Environmental Resources Section

Public Notice

Alaska District
U.S. Army Corps of Engineers

Date JAN 04 2013 Identification No. ER-13-02
Please refer to the identification number when replying.

The U.S. Army Corps of Engineers (Corps) has prepared an environmental assessment (EA) and finding of no significant impact (FONSI) for the following project:

Maintenance Dredging
Cook Inlet Navigation Channel, Alaska

The U.S. Army Corps of Engineers (Corps) is proposing to test and maintenance dredge 10 million cubic yards (cy) of sand, gravel, cobbles occasional rocks and silty sediments that have accumulated in the Knik Arm portion of the existing Cook Inlet Navigation Channel between 2013 and 2017. Annual maintenance dredging of the existing channel to -43 feet MLLW, width of 1,100 feet, and length of 11,000 feet will consist of hydraulic and/or mechanical dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the existing Fire Island disposal site.

The proposed project, alternatives, and potential environmental impacts are described in the enclosed EA. The EA is available for public review and comment for 30 days from the date of this public notice. The EA and primary supporting documents may be viewed on the Alaska District's website at: www.poa.usace.army.mil. Click on the Reports and Studies button, look under Documents Available for Review, and click on the Civil Works link.

To request a printed copy, email:Michael.9.Salyer@usace.army.mil or send your request to the address below:

U.S. Army Corps of Engineers, Alaska District
ATTN: CEPOA-EN-G-ER (Salyer)
P.O. Box 6898
Joint Base Elmendorf-Richardson, Alaska 99506-0898

Comments on the EA and proposed project may be sent to the email or postal address.

Notice is hereby given that the Corps is applying for State Water Quality Certification from the Alaska Department of Environmental Conservation (ADEC). ADEC may certify there is a reasonable assurance this project and any discharge that might result will comply with the Clean Water Act, Alaska Water Quality Standards, and other applicable State laws. ADEC may also deny or waive certification.

Any person desiring to comment on this project with respect to Water Quality Certification may submit written comments to ADEC at the address below by the expiration date of the Corps of Engineer's Public Notice.

Alaska Department of Environmental Conservation
WDAP/401 Certification
555 Cordova Street
Anchorage, AK 99501-2617

Please contact me at (907) 753-2690 or at the above email and postal addresses if you have any questions or need additional information about the proposed project.

Michael R. Salyer
Chief, Environmental Resources Section

US Army Corps of Engineers
Alaska District

Environmental Assessment and Finding of No Significant Impact

Maintenance Dredging
Cook Inlet Navigation Channel, Alaska

January 2013

FINDING OF NO SIGNIFICANT IMPACT

Maintenance Dredging
Cook Inlet Navigation Channel, Alaska

The U.S. Army Corps of Engineers (Corps) will be conducting test and maintenance dredging of 10 million cubic yards (cy) of sand, gravel, cobbles, occasional rocks and silty sediments that have accumulated in the Knik Arm portion of the existing Cook Inlet Navigation Channel. Maintenance dredging of the existing channel to the maximum depth of -43 feet MLLW, width of 1,100 feet and length of 11,000 feet will consist of hydraulic and or clamshell dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the existing Fire Island disposal site. Dewatering is necessary to facilitate the movement of the largest quantity of dredged material per barge load, therefore minimizing vessel traffic related to the dredging action. The attached NEPA analysis includes the effects of annual maintenance dredging of the existing Cook Inlet Navigation Channel and in-water disposal, with a sampling and production test run dredging (50,000 cy) event as needed.

Incorporating the following mitigation measures into the recommended plan will mitigate adverse impacts to potentially affected fish and wildlife populations including species listed under the Endangered Species Act (ESA), marine mammals, and Essential Fish Habitat (EFH):

- Juvenile salmon may be present in Knik Arm for more than a month during the dredging period and feed successfully at the surface during their residence. All dredged material and overflow water from dredging will be discharged beneath the surface to avoid impacts on juvenile salmon feeding. Turbidity at the surface will be tested during dredging to determine whether additional adaptive measures should be incorporated to protect this resource.

- Sounds generated by dredging and related activities are similar in intensity to those associated with other harbor activities and most are close to ambient noise levels. To protect beluga whales, dredging activities will be suspended any time beluga whales are within 165 feet of the activity.

The Corps believes the maintenance dredging of Cook Inlet Navigation Channel is consistent with State and local management programs to the maximum extent possible.

This Finding of No Significant Impact's associated environmental assessment (EA) supports the Corps' conclusion that the maintenance dredging project in the Cook Inlet Navigation Channel does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, preparation of an environmental impact statement is not necessary.

______________________ Date: ________________________

Christopher D. Lestochi
Colonel, Corps of Engineers
District Commander

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ABBREVIATIONS AND ACRONYMS

ADEC – Alaska Department of Environmental Conservation

ADF&G – Alaska Department of Fish and Game

AHRS – Alaska Heritage Resources Survey

APE – Area of Potential Effect

BMP's – Best Management Practices

Corps – U.S. Army Corps of Engineers

CWA – Clean Water Act

cy – Cubic Yards

EA – Environmental Assessment

EFH – Essential Fish Habitat

EPA – U.S. Environmental Protection Agency

ESA – Endangered Species Act

FONSI – Finding of No Significant Impact

HAPC – Habitat Area of Particular Concern

MHHW – Mean Higher High Water

MLLW – Mean Low Low Water

MSFCMA – Marine Sanctuaries Fishery Conservation and Management Act

NMFS – National Marine Fisheries Service

NOAA – National Oceanic Atmospheric Administration

SHPO – State Historic Preservation Act

USFWS – U. S. Fish and Wildlife Service

USACE – U.S. Army Corps of Engineers

Environmental Assessment
Maintenance Dredging
Cook Inlet Navigation Channel
Anchorage, Alaska

1.0 Introduction

1.1 Purpose and Need

The proposed Federal action is maintenance dredging of the Cook Inlet Navigation Channel (CINC) in the Knik Arm Shoal region of Cook Inlet depicted in figure 1. The CINC has not required maintenance dredging since it was initially constructed. The purpose of the proposed action is the restoration of channel depth to facilitate safe navigation through the Cook Inlet Navigation Channel. The U.S. Army Corps of Engineers (Corps) will be conducting test and maintenance dredging of 10 million cubic yards (cy) of sand, gravel, cobbles, occasional rocks and silty sediments that have accumulated in the Knik Arm portion of the existing Cook Inlet Navigation Channel. Maintenance dredging of the existing channel to the maximum depth of -43 feet MLLW, width of 1,100 feet and length of 11,000 feet will consist of hydraulic and or clamshell dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the existing Fire Island disposal site. The proposed Federal action includes a production run test dredging of up to 50,000 cubic yards, geo-technical sampling, laboratory testing as needed, and disposal of sampled sediments as needed. This EA considers the effects of maintenance dredging for the CINC for years 2013 through 2017; any required maintenance dredging beyond 2017 will be addressed in further NEPA analyses.

Maintenance dredging has not been necessary since the CINC was created over a decade ago, but the shoal has been extending into the CINC in recent years, and the reduced depths are affecting navigation. If shoaling continues without the proposed maintenance dredging, deeper draft vessels will have a shorter window to access the Port of Anchorage facilities upstream of the shoal on high tide cycles, and they could eventually lose access to these facilities

Over the 5-year period considered in this EA, approximately 10 million cubic yards would be dredged from the CINC. The 10 million cubic yard volume is a best estimate, but how that quantity breaks down over the 5-year period is uncertain given the changeable nature of the shoal. Since a shoal is, by definition, a changeable area, dredging may occur on an annual basis or any combination of years that dredging is necessary to achieve the removal of shoaling sediments.

1.2 Project Authority

The Cook Inlet Navigation Channel was initially authorized by the Water Resources Development Act (WRDA) of 1996 (Public Law 104-303). That authorization was subsequently modified by language in the Energy and Water Development Appropriations Act of 1999 (Public Law 105-245) and the Energy and Water Development Appropriations Act of 2005.

1.3 Project Area Description

The Cook Inlet Navigation Channel is 11,000 feet long, 1,100 feet wide, with a maximum depth of -43 feet MLLW (figure 1).

The four corners of the existing navigation channel are:

Northwest = N61° 11' 42.00", W150° 07' 05.4";

Northeast = N61° 11' 33.20", W150° 06' 55.7"

Southwest = N61° 12' 23.70", W150° 03' 38.6"

Southeast = N61° 12' 32.50", W150° 03' 48.3"

The originally authorized disposal area is as shown in figure 1. The four corners of the disposal area are defined as follows:

Northwest = N61° 11' 18.40", W150° 08' 57.98";

Northeast = N61° 11' 18.45", W150° 08' 04.43";

Southwest = N61° 10' 59.01", W150° 08' 57.89";

Southeast = N61° 10' 59.07", W150° 08' 04.35".

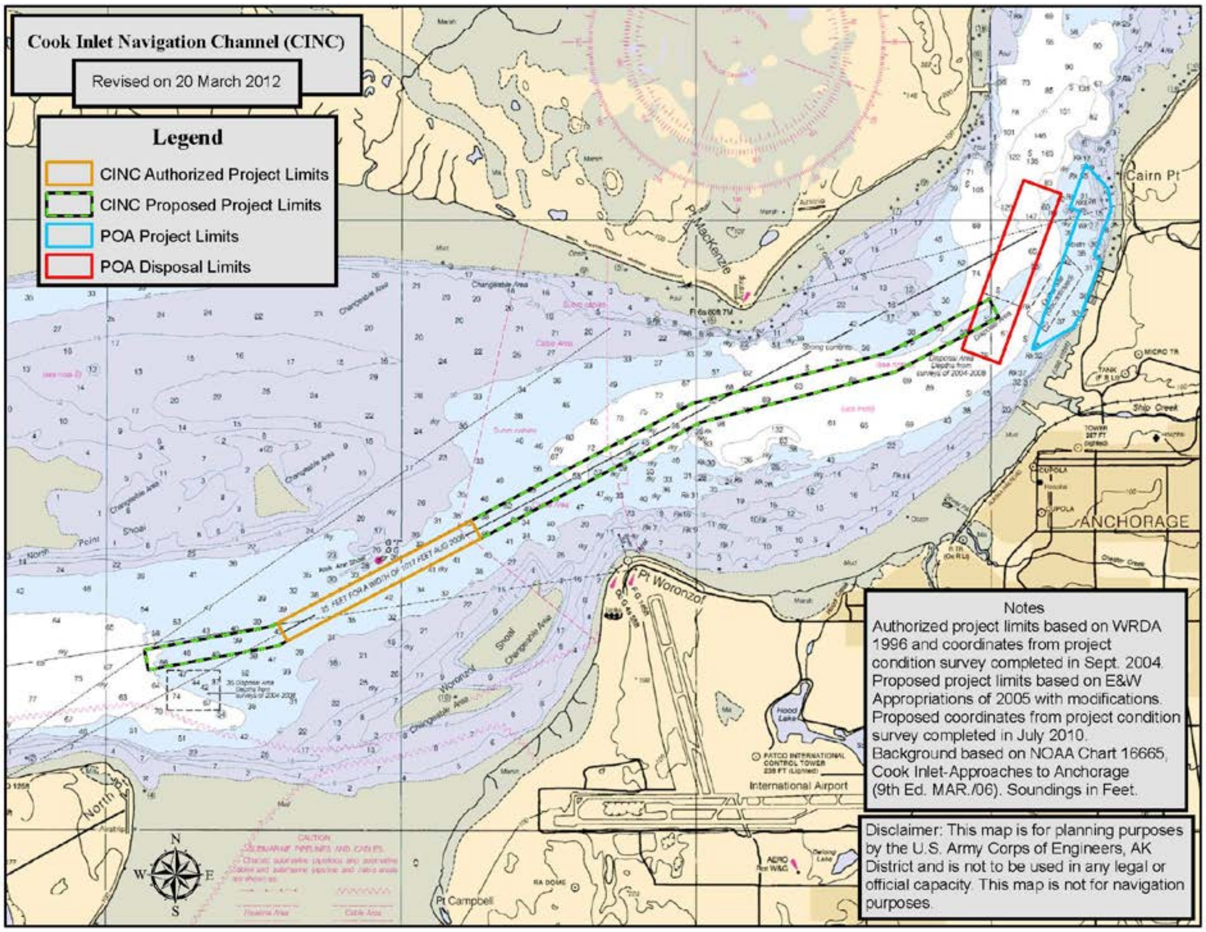

Figure 1. Cook Inlet Navigation Channel (CINC, gold bordered area within figure).

2.0 Alternatives

2.1 No Action Alternative

With the No Action alternative, neither dredging of CINC nor disposal of dredged material would occur. The accumulated sediments that currently restrict deep draft navigational access would not be removed, and no window would be provided within which additional materials could accumulate before additional negative impacts to navigational access occurred. Shoaling would likely continue at the current rate and lead to additional shipping restriction in terms of timing and eventually lack of access at all tide stages for larger vessels.

2.2 Proposed Action

The U.S. Army Corps of Engineers (Corps) is proposing to conduct test and maintenance dredging of approximately 10 million cubic yards of sand, gravel, cobbles, occasional rocks, and silty sediments that have accumulated in the Knik Arm portion of the existing CINC. The 10 million cubic yards would involve dredging approximately 2 million cubic yards each summer over a period of 5 years because the rate of shoaling is unknown. Maintenance dredging of the existing channel to the maximum depth of -43 feet MLLW, width of 1,100 feet and length of 11,000 feet would consist of hydraulic and or clamshell dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the Fire Island disposal site. Dewatering is necessary to facilitate the movement of the largest quantity of dredged material in the hopper or scow load, therefore minimizing vessel traffic related to the dredging action. In-water disposal of dredged material would consist of dredged material being placed north of Fire Island in the existing disposal site. The NEPA analysis for this project includes the effects of maintenance dredging of the Knik Arm Shoal of the CINC and in-water disposal of the material over the next 5-year interval.

2.2.1 Dredging Options

As noted below, the Corps considered several alternative methods for conducting the test and maintenance dredging described in this section. The Corps would use a suction dredge for the 2013 dredging event because it is the most efficient means of excavating sand found during the test dredging event. This document also includes an analysis of the effects of mechanical dredging because subsequent maintenance dredging events may require dredging a combination of sand, silt, gravel, cobbles, and rock.

Hopper Dredge. A hopper dredge operates by use of suction “drag heads” that extend from the hull of the dredge down into the substrate to be dredged. Through suction, materials are brought up into the open hull of the dredge or into multiple hoppers until the hopper(s) is full and the material can then be moved to a dredged material placement site. Use of a hopper dredge works best in sandy environments. The suction of material also brings in huge volumes of water. The excess water (return water) is allowed to overflow weirs in the hopper and flow back into the waterbody. The overflow water can increase turbidity and may not meet water quality standards immediately after discharge (dewatering) in the immediate vicinity of the outlet. Cook Inlet is a highly turbid environment as described later in this document. Because the dredged material is expected to be largely sand and gravel and because of the normally high background turbidity levels, rapid rate at which dredged sands and gravels are expected to dissipate/disperse upon disposal, and the very localized footprint of the dewatering and disposal related turbidity, the hopper dredge is the primary dredging methodology proposed for both the test and maintenance dredging actions.

Side-caster or Boom Dredges. Side-caster or boom dredges excavate sediments via a cutter or drag head and dispose of them a short distance away via a pipeline. Because this project is a minimum of 1.5 miles from the disposal site and because of the hydraulic environment (waves and current velocity), long distance piping of dredged material is highly problematic. This technology was determined to be impractical for this environment and therefore was not considered further.

Dustpan Dredge. Dustpan dredges utilize a water jet-assisted suction head and pipeline to transport dredged material a short distance to an in-water disposal site. Because this project involves the excavation of cobbles and some rock, is a minimum of 1.5 miles from the disposal site, and because the hydraulic environment (waves and current velocity) make long distance piping of dredged material highly problematic, this technology was determined to be impractical for this environment and therefore was not considered further.

Clamshell Dredge. Clamshell dredging for the proposed project requires the use of a barge-mounted crane with a clamshell bucket that would be used to remove sediment from the channel bottom. The open bucket clamshell dredge is often used in marine environments due to an increased rate of efficiency for moving sediment. The captured sediment is primarily what is lifted to the surface and placed in a scow. Weirs in the scow are allowed to overflow back into the waterbody.

2.2.2 Dredged Material Placement Options

The existing Fire Island disposal site is in relatively deep water (-38 to - 90 feet MLLW) where tides and currents can exceed 5 knots and where the discharged material is rapidly suspended and dispersed into the already highly turbid waters of Upper Cook Inlet. Based on current survey information, the disposal site will accommodate approximately 3.3 million cubic yards. However, due to a history of the disposal site eroding, over a 5-year timeframe the total 10 million cubic yards is expected to be placed in this disposal site. Therefore, because the disposal site was created to accommodate disposal of CINC dredged material, and it has the current capability to do so, alternate disposal sites were not evaluated.

Hydrologic characteristics of the marine environment in Upper Cook Inlet and factors affecting settling and dispersal of dredged material are briefly described in sections 3.1 and 3.2 and in the attached Clean Water Act Section 404(b)(1) analysis.

2.3 Best Management Practices and Monitoring

Each Corps of Engineers maintenance dredging project employs appropriate standard industry best management practices and requires contractors to provide quality control to ensure that water quality standards and pollution control requirements are met. Those practices are, and will continue to be, implemented whenever appropriate for all future Corps dredging for the CINC. Scoping for the proposed action identified two specific areas of concern related to channel. One was that noise generated by dredging could adversely affect beluga whales and the other that turbidity could adversely affect juvenile fish. Based on 2008 consultations with concerned conservation groups, the Corps adopted a whale watch program for belugas and other cetaceans during dredging and disposal operations for nearby Anchorage Harbor dredging. That program will be repeated for this dredging action. The Corps' Beluga Monitoring Program requires the crew of the vessel to monitor the presence of belugas on a daily Quality Control (QC) report. A Corps Alaska District biologist would brief the crew prior to the initiation of dredging on the identification of belugas, their general behaviors in the area, and reporting requirements. The reporting requirements include recording the numbers of adults and juveniles present or not present, distance from the dredge, any sudden course changes, reactions to dredging and disposal, directional movements, and any other behaviors on a daily basis. If beluga whales are present within 50 meters of the dredging operation, the dredge operator is instructed to stop dredging until the whales disperse. Similarly, if beluga whales are in the vicinity of the disposal site, the dredge delays disposal. The Corps will continue this method of operation for the duration of the project unless modified to be more restrictive. The other concern, expressed in the U.S. Fish and Wildlife Coordination Act report for the Anchorage Harbor dredging action (USACE 2008, Appendix A), was that increased sediment concentrations and turbidity at the surface could adversely affect the ability of juvenile fish, particularly salmon juveniles, to feed on surface and near-surface invertebrates. Two actions would be adopted to mitigate those potential effects: (1) dredgers would be required to discharge excess water and to dispose of dredged material well beneath the surface to avoid increasing surface turbidity, and (2) surface water turbidity would be monitored adjacent to and down-current of the dredge while disposing sediment to determine whether there is an appreciable increase in surface turbidity during disposal. A sampling plan would be prepared prior to the start of the dredging season to work out the details of the protocols and strategy.

2.4 Conservation Measures

Incorporating the following mitigation measures into the recommended plan would help to ensure that no adverse impacts would occur on local fish and wildlife resources, including ESA-listed species and their critical habitats, marine mammals, and EFH.

- Project-related vessels shall not be permitted to ground themselves on the bottom during low tide periods unless there is a human safety issue requiring it.

- An oil spill prevention plan shall be prepared.

- A hopper dredge will be loaded so that enough of the freeboard remains to allow for safe movement of the dredge and its material on the route to the offloading site to be identified.

- Dredging and/or disposal shall cease or move to another location distant from any beluga whales within a 50-meter radius of the dredging operation. This is the same distance that has been successfully applied to maintenance dredging at the Port of Anchorage for the last few years.

- Surface water turbidity would be monitored adjacent to and down-current of the dredge while disposing sediment to determine if there is an appreciable increase in surface turbidity during disposal. A sampling plan would be prepared prior to the start of the dredging season to work out the details of the protocols and strategy.

3.0 Affected Marine Environment

3.1 Tides, Currents and Circulation

The lower half of the upper portion of Cook Inlet (above the east and west forelands) in which the existing channel and disposal area lies is characterized by shallow water depths averaging 50 feet. Because the existing channel was cut through Knik Arm shoal, water depths within the immediate vicinity of the shoal range from approximately -20 feet MLLW to -45 feet MLLW along and on either side of the navigation channel's alignment. Water depths within the perimeter of the disposal site range from -38 MLLW to -90 MLLW. Upper Cook Inlet has the second highest tides in all of the Americas, exceeded only at the Bay of Fundy in Nova Scotia. The mean daily tidal range varies from 13 feet at the mouth of the inlet to 29 feet at Anchorage, several miles north of the navigation channel. The high tide range creates strong currents in the inlet. The maximum flood current at Anchorage is 3.5 knots, while the maximum ebb current is 3.1 knots. Currents at the surface above the Cook Inlet Navigation Channel (i.e. between Knik Arm shoal and Woronzof shoal) can reach 4.4 knots. Currents at mid-depth reduce to 2.6 knots and currents near the bottom are less than 1.9 knots (USACE 1996). Currents in the upper inlet are classified as reversing currents; as the flow changes to the opposite direction it is briefly near zero velocity at each high and low tide. The upper inlet, therefore, experiences strong turbulence and vertical mixing during each tidal cycle, resulting in fairly uniform water properties throughout the water column. The upper inlet's shallow depths usually restrict wave heights to less than 10 feet. The wave climate in the Knik Arm shoal – Fire Island area is further constrained by the limited fetch between Fire Island and Point Campbell immediately south of the navigation channel. Strong tidal currents in Upper Cook Inlet can oppose wind generated waves, making the waves steeper and more chaotic.

The tides in the inlet occur as two high unequal tides and two unequal low tides per day. A tidal (lunar) day is 24 hours and 50 minutes. The greatest tides occur in the spring, with high and low tides exceeding the mean by more than 1.4 meters (4.9 feet). Tides vary within the lower portion of the inlet from 5.8 meters (19 feet) on the east side to 5.1 meters (16.7 feet) on the west side. The high tide range creates especially strong currents along the eastern shore of the lower inlet. High tide at the mouth of the inlet occurs approximately 4.5 hours before high tide at Anchorage. The mean tidal range at Anchorage is 7.9 meters (25.9 feet). The diurnal tidal range is 8.9 meters (29.1 feet) (USACE 1996).

Tidal currents in lower Cook Inlet are classified as rotary currents because the flow typically does not slow to zero velocity, but rather changes direction through all points of the compass. The upper inlet experiences strong turbulence and vertical mixing during each tidal cycle, so water properties tend to be uniform from the surface to the bottom. The lower inlet tends to be more stratified in temperature and salinity. Tidal currents are superimposed on the longer-term net circulation trends. Water in lower Cook Inlet generally circulates in a clockwise pattern. Less turbid, more saline Gulf of Alaska water enters at the southeast end of the inlet, and sediment-laden fresher water flows out along the west side (USACE 1996).

Sea ice forms in seawater as a thin layer, which increases in thickness as layers are added to the bottom. Sea ice can exist in the inlet as floes nearly 1,000 feet wide and 10 feet thick. Pressure ridges up to 16 feet thick sometimes form as floes collide. Beach ice forms on tidal flats as seawater contacts frozen tidal mud. Beach ice rarely gets thicker than 1.64 feet before floating free of the mud and then frequently piling up (forming deposits) on the mudflats. These deposits often form into stamukhi, the third type of Cook Inlet ice. Stamukhi is created when overhanging pieces of deposited beach ice breaks off as the tide recedes, leaving behind layered ice with nearly straight sides. The fourth type of ice formed in the inlet is estuary or river ice. This freshwater ice is similar to sea ice but is much harder and is frequently discharged into the inlet during spring breakup. Ice can be a navigational hazard for 5 months of the year and can be present for up to 8 months of the year (USACE 1996).

3.2 Sediment Transport and Water Quality

The waters of Knik Arm are brackish, with salinities ranging from 10 to 12 practical salinity units (PSU, equivalent to grams of dissolved solids per kilogram of seawater) at Fire Island (Gatto 1976) and 4 to 6 PSU north of Cairn Point. Water temperatures range from freezing (about 31°F) to 63°F or more (in surface pockets observed during the summer months). Measurements of suspended sediment at several locations near the river mouths tend to be similar, showing concentrations of up to 1,000 mg/L between water surface and depths of 15 feet, then increasing to more than 4,000 mg/L at greater depths (Smith et al. 2005). The average natural turbidity of Upper Cook Inlet and Knik Arm typically ranges from 400 to 600 nephelometric turbidity units (NTU's). The turbulent nature of the system mixes the water and maintains relatively high dissolved oxygen concentrations throughout the entire water column. At the mouths of the streams and rivers that flow into Knik Arm, fresh water interacts with the sea water to create an identifiable zone. Since the sea water is denser, the fresh water will float on top until it is mixed by tides and currents, creating a freshwater lens that is sometimes less turbid than the sea water. The lenses extend relatively short distances out from the river mouths and in the direction of the current and may provide important fish habitat. The significant streams flowing into the Knik Arm near the CINC include Ship Creek, Chester Creek, Campbell Creek, Fish Creek, and Little Campbell Creek. All these streams flow through urban areas and are identified as CWA Section 303(d) impaired water bodies (ADEC 2008).

As noted in KABATA 2007 regarding the physical processes affecting and determining the rates of sedimentation, "Erosion, deposition, transport, and consolidation are the four processes that control the dynamics of sediments. Researchers have yet to develop a deterministic, physically based description of the behavior of cohesive sediments, so the state-of-the-practice is to rely on empirical relationships to describe these processes." This report goes on to discuss the state of scientific knowledge of erosion related bed shear stress, expression of deposition rates in relation to critical shear stress or settling velocity, and the effect consolidation of sediments can have on erosion rates and re-suspension rates. Together, all these components affect and help determine sediment transport characteristics, rates, and ultimately the bathymetry of Upper Cook Inlet.

Therefore, without sound scientific methodologies to predict sediment movement the Corps must rely on past surveys and professional judgment to estimate sediment movements. Therefore, the Corps has since 1996 surveyed the channel floor to define existing bathymetry and uses those snapshots-in-time to estimate future effects of dredging actions in Upper Cook Inlet.

3.3 Air and Noise Quality

The following air and noise quality analysis is excerpted from the August 2008 Anchorage Harbor Deepening and Disposal EA and has been updated as needed. The original analysis was for the Port of Anchorage and considers the baseline condition and assessment of effects on impacts to air quality in nearby Anchorage, Alaska. Although the two projects are 8 miles apart in Cook Inlet, both abut the developed portion of the city due to the size of the Municipality of Anchorage and shape of the coastline.

The Cook Inlet Navigation Channel is approximately 3 miles west of Anchorage. Overall, Anchorage enjoys very clean air, with an Air Quality Index rating of “good” between 1999 and 2009 (Anchorage Air Quality 2009). The city maintains levels of regulated pollutants within the National Ambient Air Quality Standards (NAAQS) established under the Clean Air Act. The air quality standards include concentration limits on the “criteria pollutants” carbon monoxide (CO), ozone, sulfur dioxide, nitrogen oxides, lead, and particulate matter. Anchorage has historically experienced elevated CO concentrations during the winter, when cold temperatures and the nearby mountains can result in temperature inversions that trap pollutants close to the ground. As in most urban areas, carbon monoxide emissions are generated primarily by vehicles, with cars and trucks accounting for around three-quarters of the annual CO emissions in Anchorage. A large part of metropolitan Anchorage was designated a “non-attainment” area for CO in November 1990. The Cook Inlet Navigation Channel is not within the boundaries of this non-attainment area, but is approximately 2 miles west of its western edge. The city was re-designated from “non-attainment” to “maintenance” status for CO in July 2004, largely through a program of vehicle inspection and emission control. The state maintenance plan specifies measures the state will take to maintain compliance with air quality standards. The EPA requires a demonstration of maintenance for 10 years following re-designation.

The primary natural component of the noise climate above water within Knik Arm is wind noise. The primary anthropogenic component of noise is aircraft engine noise related to take-off’s and landings at Ted Stevens Anchorage International Airport. The primary natural components of underwater noise are sediment transport, bottom scour, wave action, ice, and resident species, while the primary component of anthropogenic noise is vessel traffic and seasonal dredging.

Noise Transmitted Underwater. Project-related underwater noise can be produced by equipment used for dredging, disposal, and associated noise from vessels involved with dredging. Ambient noise is background noise that masks sounds of interest. For example, noise produced from ice, tides, and currents would be present in recordings aimed at measuring the noise from a tug boat operated at a port. Similarly, if one were measuring noise produced by beluga whales near a port, the sounds from other marine mammals, tides, currents, ships, tugs and other sources would be considered background noise. For underwater environments, ambient noise could include noise produced by tidal action, currents, wind, rain, floating ice, and waves. Human-caused (anthropogenic) underwater noise can be generated from operation of vessels, sonar, aircraft over-flights, seismic surveys, oil and gas platforms, dredging, shore based activities, and other events. There is no single "source" of ambient noise; instead the sources are continually changing in their contribution to the background level. Ambient noise can change from season to season, day to day, and when anthropogenic sources are present, the noise levels can change from minute to minute.

Ambient noise is important in discussions of sounds and their effects because ambient noise is an important reference point for measuring sounds and because sounds are considered to have diminished to the point that they can no longer be detected by recording instruments when they are reduced to (attenuate to) background or ambient levels.

Because sound moves differently through air than it does through water, it is measured differently in each medium. Water is denser than air, and sound travels about 5 times faster in water than air. The higher density of water is also the reason why sound may go farther underwater than in air. Sound pressure levels (SPLs) in air and water are referenced differently due to different pressures in the two mediums. While intensity is reported in decibels, the instruments used to measure underwater noise actually sense pressure. Noise traveling through air is typically measured in decibels (dB) relative to a reference pressure of 20 micro-pascals (μPa), whereas noise traveling through water is measured in dB relative to a much lower reference pressure of 1 μPa. These reference pressures are standards adopted among acoustic researchers (Richardson *et al.* 1995). Because the reference pressures that apply to the mediums are not the same, it is inappropriate to make direct comparisons between measurements taken in air and water. Levels of sounds (in either air or water) are measured on a logarithmic instead of a linear scale. This means, for example, that a sound measured at 80 dB is 10 times more powerful than a sound measured at 70 dB, and a sound measured at 90 dB is 100 times more powerful than the sound that was measured at 70 dB. But, at the same time, the 90 dB sound is only 10 times more powerful than the 80 dB sound.

A very important, yet frequently overlooked component of sound is the spectrum over which it occurs. While the term 145 dB re 1 μPa gives an indication of the intensity of an underwater sound, it does not indicate how that intensity is distributed across the band of potential frequencies. A frequency is the rate at which a repetitive event occurs and is measured in hertz (cycles per second). If all of the energy for a measured sound is concentrated at a single frequency then it is called a tone. Underwater industrial noises typically span a range of frequencies due to the nature of the source; an engine emits a range of frequencies because of its multiple internal components, and a ship emits even more frequencies produced by engines, generators, propellers, and other onboard sources. Sometimes these sounds are measured and presented relative to a broadband range of frequencies. This is common for ambient noise because there are various spectral components due to the wide range of sources. Sounds can also be analyzed to one-third octave band levels. Sound levels are often reported in one-third octave bands because it is the effective filter bandwidth (i.e. levels which can be distinguished) detectable by humans and some animals. A complete description of octave and one-third octave bands is provided in Richardson *et al.* (1995).

When attempting to interpret the meaning of any reported sound level, it is critical to understand the bandwidth over which the level was measured. Sounds are sometimes discussed with reference to their spectral composition. In this case, for example, a sound may be described as having a dominant tone at 50 Hz where most of the sound energy is concentrated, but there may also be prominent components of the sound between 1000 and 1200 Hz.

Underwater noise data is often measured to determine potential effects to fish, diving birds, and marine mammals. The sensitivity of organisms to underwater noise varies with frequency. The response of an animal is likely to depend on the presence and levels of sound in the range of frequencies to which it is sensitive (Richardson *et al.* 1995). Given this rationale, sounds may be measured at 95 dB re 1 μPa at a frequency of 100 Hz, but the threshold level for a sound to be audible to certain animals may be 130 dB. In that instance, the 95 dB re 1 μPa sound source at a frequency of 100 Hz would not be detectable to the animal. Similarly, a dog whistle blown at a high dB level is not detectable to humans because it is at a higher frequency than we can detect.

The following paragraphs and figures related to underwater noise (ambient, ships and tugs, and aircraft) have been adapted from Blackwell and Greene (2002), sometimes verbatim. The section on dredging noise was adapted from Dickerson *et al.* (2001). It is uncommon for a project to have such a wealth of recent and applicable underwater noise data, so it was utilized extensively in this document. Both documents are cited and are available on the internet.

Natural Sources of Ambient Noise. Underwater noise was measured at five locations in Cook Inlet and Knik Arm in 2001 to document naturally occurring underwater sounds. Some sites selected are known to harbor beluga whales at certain times of the year (recording locations are shown as red inverted triangles in figure 2). Those locations were not in the immediate vicinity of industrial activities and are more representative of “natural” ambient sound levels in the study area.

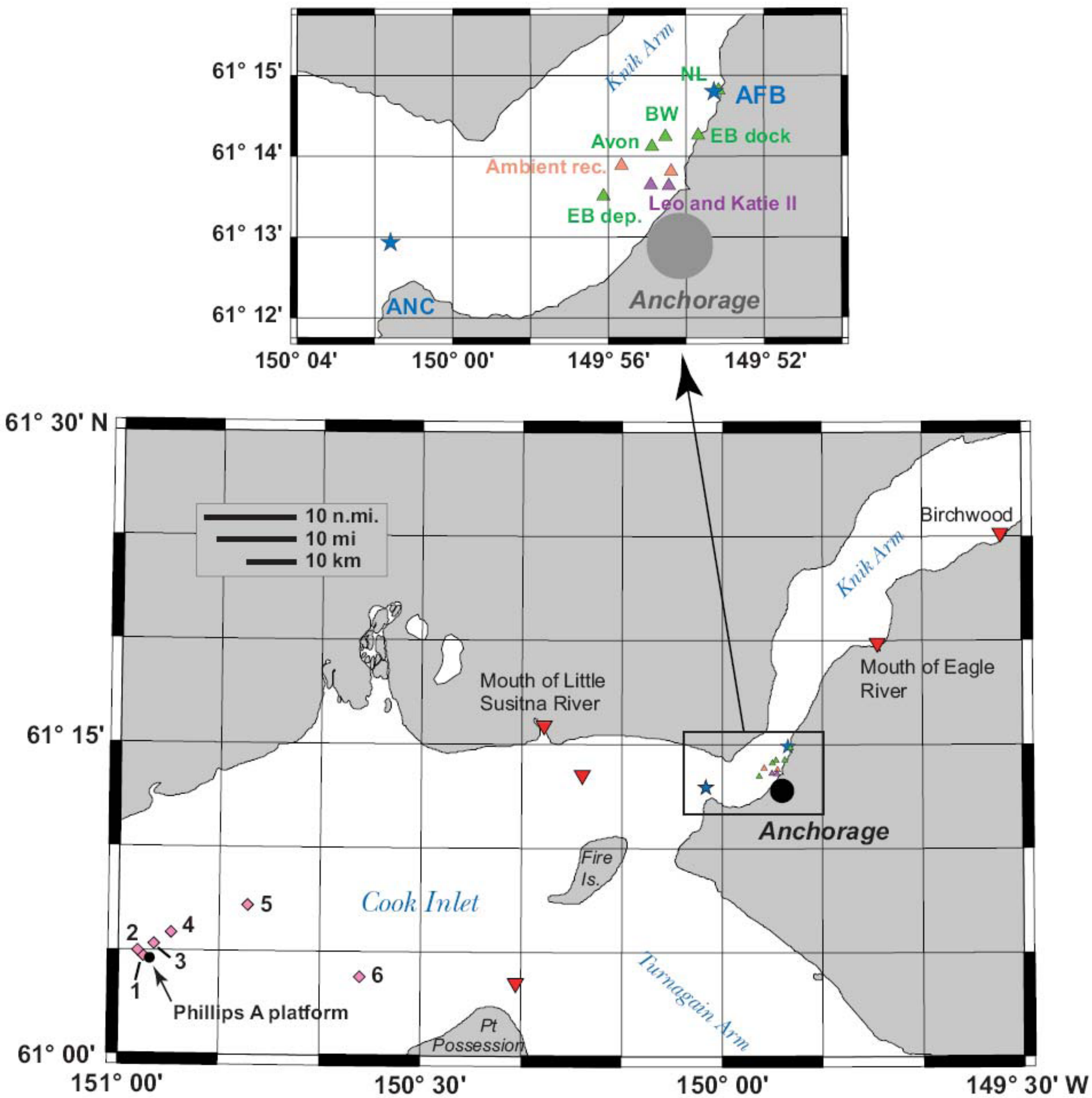

Figure 2. Map of Cook Inlet, Alaska, showing recording locations from 21-24 August 2001.

Locations marked in the figure 2 inset show where over flights were recorded seaward of the Ted Stevens (Anchorage) International Airport (ANC) and Joint Base Elmendorf -Richardson(JBER) (blue stars); recording stations 1-6 for measurement of the Phillips A platform (pink diamonds); vessels in Anchorage harbor (purple, green, and orange triangles); and ambient sound level recordings (red inverted triangles). NL = *Northern Lights*, EB = *Emerald Bulker*, BW = Boston Whaler. Locations of the Phillips A platform and the small vessel (Avon and Boston Whaler) recording sites are presented on the figure, but are not discussed in this report (Blackwell and Greene 2002).

Underwater broadband (10 - 20,000 Hz) SPLs are presented in figure 3 for the locations shown in figure 2. In addition, three ambient levels from the general area are shown for comparison. They include ambient levels at the Anchorage airport and JBER locations (recorded while no airplanes were landing or taking off; blue stars in figure 2), and the Anchorage harbor ambient recordings.

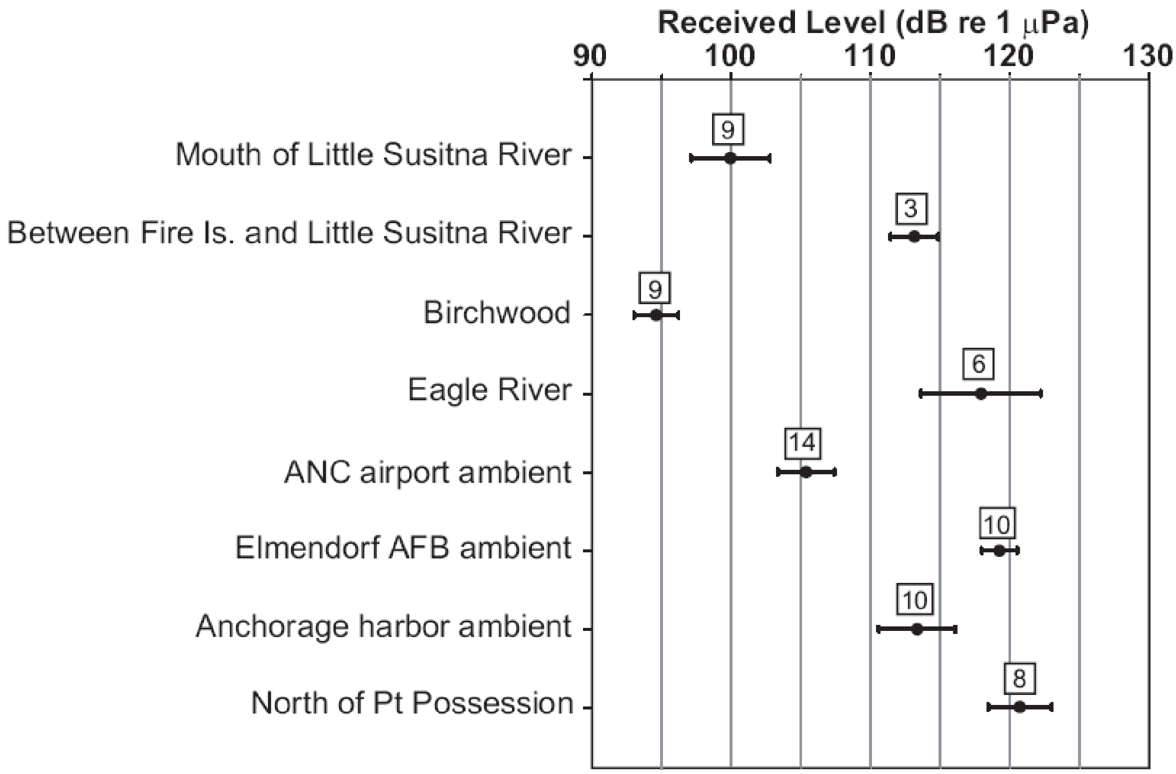

Figure 3. Broadband (10 - 20,000 Hz) levels of ambient underwater sound at eight locations in Cook Inlet and Knik Arm, with varying levels of proximity to industrial activities (see text for details). Values shown are means □one standard deviation. The number of 8.5-second samples used for each mean is indicated above the mean. (Source: Blackwell and Greene, 2002).

The mean ambient underwater broadband levels shown in figure 3 span a fairly wide range, from 95 to 120 dB re 1 μPa. The variation within each recording, however, was generally small. The two quietest locations (Little Susitna River and Birchwood) were in areas removed from the proximity of industrial activity, but so was the loudest (north of Point Possession), where elevated broadband levels were attributed to the incoming tide. Broadband levels for the location between Fire Island and Little Susitna River were probably artificially inflated as there was a fair amount of wave slap noise on the recording vessel. It is not surprising that the recording location seaward of Stevens (Anchorage) International Airport was the quietest of the "industrial" locations, as it is somewhat removed from Anchorage itself and the harbor. The ambient Port of

Anchorage (POA) recording was from farther off shore than the JBER ambient (which was also in the harbor area); this could explain the lower values.

Underwater narrowband spectra are shown in figure 4 for three contrasting locations Birchwood, northeast of Anchorage up the Knik Arm (figure 4A, pink line), the POA area (figure 4A, black line), and the location north of Point Possession (figure 4B, green line). Birchwood was the quietest location (see figure 3) and also the only one at which beluga whale noise was heard. The whales produced a variety of whistles and noisy vocalizations, which contributed to the peaks in sound levels between 200 Hz and somewhat over 1 kHz that are shown in figure 4A The sounds heard on the Anchorage harbor recording included a variety of noises of the type that can be expected in an area with construction, boat traffic, and loading and offloading of vessels. Sound levels are higher at all frequencies and include two prominent peaks at 30 to 40 Hz and 60 Hz. These can be linked to power generation and industrial activities in general. The location north of Point Possession had the highest broadband level of all the locations shown in figure 5 and reached 124 dB re 1 μPa. During that recording, the tide was coming in and the sounds it generated predominated in the recording and were audible by the field crew in air and underwater. The lack of prominent tones over most of the frequency range (i.e., atonality of the sound source) and “bell” shape at higher frequencies (500 - 20,000 Hz) is characteristic of this type of sound. The source of the peaks at 21, 29 and 38 Hz is not known.

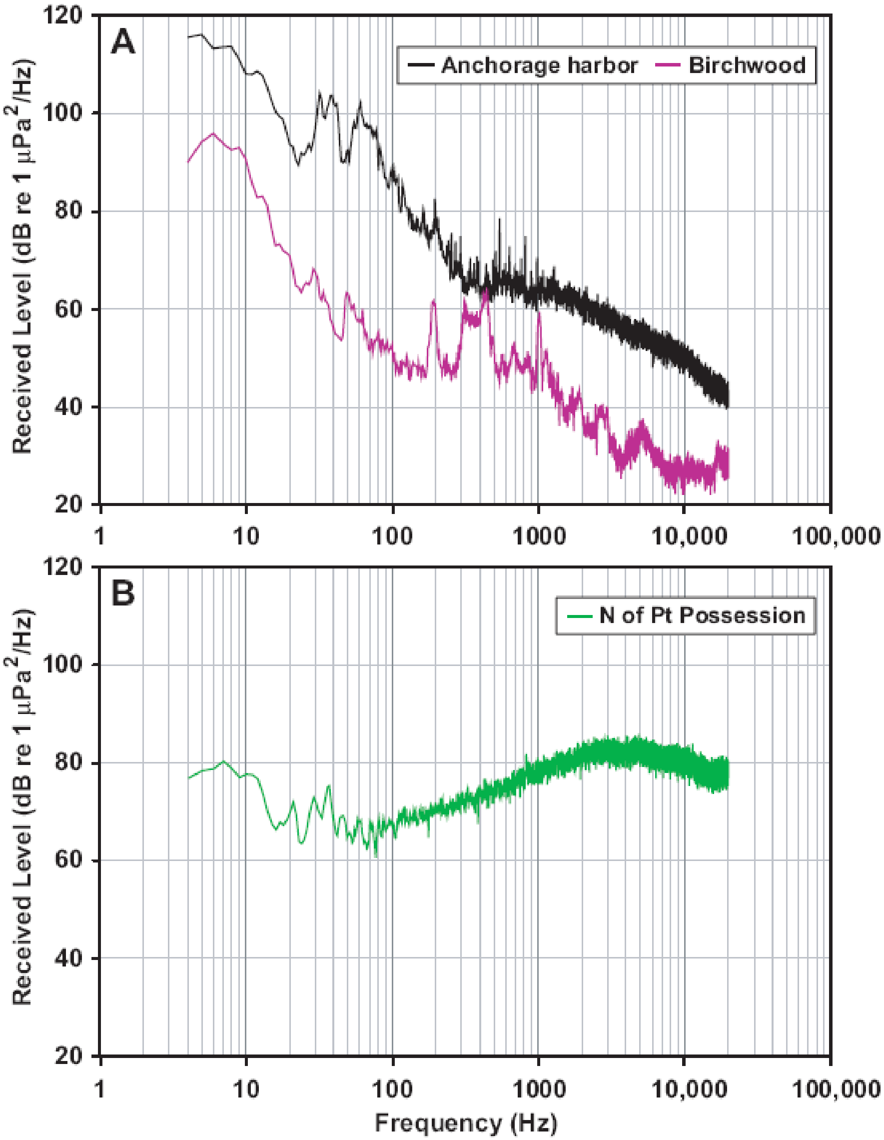

Figure 4. Narrowband underwater spectra (4 to 20,000 Hz) from typical 8.5-s samples. (*A*) Anchorage harbor (24 Aug 2001) and Birchwood (23 Aug 2001); (*B*) North of Point Possession (22 Aug). (Source: Blackwell and Greene, 2002).

A comparison of the narrowband spectra from the Birchwood and POA (see figure 4A) shows roughly a 20 dB increase in sound pressure levels across all frequencies at the "industrial" site. In addition, there are several peaks at low frequencies (<100 Hz) and a smooth decrease with frequency above 1 kHz. This is fairly typical of most industrial noise as well as oceanic traffic, which primarily affects frequencies below 1 kHz. The recording north of Point Possession yielded some of the highest broadband levels, up to 25 dB above the quietest station (Birchwood, see figure 3). The narrowband spectrum plot (figure 4B) shows an unusual presence of higher frequencies, specifically 1 to 10 kHz. For example, the received level for the one-third octave band centered at 5 kHz was about 16 dB higher than the POA recording and 40 dB higher than the Birchwood recording. Blackwell and Greene (2002) report that this source is likely due to rolling gravel being moved by tidal action.

Industrial Sources of Underwater Noise

Ships and Tugs. The sounds produced by small and large vessels in Anchorage Harbor were recorded seven times on 21, 23 and 24 August 2001. Recordings were opportunistic, except for those involving the Boston Whaler and Avon inflatable boat. Recording locations are all shown on the insert of figure 2 as green and purple triangles. Recorded sound sources included:

● the cargo-freight ship *Northern Lights* while docked in the harbor during loading or unloading
● the cargo-bulk carrier *Emerald Bulker* while being held at the dock by two tugs immediately preceding its departure, and then during its departure from Anchorage Harbor.
● the tug *Leo* while pushing the gravel barge *Katie II* towards a dock, and then while maneuvering and holding the barge against the dock Broadband (10 - 20,000 Hz) underwater SPLs as a function of distance to the presumed sound source are shown in figure 4A for all the larger vessels. The highest SPL recorded was 149 dB re 1 μPa, about 328 feet from the tug *Leo* while it was holding or maneuvering the gravel barge *Katie II* against a dock.

Most of the sound energy from the recording of the tug *Leo* pushing the gravel barge *Katie II* is in the band 100 - 2000 Hz. A large peak at 50 Hz was recorded and tones were detected at numerous multiples of 25 Hz up to 426 Hz. It is likely that the tug was the source of the 25-Hz tone, which could have been a blade-turning rate. The dip in received levels for frequencies below about 400 Hz, and especially below 150 Hz, is indicative of the rapid attenuation of those frequencies in very shallow water–the water depth during the recording was only about 7 meters (23 feet). The levels rise for frequencies below 100 Hz as “ground waves” contribute to the received levels. The highest recorded broadband level underwater in this study was 149 dB re 1 μPa, obtained 100 meters (about 328 feet) from the tug *Leo* while docking a gravel barge.

Source levels cannot be computed reliably from far-field measurements, but a large ship such as the *Emerald Bulker* will likely produce broadband source levels on the order of 180 dB re 1 μPa-m (i.e., at 1 meter [3 feet]) while cruising, as suggested by the data in figure 5. Source levels of that magnitude are not uncommon for large ships such as container ships, supertankers, and icebreakers (Richardson *et al.* 1995).

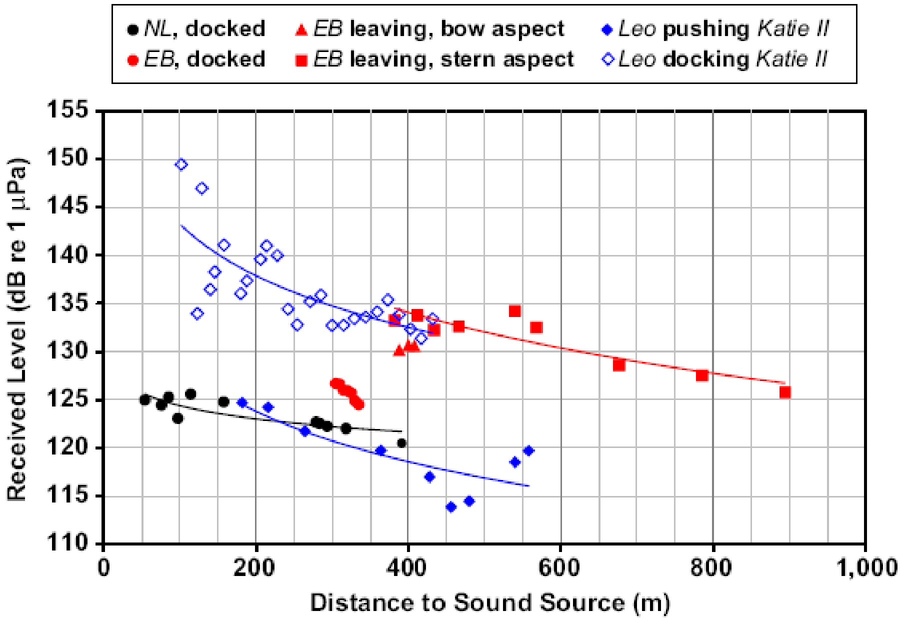

Figure 5. Broadband (10 - 20,000 Hz) underwater SPLs as a function of distance to sound source for various large vessels operating in Anchorage Harbor. *NL* = *Northern Lights*, *EB* = *Emerald Bulker*. (Source: Blackwell and Greene, 2002)

Dredging Noise. The proposed project would involve maintenance dredging on an as needed basis over the next 5 years. Dredging is not a new addition to the noise environment within Cook Inlet. Dredging is necessary to maintain access to the Port of Anchorage.

Researchers at the U.S. Army Engineer Research and Development Center in Vicksburg, Mississippi measured underwater noise from a bucket (clamshell) dredge in Cook Inlet near the POA in September 1999 and August 2001. Their results are summarized below and are available in detail in Dickerson, Reine, and Clarke, 2001. During this study, the greatest sound levels were produced by the clamshell striking the sea bottom. These sounds ranged from approximately 95 to 122 db re 1 µPa, levels that are near ambient conditions for most of Upper Cook Inlet. It should be noted that this study only measured underwater sounds associated with a dredge (i.e. bottom contact, bucket digging, bucket closing, winch up, and barge loading). Sounds produced by the tug needed to move the dump barge or the barge on which the dredge was stationed was not recorded. Based on data provided above for tugs, it is reasonable to conclude that the tug would create the strongest sound source during the dredging operation where clamshell dredges are involved. The majority of underwater sounds produced by bucket dredging operations occur in relatively low frequency ranges, primarily 20 to 1,000 Hz. As is typical, noise levels decreased with increasing distance from the source. Sound pressure levels diminished from 15 to 30 dB re 1 µPa at 150-meter (492 feet) and 5,500-meter (about 18,000 feet) distances, respectively. In this study dredge sounds were audible at 5,500 meters, whereas at 7,000 meters (about 23,000 feet), only the most intense event, that of the bucket striking the bottom, remained faintly audible.

The apparent maximum detection distance of 7 km (about 4 miles) observed in this study is much lower than that reported for the Beaufort Sea and is probably influenced in large part by bottom composition and concentrations of suspended sediment. Much greater detection distances for dredge noise above ambient were reported by Greene (1987, 1985), who measured broad-band (20-1,000 Hz) noise emitted by a hydraulic cutter head-pipeline dredge at ranges extending to 25 km (about 15 miles) in the Beaufort Sea. Also in the Beaufort Sea, Miles, Malme, and Richardson (1987) and Miles et al. (1986) recorded sounds produced by a bucket dredge, noting most intense sounds in the 1/3 octave at 250Hz, ranging from 150 to 162 dB re 1 μPa-m.

Unlike the Beaufort Sea, Cook Inlet waters near the POA have extremely high suspended sediment loads. High prevailing suspended sediment concentrations may have a pronounced sound-scattering effect, thereby reducing sound detection distances rapidly compared with sounds emitted from sources in clear oceanic waters. For example, Richards, Heathershaw, and Thorne (1996) reported that concentrations on the order of 20 mg/L could cause an attenuation of 3 dB over a path length of 100 meters at 100 kHz. Although sediment concentrations were not measured when the bucket dredge noise was measured in 1999 and 2000, suspended sediment concentrations were measured near POA in 2006 and 2007 (USACE, unpublished data). In September and October 2006 suspended sediment concentrations ranged from approximately 1,000 to 2,500 mg/L; concentrations that are more than ten times greater than those reported to cause an attenuation of 3 dB over a path length of 100 meters at 100 kHz. Thus, site-specific conditions should be an important consideration in evaluating dredging-related underwater noise at the POA.

Miles, Malme, and Richardson (1987) and Miles et al. (1986) reported that the loudest sounds measured in their study were produced during the winching of the loaded bucket up through the water column. In contrast, the winching events recorded by Dickerson, Reine, and Clarke (2001) were relatively weak in terms of acoustic energy compared with that of the bucket striking the bottom. This variability indicates that the condition of the dredge plant greatly affects the character of the sounds produced. Poorly maintained or lubricated mechanical gear can potentially generate very intense sounds. The character of bucket dredging sounds also appears to be greatly influenced by the granulometry of the sediments being dredged; i.e., a bucket impacting coarse sands and gravels, as exemplified by the dredge *Viking* performing deepening work in coarse sand and gravel, produced very different, less intense sounds from those of the dredge *Crystal Gayle* performing maintenance work in unconsolidated mud. Miles, Malm, and Richardson (1987) and Miles et al. (1986) also noted that the noise from the tug and barge used to transfer the dredged material was stronger than that produced by the clamshell dredge. Pipeline dredge noise was measured in the Beaufort Sea on two separate dredges and produced sounds of 135-140 dB re 1 μPa-m (20-1000 Hz) at a range of 0.5 km (0.3 mile) from the source. A hopper dredge in the same area produced approximately 150 dB re 1 μPa-m at the same frequency range and distance. In the Beaufort Sea, these broadband sounds were detectable to about 25 km (15 miles), although some strong tones were likely to be detectable at greater distances. Low frequency sounds predominated in recording of pipeline and hopper dredges (Richardson *et al.* 1995). As previously stated, sound level attenuation rates are greater with increased concentrations of suspended sediment. Therefore, sounds produced from hopper and pipeline dredges would likely travel much shorter distances.

Aircraft Noise. Though aircraft noise is not influenced by the dredging project it is presented here with the intent of providing a complete and realistic description of the sound environment within the Cook Inlet Navigation Channel.

During transmission of sound from air to water, a large amount of the acoustic energy is reflected by the water surface. In the case of an overhead sound source, such as an aircraft, most (but not all) of the sound at angles greater than 13 degrees from the vertical is reflected and does not penetrate the water (the area of maximum transmission under an aircraft can therefore be visualized as a 26 degree cone with the aircraft at the apex). This is particularly true if the conditions are calm, the water is deep or the water is shallow but with a non-reflective bottom (Richardson *et al.* 1995). When waves are present, they provide suitable angles for additional transmission, but only above certain frequencies (Lubard and Hurdle 1976). Water depth and bottom conditions (i.e., whether the bottom is reflective to sound or not) also have an important influence on the propagation of aircraft sound underwater.

Broadband levels recorded underwater all fell in the range of 110 to 125 dB re 1 μPa for the commercial aircraft when measured offshore from the Stevens (Anchorage) International Airport and up to 135 dB re 1 μPa for one F-15 military jet measured offshore from JBER during August 2001. "Ambient" broadband levels, recorded in the same locations while no over flights were taking place, were higher for Elmendorf Air Force Base (119 dB re 1 μPa) than for Anchorage International Airport (105 dB re 1 μPa).

Other Sources of Underwater Noise. In an acoustic study conducted at the POA in October 2007, hydrophones were used to measure sound propagation during both impact and vibratory pile driving (Federal Register, March 2008). For impact pile-driving, the most conservative measurement showed that at 19 meters (62 feet), the received level was 177 dB re 1 μPa (root mean square (rms), ranging from 100-15,000 Hz. For vibratory pile-driving, the most conservative measurement showed that at 20 meters (66 feet) the received level was 162 dB, ranging from 400 2,500 Hz. These measurements were used to estimate the distances at which animals might be exposed to received levels that could lead to injury or behavioral harassment. Impact pile driving produces much more energy (*i.e.*, is louder) than vibratory pile driving due to the nature of the operations. However, low frequency sound travels poorly in shallow water, so transmission of these sounds in Knik Arm is expected to be confined to relatively short ranges. Sounds generated from pile driving, dredging, and other construction activities will be detectable underwater and/or in air some distance away from the area of activity. Audible distance, or received levels (RLs) will depend on the nature of the sound source, ambient noise conditions, and the sensitivity of the receptor to the sound (Richardson *et al.*, 1995, USACE 2008).

3.4 Marine Mammals

Seventeen species of marine mammals are reported at least occasionally in Cook Inlet, but only harbor seal (*Phoca vitulina*) and beluga whale (*Delphinapterus leucas*) are commonly observed in Upper Cook Inlet Sheldon *et al.* 2003, NMML 2004).

Beluga Whale. In western U.S. waters, beluga whales comprise five distinct stocks: Beaufort Sea, Eastern Chukchi Sea, Eastern Bering Sea, Bristol Bay, and Cook Inlet (Angliss and Outlaw, 2006). Belugas in Upper Cook Inlet are of the Cook Inlet stock. This population stays in Cook Inlet and is geographically separated from others (Hobbs *et al.*, 2006). The Cook Inlet beluga's range is believed to be largely confined to Cook Inlet with a high occurrence of animals in the upper inlet and Knik Arm during the spring, summer, and fall seasons. These whales demonstrate site fidelity to regular summer concentration areas (Seaman *et al.*, 1985), typically near river mouths and associated shallow, warm, low-salinity waters (Moore *et al.*, 2000).

Fourteen belugas were satellite-tagged in Upper Cook Inlet and Knik Arm between late July and early September 2000–2002. The tags provided location and movement data through the autumn and winter and into May. During summer and autumn, belugas were concentrated in river and bays in Upper Cook Inlet, traveling back and forth between Knik Arm, Chickaloon Bay, and upper Turnagain Arm, although some also spent time offshore. When in those areas, belugas often remained in one area for many weeks followed by rapid movement to another area. Those movements often were between distinct bays or river mouths (moving either to the east or to the west of Fire Island, past Pt. Woronzof and the Port of Anchorage). One beluga tracked in 2001 moved back and forth between those three bodies of water seven times in 3 months. Area use in August was the most limited of all months. Approximately 50 to 75 percent of the recorded August locations were in Knik Arm and were concentrated near Eagle River. In September they continued to use Knik Arm and increased use of the Susitna delta, Turnagain Arm and Chickaloon Bay, and also extended use along the west coast of the upper inlet to Beluga River. In October, beluga whales ranged widely down the inlet in coastal areas, reaching Chinitna Bay and Tuxedni Bay and continued to use Knik Arm, Turnagain Arm, Chickaloon Bay, and Trading Bay (MacArthur River).

November use was similar to September. In December, belugas moved offshore with locations distributed throughout the upper to mid-inlet. In January, February, and March, they used the central offshore waters, moving as far south as Kalgin Island and slightly beyond. Belugas also ranged widely during February and March with excursions to Knik and Turnagain Arms, in spite of greater than 90 percent ice coverage. Average daily travel distance ranged from about 7 to 19 miles. Belugas were not tracked by satellite tags from April through mid July. Historic data suggest the Cook Inlet beluga population once numbered around 1,300 (Calkins, 1989), but it has declined significantly. Systematic aerial surveys counted 653 belugas in 1994 and 347 belugas in 1998 (Hobbs *et al.*, 2000). Aerial surveys conducted each June/July from 1999 to 2005 produced estimates of 367, 435, 386, 313, 357, 366, and 278 belugas for each year, respectively (Rugh *et al.*, 2005, NMFS unpublished data). A NMFS 2006 stock assessment report estimated the Cook

Inlet beluga population at 278, with a minimum population estimate of 238. The 2006 survey estimated the population to be 302 belugas (Rugh *et al.*, 2006). Subsistence harvest is believed to have been the major contributor to the population decline (Federal Register 2008). This stock is listed as depleted under the Marine Mammal Protection Act and was proposed for listing under the Endangered Species Act on April 20, 2007 (72 FR 19854).

Cook Inlet beluga distribution has narrowed as their population declined (Rugh *et al.*,2000); however, there is obvious and repeated use of certain habitats. From April through November, whales concentrate at river mouths and tidal flat areas, moving in and out with the tides. The timing and location of eulachon and salmon runs affect beluga whale feeding behavior and have a strong influence on their summer movements. Beluga and prey distribution are heavily influenced by tides in Knik Arm. Monitoring data in 2006 reported approximately 70 percent of sightings at the POA were around low tide.

Beluga whales are opportunistic feeders. They eat octopus, squid, crabs, shrimp, clams, mussels, snails, sandworms, and fish such as capelin, cod, herring, smelt, flounder, sole, sculpin, lamprey, lingcod, and salmon (Perez, 1990; Haley, 1986; Klinkhart, 1966). Belugas capture and swallow their prey whole, using their blunt teeth only to grab. They often feed cooperatively. Hazard (1988) hypothesized that beluga whales were more successful feeding in rivers where prey were concentrated than in bays where prey were dispersed. Concentrations of Cook Inlet belugas offshore from several important salmon streams in the Upper Cook Inlet are assumed to be a feeding strategy that takes advantage of the bathymetry. The fish are funneled into the channels formed by the rivers where they are more vulnerable to the waiting belugas. At the POA, belugas have been observed to position one whale along a rip-rap dock, while a second whale herded salmon along the structure toward the stationary beluga.

NMFS characterized the relative value of three types of habitat based on usage patterns as part of the conservation strategy presented in the Conservation Plan for the Cook Inlet Beluga Whale (*Delphinapterus leucas*) (NMFS 2008). As a result, Cook Inlet has been stratified into three habitat regions (figure 6).

- Type 1 habitat is the most valuable due to its intensive use by beluga whales from spring through fall for foraging and nursery purposes.
- Type 2 habitat includes areas with high fall and winter use, and a few isolated spring feeding areas.
- Type 3 habit encompasses the remaining portions of the Cook Inlet beluga whale range.

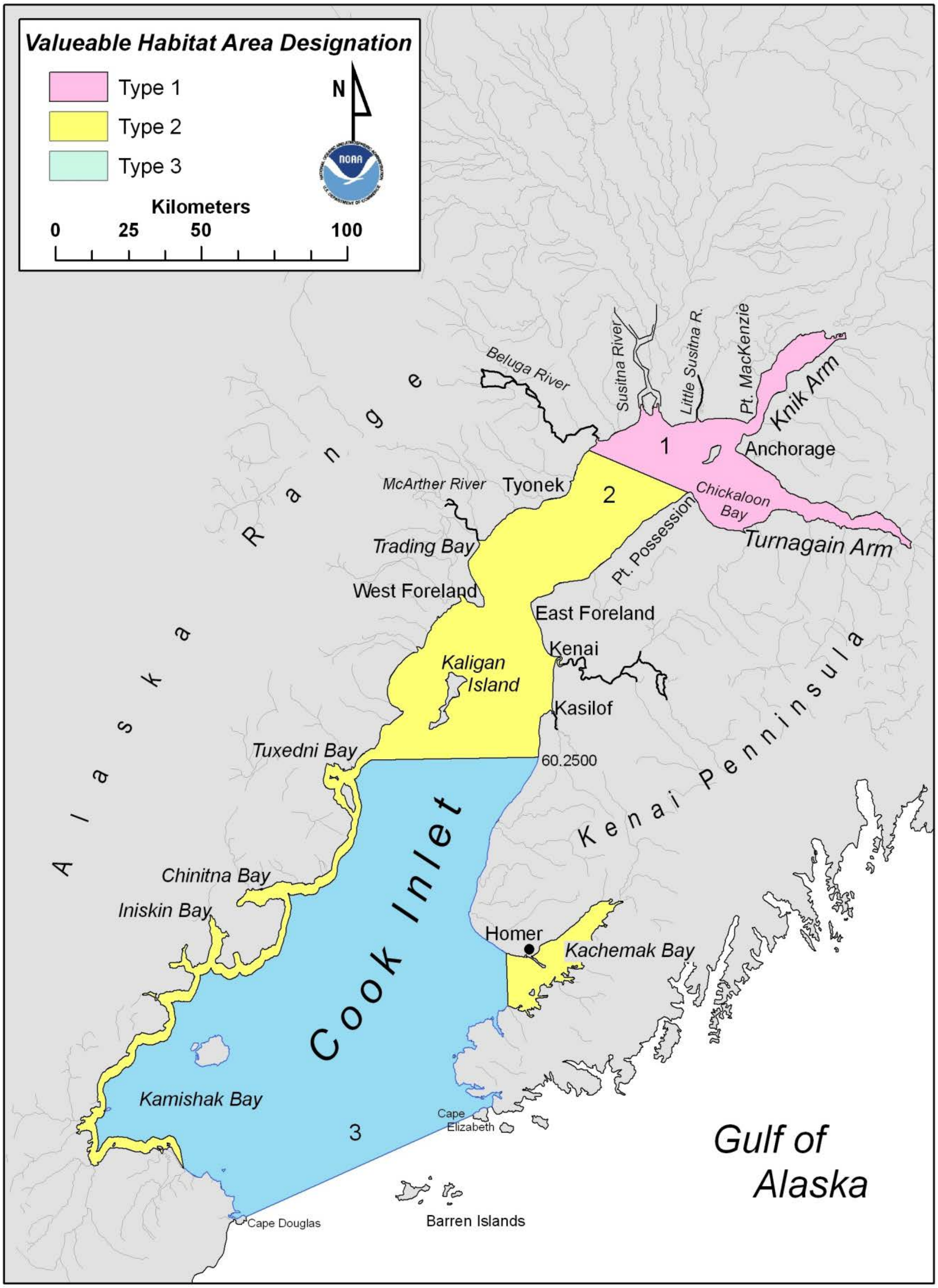

Figure 6. Valuable Habitat Areas (Types 1, 2, and 3) Identified for Cook Inlet Beluga Whales

(Source: Conservation Plan for the Cook Inlet Beluga Whale, NMFS 2008.)

Type 1 habitat encompasses all of Cook Inlet northeast of a line 4.8 km (3 miles) southwest of the Beluga River across to Point Possession. This area is full of shallow tidal flats, river mouths, and estuarine areas, and is important for foraging and calving purposes. These shallow areas may also provide for other biological needs, such as molting or escape from predators. Type 1 habitat also has the highest concentrations of beluga whales from spring through fall and has the greatest potential to experience impacts from anthropogenic threats (NMFS 2008). All marine waters in the action area are categorized as Type 1 habitat.

Beluga peak hearing sensitivity underwater is between 10 and 100 kHz (summarized in Richardson *et al.* 1995); at the most sensitive frequencies within that range their hearing threshold approaches 42 dB re 1 μPa. The bandwidth of their hearing extends to as high as 150 kHz , but above 100 kHz their sensitivity drops off rapidly (Au 1993). Below 8 kHz, the decrease in sensitivity is more gradual, approximately 11 dB per octave (Awbrey *et al.* 1988). Beluga whales are able to hear frequencies as low as 40-75 Hz (Johnson *et al.* 1989), but at those frequencies their sensitivity is quite poor (the threshold level at 40 Hz is on the order of 140 dB re 1 μPa). For comparison, humans with the keenest hearing have a bandwidth about one-eighth that of beluga whales (Au 1993).

This type of information is obtained from behavioral audiograms on trained captive animals. Audiograms represent the lowest levels of sound that an animal can detect in a quiet environment, which is usually different from conditions animals are subjected to in the wild. Critical ratios express the amount (in dB) by which a pure tone signal must exceed the spectrum level background noise (in dB re 1 μPa2/Hz) to be audible. In belugas, critical ratios are on average below 20 dB (re 1 Hz) up to frequencies of about 3 kHz; at higher frequencies the critical ratios continue increasing exponentially, reaching 25 to 30 dB at 20 kHz and 40 to 50 dB at 100 kHz (Johnson *et al.* 1989). Depth (i.e., pressure) has no effect on beluga hearing sensitivity (Ridgway *et al.* 2001). The same study also found that threshold levels for 500 Hz were 16 to21 dB lower than previously published numbers (i.e., Awbrey *et al.* 1988, Johnson *et al.* 1989) and hypothesized that this difference may be attributable to differences in methodology (Schusterman 1974).

Harbor Seal. Harbor seals are important upper trophic marine predators that occupy a broad range in Alaska from approximately 130ºW to 172ºE (more than 2,000 miles east to west) and from 61ºN to 51ºN (more than 600 miles north to south). Harbor seals in Alaska are in three stocks: Bering Sea, Gulf of Alaska (GOA), and Southeast Alaska. New genetic information may lead to a reassessment of this delineation. Harbor seals in Upper Cook Inlet belong to the GOA stock. Based on aerial GOA and Aleutian Islands surveys in 1996 and 1999, the current abundance estimate for this stock is 45,975 (CV = 0.04), with a minimum population estimate of 44,453 (Federal Register, 2008).

Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice. They feed in marine, estuaries, and occasionally in fresh waters. They are generally non-migratory, with local movements associated with tides, weather, season, food availability, and reproduction; however, some long-distance movements have been recorded from tagged animals (mostly juveniles). The major haul-out sites for harbor seals are lower Cook Inlet. The identified harbor seal haul-out closest to the POA is approximately 25 miles south along Chickaloon Bay in southern Turnagain Arm. They sometimes are observed around the port. In 2004–2005, 22 harbor seal sightings were reported over a 13-month period comprising 14,000 survey hours. From these surveys, it is estimated that about 1.7 harbor seals are in Knik Arm per month. Pinniped hearing is measured for air and water. In water, hearing ranges from 1to180 kHz with peak sensitivity around 32 kHz. In air, hearing capabilities are greatly reduced to 1to 22 kHz with sensitivity at 12 kHz. This range is comparable to human hearing (0.02 to 20 kHz). Harbor seals have the potential to be affected by both in-air and in-water noise.

Orca Whale. Orca whales (*Orcinus orca*) in the Gulf of Alaska are divided into two ecotypes: resident and transient. Orca whales are relatively common in lower Cook Inlet (at least 100 sightings from 1975 to 2002), but in the upper inlet, north of Kalgin Island, sightings are infrequent (11 in 25 years). Transient orca whales are known to feed on the Cook Inlet stock of beluga whales and all recorded predation events were in the upper inlet. Transient orca whales in Cook Inlet belong to the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock or the small AT1 Stock. Based on the 2006 NMFS stock assessment reports, the minimum population estimate for the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of orca whales is 314 animals based on the count of individuals using photo-identification. As of 2004, the AT1 population size is 8, a 64 percent decrease from 22 whales in 1989. Orca whale hearing is well developed. They have hearing ranges from 0.05 to 100 kHz, which is lower than many other odontocetes. Peak sensitivity is around 15 kHz.

Harbor Porpoise. Harbor porpoise (*Phocoena phocoena*) are in Cook Inlet but are rarely in Knik Arm. NMFS (2006) estimated the Gulf of Alaska stock at 41,854 with a minimum population estimate of 34,740. Estimated density of harbor porpoise in Cook Inlet is only 7.2 per 1,000 square kilometers (385 square miles) (Dahlheim *et al.* 2000). The highest monthly count recorded in Upper Cook Inlet between April and October was 18. Harbor porpoise have a wide hearing range and the highest upper-frequency limit of all odontocetes studied. They have a hearing range of 250 Hz to180 kHz, with maximum sensitivity between 16 and 140 kHz.

3.5 Invertebrates

Marine invertebrates include forms like polychaete worms that burrow into the bottom, snails and bottom-dwelling crustaceans that live on the top of the seafloor, and the many forms of sea life in the water column such as shrimp, smaller crustaceans, and the sub-adults forms of bottom-living species (table 1). Diversity of marine invertebrates in Knik Arm is extremely limited. Pentec (2005), summarizing extensive studies between 1982 and 2004 for a Knik Arm bridge, identified fewer than a dozen species of marine invertebrates from both the bottom and the water column. The collections also were unusual because most of the same species were collected both from the bottom and from the water column. The Pentec report suggested that severe scouring, mixing, and sediment transport may carry normally bottom-dwelling polychaete worms, mysid and crangonid shrimp, and amphipods up into the water column. Densities of these small organisms were about the same in most places sampled, which also indicates an unusual degree of mixing. The only notable stratification in the deeper waters was by one species of amphipod that was unusually abundant just beneath the surface in pockets and lenses of water with less suspended sand and silt than in most Knik Arm water. Knik Arm has often been described as a "sterile" environment, almost devoid of fish and invertebrates except for anadromous fish moving through the arm to and from spawning habitat. The Knik Arm studies did not find as many invertebrates as might be found in central and southern Cook Inlet, but did find more invertebrate numbers than might have been expected. Collections in a net towed through two transects in deeper water near the Corps' historically used dredged material disposal site collected an average of about 250 invertebrates per tow. They were mostly small, almost clear, crustaceans. Many of the little amphipods that made up most of the collection were so small that, if given time, they could crawl through the ¼ - inch mesh of the net bag. Kink Arm collection data suggest that in the spring, summer, and autumn periods when invertebrates were collected, the numbers of invertebrates present in Knik Arm are low for marine waters and the diversity is extremely low. There are, however, invertebrates that could be prey for birds and fish. The most promising habitat for predators that might feed on the little amphipods is in the small pockets of surface water with comparatively little sediment where sight-feeding birds and fish might be able to locate them. While marine invertebrates are relatively limited in availability to predators, terrestrial insects are apparently relatively abundant on the surface of Knik Arm waters. Aphids, dipterans (flies, mosquitoes, midges, and associated flying insects), and other insects are predominant terrestrial insects.

Table1. Marine Invertebrates in Knik Arm Collections

Common Name	**Species Name**
California Bay shrimp	Crangon franciscorum
Blacktail Bay shrimp	Crangon nigricauda
Bay Shrimp	Crangon spp.
Baltic macoma (Clam)	Macoma baltica
Gammarid amphipod	Lagunogammarus setosus
Aquatic sow bug	Saduria entomon
Mysid shrimp	Mysis litoralis
Opossum shrimp	Neomysis mercedis
Mysid shrimp	Neomysis rayii
Gammarid amphipod	Onisimus spp.
Nereid polychaete worm	Neanthes limnicola

Upper Cook Inlet has a relatively low diversity and abundance of zooplankton (except copepods), suggesting that the overall sediment load, silt, debris, and low salinity at certain times of the year combine to severely restrict survival (USACE 1996).

Subtidal benthic organisms are also sparse in Upper Cook Inlet. Burial of organisms by silt, subtidal erosion and scouring of the seafloor by sediment and ice, exceptionally high turbidity, strong currents, low temperatures, and low and fluctuating salinity all combine to create an unusually severe estuarine environment (USACE 1996).

3.6 Fish

Five species of Pacific salmon and two species of smelt migrate through Knik Arm to and from spawning habitat. Recent studies by Pentec (2005) reported other species that are occasionally or seasonally present, including herring larvae drifting in the water column as plankton. Table 2 lists the species identified in Knik Arm by those studies. The results of these studies are backed up by sampling trawl results conducted by NOAA's Alaska Marine Fisheries Science Center, Auke Bay Laboratories staff on November 18, 2009 and July 27, 2010. Knik Arm has long been identified as habitat for migrating anadromous fish, but only more recently have biologists shown that juvenile salmon can survive and grow in Upper Cook Inlet, including Knik Arm (Moulton 1997, Pentec 2005), at rates that may not be too different from those in Prince William Sound. Juvenile salmon were not substantially more abundant close to shore in Knik Arm, which is somewhat unusual. Pentec (2005) attributed this to the cover provided by the turbid water, which protected them from predators. The same source also noted that juveniles did not school in Knik Arm, presumably because they did not need the protection from predation or because they could not see each other well enough to maintain a cohesive school. All the juvenile salmon reported in Knik Arm literature were collected within 10 feet of the water surface. Seasonal abundance matched well with times when juvenile salmon typically migrate out from their home streams and occupy nearby marine waters.

Collections in Knik Arm and nearby waters show that pink and chum salmon juveniles, which out-migrate in their first year, are seasonally abundant, but move rapidly through the area, presumably to clearer waters farther south in Cook Inlet and eventually the Pacific Ocean. The juveniles of those species are not particularly well-adapted to feeding on surface prey and are too small to eat most of the available marine invertebrates, so they need to get to waters where food is available farther south in Cook Inlet. Chinook, sockeye, and coho salmon, however, are adapted to feed on surface prey and apparently survive and grow well in the waters around Anchorage, including Knik Arm. The most common food organisms in their stomachs were terrestrial insects, particularly aphids and dipterans. They also consumed other insects, herring larvae, polychaete worms, and a variety of other invertebrates. Those juvenile salmon were collected from the time they out-migrated into Knik Arm until well into the autumn. They were reported to be well fed and growing. Adult salmon returning to spawning streams in the Knik Arm drainage may be in Upper Cook Inlet and Knik Arm for days or weeks before entering their spawning streams. Pentec (2005) reported that adults tended to remain close to shore, often in less than 2 feet of water. They suggested this near-shore orientation was to avoid beluga whales, which prey on adult salmon.

The most common fish in Knik Arm collections were sticklebacks. Both three-spined and nine-spine were collected, but three-spined sticklebacks were far more numerous. These small and extremely hardy little fish are abundant in the fresh and brackish marshes around Knik Arm and may do well in estuarine waters. They, like the juvenile salmon, were widely distributed in both near-shore and deeper waters. Pacific herring were present both as adults in the spring and as juveniles throughout the seasons sampled. They were most abundant as small larvae, drifting as plankton with the tide and currents. They were not abundant as larger juveniles. No important habitat was identified. Two smelt species were seasonally abundant. Eulachon return to the area each spring to spawn in coastal beaches, and longfin smelt return to spawn in the autumn. Both migrate through the general project area, but the only identified important habitats are the coastal streams and nearby beaches. Bering cisco are whitefish that are generally associated with coastal waters with less than marine salinity. Several species of marine fishes move into near-shore or estuarine waters when conditions are favorable. Among them are saffron cod, Pacific tom cod, ringtail snailfish, Pacific staghorn sculpin, starry flounder, walleye pollack, and snake prickleback that were occasionally collected in Knik Arm or nearby waters. Most were collected in relatively small numbers and were most abundant during the winter or at least were most abundant in collections after sediment loads had begun to drop in early autumn. Saffron cod was the most abundant of these fish. They were reported to be in spawning condition and well-fed. Dolly Varden and rainbow trout can be freshwater fish or can be anadromous. Since they were not collected in any abundance, they probably were passing through Knik Arm to or from freshwater habitat.

Table 2. Fish in Knik Arm Collections

Common Name	**Species Name**
Pink salmon	Oncorhynchus gorbuscha
Chum salmon	Oncorhynchus keta
Coho salmon	Oncorhynchus kisutch
Chinook salmon	Oncorhynchus tshawytscha
Sockeye salmon	Oncorhynchus nerka
Rainbow trout	Oncorhynchus mykiss
Dolly Varden	Salvelinus malma
Saffron cod	Eleginus gracilis
Longfin smelt	Spirinchus thaleichthys
Threespine stickleback	Gasterostreus aculeatus
Ninespine stickleback	Pungitius pungitius
Bering cisco	Coregonus laurettae
Pacific herring	Clupea pallasii
Ringtail snailfish	Liparis rutteri
Pacific Staghorn sculpin	Leptocottus armatus
Starry flounder	Platichthys stellatus
Eulachon	Thaleichthys pacificus
Pacific Tom cod	Microgadus proximus
Walleye pollock	Theragra chalcogramma
Snake prickleback	Lumpenus sagitta
Unidentified flatfish	
Unidentified larval fish	

3.7 Essential Fish Habitat

Essential Fish Habitat (EFH) has been designated by the NMFS for the following species within and adjacent to the proposed projects footprint:

Pacific Salmon – sockeye, pink, coho, chum and Chinook.

GOA Groundfish – big skate, longnose skate, octopus, sharks, shallow water flatfish complex.

BSAI Groundfish – octopus (Bering Sea), forage fish complex, sharks (Bering Sea), squid complex.

NMFS EFH Mapper website (http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html), the EFH assessment for the Knik Arm Crossing (KABATA 2006) 2 miles north of the POA, and the 2008 EFH assessment for the POA were used to develop this EFH assessment for dredging and disposal.

3.7.1 Importance of EFH Species Stocks in Upper Cook Inlet

Most fish species with designated EFH near the Cook Inlet Navigation Channel are important sport or commercial fishery species in Cook Inlet and its tributaries, and are prey species depending on life stage for beluga whales and most other marine mammals utilizing the area.

3.7.2 Importance of EFH Species to Beluga Whales

Knik Arm EFH species Pacific cod, sculpin, walleye pollock, eulachon, and likely all five Pacific salmon species have been found in the stomachs of Cook Inlet beluga whales. Stomach contents in April and May included Knik Arm EFH species walleye pollock, Pacific cod, eulachon, and unidentified salmon; July through September contents consisted primarily of salmon; and contents from October contained Knik Arm EFH species Pacific staghorn sculpin (*Leptocottus armatus*). Beluga also fed on other species that do not have EFH near the Cook Inlet Navigation Channel. (KABATA 2006)

3.7.3 EFH Species in the Study Area

Groundfish

Pacific Cod. No Pacific cod were collected in KABATA (2006a) shoreline sampling of Knik Arm during July through November 2004 or in shoreline and mid-channel sampling in April through July 2005. Pacific cod also were not caught during extensive seine and trawl surveys in Knik Arm in 1983 (FHWA 1984 and ADOT&PF), suggesting that the density of this species is very low or zero in Knik Arm.

Sculpin spp. The sculpin family (Cottidae) contains numerous species that have successfully adapted to a wide range of salinities and environments. The only cottid species collected in Knik Arm was the Pacific staghorn sculpin, suggesting that this may be the only cottid in Knik Arm.

Walleye Pollock. Only three walleye pollock were collected during a 2-year sampling effort of Knik Arm (KABATA 2006). They were caught in beach seine sampling conducted in April through July 2005. No walleye pollock were collected during extensive trawl and beach seine sampling in 1983 (FHWA 1984 and ADOT&PF). These data indicate that density of this species is low within Knik Arm.

Forage Fish

Eulachon. Eulachon spawn in Upper Cook Inlet streams, including those of Knik Arm, in April and are present until early summer. The personal use fishery typically takes gravid adults in April and post spawning adults in May.

Pacific Salmon Species. Juveniles and adults of five Pacific salmon species use Knik Arm. Adult salmon use the near shore environments of Knik Arm as a migratory corridor to river and stream spawning and rearing areas between May and September (KABATA 2006a). Juvenile salmon numbers peak in Knik Arm from May into August, depending on species, and are found in the near shore environment as well as in mid-channel surface waters (Moulton 1997; KABATA 2006a). Analysis of length, frequency, and timing patterns suggests that juvenile pink and chum salmon move through Knik Arm relatively quickly and do not grow much in this environment. On the other hand, Knik Arm may be important rearing habitat for the juvenile coho, Chinook, and sockeye salmon emerging from streams and rivers that discharge into Knik Arm. Juveniles of these species appear to be feeding and growing actively in Knik Arm into August (FHWA 1984 and ADOT&PF; Moulton 1997; KABATA 2006).

Coho Salmon. Shoreline sampling of Knik Arm from July through November 2004 and shoreline and mid-channel sampling in April through July 2005 showed that coho juveniles were relatively abundant in Knik Arm during May through July and present into late November (KABATA 2006). Coho salmon were the most abundant juvenile salmon captured in beach seine sampling in 2005 and the second most abundant in 2004. Adults were commonly caught in beach seines during July and August. These results are consistent with the reported Anchorage, Matanuska-Susitna freshwater runtime peak of August (present from July through September) for adult coho salmon (ADF&G 2005a). No adult coho salmon were captured in Knik Arm after August.

Chum Salmon. Shoreline sampling of Knik Arm from July through November 2004 and shoreline and mid-channel sampling in April through July 2005 collected a few chum salmon juveniles in April followed by significant increases in May and June. No chum salmon juveniles were collected in the 2004 and 2005 July samples. Chum salmon were fourth in abundance relative to all juvenile salmonids behind coho, Chinook, and sockeye salmon. Adults were caught in beach seine samples during July. This is consistent with the reported Anchorage, Matanuska-Susitna freshwater runtime peak of July and August (present July through September) for adult chum salmon (ADF&G 2005a). No adult chum salmon were captured from August to November beach seining.

Pink Salmon. No juvenile pink salmon were observed from July through November 2004 shoreline sampling of Knik Arm, and few were expected because the larger even-year pink runs in this region of Alaska would produce odd-year outmigrants. In 2005, only 33 pink salmon juveniles were captured in beach seines (1.9 percent of all juvenile salmonids), most of which were captured in May. A few pink salmon juveniles were captured in April, June, and July. Adults were caught in beach seine samples during July. This pattern is consistent with the reported Anchorage, Matanuska-Susitna freshwater runtime peak of July (present during July and August) for adult pink salmon (ADF&G 2005a). No adult pink salmon were captured from August to November beach seining.

Chinook Salmon. Shoreline sampling of Knik Arm from July through November 2004 and shoreline and mid-channel sampling from April through July 2005 indicated highest Chinook juvenile abundance during May and June, with a steady decline in abundance into mid- and late summer. Chinook juveniles were considerably longer in May than in June, perhaps because of the Chinook smolt releases from the Ship Creek hatchery, which occur in May. Only one adult Chinook salmon was captured during 2004 and 2005 sampling. The fish was collected in May, just before reported Anchorage and Mat-Su freshwater runtime peak of June and July (present during May through August) for adult Chinook salmon (ADF&G 2005a).

Sockeye Salmon. Sockeye salmon were the most abundant juvenile salmon collected from July to November beach seine sampling during 2004. During the April through July 2005 sampling period, juvenile sockeye were third in abundance among salmonids, behind coho and Chinook in beach seine samples. Overall, juvenile sockeye catches were variable from May through August, highest in August, lowest in April and September through October, and zero in November. Adults were caught in beach seine samples in July. This is consistent with the reported Anchorage and Matanuska-Susitna freshwater runtime peak of July through August for adult sockeye salmon (ADF&G 2005b). No adult sockeye salmon were captured during August to November beach seine sampling.

3.8 Avifauna

The three primary groups of birds making up the majority of Upper Cook Inlet’s bird population are waterfowl, shore birds, and breeding seabirds. Breeding seabird use is highly seasonal as is migration related waterfowl use. Peak numbers are expected in spring when a combination of spring migration and breeding/nesting season brings the largest annual number of birds into the area. Spring migration begins in late March and peaks from late April to early May. Densities decline in Cook Inlet coastal habitats between spring and summer. Departures of shorebirds and waterfowl account for the majority of the decline (MMS 2002). While densities of most bird species drop off sharply during fall, dabbling duck and geese densities rise as the fall migration progresses. “Fall migration movements in Cook Inlet begin in July and end in November.

Shorebirds are the first to move into the area and probably the last to leave. By August, waterfowl begin to move south through the area, and wintering sea ducks begin to arrive. By early October, most breeding migrants and non-breeding summer-season migrants have left." (MMS 2002)

Bird habitat involved with the dredging and disposal activities is aquatic. Corps activities would be offshore in water that has suspended sediment concentrations as high as 2400 mg/L in the summer and early fall when dredging and disposal would take place.

For maintenance dredging related to the Anchorage Harbor Dredging and Disposal Environmental Assessment (USACE 2008), which forms a major portion of this document's referenced background information or related analysis, Corps biologists surveyed the intertidal and shallow subtidal habitat from the Anchorage boat launch ramp (i.e. about 300 meters [984.2 feet] south of the mouth of Ship Creek) from one to four times per month from spring through late fall in 2006. The survey area extended from the boat ramp to approximately one-half mile south. One sector, which covered approximately the lowest 300 feet of intertidal habitat and the nearest 300 feet of subtidal aquatic habitat (both distances measured horizontally), was routinely surveyed during this period, although depending on the tide level the entire sector was sometimes completely submerged or nearly completely exposed. Bird activity observed in this survey sector provides insight into the near shore bird habitat near the POA and similar habitats in adjacent areas in Upper Cook Inlet. Other than a single observation of 78 Canada geese, most birds observed were mew gulls (36 total in 10 surveys), followed by Bonaparte's gulls (13 in 10 surveys), and followed by lesser numbers of herring gulls, mallards, arctic terns and a single western sandpiper. Many of the gulls counted were flying and the Canada geese and mallards were foraging on either the exposed mudflats or at the tide line. As previously noted the area to be dredged is not intertidal so the most likely birds in the project area would be gulls and waterfowl that are flying, resting or foraging at or very near the water's surface. Given the water depth and high suspended sediment loads, it is unlikely that ducks or geese would be found in the project area in appreciable numbers on a regular basis.

3.9 Threatened and Endangered Species

3.9.1 Vegetation.

There are no marine species of aquatic vegetation listed in Alaska.

3.9.2 Fish.

All West Coast salmon species (and associated Evolutionary Significant Units [ESU's]) currently listed as threatened or endangered under the ESA originate in freshwater habitat in Washington, Idaho, Oregon, and California. No stocks of Pacific salmon or steelhead from freshwater habitat in Alaska are endangered species.

3.9.3 Marine Mammals.

Eight species of whales listed as endangered by the NOAA Fisheries under the ESA are found in Alaska waters. They are: sperm whale (*Physeter macrocephalus*); bowhead whale (*Balaena mysticetus*); humpback whale (*Megaptera novaeangliae*); northern right whale (*Eubalaena japonica*); fin whale (*Balaenoptera physalus*); sei whale (*Balaenoptera borealis*); blue whale (*Balaenoptera musculus*), and Beluga Whale (*Delphinapterus leucas*) (NOAA Fisheries 2004a, http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/). Fin, sei, and humpback whales occasionally range into the lower-most sections of Cook Inlet, but are uncommon to rare in Upper Cook Inlet. Four species are generally found in deeper offshore waters of the Gulf of Alaska, Bering Sea, and Beaufort Sea, and are not in Upper Cook Inlet (NOAA Fisheries 2003a). Only Beluga whales are indigenous to Upper Cook Inlet.

The endangered western population of Steller sea lion (*Eumatopias jubatus*) and the proposed threatened distinct population segment of northern sea otter (*Enhydra lutris kenyoni*) range into Lower Cook Inlet, but are not known in Upper Cook Inlet (NOAA Fisheries 2003b, USFWS 2004a)

3.10 Cultural and Historic Resources

Section 3 of USACE 1996 briefly discusses the anthropogenic history of the Upper Cook Inlet area and is incorporated by reference. Coordination of the proposed project with the Alaska State Historic Preservation Office has demonstrated no known cultural, historic or shipwreck resources within the proposed projects off-shore footprint.

3.11 Subsistence Resources

The majority of Upper Cook Inlet is a non-subsistence area http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.nonsubsistence. A non-subsistence area is an area in which the Joint Board of Fisheries and Game determines that 12 principal characteristics of the economy, culture and way of life are not dependent on subsistence, and therefore, does not authorize subsistence harvesting within that area. Most of the off-shore area immediately around Anchorage is a non-subsistence use area. Tyonek's subsistence fishery is the closest subsistence use fishery to the area proposed to be dredged.

3.11.1 Subsistence Fishing

For season dates, species, locations applicable to the Upper Cook Inlet area see 2012 – 2013 Subsistence and Personal Use Statewide Fisheries Regulations, Cook Inlet Area. NOAA characterizes what constitutes subsistence fishing in Upper Cook Inlet and the somewhat problematic definition of what is subsistence versus sport fishing in Upper Cook Inlet. As noted above there is very limited subsistence fishing in Upper Cook Inlet.

3.11.2 Subsistence Hunting

NOAA also briefly characterizes subsistence hunting in Upper Cook Inlet. Water based subsistence hunting in Upper Cook Inlet is also very limited.

3.12 Socioeconomic Resources

3.12.1 Population

Per 2010 U.S. Census Bureau data the population of Anchorage was 291,826 persons. The primary racial breakdown was 66.0 percent white, 5.6 percent black, 7.9 percent American Indian or Alaska native, 8.1 percent Asian with the remaining 12.4 percent comprised of other racial or mixed racial groups.

3.12.2 Employment and Income

Anchorage is by far the largest and most diverse community in the State and also has the most diverse employment and income profiles.

The largest industries measured by employment are as follows:

Government	31,300	20.7%
Trade	21,700	14.3%
Health & Education Services	21,600	14.3%
Business & Professional Services	18,400	12.2%
Leisure & Hospitality	15,700	10.4%
Transportation	10,800	7.1%
Financial Activities	8,900	5.9%
Construction	8,400	5.6%
Other Services	5,700	3.8%
Information	4,100	2.7%
Oil, Gas & Mining	2,800	1.9%
Manufacturing	1,900	1.3%

(http://aedcweb.com/aedcnew/index.php/anchorage-fast-facts)

Income distribution in Anchorage breaks down as follows: (K = thousand)

Over 200K	6%
Over 150K	7%
Over 125K	7%
Over 100K	10%
Over 75K	17%
Over 60K	11%
Over 50K	8%
Over 45K	5%
Over 40K	4%
Over 35K	4%
Over 30K	4%
Over 25K	4%
Under 25K	13%

(http://www.city-data.com/income/income-Anchorage-Alaska.html)

3.13 Marine Economic Activity

The Cook Inlet Navigation Channel is primarily designed to serve deep draft vessels. The January 2012 Cook Inlet Vessel Traffic Study (Eley 2012) notes that large vessel traffic, vessels over 300 gross tons with a fuel capacity over 10,000 gallons, is expected to increase over the next 10 years at a rate of between 1.5 and 2.5 percent annually. The major component of marine economic activity within Upper Cook Inlet is the shipment of goods and/or bulk cargos into or out of the Ports of Anchorage and Mackenzie. Within the last 10 years the Port of Anchorage has averaged receipt of 4.3 million tons of primarily freight, dry bulk goods, containers, vehicles and petroleum annually as well as deep draft cruise ships. Port Mackenzie currently exports primarily wood chips and cement. Ninety percent of all goods shipped to Alaska enter through Anchorage's ports via the Cook Inlet Navigation Channel and are then shipped throughout the State. The primary types of commercial vessels (not necessarily deep draft vessels) operating in Upper Cook Inlet in decreasing order of activity include tugs, cargo vessels, tug/tank barges, tank ships, cruise ships and fishing vessels.

4.0 Environmental Consequences

4.1 Marine Environment

4.1.1 No Action

No test or maintenance dredging would occur. Water quality would remain the same as it is now including overall trends in changes to water quality that result from activities not including project related dredging actions (cumulative actions).

4.1.2 Proposed Action

The proposed action is to dredge approximately 2 million cubic yards (cy) per year for the next 5 years to remove 10 million cubic yards of material in the vicinity of the Knik Arm Shoal of Cook Inlet. The proposed action includes up to 50,000 cy production test run dredging action as needed. The proposed action may utilize USACE's hydraulic hopper dredge Essayon's, the hopper dredge "Westport," or other contract dredges.

For planning purposes, the 10 million cy would involve approximately 2 million cy each summer over a period of 5 years because the rate of shoaling is unknown. However, USACE recognizes the dynamic environment of Cook Inlet. Some years may require more material to be dredged and disposed of, and some years may require less (or possibly no dredging). Maintenance dredging of the existing channel to the maximum depth of -43 feet MLLW, width of 1,100 feet and length of 11,000 feet would consist of hydraulic and or clamshell dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the Fire Island disposal site. Dewatering is necessary to facilitate the movement of the largest quantity of dredged material in the hopper or scow load, therefore minimizing vessel traffic related to the dredging action. In-water disposal of dredged material would consist of dredged material being placed north of Fire Island in the existing disposal site. The NEPA analysis for this project includes the effects of maintenance dredging of the Knik Arm Shoal of the Cook Inlet Navigation Channel and in-water disposal of the material over the next 5-year interval.

Water quality and other effects of sediment re-suspension resulting from various aspects of the dredging process as discussed in this document result in part from the following description of physical effects of the dredging action in relation to the type of dredge used. A detailed discussion of the water quality effects of dredging and disposal is contained in the attached 404(b)(1) analysis (Appendix 1).

Physical Effects of Disposal per Dredge Methodology. Montgomery (1986) in EEDP-01-2 described the results of research into the "Fate of Dredged Material During Open-Water Disposal." The research and related results demonstrated the following physical effects/processes of the open-water disposal process resulting from instantaneous discharge from a barge or hopper (figure 7). The behavior of the material disposed of is divided into three distinct transport phases: convective descent, dynamic collapse, and passive diffusion. Upon release the dredged material flows downward (descent phase) through the water column as a dense fluid like jet. The jet and its core of cohesive material collapses (diffusive phase) usually as a result of impact on the bottom. Non-cohesive material or material descending more slowly may move radially around or down current/slope at the disposal site. Very low density material at any point in the descent process may move directly laterally through the water column or diagonally down and away from the point directly below the release point due to turbulent shear and other factors (material density, cohesiveness, current speed, tidal forces, vessel movement, stratification within the water column, etc). The study determined that in relation to instantaneous discharge of dredged material from a barge or hopper "…throughout a wide range of sediments, equipment types, and site conditions, the same basic description of the transport process was found to be valid." "Significant concentrations of solids were found only in a well-defined bottom layer, and impacts in the upper water column were minimal." The "amount of material in suspension transported through the upper water column during the placement process was very small (less than 1 percent in most cases)." The water entrained in the descend jet acquired the lateral speed of currents in the receiving water, which displaced the point of impact but resulted in no greater dispersion, disruption of the jet or additional loss of material. "The study confirmed that only a small amount of suspended sediment is typically transported away from the jet through the upper water column during disposal. The principal transport mechanism at the disposal site was the bottom surge or density flow…"

The five studies discussed in this reference each confirmed the basic dredged material transport process described above. Only one of the five studies dealt with clamshell dredged material.

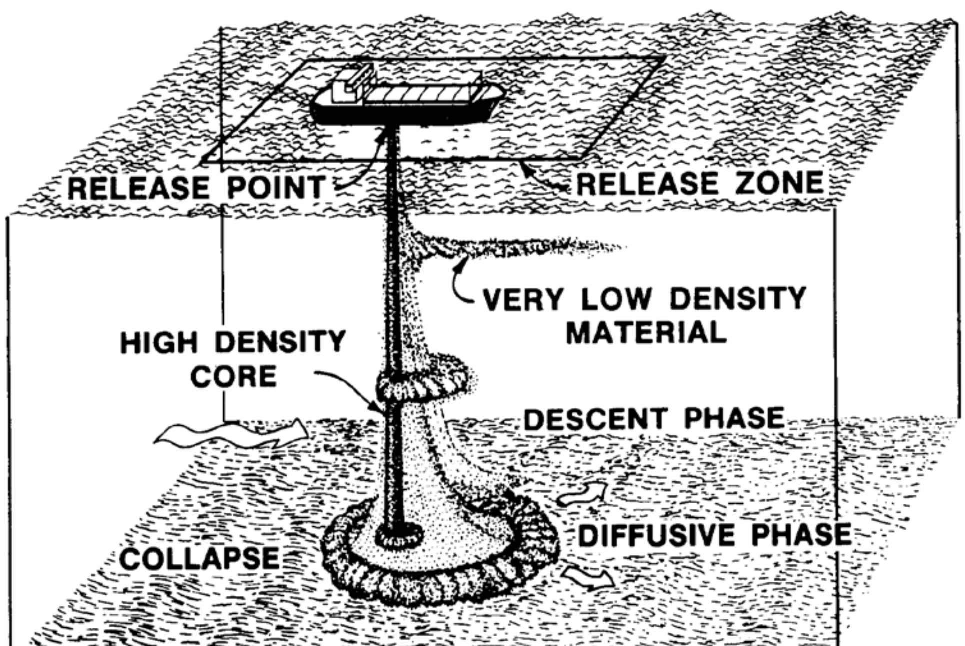

Figure 7. Dredged material disposal trajectory.

Resuspension Effects per Dredging Methodology. Hayes (1986) in EEDP-09-1 described the results of research into "…Selecting a Dredge for Minimizing Resuspension of Sediment." This study did not take into account the method of disposal in evaluating sediment resuspension. The study characterized the sediment resuspension effects of hydraulic (cutterhead, dustpan, and hopper dredges) and mechanical (clamshell) dredges. The study related to cutterhead dredges was conducted in two rivers and determined that cutterhead dredges operated to maximize productivity via selection of appropriate cutter rotation speed, ladder swing speed, and depth of cut, produced relatively small amounts of resuspension compared with other dredge types. The Dustpan dredge test was inconclusive due to problems operating the dredge. In relation to hopper dredges operated without overflow, resuspension may actually be less than for a cutterhead dredge. Clamshell dredges utilizing open-buckets demonstrate resuspension typically higher than most cutterhead dredges. This was largely due to the effect of impact of the bucket with the substrate, spillage and leakage from the filled bucket, and the washing action of the empty bucket descending through the water column. Resuspension was also increased by allowing the scow to overflow to dewater dredged materials. The use of an enclosed clamshell bucket significantly reduced resuspension in the lower and middle water column but only moderately in the upper water column. Overall the study showed that cutterhead and hopper dredges operated without overflow generated less resuspension than clamshell dredges. It went on to note that maneuverability requirements, hydrodynamic conditions, location of the disposal site in relation to the dredging footprint and other factors may dictate the type of dredge that must be used.

Havis (1988) in EEDP-09-2 in a follow-up study to the above study described the results of research into "Sediment Resuspension of Selected Dredges." This study also did not take into account resuspension related to the disposal action. Results of the study demonstrated that clamshell dredging produced total suspended solids (TSS) an order of magnitude higher than cutterhead dredging in similar sediments. It also demonstrated that the TSS plume related to clamshell dredging occurred throughout the water column, while the cutterhead's plume occurred at the bottom of the water column. It demonstrated that hopper overflow (dewatering) resulted in a turbid plume an order of magnitude higher than without overflow. It should be noted that the sediments dredged in this study were unconsolidated and composed of relatively fine particles versus the EEDP-01-2 study, which dealt primarily with cohesive materials. This study's results also showed that cutterhead dredge operations produced less TSS than hopper/drag-arm dredges and both produced less than clamshell dredges (open bucket). It also showed that operating conditions (wave height, infrastructure, etc) may dictate the type of dredge needed.

Hydraulic versus Clamshell Dredged Material Removal Effects. Test and/or maintenance dredging could incorporate either clamshell or hydraulic dredging or both. Hydraulic dredging (particularly cutterhead, EEDP 09-1, EEDP 09-2) typically has the least temporary impact on water quality in relation to the removal of dredged materials because hydraulic dredging sucks dredged material, interstitial water, and surrounding water up through the intake line prior to depositing dredged material and water into individual hoppers or a barge. Use of a clamshell bucket for dredged material removal causes dredged material to be lofted into the water column when the bucket impacts the substrate and takes-a-bite, followed by a small percentage of the buckets contents being “eroded” out of the bucket as it is lifted through the water column and then “washing” of the material remaining on the bucket when it is lowered for the subsequent bite. The amount of turbidity created by this process depends in large part on the type of material being dredged and the speed with which the bucket is raised and lowered.

Hydraulic dredging in relation to the excavation of sediments is therefore not expected to result in an exceedance of Federal or State water quality criteria in part due to the minimal effect it has on re-mobilizing sediments, and because as noted above, the type of sediments found in past and recent sampling/dredge events are expected to rapidly precipitate out of the water column (EEDP-09-1, EEDP-09-2).

Clamshell excavation (dredging) of benthic substrates is not expected to result in more than temporary exceedance’s of Federal or State water quality criteria beyond several hundred yards down-current, in part due to the minimal amount of turbidity (EEDP 09-2) generated by the bucket extracting bites of substrate and then moving up through the water column in relation to the types of substrate (largely sand and gravel) being dredged. Also, as noted in Section 3.2, Cook Inlet has very high background levels of natural turbidity (400 – 600 NTU’s).

Hydraulic versus Clamshell Dewatering Effects. Hydraulic, cutterhead, and suction dredging with overflow has the greatest temporary impact on water quality in relation to the temporary placement of dredged material into the hopper/barge for transport prior to disposal because dewatering of the dredged material is required to permit the maximum quantity of dredged sediments to be transported and disposed of per trip. This is a direct result of the large volumes of water sucked up and later discharged to carry the sediments being dredged. Dewatering of dredged material typically occurs with this style barge via weirs that allow water to flow out of the barge as it is filled with sediments. By utilizing weirs in the barge versus simply letting the water cascade over the sides of the barge as it nears full capacity, some sediment can settle out of the water column before returning. Because a clamshell bucket typically takes as full a bite of the substrate as possible, it typically contains little water and therefore when emptied into the barge, little water (compared with hydraulic dredging) is available for dewatering at the dredged site and during the transport process (EEDP-09-1, EEDP-09-2).

Hydraulic dredging may result in temporary short term (minutes versus hours) exceedance of Federal and/or State water quality criteria in the immediate vicinity of the barge, particularly if wave action is causing a barge to roll. As a result, sediments in the barge will not have time to settle out prior to being discharged through the discharge weir(s).

Dewatering affects related to clamshell dredging are, as noted previously, less of an issue related to water quality because of the relatively small quantity of water remaining in the bucket with each load of sediment deposited into the barge. Therefore, there is radically less dewatering needed and therefore less dredged material being carried back into the water around the barge. Dewatering of sediments contained in a barge loaded via a clamshell bucket is not expected to result in a temporary exceedance of Federal and/or State water quality criteria.

Hydraulic versus Clamshell Disposal Effects. In relation to disposal, hydraulic dredging may or may not have the greatest temporary impact on water quality because of the method of material disposal. Hydraulic dredging may incorporate the use of hopper dredges. Material dredged is pumped into the hopper, which is dewatered and then emptied at the disposal site. However, the overall water quality effect is also determined by the number of discharge events. If a clamshell was used for some or all of the dredging action, disposal could occur via a split hull barge. Which method of disposal has the greatest temporary affect on water quality depends in part on the method of disposal, composition of dredged material, how and where the various constituents of the dredged material are oriented in the barge or hopper, whether or not the vessel is moving during disposal, current velocity, stratification of the water column (if any), depth of the disposal site, to a lesser degree water chemistry, and the number of disposal actions. Given the number of variables involved and without an extremely thorough breakdown of each variable in relation to the other, including the condition of the receiving water column and substrate, it is not possible to make highly detailed predictions about the fate/behavior of each constituent of the dredged material (ERDC TN-DOER-D2, 2004). However, the basic behavior of solids in a liquid can guide the description of dredged material as it is disposed of. For example, clean large rock and larger gravels typically fall nearly straight to the sea floor and could have their greatest water quality effect, based not on their disposal, but on the type of substrate they impacted and lofted into the water column. Likewise, clean sand also tends to precipitate out rapidly and typically has little water quality effect. Solid organics tend to precipitate slowly if at all. Silts, loams and clays tend to precipitate slowly to very slowly depending on particle size and density. Whereas a clamshell bucket of blue clay may fall nearly as fast as rock to the sea floor and result in very limited turbidity, a clamshell bucket of bentonite (fine clay) powder would take many hours to days to fully precipitate out of a water column. However, sediment analyses indicates that the material being dredged is composed of greater than 95% clean sand.

The least likely method of disposal due to cost and time required (e.g. least efficient) would be clamshell. Disposal of these same materials via that method would result in both the longest duration but smallest volume (per individual disposal action) turbid plume. As suggested by the findings in EEDP-09-1, EEDP-09-2, dumping fewer very large (comparatively) loads versus many much smaller loads (one 18 cy clamshell bucket at a time for a total on 555,555 total buckets to dispose of and 5,000 round trips) would ultimately generate the largest turbid plume. The USACE dredge Essayon’s has a total hopper capacity of 6,423 cy and the Westport approximately 1600 cy. For the expected 10 million cubic yards of material to be dredged that equates to 1,556 dredging and disposal actions and 1,556 round trips between the navigation channel and disposal site(s). If a 2,000 cy capacity, the largest size split-hull barge expected to be used in Cook Inlet, was used, 5,000 dredging and disposal actions and 5,000 round trips between the navigation channel and disposal site(s) would be required.

Given the above capacity use of the Essayon's or similar capacity hopper dredge, over two-thirds less discharge events than use of a split hull barge would result, assuming all hoppers are dumped simultaneously. As noted above the result of a smaller number of larger quantity disposal events would be a smaller surface to volume ratio of sediment available to be entrained into the water column (Montgomery 1986).

Whether or not sediment disposed of is dumped from a split hull barge in a single load or out of hoppers, both Federal and State water quality criteria are expected to be exceeded in the immediate vicinity of the barge or hopper dredge disposal action simply due to the volume of sediments being disposed of per unit time. Obviously, a single dump of a split hull barge would disgorge the largest quantity of material per unit time. However, that does not necessarily equate to the largest cumulative sediment plume as a single dump of material resulting in more material reaching effectively the same point on the disposal site versus individual bucket loads of material because individual bucket loads of material may be more susceptible to being carried by currents. This is simply a matter of the smaller quantity of material having a higher surface to volume ratio than the larger quantity of material and therefore potentially providing more opportunity for disposed of sediments to be moved laterally by currents. As noted in 40 CFR 230.60 (a)(b)(c)(d) respectively; material to be dredged may be excluded from testing if a combination of the following criteria and circumstances exist that demonstrate a very limited probability of contamination:

- dredged material is comprised primarily of sand, gravel and other inert materials and is found in a high(er) current and/or wave energy environment
- the proposed dredge site is sufficiently removed from contaminant sources
- the dredge and discharge actions are adjacent
- dredge and disposal sites are subject to the same contaminants
- contaminant management occurs on site
- dredged material will not be transported off-site

The decision to exclude materials from testing is made in part in light of the following types of related information:

- potential routes of contamination or contaminated sediments to the extraction site(s);
- pertinent results from previous testing;
- potential for significant introduction of persistent pesticides;
- records of spills
- information from pertinent Federal, State and local records
- possibility of presence of substantial natural deposits of minerals.

Test and maintenance dredging and disposal activities for Cook Inlet Navigation Channel could begin any time during the ice free portions of the year.

The water quality effects of the proposed action, potentially incorporating multiple dredging and disposal methodologies, are described in the 404(b)(1) analysis attached in Appendix 1.

4.2 Water Circulation Patterns and Sedimentation

4.2.1 No Action

Water circulation patterns and sedimentation rates would continue in the same pattern and rate as they are currently occurring, including overall trends in changes to circulation patterns and sedimentation footprints related to continuing changes in part to the growth of the Knik Arm Shoal.

4.2.2 Proposed Action

Water circulation and sedimentation processes in Upper Cook Inlet are complicated and not truly well understood. As yet no functional explanation exists for the complicated nature of sediment movement that occurs north of the project area in the immediate vicinity of the Ports of Anchorage and MacKenzie. Dredging at the Port of Anchorage has demonstrated that within the overall Upper Cook Inlet area large (10,000+ cy) to very large quantities (100,000+ cy) of sediments move in a matter of days or weeks into or out of areas of the upper inlet. Based on survey results of the existing Cook Inlet Navigation Channel from 1996 to 2012, this same scenario does not appear to be occurring within the navigation channel at the same rate as the Port of Anchorage (e.g. more northerly portions of Upper Cook Inlet). Survey results and the lack of a need to maintenance dredge the channel for approximately 10 years after it was completed appear to demonstrate that the rate of sedimentation/flocculation occurs at a slower rate within the Knik Arm Shoal portion of Upper Cook Inlet. However, this conclusion is based on only a 16-year timeframe and therefore represents only a snapshot of a larger and longer term geotechnical process. Therefore, the analysis within this document assumes that maintenance dredging may be required as frequently as annually to assure that the most frequent rate of potential dredging actions is addressed. The proposed action would restore the authorized depth of the navigation channel. Therefore, circulation patterns that flow over and around Knik Arm shoal would likely follow the restored contours of the channel bottom and side slopes in relation to the hydrologic capacity of the restored portion of the channel.

4.3 Air Quality and Noise

4.3.1 No Action

No test or maintenance dredging would occur. Selection of the No Action alternative would not affect current air and noise quality impacts.

4.3.2 Proposed Action

The proposed dredging action would not increase airborne particulate matter in the project area above acceptable threshold levels. Operation of dredging machinery and related equipment would cause a minor, temporary increase in hydrocarbon emissions as a result of power plant exhaust, which would cease once dredging is completed. There would also be localized increases in noise levels from dredging and barging of dredged material. Air borne noise levels resulting from the dredging operation would be noticeable over ambient conditions at both the dredging and disposal sites with the possible exception of other anthropogenic vessel based actions that could routinely be occurring within the area (transshipment of cargo). As discussed in Section 3.3, underwater noise levels are expected to fall within decibel limits that may cause localized avoidance responses by fish and marine mammals but not reach a level that would result in injury.

4.4 Marine Mammals

4.4.1 No Action

No test or maintenance dredging would occur. Therefore, no effect to marine mammals would result from dredging of the Cook Inlet Navigation Channel. Effects to marine mammals from selection of the No Action alternative would be a continuation of the effects of noise and vessel traffic disturbance that currently occur as a result of deep draft loaded vessels typically being delayed using the Cook Inlet Navigation Channel.

4.4.2 Proposed Action

Because the proposed action would largely eliminate the need for deep draft vessels to delay transit of the Cook Inlet Navigation Channel until high tide, deep draft vessel timing is expected to follow the routine shipping and porting priorities for accessing the Cook Inlet Navigation Channel. As noted above, because dredging the channel is not expected to change the frequency or quantity of deep draft vessel traffic, only the timing of some traffic, no substantial effects are known for marine mammals. The lack of substantial impact from the modification of vessel timing is due to the fact that deep draft vessels typically arrive to travel through the channel weekly or monthly throughout the year, versus some waterways in Alaska that see the majority of all traffic through the ice free portion of the year alone. Therefore, while the dredging action would facilitate the arrival and departure of deep draft vessel traffic, it has little effect on the timing of that traffic over the course of the year and therefore the affected species life cycle stages. Delays to await a high tide typically do not exceed 12 hours because the coast of Alaska normally experiences two high and low tides each day.

NMFS 2009 Biological Opinion for the Port of Anchorage’s Marine Terminal Redevelopment Project notes that as of that timeframe only one beluga whale was suspected of having been killed by a ship strike in Upper Cook Inlet. It notes that beluga are generally at greater risk of ship strikes from smaller faster moving vessels than larger vessels. It also notes that Upper Cook Inlet beluga whales appear, based on their behavior, to have become substantially habituated to routine vessel operations in Upper Cook Inlet. Therefore, because vessels to be used for routine dredging operations are larger and slower moving vessels, typically moving slowest while dredging, the probability of a ship strike and subsequent injury or death of a beluga whale is considered a very low probability.

Spill effects from the loss of a tug or dredge vessel would result in a maximum loss of several thousand gallons of diesel fuel or oil. While that size spill would not be considered small within the upper inlet, the current and tidal effects present in the inlet would rapidly disperse spilled hydrocarbons albeit in either direction (north or south). Stress/irritation from contact, ingestion and/or inhalation could occur but mortality is not expected due to any present marine mammal species being highly mobile.

The following is a discussion of the effects of dredging and vessel noise disturbance on marine mammals, primarily beluga whales, excerpted from USACE 2008.

Beluga Whale. There are no consistent observed threshold levels at which belugas, and marine mammals in general, respond to introduced sound. Beluga responses to sound stimuli are reported to be highly dependent upon their behavioral state and their motivation to remain in or leave an area. Few field studies involving industrial sounds have been conducted on beluga whales. Reactions of belugas in those studies varied. In Awbrey and Stewart (1983) (as summarized in Southall et al., 2007), recordings of noise from SEDCO 708 drilling platform (non-pulse) were projected underwater at a source level of 163 dB rms. Beluga whales less than 1.5 km (about 1 mile) from the source usually reacted to onset of the noise by swimming away (RLs approximately 115.4 dB rms). In two instances groups of whales that were at least 3.5 km (about 2 miles) from the noise source when playback started continued to approach (RLs approximately 109.8 dB rms). One group approached to within 300 meters (about 1,000 feet)(RLs approximately 125.8 dB rms) before all or part turned back. The other group submerged and passed within 15 meters (50 feet) of the projector (RL approximately 145.3 dB).

Man-made sounds can mask whale calls or other sounds potentially relevant to whale vital functions. Masking occurs when the background noise is elevated to a level that reduces an animal’s ability to detect relevant sounds. Belugas have been known to increase their levels of vocalization as a function of background noise by increasing call repetition and shifting to higher frequencies (Lesage *et al.*, 1999; Scheifele *et al.*, 2005). Low tonal frequencies of construction noise and the ability of belugas to adapt vocally to increased background noise would tend to minimize masking potential interruption of behaviors such as feeding and communication.

Many marine mammals, including beluga whales, perform vital functions (e.g., feeding, resting, traveling, socializing) on a deil (i.e., 24 hr) cycle. Repeated or sustained disruption of these functions is more likely to have a demonstrable impact than a single exposure (Southall *et al.*, 2007). However, it is possible that marine mammals exposed to repetitious construction sounds from the proposed construction activities will become habituated and tolerant after initial exposure to these sounds, as demonstrated by beluga vessel tolerance (Richardson *et al.*, 1995, Blackwell and Green, 2002). Although the POA is a highly industrialized area supporting a large volume of ship traffic, belugas are present almost year round. Belugas evidently have become habituated to POA operations and annual dredging activities. Belugas are routinely sighted near dredges used each summer for maintenance at the POA. Belugas also demonstrate tolerance to ship traffic around the POA, as documented in numerous surveys conducted by LGL in that area.

Belugas are and will continue to be exposed to greater than background noise levels from dredging; however, background sound levels in Knik Arm are already higher than most other marine and estuarine systems due to strong currents and eddies, recreational vessel traffic, and commercial shipping traffic entering and leaving the POA. During clamshell (bucket) dredging, the strongest sounds are actually produced by the tugs that dump the barges of dredged material and reposition the clam shell dredges. Hopper and pipeline dredges also produce sound levels similar to tugs and large ship traffic that routinely operate near the POA.

NMFS 2009 Biological Opinion for the Port of Anchorage's Marine Terminal Redevelopment Project, which included a substantial quantity of dredging stated: "Long-term observation of beluga whales in Knik Arm suggest that construction activities are not influencing beluga whale abundance or habitat use around the port. In general, scientific literature suggests the following reactions are the most common with exposure to anthropogenic noise: altered headings, fast swimming, changes in dive, surfacing, respiration, feeding patterns, and changes in vocalizations. Death and injury are recorded but very rare, and associated with much higher source levels than presented by the proposed dredging."

Because USACE has no reason to believe that the dredging equipment to be utilized to maintain the Cook Inlet Navigation Channel will exceed the decibel levels previously described and discussed, the effects of such noise are as noted above. Therefore, only moderate disturbance is expected from dredging related anthropogenic noise sources.

Harbor Seal, Orca Whale, and Harbor Porpoise. Given the low density of these marine mammals in Upper Cook Inlet and the Cook Inlet Navigation Channel, impacts from dredging noise or a combination of noise from dredging and shipping are unlikely. Their infrequent occurrence coupled with the noise tolerance issues addressed above on belugas and marine mammals in general decreases the likelihood of negative effects to marine mammals from underwater noise due to vessels transiting the Cook Inlet Navigation Channel.

4.5 Fishery Resources and Essential Fish Habitat

4.5.1 Fishery Resources

No Action. No test or maintenance dredging would occur. Effects to indigenous fish species from selection of the no action alternative would be a continuation of the effects of noise and vessel traffic disturbance that currently occur as a result of deep draft loaded vessels typically being delayed using the Cook Inlet Navigation Channel.

Proposed Action. The principal concerns of dredging and disposal are temporary and local increases of suspended sediment over the already high ambient levels within Upper Cook Inlet, and their potential effects on juvenile salmon. Suspended solids in estuarine waters have been reported to injure juvenile salmon and could reduce their ability to sight-feed on surface and near surface invertebrates at higher concentration levels (USACE 2008). At lower concentration levels juvenile salmon may use turbid waters to hide from predators.

The following analysis, excerpted from USACE 2008, is applicable to Cook Inlet Navigation Channel because the affected species are the same, the baseline environment is very similar except that the navigation channel has substantially less anthropogenic noise sources immediately adjacent to it (i.e. its quieter), the noise sources and the activities generating them (re dredging) are very similar, and the sediment profile contains substantially less fine grained material.

"Effects of turbidity and suspended solids on juvenile salmon are summarized in a comprehensive compilation by Bash et al. (2001). The impacts of high suspended solids concentrations on salmonids have been reported to include mortality, reduced survival, reduced growth, reduced feeding, stress, disease, avoidance, displacement, change in body color, alerted behavior, and reduced tolerance to salt water (Loyd 1987 in Bash et al. 2001). Potential severity of effects is related to: (1) duration of exposure, (2) frequency of exposure, (3) toxicity, (4) temperature, (5) life stage of fish, (6) angularity of particles, (7) size of particles, (8) type of particles, (9) severity and magnitude of pulse, (10) natural background turbidity, (11) time of occurrence, (12) other stressors and general condition of biota, and (13) availability of and access to areas with less suspended material.

Much of the research on juvenile salmonids and turbidity was done in laboratory settings. Applicability to field situations has not been thoroughly verified. Other research applies to headwaters and systems that are normally clear except for seasonal and infrequent sediment. Turbidity values reported by some research may not be a consistent and reliable tool for determining the effects of suspended solids on salmonids. Bash et al. concluded that, "salmonids encounter naturally turbid conditions in estuaries and glacial streams," but that this does not necessarily mean that salmonids in general can tolerate increases of suspended sediments over time. Relatively low levels of anthropogenic turbidity may adversely affect salmonid populations that are not naturally exposed to relatively high levels of natural turbidity (Gregory 1992 in Bash et al. 2001). Bash et al. also noted that managers are interested in learning whether there is something inherent in "natural" turbidity sources that make them somehow less harmful to fish than are anthropomorphic sources of turbidity because it is apparent that salmonids are able to cope with some level of turbidity at certain life stages. Evidence of their ability to cope is illustrated by the presence of juvenile salmonids in turbid estuaries and local streams with high natural levels of glacial silt (Gregory and Northcote 1993 in Bash et al. 2001). Feeding efficiency of juvenile salmonids has been shown to be impaired by turbidities in excess of 70 NTU, well below typical and persistent levels in Knik Arm (Pentec, 2005a). Section 3.6 discussed reports that juvenile salmon and saffron cod may feed and grow in surface water microhabitats in Knik Arm where short periods (minutes) of relative quiescence in the generally turbulent water allow partial clearing.

Section 3.5 presented information indicating that dredging would have little effect on surface and near-surface invertebrates given the highly turbid environment that already exists. Dredging would have equally little effect on any fish sight-feeding on those invertebrates. Collection data indicate that juvenile salmon are largely or entirely in the upper 10 feet of water in Knik Arm, so mechanical effects of dredging and turbidity produced by dredging at project depths also would be unlikely to negatively affect resident fish significantly.

A surface, peak tidal current might be able to lift some of the material to the surface where it could increase near-surface local turbidity for short periods. This could affect ability of juvenile fish to feed at or near the surface in small areas when dredged material was being dumped. Near-surface turbidity will be monitored during dredging for the proposed action to see if it is affected by disposal activity. Effects on fish near-surface habitat use will be determined or dredging and disposal methodology will be modified to avoid effects if near-surface turbidity is higher. Adult salmon in the project areas of Knik Arm could be subjected to higher suspended solids concentrations from dredging and dispersion of disposed material. Pentec (2005a) and other sources indicate that returning adults tend to run in shallow water, probably to reduce predation by beluga whales. This shallow water orientation would tend to keep them away from dredging and dredged material disposal, which would be largely in deeper water. There is no indication that noise and turbidity, both natural and from dredging at the POA, are affecting salmon migration. Salmon regularly return to Ship Creek, which terminates adjacent to the POA, and to other area streams. The apparent lack of effect at the POA is consistent with the literature, which indicates a similar lack of effect in other areas where salmon migrate near dredging and other activity.

4.5.2 Essential Fish Habitat

No Action. No test or maintenance dredging would occur. The effect of selection of the no action alternative on essential fish habitat within the Cook Inlet Navigation Channel and the Fire Island disposal area would be a continuation of the trend toward shoaling in the navigation channel and deposition and erosion at the Fire Island disposal site. In other words, benthic habitat in the channel would continue to be buried by accumulating sediments and therefore benthic habitats would continue to get shallower overall. Benthic habitats at the Fire Island disposal site would continue to see the current varying levels of deposition and erosion and therefore related changes to the benthic substrate.

Proposed Action. Knik Arm is a highly turbid ecosystem with high and variable suspended sediment concentrations and mobile soft-bottom sediments that are shifted consistently by extreme tidal forces and powerful currents. Pacific salmon and other EFH species that might be in the area have adapted to high suspended sediment levels and would likely avoid the immediate area near the discharge without suffering adverse impacts. It is unlikely that noise generated from dredging and disposal for channel maintenance would impact EFH (see Noise section 3.3 and Marine Mammal section 3.4). Reintroduction of sediments (95+% clean sand) into the Cook Inlet water column during dredging and disposal is not expected to adversely impact essential fish habitat (e.g. habitat comprised by the water column). The minimal negative impact of turbidity resulting from dredging, dewatering, and disposal is a result of the high suspended sediment loads noted in Water Quality section 3.2 and the very short duration the dredged material (sand) is expected to remain suspended before re-depositing on the inlet floor. The excavation of the navigation channels benthic substrate will temporarily remove EFH at its current elevation and result in the available habitat being lowered several to tens of feet depending on the location within the channel. As is normal for Upper Cook Inlet (albeit at a likely slower rate), the substrate is expected to immediately begin building back up as currents and tidal forces move sediments through the area. Conversely, the benthic substrate at the disposal area will be buried by deposition of disposed material. Given the varying bathymetry of the disposal site over time due to the naturally occurring erosion/deposition cycle, a portion of this material is expected to remain somewhere within the disposal area with the remainder moving off-site. This natural sediment movement demonstrates that the effects of dredging and disposal will not be confined entirely within the dredging/disposal footprints. However, given the scale of sediment movement events, discrete or defined, within Upper Cook Inlet, and the necessity of species to have adapted to moderate to large scale sediment movement events, the effects are expected to be temporarily minor to moderate and localized in relation to this portion of Upper Cook Inlet.

The attached EFH Assessment (Appendix 2) further defines potential effects expected to result from the proposed project.

4.6 Avifauna

4.6.1 No Action

No test or maintenance dredging would occur. Therefore, effects to bird species utilizing the area would be those that are already occurring.

4.6.2 Proposed Action

The activities with the greatest potential to affect local avian populations (primarily rafting waterfowl and foraging seabirds) is the movement of dredging equipment to and from the dredging site and dredge runs between the dredging and disposal site. The effect of this type of disturbance would be the temporary displacement of resting or feeding birds to another location. Dredging would have similar effects, but the slow movement of the dredge within a limited area is expected to result in the disturbance being highly localized. Vessel lights could potentially become an attractive nuisance causing bird collisions and subsequent injury or death at night; however, the greater potential for environmental impacts (albeit at a radically lower probability) associated with vessels would be the effects of petroleum compounds and other hazardous man made materials used on or powering the vessels if spilled. The effects of petroleum based spills on avian populations are well documented. Direct contact and mortality are caused by swimming through or by ingesting petroleum based substances during preening as well as hypothermia resulting from matted feathers. Ingestion of contaminated prey/food items resulting from spills are also a frequent cause of avian injury or death. The displacement of local avian populations and disruption of resting, feeding, pairing, mating behaviors from the project area during construction or a spill would be short-term effects lasting the duration of the activity or the spill event. Overall, the Corps believes that the recommended corrective action (maintenance dredging) would not have either substantial or long-term effect on local avian populations. No significant adverse impacts are expected.

4.7 Threatened and Endangered Species

4.7.1 No Action

No test or maintenance dredging would occur. The effect of selection of the no action alternative would be a continuation of the minimal effects of vessel disturbance to listed species present based on the timing of the transit of the navigation channel.

4.7.2 Proposed Action

The affect of the proposed action and the primary mechanisms for those effects (noise and vessel traffic) to listed species present during the dredging action are effectively discussed in the marine mammal section. Section 4.4 Marine Mammals specifically addresses noise impacts to beluga whales.

Spill effects are the same as those discussed under the marine mammal section.

Ship strike effects and their potential to occur are the same as discussed in the marine mammal section.

4.8 Cultural and Historic Resources

4.8.1 No Action

No test or maintenance dredging would occur.

4.8.2 Proposed Action

The Alaska State Historic Preservation Officer (ASHPO) concluded via a “No Historic Properties Affected” determination dated August 3, 2012, that there were no known cultural or historic resources, including shipwrecks, within the project footprint that would be affected. There are no staging areas outside the dredging and disposal areas. The contractor would use his own or developed facilities for mooring, staging, and/or storing equipment.

4.9 Subsistence Resources

4.9.1 No Action

No test or maintenance dredging would occur. Effects to subsistence resources from selection of the no action alternative, primarily fish and secondarily marine mammals, would be those discussed in the Fish and Marine Mammal No Action sections.

4.9.2 Proposed Action

The Alaska Native Interest Lands Conservation Act identifies three factors related to subsistence uses as items affected by changes in management activities or land uses: (1) resource distribution and abundance; (2) access to resources; and (3) competition for the use of resources.

Subsistence resources, such as marine plants and animals potentially affected by the dredging action, are predominantly food resources (i.e. fish, birds and possibly marine mammals) collected for primary diet, customary and traditional practices, or to supplement other existing food resources.

Maintenance dredging of the inlet floor within the navigation channel and deposition at the Fire Island disposal site could temporarily affect (disturb or displace) local subsistence fishing if it were to occur in the same timeframe. While the Corps is not aware of any water based subsistence hunting that would likely occur in either the dredge or disposal footprints, if water based subsistence hunting was to occur during dredging/disposal, the same temporary disturbance or displacement could occur.

4.10 Socioeconomic Resources

4.10.1 No Action

No test or maintenance dredging would occur.

4.10.2 Proposed Action

The proposed action would remove the shoaled areas of the existing navigation channel, which would alleviate the immediate impact to navigation. The transshipment of cargos through the authorized channel would resume at a rate determined primarily by shipping schedules, weather, and available berthing space primarily at the Port of Anchorage. Deeper draft vessels would no longer have to wait until the higher tides to transit the navigation channel because shoaling has reduced the depth from -43 feet MLLW to about -27 feet MLLW. Waterborne commerce would remain a major economic driver of the local and regional economy. The proposed action would not change the type or quantity of goods and services at the Port of Anchorage. Some short-term interference to commercial and recreational traffic could occur during dredging and transportation of dredged material to the disposal site. However, these conflicts are expected to be an inconvenience (temporary effect) rather than an impact to commercial and recreational socioeconomic resources.

4.11 Navigation

4.11.1 No Action

No action would mean the navigation channel, which was created in 1999-2000, would not be maintained and sedimentation and shoaling would continue at its current rate. Vessels that currently have to stage and wait or time their arrivals for higher to extreme high tides to travel through the channel would face increasingly shorter access windows and eventually the largest draft vessels could lose access.

4.11.2 Proposed Action

The proposed action would restore the navigational servitude that existed after the original construction of the Cook Inlet Navigation Channel as originally authorized and modified. Because there is no change to the depth, dimensions or alignment of the navigation channel, or any known substantial increase in demand for in or out-bound shipping, no substantial impact to navigational servitude beyond restoration of prior access levels in known.

4.12 Environmental Justice and Protection of Children

4.12.1 No Action

No test or maintenance dredging would occur.

4.12.2 Proposed Action

On February 11, 1994, Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations was issued. The purpose of the order is to avoid the disproportionate placement of Federal actions and policies having adverse environmental, economic, social, or health effects on minority and low-income populations. Construction of the proposed action would have beneficial effects on the greater Anchorage community as well as the region overall through the facilitation of the transshipment of goods. No racial, ethnic, age, or other population group would be adversely affected disproportionately. Therefore, the proposed action would not cause changes to population or other indicators of social well being and would not result in disproportionately high or adverse effects to minority or low-income populations.

On April 21, 1997, Executive Order 13045, Protection of Children from Environmental Health and Safety Risks was issued to identify and assess environmental health and safety risks that may disproportionately affect children. The proposed action would affect the community as a whole, and there would be no environmental health or safety risks associated with the action that would disproportionately affect children. All the alternatives considered in detail are located offshore, in proximity to commercially developed areas, and away from homes, schools, and playgrounds. Children would not be put at risk by the proposed corrective action.

4.13 Cumulative Effects

4.13.1 No Action

No test or maintenance dredging would occur. Previous impacts and existing trends determining cumulative effects would not change.

4.13.2 Proposed Action

Cumulative effects are defined as, "The impact on the environment which results from the incremental impact on an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 Code of Federal Regulations, Section 1508.7). Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. The past and present actions that have occurred within and adjacent to the project area are identified below. Together these actions have resulted in the existing conditions of the project area (see section 2).

● 2000 - The original channel project is successfully completed.

● 2005 - Energy and Water Appropriations Act authorizes an extension of the existing channel. This action cannot be completed until a cost share sponsor is found and all legal and regulatory requirements are met.

● From the early 1900's to the present, a wide range of activities have taken place at or in the vicinity of the current Port of Anchorage to facilitate the importation and exportation of a wide variety of goods and services. Other than development of the port and its related facilities, these activities include dredging by the Corps and others, continued maintenance and expansion of port facilities, and marking of the channel by the U.S. Coast Guard. These activities are expected to continue to varying degrees for the foreseeable future.

4.13.3 Marine Environment

Potential future dredging to expand the Cook Inlet Navigation Channel, future port development, related construction activities, and other foreseeable future dredging projects in the port area, in combination with population growth within and adjacent to the project area, would produce changes in port use and the amount of impervious surfaces and associated runoff in and around the harbor and adjacent watersheds. However, all projects are required to adhere to local, State, and Federal storm water control regulations and best management practices, which are designed to limit surface water inputs.

4.13.4 Biological Resources

Biological resources include fish and wildlife, aquatic vegetation, Federal threatened and endangered species, other protected species, and natural resources management. The use of the overall Upper Cook Inlet area as a hub for the transshipment of goods, related development, and industrial use of the port area would continue to affect indigenous marine aquatic species and benthic habitat during dredging and disposal events. Any future Federal actions would require additional evaluation under the National Environmental Policy Act at the time of their development.

4.13.5 Cultural and Historic Resources

The navigation channel was dredged when originally constructed. No known cultural and historic resources would be impacted by the proposed dredging or disposal actions. Reasonably foreseeable future actions within and adjacent to the developed project area are subject to review and approval by the State Historic Preservation Officer.

4.13.6 Air and Noise Quality

The proposed action and the past, present, and reasonably foreseeable future actions identified above are not anticipated to result in cumulatively significant air quality deterioration as defined by the state of Alaska. Noise associated with the proposed action also would occur. These noise impacts would be localized, short-term, and of an intermittent nature and are not expected to be cumulatively significant.

4.13.7 Socio-economic Resources

The proposed action and future Corps' maintenance dredging activities would alleviate shoaling impacts to navigation in the channel and would not change the type or quantity of goods shipped or the type or size of commercial vessels transiting the channel. Waterborne commerce would remain an important component of the local and regional economy.

Some short-term interference to recreational and commercial traffic could occur during proposed and future dredging and dredged material disposal activities, including Corps' maintenance dredging of the harbor and any future dredging that may be recommended. However, these conflicts are expected to be an inconvenience rather than a direct impact to commercial and recreational activity. The proposed action, when added to other past, present, and reasonably foreseeable future actions, is not expected to cause a cumulative adverse change to population or other indicators of social well being, and should not result in an adverse effect, and therefore, there would be no disproportionately high or adverse effect on minority or low-income populations.

4.13.8 Cumulative Effects Summary

The cumulative impacts analysis evaluated the effects of implementing the proposed action in association with past, present, and reasonably foreseeable future Corps' and other parties' actions within and adjacent to the project area. Past and present actions have resulted in the present conditions in the harbor. Reasonably foreseeable future actions considered included relevant foreseeable actions within and adjacent to the project area, including those of the Corps', other Federal agencies, State and local agencies, and private and commercial entities. The cumulative impacts associated with implementation of the proposed action were evaluated with respect to each of the resource evaluation categories, and no cumulatively significant adverse impacts were identified.

5.0 Public Involvement, Federal Compliance and Agency Coordination

This EA and Finding of No Significant Impact (FONSI) were prepared relying on previous NEPA-related scoping efforts and the most recent correspondence with State and Federal resource agencies. Per the NEPA process and Corps regulations and guidance, the EA and FONSI is subject to a 30-day public review. If requested, a public meeting would be held to discuss project alternatives and solicit public views and opinions.

5.1 Compliance with Laws and Regulations

The development and preparation of this EA and FONSI is being coordinated with a variety of State and Federal agencies. An evaluation to determine consistency with Section 404(b)(1) of the Clean Water Act, which governs discharge of dredged or fill material, has been completed (Appendix 1).

Both the Corps and ASHPO determined that the project would have no effect on known historical or prehistoric resources in the immediate vicinity of the dredged and disposal sites.

The ADEC determines compliance with State of Alaska water quality standards under Section 401 of the Clean Water Act. The Corps determined that the proposed corrective action would not violate State water quality standards. The Corps is coordinating their determination with the ADEC, and if ADEC concurs, they will issue a water quality certificate if there is reasonable assurance that the proposed corrective action will meet and maintain water quality standards.

A checklist of project compliance with relevant Federal, State, and local statutes and regulations is shown in table 3.

Table 3. Environmental Compliance Checklist

FEDERAL	Compliance
Archeological & Historical Preservation Act of 1974	FC
Clean Air Act	FC
Clean Water Act	PC
Coastal Zone Management Act of 1972 *	FC
Endangered Species Act of 1973	PC
Estuary Protection Act	FC
Federal Water Project Recreation Act	FC
Fish and Wildlife Coordination Act	FC
National Environmental Policy Act *	PC
Land and Water Conservation Fund Act	FC
Marine Protection, Research & Sanctuaries Act of 1972	FC
National Historic Preservation Act of 1972	FC
River and Harbors Act of 1899	FC
Magnuson-Stevens Fishery Conservation & Management Act *	PC
Marine Mammal Protection Act	PC
Bald Eagle Protection Act	FC
Watershed Protection and Flood Preservation Act	FC
Wild & Scenic Rivers Act	N/A
Executive Order 11593, Protection of Cultural Environment	FC
Executive Order 11988, Flood Plain Management	FC
Executive Order 11990, Protection of Wetlands	FC
Executive Order 12898, Environmental Justice	FC
Executive Order 13045, Protection of Children	FC
STATE AND LOCAL	
State Water Quality Certification *	PC
Alaska Coastal Management Program *	PC

PC = Partial compliance, FC = Full compliance
*Full compliance will be attained upon completion of the public review process and/or coordination with the responsible agency.

6.0 Conclusions and Mitigation Recommendations

The Corps concludes that the EA supports the conclusion that the navigation improvements do not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, preparing an environmental impact statement is not necessary and signing a FONSI is appropriate.

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APPENDIX 1

EVALUATION UNDER SECTION 404(b)(1) of the CLEAN WATER ACT

EVALUATION UNDER SECTION 404(b)(1)
of the CLEAN WATER ACT

Cook Inlet Navigation Channel
Operations & Maintenance Dredging

This is the factual documentation of evaluations conducted under Section 404 of the Clean Water Act of 1977.

I. PROJECT DESCRIPTION

A. Location: The project is located within Knik Arm of Cook Inlet, west of Anchorage, Alaska, and to the north and east of Fire Island.

B. General Description: The U.S. Army Corps of Engineers (Corps) is proposing to conduct test and maintenance dredging of approximately 10 million cubic yards of sand, gravel, cobbles, occasional rocks, and silty sediments that have accumulated in the Knik Arm portion of the existing Cook Inlet Navigation Channel. The 10 million cubic yards would involve dredging approximately 2 million cubic yards each summer over a period of 5 years because the rate of shoaling is unknown. Maintenance dredging of the existing channel to the depth of -43 feet MLLW, width of 1,100 feet, and length of 11,000 feet would consist of hydraulic and or clamshell dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the Fire Island disposal site. Dewatering is necessary to facilitate the movement of the largest quantity of dredged material in the hopper or scow load, therefore minimizing vessel traffic related to the dredging action. In-water disposal of dredged material would consist of dredged material being placed north of Fire Island in the existing disposal site. The attached NEPA analysis includes the effects of annual maintenance dredging of the existing Cook Inlet Navigation Channel and in-water disposal.

C. Authority: The Cook Inlet Navigation Channel was initially authorized via the Water Resources Development Act (WRDA) of 1996 (Public Law 104-303). That authorization was subsequently modified by language in the Energy and Water Development Appropriations Act, 1999 (Public Law 105-245) and the Energy and Water Development Appropriations Act, 2005.

D. General Description of Dredged or Fill Material: Based on the results of test dredging performed in October 2012, the dredged material is expected to be almost entirely (99%) sand, with a trace of silt (USACE 2012b).

E. Description of the Proposed Discharge Site: The disposal site for material dredged from the navigation channel is an area of deeper water (up to about 90 feet below MLLW) off the northeast tip of Fire Island. The four corners of the approximately 2,000-by-2,600-foot, 20-acre disposal area are defined as follows:

Table 2 – Coordinates for corners of CINC Disposal Area.

NW Corner	61° 11' 18.40" N	150° 08' 57.98" W
NE Corner	61° 11' 18.45" N	150° 08' 04.43" W
SW Corner	61° 10' 59.01" N	150° 08' 57.89" W
SE Corner	61° 10' 59.07" N	150° 08' 04.35" W

This disposal site was previously used in 1999 and 2000.

F. Description of Disposal Method: The dredging could be carried out by either clamshell or hydraulic hopper dredge over the course of the project. The disposal method in either case would be disposal of dewatered sediment from the bottom of a scow or hopper.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations: The disposal area is a 20-acre expanse roughly 40 to 90 feet below MLLW. The existing bottom sediment of the disposal area has not been sampled, but based on previous disposal of navigation channel sediment there, it is expected to be similar in overall composition to sediments in the navigation channel, perhaps reduced in fines due to the separation and washing away of silts during disposal. A characterization of material to be dredged is contained in General Description of Dredged or Fill Material above. The particle size of the dredged material is expected fall in a fairly narrow range of roughly 0.85 to 0.25 mm (sand to fine sand).

B. Water Circulation, Fluctuation, and Salinity Determinations: The discharge of dredged material into the approved disposal area is expected to have a negligible local and temporary effect on circulation within the depressions into which it is deposited. A quantity of 10 million cy of sediment distributed evenly over the 20-acre disposal site at one time would create a layer roughly 29 feet thick; if distributed over 5 years, the added sediment would average 5.5 feet per year. However, the deposited material would be quickly redistributed on the sea floor by the strong tides and currents of Cook Inlet and would have no discernible effect on tidal fluctuations or water levels. Sea water transported and discharged at the disposal site with the sediment would be coming from an adjacent area of the same marine waters and would not cause any changes in salinity at the disposal site.

C. Suspended Particulate/Turbidity Determinations: The waters within Knik Arm often contain extreme levels of suspended sediments due to discharge of glacial silt from several large river systems, and constant resuspension by the strong tidal flux. Suspended sediment concentrations of over 1,000 mg/L have been recorded, and turbidity readings average 400 to 600 NTUs (Kinnetic Laboratories 2004). By comparison, State of Alaska water quality standards (18 AAC 70) require that the discharge not cause the receiving water to exceed 25 NTUs, or to not reduce the maximum secchi disk depth by more than 10%; as a practical matter, neither of these criteria can be applied in the near-opaque waters of Knik Arm. Based on the results of the October 2012 test dredging, the dredged material is expected to contain only trace levels (less than 1%) of fines. The dredged material of 99% sand would be expected to settle very quickly to the sea floor, contributing a minor, non-measurable quantity of additional suspended silt to the water column. A descending load of dredged material released from a scow or hopper may loft a cloud of additional fines from the sea floor upon impact, but these would likewise cause only a small incremental increase to the large ambient load of suspended sediments.

D. Contaminant Determinations: Samples of sediment for chemical analysis were collected during the October 2012 test dredging (USACE 2012a). The results of chemical analysis showed little indication of chemical contamination. The 14 samples collected were reported to contain arsenic concentrations within a very narrow range of 5.4 to 6.8 mg/kg. These concentrations are above certain State of Alaska soil cleanup standards but below the most protective threshold effects level (TEL) for arsenic in marine sediment of 7.24 mg/kg published by the National Oceanic and Atmospheric Administration (Buchman 2008). No background sediment samples were collected during the October 2012 test dredging, and the Corps has not found marine sediment data from other studies that would be suitable for demonstrating a background arsenic concentration in Knik Arm sediments. However, the Corps' Tier I analysis of the dredging project has identified no human sources of arsenic that could have contributed to the arsenic concentrations in the sediments tested, and the Corps believes that the reported arsenic concentrations of 5.4 to 6.8 mg/kg in the samples most likely represent the natural mineralogical composition of the sediment. Several studies by the US Geological Survey have found widespread and presumably naturally-occurring arsenic in stream sediments in the Cook Inlet drainage basin (USGS 2001). One study of 47 stream locations reported sediment arsenic concentrations ranging from 1.7 to 88 mg/kg; nearly half of those locations had arsenic above a threshold of 17 mg/kg. These stream sediments ultimately become the marine sediments of Cook Inlet and Knik Arm.

E. Aquatic Ecosystem and Organism Determinations: The existing ecosystem at the disposal site appears to be a low-productivity benthic community of sparse algae and a small number of epibenthic and infaunal organisms on a flat expanse of silty, sandy gravel. The natural environment includes the continuous migration and redistribution of benthic sediments. The dredged material to be discharged is similar to the existing benthic sediments in the discharge area; existing populations of organisms, adapted to maneuvering and burrowing through loose sediment, would most likely not suffer significant adverse effects from the addition of feet of new material to their environment. The high ambient turbidity of upper Cook Inlet tends to limit primary productivity of the marine waters.

F. Proposed Disposal Site Determinations: The bulk of the material would settle more rapidly to the sea floor in the immediate discharge area. Currents and storms would cause the material to spread fairly evenly on the sea floor.

The disposal action would comply with the applicable water quality standards and would have no detrimental effects on any of the following:

1. Municipal and private water supplies

2. Recreational and commercial fisheries

3. Water-related recreation

4. Esthetics

5. Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves.

G. Determination of Cumulative/Secondary Effects: The primary cumulative effects of the proposed dredging and disposal operation would be a repeat dredging and disposal cycle with all the attendant effects of those actions as defined in the attached EA. While 8 miles distant the proposed project adds to the effects of dredging operations within upper Cook Inlet overall due to the annual maintenance dredging that takes place at and in the vicinity of Anchorage Harbor. The primary secondary effects are those related to the continued use of the navigation channel and the attendant effects of vessels transiting the area. Maintenance of the channel does not in-and-of itself increase vessel traffic or engender the development of ancillary facilities.

III. FINDINGS OF COMPLIANCE

A. Adaptation of the Section (404)(b)(1) Guidelines to this Evaluation: No adaptations of the guidelines were made relative to this evaluation.

B. Evaluation of Availability of Practical Alternatives: No practicable alternative to dredging the approved navigation channel is known. No known potential upland disposal sites in upper Cook Inlet are practicable locations for disposal due to the increased time, cost, and environmental effects of disposal of salt contaminated sediments in a non-saline environment.

C. Compliance with Applicable State Water Quality Standards: Disposal of the dredged material would not violate any applicable State water quality standards. Disposal constitutes a fill operation and would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

D. Compliance with Endangered Species Act of 1973: The proposed action is not expected to harm any endangered species or the critical habitat of beluga whales. The work would be planned to minimize the risk of taking of beluga whales known to frequent upper Cook Inlet, as well as to avoid potential impacts to other Federally-listed species that could be present in upper Cook Inlet (e.g., Steller sea lion, Steller's eider, yellow-billed loon, Kittlitz's murrelet).

E. Compliance with Specified Protection Measures for Marine Sanctuaries Designed by the Marine Protection Research and Sanctuaries Act of 1972: There is no action associated with the proposed project which would violate the above Act.

F. Evaluation of Extent of Degradation of the Waters of the United States: There would be no more than negligible (i.e. no significant) adverse impacts to municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife and/or aquatic sites caused by the proposed action. There would be no more than negligible (i.e. no significant) adverse effects on regional aquatic ecosystem diversity, productivity, and/or stability caused by the placement of the fill material, and there would be no more than negligible (i.e. no significant) adverse effects on recreation, aesthetic, and/or economic values caused by this project.

G. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on Aquatic Ecosystems: All appropriate and practicable steps would be taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. Those steps include timing of disposal activities to avoid species of concern.

On the basis of the Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR part 230), the proposed project has been specified as complying with the requirements of the guidelines for Section 404 of the Clean Water Act.

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APPENDIX 2

Essential Fish Habitat Assessment

ESSENTIAL FISH HABITAT ASSESSMENT

Cook Inlet Navigation Channel
Operations and Maintenance Dredging
Anchorage, Alaska

Preface

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act set forth the essential fish habitat (EFH) provision to identify and protect important habitats of federally managed marine and anadromous fish species. Federal agencies, that fund, permit, or undertake activities that may adversely affect EFH, are required to consult with National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH, and respond in writing to NMFS recommendations.

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities.

Upon completing the Corps's EFH-coordination with the NMFS, the Corps' will incorporate its EFH evaluation and findings and NMFS conservation recommendations (if any) into the project's environmental assessment.

Project Purpose

The proposed federal action is operations and maintenance dredging of the Cook Inlet Navigation Channel depicted in figure 1. The purpose of the proposed action is to maintain authorized channel depth and width to previously dredged dimensions by maintenance dredging. The underlying need is the maintenance of formerly achieved depths to facilitate the unimpeded movement of deep draft vessels.

If the proposed action is not implemented access for deep draft vessels would be limited at some lower tidal elevations.

Project Authority

The project was authorized via the Water Resources Development Act of 1996 (Public Law 104-303, 104th Congress). Project re-authorization was provided in the Energy and Water Development Appropriations Act of 1999 (Public Law 105-245). While the Energy and Water Appropriations Act of 2005 authorized extension of the channel the entire length of the Fire Island and Point Woronzof range lines, it also required that a sponsor fund a portion of the analysis of the effects of that extension. To date the Corps has found no sponsor to cost share the expansion of the project. Therefore, the Corps is authorized to maintain the existing channel.

Project Area Description

Cook Inlet Navigation Channel and the Fire Island disposal site are located north of Fire Island, south of the Port's of Anchorage and MacKenzie and east of the municipality of Anchorage within Upper Cook Inlet, Alaska. See figure 1 below.

The four corners of the existing navigation channel are:
Northwest = N61° 11' 42.00", W150° 07' 05.4";
Northeast = N61° 11' 33.20", W150° 06' 55.7"
Southwest = N61° 12' 23.70", W150° 03' 38.6"
Southeast = N61° 12' 32.50", W150° 03' 48.3".
The four corners of the disposal site are:
Northwest Corner = N61° 11' 18.40", W150° 08' 57.98";
Northeast Corner = N61° 11' 18.45", W150° 08' 04.43";
Southwest Corner = N61° 10' 59.01", W150° 08' 57.89";
Southeast Corner = N61° 10' 59.07", W150° 08' 04.35".

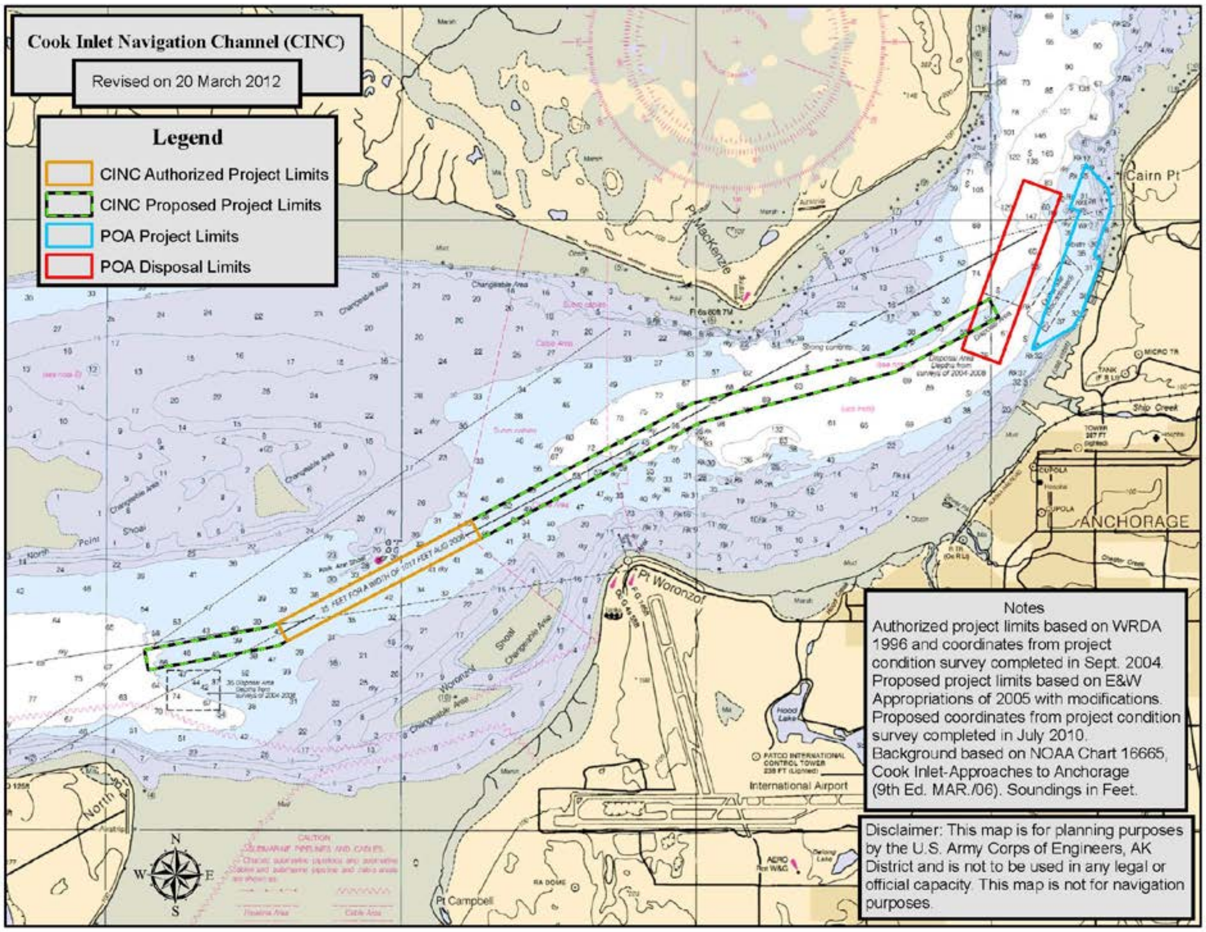

FIGURE 1. Cook Inlet Navigation Channel (CINC, gold bordered area within figure).

Project Description

The U.S. Army Corps of Engineers (Corps) is proposing to conduct test and maintenance dredging of 10 million cubic yards (cy) of sand, gravel, cobbles occasional rocks and silty sediments that have accumulated in the Knik Arm portion of the existing Cook Inlet Navigation Channel (figure 1). Maintenance dredging of the existing channel to the depth of -43 feet MLLW, width of 1,100 feet and length of 11,000 feet would consist of hydraulic and or clamshell dredging of accumulated sediments into a hopper dredge or barge; dewatering during dredging and transport; and in-water disposal at the Fire Island disposal site. Dewatering is expected to be utilized to facilitate the movement of the largest quantity of dredged material per hopper or barge load. In-water disposal of dredged material would consist of dredged material being disposed of north of Fire Island in the existing disposal site.

Essential Fish Habitat

NMFS authority to manage EFH is directly related to those species covered under Fishery Management Plans (FMPs) in the United States. The Corps' maintenance dredging action is within an area designated as EFH for three FMPs—Gulf of Alaska (GOA) Groundfish, Bering Sea/Aleutian Island (BSAI) Groundfish, and Alaska Stocks of Pacific Salmon. These three FMPs include species or species complexes of groundfish and invertebrate resources and the Pacific salmon species (table 1). No EFH “habitat areas of particular concern” are in the Corps’ project area.

Pelagic habitat in proximity to the channel is expected to be used by juvenile salmonids during their early marine life history only if transiting the area to move between shallower habitats. According to the Alaska Department of Fish and Game mapping tool used to identify anadromous waters, salmon streams exist along both shorelines paralleling the channel. As previously discussed in Section 3 of the attached EA, five species of Pacific salmon and two species of smelt migrate through Knik Arm to and from spawning habitat. Recent studies by Pentec (2005) reported other species that are occasionally or seasonally present, including herring larvae drifting in the water column as plankton. Table 1 lists the species identified in Knik Arm by those studies. The results of these studies are backed up by sampling trawl results conducted by NOAA’s Alaska Marine Fisheries Science Center, Auke Bay Laboratories staff on November 18, 2009 and July 27, 2010.

Knik Arm has long been identified as habitat for migrating anadromous fish, but only more recently have biologists shown that juvenile salmon can survive and grow in Upper Cook Inlet including Knik Arm (Moulton 1997, Pentec 2005) at rates that may not be too different from those in Prince William Sound. Juvenile salmon were not substantially more abundant close to shore in Knik Arm, which is somewhat unusual. Pentec (2005) attributed this to the cover provided by the turbid water, which protected them from predators. The same source also noted that juveniles did not school in Knik Arm, presumably because they did not need the protection from predation or because they could not see each other well enough to maintain a cohesive school. All the juvenile salmon reported in Knik Arm literature were collected within 10 feet of the water surface. Seasonal abundance matched well with times when juvenile salmon typically migrate out from their home streams and occupy nearby marine waters.

Collections in Knik Arm and nearby waters show that pink and chum salmon juveniles, which out-migrate in their first year, are seasonally abundant, but move rapidly through the area, presumably to clearer waters farther south in Cook Inlet and eventually the Pacific Ocean. The juveniles of those species are not particularly well-adapted to feeding on surface prey and are too small to eat most of the available marine invertebrates, so they need to get to waters where food is available farther south in Cook Inlet. Chinook, sockeye, and coho salmon, however are adapted to feed on surface prey and apparently survive and grow well in the waters around Anchorage, including Knik Arm. The most common food organisms in their stomachs were terrestrial insects, particularly aphids and dipterans. They also consumed other insects, herring larvae, polychaete worms, and a variety of other invertebrates. Those juvenile salmon were collected from the time they out-migrated into Knik Arm until well into the autumn. They were reported to be well fed and growing. Adult salmon returning to spawning streams in the Knik Arm drainage may be in Upper Cook Inlet and Knik Arm for days or weeks before entering their spawning streams.

Pentec (2005) reported that adults tended to remain close to shore, often in less than 2 feet of water. They suggested this near-shore orientation was to avoid beluga whales, which prey on adult salmon. The most common fish in Knik Arm collections were sticklebacks. Both three-spined and nine-spine were collected, but three-spined sticklebacks were far more numerous. These small and extremely hardy little fish are abundant in the fresh and brackish marshes around Knik Arm and may do well in estuarine waters. They, like the juvenile salmon, were widely distributed in both near-shore and deeper waters. Pacific herring were present, both as adults in the spring and as juveniles throughout the seasons sampled. They were most abundant as small larvae, drifting as plankton with the tide and currents. They were not abundant as larger juveniles. No important habitat was identified. Two smelt species were seasonally abundant. Eulachon return to the area to each spring to spawn in coastal beaches and longfin smelt return to spawn in the autumn. Both migrate through the general project area but the only identified important habitats are the coastal streams and nearby beaches. Bering cisco are whitefish that generally are associated with coastal waters with less than marine salinity.

Several species of marine fishes move into near-shore or estuarine waters when conditions are favorable. Among them are saffron cod, Pacific tom cod, ringtail snailfish, Pacific staghorn sculpin, starry flounder, walleye pollack, and snake prickleback that were occasionally collected in Knik Arm or nearby waters. Most were collected in relatively small numbers and were most abundant during the winter or at least were most abundant in collections after sediment loads had begun to drop in early autumn. Saffron cod was the most abundant of these fish. They were reported to be in spawning condition and well-fed. Dolly Varden and rainbow trout can be freshwater fish or can be anadromous. Since they were not collected in any abundance, they probably were passing through Knik Arm to or from freshwater habitat.

Table 1. Fish in Knik Arm Collections

Common Name	Species Name
Pink salmon	Oncorhynchus gorbuscha
Chum salmon	Oncorhynchus keta
Coho salmon	Oncorhynchus kisutch
Chinook salmon	Oncorhynchus tshawytscha
Sockeye salmon	Oncorhynchus nerka
Rainbow trout	Oncorhynchus mykiss
Dolly Varden	Salvelinus malma
Saffron cod	Eleginus gracilis
Longfin smelt	Spirinchus thaleichthys
Threespine stickleback	Gasterostreus aculeatus
Ninespine stickleback	Pungitius pungitius
Bering cisco	Coregonus laurettae
Pacific herring	Clupea pallasii
Ringtail snailfish	Liparis rutteri
Pacific Staghorn sculpin	Leptocottus armatus
Starry flounder	Platichthys stellatus
Eulachon	Thaleichthys pacificus
Pacific Tom cod	Microgadus proximus
Walleye pollock	Theragra chalcogramma
Snake prickleback	Lumpenus sagitta
Unidentified flatfish	
Unidentified larval fish	

Fish with designated essential fish habitat in the immediate vicinity of the Cook Inlet Navigation Channel are listed in table 2 and include Gulf of Alaska Groundfish, Bering Sea/Aleutian Islands Groundfish and Alaska Stocks of Pacific Salmon.

Table 2. Fish with designated essential fish habitat in the immediate vicinity of the Cook Inlet navigation Channel include Gulf of Alaska Groundfish, Bering Sea/Aleutian Islands Groundfish and Alaska Stocks of Pacific Salmon.

Gulf of Alaska Groundfish		**Alaska Stocks of Pacific Salmon**
Skates (Rajidae) Pacific cod Walleye Pollock Thornyhead Rockfish Pacific ocean perch Rougheye rockfish Yelloweye rockfish Rex sole Dover sole Flathead sole Sablefish Atka mackerel	Shortraker rockfish Northern rockfish Dusky rockfish Yellowfin sole, Arrowtooth flounder Rock sole Alaska plaice Sculpins (Cottidae) Sharks Forage fish complex Squid Octopus	Chinook salmon Coho salmon Pink salmon Chum salmon Sockeye salmon

BSAI Groundfish	
Walleye Pollock	Pacific Ocean Perch
Pacific Cod	Shortraker & Rougheye Rockfish
Yellowfin Sole	Northern Rockfish
Greenland Turbot	Thornyhead Rockfish
Arrowtooth Flounder	Yelloweye Rockfish
Rock Sole	Dusky Rockfish
Alaska Plaice	Atka Mackerel
Rex Sole	Skates
Dover Sole	Sculpins
Flathead Sole	Sharks
Sablefish	Forage Fish Complex
Octopus	Squid

Assessment of Project Effects on Essential Fish Habitat
Short-term impacts include: (1) water quality impacts in the form of increased levels of turbidity resulting from dredging, dewatering, and disposal; (2) oil/grease releases from work vessels and equipment;(3) noise disturbance from operation of heavy equipment, dredging via a clamshell bucket, hydraulic dredging; and (3) disturbance from increased construction-related work boat traffic in the project area and along the disposal route.

Long-term impacts include continual reconfiguration of the depth and surface contour of EFH on the channel bottom and at the disposal site. Specifically the channel is expected to perpetually fill in due to sediment movements and require dredging to maintain the authorized depth and profile.

Short-term Impacts

Water Quality

Any turbidity would be temporary, occur only in the immediate vicinity of the dredging, dewatering and dredge material disposal sites and dissipate rapidly by tidal mixing (see attached 404(b)(1) and the water quality section in the attached EA for additional information.

Juvenile salmon have been shown to avoid areas of high turbidities (Servizi 1988), although they may seek out areas of moderate turbidity (10 to 80 NTU), presumably as refuge against predation (Cyrus and Blaber 1987a and 1987b). Feeding efficiency of juveniles is impaired by turbidities in excess of 70 NTU, well below sub-lethal stress levels (Bisson and Bilby 1982). Reduced preference by adult salmon homing to spawning areas has been demonstrated where turbidities exceed 30 NTU (20 mg/L suspended sediments). However, Chinook salmon exposed to 650 mg/L of suspended volcanic ash were still able to find their natal water (Whitman et al. 1982).

Based on these data, it is unlikely that the short-term (measured in hours based on tidal exchange frequency) localized elevated turbidities generated by the proposed action would directly affect EFH juvenile or adult salmonids and EFH groundfish, such as flatfish, sculpins, and rockfish that may be present. Particularly given the high background levels of suspended sediments that exist in Upper Cook Inlet. Potential impacts would be further minimized by conducting all in-water work within approved regulatory work windows that would avoid major periods of juvenile salmon outmigration.

Except for the short-term, localized turbidity associated with maintenance dredging, no adverse impacts to water or sediment quality is expected to occur as a result of the recommended dredging action.

Waterborne Noise and Pressure

Waterborne noise would result from construction activities, such as the noise generated directly by work vessels (propulsion, power generators, on-board cranes, etc.) or by activities conducted by those vessels (e.g. clamshell or hydraulic dredging, placement of or removal of material from the barge).

Underwater noise or sound pressure from construction activities can have a variety of impacts on marine biota, especially fish and marine mammals. The most adverse impacts are associated with activities like full-power movement of the tugs/dredge vessels, disposal from a barge or crane operations that produce higher decibel sounds in the water column (Hastings and Popper 2005). None of the dredging or dredge related operations is expected to produce sound levels at decibels that could injure fish. Sound and pressure waves produced by all other in-water work do not have the potential to generate the type and intensity of sound or pressure waves that would result in injury or death of fish. Higher decibel dredging activities are expected to cause both adult and juvenile fish to leave or avoid the work area. These affects would be further minimized by restricting in-water work to periods when few juvenile salmonids are in the area. Groundfish species such as flatfish, rockfish, and sculpins can be present year-round, so they may move out of the area during the construction period as well.

<u>Construction-related Work Boat Traffic</u>

Constructing the Corps's proposed project may involve a test/production dredging action prior to each maintenance dredging action, hydraulic and/or clamshell dredging, and the placement of materials into a dump barge. For fish with designated EFH, interactions with dredge, tug, and barge traffic would be relatively benign in Knik Arm and the marine navigational channel, mainly consisting of the fish moving away from the vessels and barge. Vessels and barges would not be working at depths that would result in their grounding on the bottom during low tide periods, thus no destruction or alteration of bottom habitats that constitute EFH other than that impacted by the dredging or disposal would occur.

Long-term Impacts

<u>Loss and Conversion of Marine Habitat</u>

EFH marine habitat will not be lost. Within the dredging and disposal area footprints, substrates will be repeatedly modified during each dredging/disposal event.

<u>Water Quality</u>

With the exception of the previously discussed short term, localized turbidity associated with the dredging of and disposal of dredged material into the marine environment, no long term adverse impacts to water or sediment quality, EFH, and EFH-related species/species complexes are expected to occur as a result of the proposed maintenance dredging.

Mitigation Measures

"Mitigation" is the process used to avoid, minimize, and compensate for environmental consequences of an action. Incorporating the following mitigation measures and conservation measures into the recommended corrective action will help to assure that no significant adverse impacts would occur to EFH and EFH-managed species/species complexes and other fish and wildlife resources in the project area.

- Project-related vessels shall not be permitted to ground themselves on the bottom during low tide periods unless there is a human safety issue requiring it.
- A construction oil spill prevention plan shall be prepared.
- A hopper dredge will be loaded so that enough of the freeboard remains to allow for safe movement of the dredge and its material on the route to the offloading site.
- Dredging and/or disposal shall cease or move to another location distant from any beluga whales within a 50-meter radius of the dredging operation. This is the same distance that has been successfully applied to maintenance dredging at the Port of Anchorage for the last few years.

- Surface water turbidity would be monitored adjacent to and down-current of the dredge while disposing sediment to determine whether there is an appreciable increase in surface turbidity during disposal. A sampling plan would be prepared prior to the start of the dredging season to work out the details of the protocols and strategy.

Conclusions and Determination of Effect

The project actions described above have the potential to affect the EFH for several Gulf of Alaska groundfish species (e.g., rockfish, sculpin, and flatfish), Bering Sea/Aleutian Island groundfish species, and for Alaska stocks of Pacific salmon, in the short-term. Short-term effects in the form of avoidance and possibly injury of a few individuals because of noise disturbances, vessel traffic, and turbidity would be intermittent and low level. No long-term effects are expected other than the change in the elevation and surficial texture of the EFH on that portion of the harbor substrate that is dredged.

The potential effects of turbidity would be intermittent and low level. No adverse impacts related to circulation and harbor-flushing is expected. Year-round resident EFH species would likely respond by temporarily moving out of work areas during construction.

Potential impacts to EFH and EFH-managed species/species complexes are likely to be highly localized, temporary, and minimal, and not reduce the overall value of EFH. The aforementioned mitigation measures will be prescribed to offset the potential impacts of the Corps' maintenance dredging activity. Therefore, the Corps concludes that its Federal action may affect, but is not likely to adversely affect, EFH and EFH-managed species/species complexes for Gulf of Alaska groundfish, Bering Sea/Aleutian Island groundfish, and Alaska stocks of Pacific salmon.

Description of Essential Fish Habitat for the Groundfish Resources of the Gulf of Alaska Region[1]

Walleye Pollock

Eggs
EFH for walleye pollock eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the GOA.

Larvae
EFH for larval walleye pollock is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Limited information exists to describe walleye pollock early juvenile larval general distribution.

Late Juveniles
EFH for late juvenile walleye pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf along the throughout the GOA. No known preference for substrates exist.

Adults
EFH for adult walleye pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the entire shelf (0 to 200) and slope (200 to 1,000 m) throughout the GOA. No known preference for substrates exist.

Pacific Cod

Eggs
EFH for Pacific cod eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper (200 to 500 m) slope throughout the GOA wherever there are soft substrates consisting of mud and sand.

Larvae
EFH for larval Pacific cod is the general distribution area for this life stage, located in pelagic waters along the inner (0 to 50 m) and middle (50 to 100 m) shelf throughout the GOA wherever there are soft substrates consisting of mud and sand.

[1] http://sharpfin.nmfs.noaa.gov/website/efh_mapper/newinv/efh_inventory.html

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting of sand, mud, sandy mud, and muddy sand.

Adults
EFH for adult Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are soft substrates consisting of sand, mud, sandy mud, muddy sand, and gravel.

Yellowfin Sole

Eggs
EFH for yellowfin sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper (200 to 500 m) slope throughout the GOA.

Larvae
EFH for larval yellowfin sole is the general distribution area for this life stage, located in pelagic waters along the shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are soft substrates consisting mainly of sand.

Adults
EFH for adult yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are soft substrates consisting mainly of sand.

Arrowtooth Flounder

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval arrowtooth flounder is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the GOA wherever there are softer substrates consisting of gravel, sand, and mud.

Adults
EFH for adult arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the GOA wherever there are softer substrates consisting of gravel, sand, and mud.

Rock Sole

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval rock sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 1,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble.

Adults
EFH for adult rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble.

Alaska Plaice

Eggs
EFH for Alaska plaice eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the GOA in the spring.

Larvae
EFH for larval Alaska plaice is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud.

Adults
EFH for adult Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud.

Rex Sole

Eggs
EFH for rex sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the GOA in the spring.

Larvae
EFH for larval rex sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for juvenile rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are substrates consisting of gravel, sand, and mud.

Adults
EFH for adult rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are substrates consisting of gravel, sand, and mud.

Dover Sole

Eggs
EFH for Dover sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Larvae
EFH for larval Dover sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the GOA wherever there are substrates consisting of sand and mud.

Adults
EFH for adult Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the GOA wherever there are substrates consisting of sand and mud.

Flathead Sole

Eggs
EFH for flathead sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Larvae
EFH for larval flathead sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for juvenile flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are softer substrates consisting of sand and mud.

Adults
EFH for adult flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the GOA wherever there are softer substrates consisting of sand and mud.

<u>Sablefish</u>

Eggs
EFH for sablefish eggs is the general distribution area for this life stage, located in deeper waters along the slope (200 to 3,000 m) throughout the GOA.

Larvae
EFH for larval sablefish is the general distribution area for this life stage, located in epipelagic waters along the middle shelf (50 to 100 m), outer shelf (100 to 200 m), and slope (200 to 3,000 m) throughout the GOA..

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 m) throughout the GOA.

Adults
EFH for adult sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 m) throughout the GOA.

<u>Pacific Ocean Perch</u>

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval Pacific Ocean perch is the general distribution area for this life stage, located in the middle to lower portion of the water column along the inner shelf (0 to 50 m), middle shelf (50 to 100 m), outer shelf (100 to 200 m), and upper slope (200 to 500 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Pacific Ocean perch is the general distribution area for this life stage, located in the middle to lower portion of the water column along the inner shelf (0 to 50 m), middle shelf (50 to 100 m), outer shelf (100 to 200 m), and upper slope (200 to 500 m) throughout the GOA wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand.

Adults
EFH for adult Pacific Ocean perch is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the GOA wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand.

Shortraker and Rougheye Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval shortraker and rougheye rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult shortraker and rougheye rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) regions throughout the GOA wherever there are substrates consisting of mud, sand, sandy mud, muddy sand, rock, cobble, and gravel.

Northern Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval northern rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult northern rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer slope (100 to 200 m) and upper slope (200 to 500 m) throughout the GOA wherever there are substrates of cobble and rock.

Thornyhead Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval thornyhead rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 m) and upper to lower slope (200 to 1,000 m) throughout the GOA wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel.

Adults
EFH for adult Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 m) and upper to lower slope (200 to 1,000 m) throughout the GOA wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel.

Yelloweye Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval yelloweye rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the GOA wherever there are substrates of rock and in areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges.

Adults
EFH for adult Yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner shelf (0 to 50 m), middle shelf (50 to 100 m), outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the GOA wherever there are substrates of rock and in areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges.

Dusky Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval dusky rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the GOA.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult Dusky rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the GOA wherever there are substrates of cobble, rock, and

Atka Mackerel

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval Atka mackerel is the general distribution area for this life stage, located in epipelagic waters along the shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the GOA.

Early Juveniles —No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult Atka mackerel is the general distribution area for this life stage, located in the entire water column, from sea surface to the sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the GOA wherever there are substrates of gravel and rock and in vegetated areas of kelp

Sculpins

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Juveniles
EFH for juvenile sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), outer shelf (100 to 200 m) and portions of the upper slope (200 to 500 m) throughout the GOA wherever there are substrates of rock, sand, mud, cobble, and sandy mud.

Adults
EFH for adult sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), outer shelf (100 to 200 m) and portions of the upper slope (200 to 500 m) throughout the GOA wherever there are substrates of rock, sand, mud, cobble, and sandy mud.

Skates

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult skates is the general distribution area for this life stage, located in the lower portion of the water column on the shelf (0 to 200 m) and the upper slope (200 to 500 m) throughout the GOA wherever there are of substrates of mud, sand, gravel, and rock.

Sharks

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults—No EFH Description Determined
Insufficient information is available.

Forage Fish Complex—Eulachon, Capelin, Sand Lance, Sand Fish, Euphausiids, Myctophids, Pholids, Gonostomatids, etc.

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults. No EFH Description Determined
Insufficient information is available.

Squid

Eggs—No EFH Description Determined
Insufficient information is available.

Young Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for older juvenile squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer (200 to 500 m) shelf and the entire slope (500 to 1,000 m) throughout the GOA.

Adults
EFH for adult squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer (200 to 500 m) shelf and the entire slope (500 to 1,000 m) throughout the GOA.

Octopus

Eggs—No EFH Description Determined
Insufficient information is available.

Young Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults. No EFH Description Determined
Insufficient information is available.

Description of Essential Fish Habitat for the Groundfish Resources of the Bering Sea/Aleutian Islands Region[2]

Figures referred to in this section can be found on the website:
http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html

EFH Description for BSAI Walleye Pollock

Eggs
EFH for walleye pollock eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure D-77.

Larvae
EFH for larval walleye pollock is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure D-78.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile walleye pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI, as depicted in Figure D-79. No known preference for substrates exist.

Adults
EFH for adult walleye pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the entire shelf (0 to 200 m) and slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure D-79. No known preference for substrates exist.

EFH Description for BSAI Pacific Cod

Eggs—No EFH Description Determined
Scientific information notes the rare occurrence of Pacific cod eggs in the BSAI.

Larvae
EFH for larval Pacific cod is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure D-80.

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[2] http://sharpfin.nmfs.noaa.gov/website/efh_mapper/newinv/efh_inventory.html

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting of sand, mud, sandy mud, and muddy sand, as depicted in Figure D-81.

Adults
EFH for adult Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting of sand, mud, sandy mud, muddy sand, and gravel, as depicted in Figure D-81.

EFH Description for BSAI Yellowfin Sole

Eggs—No EFH Description Determined
Scientific information notes the rare occurrence of yellowfin sole eggs in the BSAI.

Larvae—No EFH Description Determined
Scientific information notes the rare occurrence of larval yellowfin sole in the BSAI.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand, as depicted in Figure D-82.

Adults
EFH for adult yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand, as depicted in Figure D-82.

EFH Description for BSAI Greenland Turbot

Eggs
EFH for Greenland turbot eggs is the general distribution area for this life stage, located principally in benthypelagic waters along the outer shelf (100 to 200 m) and slope (200 to 3,000 m) throughout the BSAI in the fall, as depicted in Figure D-83.

Larvae
EFH for larval Greenland turbot is the general distribution area for this life stage, located principally in benthypelagic waters along the outer shelf (100 to 200 m) and slope (200 to 3,000 m) throughout the BSAI and seasonally abundant in the spring, as depicted in Figure D-84.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Greenland turbot is the general distribution area for this life stage, located in the lower and middle portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of mud and sandy mud, as depicted in Figure D-85.

Adults
EFH for late adult Greenland turbot is the general distribution area for this life stage, located in the lower and middle portion of the water column along the outer shelf (100 to 200 m), upper slope (200 to 500 m), and lower slope (500 to 1,000 m) throughout the BSAI wherever there are softer substrates consisting of mud and sandy mud, as depicted in Figure D-85.

EFH Description for BSAI Arrowtooth Flounder

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Scientific information notes the rare occurrence of larval arrowtooth flounder in the BSAI.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of gravel, sand, and mud, as depicted in Figure D-86.

Adults
EFH for adult arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of gravel, sand, and mud, as depicted in Figure D-86.

EFH Description for BSAI Rock Sole

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval rock sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure D-87.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble, as depicted in Figure D-88.

Adults
EFH for adult rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble, as depicted in Figure D-88.

EFH Description for BSAI Alaska Plaice

Eggs
EFH for Alaska plaice eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the BSAI in the spring, as depicted in Figure D-89.

Larvae—No EFH Description Determined
Scientific information notes the rare occurrence of larval Alaska plaice in the BSAI.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure D-90.

Adults
EFH for adult Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure D-90.

EFH Description for BSAI Rex Sole

Eggs—No EFH Description Determined
Scientific information notes the rare occurrence of rex sole eggs in the BSAI.

Larvae—No EFH Description Determined
Scientific information notes the rare occurrence of larval rex sole in the BSAI.

Late Juveniles
EFH for juvenile rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are substrates consisting of gravel, sand, and mud, as depicted in Figure D-91.

Adults
EFH for adult rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are substrates consisting of gravel, sand, and mud, as depicted in Figure D-91.

EFH Description for BSAI Dover Sole

Eggs—No EFH Description Determined
Scientific information notes the rare occurrence of Dover sole eggs in the BSAI.
Larvae—No EFH Description Determined
Scientific information notes the rare occurrence of larval Dover sole in the BSAI.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of sand and mud, as depicted in Figure D-92.

Adults
EFH for adult Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of sand and mud, as depicted in Figure D-92.

EFH Description BSAI Flathead Sole

Eggs
EFH for flathead sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI in the spring, as depicted in Figure D-93.

Larvae
EFH for larval flathead sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-94.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for juvenile flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure D-95.

Adults
EFH for adult flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure D-95.

EFH Description for BSAI Sablefish

Eggs—No EFH Description Determined
Scientific information notes the rare occurrence of sablefish eggs in the BSAI.

Larvae
EFH for larval sablefish is the general distribution area for this life stage, located in epipelagic waters along the middle shelf (50 to 100 m), outer shelf (100 to 200 m), and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-96.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure D-97.

Adults
EFH for adult sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure D-97.

EFH Description for BSAI Pacific Ocean Perch

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval Pacific ocean perch is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-98, General Distribution of Rockfish Larvae.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Pacific ocean perch is the general distribution area for this life stage, located in the middle to lower portion of the water column along the inner shelf (1 to 50 m), middle shelf (50 to 100 m), outer shelf (100 to 200 m), and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand, as depicted in Figure D-99.

Adults
EFH for adult Pacific ocean perch is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand, as depicted in Figure D-99.

EFH Descriptions for BSAI Shortraker and Rougheye Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval shortraker and rougheye rockfish is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-98, General Distribution of Rockfish Larvae.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult shortraker and rougheye rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) regions throughout the BSAI wherever there are substrates consisting of mud, sand, sandy mud, muddy sand, rock, cobble, and gravel, as depicted in Figure D-100.

EFH Description for BSAI Northern Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval northern rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-98, General Distribution of Rockfish Larvae.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult northern rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer slope (100 to 200 m) and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of cobble and rock, as depicted in Figure D-101.

EFH Description for BSAI Thornyhead Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval thornyhead rockfish is the general distribution area for this life stage, located in epipelagic waters along the outer shelf (100 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-98, General Distribution of Rockfish Larvae.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 m) and upper to lower slope (200 to 1,000 m) throughout the BSAI wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel, as depicted in Figure D-102.

Adults
EFH for adult Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 m) and upper to lower slope (200 to 1,000 m) throughout the BSAI wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel, as depicted in Figure D-102.

EFH Description for BSAI Yelloweye Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval yelloweye rockfish is the general distribution area for this life stage, located in the epipelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-98, General Distribution of Rockfish Larvae.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates of rock and in areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges, as depicted in Figure D-103.

Adults
EFH for adult yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner shelf (0 to 50 m), outer shelf (100 to 100 m), and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of rock and in vegetated areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges, as depicted in Figure D-103.

EFH Description for BSAI Dusky Rockfish

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval dusky rockfish is the general distribution area for this life stage, located in the pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure D-98, General Distribution of Rockfish Larvae.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult dusky rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of cobble, rock, and gravel, as depicted in Figure D-104.

EFH Description for BSAI Atka Mackerel

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae
EFH for larval atka mackerel is the general distribution area for this life stage, located in epipelagic waters along the shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure D-105.

Early Juveniles —No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult Atka mackerel is the general distribution area for this life stage, located in the entire water column, from sea surface to the sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates of gravel and rock and in vegetated areas of kelp, as depicted in Figure D-106.

EFH Description for BSAI Skates

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Adults
EFH for adult skates is the general distribution area for this life stage, located in the lower portion of the water column on the shelf (0 to 200 m) and the upper slope (200 to 500 m) throughout the BSAI wherever there are of substrates of mud, sand, gravel, and rock, as depicted in Figure D-107.

EFH Description for BSAI Sculpins

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Juveniles
EFH for juvenile sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), outer shelf (100 to 200 m) and portions of the upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of rock, sand, mud, cobble, and sandy mud, as depicted in Figure D-108.

Adults
EFH for adult sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m, outer shelf (100 to 200 m) and portions of the upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of rock, sand, mud, cobble, and sandy mud, as depicted in Figure D-108.

EFH Description for BSAI Sharks

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults—No EFH Description Determined
Insufficient information is available.

EFH Description for BSAI Forage Fish Complex—Eulachon, Capelin, Sand Lance, Sand Fish, Euphausiids, Myctophids, Pholids, Gonostomatids, etc.

Eggs—No EFH Description Determined
Insufficient information is available.

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults—No EFH Description Determined
Insufficient information is available.

EFH Description for BSAI Squid

Eggs—No EFH Description Determined
Insufficient information is available.

Young Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for older juvenile squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer (200 to 500 m) shelf and the entire slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure D-109.

Adults
EFH for adult squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer (200 to 500 m) shelf and the entire slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure D-109.

EFH Description for BSAI Octopus

Eggs—No EFH Description Determined
Insufficient information is available.

Young Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles—No EFH Description Determined
Insufficient information is available.

Adults—No EFH Description Determined
Insufficient information is available.

D.3.1.3 EFH Map Descriptions for BSAI Groundfish

Figures D-77 through D-109 show EFH distribution under Alternative 3 for the BSAI groundfish species as described in Section D.3.1.2.

Description of Essential Fish Habitat for Alaska Stocks of Pacific Salmon

EFH Description for Pink Salmon

Freshwater Eggs
EFH for pink salmon eggs is the general distribution area for this life stage, located in gravel substrates in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a), as depicted in Figures D-156 through D-161.

Freshwater Larvae and Juveniles
EFH for larval and juvenile pink salmon is the general distribution area for this life stage, located in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and contiguous rearing areas within the boundaries of ordinary high water during the spring, generally migrate in darkness in the upper water column. Fry leave streams in within 15 days and the duration of migration from a stream towards sea may last 2 months, as depicted in Figures D-156 through D-161.

Estuarine Juveniles
Estuarine EFH for juvenile pink salmon is the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters and generally present from late April through June, as depicted in Figures D-156 through D-161.

Marine Juveniles
Marine EFH for juvenile pink salmon is the general distribution area for this life stage, located in all marine waters off the coast of Alaska from the mean higher tide line to the 200-nautical mile (nm) limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean, as depicted in Figure D-162.

Marine Immature and Maturing Adults
EFH for immature and maturing adult pink salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska to depths of 200 m and range from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean. Mature adult pink salmon frequently spawn in intertidal areas and are known to associate with smaller coastal streams, as depicted in Figure D-162.

Freshwater Adults
EFH for pink salmon is the general distribution area for this life stage, located in freshwaters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and wherever there are spawning substrates consisting of medium to course gravel containing less than 15 percent fine sediment (less than 2-mm diameter), 15 to 50 cm in depth from June through September, as depicted in Figures D-156 through D-161.

EFH Description for Chum Salmon

Freshwater Eggs

EFH for chum salmon eggs is the general distribution area for this life stage, located in gravel substrates in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a), as depicted in Figures D-163 through D-168.

Freshwater Larvae and Juveniles

EFH for larval and juvenile chum salmon is the general distribution area for this life stage, located in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and contiguous rearing areas within the boundaries of ordinary high water and contiguous rearing areas within the boundaries of ordinary high water during the spring, generally migrate in darkness in the upper water column. Fry leave streams in within 15 days and the duration of migration from a stream towards sea may last 2 months, as depicted in Figures D-163 through D-168.

Estuarine Juveniles

Estuarine EFH for juvenile chum salmon is the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters from late April through June, as depicted in Figures D-163 through D-168.

Marine Juveniles

Marine EFH for juvenile chum salmon is the general distribution area for this life stage, located in all marine waters off the coast of Alaska to approximately 50 m in depth from the mean higher tide line to the 200-nm limit of the EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean, as depicted in Figure D-169.

Marine Immature and Maturing Adults

EFH for immature and maturing adult chum salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska to depths of 200 m and ranging from the mean higher tide line to the 200-nm limit of the EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean, as depicted in Figure D-169.

Freshwater Adults

EFH for chum salmon is the general distribution area for this life stage, located in freshwaters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and wherever there are spawning substrates consisting of medium to course gravel containing less than 15 percent fine sediment (less than 2-mm diameter) and finer substrates can be used in upwelling areas of streams and sloughs from June through January, as depicted in Figures D-163 through D-168.

EFH Description for Sockeye Salmon

Freshwater Eggs

EFH for sockeye salmon eggs is the general distribution area for this life stage, located in gravel substrates in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a), as depicted in Figures D-170 through D-175.

Freshwater Larvae and Juveniles

EFH for larval and juvenile sockeye salmon is the general distribution area for this life stage, located in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and contiguous rearing areas within the boundaries of ordinary high water. Juvenile sockeye salmon require year-round rearing habitat. Fry generally migrate downstream to a lake or, in systems lacking a freshwater lake, to estuarine and riverine rearing areas for up to 2 years. Fry out migration occurs from approximately April to November and smolts generally migrate during the spring and summer, as depicted in Figures D-170 through D-175.

Estuarine Juveniles

Estuarine EFH for juvenile sockeye salmon is the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters. Under-yearling, yearling, and older smolts occupy estuaries from March through early August, as depicted in Figures D-170 through D-175.

Marine Juveniles

Marine EFH for juvenile sockeye salmon is the general distribution area for this life stage, located in all marine waters off the coast of Alaska to depths of 50 m and range from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean from mid-summer until December of their first year at sea, as depicted in Figure D-176.

Marine Immature and Maturing Adults

EFH for immature and maturing adult sockeye salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska to depths of 200 m and range from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean, as depicted in Figure D-176.

Freshwater Adults

EFH for sockeye salmon is the general distribution area for this life stage, located in freshwaters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and wherever there are spawning substrates consisting of medium to course gravel containing less than 15 percent fine sediment (less than 2-mm diam.) and finer substrates can be used in upwelling areas of streams and sloughs from June through September. Sockeye often spawn in lake substrates, as well as in streams, as depicted in Figures D-170 through D-175.

EFH Description for Chinook Salmon

Freshwater Eggs
EFH for Chinook salmon eggs is the general distribution for this life stage, located in gravel substrates in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) (see Figures D-177 through D-182).

Freshwater Larvae and Juveniles
EFH for larval and juvenile Chinook salmon is the general distribution area for this life stage, located in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and contiguous rearing areas within the boundaries of ordinary high water. Juvenile Chinook salmon out-migrate from freshwater areas in April toward the sea and may spend up to a year in a major tributaries or rivers, such as the Kenai, Yukon, Taku, and Copper Rivers (see Figures D-177 through D-182).

Estuarine Juveniles
Estuarine EFH for juvenile Chinook salmon is the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters. Chinook salmon smolts and post-smolt juveniles may be present in these estuarine habitats from April through September (see Figures D-177 through D-182).

Marine Juveniles
Marine EFH for juvenile Chinook salmon is the general distribution area for this life stage, located in all marine waters off the coast of Alaska from the mean higher tide line to the 200-nm limit of the EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean. Juvenile marine Chinook salmon are at this life stage from April until annulus formation in January or February during their first winter at sea (see Figure D-183).

Marine Immature and Maturing Adults
EFH for immature and maturing adult Chinook salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska and ranging from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean (see Figure D-183).

Freshwater Adults
EFH for adult Chinook salmon is the general distribution area for this life stage, located in fresh waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) wherever there are spawning substrates consisting of gravels from April through September (see Figures D-177 through D-182).

EFH Description for Coho Salmon

Freshwater Eggs
EFH for coho salmon eggs is the general distribution area for this life stage, located in gravel substrates in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a), as depicted in Figures D-184 through D-189.

Freshwater Larvae and Juveniles
EFH for larval and juvenile coho salmon is the general distribution area for this life stage, located in those waters identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and contiguous rearing areas within the boundaries of ordinary high

water. Fry generally migrate to a lake, slough, or estuary and rear in these areas for up to 2 years, as depicted in Figures D-184 through D-189.

Estuarine Juveniles
Estuarine EFH for juvenile coho salmon is the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters. Juvenile coho salmon require year-round rearing habitat and also migration habitat from April to November to provide access to and from the estuary.

Marine Juveniles
Marine EFH for juvenile coho salmon is the general distribution area for this life stage, located in all marine waters off the coast of Alaska from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean, as depicted in Figure D-190.

Marine Immature and Maturing Adults
EFH for immature and maturing adult coho salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska to 200 m in depth and range from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean, as depicted in Figure D-190.

Freshwater Adults
EFH for coho salmon is the general distribution area for this life stage, located in freshwaters as identified in ADF&G's *Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 1998a) and wherever there are spawning substrates consisting mainly of gravel containing less than 15 percent fine sediment (less than 2-mm diameter) from July to December, as depicted in Figures D-184 through D-189.

D.3.5.3 EFH Map Descriptions for Alaska Stocks of Pacific Salmon

Figures D-155 through D-190 show EFH distribution under Alternative 3 by region for the Alaska stocks of Pacific salmon as described in Section D.3.5.2.