ocean waters. Thus, no critical habitat is designated for this species in the action area.

Lower Columbia River Coho Salmon. In 2005, the Lower Columbia River (LCR) coho salmon evolutionarily significant unit (ESU) was listed as threatened and includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood rivers, and includes the Willamette River to Willamette Falls, Oregon, as well as 25 artificial propagation programs (70 FR 37160). With regards to their use of the ocean, their distribution patterns are not well understood. However, Weitkamp and Neely (2002) conducted a coast wide analysis of the oceanic distribution of coho salmon. In that analysis, they reported that coded-wired tags were recovered in the Northern Oregon recovery area (~Tillamook Bay to Alsea River) from hatchery-raised coho salmon that originated from hatcheries as far north as the Columbia River and down to Rock Creek on the Southern Oregon Coast.

Given this information, adult LCR coho salmon may use the action area. The NMFS has not designated or proposed critical habitat for LCR coho salmon.

Chinook Salmon

Several ESUs of Chinook salmon were listed in 2005 (70 FR 37160) including LCR Chinook salmon, Upper Willamette River (UWR) Chinook salmon, and Snake River spring/summer run Chinook salmon. Each of these species enters and exits the Pacific Ocean through the Columbia River. As is the case for coho salmon mentioned above, the oceanic distribution of each of these species is not well understood. However, Weitkamp (2010) conducted a coast wide analysis of the oceanic distribution of Chinook salmon. In that analysis, she reported that coded-wired tags were recovered in the Northern Oregon recovery area (~Tillamook Bay to Alsea River) from hatchery-raised Chinook salmon that originated from hatcheries on the Snake River, Upper Willamette River, and Columbia River tributaries. Given this information, adult LCR Chinook salmon, UWR Chinook salmon, and Snake River spring/summer Chinook salmon may use the action area. NMFS has designated critical habitat for each of these ESUs but the designation does not include ocean waters. Thus, no critical habitat is designated for this species in the action area.

Green Sturgeon

The threatened Southern Distinct Population Segment (DPS) of green sturgeon includes all green sturgeon that spawn within the Sacramento-San Joaquin Rivers. Green sturgeons that spawn to the north, primarily in the Klamath and Rogue Rivers, constitute the Northern DPS, which is not federally listed. The Northern DPS and the Southern DPS were found to be genetically distinct.

Green sturgeons spend more time in the marine environment than other sturgeon species (Adams et al., 2002). Green sturgeons spawn in their natal rivers and migrate downriver to the ocean after 3 to 5 years and disperse along the coastline. Green sturgeon reach sexual maturity on a delayed basis, somewhere between 13 to 20 years, and they apparently only spawn every 2 to 5 years (Moyle et al., 1992). Sexually mature individuals are considered adults and are around 1.5 meters in length. Sexually immature fish that have entered coastal waters (usually 3 years of age) are considered subadults and are around 0.75 meters in length. Juveniles are those fish who have not made their first entry into saltwater (NMFS 2009). Green sturgeon in the ocean can be assumed to remain largely inside the 100-meter depth contour and typically occupy depths of 40-70 meters (Erickson and Hightower 2007). In the Rogue River, green sturgeon spend approximately 6 months in fresh water annually and have been captured as far upriver as RM 65 (105 km) and emigrate to the ocean between October and January (Erickson et al., 2002; Erickson and Webb 2007). Southern DPS green sturgeon, radio-tagged in the Sacramento River, have recently been shown to occur seasonally in Willapa Bay, as well as other northern estuaries including the Columbia River estuary during the summer and early fall (Moser and Lindley 2007). Although there appears to be substantial spatial overlap in the two DPSs, the Northern DPS appears to utilize smaller river estuaries to a greater extent than the Southern DPS (NMFS 2007).

The NMFS identified one of the major threats to the Southern DPS green sturgeon as harvest in the spawning and natal areas of the Sacramento-San Joaquin Rivers and in more northern ocean, coastal, and estuarine waters. In the northern fisheries, it is during their aggregation in estuaries that the greatest catch of Southern DPS green sturgeon occurs. In northern waters, green sturgeon are captured either in directed sturgeon fisheries in estuarine waters, as by-catch in salmon gillnet fisheries in estuaries and rivers, or in coastal trawl fisheries along the West Coast (NMFS 2007). Historically, harvest came predominately from the Columbia River (51%), coastal trawl fisheries (28%), the Oregon fishery (8%), and the California tribal fishery (8%) (Adams et al., 2002).

There is evidence that green sturgeon utilize northern estuaries to optimize their growth potential in summer and then occupy coastal marine waters during the winter. During their use of coastal marine areas, they can make sustained migrations of 100 kilometers per day or reside in aggregations, potentially feeding aggregations, for several days at a time (NMFS 2009).

The NMFS designated critical habitat in the ocean to extend from the shore to 110 meters depth. The primary constituent elements of their critical habitat in coastal waters are: food resources, migratory corridor, and water quality. With regards to food resources, data on prey resources in coastal marine waters is lacking, however NMFS believes that they likely rely on the same suite of species in the marine environment as they do in estuaries. Thus, their food resources in the ocean would include: burrowing ghost shrimp, crangonid shrimp, isopods, clams, Dungeness crabs, anchovies, and sand lance (NMFS 2009).

Southern DPS green sturgeons are likely to occur at the Yaquina North and South sites. Given the information that is known to date about this species, they are likely be found in greater numbers at the North and South sites during winter, when disposal is not occurring.

Pacific Eulachon

The Southern DPS of Pacific eulachon was listed as threatened on May 17, 2010 (75 FR 13012). Eulachon (commonly called smelt, candlefish, or hooligan) are a small, anadromous fish from the eastern Pacific Ocean. Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid spring. Eulachon occur in nearshore ocean waters up to 1,000 feet (300 meters) in depth, except for the brief spawning runs into their natal (birth) streams. In the continental United States, most eulachon originate in the Columbia River Basin. Other areas in the United States where eulachon have been documented include the Sacramento River, Russian River, Humboldt Bay and several nearby smaller coastal rivers (e.g., Mad River), and the Klamath River in California; the Rogue and Umpqua rivers in Oregon; and infrequently in coastal rivers and tributaries to Puget Sound, Washington. Although eulachon migrate along the coast, little is known about their use of nearshore marine waters. In October 2011, NMFS designated critical habitat for eulachon. Critical habitat is designated in the Columbia River, Tenmile Creek (ocean tributary on Oregon Coast), and the Umpqua River. Thus, critical habitat is not designated in the action area.

Marine Mammals

Steller Sea Lion. The Steller sea lion, listed as threatened in 1990 and reconfirmed as threatened for the eastern DPS in 1997 (58 FR 45269), breeds along the West Coast of North America from California's Channel Islands to the Kurile Islands and the Okshotsk Sea in the western north Pacific Ocean. Steller sea lion population counts for Oregon have increased since 1977, when the statewide non-pup population totaled 1,431, to 4,169 in 2002, an annual rate of increase of about 3.7% (Brown et al., 2002). Brown and others (2002) also found that the pup counts for the Rogue Reef rookery have increased over time, from 492 in 1990 to 746 in 2002, and at Orford Reef rookery from 298 in 1990 to 382 in 2002, although the pup counts have not been completed annually. Steller sea lion numbers appear to be lower off Oregon in the winter than summer. However, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears low (Angliss and Outlaw 2005). Steller sea lions forage at river mouths and nearshore areas along the coast. Roffe and Mate (1984) determined that proximity to the mouth of a river was the most important factor in determination of forage areas.

Steller sea lions are known to haul out at 10 sites along the Oregon coast: Columbia River South Jetty (Clatsop County), Ecola State Park (Clatsop County), Three Arch Rocks (Tillamook County), Cascade Head (Tillamook County), Seal Rock (Lincoln County), Sea Lion Caves (Lane County), Cape Arago (Coos County), Blanco Reef (Curry County), Orford Reef (Curry County) and Rogue Reef (Curry County). The Seal Rock haul out site is located about 7 miles south of the Yaquina North Jetty. Orford Reef and Rogue Reef are rookeries and are designated critical habitat for Steller sea lion. Designated critical habitat at both the Rogue and Orford Reefs includes an air zone that extends 3,000 feet above the site measured vertically from sea level and an aquatic zone that extends 3,000 feet seaward in state and federally managed waters [50 CFR § 226.202(b)]. Orford Reef and Rogue Reef are located over 100 miles south of the action area. Given this information, Steller sea lions may occur in the action area. Critical habitat for Steller sea lions is not designated in or near the action area.

Cetaceans. The blue whale, fin whale, humpback whale, and southern resident killer whale are all listed as endangered and occur as migrants in waters off the Oregon coast. The population status of most of these species is described in the 2007 U.S. Pacific Marine Mammal Stock Assessments (Carretta et al., 2007). According to Maser and others (1981), blue whales occur off the Oregon coast in May and June, as well as August through October. Blue whales typically occur offshore as individuals or in small groups and winter well south of Oregon. Fin whales also winter far south of Oregon and range off the coast during summer. Whaling records indicated that fin whales are harvested off the Oregon coast from May to September. Humpback whales occur primarily off the Oregon coast from April to October with peak numbers from June through August. Green and others (1992) observed 35 humpback whales near Heceta Bank (approximately 15-30 miles off the Oregon coast in Lincoln and Lane counties) in June 1990. They noted that humpback whales were particularly concentrated in Oregon along the southern edge of Heceta Bank and found this species primarily on the continental shelf and slope.

The southern resident killer whale population contains three pods (or stable family-related groups)—J pod, K pod, and L pod—and is considered a stock under the Marine Mammal Protection Act. Their range during the spring, summer, and fall includes the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Their occurrence in the coastal waters off Oregon, likely transiting between Northern California and Washington, has been documented. Little is known about the winter movements and range of the southern resident stock. The southern resident population is currently estimated at about 88 whales, a decline from its estimated historical level of about 200 during the mid- to late-1800s. Critical habitat was designated for this whale in 2006 (see 71 FR 69054), but is restricted to Washington State.

Given their marine distribution and observations of use of the continental shelf off of Oregon, these cetacean species may occur in the action area.

Marine Turtles

The loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), and olive ridley sea turtle (*Lepidochelys olivacea*) have been documented off the coasts of Washington and/or Oregon either through observations at sea or strandings along the coast. The occurrence of sea turtles off the Oregon coast has been associated with the appearance of albacore and jellyfish. Albacore occurrence is strongly associated with the warm waters of the Japanese current. Because these warm waters generally occur 30 to 60+ miles offshore from the Oregon coast, these sea turtle species do not typically occur in the nearshore area. Given their wide-ranging marine distribution, these species may occur in the action area. As for critical habitat, NMFS has proposed critical habitat for the leatherback sea turtle off the coast of Oregon, which includes the action area. Otherwise, critical habitat is not designated or proposed for any of the other turtle species in the action area.

Marine Birds

The species list from the USFWS website identified the federally listed species that may occur in Lincoln County, Oregon. From this list, the EPA ascertained that the proposed Yaquina ocean disposal sites are within the range of two listed marine bird species for which USFWS has primary responsibility. These include the marbled murrelet and short-tailed albatross. Critical habitat has been designated for the marbled murrelet, but it is restricted to upland areas and does not include any marine areas, such as the proposed ocean disposal sites. No critical habitat has been designated for the short-tailed albatross.

Marbled murrelets are observed in small flocks or as individuals in the ocean and near coastal embayments throughout the year. This species is not known to utilize the sea floor at the proposed sites for foraging and feeding although prey organisms might be present in the vicinity. Marbled murrelets seem to prefer shallower waters (depth no greater than 40 feet) to forage. Because they have a preference for shallower waters, they are unlikely to be affected by the accumulation of disposed material on the ocean floor in the proposed ocean disposal sites (depth range 112 to 152 feet), and the physical disturbance associated with disposal is not likely to result in temporary decreases or displacement of foraging activity.

The short-tailed albatross was historically hunted for feathers; the current primary threat to its continued existence is posed by a catastrophic volcanic or weather event at one of the small handful of breeding locations in Japan. The short-tailed albatross may occur in the vicinity of the proposed ocean disposal sites during the summer months and may utilize the waters for foraging and feeding.

Terrestrial Birds and Invertebrates

The USFWS identified two listed terrestrial bird species and one listed invertebrate species for Lincoln County, Oregon (see Table 1). Critical habitat has been designated for the western snowy plover (70 FR 56969) and the northern spotted owl (57 FR 1796), but no designated critical habitat for either species is located in the action area. Western snowy plover breeding and feeding occur on beaches rather than in open water. Therefore, the western snowy plover is not expected to be present within the action area. Since the northern spotted owl is not aquatic, and would not be at the proposed ocean disposal sites, this species would not be affected by the EPA’s action. The Oregon silverspot butterfly occupies coastal headlands or Coast Range peaks that provide specific habitat features of its host plant, the early blue violet (*Viola adunca*). There is no suitable habitat present for this species within the action area.

ASSESSMENT OF EFFECTS

In reviewing the potential effects of the EPA’s action (final designation of ocean dredged material disposal sites) on the ESA-listed species under the jurisdiction of NMFS and USFWS, the EPA finds that site designation itself has no direct impact on any of these species or their critical habitats. This finding is supported by the EPA’s analysis that site designation does not create or confer rights on any person to use a designated site upon the effective date of site designation. Persons or entities who seek to use a site must first obtain a federal permit, or in the case of the USACE, meet the substantive permit requirements, in order to actually use a designated ODMD site. This process would include meeting the requirements of applicable statutes and regulations. The use of a site is managed through adherence to the SMMP, which must be finalized prior to site designation. The SMMP outlines site use requirements, monitoring protocols, and incorporates adaptive management principles for ongoing use of the site. The EPA recognizes, however, that site designation is intended to have a practical result. When sites are designated, it is expected that such sites will be used by persons or entities meeting the statutory and regulatory criteria for ocean disposal of dredged material. Consequently, and consistent with the Biological Opinions prepared by NMFS for other actions that include ocean disposal of dredged material, the indirect effects of the EPA's action may affect listed species and/or their designated critical habitat.[6]

The EPA is using NMFS' effects analysis in the most recently completed Biological Opinion in Oregon that addresses disposal of dredged material at ocean disposal sites as the basis for the following discussion. The NMFS analyzed the effects of the USACE's Operation and Maintenance program in coastal Oregon estuaries and provided a Biological Opinion to the USACE on May 28, 2010 (NMFS No. 2009/01756, hereafter referred to as NMFS 2010 BO). In that Biological Opinion, NMFS analyzed the effects of disposal to Oregon Coast coho salmon and southern green sturgeon and found the Corps' entire action (dredging and disposal) would not jeopardize the continued existence of the species or adversely modify designated critical habitat for southern green sturgeon. Included in the Biological Opinion was concurrence from NMFS that the USACE's proposed action would not likely adversely affect (NLAA) the following ESA-listed species:

a) eulachon (*Thaleichthys pacificus*)
b) Southern Resident killer whales (*Orcinus orca*)
c) Steller sea lions (*Eumotopias jubatus*)
d) blue whales (*Balaenoptera musculus*)
e) fin whales (*B. physalus*)
f) humpback whales (*Megaptera novaeangliae*)
g) sperm whales (*Physeter macrocephalus*)
h) sei whales (*B. borealis*)
i) leatherback sea turtles (*Dermochelys coriacea*)
j) loggerhead sea turtles (*Caretta caretta*)
k) green sea turtles (*Chelonia mydas*)
l) olive ridley sea turtles (*Lepidochelys olivacea*)

The pathways of effect for the EPA's proposed Yaquina North and South site designation are the same as in the NMFS 2010 BO, however, the scale and magnitude of the effect is significantly less because this action is narrowed in scope to only address disposal at the Yaquina North and South sites. Since the NMFS' 2010 Biological Opinion was finalized, the status of the species has remained the same. However, NMFS has since designated critical habitat for Pacific eulachon and proposed critical habitat for leatherback sea turtles. As mentioned above, the action area occurs in proposed critical habitat for leatherback sea turtles.

Indirect Effects of the Action

Potential physical, biological, and chemical effects from disposal of dredged material at the North and South sites are: 1) increased suspended sediments; 2) increased concentration of contaminants; 3) modification of bottom topography; and 4) loss of invertebrate and vertebrates from convective descent or burial.

Water Quality – Increased Suspended Sediments. Increased turbidity would occur when dredged sediments are disposed at the North and South sites. Turbidity can reduce primary and secondary productivity, and at high levels can injure or kill adult and juvenile fish, and interfere with feeding (Bjornn and Reiser 1991, Servizi and Martins 1991, Spence *et al.* 1996). Turbidity is expected to dissipate

[6] 1) Designation of the North and South Umpqua River Ocean Disposal Sites. Completed March 20, 2009; NMFS No. 2008/05438; 2) Designation of the Rogue River Ocean Disposal Site. Completed March 19, 2009; NMFS No. 2008/05437; 3) Siuslaw River Ocean Dredged Material Disposal Site Designation. Completed April 21, 2010; NMFS No. 2009/04136.

quickly, within 5 to 30 minutes, due to the relative density of the sandy dredged material and dispersive water column currents. Suspended sediment is not likely to migrate outside of the North and South sites because they have a 500-foot buffer distance from the perimeter of the site to keep material within the designated area. Primary production is not likely to be reduced given the short period of time which light penetration is reduced. Fish that may be at the site during disposal are likely to be flushed out of the area from convective descent forces or pushed to the seafloor.

Water Quality – Increased Chemical Contamination. All entities that intend to dispose of material at the Yaquina North and South sites must conduct sediment sampling in accordance with the Sediment Evaluation Framework (SEF 2009). The primary user of the sites would be the USACE and they conduct sediment sampling and analysis of Yaquina sediments on a five-year cycle. All samples are submitted for physical analysis including total volatile solids. Select samples containing higher percent fine-grained material are analyzed for metals, TOC, pesticides and PCBs, phenols, phthalates, and miscellaneous extractables, PAHs, and organotin. Although trace levels of various heavy metals, PAHs, and other compounds do occur with the sediments; these concentrations are consistent with historical sampling results and meet the guidelines established in the SEF for unconfined in-water disposal. Therefore, although trace levels of various heavy metals and other compounds would occur with the dredged sediments, these levels would not exceed concentrations harmful to organisms occupying the action area.

Physical Habitat Modification - Bottom Topography. Disposal would affect bottom topography by elevating the height of the seafloor. From the USACE's modeling, the seafloor can accrete 14 feet of material without altering the wave climate. The USACE conducts annual bathymetric monitoring which are compared to surveys from the previous year and to the baseline survey in 2001 to monitor changes and trends in bathymetry to ensure site capacity is not exceeded or surface wave height impacted. The Yaquina North and South sites are relatively deep (112 to 152 feet) which essentially removes the material from the Newport littoral cell. Material may be re-suspended and brought into the littoral cell only on extreme storm events. The annual assessment report prepared by the USACE and provided to the EPA indicate that the Yaquina 103 North site is behaving as expected and will be able to receive dredged material for at least another 10 years. The Yaquina South site has not been used for disposal yet, thus, it would have 20 years of capacity. In the Yaquina North site there are some discrete areas that have accreted 12 feet over the last 10 years of disposal (Figure 11). These are discrete areas in the Northern half of the Yaquina North site. The southern half of the Yaquina North site has areas that have not changed in depth and some areas that have accreted up to 2 feet. This accretion can be attributed to disposal during 2009 and severe storm events rearranging the seafloor sediments.

Currently, the USACE provides an annual disposal plan to the dredge operator. The disposal plan includes several instructions that minimize impacts to benthic fauna while also minimizing impacts to the wave climate. These instructions include: 1) the dredge will be continuously moving during disposal to avoid point-dumping of material. Point-dumping would create a large mound that would likely kill all organisms beneath it (as discussed in Bolam and Rees (2003)). Consequently, moving the dredge during disposal at these depths, creates a layer of sand on the seafloor that is 2 to 7 cm thick;[7] 2) the dredge would follow a new path for each disposal to avoid multiple disposals at one location; and 3) the dredge would follow the disposal plan which shows where material is to be disposed of throughout the site in order to keep the bathymetry somewhat even over time. These measures reduce the degree to which bottom topography changes, thus, there is likely no effect on fish or invertebrates because the site retains the same physical parameters (sediment grain size, temperature, dissolved oxygen, etc.) as prior to disposal.

[7] The estimates of the thickness of the disposal layers is based on modeling conducted by the USACE for both the dredge Yaquina and dredge Westport disposing in 100 feet of water. Maximum mound height for 90% of the disposal area during one disposal is expected to be less than 3 cm. Additional modeling information is available in section 6 of Appendix B to the Environmental Assessment.

Figure 11. Bathymetric difference plot showing changes in the elevation of the seafloor between 2001 baseline survey and the 2010 baseline survey.

Loss of Individuals – Convective Descent. The disposal of sand is likely to expose all organisms in its descent path to adverse physical conditions. The sand would move through the water column rapidly at a descent rate of 11 feet/second to start with and 7 feet/second near the end of the load. As water is added to the dredged material to help wash it out of the hopper, the slurry mixture becomes more neutrally buoyant and descends at a slower rate. There is potential for any planktonic organisms in the path of this material to become entrained within the material and carried to the bottom. Pelagic species are likely to try and avoid the descending material, but some are reasonably certain to be entrained and convected to the ocean floor with the sand. An unknown number of individuals of various vertebrate and invertebrate species are likely to be exposed and adversely affected by this material.

Fish species that are forage for salmon and green sturgeon may also be impacted by this action due to the sand descending through the water column. In addition to various invertebrates, green sturgeon appear to be opportunistic foragers and feed on various fish species, such as lingcod (Dumbauld *et al.* 2008), herring (Erickson and Hightower 2007), sand lace and anchovies (Moyle 2002) that may also be adversely impacted by the disposal. Adult coho salmon may also forage on similar pelagic species. Individuals of these forage species may be physically harmed by the disposed dredged material. Typically, these fish are smaller species that are less likely to avoid physical harm than larger and faster swimming species. Although the precise number of forage fish impacted is difficult to estimate, disposal would not significantly deplete the overall abundance of forage available to coho salmon or southern green sturgeon. Forage fish are not limited in number and are well distributed such that the impact of the disposal is localized relative to the surrounding habitat.

Loss of Individuals – Burial. The deposition of 2 to 7cm of sand on the seafloor would bury the infauna even further and bury epifauna invertebrates residing on the seafloor. However, because this is a relatively thin-layer of sand being deposited on the seafloor, organisms such as adult Dungeness crab, gastropods, amphipods, and polychaetes are capable of vertically migrating through such a sandy layer and likely surviving (Maurer et al 1982, Miller et al 2002, Pearson et al 2006, Bolam 2011). Studies have compared survival from burial using fine to coarse grain size sediment (silt to sand) and in all cases concluded that species have a higher degree of survivability with material similar in nature to that being deposited and when the material is sandier (greater interstitial spaces to allow for movement and oxygen for organisms) (Maurer et al 1982, as discussed in Schratzberger et al 2000; Wilber et al 2007, Ware et al 2010). For this proposed action, the material being deposited at the sites is similar in nature to the surrounding material. The Yaquina North site is 98% sand (grain size 0.195 to 0.213 mm) compared to 97% sand at the background stations (0.171 to 0.308 mm). Reestablishment of infaunal activity from vertical migration is likely to occur. Miller et al (2002) found that a tube-dwelling worm and a gastropod re-established themselves at the surface after 48- and 8 hours, respectively. However, Miller et al (2002) also found that a sessile, suspension-feeding polychaete could not withstand 2 cm of deposition. Chang and Levings (1978) (as discussed in Maurer et al 1981) found that Dungeness crab vertically migrated to the surface in less than one day after burial by 10cm or less of sand.

Invertebrate communities would also be re-established from larval settlement and/or immigration from surrounding undisturbed areas. For juvenile flatfish this may take up to a year while amphipods and other shorter-lived benthic invertebrates may only take 6 to 9 months. The result would be a potential change in the prey availability for a few days or up to a year. Further, it is possible that a slight, temporary increase in available forage may occur after disposal because of benthic prey species in the dredged material being deposited at these sites.

Effects to ESA-Listed Species

Considering the discussion of potential effects above, the EPA determines the indirect effects from the proposed action are not likely to adversely affect the following species:

a) LCR Chinook salmon
b) UWR Chinook salmon
c) Snake River spring/summer-run Chinook salmon
d) Pacific eulachon
e) Steller sea lions
f) Southern Resident killer whales
g) blue whales
h) fin whales
i) humpback whales
j) sperm whales
k) sei whales
l) leatherback sea turtles
m) loggerhead sea turtles
n) green sea turtles
o) olive ridley sea turtles
p) marbled murrelet
q) short-tailed albatross

In addition, the EPA concludes that the indirect effects of the proposed action are not likely to adversely affect proposed critical habitat for the leatherback sea turtle. For the aforementioned species and critical habitat, the EPA provides the following discussion as to why these species are not likely to be adversely affected. Following that discussion, the EPA provides further analysis of effects for the two ESA-listed species that are most likely to be found in the action area, OC coho salmon and southern green sturgeon, including the designated critical habitat for southern green sturgeon (see below).

LCR, UWR, SR spring/summer-run Chinook Salmon

Adults of these three ESA-listed species of Chinook salmon have been found off of Newport, Oregon, thus, they may be found in the action area. However, the EPA determines that the effects of the proposed action are highly discountable because of a lack of co-occurrence in the same space and time when disposal occurs (up to 32 days per year). These fish are highly dispersive once they leave the Columbia River so it is unlikely that large numbers of them would be found at one time in the action area. In addition, these fish are likely to be adults that are using areas further offshore than the action area. If an individual would be in the action area during disposal, any effect to themselves or prey would be insignificant given they have a wide array of pelagic prey resources available to them and that they are large fish that have sufficient darting and swimming speeds to escape the plume of material (see discussion item #4 in "Effects to Oregon Coast coho salmon and southern green sturgeon" section below for specifics about swimming speeds).

Pacific Eulachon

According to the NMFS' analysis supporting the listing of the Southern DPS of Pacific eulachon, the most significant threat to eulachon and their habitats are changes in ocean conditions due to climate change (75 FR 13018). Impacts associated with disposal of dredged material were not identified as a threat to eulachon. The indirect effects of the EPA's site designation would result in physical disturbance to the water column and turbidity which may have impacts to eulachon, if they were present. However, these effects are discountable because of a likely lack of spatial and temporal overlap between disposal actions (which only occur up to 32 days per year) and individual fish (which are wide ranging and any specific habitat associations in the nearshore Pacific Ocean are not known at this time).

Marine Mammals

Steller sea lions. The action area is not located near identified haul out or rookery sites for Steller sea lions. Steller sea lions may be in the action area as they migrate along the Oregon Coast, however, due to the large size of these animals, their predisposition to avoidance of human behavior, and their reliance on a wide range of food including larger forage fish, any effect to an individual or prey resources would be insignificant.

Cetaceans. The blue whale, fin whale, humpback whale, sei whale, sperm whale, and southern resident killer whale may occur off the Oregon coast but are typically farther from shore than the action area because they prefer deeper depths. The infrequent use of the nearshore area by these species combined with the relatively few days out of the year that disposal would occur makes any potential effect to an individual discountable. Potential effects from vessel traffic are also discountable because of the following: 1) vessels would only travel close to shore within 3nm, which is shallow water that is not preferred by such species; 2) dredges are slow-moving vessels at speeds of approximately 10 knots; 3) dredges follow a predictable course; 4) dredges do not target cetaceans; and 5) cetaceans should easily detect the dredge and avoid it.

Marine Turtles

Loggerhead, leatherback, olive ridley and green sea turtles may occur within the action area, however, these effects are likely to be discountable or insignificant because: 1) Sea turtle occurrence is rare (NMFS 2007 a, b, c, d). Dredge vessels are slow moving vessels such that they would have a discountable potential for interaction with these sea turtle species. Vessel strikes of sea turtles by dredge vessels are extremely unlikely. Available data indicate that vessel strikes are more likely with vessel types that travel at speeds greater than 13 knots (Laist et al. 2001, Jensen and Silber 2003). Dredge vessels moving through the action area would operate at slow speed (10 knots) and follow a predictable course (direct line of travel). Thus, as concluded above for marine mammals, the potential effects from vessel strikes are therefore discountable.

Critical Habitat Determinations Leatherback Turtle. The PCEs that NMFS identified as essential for the conservation of leatherback turtles when it proposed to revise critical habit to include marine waters off the U.S. West Coast, including the action area, are: (1) A sufficient quantity and quality of their jellyfish prey; and (2) migratory pathway conditions that allow for safe and timely passage to, from, and within high use foraging areas, including areas within the action area. Any effect on jellyfish in the action area would be limited in space (a portion of the action area at any one disposal) and time (up to 32 days per year) which is insignificant to the larger scale population dynamics of nearshore and offshore jellyfish life history patterns. As for vessel traffic, the dredge vessels travel at slow speeds, such that an effect on leatherback turtle passage through this area would be discountable, given the extremely unlikely nature of leatherback turtle occurrence and the navigation of the vessel.

Marine Birds

The marbled murrelet and short-tailed albatross are known to occur in the vicinity of Oregon coastal estuaries and adjacent ocean. However, no critical habitat for these species has been designated in the action area. Disposal activities are expected to create a limited and temporary turbid environment which could cause prey fish to move out of or avoid the immediate area during a disposal event. It is also possible that minor behavioral changes by individual birds may occur (e.g., individuals could be displaced a few dozen to several hundred feet by the presence of the dredge/barge) to avoid the immediate area during and immediately following any individual disposal event. However, there is abundant suitable foraging habitat throughout the area and marbled murrelets would likely forage elsewhere during disposal activities. Such minor behavioral changes in flight or foraging activities are expected to be temporary, thus an insignificant effect to the individual.

Short-tailed albatross are not likely to forage within the action area and therefore are not expected to be affected by the proposed site designation.

Terrestrial Birds and Invertebrates

Western snowy plover, northern spotted owl, nor Oregon silverspot butterfly are likely to be present in the Yaquina action area. The EPA concludes that the proposed action will have no effect on this species or any designated critical habitat.

Effects to Oregon Coast Coho Salmon and Southern Green Sturgeon

The ESA-listed species most likely to be in the action area are OC coho salmon and southern green sturgeon. The only critical habitat designated in the action area is for southern green sturgeon. Because of their likelihood of being in the action area and the designated critical habitat, the EPA provides additional analysis on the potential indirect effects of the proposed action prior to making a determination of effect.

OC coho salmon. OC coho salmon smolts are likely to be present in the nearshore Pacific Ocean off the Oregon coast at all times of the year, not only just after they have completed their outmigration in late spring or early summer. The proximity of the action area to the mouth of the Yaquina River creates a higher likelihood coho salmon smolts exiting Yaquina River estuary could pass through the disposal sites, thereby increasing the likelihood for smolt (yearling) coho salmon to be near the discharge field of the hopper dredge vessel. Therefore OC coho salmon smolts may be exposed to sand as it falls through the water column at the Yaquina North or South sites. Adult OC coho salmon return to the Yaquina River generally beginning in early fall. Their return overlaps with disposal actions in mid-September through October.

Southern green sturgeon. The SDPS of green sturgeon follow a north and south migration route within 360 fathoms of the shore. They are known to use the estuaries in the summer while using the nearshore ocean in the winter. Given this general pattern of use, there are likely fewer subadults and adults present in the action area during disposal activities; albeit it is assumed some individuals would be present.

As for potential effects to these species, the effects discussed earlier that are carried forward into this discussion because they warrant greater analysis include: 1) increased suspended sediments; 2) reduction in prey availability; and 3) physical injury from convective descent.

Water Quality – Increased Suspended Sediments. This pathway of effect is closely linked to the discussion item #7 in the "physical injury from convective descent" section below. Please see that section in the document for this analysis.

Reduction in Prey Availability. Yearling coho salmon forage on zooplankton and small fish. Southern green sturgeon forage on benthic invertebrates and bottom-dwelling fish. Thus, prey for OC coho salmon would be affected by convective descent whereas prey for southern green sturgeon would more likely be affected by burial. A reduction in prey species is insignificant to these individuals because: (1) Prey abundance is determined by larger scale physical and biological factors which are unaffected by the proposed action; (2) the action area, and even more so the area used on a per disposal season (approximately 250 acres), is small compared to the available surrounding habitat for these prey species in the nearshore; and (3) many invertebrate prey species are capable of vertical migration through a deposition layer of 2 to 7 cm such that rehabilitation of prey species at the site is within a short period of time (days).

Physical Injury from Convective Descent. The factors important to assessing the likelihood for disposal of dredged material to adversely affect yearling coho salmon, adult coho salmon, and adult and subadult green sturgeon include: (1) presence in the action area at the time of disposal; (2) avoidance response (vessel or disposal material); (3) discharge field size; (4) fish swimming speed and the material's descent rate; (5) quantity and weight of the material; and (6) physical interaction of the fish and the material. The avoidance response from the disposal is considered first because if the fish can avoid the exposure, then there would not be physical consequences. If the fish cannot avoid the activity, then the other factors are important for the response to this exposure. Material would be disposed at the Yaquina North and South sites using a hopper dredge. Disposal creates a discharge field from the bottom of the vessel hull to the bottom of the disposal area.

(1) Presence. It has been established in prior sections that smolt and adult OC coho salmon are likely to be present in the action area during disposal. If subadult and adult southern green sturgeon are present in the action area during disposal, they would likely be in low numbers given their use of the estuaries during summer months.

(2a.) Avoidance Response - vessel detection. For a fish to avoid the disposal material it must first detect and react to the approaching disposal vessel. An early detection and avoidance response to a vessel would increase the probability a fish could avoid the disposal material descending around them. Behavior studies related to other water vessels would suggest that unless coho salmon are near the surface, they are unlikely to react to a ship passing above them (Satterthwaite 1994). Fernandes *et al.* (2000) contend fish do not avoid survey vessels in their study of vessel avoidance by herring. There is no clear conclusion with this premise based on study results for other species (Gerlotto and Freon 1992; Misund 1996, 1993; Jorgensen *et al.* 2004). In these other studies, vertical and horizontal avoidance responses were observed where some fish reacted to the noise of the vessel by diving, others moved horizontally from the noise, and some moved away ahead of the vessel. Based on the conflicting results, it is likely that not all coho salmon or southern green sturgeon (if they would happen to be near the surface which is unlikely) would react to the vessel and move away from the discharge field.

(2b.) Avoidance Response – disposal material. It is unknown whether OC coho salmon or southern green sturgeon would elicit an avoidance response to the disposed material. It is likely the fish would detect the descending material and would attempt to evade the material because the fish would likely perceive the material as a threat. Based on the observed ship avoidance response research, it is possible that the initial movement by the fish would be to dive and then initiate horizontal evasion. The determining factor then would be whether the fish can swim fast enough to move out of the discharge field.

(3) Discharge field size. The size of the discharge field is primarily determined by the size of the dredge material disposal vessel, the volume of disposal material, the depth of water, and the length of the disposal run, although water depth appears to be the most significant variable in determining overall discharge field size. In-water disposal by hopper dredge would create a discharge field from the bottom of the vessel's hull to the ocean floor. The depths of the Yaquina North and South sites range from 112 to 152 feet, which are deeper than most disposal sites on the Oregon Coast. As dredged material is released from a hopper dredge, it falls through the water column and mixes with the ambient water to create a plume. This process is called convective descent and it is anticipated that the greatest risk to pelagic fish species occurs when these organisms interact with this descending column of dredged material. The discharge field during each disposal run would vary based on the depth during disposal; with the volume of water exposed increasing with depth.

NMFS determined the convective descent column in their May 28, 2010, Biological Opinion. Those values were based on a 60-feet depth. Even though the Yaquina North and South sites are twice this depth, OC coho salmon smolts are likely only occupy the upper 54-feet of the water (Brodeur et al 2004). Thus, these values, as they pertain to the dredge *Yaquina*, are still relevant for calculations regarding the area potentially affected by disposal material for this proposed action. The beam of the dredge ship *Yaquina* is approximately 58 feet wide. The disposal plume would begin at approximately -16 feet (bottom of hull) and be approximately 10 feet in diameter. As the plume descends to the bottom (-60 foot depth), the radius of the plume would be approximately 92 feet.[8] This discharge field would extend along the travel route.

The amount of dredged and subsequently disposed material depends on many factors including the sediment characteristics and dredging conditions. While the specific volume of sediment dredged may vary at any given time as a result of these variables, the goal of any dredging operation is to work as efficiently as possible to complete the job. Therefore, for the purposes of this analysis, a "typical" volume of dredged material disposed during a single disposal event is considered approximately 800 cy for the *Yaquina*[9]. The volume of water exposed during disposal of this amount of material then is approximately 25,000 m^3 for the *Yaquina*.

Spatial overlap between fish and the discharge field. The distance from the bottom of the hopper dredge to the surface of the water would vary depending on the specific dredge and how loaded the dredge is and would change as the material is discharged into the disposal location. Fish occurring near the water surface, above the discharge doors, would not be exposed to the material. However, the hopper dredge would start rising as dredge materials are released thereby increasing the area of the discharge field throughout most of the water column. Off of the Oregon coast, yearling coho salmon were collected in surface trawls that sampled from the surface down to 54 feet below the surface (Brodeur *et al.* 2004). Green sturgeon may use various portions of the water column, but are likely at a much deeper depth than the coho salmon. Erickson and Hightower (2007) observed green sturgeon typically occupying depths from 130 to 230 feet, making occasional rapid ascents toward the surface.

(4) Fish swimming speed and material's descent rate. Successful avoidance will depend on the swimming speed of the fish, the distance it must travel to get outside the discharge field, and the descent speed of the dredged material. Yearling coho salmon are approximately five inches in length when they enter the ocean. Their "darting" or "burst" swimming speed, the likely response when the disposal material is detected, is estimated at 4 to 5 feet/second (Bell 1990). The darting speed of adult coho salmon may exceed 20 feet/second (Bell 1990). The darting or burst speed of southern green sturgeon is unknown. Cruising speed, a sustained swimming speed, for green sturgeon is estimated at 1 body length/second (Niggemyer and Duster 2003). Darting or burst speed would likely be higher than this, possibly twice as fast. Adult green sturgeon captured in various research studies range from 3.9 to 7.4 feet in length (Moser and Lindley 2007, Erickson and Webb 2007). Subadult green sturgeon enter the ocean environment when they are approximately 3-years old and approximately 2.5 feet long. Based on the

[8] Calculations are taken directly from NMFS' Biological Opinion for the USACE (May 28, 2010).
[9] 800 cy was the value provided to NMFS by the USACE for the analysis in the 2010 Biological Opinion.

body lengths, burst speed for adult green sturgeon of this reported size would be 8 to 15 feet/second (2 body length/second) and 5 feet/second for small subadults.

Relationship between the discharge field and fish - OC coho salmon. The predictions by the USACE (the primary user of the Yaquina North and South sites) of the initial plume velocity just before impact will reach 11 feet/second (at a 60-foot disposal site depth). They also predict material last to leave the hopper to have a maximum velocity of 7 feet/second because the slurry mixture would have a greater proportion of neutral buoyant water. Assuming a central location in the discharge field (29 feet from edge of the field) and direct movement to the edge of the field, it would take a yearling coho salmon 5.8 seconds to traverse to the edge of the plume. The maximum time a fish can sustain a darting speed is 5 to 10 seconds. The yearling coho salmon may not be able to reach the edge of the plume in the allotted time, even if they choose the correct direction and move directly toward the edge. With the material descending at 7 to 11 feet/second, it would be challenging for the yearling coho salmon to avoid the descending plume. In 5 seconds the plume would descend 35 to 55 feet.

Conversely, adult coho salmon have a high likelihood of reaching the edge of the discharge field ahead of the plume due to their speed. Based on a central location and given a darting speed of 20 feet/second, an adult coho salmon would reach the edge of the 58-foot wide field in slightly over 1 second.

Given that the fish cannot sustain darting speeds for longer than five seconds; the fish may also have to rely on sustained speed to avoid the plume. The sustained speed of a five-inch yearling coho salmon is predicted to be 2.1 feet/second (Bell 1990). It would require almost 14 seconds for the fish to reach the edge of the 58-foot wide plume if they started in the center of the plume. In 14 seconds the plume would descend 98 to 154 feet. The Yaquina North and South sites range in depth from 112 to 152 feet. So, only if the fish were at the bottom, which is unlikely, could it potentially evade the plume.

The expectation is that given these swimming speed challenges and the descent rate, many yearling coho salmon are not going to be able to avoid the disposal plume. Yearling coho salmon may be exhibiting schooling behavior; therefore, numerous fish may be exposed at one time. Typical avoidance response may also include an initial dive to avoid the material and then horizontal movement, thus losing time to evade the descending material. Based on this discussion, it is likely that adult coho salmon can evade the sediment plume, but some of the yearling coho salmon would occur in locations relative to the discharge plume and not be able to avoid the descending material.

Relationship between the discharge field and fish – southern green sturgeon. The affects to southern green sturgeon are likely different. For green sturgeon, the assumption is that they would be at deeper depths, so, using a plume radius of 92 feet at a 60-foot depth (much shallower than the proposed action area), these fish may reach the edge of the discharge field in 6 to 12 seconds (using burst speeds). It would take the material 5.5 to 8.6 seconds to reach 60-feet. Therefore, they may be able to avoid the plume at those depths. Considering the disposal sites are at a minimum twice as deep as used in the calculations in NMFS' 2010 Biological Opinion, the material would take longer to reach the seafloor which would give the fish more time to evade the plume. Even if a fish swam to the edge of the plume, it would experience much lower suspended sediment concentrations than what would occur at the surface.

Whether relying on burst or sustained speed the green sturgeon occupying the deeper depths of the water column have more time to detect the descending sediments and initiate an avoidance response. Subadults at a length of 2.5 feet would have a sustained swimming speed of 5 feet/second could potentially avoid the descending plume, if the disposal was in depths greater than 120 feet. At depths between 112 to 120 feet, the subadult green sturgeon may not be able to completely avoid the plume.

5. Quantity and weight of dredged material. Disposal quantities and discharge time are important variables to consider while assessing the likelihood for OC coho salmon juveniles or small subadult southern green sturgeon to be adversely affected through a physical injury from disposal material. Based on the previous discussion, there is potential for exposure to this disposed material for yearling coho salmon and small subadult green sturgeon. The *Yaquina* dredge capacity is 1,042 cy, however, the USACE used a value of 800 cy per load as an estimate of a volume in a typical disposal load for the purposes of calculating the volume of water exposed to the disposal plume. A cubic yard of wet sand may weigh as much as 4,000 pounds (lbs). At 800 cy of sand, a maximum of 3,200,000 lbs of material may be discharged during a single event. If a typical load on the *Yaquina* is discharged over a period of five minutes, this equates to over 10,000 lbs per second of discharge. The amount and weight of this material is significant for a small fish to resist from being entrained by the descending material and dragged down to the ocean floor. The quantity of dredged material displaces a large volume of water; therefore, if some fish are pushed ahead of the discharge plume they would be entrained within the vortices of the turbulent flow. In order to assess the physical risk posed by the exposure to disposed dredge material the physical interaction between the fish and the material is of most interest.

6. Physical interaction between fish and disposed dredged material. There is a high degree of uncertainty regarding the response and risk of fish exposed to disposed materials because it has not been specifically studied in situ or in the laboratory with these species. Again, the EPA is using the analysis provided by NMFS in the USACE May 2010 Biological Opinion for this discussion. The analysis follows the assumption that listed species are subject to physical risk. Being subject to such risk creates numerous potential outcomes: (1) Allow the material to move around them and only be pulled down by the material but not injured; (2) be pushed ahead of the plume due to a boundary layer and then laterally as the plume reached the ocean floor; (3) be moved aside by the material; or (4) be carried along with the downward movement of the sediment and buried under the deposited material or experience physical abrasion of their epidermis.

These potential interactions may lead to adverse affects for OC coho salmon and southern green sturgeon and are addressed individually. The first outcome described above would require the fish to spend a length of time surrounded by dredge material and would result in the respiration of this material past the gills. Very high concentrations of suspended sediments would occur within the water column of the plume. Physical damage to gill membranes is the likely result of this exposure to the material and the subsequent increased probability of indirect effects of disease and infection would lead to increased mortality. The second and third outcomes described above are also likely to lead to similar adverse physical effects. The fluid dynamics and characteristics of the plume result in significant turbulence of the water along the edge and within the plume. A fish caught in this turbulence and the collapse phase of the discharge field would be entrained in an environment with very high suspended sediment concentrations for a time that would require the fish to respire this damaging sediment. In addition to the gill damage, some fish are likely to receive abrasion from material passing around them that would remove some of the protective epidermal mucus or when they are forced down to the ocean floor, which is most likely the point where mucus would be removed. Whether the fish is forced into the ocean floor or pushed along the bottom with the collapsing front of the plume, the fish would likely have physical abrasions that are susceptible to secondary infections. The fourth outcome would cause disorientation of a fish caught in the turbulence of the plume. These fish are likely to be more susceptible to predation due to the disorientation. It is likely that yearling coho salmon could be susceptible to increased predation or physical harm to the fish from either becoming entrained and buried in the material when it settles on the ocean floor; respiring high concentrations of suspended sediments; being physically abraded by the material; and/or harmed by collision with the bottom substrate.

The outcomes discussed above are likely for OC coho salmon smolts. For adult and subadult green sturgeon that are likely less sensitive to turbidity and suspended solids than OC coho salmon smolts, it is likely that these elevated suspended sediment concentrations would result in insignificant behavioral and physical response due to the higher tolerance of green sturgeon, which usually inhabits much more turbid environments than do salmonids. Erickson and Hightower (2007) observed green sturgeon typically occupying depths from 130 to 230 feet and making occasional rapid ascents toward the surface during their migration journey. Thus, green sturgeon are likely to be found near the seafloor in the action area. If green sturgeon are occupying the deeper depths, they would likely be exposed to lower turbidity levels because much of the fine material will have suspended higher in the water column. Because southern green sturgeon have higher tolerances for suspended sediment, the plume would last a short period of time (30 minutes), they are less likely to be mid-water column and subjected to significant convective descent forces, and the concentration is expected to be much lower near the seafloor, their normal behavioral patterns are unlikely to be disrupted such that the effects would be insignificant.

The physical force of the dredged material is also likely to have an insignificant affect on the individual because of their location at the seafloor and the disposal operations would limit the force per square inch to such levels that the fish would not be adversely affected. They may experience the sediment deposition on top of them but they are likely to unbury themselves and return to normal feeding and migratory behavior.

Numbers of fish exposed

OC coho salmon. The following discussion and analysis are as those calculated by NMFS in their 2010 Biological Opinion to the USACE. Since NMFS has conducted this analysis for the same action, the EPA is using that analysis for this biological assessment. As stated by NMFS, and the EPA agrees, the analysis concludes with estimates that are at the upper limits of the magnitude of effect. The EPA is providing this to NMFS to assist NMFS with their jeopardy analysis. However, it is important to note that due to the uncertainty associated with these methods, these values should be considered upper-end estimates and are not precise. There is a range of adverse effects based on day-to-day abundance of yearling coho salmon in the action area. This analysis builds upon conservative assumptions for the purpose of understanding the potential magnitude of the adverse effects from disposal of dredged material.

Estimating the number of individual fish adversely affected by ocean disposal activity is difficult because the number of fish in the disposal areas would vary from day to day; the number of individuals moving into the site between loads is unknown; and the habitat condition varies from season to season. In addition to habitat condition determining yearling coho salmon abundance, on a daily basis during the months of coho salmon outmigration, smolts would be passing through the action areas to enter the ocean and moving into and through the disposal areas. Accurate estimates of the number of OC coho salmon impacted are not possible, but would be estimated based on assumptions related to abundance, habitat conditions, and reoccupation rates. For the purposes of this discussion, the EPA is using the information (as contained in the NMFS 2010 Biological Opinion) obtained from Global Ocean Ecosystem Dynamics (GLOBEC) and the Northwest Fisheries Science Center (NWFSC) cruises off the northern California and Oregon coasts to determine relative abundance of coho salmon in the nearshore Pacific Ocean off the coast of Oregon (NWFSC 2000 and 2002 as cited in NMFS' 2010 Coastal BiOp). This information was used to estimate the likely number of yearling coho salmon exposed to the disposed dredge material in the action area.

These estimates are not exact; however, they provide a relative estimate of the potential impact from ocean disposal on coho salmon, allowing NMFS to better evaluate these impacts and inform the final jeopardy analysis. It is likely that the individuals in the area of disposal would avoid direct exposure to the discharge plume by: (1) avoiding the ship; (2) randomly being positioned in the action area away from the direct path of the ship; (3) exhibiting some avoidance to the discharge field due to their position in relation to the discharge plume; and (4) being randomly near the edge of the discharge field thereby facilitating avoidance. However, a conservative assumption is to assume that all coho salmon directly exposed to the convective descent phase of in-water disposal would be adversely affected. Based on the NWFSC data an estimated 45.06 coho smolts/1,000,000 m3 may be present offshore of Yaquina Bay (NWFSC 2000 and 2002 as reported in NMFS 2010).

The total maximum number of fish that may be exposed to dredged material disposal is based on the water volume exposed to a disposal event and the density of coho salmon smolts in the ocean. Given that the NWFSC only found smolts in the upper 54 feet of the water column, the estimates provided by the USACE and incorporated in NMFS 2010 for a 60-foot depth disposal site are valid here as well. No evidence exists to provide an assessment as to whether individuals from adjacent ocean areas may move into or out of the Yaquina North and South site between disposal loads, whether within the same day or different days. If fish leave the area due to an avoidance of the discharge field, some of these individuals, or others nearby, are likely to reoccupy the disposal site after some short, but uncertain period of time. When disposal is occurring during the months when OC coho salmon smolts are entering the ocean, there is a higher likelihood that these individuals may enter the ODMD sites immediately upon ocean entry. When disposal occurs after most OC coho salmon smolts have completed outmigration, yearling coho salmon may still be present, residing in the nearshore ocean for several months before migrating north but likely in lower abundances (NWFSC 2000 and 2002 as cited in NMFS 2010).

Assuming that the disposal areas repopulate between loads, the total maximum number of yearling coho salmon exposed to the disposal activities is based on the upper limit number of coho salmon that could occupy the action area multiplied by the number of disposal loads that occurs at each ODMD site. This assumption is based on the expectation that the turbidity plume and the ship activities related to disposing the material would not dissuade fish from moving back into the area between loads. While it is unknown how many coho salmon would move into the action area after each daily operation, it is assumed that reoccupation for the purpose of estimating maximum extent of potential effect.

There would be variability in the number of fish adversely affected. In 2000, more coho salmon yearlings were captured in the trawls in August than June (Brodeur *et al.* 2004). In the combined data reviewed for the two years of trawl data, the abundance of coho salmon yearlings varied and for most stations the average abundance was highest during June (NFWSC 2000 and 2002 as cited in NMFS 2010). The June densities represented the highest abundance based on the outmigration of coho smolts from the rivers and the combined two years of ocean trawl data. It is likely that fewer coho salmon are exposed in September and October when the majority of the yearling coho salmon have migrated north.

The maximum estimate of the number of OC coho salmon injured or killed from disposal operations at Yaquina North and South sites is 469 smolts per year.[10] For the additional dredging at the marina that may occur every five to eight years, an additional 177 smolts per year, may be adversely affected.

These calculations use the maximum volume of material and dredge days as provided by the USACE as conducted in the last 10 years. This level of effort and related volumes are not likely to increase due to expected, limited Congressional funding for dredging in the foreseeable future. This estimate can be considered the maximum number for the USACE disposal actions in addition to other users of the sites. Given that disposal efforts fluctuate year-to-year based on natural shoaling processes and funding, it is unlikely that the estimated number of individuals adversely affected in any one year would continue year after year, but rather, would potentially occur every decade or even less frequently than that.

[10] This number is lower than what was calculated in NMFS 2010. EPA used the following values to reach this number: maximum volume of dredge material of 320,450 cy (based on 2001 to 2011 volume of material disposed at the Yaquina North ODMD site); 32 days of disposal per year; and 13 loads per day (based on 800 cy per load).

Southern green sturgeon. The population abundance of southern green sturgeon is unknown (Adams *et al.* 2007). From what is known about their migratory behavior, they would likely be in the estuaries during summer and in the nearshore during fall and winter. In addition, they either would be traveling through the action area at a high rate of speed or in feeding aggregations. Given their seasonal use of the action area that only overlaps with potentially 6 days of disposal in April and May and then disposal in September and October, their abundance is likely to be low with the majority of individuals using coastal estuaries for feeding. The likelihood that many sturgeon are in the coastal estuaries rather than along the coast during the disposal period, makes the likelihood of an effect discountable. If an individual was present during disposal or potentially feeding, the effect would be insignificant on the individual because: (1) the southern green sturgeon do not spawn in any of Oregon coastal river basins, and therefore, small juvenile green sturgeon are not likely to be present. Larger green sturgeon have a greater likelihood of evading the plume; (2) effects on benthic invertebrates from burial are short-term and do not completely eliminate all benthic resources for southern green sturgeon; (3) the area of impact from several disposals would not meaningfully affect their prey resources because southern green sturgeon are migratory and feed upon a wide range of invertebrates and vertebrates; and (4) the larger size of the fish make them more resilient to increases in suspended sediment and elevated pressure such that any effect would be insignificant upon their behavior or themselves.

Cumulative Effects

Cumulative effects are defined as, "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). The EPA is not aware of any other future activity that would occur in the action area to consider in this analysis. No future non-federal actions have been identified that would affect ESA-listed species or their habitat.

Determination of Effect for OC coho salmon and Southern Green Sturgeon

Coho Salmon

Adult and yearling OC coho salmon are likely to be exposed to the dredged material disposal activities and some yearling coho salmon could experience adverse effects from the disposal of dredged sediments in the action area. The risk to adult coho salmon would be low based on their ability to avoid the sediment plume using their superior swimming speed. The exposure of some yearling coho salmon to the disposal material is likely inevitable based on the expectation that the fish would exhibit minimal avoidance behavior from the vessel and may exhibit avoidance behavior from the descending material but cannot swim fast to evade the descending material. It is likely that exposing yearling coho salmon could result in increased predation or physical harm to the fish from either becoming entrained and buried in the material when it settles on the ocean floor; respiring high concentrations of suspended sediments; being physically abraded by the material; and/or harmed by collision with the bottom substrate.

The number of OC coho salmon smolts exposed to the disposal of dredged material per year is based on the abundance of coho salmon smolts offshore of Yaquina Bay, the volume of water exposed during a disposal event and an assumed reoccupation of the nearshore ocean portions of the action area following each disposal event. To assist NMFS with their jeopardy analysis, the EPA is using the calculations conducted by NMFS in their May 2010 Biological Opinion for this Biological Assessment. Thus, there is the potential for 469 yearling OC coho salmon to be adversely affected by dredged material disposal at the North and South sites. Further, in those years when additional dredging and disposal occurs at the marinas, up to approximately 177 additional yearling OC coho salmon may be adversely affected. These estimates are a maximum and not likely to be attained for the following reasons: 1) this number is based on an assumption that there is an even distribution of coho salmon smolts in the ocean, which is not likely but is the best available information; 2) this number assumes the presence of coho salmon smolts is equal throughout the entire dredge disposal period, which is not likely given their seasonal movement out of Yaquina Bay which overlaps with disposal periods in April and May (6 days) and then in June; and 3) does not take into the account that some fish that are present during disposal would not be adversely affected because they would move out from beneath the dredged material.

Green Sturgeon

The southern green sturgeon likely pass through the Yaquina ODMD sites. Adult and subadult green sturgeon may inhabit the action area during their migration from their natal rivers in California to northern waters in Oregon, Washington, and Canada. The potential use, behavior and abundance of southern green sturgeon is not known for the Yaquina North and South sites. Based on general abundance, capture information, and migration routes, few southern green sturgeon may use the action area because of their preference for using estuaries during the summer (when disposal would occur) and the action area during the winter (no disposal occurring). Thus, only few numbers of individuals are likely to overlap in time and space with disposal events.

For those that do occur within the action area, there is a potential for exposure. Larger adult and subadult green sturgeon would successfully evade the sediment plume without physical injury because their faster swimming speed and occupation of deeper water depths would facilitate evasion. Subadults that may be 2.5 feet in length have a higher risk than the larger fish due to their slower swimming speed, although individuals this small should be rare given the southern green sturgeon only spawn in the Sacramento-San Joaquin Rivers and this size estimate is based on sizing fish as they leave that estuary. Thus, any effects on these smaller fish would be discountable.

Effects on the SDPS of Green Sturgeon Critical Habitat. Critical habitat for southern green sturgeon is identified as Coastal Marine Waters (within 110 meters depth). The habitat features required to support successful subadult and adult rearing and migration include food, migratory pathway, and water quality.

1. *Food Resources*. Food resource availability would temporarily decrease in the action area because of dredged material covering the substrate and any substrate dwelling organisms being buried. Disposal of dredge materials contributes a layer of unconsolidated sediment on the seafloor. In doing this, infaunal and epifaunal invertebrates would be covered with a layer of sandy sediment. The short-term deposition of this material may result in some reduction of invertebrates on the seafloor. The result would be a change in the food source and habitat available to benthic organisms in the area for a few days to up to a few months for larger benthic invertebrates and forage fish that may be killed by the disposal. Rehabilitation of the area would occur through three mechanisms: 1) vertical migration; 2) lateral immigration; and 3) larval settlement. Vertical migration in sandy substrate at depths of 2 to 7 cm has been shown to occur for Dungeness crab, polychaetes, gastropods, molluscs. Data collected from the EPA's 2008 benthic grabs and trawl surveys showed a decrease in abundance of infaunal individuals but not species at the disposal site as compared to surrounding areas immediately after disposal.

Southern green sturgeon in nearshore areas are assumed to eat similar prey species as they do in estuaries. These species include various invertebrates, green sturgeon appear to be opportunistic foragers and feed on various fish species, such as lingcod (Dumbauld *et al.* 2008), herring (Erickson and Hightower 2007), sand lace and anchovies (Moyle 2002). Similar exposure, avoidance response, and risks are likely with forage fish species as were described for the coho salmon and green sturgeon. Typically these fish are smaller species and also less likely to avoid physical harm. The number of individuals impacted cannot be estimated but it is likely that the number adversely affected would not significantly deplete the overall abundance of forage available to southern green sturgeon. Because these impacts to forage base is highly localized, the likely decrease in forage abundance is considered insignificant to the total food resources available to green sturgeon.

2. *Migratory corridor*. Some individual adult and subadult southern green sturgeon would likely experience effects from the disposal at the Yaquina North and South sites. A possible overlap in time and space with ocean disposal activity has some likelihood of occurring. Adult and subadult green sturgeon are likely to successfully evade the sediment plume without significant physical injury because their faster swimming speed and occupation of deeper water depths would facilitate evasion. Therefore, any potential effect on disruption of their migratory route would be insignificant.

3. *Water Quality*. Suspended sediment levels would be increased over background due to some fine sediment mobilized during disposal. Turbidity levels are likely to increase for a short time with the highest concentrations occurring at the ship's disposal point and dispersing from that point depending on ocean currents, disposal material size composition, wave action, dredge ship speed, and disposal rate. It is likely that suspended sediment concentrations generated by dredge material disposal would exceed the 17 mg/L effects threshold for injury as described above for salmonids, but because adult and subadult green sturgeon would be at depth where turbidity would be much lower, and inhabit much more turbid environments than do salmonids, they are likely far less sensitive to turbidity and suspended solids than salmonids. Therefore it is likely that these elevated turbidity concentrations would occur, but the exposure would be short term and result in insignificant change to this primary constituent element (PCE). For contaminants, sediments dredged from the Yaquina North and South sites are primarily large-grained sands and while trace levels of various contaminants may occur in the sediments, these levels would not exceed concentrations harmful to the organisms occupying the action area. Therefore any affects to this PCE are insignificant.

ESSENTIAL FISH HABITAT ASSESSMENT

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA) of 2006 (Public Law 109-479) and its implementing regulations at 50 CFR Part 600 Subpart K, federal agencies are required to consult with NMFS with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken, that may adversely affect essential fish habitat (EFH). An "adverse effect" is defined as "any impact that reduces quality and/or quantity of EFH." Adverse effects may include "direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH." 50 CFR § 600.910(a). The objective of federal agency consultation is to determine whether or not the federal agency's proposed action "may adversely affect" designated EFH, i.e. those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity, for fish species regulated under a federal Fisheries Management Plan (FMP). If, as a result of the consultation, NMFS determines an action would adversely affect EFH, NMFS then determines whether or not Conservation Recommendations are needed. Conservation Recommendations are non-binding measures designed to "avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from actions or proposed actions authorized, funded, or undertaken by [a federal] agency." 50 CFR § 600.905(b). If NMFS determines Conservation Recommendations are needed, NMFS notifies the Federal agency of the determination and of the recommendations. Federal agencies are required to provide a written response to NMFS after receiving Conservation Recommendations. MSA § 305(b)(4)(B). The federal agency response must describe the measures the agency proposes for avoiding, mitigating, or offsetting the impact of the activity on EFH or must explain its reasons for not following the recommendations provided by NMFS. 50 CFR § 600.920(k)(1).

Table 9 provides a list of species with designated EFH in the vicinity of the proposed Yaquina ocean disposal sites. The NMFS conducted groundfish stock assessment studies in the areas offshore of California, Oregon, Washington, and southern British Columbia triennially from 1977 to 2001 (Weinberg et al., 2002). The 2001 assessment collected data from depths ranging from 55 to 500 meters and provides useful information on the distribution of groundfish species. A detailed discussion of EFH for groundfish is provided in Appendix B of Pacific Coast Groundfish Fishery Management Plan as amended through Amendment 19 (PFMC 2006a). The report includes life history descriptions (Part 2), EFH text descriptions (Part 3), and habitat suitability maps for groundfish species of the Pacific Coast with associated life history stages. The most recent groundfish Stock Assessment and Fishery Evaluation document was published in 2006 (PFMC 2006b). A detailed discussion of EFH for coastal pelagic species is provided in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan (PFMC 1998) and a Stock Assessment and Fishery Evaluation Document (PFMC 2007). The salmon EFH is discussed in the Pacific Coast Salmon Fishery Management Plan as revised through Amendment 14 (PFMC 2003). All of this information was reviewed to assess the possible impacts to these species' EFH from the proposed action.

Table 100. Species with Designated EFH Offshore from Yaquina Bay.

Commmon Name	Scientific Name	Larvae	Juveniles	Adults
		Rockfish		
Black Rockfish	*Sebastes melanops*		X	X
Blue Rockfish	*Sebastes mystinus*	X	X	X
Bocaccio	*Sebastes paucispinis*		X	
Chilipepper	*Sebastes goodie*		X	X
Darkblotched Rockfish	*Sebastes crameri*			X
Pacific Ocean Perch	*Sebastes alutus*		X	X
Quillback Rockfish	*Sebastes maliger*			X
Redstripe Rockfish	*Sebastes proriger*			X
Rosethorn Rockfish	*Sebastes helvomaculatus*			X
Rosy Rockfish	*Sebastes rosaceus*			X
Rougheye Rockfish	*Sebastes aleutianus*		X	X
Sharpchin Rockfish	*Sebastes zacentrus*		X	X
Shortraker Rockfish	*Sebastes borealis*			X
Short-spine Thornyhead	*Sebastolobus alacanus*			X
Silvergray Rockfish	*Sebastes brevispinis*			X
Splitnose Rockfish	*Sebastes diploproa*	X	X	
Stripetail Rockfish	*Sebastes saxicola*		X	X
Tiger Rockfish	*Sebastes nigrocinctus*			X
Vermillion Rockfish	*Sebastes miniatus*			X
Widow Rockfish	*Sebastes entomelas*		X	X
Yelloweye Rockfish	*Sebastes ruberrimus*			X
Yellowtail Rockfish	*Sebastes flavidus*			X
		Flatfish		
Arrowtooth Flounder	*Atheresthes stomias*			X
Butter Sole	*Isopsetta isolepis*	X		X
Curlfin Sole	*Pleuronichthys decurrens*			X
English Sole	*Parophrys vetulus*	X	X	X
Flathead Sole	*Hippoglassoides elassodon*			X
Pacific Sanddab	*Citharichthys sordidus*	X		X
Petrale Sole	*Eopsetta jordani*			X
Rex Sole	*Glyptocephalus zachirus*			X
Rock Sole	*Lepidopsetta bilineata*			X
Sand Sole	*Psettichthys melanostictus*	X	X	X
Starry Flounder	*Platyichthys stellatus*		X	X
		Other Groundfish		

Big Skate	*Raja binoculata*			X
Cabezon	*Scorpaenichthys marmoratus*			X
California Skate	*Raja inornata*	X		
Kelp Greenling	*Hexagrammos decangrammus*	X		X
Lingcod	*Ophiodon elongatus*	X		X
Longnose Skate	*Raja rhina*			X
Pacific Cod	*Gadus macrocephalus*	X	X	X
Pacific Hake	*Merluccius productus*		X	X
Sablefish	*Anoplopoma fimbria*	X	X	X
Soupfin Shark	*Galeorhinus galeus*		X	X
Spiny Dogfish	*Squalus acanthias*			X
Spotted Ratfish	*Hydrolagus colliei*		X	X
Pelagic Species				
California Market Squid	*Loligo opalescens*			
Jack Mackerel	*Trachurus symmetricus*			
Northern Anchovy	*Engraulis mordax*			
Pacific (Chub) Mackerel	*Scomber japonicus*			
Pacific Sardine	*Sardinops sagax*			
Salmon				
Chinook Salmon	*Oncorhynchus tshawytscha*			
Coho Salmon	*Oncorhynchus kisutch*			

Potential Effects of the Proposed Action on EFH

The proposed sites have been selected to avoid rocky reefs, a unique habitat that is closer to shore than the proposed ODMD sites. In 2001, the proposed sites were sized to each have a 20-year capacity for dredged material. Given that the Yaquina 103 North site has been used for 10 years, it can be used for disposal for a minimum of 10 more years. In addition, both historical and recent studies have been conducted to further characterize the sites and help in their management and use.

The effect pathways for EFH are the same as those described above in the ESA-portion of this document. Adverse affects to EFH may occur through increased suspended sediment in the water column, reduced prey availability, and safe passage. An adverse affect in only considered to occur if a species that EFH is designated for is present during the time at which the effects occurs.

1. Water Quality. Disposal of dredged material would increase suspended sediment levels because of fine sediment mobilized by disposal from a hopper dredge transport ship. Turbidity levels, from fine and sandy material, would increase for a short time during disposal. It is likely that suspended sediment concentrations generated by dredge material disposal would exceed the 17 mg/L effects threshold for injury as described above for salmonids. Some EFH management species are far less sensitive to turbidity and suspended solids than salmonids (Wilbur and Clarke 2001). For those fish that may be found in the water column, they may be adversely affected as described in the ESA-portion of the document because they may also be of smaller size while in the action area, i.e. Chinook salmon smolts. Thus, EFH may be adversely affected from increases suspended sediment. There are some species, e.g. flatfish, which would use the ODMD sites as juveniles. Since these sites are at deeper depths, EFH would not be adversely affected from increased suspended fine-sediment because this material would remain suspended in the upper portions of the water column.

2. Sediment Quality. As discussed in the ESA-portion of the document, all material that is disposed of at the ODMD sites must be tested in accordance with the SEF 2009 sampling manual. The USACE has been conducting sediment sampling for their material every 5 years and the data provide a good historical record of the level of contaminants in the material that is being disposed of in the action area. Based on this record, only trace levels of various contaminants would occur with the sediments and these levels do not exceed concentrations harmful to the organisms occupying the action area. EFH would not be adversely affected from this potential effects pathway.

3. Prey Availability. Prey availability would temporarily decline at the dredge material disposal site because disposal will cover the substrate and some of the substrate dwelling organisms would be buried. Some organisms have the ability to migrate through dredge material disposal or unbury themselves, while others are less mobile. The ability to survive the burial is based on life history stage, size, and physical ability to move.

Disposal of dredge materials at the Yaquina North and South sites contributes a 2 to 7 cm layer of unconsolidated sediment on the ocean floor. In doing this, infaunal and epifaunal invertebrates would be covered with a layer of sandy sediment. Yaquina North and South Sites would be monitored annually to assess mounding, which was previously discussed. These annual surveys verify placement of material within the boundaries of the sites (such that adverse effects to EFH are not going beyond the area consulted on this Opinion and EFH consultation), monitor changes in bathymetry, and ensure site capacity is not exceeded.

The effects to EFH are the same as discussed in the ESA-portion of the document. The reduction in infaunal invertebrates, epibenthic invertebrates, bottom-dwelling fish, and pelagic forage fish, albeit temporary and localized, may adversely affect EFH for all of these species complexes.

4. Safe Passage. The disposal of the dredged material causes a plume of sediment in the water column that may adversely affect EFH. EFH species are using the water column and seafloor during disposal, thus, their habitat may be adversely affected.

Determination for Essential Fish Habitat

The proposed action may adversely affect EFH for groundfish species, particularly flatfish species, coastal pelagic species, and coho and Chinook salmon.

The following measures are incorporated into the proposed action to minimize adverse affects to EFH at the proposed Yaquina North and South sites.

1. Dredged material to be disposed at the Yaquina North and South ocean disposal sites must be determined to be suitable for unconfined, aquatic disposal as defined in the SEF 2009. In the event that any dredged material is not suitable for unconfined, aquatic disposal, the dredged material found unsuitable would not be disposed at the Yaquina ocean disposal sites, but will be placed at acceptable upland disposal sites.

2. Disposal at the sites would result in a thin-layer of dredge material deposited on the seafloor. Given the depth of the sites, the movement of the dredged material disposal vessel during disposal, and the

volume of the material deposited during each disposal, the USACE modeling has estimated that 2 to 7 cm layer of dredged material disposal would occur. This thickness of such a layer is likely within the range that adult and juvenile Dungeness crab would not be killed or injured and epibenthic and infaunal invertebrates would have an opportunity to migrate up through the disposal layer or dig their way out.

3. Disposal operations attempt to create uniform displacement of dredged material at the site to minimize mounding. Thus, the thickness of the disposal layer can be as thin as 2 to 7cm.

4. The proposed disposal sites are located seaward of any rocky substrate so as to avoid impacts to this high quality habitat for commercially important rockfish species.

5. Sampling of the benthic infauna, and epibenthic invertebrates and vertebrates would be conducted at least once every 10 years, as was done in 2008 by the EPA to provide a snapshot of which species are at the sites and their relative abundance within and outside the Yaquina North and South sites.

6. Disposal operations are managed to minimize the area within which adverse affects may occur. As demonstrated during the first 10 years of use of the Yaquina North and South site by the USACE, all disposal activities were contained to only within the Yaquina North site. Furthermore, only once within that 10 year period did disposal occur outside of the Northern half of the Yaquina North site.

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