Environmental Assessment on the Issuance of an Incidental Harassment Authorization and Subsequent Rulemaking for Take of Small Numbers of Marine Mammals Incidental to the Port of Anchorage Terminal Redevelopment Project, Anchorage, Alaska

Prepared by
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National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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CHAPTER 1 PURPOSE AND NEED FOR ACTION

1.1. DESCRIPTION OF ACTION

1.1.1 Proposed Action

Pursuant to the National Environmental Policy Act (NEPA), this Environmental Assessment (EA) analyzes the potential impacts to the human environment that may result from the proposed action of National Marine Fisheries Service (NMFS)' issuance of incidental take authorizations under the Marine Mammal Protection Act (MMPA 16 USC 1361 *et seq.*) to the Port of Anchorage (POA) and the U.S. Department of Transportation Maritime Administration (MARAD) for harassment of marine mammals incidental to the Port of Anchorage Marine Terminal Redevelopment Project.

In November 2005, the National Marine Fisheries Service (NMFS), Office of Protected Resources (OPR) received an application from the POA and MARAD for an authorization to take[1], by Level B harassment, marine mammals incidental to Phase I of the Port's Marine Terminal Redevelopment Project (PROJECT), Anchorage, Alaska (a two-phase project). However, in a supplemental letter, the Port indicated that modifications to the construction methods were made such that Phase I activities would occur entirely from land and not involve any significant in-water noise. On May 9, 2006, NMFS concurred that Phase I of the Project would not result in the harassment of marine mammals incidental to construction activities; therefore, an incidental take authorization was not necessary.

Discussion between NMFS and the Port led to the determination that Phase II of the Project does necessitate an incidental take authorization due to noise from construction activities, specifically pile driving. Following several delays and design changes, on September 13, 2007, the Port re-applied for MMPA Section 101(a)(5)(D) Incidental Harassment Authorization (IHA) for the first year of construction and a MMPA Section 101(a)(5)(A) 5-year rulemaking and letters of authorization (LOAs) for the subsequent construction seasons. NMFS required further refinement of the proposal and received a complete application on February 20, 2008. As such, NMFS proposed action is to issue a 1-year IHA for the 2008 construction activities and promulgate a subsequent 5-year rule to allow the Port to take small numbers of marine mammals, specifically beluga whales (*Delphinapterus leucas*), harbor porpoises (*Phocoena phocoena*), killer whales (*Orcinus orca*), and harbor seals (*Phoca vitulina*), incidental to the Project.

1.1.2 Purpose and Need

The purpose and need of the action is to ensure compliance with the MMPA and its implementing regulations for the activities associated with the Port's Project The MMPA prohibits takes of all marine mammals in the U.S. (including territorial seas) with a few exceptions. Sections 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce to

[1] Take under the MMPA means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal.

allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. Citizens who engage in a specified activity (other than commercial fishing) if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted for up to 5 years if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for certain subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as: an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

Under 50 CFR 216.104(b) of NMFS' implementing regulations for the MMPA, NMFS must, after deeming the application adequate and complete, publish in the *Federal Register* a notice of proposed IHA or receipt of a request for the implementation or re-implementation of regulations governing the incidental taking. Information gathered during the associated comment period is considered by NMFS in ensuring adequacy of preliminary determinations and proposed mitigation measures for IHAs and developing, if appropriate, regulations governing the issuance of LOAs for the proposed activity. In accordance, a notice of proposed issuance of an IHA and receipt of application for rulemaking was published in the *Federal Register* on March 17, 2008 (73 FR 14443). The public comment period closed April 17, 2008.

NMFS' decision of whether or not to issue the Port an incidental take authorizations is a Federal action that requires an analysis of its effect on the human environment pursuant to the National Environmental Policy Act (NEPA). This Environmental Assessment (EA) contains that analysis and is intended to support NMFS' issuance of an IHA in 2008 and future decisions regarding whether to promulgate 5-yr incidental take regulations in 2009.

1.1.3 Other Applicable Laws

Additional key federal laws are applicable to the evaluation of the proposed action (i.e., issuance of an IHA and issuance of a rulemaking and subsequent LOAs) including Magnuson Stevens Fisheries Management Act and the Endangered Species Act. In addition, for rulemaking, the Regulatory Flexibility Act (RFA) applies. The decision making process on this proposed action is informed by evaluating the compliance of the various alternatives with federal laws and EOs.

1.2. OBJECTIVES OF THE MARINE TERMINAL REDEVELOPMENT PROJECT

As described by the POA in the application, the overall objectives of the Project are to replace functionally obsolete structures; increase Port capacity, efficiency, and security; and accommodate the needs of the U.S. military for rapid deployment. Specific goals include:

- *Necessary replacement of obsolete infrastructure* – certain elements of the Port's existing infrastructure are functionally obsolete and near or below design safety standards for seismic events. These infrastructure elements will be replaced, warehouse storage developed, and code-compliant support structures relocated.

- *Additional capacity to accommodate growth in current customers* – current and near-future cargo-handling capacity will continue to exceed maintainable, safe, and efficient levels. Operational analysis and projected growth for the Municipality of Anchorage (MOA) and the State of Alaska have identified a need for approximately 135 additional acres of land and additional berth space to support existing and future Port operations.

- *Additional berths to provide service to new and existing customers* – expected growth of operations coupled with existing customer demand will result in at least 40 percent growth in ship calls, causing berthing conflicts, increased waiting times for berths, and increased transportation costs to the public. The expanded and upgraded Port will be capable of safely and efficiently handling commerce and military needs until 2025 and possibly beyond.

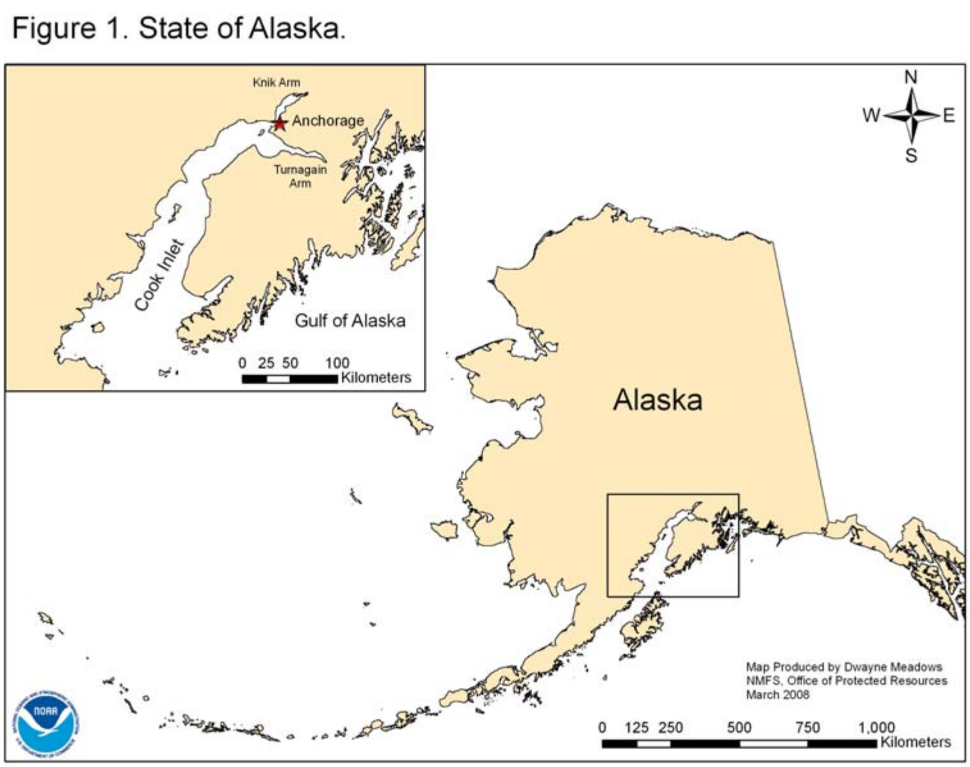
- *Deeper drafts, longer berths, larger cranes for offloading and more streamlined intermodal transportation to efficiently handle new ships with the ability to move the increasing amount of cargo out to the public* – current trends in maritime transportation have produced larger, longer ships that cannot be supported by the current Port facilities. With deeper drafts and wider beams, these large ships require longer berths and cranes with a wider capacity for unloading. Failure to expand would result in increasing inefficiencies and costs for shipping goods to Alaska's customers. Operational limitations of the existing Port infrastructure require that loading procedures at ports of origin be restricted to accommodate limited crane reach.

- *Additional space and an improved berth to support military rapid deployments without conflicting with commercial customers* – as a critical conduit for military deployment, the POA will need to maintain a sustained commitment that embodies a long-term plan, integrating intermodal efficiency with that of heightened security and positive cargo control. Current berthing facilities at the POA are insufficient to accommodate both military and commercial ships supporting the U.S. Army's Alaska-based Stryker Brigade Combat Team.

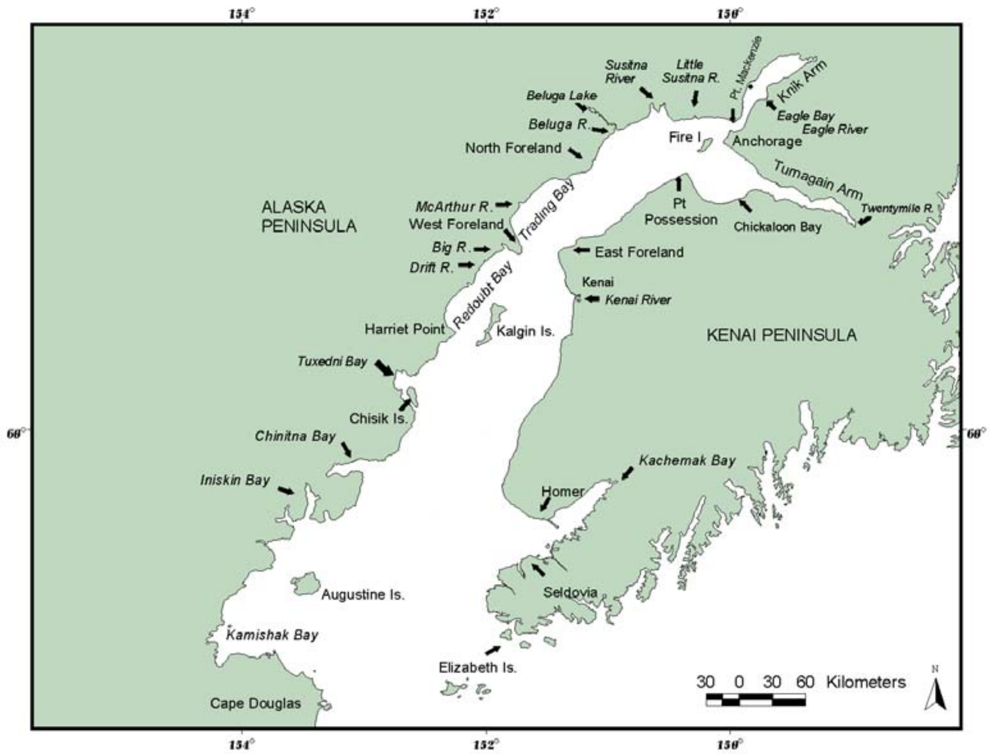
- *Lighting, gates, and other features to meet new security requirements under the new Maritime Security mandates* - the Port, like all U.S. ports, must construct facilities and implement measures to comply with the Maritime Transportation Security Act of 2002, and with the associated waterfront U.S. Coast Guard (USCG) maritime security regulations, which were designed to protect the nation's ports and waterways from terrorist attack.

The City of Anchorage is located within the upper reaches of Cook Inlet, Alaska (figures 1a, b). The existing 129-acre Port is located on the east bank of Knik Arm. According to the application submitted by the Port, the proposed Project influences the physical and economic aspects of the MOA and the State of Alaska as it will adequately support the economic growth of Anchorage and the state through 2025. The Port currently serves 80% of Alaska's populated area, and it handles over 90% of consumer goods sold within the Alaskan Railroad distribution area (the Alaska Railroad runs from Seward through Anchorage, Denali, and Fairbanks to North Pole, with spurs to Whittier and Palmer, a line locally known as "The Railbelt"). The Port is currently operating at or above sustainable practical capacity for the various types of cargo handled at the facility. The Project is designed to upgrade and expand the Port by replacing aging and obsolete structures and provide additional dock and backland areas. Operations at the Port would improve and increase with expansion, construction, and reorganization. In addition, the Project is critical to national defense by providing additional land and facilities necessary to support local military deployments.

Figure 1. Location of the City of Anchorage in Cook Inlet Alaska.
a) Polygon map of the location of Anchorage in relation to the state of Alaska.



b) Detailed map of Cook Inlet (taken from Cook Inlet Beluga Draft Conservation Plan, NMFS, 2006).



1.2.1. Design and Construction Activities

1.2.1.1. Open Cell Sheet Pile Design

According to the application, the existing dock can no longer be widened nor salvaged due to its advanced age and state of disrepair. The dock supporting the three cranes today was completed in 1961. Its projected life expectancy was 25-30 years; therefore a new port is in order. Phase II of the project, which requires an MMPA authorization, will include impact and vibratory pile driving of open cell sheet, 36 inch steal , and H- piles to construct the waterfront bulkhead structure that will facilitate increased dock space and the fendering system. The Port has indicated the following types of pile drivers would be used: a Delmag D30-42 diesel impact pile driver equipped with a 13,571lb (6,154 kg) hammer that has a maximum rated energy of 74,750 ft-lb. (approximately 101 kJ) and an APE Model 200-6 vibratory driver/extractor with Model 630 power unit. According to the U.S. Army Corps of Engineers (USACE), open cell sheet pile (OCSP) would primarily require a vibratory hammer that has a slightly higher frequency than an impact hammer but requires less energy to operate. Therefore less sound would be emitted into the water column. In addition, as described in the application, impact hammers required to drive sheet pile sections to final depth are smaller and impart less energy into the water column than those needed to drive steel pipe piles. Impact pile driving will only be conducted when desired tip elevation is not able to be reached with a vibratory hammer.

The new terminal footprint would be larger than that of the current Port but will not extend out more than 400 ft from the existing dock (Fig. 2). The Project has been divided into six construction areas, ranging in size from 17 acres to 34 acres each (Fig. 3). Upon completion, 135 acres of intertidal and subtidal habitat will be filled to accommodate the new Port. The recently completed Phase I entailed expansion and fill of the north backlands area, barge berth area, and south backland areas (48.6 acres) are now considered unusable land (figure 3, yellow areas). Again, no in-water pile driving was conducted during Phase I and therefore, a marine mammal incidental take authorization was not needed.

Figure 2. Port of Anchorage (in gray) and the Marine Terminal Redevelopment Project Footprint (black hatch marks).

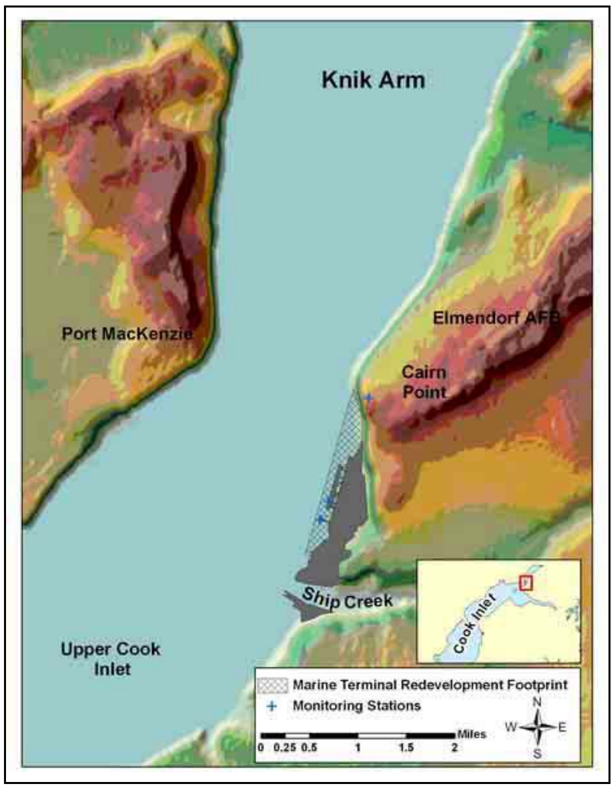
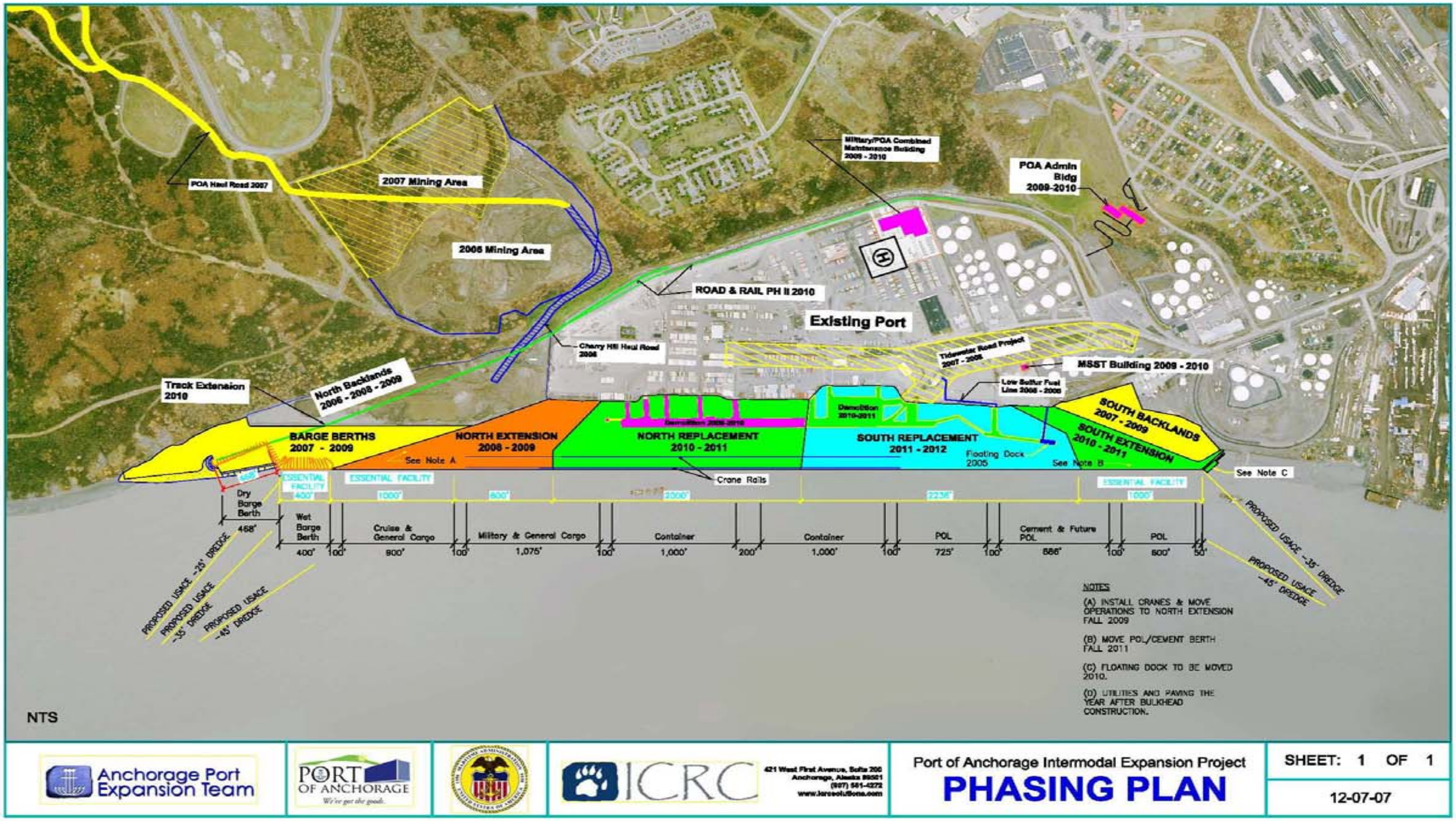


Figure 3. Port of Anchorage Marine Terminal Redevelopment Phasing Plan. Areas in yellow were filled in under Phase 1 of the Project. In 2008, the North Extension area (in orange) will be filled.



1.2.1.2. Fill Material

For the first year the proposed IHA is valid, it is expected that the north extension area fill will be completed (max. of 18.4 acres) which equates to 1.6M cubic yards (cy) of new fill on tidelands at the North Extension (figure 3- orange area). However, this is dependent upon the contractor's means/ methods (final strategy) and all 18.4 acres may not be completed. The remaining 68 acres of 135 total acres of fill will be placed at the north and south backlands and south extension (figure 3- blue and green shaded) during 2009-2012.

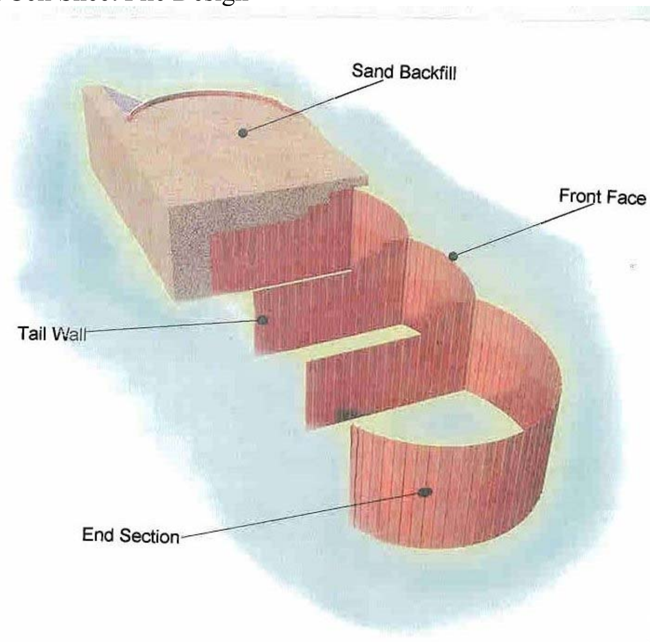
The engineered fill material, consisting of clean sand, gravel, or stone, will be placed immediately behind the sheet-pile face; common fill may be used between the engineered fill and the existing shore to complete the backlands portion of each phase under dewatered conditions where and when possible. Off-road trucks and bulldozers will deposit and spread the fill material behind the OCSP face wall (up to an elevation of +30 ft). A vibratory probe and a vibratory pile-driving hammer will be used at evenly spaced locations to consolidate this fill. Fill material placed above elevation +30 ft will be compacted using conventional sheepsfoot or vibratory equipment.

The Port and MARAD, in cooperation with Elmendorf Air Force Base (EAFB), are obtaining the majority of the fill material from two borrow sites on EAFB. Contractors will adhere to Best Management Practices (BMPs) and special procedures set forth in the bid package, in addition to complying with the laws and regulations governing placement of fill material and the protocol to be followed when contamination is encountered at source sites. Construction contractors will be required to identify and implement BMPs to prevent erosion and sedimentation during construction and operation; control specific on-site erosion and sedimentation; protect adjacent properties and watercourses from effects related to erosion, sedimentation, and flooding; control spills; and handle potentially hazardous materials and waste in accordance with federal, state, and local requirements. Construction activities will be monitored to verify proper implementation of BMPs and construction contractors will be required to provide certification that fill materials imported from commercial sources have been tested to document that the materials are free of contamination prior to being used on the Project.

1.2.1.3. Dock and Fendering Systems

The bulkhead will be comprised of conjoining face and tail sheet-pile cells, forming a row of U-shaped, open cell sheet pile (OCSP) structures which will extend approximately 400 feet from the existing dock. The face of each OSCP is curved outward, creating a scalloped surface. Individual face sheets will be approximately 20 inches wide, 0.5-inch thick, and up to a maximum of 90 ft in length. The cells will serve to retain the fill material and provide the vertical bulkhead docking structure for berthing barges and ships. In the open cell design, the tail wall acts as an anchor to the face sheets along the waterfront. The tail walls, each comprised of 110 tail sheets, will extend up to 183 ft landward into the fill material where friction and integral anchor piles in the tail wall stabilize the face sheets. The mass of the fill behind the dock structure acts as one giant anchor. Approximately 17 face sheets and one tail wall will be used per 27.5 linear ft of dock face and approximately 30 linear ft. of open cell sheet pile wall will be constructed in a 10 hour period.   An example of this OCSP design is depicted in figure 4.

Figure 4. Example of Open Cell Sheet Pile Design



The application indicates that the first year of construction using in-water pile driving will result in 1,807 face sheets and 8,175 tail sheets being installed. This is equal to a wall face length of 2,923 ft. The application estimates that for the first year, 558 hours of impact pile driving and 368 hours of vibratory pile driving will be needed to erect the desired numbered of sheet piles. The number of pile driving hours is not specifically known for future years as this will be dependent on what is accomplished in 2008/2009. However, based on the numbers provided by the POA in their application, it is anticipated 550 hours of impact pile driving and 368 hours of vibratory pile driving will be needed to install these sheets. The POA also indicated that the amount of impact pile driving will likely decrease in subsequent years. For all years, it is anticipated that mostly land-based methods will be used to install the OCSP; however, individual contractors may choose to use barge-mounted equipment for some of the work. A temporary template will be used to guide the adjacent and jointed sheet piles to their proper position. The template will be positioned in the correct location with the help of survey instruments.

The fendering system requires driving of pipe piles for attaching fenders in front of the dock. These fender piles will be driven in the open water in front of the OCSP face using a land-based crane with vibratory and impact-unit attachments. One fender pile will be placed approximately every 55 ft along the entire face of the newly constructed 723 ft of OCSP dock to be constructed in 2008 at the barge berth location for a total of 14 piles installed in 2008. These piles will be approximately 2 ft in diameter and 40 ft long.   Fifteen feet of fender piles will be embedded, with the remaining portion left freestanding for attachment of fenders. The application indicates that installation will be accomplished using vibratory (40 percent of the time) and impact pile drivers (60 percent of the time). Again, impact hammers will be used only when vibratory methods are not sufficient to complete the designed installation.

Upon completion of Phase II, approximately 7,900 linear ft of dock will be erected located approximately 400 ft west from, and parallel to, the face of the existing dock structure and backfilling behind the new dock structure to the existing shoreline; however, the entire sheet pile wall will extend 9,893 parallel to the shore. The new dock face will include 7,430 ft of vertical sheet pile wharf and 470 ft for a dry barge berth. The completed marine terminal will include seven modern dedicated ship berths; two dedicated barge berths; rail access; modern shore-side facilities; equipment to accommodate cruise passengers, cement bulk, roll on/roll off (RO-RO) and load on/load off (LO-LO) cargo, containers, general cargo, Stryker Brigade Combat Team (SBCT) deployments, general cargo on barges, and petroleum, oils, and lubricants (POL); and additional land area to support expanding military and commercial operations.

1.2.1.4. Sheet Pile Installation Process

Installation of the sheet pile is a multi-phased process. The process is as follows: (1) a template defining the curvature and shape of the cell face is placed on the ocean floor in the correct location; (2) the template is secured in place using up to four temporary pipe-piles, approximate driving time for each pile is 5 minutes; (3) adjacent sheet piles are then placed and "stabbed" over approximately half of the template, less if tidal currents are high at the time. "Stabbing" involves driving the pile a nominally short distance at reduced hammer energy to set the bottom of the pile deep enough into the soil to hold it in place while the next adjacent pile is started. Stabbing depths would be less than five feet, at reduced energy; (4) once a pile-group is "set" on the template, the pile are driven in a stair-step method advancing one pile five feet, then moving the hammer to the next pile, advancing that pile five feet, moving the next and so on. This process is repeated at 5 feet intervals without resting until all the sheet piles are at design depth. Advancing the sheet pile in increments reduces driving strain on the interlocks and provides better vertical placement control; (5) the next sheet pile-group is then "set" on the template with reduced energy in the adjacent location and the process repeated; and (6) tail walls that are driven in-water may similarly be driven in groups as well.

During the "stabbing" process, the Port has indicated that shut-down for purposes of mitigating sound exposure of marine mammals is likely not practicable due to safety concerns. If the sheet pile wall is not secured in the ground before ceasing pile driving, it could easily break free, especially during periods of stronger currents. A free-floating sheet pile wall is both dangerous to the construction workers and could become a navigational hazard.

Other water based operations may involve dump-scows (barges capable of discharging material through the bottom), standard barges, tug boats to position and move barges, barge mounted hydraulic excavators or clamshell equipment used to place or remove material. Upon sighting whales approaching or within 50 meters of a work area, in-water work would be suspended. Other on-board operations may continue.

1.2.1.5. Dredging

The current dredging depth at the Port (carried out and overseen by the USACE) is -35 ft (10.6m) mean low low water (MLLW). In conjunction with development in the tidelands, the area off the berths would be dredged to -45 ft (13.7m) MLLW. This extra 10 ft of depth is needed to accommodate larger vessels with deeper drafts. Dredge material not suitable for use as fill would be disposed off at an appropriate site. The USACE and the POA/MARAD would carry out four types of dredging around the POA.

(1) Port of Anchorage/MARAD Construction Dredging will occur each year that pile driving occurs, 2008 through completion, by the Port via MARAD to support Port development. This dredging occurs immediately prior to pile driving and only in the physical footprint of the pile being driven.. The purpose is to remove soft sediments that can not be conventionally dredged when steel is installed. This is the only dredging that would be carried out by the Port. All other dredging is conducted by the USACE.

(2) USACE Maintenance Dredging occurs every year at the Port of Anchorage harbor, including 2008, and would continue with or without Port development. The purpose of this dredging is to keep the shipping lanes and navigable channels open in the harbor to allow ships to berth at the Port. Maintenance dredging occurs in areas authorized by the USACE, but areas not needed for operational bathymetry are not routinely dredged. The operational bathymetry “zone” expands over time during development to accommodate relocation and berthing of ships during construction.

(3) USACE Transitional Dredging will be completed by the USACE (schedule to be announced), and concurrent with but slightly lagging port pile driving operations. The purpose is to widen the berthing zone to the north and south to accommodate shipping and berthing for ships continuously calling at the Port during construction. This type of dredging will not occur in 2008.

(4) USACE Harbor Deepening will also be completed by the USACE sometime after Port construction is completed. The purpose is to deepen the harbor for larger ships with deeper drafts that can currently only come in on the highest tides (Congress has authorized the USACE to deepen the draft in front of the Port of Anchorage- schedule is to be announced). During and after harbor deepening, maintenance dredging will continues at whatever depth is required for operational bathymetry but this depth is unknown at this time.

The USACE currently dredges 206 acres at the Port on an annual basis and has been doing so for years. To prep for 2008 construction, the Port dredged approximately 125,000 cubic yards (cy) from the project footprint at the North Extension area. Once construction of the expanded facilities begins, additional USACE dredging will also be necessary for creating the appropriate operational bathymetry at the Port; however, this USACE transitional dredging is not expected to take place in 2008. Upon completion of the proposed Project activities, annual dredging would be required at the face of the new Port waterfront facilities to maintain depth and a safe, navigable waterway. It is important to note that USACE dredging is a separate federal action than activities carried out by the Port and MARAD and therefore is not part of the proposed action. However, due to the need for the USACE to dredge in accordance with Port expansion, the overall impact to the environment will be analyzed in this document.

Phase II "construction dredging" activities carried out under supervision of the Port will employ methods similar to those currently used by the USACE for ongoing harbor maintenance dredging. This dredging occurs immediately prior to pile driving and only in the physical footprint of the pile driving for the purpose of removing soft sediments that can not be conventionally dredged when steel is installed. Dredge equipment will likely be one standard-size clamshell dredger on a barge, with a tugboat and another barge and tugboat to transport dredged material to the disposal site and/or one standard-size cutterhead hopper dredger on a barge with a tugboat. Once construction of the expanded facilities begins, additional USACE dredging will also be necessary for creating the appropriate operational bathymetry at the Port. USACE dredging to deepen the harbor adjacent to the North Extension area will not occur in 2008; however, maintenance dredging to keep the shipping lanes and navigable channels open in the harbor to allow ship berthing is anticipated to occur in 2009.

1.3. OTHER EA/EIS THAT INFLUENCE SCOPE OF THIS EA

In compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.), two NEPA documents have been prepared regarding the environment and potential effects from construction and continuing operations of the Port. The Port and MARAD prepared an Environmental Assessment (EA) and associated Finding of No Significant Impact (FONSI) in 2004 analyzing social, economic, and environmental effects of the Project for application for their USACE permit (available at http://www.portofanchorage.org/library_p.html). The USACE, in turn, prepared a decision document on issuance of that permit which constitutes an EA, Public Interest Review, Section 404(b)(1) Guidelines Review and Compliance Determination, and Statement of Findings for the proposed work. Both of these EAs analyze the social, economic, biological and physical environment that would be affected and potential impacts from the Project, including results from several monitoring and modeling studies (e.g., beluga whale monitoring, hydrodynamic modeling, etc.). While the biological environment, including marine mammals, is addressed, NMFS did not find the background information and analysis provided in either of the above listed EAs sufficient to adopt for the proposed action (i.e., authorization of marine mammal takes). Therefore, while these EAs are referenced for socio-economic and habitat attributes and effects, impact analysis for marine mammals and their habitat are derived strictly from NMFS assessments.

Recent studies and information regarding the Cook Inlet marine environment are available in two recently completed Environmental Impact Statements (EISs) for separate actions unrelated to the proposed Port redevelopment. These include the proposed Knik Arm Bridge Crossing EIS and the Cook Inlet Beluga Whale Subsistence Plan EIS. A previous Final EIS

(FEIS) and subsequent Draft Harvest Supplemental EIS (SEIS) have been prepared for the latter. On December 18, 2007, the Knik Arm Bridge & Toll Authority (KABATA) released a FEIS on its proposed Knik Arm Crossing, a bridge that would connect Anchorage with either Port MacKenzie/Mat-Su district. Numerous modeling and monitoring studies were conducted for this project. The Knik Arm Bridge FEIS, along with selected studies located in Appendices of that document, are referenced as appropriate to support the analysis in this EA.

In 2003 and 2004, a FEIS and Final Interim Regulations Governing the Taking of Cook Inlet Beluga Whale by Alaska Natives for Subsistence Purposes were completed to address the beluga whale harvests (68 FR 55604, September 26, 2003; 69 FR 17973, April 6, 2004). In December 2007, the NMFS Alaska Regional Office (AKR) released a Draft SEIS on its proposal to implement a long-term plan to manage subsistence harvests of the Cook Inlet beluga whale stock. The SEIS addresses proposed regulations that would manage all Cook Inlet beluga subsistence harvests until the need for harvest management and regulation is removed. The SEIS is also referenced throughout this document as it provides a comprehensive literature review of historical and current beluga abundance, biology, ecology, subsistence uses, and current natural and anthropogenic threats to the population.

1.4. DECISION AND OTHER AGENCIES INVOLVED IN THIS ANALYSIS

The analyses in this EA are products of collaboration between NMFS Office of Protected Resources (OPR) and the NMFS AKR. AKR provided invaluable beluga whale and habitat expertise during OPR's evaluation of environmental effects to the physical and biological environment. The analyses presented here are specific to the NMFS proposed action regarding issuance of two MMPA small take authorizations, first, a one-year IHA under MMPA Section 101(a)(5)(D) for 2008 activities, and second, a potential rulemaking and consideration of Letter of Authorization under MMPA Section 101(a)5(A) for the remaining construction. The IHA and LOA are proposed to be issued in these two phases so that feedback from first year monitoring and mitigation effectiveness can be incorporated, as needed, into any final rulemaking the agency may consider.

As described above, a USACE permit and separate prior EAs have been issued by other agencies with whom the Port and MARAD required action prior to proposed Port redevelopment activities. As part of those prior environmental analyses, requirements under the Clean Water Act (CWA), Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA), Coastal Zone Management Act via the Alaska Coastal Management Program, the Rivers and Harbors Act, and local zoning and associated planning requirements were met by the Port and MARAD.

1.5. SCOPING SUMMARY

On March 18, 2008, NMFS published in the Federal Register a notice of a proposed IHA for the Port and MARAD's request to take marine mammals incidental to the Project and requested comments regarding this request (73 FR 14443). During the 30-day public comment period, NMFS received comments from the Marine Mammal Commission (Commission); the

Center for Biological Diversity (CBD) on behalf of the CBD, Trustees for Alaska, and Cook Inlet Keeper; and the Kenaitze Indian Tribe. The Commission and CBD provided comments on seven major topics: 1) take numbers; 2) NMFS negligible impact determination; 3) specified activities; 4) cumulative impacts; 5) mitigation; 6) ESA requirements; and 7) NEPA requirements. NMFS will provide specific response to comments in the Federal Register notice for any MMPA authorization. In addition, NMFS considered the comments with regard to the scope of the NEPA analysis for the proposed actions. The comments are summarized by topic, below.

A majority of the comments were specific to the findings that NMFS must make for an incidental take authorization to be issued. Each of these issues are analyzed in this EA, and more detailed comment and response would be addressed in any future MMPA *Federal Register* notice, as described above. Specific to this document, Chapter 3 of this EA provides a detailed discussion of marine mammal species that may occur in the action area, and Chapter 4 provides a rigorous analysis of the environmental consequences of the Port's proposed activities with respect to marine mammals. The consideration of environmental consequences includes analysis of the components of the proposed Port activities and the rationale for determining which component of the overall action might result in incidental harassment of marine mammals that would require authorization under MMPA. In addition, Chapter 4 provides detailed discussion of the quantitative derivation of harassment estimates and consideration of incidental takes with respect to marine mammal species and stocks. Subchapter 4.5 considers a range of mitigation and monitoring measures and their effectiveness and provides analysis of additional mitigations that would be required to achieve the least practicable adverse impact on marine mammals. This EA carefully considers the estimated marine mammal harassment numbers with respect to species and stocks in consideration of the MMPA's 'negligible impact' standard. Therefore, this EA considers and addresses the range of issues that were identified by commenters.

Important comments also were raised with regard to the Endangered Species Act and the species that should be subject to ESA Section 7 consultation. In particular, the status of the Cook Inlet beluga whale population is discussed and analyzed in this EA. Status of the species and its temporal and spatial distribution in the proposed action area is described in Chapter 3, and subchapter 4.4.2 provides additional discussion regarding why an ESA Section 7 conference consultation was not considered appropriate for this proposed action. Discussion of ESA Section 7 responsibilities is provided in Chapter 1.6.2 of this EA, and Chapter 3 discusses the affected environment and the marine mammal species expected to be present and potentially affected by the proposed action. Comments related to subsistence harvest also are key considerations for NMFS analyses, and are addressed throughout this EA.

In addition to comments that relate to NMFS' responsibilities under MMPA and ESA, comments were received specific to the level of NEPA analysis and the availability of environmental documentation for public review and comment. These comments are summarized and discussed below.

Cumulative Impacts

- Both the Commission and CBD state that the Port's application is largely confined to looking at the immediate effects of construction and NMFS' has a responsibility to responsibility to consider cumulative impacts of the Project.

NMFS Response: NMFS concurs that NEPA requires consideration of the cumulative impacts of proposed action, and Section 4.7 of this EA provides a detailed cumulative impacts analysis. NMFS gave careful consideration to a number of issues and sources of information and assessed the cumulative impacts from multiple proposed activities in upper Cook Inlet and the effects of climate change in the context of the specified activity and impacts to marine mammals.

NEPA Requirements

- The MMC raised issue with NMFS' preliminary negligible impact determination in its proposed IHA FR, given the fact that NMFS had indicated it was going to prepare its own EA because additional analysis was needed over and above the Port's and MARAD's EA. MMC believes this is inconsistent with NEPA.

- The CBD argues that NMFS must make the EA available for public comment, an EIS should have been prepared, and direct and indirect impacts from the Project should be analyzed in an EIS.

NMFS Response: With regard to the first bullet, NMFS' MMPA preliminary negligible impact determination was based on the Port's MMPA IHA application, which included NMFS' recommended mitigation from preliminary discussions; NMFS' review of that application for completeness; supplemental information from the Port; and discussions with NMFS' AKR. The information from these sources was sufficient for NMFS to make its preliminary determination of negligible impact under the MMPA. With respect to NMFS' NEPA responsibilities, NMFS determined additional NEPA analyses were necessary beyond the Port's EA; however, there is no requirement that NMFS complete an EA at the time it proposes its action. The MMPA requirements for permit issuance are discussed in Section 1.6.1 of this EA, and Section 4 provides a detailed analysis of environmental consequences of the alternatives.

With regard to the second bullet, neither NEPA, nor the CEQ regulations explicitly require circulation of a draft EA for public comment prior to finalizing the EA. The federal courts have upheld this conclusion, and in one recent case the Ninth Circuit squarely addressed the question of public involvement in the development of an EA. In Bering Strait Citizens for Responsible Resource Development *v.* U.S. Army Corps of Engineers (9th Cir. 2008), the Court held that the circulation of a draft EA is not required in every case; rather, federal agencies should strive to involve the public in the decision-making process by providing as much environmental information as is practicable prior to completion of the EA so that the public has a sufficient opportunity to weigh in on issues pertinent to the agency's decision-making process. In the case of the Port's MMPA IHA issuance, NMFS involved the public in the decision-making process by publishing its notice of a proposed IHA for a 30-day notice and comment period and also notified the public of the availability of the Port's MMPA application and other NEPA documents written for the Project and the Knik Arm Crossing (73 FR 14443, March 18, 2008). The IHA application and FR notice contained information relating to the project and specifically requested information from the public. For example, the application and FR notice includes a project description, its location, environmental matters such as species and habitat to be affected by project construction, and measures designed to minimize adverse impacts to the environment. NMFS also incorporated, where appropriate, additional measures to reduce impacts to marine mammals resulting from the Project. The EA for this action is available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.

Comments Outside the Scope of this EA

- The Kenaitze Indian Tribe questioned the feasibility of the port of Anchorage expansion project, because there is a deep-water port in Whittier that does not have the silting problems as the Cook Inlet's Port of Anchorage. The deep-water port of Whittier has easy access to Anchorage via the Rail Road and/or tunnel access for trucking goods. The Port of Anchorage's estimated cost of construction is $700,000, with no guarantees that it will not silt up again and cause more problems and money. During World War II the engineer built the Whittier Port because they also recognized the problems that would be incurred by building a port in Anchorage and because Whittier is close and accessible to Anchorage;" and

  "The damage that will be incurred to the marine mammals and environment is not worth the expense of the proposed re-construction of the Port of Anchorage"

NMFS Response: NMFS acknowledges the comments provided by the Kenaitze Indian Tribe; however, these comments on engineering feasibility and cost are outside the scope of the NMFS' jurisdiction when considering issuance of an incidental take authorization, and therefore are not considered in the scope of this EA.

1.6 APPLICABLE LAWS AND NECESSARY FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

The subsections below provide an overview of the applicable laws and permits most directly applicable to NMFS' proposed action of issuance of MMPA small take authorizations. As described above, the applicant has already completed other related permitting and review criteria, including requirements associated with the Clean Water Act (CWA), the Coastal Zone Management Act (CZMA), and local zoning and associated planning requirements. For additional information on all permits required and secured by the applicant, please visit www.portofanchorage.org/library_p.html.

This section summarizes federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed action, as well as who is responsible for obtaining them. Even when it is the applicant's responsibility to obtain such permissions, NMFS is obligated under NEPA to ascertain whether the applicant is seeking other federal, state, or local approvals for their action.

1.6.1 Marine Mammal Protection Act

The MMPA prohibits takes of all marine mammals in the U.S. (including territorial seas) with a few exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional, taking of marine mammals by U.S. Citizens who engage in a specified activity (other than commercial fishing) if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted for up to 5 years if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for certain subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as: an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

Under the MMPA, harassment is defined as any act of pursuit, torment, or annoyance which has the potential to: (i) injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment). An IHA may be issued, except for activities that have the potential to result in serious injury or mortality (i.e., it may only authorize harassment), for a period of no more than one year, following a 30-day public review period. Alternatively, an incidental take authorization may be granted for a period of 5-years and may include serious injury and takes by mortality. For both an IHA and regulations, authorization shall be granted if the Secretary finds that the taking will have a negligible impact on a species or stock, and that the IHA or regulations are prescribed setting forth the permissible methods of taking, the means of effecting the least practicable adverse impact, and requirements pertaining to monitoring and reporting. Upon rulemaking (i.e., defining regulations), Letters of Authorizations (LOAs) will be issued each year to the authorization holder. For IHAs associated with activities that could impact marine mammals in Arctic waters (i.e., waters north of 60ºN), the action agency must also consider means of effecting the least practicable impact on the availability of the species for subsistence uses.

1.6.2 Endangered Species Act

Section 2 of the ESA sets forth the purposes and policy of the Act. The purposes of the ESA are to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in section 2(a) of the ESA. It is the policy of the ESA that all Federal departments and agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA. In consideration of the ESA's definition of conserve, which indicates an ultimate goal of bringing a species to the point where listing under the ESA is no longer necessary for its continued existence (i.e., the species is recovered), exemption permits issued pursuant to section 10 of the ESA are for activities that are likely to further the conservation of the affected species.

Section 7 of the ESA and implementing regulations at 50 CFR 402 require consultation with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service) for federal actions that "may affect" a listed species or adversely modify critical habitat. NMFS issuance of an IHA or LOA proposing to authorize take of ESA-listed species or adverse modification or destruction of designated critical habitat, directly or indirectly, is a federal action subject to these Section 7 consultation requirements. Section 7 requires federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. NMFS is further required to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of habitat for such species.

1.6.3 National Environmental Policy Act

The National Environmental Policy Act (NEPA, 42 U.S.C. 4321 et seq.) was enacted in 1969 and provides for the consideration of environmental issues in federal agency planning and decision-making for defined "major" federal actions. A major federal action is an activity that is fully or partially funded, regulated, conducted, or approved by a federal agency. NMFS issuance of a small take authorization represents approval and regulation of activities. While NEPA does not dictate substantive requirements for permits, licenses, etc., it requires consideration of environmental issues in federal agency planning and decision making. The procedural provisions outlining federal agency responsibilities under NEPA are provided in the Council on Environmental Quality's implementing regulations (40 CFR Parts 1500-1508).

NMFS has, through NOAA Administrative Order (NAO) 216-6, established agency procedures for complying with NEPA and the implementing regulations issued by the Council on Environmental Quality. This EA is prepared in accordance with NEPA, its implementing regulations, and NOAA 216-6.

1.6.4 Magnuson-Stevens Fishery Conservation and Management Act

Under the MSFCMA, Congress defined Essential Fish Habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). The EFH provisions of the MSFCMA offer resource managers means to accomplish the goal of giving heightened consideration to fish habitat in resource management. NMFS action of authorizing harassment of marine mammals does not directly affect EFH. However, for the underlying activity of the Port's redevelopment, the NMFS AKR provided extensive comment on the draft USACE permit for the proposed action, and these comments included conservation recommendations specific to EFH. The USACE's final determination, which also serves as an EA for purposes of NEPA, included response to the AKR EFH conservation recommendations. This USACE permitting process served as the EFH consult for the purposes of MSFCMA and requirements under this Act will not be discussed further.

1.7 SCOPE OF THE ANALYSIS

To ensure consideration of direct, indirect and cumulative impacts, this EA describes the affected environment and evaluates effects on marine mammals and their habitat, including EFH (with a particular focus on the importance of certain fish species as marine mammal prey), and cumulative actions, including analysis of foreseeable activities following completion of the Project. Note that the decision on the issuance of regulations would not occur until approximately June of 2009 and any appropriate supplement to the analysis in this EA that may be warranted based on new information, in particular feedback from monitoring and reporting that would be required as part of the first-year IHA, would be incorporated into the rulemaking decision process.

CHAPTER 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The CEQ regulations for implementing the procedural provisions of NEPA require consideration of several alternatives, or a range of alternatives, to be evaluated in addition to the proposed action, and the environmental impacts of activities under each of these management alternatives to be evaluated. Two alternatives are presented for analytical purposes. These can be evaluated from information and analysis provided in Chapter 3 (Affected Environment) and Chapter 4 (Environmental Consequences). This information presents the issues and impacts, thus providing the basis for choice among alternatives by the agency and the public.

Upon receipt of an application for incidental take authorization, NMFS reviews the application for completeness and works with applicants, as needed, to revise and resubmit the application. NMFS AKR and OPR has been involved in discussions with the Port and MARAD since 2005 to ensure that the application included an appropriate level of detail and proposed mitigation measures. As described above, a revised application was submitted by the Port in 2007 to reflect the additional analyses and considerations presented by NMFS. That application was further refined by the applicant based on discussions with NMFS OPR and a complete application was submitted in February 2008. As proposed by the applicant, the Project protocol, with respect to marine mammals, incorporates several important features that reduce the potential exposure of marine mammals to sound. NMFS proposed additional mitigation measures beyond those in the application and discussed the practicality of implementing these measures with the Port. These supplemental mitigation measures are now included as part of the Port's proposed actions. Therefore, NMFS did not feel the consideration of a third, mitigated alternative was required for purposes of analyzing a reasonable range of alternatives; however,

2.1 ALTERNATIVE 1- NO ACTION

The No Action Alternative would constitute a denial of an IHA and no promulgation of a 5-year rule for future LOAs. Without an incidental take authorization from NMFS, the Port would not be authorized to harass marine mammals from Port expansion construction activities, specifically pile driving. Sound propagation studies have indicated that animals traveling within a certain distance of the pile hammer during their operation would likely be exposed to levels of sound above NMFS determined harassment threshold levels. Any harassment of a marine mammal without authorization would constitute a violation of the MMPA. This would effectively mean that the Port could not pursue further Project operations without likely violating the MMPA, unless they were to use additional sound propagation minimization technology or additional mitigation. To date, there is no such technology that would be appropriate for the harsh conditions (e.g., strong currents) of Knik Arm.

2.2 ALTERNATIVE 2- PROPOSED ACTION

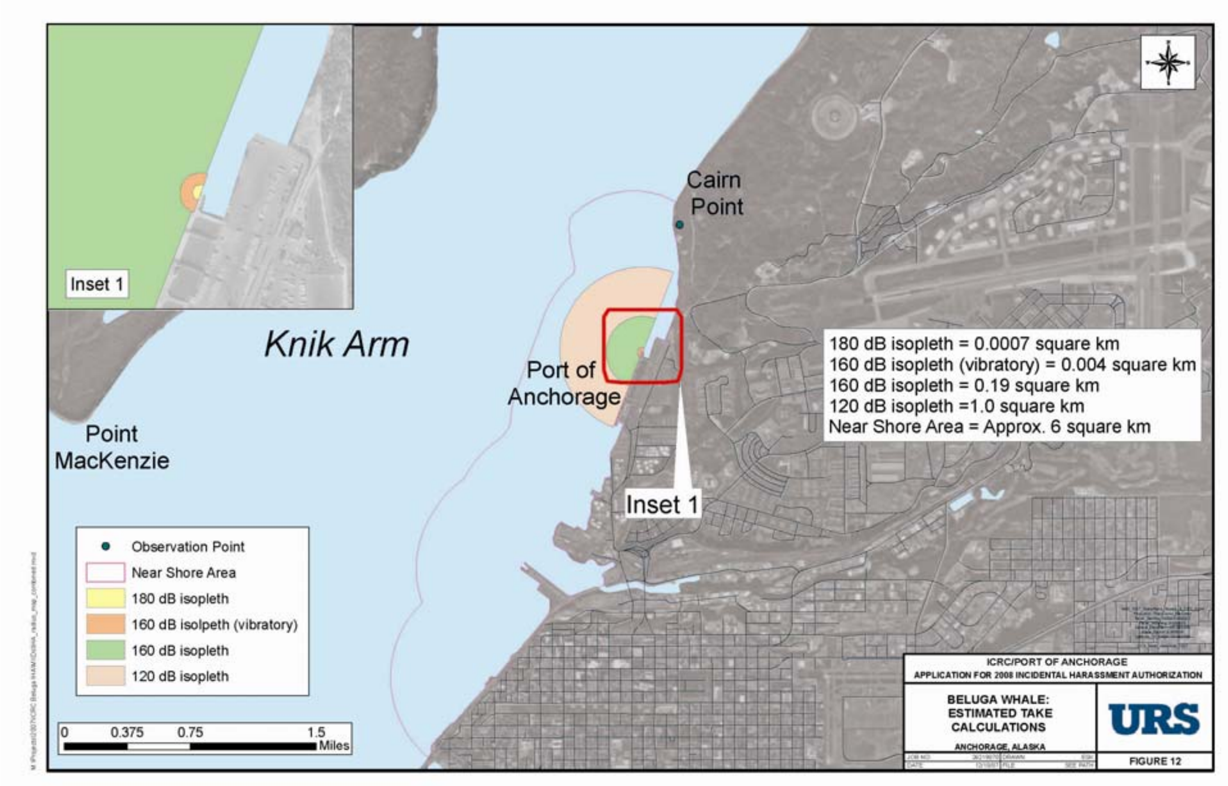
The proposed action is issuance, in accordance with MMPA, of a 1-year IHA with intent to promulgate regulations in 2009 for issuance of subsequent LOAs. Impact analyzes of the Project are based upon the current Project plan, an OCSP design.

The proposed action would authorize the take, by Level B harassment, of small numbers of marine mammals incidental to Port expansion operations. Harassment is likely to occur from exposure to loud sounds during pile driving; therefore, an MMPA incidental take authorization is appropriate. While dredging and vessel operations would be altered slightly due to Port expansion, these activities have and would continue to occur regardless of the Project and are considered part of the baseline environmental conditions. However, while dredging and vessel presence would not be allocated takes in the IHA or future LOAs, the overall cumulative impacts from these activities are assessed in this EA.

The marine mammal that will be most affected by pile driving is the beluga whale; however, harbor seals, harbor porpoise, and killer whales may also be potentially exposed to sounds greater than current NMFS threshold levels. NMFS is proposing to allow the incidental taking of 34 beluga whales and 20 of each of the other above listed marine mammals for the a one year construction season (i.e., July 2008- October 2008; April 2009-July 2009). The method of how number of animals authorized to be taken was calculated is outlined in Chapter 4. Take numbers for future LOAs would be determined based on pile driving hours and the natural fluctuation of beluga population estimates and density. However, while the number of animals harassed may vary across years, the type and effects of harassment at expected to remain as described in this EA.

Marine mammals will be considered harassed if they are present within the distances at which sound measurements of pile driving conducted by the Port indicate that they will be exposed to sound levels above the behavioral harassment thresholds that NMFS has established. No animals are expected to be exposed to injurious sound levels. Currently, NMFS considers 190dB and 180dB re 1 μPa to be in-water injury thresholds for pinnipeds and cetaceans, respectively. Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to root mean square (rms) sound levels at or above 160dB rms for impulse sounds (e.g., impact pile driving) and 120dB rms for continuous noise (e.g., vibratory pile driving), but below injurious thresholds. These distances have been empirically established during a sound study conducted at the Port in 2007 (Figure 4). For impact pile driving, Level A harassment sound levels are within 20m of the pile hammer and the 160dB re 1 μ Pa Level B harassment isopleth distance is 350m from the sound source. For vibratory pile driving, these distances are less than 20m for Level A sounds and 800m for Level B harassment at 120dB 1 μ Pa. These distances will be further verified with additional sound measurements upon commencement of construction (see Mitigation Measures).

Figure 4: Diagram of harassment isopleth distances from Port of Anchorage (note: isopleth distances will begin at the sound source; therefore, this diagram should only be used as a reference).



CHAPTER 3 AFFECTED ENVIRONMENT

The purpose of this chapter is to provide baseline information for consideration of the alternatives, and describes the environment that might be affected by the proposed action and alternative.

For issuance of a MMPA authorization, NMFS must evaluate the proposed action in terms of the current OCSP design plan, as described in the application, related to marine mammals and their habitat. This chapter will discuss the socio-economic and environmental resources that may be affected by issuance of an IHA, an authorization which would allow for harassment to marine mammals, in particular beluga whales, from pile driving as well as any overall long term effects from the 5 year Project. A future SEA will be prepared, if appropriate, before issuance of regulations which would allow the Port to take marine mammals under yearly LOAs.

3.1 SOCIAL AND ECONOMIC ENVIRONMENT

Alaska became an official U.S. state in 1954 and by the 1980's, the economy was booming from oil revenue, thanks to the construction of the Alaska pipeline. Anchorage became the hub of Alaska's economic growth and today is home to 283,000 residents (42% of the state's population). The Port of Anchorage plays a pivotal role in Alaska's economic growth. It serves all of Alaska, except the Southeast, from Homer to the North Slope by means of rail, road and air cargo connections, and the major military installations; provides 100% of the jet fuel to Elmendorf AFB and 80% to Ted Stevens International Airport; stages 100% of the exports of refined petroleum products from the state's largest refinery in Fairbanks and facilitates petroleum deliveries from refiners on the Kenai Peninsula and in Valdez; generates direct and indirect employment opportunities for stevedores, truckers, railroaders, warehousemen, the oil land construction industries, the Finance-Insurance-Real Estate sector and a growing number of export-related jobs in petroleum products, forest products, mining and manufacturing; provides direct interties with the Anchorage International Airport for competitive supplies of jet fuel and the sea-air movement of cargo to Bush Alaska; offers the only active Foreign Trade Zone services presently available in Alaska; and is poised to expand in direct response to demand from additional containerized cargo carriers, export-related industries such as mining industries, forest products and oil field module assembly/load-out support. Further information on the social and economic resources affected by the Project can be found in the previously cited MARAD and USACE EA and the Knik Arm Crossing FEIS. Because the proposed action does not authorize the Project itself, it would only authorize harassment to marine mammals from the Project, these resources will not be the focus of the environmental analysis in this EA. However, the EA does consider the subsistence harvest of marine mammals as an important socio-cultural component of the affected environment and related analysis of environmental consequences in Chapter 4.

3.1.1 Subsistence Needs

Alaska Natives who reside in communities on or near Cook Inlet and some hunters who live in other Alaska towns and villages continue to subsistence harvest belugas (Stanek 1994, Angliss and Outlaw 2005). The subsistence beluga harvest transcends the nutritional and economic value of the whale as the harvest is an integral part of the cultural identity of the region's Alaska Native communities. Inedible parts of the whale provide Native artisans with materials for cultural handicrafts, and the hunting itself perpetuates Native traditions by transmitting traditional skills and knowledge to younger generations (NOAA 2007). However, due to dramatic decreases in Cook Inlet beluga whale populations, on May 21, 1999, a temporary moratorium on beluga whale harvest was set in place in 1999 (Pub. L. No. 106-31,§3022, 113 Statute [Stat.] 57, 100) from such date until October 1, 2000. This moratorium was extended indefinitely on December 21, 2000 (Pub. L. No. 106-553, §1(a)(2), 114 Stat. 2762).

NMFS entered into co-management agreements with the Cook Inlet Marine Mammal Council (CIMMC) in 2000 through 2003, 2005, and 2006. CIMMC is comprised of Alaska Natives from the Cook Inlet Treaty Tribes (CITT), local Native hunters, and concerned Alaska Natives residing in the Cook Inlet region. CIMMC was organized and incorporated in 1994 to protect cultural traditions and promote conservation, management, and use of Cook Inlet marine mammals by Alaska Natives. No belugas were successfully harvested under the 2000 and 2006 agreements; CIMMC harvested one whale under the 2001, 2002, and 2003 agreements; two whales were taken under the 2005 agreement; no agreement was signed in 2004 or in 2007 when hunters from the Native Village of Tyonek agreed to stand down from the hunt (NMFS News Release, April 16, 2007). As described in the Draft Harvest SEIS, NMFS proposes to implement a long-term plan to manage subsistence harvests of the Cook Inlet beluga whale stock (NOAA 2007). The objectives of a long-term subsistence harvest plan as evaluated in this SEIS are: 1) to allow this depleted stock to recover to its optimal sustainable population, where it will no longer be considered depleted under the MMPA; and 2) to provide for a subsistence harvest by Alaska Natives in support of traditional cultural and nutritional needs.

3.2 PHYSICAL ENVIRONMENT

Cook Inlet is a large tidal estuary that flows into the Gulf of Alaska and covers an area more than 26×103 km^2. It is comprised of large expanses of glacial flour deposits and extensive tidal mudflats and has an average depth of 328 feet (~100m). The NOAA Draft Harvest SEIS provides a detailed description of Cook Inlet's climate, geology, water quality, and physical properties and are incorporated here by reference (NOAA 2007). In summary, Cook Inlet is a seismically active region susceptible to earthquakes with magnitudes 6.0 to 8.8; has some of the highest tides in North America which are the driving force of surface circulation; and contains substantial quantities of mineral resources, including coal, oil, and natural gas. During winter months, sea, beach, and river ice is a dominant physical force within the Inlet. In the upper inlet, sea ice generally forms in October to November, developing through February from the West Forelands to Cape Douglas.

Northern Cook Inlet bifurcates into Knik Arm to the north and Turnagain Arm to the east (Figures 1 and 2). Knik Arm is generally considered to begin at Point Woronzof (west of the Ted Stevens Anchorage International Airport), from which it extends three miles to the east and then more than 25 miles in a north-northeasterly direction to the mouths of the Matanuska and Knik Rivers. Cairn Point is located just north of the Port and is an excellent beluga whale monitoring site due to its elevation and uninterrupted northern and southern view of Knik Arm. Approximately 4 miles to the northeast at Cairn Point, Knik Arm narrows to about 1.5 miles before widening to as much as 5 miles at the tidal flats northwest of the mouth of Eagle River (KABATA 2007).

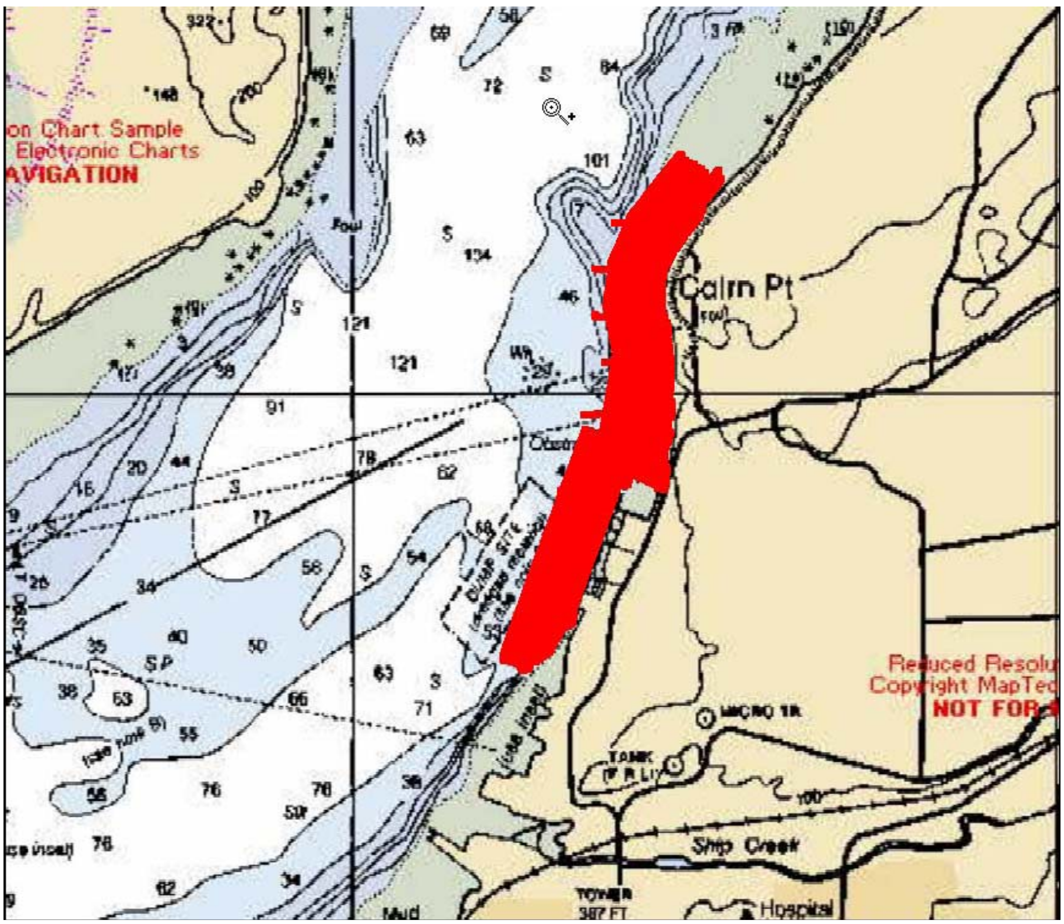
Knik Arm is comprised of narrow channels flanked by large tidal benches composed of sand, mud, or gravel depending on location. Approximately 60% of Knik Arm is exposed at MLLW. The intertidal areas of Knik Arm are mudflats, both vegetated and unvegetated, that primarily consist of fine, silt-size glacial flour. Freshwater sources often are glacially born waters, which carry high-suspended sediment loads, as well as a variety of metals such as zinc, barium, mercury, and cadmium. In turn, surface waters in Cook Inlet typically carry high silt and sediment loads, particularly during summer, making Knik Arm an extremely silty, turbid water body with low visibility through the water column. The Matanuska and Knik Rivers contribute the majority of fresh water and suspended sediment into the arm during summer months. Smaller rivers and creeks also enter along the sides of the Arm. Ship Creek, a stocked creek which serves as an important recreational fishing resource, flows into Knik Arm through the City of Anchorage Industrial area approximately 2000 ft. south of the southern end of the Project footprint. To the north and east of the Project area, Elmendorf Air Force Base (EAFB) lies on a terrace roughly 100 feet above the Port.

Tides in Cook Inlet are semidiurnal, with two unequal high and low tides per tidal day (tidal day = 24 h 50 min). The mean diurnal tidal range varies from roughly 6 m (19 ft) at Homer to about 9.5 m (30 ft) at Anchorage (Moore et al. 2000). Because of Knik Arm's predominantly shallow depths and narrow widths, tides here are greater than in the main body of Cook Inlet. The range of tides at Anchorage is extreme at about 29 feet and the observed extreme low water is 6.4 feet below MLLW (KABATA 2007). Maximum current speeds in Knik Arm, observed during spring ebb tide, exceed 7 knots (12 feet/second). These extreme physical characteristics of Knik Arm increase ambient sound level. The lower range of broadband (10-10,000 Hz) background levels obtained in at Port MacKenzie, located across the Arm from the Port, were 115-133 dB re 1 pPa (Blackwell and Greene 2005). These levels were not "ambient" levels in the sense that they were obtained close to an industrialized area (Anchorage) and were not devoid of industrial sounds; however, pile driving was not taking place at this time and therefore these levels portray an accurate picture of baseline sound levels in Knik Arm near the Port.

Anchorage, Alaska is located in the lower reaches of Knik Arm of upper Cook Inlet (Fig.2). The Port sits in the industrial waterfront of Anchorage, just south of Cairn Point and north of Ship Creek (Latitude 61° 15' N., Longitude 149° 52' W.; Seward Meridian) (Fig. 3). The Port's boundaries currently occupy an area of approximately 129 acres. Other commercial/industrial activities related to Port operations are located on Alaska Railroad Corporation property immediately south of Port property covering approximately 111 acres.

The harbor basin at the Port is basically a dredged notch in the tidal flat (Fig. 5). Ebersole and Raad (2004) describe sediment loads in upper Cook Inlet as quite high; spring thaws occur and accompanying river discharges introduce considerable amounts of sediment to the system. Natural sedimentation processes act to fill the notch each spring and summer season, probably working to recreate the general tidal flat structure in this region which is in some state of quasi-equilibrium, or balance, with the predominant tidal currents. The distance across the Arm from Port to Port MacKenzie (on the west side of Knik Arm) is approximately 4.88 km. The distance to the west bank directly across the Arm from the Port is approximately 4.17 km.

Figure 5. Bathymetry of Knik Arm in front of the Port of Anchorage. The shaded red portion indicates survey area for the hydrological model study. Taken from Erbesole and Raad 2004.



The intertidal and subtidal habitats directly surrounding the Port are shallow waters prevalent with tidal flat beaches. Function of these habitats in this area have not been studied comprehensively, but surveys completed to date indicate that the area immediately around the Port supports a wide diversity of marine and anadromous fish species and provide migrating, rearing, and foraging habitat. Best available information indicate that that shallow waters along the tidal flat benches of Knik Arm are used by all five species of Pacific salmon, saffron cod, and a variety of prey species such as eulachon and longfin smelt (Houghton 2005a; Dames and Moore, 1983; Moulton 2006). These species are ones that are targeted directly by recreational and commercial fisheries and serve as prey for larger fish and marine mammals.

3.1.1 Essential Fish Habitat

Essential Fish Habitat (EFH) means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "waters" include aquatic areas that are used by fish and their associated physical, chemical, and biological properties and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' entire life cycle.

The NMFS and the North Pacific Fishery Management Council identified Essential Fish Habitat (EFH) in upper Cook Inlet for anadromous Pacific salmon; no salmon species that would be adversely affected by the Project are listed under the Endangered Species Act. Designated EFH present in the vicinity of the Port is for both juvenile and adult lifestages of Pacific cod, walleye pollock, sculpins, and eulachon (also called hooligan and candlefish). In addition, all streams, lakes, ponds, wetlands, and other water bodies that currently support or historically supported anadromous fish species (e.g., salmon) are considered freshwater EFH. Marine EFH for salmon fisheries in Alaska include all estuarine and marine areas utilized by Pacific salmon of Alaska origin, extending from the influence of tidewater and tidally submerged habitats to the limits of the U.S. Exclusion Economic Zone (EEZ). Details of EFH and the life stage of these species can be found in the "Knik Arm Crossing Essential Fish Habitat Assessment of the Proposed Action" and are incorporated here by reference (HDR and URS 2006). EFH information can also be found at www.nmfs.noaa.gov/habitat/habitatprotection/efh.

3.1.2 Designated Critical Habitat

Currently, there are no ESA-listed species within the action area nor are there areas designated as critical habitat under the ESA. However, Cook Inlet beluga whales are proposed to be listed as an endangered distinct population segment (DPS). A final decision on this listing is pending, and NMFS announced its intent to make a determination on this listing action no later than October 20, 2008 (FR 21578, Apr 22 2008). In accordance with Section 4 of the ESA and implementing regulations (50 CFR 424), critical habitat must be designated within 12 months of the species listing. Currently, no critical habitat has been established.

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Birds

As described in KABATA (2007), coastal marshes in upper Cook Inlet provide important resting and staging areas for migrating waterfowl and breeding habitat. Common waterfowl observed in the salt marshes and wetlands of upper Cook Inlet include pintails, mallards, green-winged teal, lesser Canada geese, cranes, and swans. Common shorebirds include plover, sandpipers, yellowlegs, dowitchers, and phalaropes. Shorebird distribution is related to food availability, primarily clams, gammarid amphipods and algal cover. Vegetated flats and marshes provide important shelter food sources to shorebirds and waterfowl, including alkali-grass, insects, and algae. The primary shorebird concentration areas are along the western shores of upper Cook Inlet in Redoubt Bay, Trading Bay, and the marsh flats of the Matanuska, Knik, Susitna, and little Susitna Rivers. The shoreline tidal flats and marshes south of Ship Creek to Potter Marsh and West Chester Lagoon have high concentrations of migrating waterfowl and shorebirds and is considered high value habitat. There is limited use of the mudflats of the Ship Creek estuary by birds; however, shorebirds, gulls, and waterfowl are observed in the area. The area of designation for migrating birds terminates approximately one mile south of the project area. The Port and MARAD EA further discuss birds and their habitat around the Port and as such, they will not be discussed further in this analysis (pgs 3-70-71; 3-78).

3.2.2 Zooplankton and Invertebrates

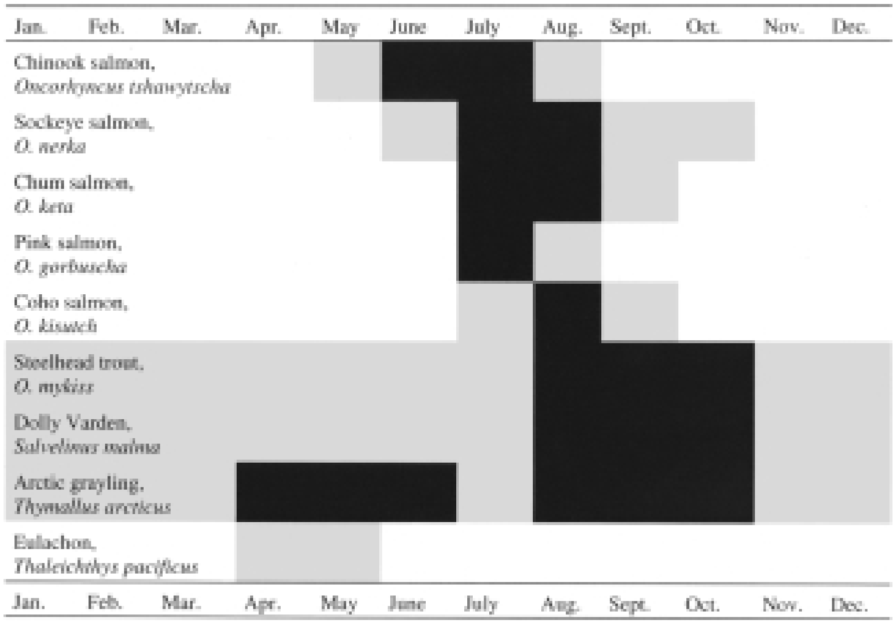
Consideration of marine mammal habitat effects is a component of the analysis associated with MMPA incidental take authorization. The proposed Project involves the removal of 135 acres of intertidal habitat; therefore, NMFS believes that consideration of the living resources generally supported by this type of habitat is important to the analysis due to the need to consider potential food web consequences that might affect the availability of certain fish species as prey for marine mammals, in particular beluga whales. Despite its harsh conditions, Knik Arm is a highly productive ecosystem. Fish and benthos sampling was conducted around the Port north to Eagle Bay during July through November 2004 and from April through September 2005 (Houghton et al., 2005b). These studies revealed that the area around the Port supported low benthic primary productivity except for small patches of macroalgae (rockweed and annual green algae) are present on occasional boulders, ripraps, and tidal marshes. Plankton samples included three species of copepods, four additional species of amphipods, one additional species of mysids, and several additional classes, orders, and families of freshwater invertebrates. The zooplankton samples were generally characterized by eight primary taxonomic groups including Crangon shrimp, copepods, amphipods, mysids, fish and larval fish, isopods, terrestrial invertebrates, and the polychaete, *Neanthes limnicola*. Overall, the most abundant group captured were larval fish (55 percent of total catch), followed by amphipods (10.7 percent), mysids (10.1 percent), copepods (9.1 percent) and Crangon spp. (2.3 percent). In general, zooplankton abundance was low while crustaceans of sizes larger than could be consumed by juvenile salmon were abundant.

3.2.3 Fish

Knik Arm supports 14 to 18 species of fish including sticklebacks, sculpin, cod, herring, and salmon (Houghton et al., 2005a, 2005b; Moulton 1997). All species of fish in this area play an important role in beluga diet and nutrition (NMFS letter to the USACE; Brian Lance, pers. comm.) and as a resource to recreational fishermen. The fish fauna of upper Cook Inlet is primarily characterized by the spring to fall availability of migratory eulachon, outmigrating Pacific salmon smolt, and returning adult Pacific salmon. Species abundance and distribution vary greatly through-out the summer (Fig. 6) (Moore et al., 2000). Houghton et al., 2005b revealed that juvenile salmon spp. were the most abundant fishes sampled with abundance of chinook and pink salmon beginning in April, peaking in May and then sharply declining in July. Coho, and to a lesser degree sockeye salmon, had the largest and longest presence in the Arm of the juvenile salmonids. Coho were the most abundant juvenile salmonid in April, increasing to a peak in August (in 2005) before declining, but maintaining a presence in the nearshore Arm through November (in 2004). Few sockeye were observed before May but they were more abundant from June through August, before declining in September and October.

Stomach content analysis of 39 juvenile Chinook salmon show that aphids; mysids and adult and aquatic insects from the orders Ephemeroptera (mayflies), Plecoptera (beetles), Diptera (flies), and the nereid polychaete, *Neanthes limnicola,* contributes substantially to the overall diet. Chum and trout stomach contents displayed a similar pattern of amphipods and other crustaceans and insects making up a large portion of fish diet. The extreme turbidity and poor visibility in the Arm likely severely limits the success of visual feeding by fish but visual feeding may be possible in microhabitats within the surface water in the Arm where short periods (minutes) of relative quiescence in the generally turbulent water allow partial clearing (Houghton et al., 2005b). During the study, surface feeding by saffron cod was observed where they appeared to be feeding on crustaceans in the clearer surface microhabitats. The authors also hypothesized that juvenile salmonids can also feed in these small lenses of clearer waters where prey can be seen. From observations, it appears that these areas can occur along shorelines as well as in the middle of the Arm. Tow net sampling for KABATA has shown substantial presence of juvenile salmonids in the open waters of Knik Arm during the spring (Houghton et al., 2005a). Data from Houghton et al. (2005b) and those of Moulton (1997) collected in offshore surface waters of upper Cook Inlet south of Fire Island suggest that juvenile salmon were not favoring shorelines as many of these fish, including many small individuals (e.g., chum and sockeye less than 50 mm in length) appeared to have very full stomachs. However, adult salmon displayed extreme orientation to the narrow inshore areas (where they may gain some refuge from beluga whale predation) (Houghton et al., 2005b).

Figure 6. Approximate timing of the presence (gray shading) and peak availability (black shading) of fish species entering fresh water drainages in upper Cook Inlet (taken from Moore et al., 2000).



The southernmost end of the project area is located approximately 2000 feet north of the mouth of Ship Creek. Juvenile salmonids are reared at this hatchery for two years prior to release at the smolt stage. Smolts released from this hatchery are ready for out migration and it is believed that the smolts reside in the Ship Creek area for a limited period before migrating elsewhere in Knik Arm and/or Cook Inlet estuaries. Juvenile chinook salmon sampled between Cairn Point and Point Woronzof were primarily of Ship Creek hatchery origin. Otoliths for juvenile Chinook salmon sampled between Cairn Point and Point Woronzof showed that 80-85% of the fish were of hatchery origin (interpolated from Table 12 of Houghton et al., 2005). It is inferred that salmon smolts around the Port and Ship Creek are flushed to the northern end of Knik Arm (primary beluga whale feeding habitat) by flood tides. The southern most portion of the prime feeding habitat (i.e., Eagle River mouth) is approximately 16 km from the proposed Project footprint. On high tide, beluga whales forage even farther north in the upper reaches of the Arm, approximately 48 km to the north of the Port.

3.2.4 Marine Mammals

Cook Inlet is utilized by several species of marine mammals; however, upper Cook Inlet marine mammal species diversity is limited. The Cook Inlet beluga whale is the most prevalent marine mammal in the action area. Harbor seals, harbor porpoise, and killer whales are also found in upper Cook Inlet but sporadically and in low density. While Steller's sea lions (*Eumetopias jubatus*) are present in lower Cook Inlet, sightings in upper Cook Inlet are rare and there has never been a sighting reported in Knik Arm. Since 1999, only 4 Steller's sea lions have been reported in upper Cook Inlet. Two Steller's sea lions were sighted at the mouth of the Susitna River in 1999 and two adults were near the same locating in 2005 (Barbara Mahoney, personal communications, June 20, 2008). Therefore, Steller's sea lions are not anticipated to be affected by the Project and will not be included in any MMPA authorization for the proposed action nor considered in more detail in this analysis. More information on Alaskan marine mammals can be found at (http://www.fakr.noaa.gov/protectedresources).

3.2.4.1 Beluga Whales

Description and Taxonomy

The beluga whale is a small, toothed whale in the family Monodontidae. Beluga whales may live more than 30 years (Burns and Seaman, 1986) and reach a length of 5 m (16 feet), although the average adult size is more often 3.6-4.3 m (12-14 ft) in length. Native hunters have reported that some Cook Inlet beluga whales may reach 20 feet in length (Huntington 2000). Males may weigh about 1,500 kg (3,307 pounds) and females 1,360 kg (2,998 pounds) (Nowak 1991). Calves are born dark gray to brownish gray and become lighter with age. Adults become white to yellow-white at sexual maturity, although Burns and Seaman (1986) report females may retain some gray coloration for as long as 21 years.

A thick layer of blubber that accounts for as much as 40 percent of a beluga whale's body mass (Sergeant and Brodie, 1969) provides thermal protection and stores energy for this species. Native hunters in Cook Inlet have stated that beluga whale blubber is thinner in the early spring than later in the summer. This suggests that feeding in the upper Inlet, principally on fat-rich fish such as eulachon and salmon, is very important to the energetics of these animals. NMFS has measured blubber thickness in excess of 10 cm on CI beluga whales.

Beluga whales typically give birth to a single calf every two to three years, after a gestation period of approximately 14 months. Most of the calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1983), although Native hunters have observed calving from April through August (Huntington 2000). Alaska Natives described calving areas within Cook Inlet as the northern side of Kachemak Bay in April and May, off the mouths of the Beluga and Susitna Rivers in May, and in Chickaloon Bay and Turnagain Arm during the summer. The warmer waters from these freshwater sources may be important to newborn calves during their first few days of life (Katona et al., 1983; Calkins, 1989). Mating follows the calving period. Reports on the age of sexual maturity vary from 10 years for females and 15 for males (Suydam et. al., 1999), to four to seven years for females and eight to nine years for males (Nowak, 1991). The area around the Port of Anchorage is not classified as a calving, nursery, or mating ground.

Status and Abundance

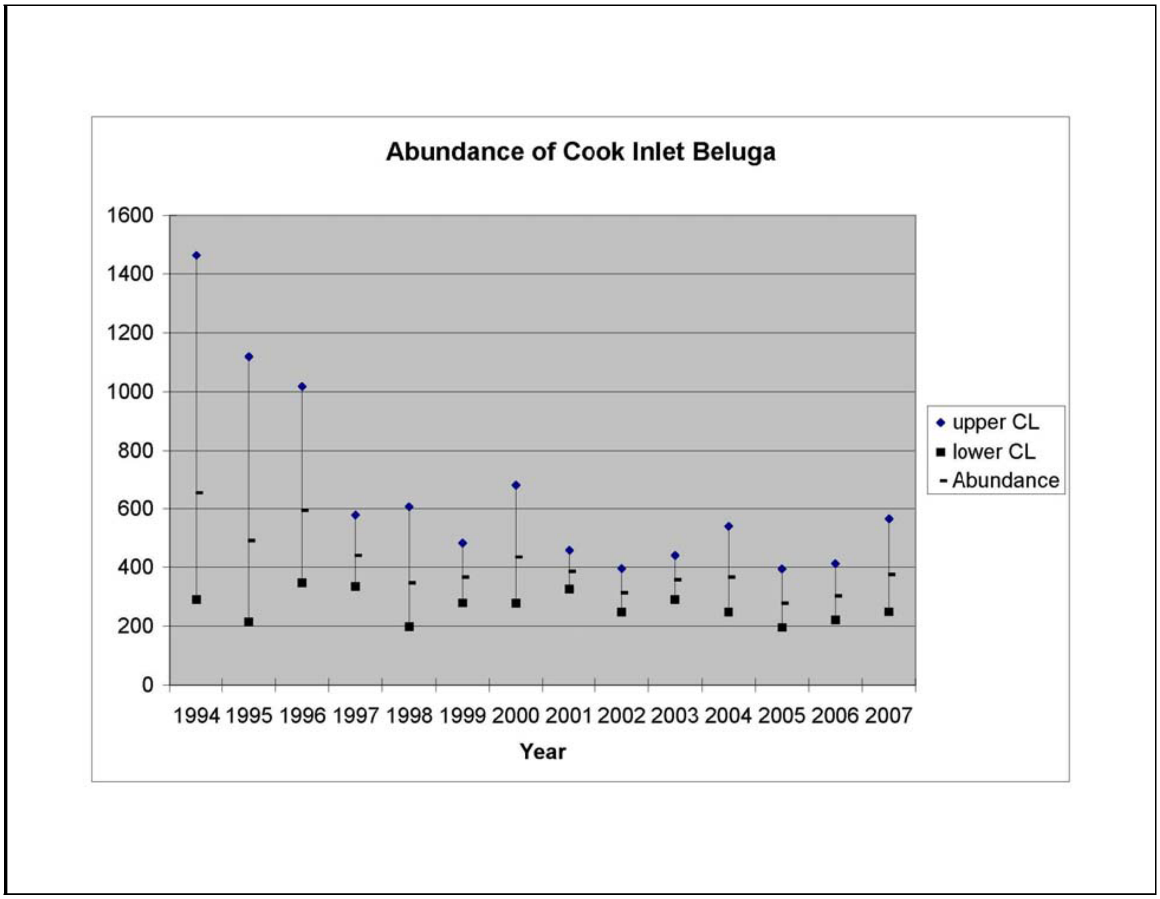
Beluga whales are circumpolar in distribution and occur in seasonally ice-covered arctic and subarctic waters. Beluga whales occur seasonally in marine waters around most of Alaska, except the Southeast panhandle region and the Aleutian Islands. This species comprises five distinct stocks: Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet (Hill and DeMaster, 1998). Of these, the Cook Inlet stock, the only stock that would be affected by the Project. This stock is considered to be the most isolated, based on the degree of genetic differentiation between it and the four other stocks (O=Corry-Crowe *et al*., 1997), suggesting the Alaska Peninsula may be an effective barrier to genetic exchange (Hobbs et. al., 2006). Also supporting this find, is the lack of observations of beluga whales along the southern side of the Alaska Peninsula (Laidre et al., 2000). Murray and Fay (1979) postulated that this stock has been isolated for several thousand years, an idea which has since been corroborated by genetic data (O=Corry-Crowe et al., 1997).

The Cook Inlet beluga whale population has declined significantly over the years. Historical data suggest this population once numbered around 1,300 (Calkins 1989). NMFS systematic aerial surveys documented a decline in abundance of nearly 50 percent between 1994 and 1998, from an estimate of 653 whales to 347 whales (Hobbs et al., 2000). Aerial annual abundance surveys conducted each June/July from 1999 to 2007 have resulted in abundance estimates of 367, 435, 386, 313, 357, 366, 278, 302, and 375 whales for each year, respectively (Fig. 7) (Hobbs et al., 2000; Rugh et. al., 2005; NMFS, unpubl. data). These data indicate that there have been annual declines of 4.1 percent (1994 to 2007) and 2.7 percent (1999 to 2007) (note: 1999 was the year beluga harvest was regulated).

The Cook Inlet beluga whale population is listed as depleted under the MMPA and was proposed for listing as endangered under the ESA on April 20, 2007 (72 FR 19854). The ESA allows for one year from the proposed date for a listing decision to facilitate gathering of the best available scientific data on the proposed species. However, the ESA also provides for a 6-month extension at this stage for soliciting additional data if there is substantial disagreement regarding the sufficiency or accuracy of the available data (Sect 4(b)(6)(A)). On April 22, 2008, NMFS published a notice in the *Federal Register* announcing a 6-month extension (to October 20, 2008) on the determination for listing the Cook Inlet beluga whale DPS under the ESA (73 FR 21578).

Subsistence harvest is believed to have been the major contributor to the population decline (NOAA 2007). The history of harvest and harvest plan alternatives are detailed in the Draft Harvest SEIS (NOAA 2007). NMFS estimates that the average annual take for subsistence harvest, including whales that were struck and lost, was 67 whales per year from 1994 through 1998. Annual harvest estimates for 1994 thru 1998 are 21 whales (1994), 70 whales (1995), 98 whales (1996), 70 whales (1997) and 50 whales (1998). The harvest, which was as high as 20 percent of the stock in 1996, was sufficiently high to account for the 14 percent annual rate of decline in the stock during the period from 1994 through 1998 (Hobbs et al. 2000). The last year in which unregulated subsistence harvests occurred was 1998. In 1999 and 2000, there was no harvest as a result of legislation and a voluntary moratorium by the hunters in spring 1999. Since 1999, a moratorium was enacted to prohibit the harvest of Cook Inlet beluga whales except through a co-management agreement between NMFS and an Alaska Native organization. This moratorium was made permanent in December 2000. NMFS promulgated regulations for the taking of Cook Inlet beluga whales by Alaska Natives for the years 2001-2004 (69 FR 17973), and proposed long-term harvest regulations through recovery. This was followed by the November 2004 long-term harvest plan which allows for a total of 6 whales to be harvested between 2005 and 2009 with harvest in subsequent 5-year periods to depend on the average abundance in the previous 5-year period and the observed growth rate of the population (NMFS 2005). Despite the strict harvest limits since 1999, the population has not recovered. Factors inhibiting recovery include vessel traffic, small stock size, restricted summer range, habitat alteration, and natural mortality (NMFS 2006).

Figure 7. Annual estimates of abundance for Cook Inlet beluga whales as determined by aerial surveys in June/July 1994-2007. The vertical bar with each estimate represents the 95 percent confidence interval for the estimate (Hobbs et al. 2000b, NMFS unpublished data). Taken from the Draft Harvest EIS pg. 3-16 (NMFS 2007).



Distribution

The Cook Inlet beluga's range is believed to be largely confined to the Inlet with a high occurrence of animals in the upper Inlet and Knik Arm during the spring, summer, and fall seasons. The shift in distribution of belugas in Cook Inlet to the south during the winter (Sheldon 1994) is likely due to lack of food availability and ice formation in the north. The arrival of prey species and reduction of ice in the spring leads to their northward return (Morris 1988). Warm rivers feeding into the inlet could provide a thermal advantage to newborns (Sergeant and Brodie 1969; Fraker et al., 1979) as well as accelerate the breakdown of old cells and promote new cell growth during the molt (Finley 1982; St. Aubin et al., 1990; Watts et al., 1991). These whales demonstrate site fidelity to regular summer concentration areas (Seaman et al., 1985), typically near river mouths and associated shallow, warm and low salinity waters (Moore et al., 2000). In the winter, beluga whales concentrate in deeper waters in the mid- Inlet down to Kalgin Island with occasional forays into the upper Inlet, extending to the upper ends of Knik and Turnagain Arms.

From April through November whales concentrate at river mouths and tidal flat areas, moving in and out with the tides (Rugh et al., 2000). In Knik Arm, beluga whales generally are observed arriving in May and often use the area all summer, feeding on the various salmon runs and moving with the tides. There is more intensive use of Knik Arm in August and through the fall, coinciding with the coho run. Whales will gather in Eagle Bay and elsewhere on the east side of Knik Arm on the low tide. During high tides, beluga whales are generally concentrated around prime feeding habitats in the upper reaches of the Arm, an area unaffected by the Project. They often retreat to the lower portion of Knik Arm during low tides gathering in Eagle Bay and elsewhere on the east side of Knik Arm (approximately 15 miles north of Anchorage) and sometimes in Goose Bay on the west side of Knik Arm (across from Eagle Bay). Beluga whales will often travel between these two areas (upper reaches of the Arm and the Bays) with the tide daily for a season before traveling farther south past Anchorage and out of Knik Arm.

Fourteen beluga whales were satellite-tagged in upper Cook Inlet in Knik Arm between late July and early September 2000-2002 (Hobbs et al., 2005). These tags provided location and movement data through the fall and winter and into May. During summer and autumn, whales were concentrated in river and bays in upper Cook Inlet with whales traveling back and forth between Knik Arm (Eagle River), Chichaloon Bay, and upper Turnagain Arm, although some whales also spent time offshore. When in these areas, whales made rapid movements 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) and often remained stationary in one area for many weeks followed by a rapid movement to another area (within a day). One whale tracked in 2001 moved back and forth between the 3 bodies of water listed above seven times in three months. Area use in August was the most limited of all months with approximately 50-75% of the recorded locations in August were in Knik Arm, concentrated near Eagle River. In September, the tagged whales 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 the Beluga River. In October, they 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, the beluga whales 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. The whales 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 11-30 km per day. No satellite tags were on animals from April-mid July.

Social Dynamics

Beluga whales are extremely social animals that typically migrate, hunt, and interact together. Nowak (1991) reports the average pod size as 10 animals, although beluga whales may occasionally form larger groups, often during migrations. Groups of 10 to several hundred beluga whales have often been observed during summers in Cook Inlet; however, solitary animals and smaller groups are not uncommon around the Port (Funk et al., 2005, Ramos et al., 2005, Markowitz and McGuire, 2007, Cornick and Kendall, 2007). Native hunters have stated that beluga whale form family groups and suggest that there are four types of beluga whales in Cook Inlet, distinguished by their size and habits (Huntington 2000); however, this has not been confirmed.

Feeding

Prey availability likely has the strongest influence on the distribution and relative abundance of beluga whales in Cook Inlet (Moore et al. 2000). Beluga whales are opportunistic feeders known to prey on a wide variety of animals. 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). Natives also report that Cook Inlet beluga whales feed on freshwater fish: trout, whitefish, northern pike, and grayling (Huntington 2000), and tomcod during the spring (Fay et al., 1984). While beluga whales feed on a variety of prey, they focus on specific species when they are seasonally abundant. Increased foraging success results in a thick blubber layers that provides both energy and thermal protection. Native hunters in Cook Inlet report that beluga whale blubber is thinner in early spring than later in the summer. This suggests that their spring feeding in upper Cook Inlet, principally on fat-rich fish such as eulachon and salmon, is very important to the energetics of these animals.

Salmon and eulachon species are high quality prey that have high lipid (fat) content, up to 21% (Payne et al., 1999). By late spring, beluga whales begin to shift from lipid-poor prey to lipid-rich species (Abookire and Piatt 2005) as anadromous fish runs of eulachon and salmon enter the Inlet. Calkins (1989) recovered 13 salmon tags from the stomach of an adult beluga whale found dead in Turnagain Arm. These salmon had been tagged in upper Susitna River; however, where these fish were eaten could not be determined. Beluga whales in captivity may consume 2.5-3 percent of their body weight daily, or approximately 40-60 pounds. Wild beluga whale populations, faced with an irregular supply of food or with increased metabolic needs, may easily exceed these amounts while feeding on concentrations of eulachon and salmon. Beluga whale hunters in Cook Inlet reported one whale having 19 adult king salmon in its stomach (Huntington 2000) and an adult male beluga whale had 12 adult coho salmon in its stomach at a weight of 27.8 kg (61.5 lb) (Vos, 2003). Herring may be another important forage fish for beluga whales as identified by a 1993 smolt survey of the upper Inlet which found juvenile herring to be the second-most abundant fish species collected. These herring were primarily caught along the northwest shore, including the Susitna delta (Moulton 1994).

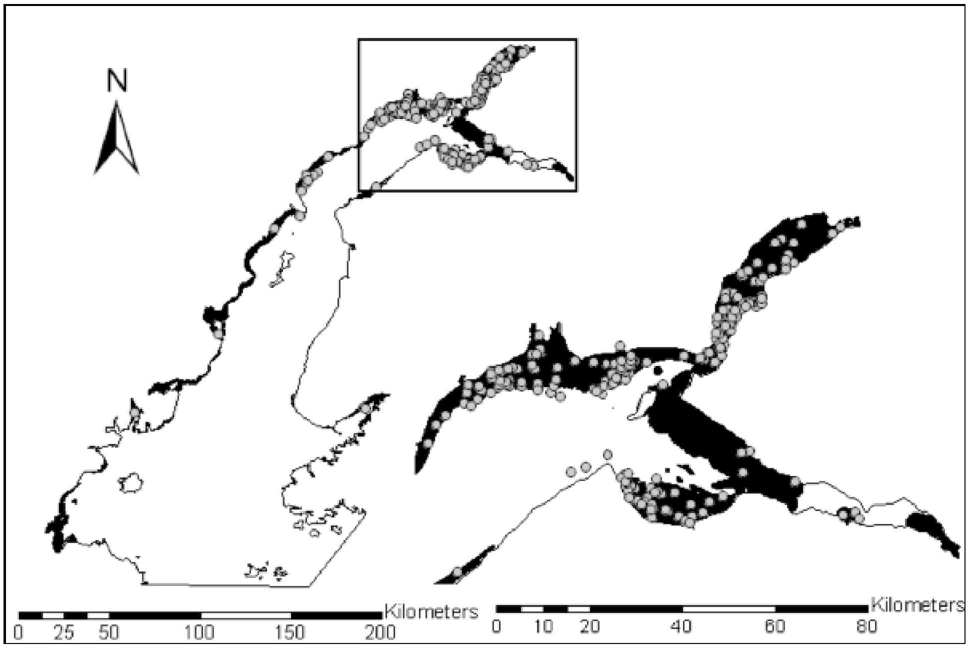
Beluga whales capture and swallow their prey whole, using their blunt teeth only to grab. The observed cohesion of beluga groups indicate the whales interact with each and behave cooperatively. At the Port, beluga whales have been observed positioning one whale along a rip rap dock, while a second whale herds salmon along the structure toward the stationary beluga whale (Brad Hanson, pers. comm.). The concentrations of beluga whales offshore of several important salmon streams in the upper Inlet is assumed to be a feeding strategy which takes advantage of the bathymetry of the area. The fish are funneled into the channels formed by the river mouths and the shallow waters act as a gauntlet for salmon as they move past waiting beluga whales. These dense concentrations of prey appear essential to beluga whale feeding success. Hazard (1988) hypothesized that beluga whales were more successful feeding in rivers where prey were concentrated than in bays where prey were dispersed.

Habitat and Habitat Use

Since their rapid population decline, Cook Inlet beluga whale distribution has also decreased (Rugh et al., 2000); however, there is obvious and repeated use of certain habitats. Habitat associations of beluga prey species in Cook Inlet include preferences for sand and mud substrates (Cohen et al. 1990, Eschmeyer et. al., 1983) and movements of beluga whales within the Inlet are similar to the seasonal movements of their prey (Hobbs et al., 2006). During surveys conducted by NMFS from 1993 to 2005, beluga whales were frequently seen aggregating near the mouths of rivers and streams in June and July when anadromous fish species were present and often at their peak availability (Moore et al. 2000). The repeated concentrations of Cook Inlet beluga whales within discrete areas of the upper Inlet and offshore of several important salmon streams is assumed to be a feeding strategy that takes advantage of the bathymetry of the area: the fish are funneled into the channels formed by the river mouths and the shallow waters act as a gauntlet for salmon as they move past waiting beluga whales (Hobbs et al., 2006).

Goetz et al. (2007) imported June/July aerial survey data from 1993-2004 into a classification and regression tree (CART) model and a resources selection function to determine importance of selected environmental variables (i.e., bathymetry, proximity to mudflats, distance from rivers classified by flow accumulation) in structuring the habitat use of beluga whales in Cook Inlet (Fig. 8). Mudflats were a significant predictor of beluga distribution with freshwater flow accumulation also determining beluga whale distribution. That is, beluga whales are found near mudflats and prefer medium and high flow accumulation areas. Bathymetry was not a significant variable. The CART model correctly classified 88% of the sightings, with the majority of beluga sightings found within 2.7 km of mudflats and 11.5 km of medium flow accumulation inlets. A resource selection function model correctly discriminated between beluga sighting and non-beluga sightings furthering verifying the importance of these parameters. Therefore, distance to mudflats and flow accumulation rates are important physical environmental variables in determining beluga distribution.

Figure 8. Preferred habitat of beluga whales (black) in Cook Inlet based on the resource selection function (taken from Goetz et al., 2007). Circles represent beluga sightings.



NMFS has characterized the relative value of four habitats as part of the management and recovery strategy in its "Draft Conservation Plan for the Cook Inlet Beluga Whale (*Delphinapterus leucas*)" (NMFS 2005). These are sites where beluga whales are most consistently observed, where feeding behavior has been documented, and where dense numbers of whales occur within a relatively confined area of the Inlet. Type 1 habitat is termed "High Value/High Sensitivity" and includes what NMFS believes to be the most important and sensitive areas of the Inlet for beluga whales. Type 2 is termed "High Value," and includes summer feeding areas and winter habitats in waters where whales typically occur in lesser densities or in deeper waters. Type 3 habitat occurs in the offshore areas of the mid and upper Inlet and also includes wintering habitat. Type 4 habitat describes the remaining portions of the range of these whales within Cook Inlet. The habitat that would be directly impacted from Project construction, from both noise and fill, is considered Type 2 habitat.

Beluga whales frequently move in and out of deeper water and between feeding, calving, and nursery areas throughout the mid and upper Inlet. Access to these areas and corridors in between these areas is important. Knik Arm, Turnagain Arm, Chickaloon River and the Susitna River delta areas are used extensively. Besides localized prime foraging areas, it is possible these sites provide for other biological needs, such as calving or molting but this has not been confirmed. Such habitat sites and use have been reported elsewhere in Alaska, although there is not adequate information to identify these calving and molting habitat attributes in Knik Arm. Within Knik Arm, the upper reaches have been identified as prime foraging area, not the area around the Port.

Opportunistic beluga whale sightings at or near the Port have been reported for years to the NMFS AKR (NMFS unpubl. data). The sighting information has been collected by Port authorities on land or crew aboard commercial vessels (e.g., tugs). Although behavioral data were not collected for all sightings, available reports indicate that traveling is the prevalent behavior of beluga whales around the Port. Out of the 60 group sightings that had behavioral data associated with them, 47 groups were reported traveling. Other behaviors noted included feeding (n=4), possible feeding (n=2), transversing Knik Arm (n=3), and association with vessels (n=4) where n is equal to the number of groups sighted. Interestingly, two groups associated with vessels were highly vocal and the crew reported vocalization resonating though the tug. Based on these data, habitat use around the Port from April- October has been determined to be primarily traveling. Whales are using this area as a migration route to access the upper reaches of Knik Arm where fish runs are prevalent in the summer months.

Tidal Influence on Distribution

Two major dedicated beluga whale monitoring studies have been conducted in Knik Arm; one for the proposed Knik Arm Crossing (Funk et al., 2005); and one for the Port (Ramos et al., 2006, Cornick and Kendall 2007, Markowitz and McGuire 2007). These studies investigated and provided data on beluga whale presence, behavior, and group composition data around the Port. In 2004 and 2005 whales were seen at all tide stages but most beluga sightings occurred at or around low tide (Funk et al., 2005). Areas around lower part of Knik Arm near Sixmile Creek (across from Cairn Point) were used by beluga whales during the lower portion of the tidal cycle. Whales were often seen moving between the Sixmile Creek area and Eagle Bay to the north during periods of low tide. As the tide flooded, beluga whales typically moved from the area near Sixmile Creek and Eagle Bay into the upper reaches of Knik Arm. The whales would continue to move north through the Birchwood area and into areas visible from the Eklutna monitoring station where some remained for much of the highest portion of the tide. During the ebb tide, whales moved south and west out of the upper reaches of Knik Arm and returned to the Sixmile Creek and Eagle Bay areas. The heading of whales was also noted during this 2004/2005 monitoring year. In general, whales appeared to ride the ebbing tide down the Arm and the flooding tide up the Arm. Daily temporal variability of habitat use by beluga whales in Knik Arm was primarily driven by the tidal cycle with whale distribution directly related to tide height.

Beluga whales monitoring also occurred at the Port specifically for the Project from August-November 2005; April-November 2006; and October-November 2007 (Ramos et al., 2006, Markowitz and McGuire 2007, Cornick and Kendall 2007). Beluga whales were sighted in all months in which Port construction would occur (April-October). In 2005, 80.9% of sightings occurred within three hours of low tide and more than half of the sightings (66.6%) occurred within two hours of low tide. On average, sightings were just under 120 minutes from low tide in August (n=5) and September (n=10), less than 80 minutes from low tide in October (n=2), and approximately 90 minutes from low tide in November. No whales were sighted during high flood tide in 2006 during these months (Table 2). In October 2007, whales were not observed during low flood or high flood stages but group sightings (n= 10) were evenly distributed among all other tide stages. Because data was collected over all months pile driving would take place in 2006, these data were used to determine percentage of beluga occurrence at the Port in relation to the tide. In 2006, approximately 70% of sightings occurred 2 hours around either side of low tide (Table 2). In August and September 2007, the trend for sighting whale more frequently around low tide was the same as in previous years. Therefore, a 70% sighting rate is likely an accurate, if not an underestimate, of when beluga whales are using the area around the Port. Therefore, the restriction of restricting impact pile driving during this time (see Mitigation Measures) is appropriate and will minimize harassment to beluga whales. More sighting data is also described in Chapter 4.

Table 2: Tidal distribution data from 2006 studies conducted at Cairn Point for the Project (April-October)

Tidal Stage	Hours of Effort (563.8)	% Effort	# Beluga whales Sighted	Total # Hours Beluga whales Sighted	Beluga sighting rate	% of observation time w/ Beluga	% Beluga tide use	2 hours either side of low*
Low Ebb	116.5	22	31	3.78	0.26	3.24	42.035	21.02
Low Slack	143.5	27	49	5.37	0.34	3.74	48.480	48.48
Low Flood	110.4	21	10	0.08	0.09	0.07	0.939	0.47
High Flood	61.2	11	0	0	0	0.00	0.000	n/a
High Slack	36.4	7	5	0.2	0.14	0.55	7.118	n/a
High Ebb	63.5	12	4	0.07	0.06	0.11	1.428	n/a

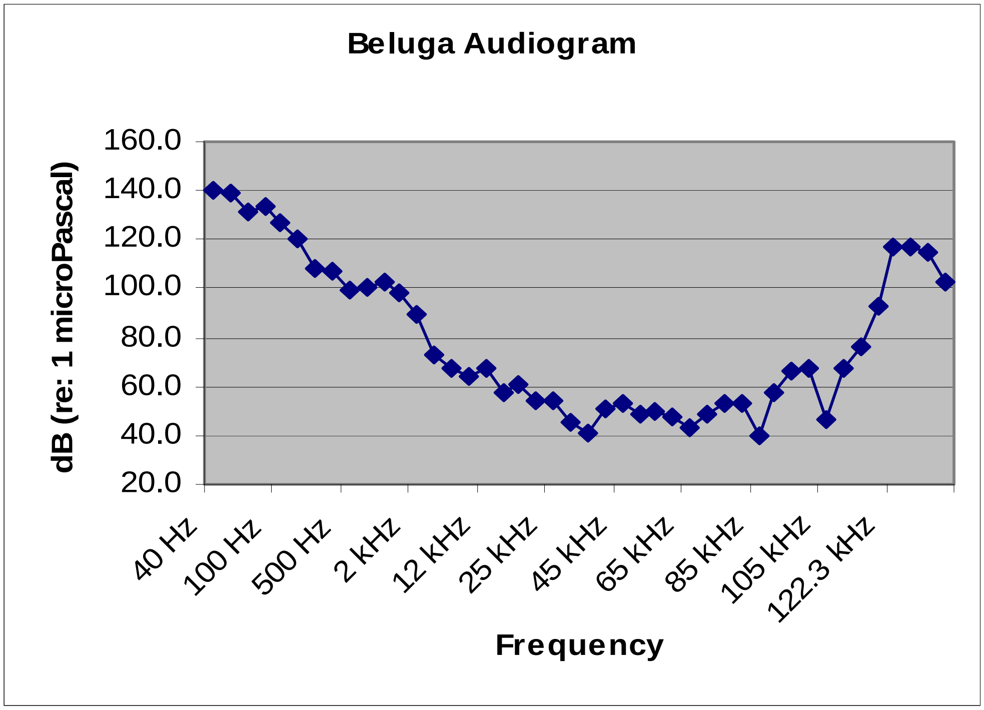
* The last column represents ½ of low ebb (1 hr), all of low slack (2 hr) and ½ of low flood (1hr) to represent 2 hours either side of low tide. Adding these together equals 70% beluga use during 2 hours either side of low.

Beluga Hearing

As for all toothed whales, beluga whale sound reception probably takes place through the lower jaw. The lower jawbone of toothed whales broadens and is hollow at the base, where it hinges with the skull. Within this very thin, hollow bone is a fat deposit that extends back toward the auditory bulla (earbone complex). Sounds are received and conducted through this fat filled lower jawbone where the sound waves are conducted to the middle ear and then to hearing centers in the brain via the auditory nerve.

Beluga whales are characterized as mid-frequency odontocetes but are able to hear an unusually wide range of frequencies, covering most natural and man-made sounds. NMFS developed a beluga whale audiogram based on the best available scientific literature available for this species based on Awbrey et al., 1988; Erbe and Farmer, 1998; Finneran et al., 2005; Johnson et al., 1989; Klishin, 2000; Ridgway et al., 2001; and White et al., 1978 (Fig. 9). The hearing frequency range of this species is believed to be between 40 Hz-150 kHz with keen hearing at 10-100 kHz. Above 100 kHz, sensitivity drops off very fast (Au, 1993) and below 16 kHz the decrease in sensitivity is more gradual at approximately 10 dB per octave (White et al., 1978; Awbrey et al., 1988). While peak sensitivity range is outside of most industrial sounds, studies have shown that beluga whales can hear and react to such low frequency noise, dependent upon intensity (i.e., decibels); however, masking of their high frequency communication and echolocation signals is not as likely when exposed to lower frequency sounds (Thomas et al., 1990).

Figure 9. Typical Beluga Whale Audiogram. At low and high end frequency ranges, sound must be louder to be heard than at frequencies in the peak hearing range.



Natural and Anthropogenic Threats

Beluga whales are subject to strandings, killer whale predation, and parasitism and disease. As described in Hobbs et al. (2006), beluga stranding events in upper Cook Inlet are not uncommon. Beluga whales are known to intentionally strand themselves during molting while rubbing their skin against rocky bottoms (e.g., Smith et al. 1992). Beluga whales may also strand purposely or accidentally to avoid predation by killer whales or when injured or sick. NMFS has reports of 804 stranded whales (some of which were involved in mass stranding events) in upper Cook Inlet since 1988 (Vos and Shelden 2005). Mass stranding events occurred most frequently along Turnagain Arm, and often coincided with extreme tidal fluctuations ("spring tides") and/or killer whale sighting reports (Shelden et al. 2003). Other mass strandings have been reported in the Susitna Delta (Vos and Shelden 2005) and most recently on September 12, 2006 in Knik Arm (B. Mahoney, NMFS Alaska Region Office, unpublished data). These mass stranding events usually involve both adult and juvenile beluga whales that are apparently healthy, robust animals. Sex ratios for stranded whales were approximately 1:1.

Only opportunistic data exist on the level of removals of beluga whales in Cook Inlet due to killer whale predation. Sheldon et al. (2003) reported that during 11 of 15 observed interactions, beluga whales were obviously injured or killed, either through direct attacks or indirectly as a result of stranding. Assuming at least one beluga mortality occurred during the other four encounters, this accounts for 21 beluga whales killed between 1985 and 2002. This would suggest a minimum estimate of roughly 1 death/yr and does not include at least three instances where beluga calves accompanied an adult that was attacked. The total impact of killer whale predation is unknown but the potential for significant impacts from killer whale predation on the Cook Inlet beluga population certainly exists given the low abundance of the beluga population and recent changes in prey availability to killer whales throughout the Gulf of Alaska (GOA) (referring to declines in pinniped populations in the Central and Western GOA since the mid-1970s) (Hobbs et al., 2006).

Disease and parasitism are natural occurrences in all marine mammals. Necropsied beluga whales have revealed loads of lungworms (Measures, 2001) and stomach and kidney parasites (e.g., nemetodes), as well as skin lesion, bacterial pneumonia, and respiratory tract bacterial infections (NMFS 2007; Hobbs et al., 2006). Not all endoparasites or diseases alone are considered to cause mortality; however, in combination or in severe cases, these could result in death. For example, a young (130 cm) female beluga stranded on September 17, 2000 with severe parasitic pneumonia and secondary bacterial involvement: hepatic trematodiasis (liver flukes), ulcerative dermatitis (skin infections), linguatuliasis (tongue worms), and probable sepsis (blood poisoning) (Hobbs et al., 2006). While parasites and the potential for infectious disease occur in Cook Inlet belugas, no indication exists that their occurrence has had any measurable (detrimental or adverse) impact on the survival and health of the Cook Inlet beluga population despite the considerable pathology that has been done (NMFS 2006). Contaminants are not considered an immediate concern to the health of the Cook Inlet beluga whale population as previous analyses of Cook Inlet beluga samples have found contaminant loads lower or equal to the other Alaska populations (with the exception of copper levels) (Becker 2000). The toxicological implication of the copper levels is unknown (Becker 2000).

3.2.4.2 Harbor Seals

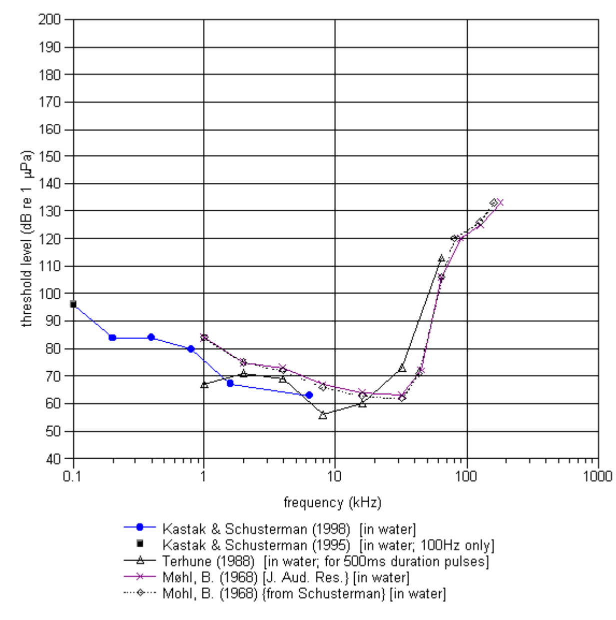
Harbor seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. They are important upper-trophic marine predators that occupy a broad range in Alaska from approximately 130°W to 172°E (over 3,500 km east to west) and from 61°N to 51°N (over 1,000 km north to south). Currently, harbor seals in Alaska are divided into three stocks: Bering Sea, GOA, and Southeast Alaska. While new genetic information has lead to a reassessment of this delineation, this has not yet been finalized. Harbor seals which could be affected by the Project belong to the GOA stock. Based on aerial GOA and Aleutian Islands surveys, in 1996 and 1999 respectively, the current abundance estimate for this stock is 45,975 (CV = 0.04) with a minimum population estimate of 44,453 (Angliss and Outlaw 2006). Sources of anthropogenic caused mortality for this stock include interactions with fishing gear (mean annual mortality is approximately 24 animals), subsistence hunting (mean annual harvest from 2000-2004 equals 795), and, to a lesser degree, illegal intentional killing.

Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuaries, and occasionally fresh waters (Fisher 1952; Bigg 1969, 1981). In Alaska, commonly eaten prey include walleye, pollock, Pacific cod, capelin, eulachon, Pacific herring, salmon, octopus, and squid. They are generally non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction; however, some long-distance movements have been recorded from tagged animals with juveniles traveling farther than adults (Lowry et al., 2001). The major haul-out sites for harbor seals are located in Lower Cook Inlet with the closest identified harbor seal haul-out site to the Port approximately 25 miles south along Chickaloon Bay in the southern portion of Turnagain Arm. However, harbor seals have been observed around the Port. In 2004-2005, 22 harbor seal sightings were reported over a 13-month period comprising of 14,000 survey hours. From these surveys, it is estimated that harbor seals occur in a density of approximately 1.7 animals per month in Knik Arm (LGL unpubl. data).

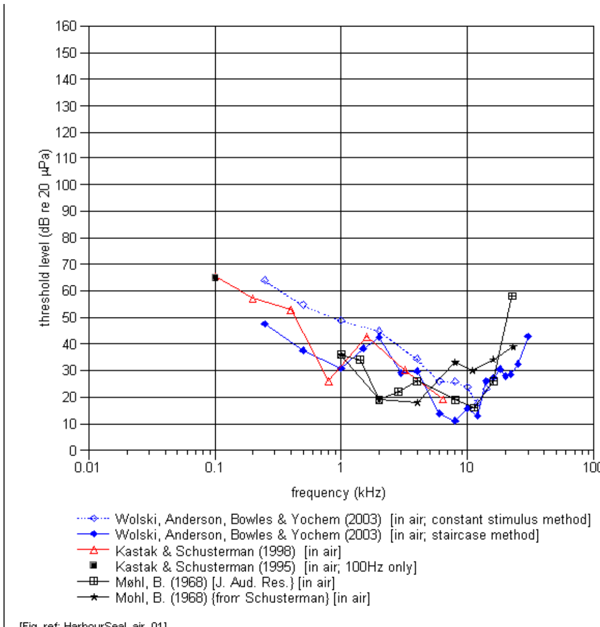
Pinniped hearing is dependent upon the medium (i.e., air or water) in which they receive the sound. Most pinniped species have essentially flat audiograms from 1 kHz to 30 – 50 kHz with thresholds between 60 and 85 dB re 1 µPa (Møhl, 1968; Kastak and Schusterman, 1995; review by Richardson et al., 1995; Terhune and Turnbull, 1995; Kastelein *et al.*, 2005;). At frequencies below 1 kHz, thresholds increase with decreasing frequency (Kastak and Schusterman, 1998). For example, for a harbor seal, the 100-Hz threshold for hearing was 96 dB re 1 µPa (Kastak and Schusterman, 1995). Harbor seals hearing thresholds in-water and in-air display the significant disparities between hearing capabilities (Figure 10a,b) with hearing 25–30 dB better underwater than in air (Kastak and Schusterman, 1994).

Figures 10. Harbor seal audiograms (taken from Nedwell et.al., 2004).

a) Audiogram in-water (re 1 µPa).



b) Audiogram in-air (re 20 µPa).

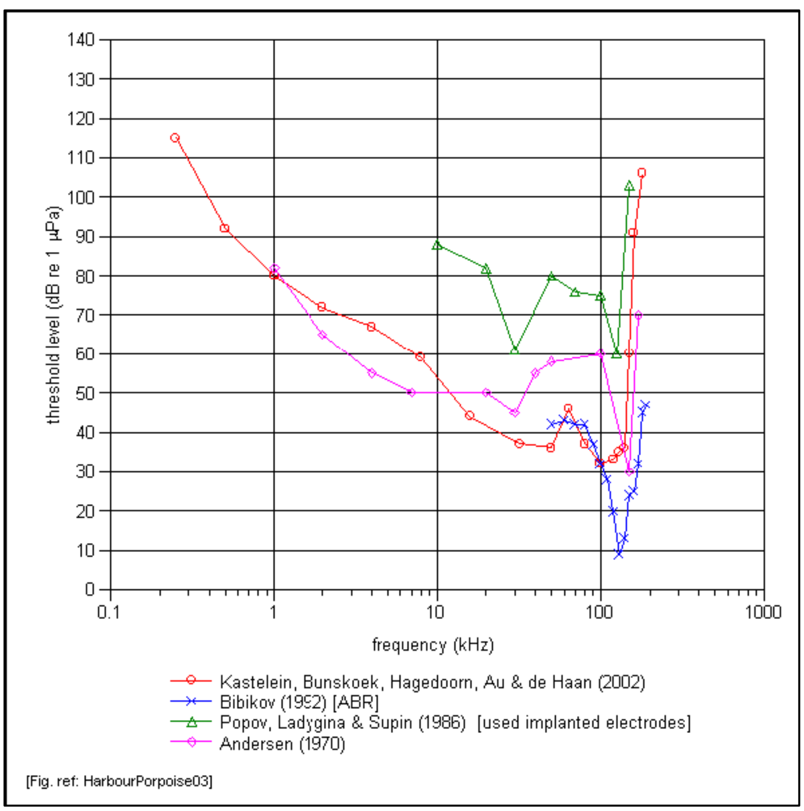


3.2.4.3 Harbor Porpoise

Harbor porpoises are found within Cook Inlet but in low abundance, especially in Knik Arm. Currently, the population estimate for the Gulf of Alaska harbor porpoise stock is 41,854 with a minimum population estimate of 34,740 (Angliss and Outlaw, 2006). However, density of harbor porpoise in Cook Inlet is only 7.2 per 1000 square kilometers (Dahlheim et al., 2000). The highest monthly count in upper Cook Inlet between April and October is 18 (Ramos et al., 2006). Interactions with fisheries and entanglement in gear is the prime anthropogenic cause of mortality for this stock (mean annual mortality of 67.8) (Angliss and Outlaw, 2006). Harbor porpoise are not killed for subsistence reasons.

Harbor porpoise have a wide hearing range and the highest upper-frequency limit of all odontocetes studied (Figure 11). They have a hearing range of 250 Hz-180 kHz with maximum sensitivity between 16-140 kHz. There is no available data on high frequency cetacean reactions to impulsive sounds (e.g., impact pile driving); however, numerous studies have been conducted in the field (Culik et al., 2001; Olesiuk et al., 2002; Johnston, 2002) and laboratory (Kastelein et al., 1995, 1997, 2000) for non-pulse sounds. The results of these studies demonstrate the harbor porpoise are quite sensitive to a wide range of human sounds at very low exposure levels: approximately 90- 120dB re: 1μPa. However, most of these studies involved acoustic harassment devices (e.g., pingers) in the range of 10 kHz which is 6-7 kHz greater than most industrial sounds, including pile driving.

Figure 11. Harbor Porpoise Audiogram (taken from Nedwell et al., 2004).



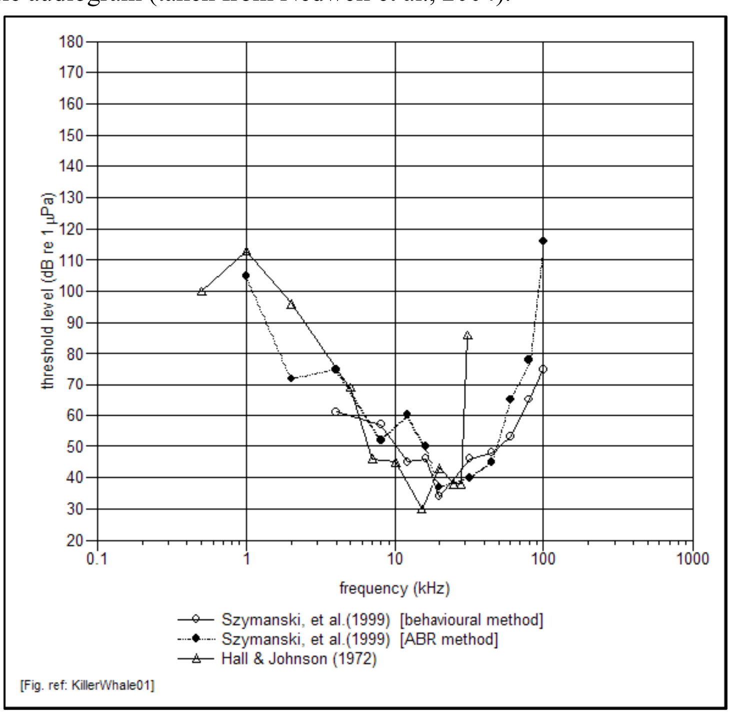
3.2.4.4 Killer Whales

Killer whales in the Gulf of Alaska are divided into two ecotypes: resident and transient. Killer 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 (18 sightings have been noted from 1976-2003) (Sheldon et al. 2003). Transient killer whales seen in Cook Inlet belong to the Gulf of Alaska, Aleutian Islands, 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 killer whales is 314 animals based on the count of individuals using photo-identification. As of 2004, the AT1 population size is eight animals, a 64% decrease from 22 whales in 1989.

As stated, killer whales are known to feed on beluga whales in Cook Inlet. Most observed killer whale/beluga interactions were in the upper Inlet; however, killer whale predation on beluga whales in Cook Inlet appears to be random and does not appear to be an influential factor on beluga distribution (Hobbs et al., 2006). However, a decrease in killer whale prey comprised of seals and sea lions in the Gulf of Alaska could result in killer whales moving from the southern portion of the Inlet to the northern portion in search of beluga prey.

The hearing of killer whales is well developed and this species exhibit complex underwater communication structure. They have hearing ranges of 0.05 to 100 kHz which is lower than many other odontocetes (Figure 12). Peak sensitivity is around 15 kHz. Interestingly, mammal-eating killer whales (i.e. transients) limit their vocal communication and often travel in silence. This is in contrast to the very vocal fish eating (i.e., resident) killer whale pods who are constantly vocalizing. The difference for this behavior is that fish do not possess the advanced hearing capabilities as the marine mammals, who can hear or eavesdrop on mammal eating killer whale calls and escape from being prey (Deecke et al. 2005).

Figure 12. Killer whale audiogram (taken from Nedwell et al., 2004).



CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

This chapter outlines the effects or impacts to the aforementioned resources in Knik Arm from the proposed action. Significance of those effects is determined by considering the context in which the action will occur and the intensity of the action. The context in which the action will occur includes the specific resources, ecosystem, and the human environment affected. The intensity of the action includes the type of impact (beneficial versus adverse), duration of impact (short versus long term), magnitude of impact (minor versus major), and degree of risk (high versus low level of probability of an impact occurring). This EA covers the environmental consequences of issuance of the proposed one-year IHA in detail and also addresses the long-term impact from Port construction over a 5-year period. However, factors such as take numbers for years beyond 2008 cannot be addressed in this EA as pile driving hours and percentages of impact and vibratory pile driving may change from year to year. As such, a supplemental EA will be prepared, if appropriate, to assess effects from issuance of a rulemaking in 2009. Acoustic and beluga monitoring reports, which would be required under the IHA, during the first year of construction would be used for future analyses.

The terms "effects" and "impacts" are used interchangeably in preparing these analyses. The CEQ regulations for implementing the procedural provisions of NEPA, also state, "Effects and impacts as used in these regulations are synonymous." (40 CFR §1508.8). The terms "positive" and "beneficial", or "negative" and "adverse" are likewise used interchangeably in this analysis to indicate direction of intensity in significance determination.

4.1 EFFECTS OF ALTERNATIVE 1

Under the No-Action Alternative (i.e., denial of the harassment authorization), marine mammals would not authorized under the MMPA to be harassed from Project activities. Again, the proposed incidental take authorization does not permit the Port to carry out Project construction activities. These are authorized under other permits such as the USACE permit. If the incidental take authorization is denied, the Port could complete construction if methods were employed which involved pile driving sound propagation minimization measures below NMFS determined injurious or behavioral harassment thresholds. At this time, the Port has indicated that such technology is not available. The Port could, without consideration of other factors, conduct pile driving during times when marine mammals are not in the area; however, this would require extensive aerial, vessel, and land based surveys and would not be economically feasible. Further, conducting pile driving in winter when beluga whales are rarely seen around the Port is not practicable due to dangerous ice conditions and frozen ground. Therefore, to work around marine mammals presence is impracticable, costly, and, in the case of winter months, dangerous.

In contrast to the lack of environmental consequences from an authorization denial, the socio-economic environment of Alaska would be affected if Port construction would cease (Phase I is already completed). The USACE EA states: "The Port of Anchorages handles the majority of commercial commodities entering the state of Alaska, serving 80% of Alaskan communities and handling approximately 90% of the state commercial cargo imports. There are no other ports in the state capable of handling the commercial and military logistical requirements for cargo handling and transport. The existing wharf is beyond its structural life and, at minimum, would need to receive major repairs and replacements to maintain critical service to the City of Anchorage and the state of Alaska. Additionally, the Port of Anchorage is designated by the Department of Defense and the Maritime Administration as the fifteenth Strategic Commercial Port in the United States. The no-action alternative (referring to denial of the USACE permit) would result in major delays in the distribution of commercial goods throughout the state due to congestion and delay during major military deployments. Failure to expand the Port would result in increasing inefficiencies and costs for shipping goods to Alaska customers. Also, certain elements of the Port's existing infrastructure are severely degraded and functionally obsolete and near or below design safety standards for seismic events. The Port of Anchorage's existing operational demands along with the foreseen rate of growth would result in berthing conflicts, increased ship berth waiting periods, and increased transportation costs to the public. Additionally, the Port's current infrastructure (berth and crane size, staging areas) would not be able to accommodate the larger and longer ships being used in maritime transportation. Finally, the current berthing facilities at the Port are insufficient to efficiently accommodate the military and commercial ships supporting the U.S. Army Alaska's (USARAK) military deployments."

4.2 EFFECTS OF ALTERNATIVE 2

Under Alternative 2, the Port would be authorized to harass marine mammals incidental to Project construction activities with certain mitigation requirements set in place. Because the proposed action concerns marine mammals and their habitat, these factors will be the primary focus of this chapter. As mentioned previously, KABATA prepared a FEIS which examines impacts from alternative bridge design plans. While the actions of the Port would not be identical to bridge construction, some aspects of the projects are similar (e.g., pile driving, habitat loss and/or degradation). The FEIS and associated technical reports evaluated effects to marine mammals and their habitat from construction of the Knik Arm Crossing. These reports also contain information on the ecosystem structure around the Port and contribute to data information used in the analyzes in this EA. The Port, MARAD, and USACE addressed marine mammals in their respective EAs; however, NMFS is providing a more comprehensive analysis on the potential effects to marine mammals, specifically beluga whales, as a result of this issuance of an IHA to the Port in 2008/2009, and subsequent rulemaking in 2009.

4.2.1 Socio-Economic Environment

Impacts to the socio-economic environment from the Project are addressed in the aforementioned Port and MARAD EA (pgs. 3-15-3-18). In summary, noise generation associated with the construction of pile-supported sections of the dock would likely resonate to surrounding communities. The residents of the Government Hill community just east of the project site would be subjected to much greater noise levels for longer durations over the construction phase of the project. However, most of the area around the Port is highly industrialized and this community would likely be the only one exposed to construction noise. Long term impacts from the Port expansion would likely equate to a prosperous economy for Alaska and specifically for Anchorage and its surrounding communities. This economic development would occur due to 1) decreased vessel waiting time for berths which would reduce transportation costs, 2) increased commerce due to ability to handle more cargo; and 3) increased revenue for Anchorage from cruise passengers.

Subsistence hunting of beluga whales does not occur in the area surrounding the Port. Therefore, the Project would not directly impact the actual hunting of beluga whales. In addition, as outlined in this chapter, harassment to marine mammals from the Project is expected to result in a negligible impact to the affected marine mammals, including beluga whales. The availability of marine mammals, specifically beluga whales, for subsistence purposes would not be impacted nor would recovery of the population be hindered.

4.2.2 Physical Environment

The effects to the physical environment from expanding the Port based on the current project design have been evaluated in the Port/MARAD and USACE EAs. The completed Project design calls for a total of 135 acres of wetland loss due to fill requirements. As previously stated, permits have been issued and 48.6 of the 135 acres have already been filled, leaving 86.4 acres remaining to be filled with 18.4 of those proposed to be filled in 2008/2009. Although fish habitat has been the focus of previous NMFS' concern with this design plan, because this habitat is utilized by beluga whales and their prey, impacts of direct habitat loss is analyzed in this EA.

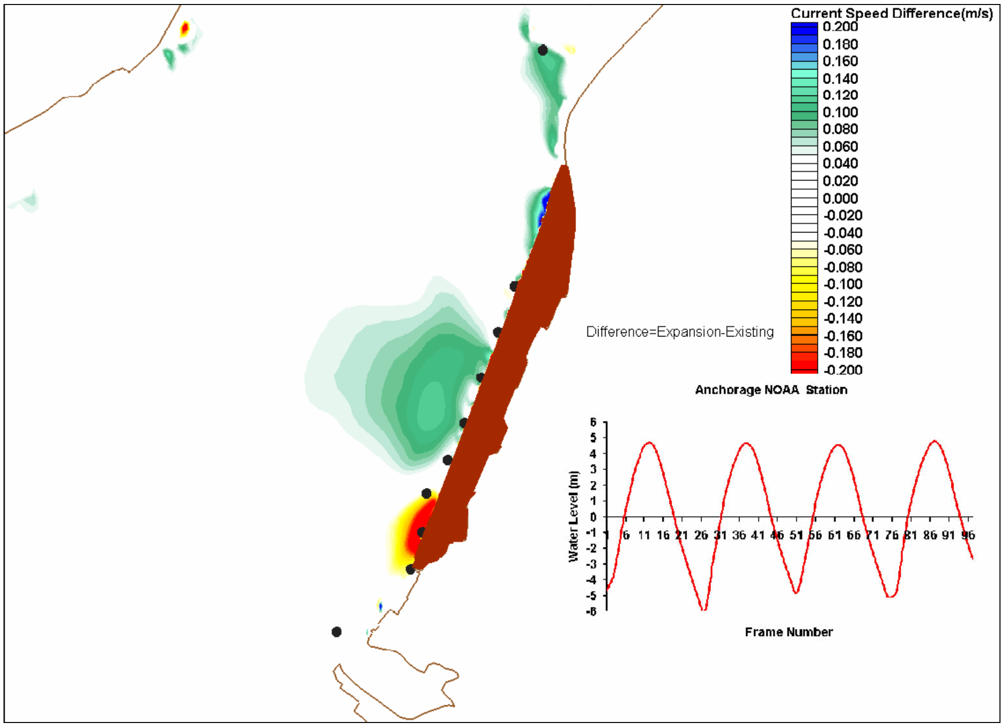
The primary impact to the physical environment would be direct loss of habitat with potential for some oceanographic changes. Erbesole and Raad (2004) conducted a thorough modeling study comparing existing physical conditions around the Port (e.g., sea level, current speed, current direction, etc.) to those expected after construction is completed. Models demonstrated that Port expansion is not expected to have any effect on the water level at the Port or the propagation of the tide wave through upper Cook Inlet. At Cairn Point, current speed during flood flow would be increased slightly during neap tide conditions with the expansion in place. During spring tide conditions, changes are even less pronounced. At Port MacKenzie, change in current speed and direction are unaffected by the proposed expansion.

Based on this Two-Dimensional Tidal Circulation Modeling and 3-D Flow Table Model, Port expansion is likely to change the hydrology and sedimentation patterns of Knik Arm at and around the Port (Erbesole and Raad 2004). Measurements taken in 2004 indicate that certain parts of upper Cook Inlet display significant three-dimensional structure to the current fields, particularly in gyres formed by strong flows past headlands, and deeper areas of the inlet gorge. Changes in these tidal hydrodynamic circulation patterns could affect shoaling/ scouring patterns in the vicinity, which would affect the USACE dredging projects at the Port and adjacent properties (barge terminals) and watercourses (Ship Creek). The results of these models are described thoroughly in Appendix E of the Port/MARAD EA are incorporated here by reference. In summary, the most overt change from expansion was the suppression of formation of gyres in front of the Port and Cairn Point and that when formed, they would occur much later in the ebb tide cycle. Current speed and direction was also altered but very slightly (Figs 8-9). For the northern part of the new dock, current speed increased (but only by a few cm/sec) during flood tide and during the end of ebb tide (weaker ebb flows). Current direction would be diverted toward the dock face during flood tide and away from the dock face during ebb tide primarily due to eddy alteration. For the southern part of the dock, current speed decreased (again by only a few seconds at Berths 2 and 3 and up to 20cm/sec at Berth 1) during flood tide and increased during the ebb (0- a few cm/sec) tide. Current direction was diverted away from the dock face during flood tide and toward the dock face during ebb tide.

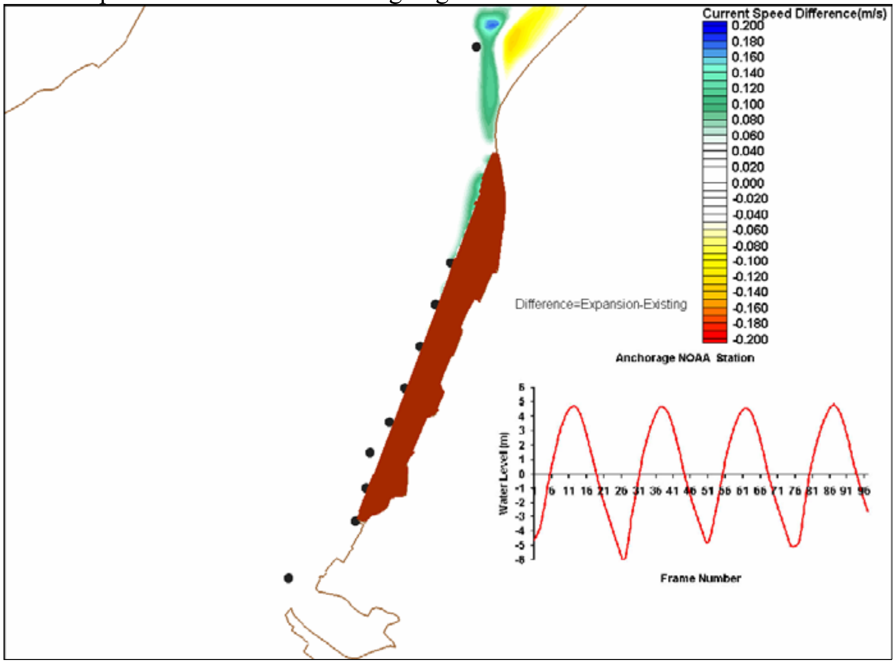
Pattern and velocity flow during flood, high slack, and ebb tides would be affected by dock expansion based on the Erbesole and Raad (2004) models (Figure 13a-c and 14 a, b). The presence of the expansion greatly alters the formation of the gyre during the ebb portion of the tidal cycle. The expansion would remove the flats and causes formation of the gyre around Cairn Point to be suppressed and its formation to occur much later in the ebb tidal cycle. Flows are directed to the south on ebb for a larger percentage of time at higher strength, along much more of the dock face, compared to the without expansion conditions when weaker flows were directed toward the dock and into the northern corner of the basin. This reduces the time during which flows are weak, reducing the time during which a gyre is present at the north end of the harbor basin, and reduces the time when a weak gyre core is present at the north side of the harbor. Models also indicated that, overall, the proposed expansion appears to have less potential for sedimentation that the existing port, which is probably not surprising in light of the fact that the filled expansion moves the dock face out into deeper water and into a higher flow regime.

Figure 13 a-c. Model illustrations depicting current speeds changes around the Port of Anchorage due to Port expansion.

a) Current Speed Difference Plot During Beginning of Flood Tide



b) Current Speed Difference Plot During High Water Slack Tide



c) Current Speed Difference Plot During Ebb Tide

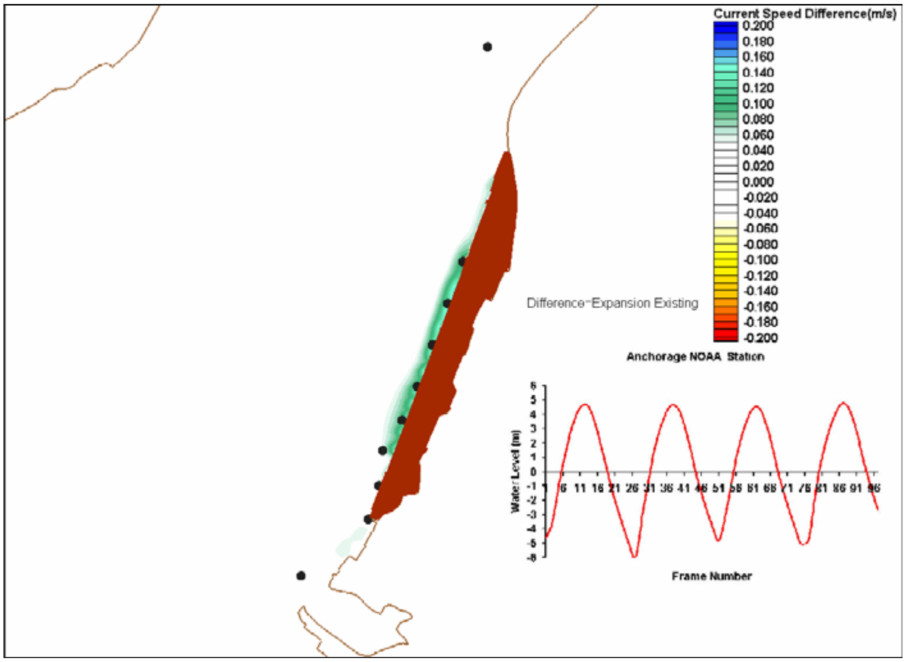
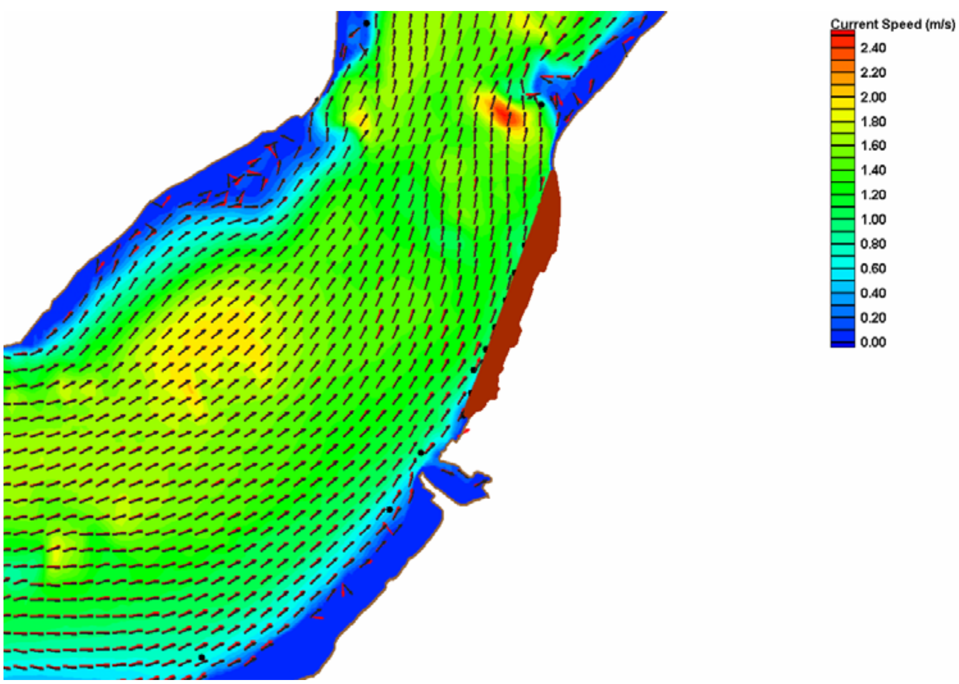
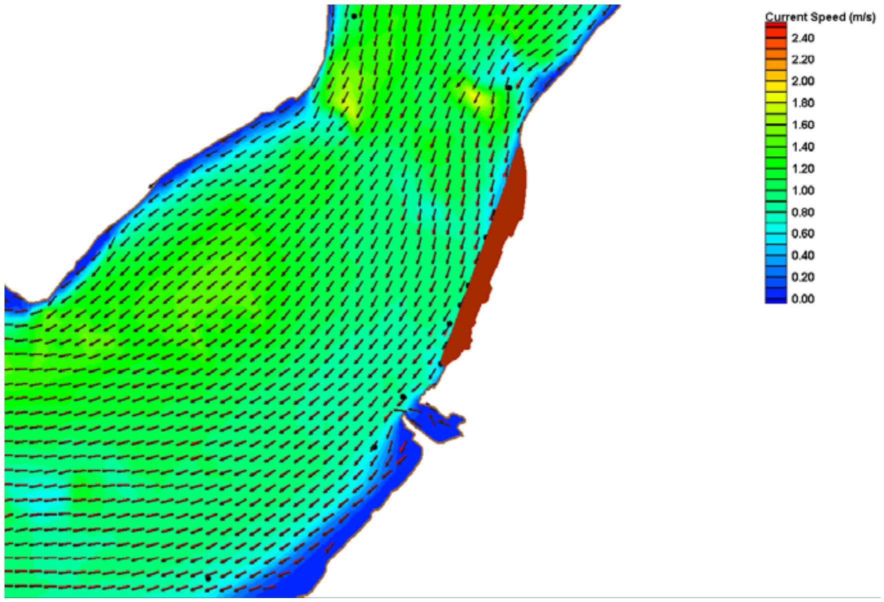


Fig. 14 a-b. Comparison of current direction between present condition and with completed expansion. Taken from Erbesole and Raad (2004).

a) Existing (black) and with Expansion (red) Circulation Pattern During Flood Tide



b) Existing (black) and with Expansion (red) Circulation Pattern During Starting Ebb Tide



These minor changes in current speed and direction are not expected to impact marine mammals other than being restricted from entering this area due to elimination of the habitat. However, this area is not identified as an area used for any vital life function such as calving, mating, or a prime foraging area. In contrast, the area around the Port has been identified as nursery, foraging, and migration habitat for certain marine mammal prey species. Therefore, the next two sections will focus on how changes to this habitat would affect availability of prey to marine mammals, specifically beluga whales as they are the primary predators of fish in this area.

4.2.2.1 Essential Fish Habitat

The elimination of 135 acres of intertidal and subtidal habitat due to Port expansion would result in habitat loss and changes in this portion of Knik Arm. A 7,900 foot long dock face would replace existing acres of shallow slow moving water with deeper faster moving water across a sheer sheet pile face; however, models show current speed would not increase significantly. While these sheltered areas of slower moving water where juvenile fish tend to be more abundant would be eliminated, habitats of similar characteristics exist along other areas of Knik Arm. The clearer water microhabitats in the intertidal area that allow for visual feeding also would be reduced but Houghton et al. (2005a,b) identified that these patches of clear water are random and also exists in the middle of the Arm. The concrete top deck of the extended dock would also shade these naturally turbid waters which could further limit visual feeding opportunities; however, as shown in observations during the fish studies conducted at the Port, other waters surrounding the Port provide clear, less turbid waters in which feeding can take place. This habitat alteration would likely negatively impact Chinook and coho salmon juveniles that now use the intertidal area by displacing the fish from a preferred habitat and eliminating a feeding area. However, the degree of the impact to fish populations is difficult to quantify.

The intertidal and nearshore subtidal waters of the Project area are used by juvenile and adult salmonids for refuge from stronger currents as the shallower benches on each side of Knik Arm experience lower current speeds than in the deeper main channel. Continued shoreline development and dredging in Knik Arm will have impacts on EFH. EFH will be permanently lost within the Project footprint; however, the Port is required, under their USACE permit, to establish a mitigation fund to carry out projects that would restore fish habitat in other parts of Knik Arm, including stream restoration. This condition in the USACE permit also includes the requirement to conduct a feasibility study to identify the most practicable and beneficial aquatic habitat restoration enhancement, creation, and preservation projects. Prior to the allocation of funds, mitigation projects will be prioritized in accordance to their overall ability to offset aquatic function losses of the Port expansion and their respective cost/benefit or cost/credit ratio. Areas of potential restoration include, but are not limited to, Chester Creek, Six Mile Creek, and the Lower Ship Creek watershed. Such restoration projects could include estuary enhancement and expansion, dam removal and or fish/passage modifications, conservation easements, and riparian buffering. All potential projects would be reviewed and considered by an advisory panel consisting of representatives from the Alaska Department of Natural Resources, U.S. Fish and Wildlife, Environmental Protection Agency, NMFS, USACE, Municipality of Anchorage, and the Department of the Air Force, 3 CES/CEVP. Use of this mitigation fund would benefit fish and other biota in areas that currently may be unsuitable for inhabitance, offsetting some loss of the area to be filled.

4.2.2.2 Habitat Around the Port

The project area is located approximately 2000 feet north of the mouth of Ship Creek and the proposed action would remove most of the remaining intertidal and shallow subtidal waters north of the mouth to Cairn Point. As stated, this habitat is used as a nursery and foraging habitat as well as a migration route for numerous fishes. The project would remove most of this intertidal and shallow subtidal waters north of the mouth of Ship Creek to Cairn Point. Modeling or quantifying a decrease in fish abundance, if any, in Knik Arm as a result of the Project is not feasible; however, if prey availability is substantially decreased, it could result in decreased foraging opportunities for marine mammals, specifically beluga whales, and result in increased energy expenditure to find prey. However, beluga whales primarily use the habitat around the Port as a migratory route with limited feeding observed. Moreover, belugas have been known to utilize man-made structures (e.g., pilings) to facilitate prey capture. For example, at the Port, beluga whales have been observed positioning one whale along a rip rap dock, while a second whale herds salmon along the structure toward the stationary beluga whale (Brad Smith, pers. comm.).

Along with direct habitat loss and hydrological changes, sounds emitted from pile driving would decrease habitat quality during operations and could affect fish and marine mammals. Sound will be discussed thoroughly in this chapter as it constitutes the method of harassment to beluga whales. Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water. Sound levels are compared to a reference sound pressure to identify the medium. For air and water, these reference pressures are "re 20 μPa" and "re 1 μPa", respectively (unless otherwise noted, sound levels should be considered as measured in water, i.e., re 1 μPa). Sound is generally characterized by several variables, including frequency and sound level. Frequency describes the sound's pitch and is measured in hertz (Hz) or kilohertz (kHz), while sound intensity (or how loud it is) is measured in decibels (dB). Sound level increases or decreases exponentially with each dB of change. For example, 10-dB yields a sound level 10 times more intense than 1 dB, while a 20 dB level equates to 100 times more intense, and a 30 dB level is 1,000 times more intense. However, it should be noted that humans perceive a 10 dB increase in sound level as only a doubling of sound loudness, and a 10 dB decrease in sound level as a halving of sound loudness. More information on sound can be found at www.dosits.org.

4.2.3 Biological Environment

The biological marine environment resources that will be impacted from the Project most relevant to NMFS' proposed action include fish and marine mammals, addressed in more detail in the following subsections. Plants, fish, and invertebrates may experience immediate localized abundance declines due to fill of habitat but populations would likely not sustain a significant long-term decline as other habitats in Knik Arm are suitable to maintain biota. During construction activities, introduction of sound from pile driving would likely adversely impact marine mammals and other marine life. However, these impacts are not expected to be significant. In terms of biological consequences, it is not only the source level that marine mammals and fish are exposed to that is important but is the received level of sound along with the context of the exposure, including the particular characteristics of a signal of interest, the specific environment in which the sound is produced, and the physical orientation of source and receiver. Also of importance may be factors such as the rise time of the signal, the number of exposures of an animal to a particular signal, the time between each exposure, and the physiological accumulation of effects (Popper et al., 2006).

4.2.3.1. Fish

The Port of Anchorage expansion project will adversely impact fish in Cook Inlet but likely not to the degree where prey availability to marine mammals would be significantly affected. NMFS AKR's review of historical documents related to studies in upper Cook Inlet (including Dames and Moore 1983 and Moulton 1996) and more recent studies (Houghton et al., 2005a, 200b) leads NMFS to conclude that a wide variety of fish species, including all five species of Pacific salmon, safion cod, and a variety of prey species such as eulachon and longfin smelt are present in the vicinity of the Port and use the habitat for migrating, rearing, and foraging. While there may be few definitive studies on the use of the nearshore shallow coastal areas in the upper Inlet, use type of habitat elsewhere by salmon and other species in Cook Inlet is well supported in literature (Groot and Margolis, 1991).

The Port of Anchorage expansion project would fill approximately 135 acres and eliminate approximately 9,000 linear feet of intertidal habitat. Filling waters where fish are present can kill, injure, and isolate fish in the discharge area. Numerous studies have shown that pile driving can kill and injure fish. For example, acoustic waves caused by pile driving could cause swim bladders of fish to expand and contract, in some cases disrupting their behavior or causing death (Hastings and Popper 2005). Such results of pile driving operations have occurred in California and Canada. The proposed port construction would require driving sheet pilings across to create the 9,893 -foot sheet pile wall. The pile driving would occur over an extended period of time, from 2008-2012, from April to October each year. Since fish are found in the project area during the entire year, it is likely they would be impacted for the entire yearly pile driving season. However, differences in seasonal fish abundance, as described in Chapter 3, would limit amount of impact to any one fish species.

Injured and isolated fish are subject to increased predation (e.g., from birds, beluga whales), disease, decreased feeding efficiency and or death from subsequent fills. The fill of intertidal and subtidal area around the current Port will eliminate nursery and refuge habitat used by juvenile fish and smolt and could force migrating adult salmon to move out of shallow, nearshore water into deep-water channels in Knik Arm to get around the proposed OCSP wall. This could expose the migrating adult fish to greater risk of predation by beluga.

Mitigation measures would minimize some of the adverse impacts to fish survival and recruitment thereby minimizing any reduction in prey availability to beluga whales and other marine mammals (USACE 2007b). The USACE has incorporated the following mitigation requirements into the construction permit: (1) no in-water fill placement or pile driving activities shall occur within a one week period following smolt release from the Ship Creek hatchery; (2) in-water sheet pile will be driven with a vibratory hammer to the maximum extent possible prior to using an impact hammer; (3) the final design plan shall, wherever possible, incorporate end-of-phase construction joints that provide potential refuge habitat areas for salmonids in the non-structural voids; (4) a Fish Rescue and Release Plan will be implemented to capture and release inadvertently trapped fish during construction; and (5) the refuge area shall be monitored for a minimum of 2 years following construction to determine the extent and nature of use of salmonids. In addition, the habitat compensatory mitigation fund and aquatic habitat restoration, enhancement, creation, and preservation projects as described previously would offset many fish/habitat related impacts.

As stated, otoliths for juvenile Chinook salmon sampled between Cairn Point and Point Woronzof showed that 80-85% of the fish were of hatchery origin (interpolated from Table 12 of Houghton et al., 2005a). This suggests that waters in this portion of upper Cook Inlet are very important to the hatchery produced Chinook salmon smolts from Ship Creek. The remaining 15-20% of the fish was not of hatchery origin suggesting that the area within the Project footprint also provides important habitat for wild Chinook, likely including fish from other Kink Arm tributaries. However, other habitats around the Port and portions of Knik Arm could be considered as having the same attributes which makes the area around the Port an ideal nursery ground (Houghton et al. 2005a, b) further indicating a significant decrease in marine mammal prey availability is not anticipated. In addition, the area around the Port is not considered a primary feeding area, such as upper Knik Arm and the Susitna Flats region, although beluga whales have been observed using structures such as docks to facilitate prey capture, reducing foraging energy expenditure. Furthermore, Ship Creek is stocked and would be continually replenished, minimizing impact to prey availability. Due to the natural ecology of the fish in Knik Arm (i.e., using habitats other than those to be filled), mitigation measures set in place by the USACE permit, and that Ship Creek is stocked yearly, abundance and survival rates of fish are expected to be high and therefore availability of those fish as beluga whale prey would not be significantly negatively impacted.

4.2.3.2. Marine Mammals

The Project would result in the loss of intertidal and subtidal habitat used by marine mammals and exposure to loud noise could result in behavioral and mild physiological changes in marine mammals. The increased level of in-water sound from the Project, specifically pile driving, is the primary concern to marine mammals. While dredging and fill compaction would also release sound into the environment, these activities are not expected to result in harassment of marine mammals. Dredging has been occurring at the Port for decades and marine mammals, specifically beluga whales, have become habituated to this activity as indicated by their observed interaction with such vessels and large ships (NMFS, unpubl. data). Fill compaction requires the use of a vibratory pile driver; however, absorption of sound by the fill and sheet pile wall would reduce sound levels below harassment level thresholds. Because Cook Inlet is an already noisy environment (ambient levels around 115 dB), and with proposed mitigation measures, NMFS believes harassment to marine mammals, including beluga whales, from pile driving will result in a negligible impact and will not result in a significant adverse impact to any affected marine mammal or stock.

This EA uses the best scientific literature available and expertise of NMFS biologists to analyze effects from issuance of a 1 year IHA and anticipated long-term effects from authorizing marine mammal harassment for the duration of Port construction. However, because pile driving hours will change in future years, this EA only specifies takes from year one of construction but anticipates effects from pile driving to be consistent, if not milder due to habituation, in future years. Monthly acoustic and beluga whale monitoring reports required under the 1-year IHA will confirm these assumptions before regulations are proposed or subsequent LOAs are issued. A supplemental EA will be prepared, if appropriate, incorporating the findings of these reports and any new scientific data for the rulemaking and future LOAs. The anticipated effects to marine mammals are discussed throughout the rest of this chapter.

Marine mammals use hearing and sound transmission to perform vital life functions. Introducing sound into their environment could be disrupting to those behaviors. Sound (hearing and vocalization/echolocation) serves 4 main functions for odontocetes (toothed whales and dolphins). These functions include (1) providing information about their environment; (2) communication; (3) enabling remote detection of prey; and (4) enabling detection of predators. Sounds and non-acoustic stimuli will be generated and emitted into the aquatic environment by vehicle traffic, vessel operations, roadbed construction, and vibratory and impact pile driving. The distances to which these sounds are audible depend on source levels, frequency, ambient noise levels, the propagation characteristics of the environment through which the sound is moving, and sensitivity of the receptor (Richardson et al., 1995). As stated, NMFS believes that exposure to pile driving sounds of the indicated received levels will likely result in the harassment of marine mammals. It is important to reiterate that impact pile driving and vibratory pile driving constitute different types of sound (i.e., pulse vs. continuous noise) and therefore are perceived by animals differently. Hence the harassment threshold levels for each type (i.e., 160 vs. 120db respectively). While the 120dB for vibratory extends farther than the 160 dB for impact pile driving, exposure to impact pile driving is believed to likely result in a more severe behavioral response due to intensity and sound type. Belugas are expected to engage in an avoidance reaction to noise levels that could result in injury. To further ensure injury would not occur, strict mitigation measures (see Mitigation measures) would preclude marine mammals from occurring in or near Level A harassment sound level zones.

Sounds generated from pile driving, dredging, and other construction activities will be detectable underwater and in air some distance away from the area of activity; however, pile driving is the only source that would raise exposure levels above the baseline (i.e., ship traffic and dredging already occurs in the area) and due to assumed habituation of beluga whales to sounds present already (discussed later in this chapter) is the only sound source believed to cause harassment. Impact pile driving requires much more energy (i.e., louder) than vibratory pile-driving due to the nature of the operations. However, low frequency sounds travel poorly in shallow water, so transmission of these sounds in Knik Arm is expected to be confined to relatively short ranges. A comparison of various construction and vessel sounds are outlined in Table 3 for reference.

Table 3: A comparison of anthropogenic noise sources from various construction activities and vessels.

Noise Source	***Frequency Range(Hz)***	***Noise Level***	***Source***
Small vessels	250-1,000	151 dB re 1 µPa at 1 m	Richardson et al. 1995
Tug docking gravel barge	200 – 1,000	149 dB re 1 µPa at 100 m	Blackwell and Greene 2002
Container ship	100 – 500	180 dB re 1 µPa at 1 m	Richardson et al. 1995
Drilling platform	80	119 dB re 1 µPa at 1.2 km	Blackwell and Greene 2002
Dredging	50 – 3,000	120 – 140 dB re 1 µPa at 500 m	URS Corporation
Impact pile driving of 36-inch piles	100 – 1,500	206 dB_{PEAK} re 1 µPa at 19 m	Blackwell 2005
Vibratory pile driving of 36-inch piles	400 – 2,500	165 dB_{RMS} re 1 µPa at 19 m	Blackwell 2005
Impact pile driving of 14-inch H-piles	100 – 1,500	94 dB_{PEAK} re 1 µPa at 19 m	URS Corporation 2007
Vibratory pile driving of 14-inch H-piles	400 – 2,500	168 dB_{RMS} re 1 µPa at 10 m	URS Corporation 2007

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). Type and significance of marine mammal behavioral and physiological reactions are likely to be dependent upon, among other parameters, the age, sex, or gender of the individual, the behavioral state (e.g., feeding, traveling, etc.) of the animal at the time it receives the stimulus, as well as the distance from the sound source, whether the source is moving toward or away, and the level of the sound relative to ambient conditions (Southall et al., 2007). Marine mammal hearing, physiological, and behavioral changes may occur from expose to pile driving noise.

4.2.3.2.1. Hearing Impairment and Other Physical Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very loud sounds, but no studies have been conducted that examine impacts to marine mammal from pile driving noise. Current NMFS practice regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB rms or above, respectively, have the potential to be injured (i.e., Level A harassment). NMFS considers the potential for behavioral harassment (Level B) to occur when marine mammals are exposed to sounds at or above 160 dB rms threshold for impulse sounds (e.g., impact pile driving) and 120 dB rms threshold for continuous noise (e.g., vibratory pile driving), but below injury thresholds.

Several aspects of the planned monitoring and mitigation measures for the Project are designed to detect marine mammals occurring near pile driving, and to avoid exposing them to sound that could potentially cause hearing impairment (e.g., mandatory shut-down zones). In addition, marine mammals will be given a chance to leave the area during “soft start” procedures to minimize exposure to full energy pile driving. As discussed in Chapter 1, NMFS has acknowledged that shut-down during the “stabbing” phase of sheet pile installation is not practicable. However, pile driving during this phase is vibratory in nature and works at reduced energy. NMFS does not expect marine mammals to be exposed to any injurious level sounds.

Temporary Threshold Shift (TTS)

TTS is the mildest form of hearing impairment that can occur during exposure to a loud sound (Kryter, 1985). Southall et al. (2007) considers a 6 dB TTS (i.e., baseline thresholds are elevated by 6 dB) sufficient to be recognized as an unequivocal deviation and thus a sufficient definition of TTS-onset. Auditory fatigue (i.e., TTS) in mid-frequency cetaceans has been measured after exposure to tones, impulsive sounds, and octave-band noise. The transitory nature of temporary threshold shift means that hearing completely recovers following the shift. The course and time of recovery generally depend on the amount of exposure to noise and the amount of shift incurred (Natchtigall et al., 2003). NMFS considers TTS non-injurious (Level B) harassment that is mediated by physiological effects (fatigue) on the auditory system; however, NMFS does not consider onset TTS to be the lowest level at which Level B Harassment may occur, as discussed in more detail in later subsections of this analysis.

While experiencing TTS, the hearing threshold rises and a sound must be louder in order to be heard. TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS-onset threshold, hearing sensitivity recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals. For toothed whales exposed to single short pulses, the TTS threshold appears to be, to a first approximation, a function of the energy content of the pulse (Finneran et al., 2002).

Laboratory experiments investigating TTS onset for beluga whales have been conducted for both pulse and non-pulse sounds. Finneran et al. (2000) exposed a trained captive beluga whale to a single pulse from an explosion simulator. No TTS threshold shifts were observed at the highest received exposure levels (179dB re 1 μPa^2-s SEL; approximately 199 dB rms). It should be noted in this study that amplitudes at frequencies below 1 kHz were not produced accurately to represent predictions for the explosions. Finneran et al. (2002) repeated the study using seismic waterguns with a single acoustic pulse. Masked hearing TTS was 7 and 6 dB in the beluga at 0.4 and 30 kHz, respectively, after exposure to intense single pulses (186 dB SEL; ~ 208 dB rms). Schludt et al. (2000) demonstrated temporary shifts in masked hearing thresholds for beluga whales occurring generally between 192 and 201 dB rms (192-201 dB SEL) after exposure to intense, non-pulse, 1-s tones at , 3, 10, and 20 kHz. TTS onset occurred at mean sound exposure level of 195 dB rms (195 dB SEL). To date, no studies relating

TTS onset to pile driving sounds have been conducted for any cetacean species. Marine mammals would not be exposed to sounds at or near those levels eliciting TTS in the Finneran et al. (2002) or Schludt et al. (2000) studies; however, NMFS does acknowledge that some TTS or other non-injurious hearing related impacts (e.g., masking) could occur.

During in-air auditory threshold testing, Kastak and Schusterman (1996) inadvertently exposed a harbor seal to broadband construction noise for 6 days, averaging 6 to 7 h of intermittent exposure per day. When tested immediately upon cessation of the noise, a temporary threshold shift (TTS) of 8 dB at 100 Hz was evident. Following one week of recovery, the subject's threshold was within 2 dB of its original level. Therefore, NMFS does not anticipate long-term impacts to harbor seal hearing when exposed to Project related noise.

Permanent Threshold Shift (PTS)

When permanent threshold shift (PTS) occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges. PTS consists of non-recoverable physical damage to the sound receptors in the ear and is therefore classified as Level A harassment under the MMPA. There is no empirical data for onset of PTS in any marine mammal, and therefore, PTS-onset must be estimated from TTS-onset measurements and from the rate of TTS growth with increasing exposure levels above the level eliciting TTS-onset. PTS is presumed to be likely if the threshold is reduced by ≥ 40 dB (i.e., 40 dB of TTS). Due to proposed mitigation measures and source levels, NMFS does not expect that marine mammals will be exposed to levels that could elicit PTS.

Non-Auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage. Due to proposed mitigation measures (e.g., mandatory shut-downs) marine mammals would not be exposed to sound at or above 180dB; therefore, it is not expected that severe physiological effects from exposure to sound (e.g., organ/tissue damage, resonance effects) would be expected; however, a hormonal stress response is possible. Repeated or long term stress responses could result in reduced energy budget, immunosuppression, or other changes in chemical physiology (extrapolated from Figure 1 in NMFS 2008). Romano et al. (2004) demonstrated that captive beluga whales exposed to high level impulsive sounds (i.e., seismic water gun and (or) single pure tones (up to 201 dB rms) resembling sonar pings showed increased stress hormone levels of norepinephrine, epinephrine, and dopamine when TTS was reached. Thomas et al. (1990) exposed beluga whales to playbacks of an SEDCO 708 oil drilling platform in operation (40 Hz-20 kHz; source level 153 dB). Ambient sound pressure level at ambient conditions in the pool before playbacks was 106 dB and 134-137 dB at the monitoring hydrophone across the pool during playbacks. All cell and platelet counts and 21 different blood chemicals, including epinephrine and norepinephrine, were within normal limits throughout baseline and playback periods and stress response hormone levels did not increase immediately after playbacks. The difference between the Romano et al. (2004) and Thomas et al. (1990) study could be the differences in the type of sound (oil drilling versus simulated underwater explosion), intensity and duration of the sound, the individual's response, and the surrounding circumstances of the individual's environment (Romano et al., 2004). The construction sound in the Thomas et al (1990) study would be more similar to those of pile driving than those in the study investigating stress response to water guns and pure tones. Therefore, NMFS expects no more than a short-term, low hormone stress responses, if any, of marine mammals as a result of exposure to pile driving sounds.

Studies have also demonstrated that behavioral reactions of animals to sounds could result in physical injury. For example, it has recently been reported that stranded deep diving marine mammals displayed physical attributes similar to the bends (e.g., in vivo gas bubble formation) (Ferndandez et al., 2005, 2006). It is hypothesized that marine mammals may experience these symptoms if surfacing rapidly from deep dives in response to loud sounds. Additionally, most strandings in which animals indicate the bends have been documented in response to mid-frequency active sonar, typically in the presence of multiple fast moving sound sources, steep bathymetry, and a narrow channel without egress escape routes. Knik Arm is a shallow water estuary and marine mammals found there are not considered deep divers, the sound source would be stationary, and source and received sound levels would not be as high as those related to Navy sonar. Again, mitigation measures will ensure that cetaceans and pinnipeds are not exposed to sounds louder than 180dB and 190 dB, respectively. Therefore, no non-auditory related physical impairments, other than a short-term stress response, are likely to occur.

4.2.3.2.2. Behavioral Effects

A central question about an animal's reaction to anthropogenic noise is whether its negative impacts are biologically meaningful. An example of a short-term reaction that is probably irrelevant to fitness is making a minor deviation in migration path to avoid a sound source (e.g., Malme et al., 1983). For example, as described in Gisiner (1998), a marine mammal avoidance response may appear by humans to be "bad" but may in fact be a coping strategy. An animal which initially exhibits a startle and fleeing response may then engage in a series of approach and avoidance behaviors. This investigation of sound and the resulting learning should demonstrate that animals adapt to a potentially negative stimulus. Marine mammals, particularly beluga whales, may demonstrate such startle or fleeing behaviors when exposed to pile driving sounds during Port construction. While this could be considered harassment under the MMPA, the long-term impact to the animal may very well be insignificant as the animal may learn about the stimulus through this interactive process. Studies investigating short term behavioral responses of marine mammals to anthropogenic sound are well documented; however, interpreting the biological significance of those reactions is much more difficult. There are few examples of this in literature. For example, Perry et al. (1998) conducted a long-term study investigating the reproductive behavior of grey seals exposed to sonic booms from Concorde overflights. At the time of the study, the

Concorde flew over the Sable Island grey seal breeding ground three times per day. No difference in reproductive behavior between control conditions and periods following sonic booms was evident.

The behavioral responses of marine mammals to sound is dependent upon a number of factors, including: 1) sound pressure levels, frequency, duration, etc.; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., does it sound like a predator) (Laist and Reynolds 2005). Anticipated behavioral reactions of marine mammals exposed to pile driving noise at or above NMFS harassment levels include altered headings, fast swimming, changes in dive, surfacing, respiration, and feeding patterns, and changes in vocalizations. Harbor seals around the Port may also flush into the water, disturbing resting and warming behaviors. However, behavioral responses to sound can not be determined from sound pressure levels alone as they are shown to be context specific (Southall et al., 2007). For example, for a given source level, fin and right whales are more likely to tolerate a stationary source (e.g., pile hammer) than one that is approaching them (Watkins, 1986). Humpback whales are more likely to respond at lower received levels to a stimulus than with a sudden onset than to one that is continuously present (Malme et al., 1985; Perry et al. 1998). NMFS believes that the fact the pile hammer is stationary and given the "soft start" mitigation measure that will be employed each time pile driving begins, startle reactions and therefore stress and behavioral reactions of marine mammals exposed to pile driving sounds will be minimized.

Marine mammal behavioral responses to anthropogenic sound are highly variable. Interpretation of what the behavioral response equates to on a biologically meaningful scale is not only relative to magnitude and apparent severity of the behavioral reaction to anthropogenic sound but also to the relevant acoustic, contextual, and ecological variables (Southall et al., 2007). For example, a sound resembling a predator call may induce a strong behavioral response at low RLs while an animal in a behavioral state that motivates them to stay in one area (e.g., feeding) may result in the animal tolerating a higher sound level. In any case, the behavioral response must be evaluated both in the short and long term to determine the effect the introduced sound has on the fitness and survival of an individual and population. Making it even more complex is that temporary behavioral effects are often simply evidence that an animal has heard a sound and may not indicate lasting consequence for exposed individuals (Southall et al., 2007). The following analysis will present the anticipated behavioral impacts of marine mammals, most comprehensively in relation to beluga whales, in response to project-specific construction sound, specifically pile driving, and how NMFS evaluates how those reactions relate to fitness and survival of exposed animals.

4.2.3.2.3. Beluga Whales

The marine mammal species or stock that could be most affected from the Project is the beluga whale. Observation and tagging data indicate that the northernmost parts of upper Cook Inlet, including Knik Arm, are the focus of the stock's distribution during times pile driving would occur (Rugh et al., 2000). The following section provides an analysis on the potential impacts to Cook Inlet beluga whales, both in the long and short term, from the Project and identifies how mitigation measures will minimize these impacts.

Hearing and Threshold Shifts

Beluga whales are characterized as mid-frequency odontocetes but have an excellent range of hearing. While their peak sensitivity range is outside of most industrial sounds, studies have shown that they can hear such low frequency noise, dependent upon intensity (i.e., decibels). Awbrey et al. (1988) conducted a hearing study on captive, trained beluga whales to discern low frequency threshold levels of this species (Table 4). This study investigated frequencies comparable to frequencies of pile driving/construction sounds (e.g., 100Hz-2,500 Hz). Average behavioral auditory thresholds obtained at 125 Hz, 250 Hz, and 500 Hz and 1-2 kHz were 121, 118, 108, and 101 dB, respectively. Therefore, as frequency decreased, so did sensitivity (i.e., the sound had to be louder for the beluga to be able to hear it). This study augments that of White et al., 1978 and Johnson et al., 1989 (Table 5). These studies only indicate that animals must be exposed to these sound pressure levels at a given frequency in order to hear them. They do not indicate any measure of "annoyance".

Table 4. Beluga hearing threshold data in decibels; reference pressure=1/tPa; N= number of ascending series used for determining thresholds and the total number of "catch" series; Fa= number of false alarms. From Awbrey et al., 1998).

	Frequency							
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Catch
Adult male								
Mean	124	126	108	102	99	78	66	
Range	121–127	125–127	104–112	97–111	97–99	76–80	65–67	
N	2	2	18	20	7	8	3	28
FA								4
Adult female								
Mean	122	122	109	102	103	76	65	
Range	121–123	121–123	94–116	97–107	101–111	76–78	63–67	
N	7	3	14	7	6	5	5	25
FA								2
Juvenile male								
Mean	118	114	106	100	101	77	65	
Range	115–121	111–121	100–114	97–107	99–103	76–78	63–67	
N	7	9	13	18	11	5	7	30
FA								3
Combined								
Mean	121	118	108	101	101	77	65	
Range	115–127	111–127	94–116	97–111	97–111	76–80	63–67	
N	16	15	41	46	26	17	15	83
FA								9

Table 5. Absolute beluga whale tonal thresholds for frequencies from 40 to 4,000 Hz in dB re: 1/µPa. From Johnson et al., 1989.

Frequency (Hz)	Threshold (dB *re*: 1 µPa)
40	140 ± 3
50	139 ± 3
60	131 ± 4
80	133 ± 5
100	127 ± 4
300	108 ± 4
400	107 ± 4
500	105 ± 4
600	100 ± 4
800	103 ± 4
1000	102 ± 4
1500	96 ± 3
2000	95 ± 3
3000	83 ± 6
4000	81 ± 3

Results of some TTS experiments are described earlier in this chapter. Some of these TTS experiments have documented behavioral responses by trained beluga whales to hearing experiments. Responses included reluctance to return to experimental stations when exposed to watergun pulse sounds at approximately 185.3 dB rms (171dB SEL) (Finneran et al., 2002) and behavioral changes when exposed to sounds from the explosion simulator at approximately 200 dB rms (177 dB SEL) (Finneran et al., 2000). In a non-pulse exposure experiment (i.e., 1 sec tones), beluga whales displayed altered behavior when exposed to 180–196 dB rms (180-196 dB SEL) (Schlundt et al., 2000).

Behavioral Reactions

There are no consistent observed threshold levels at which beluga whales, and marine mammals in general, respond to an introduced sound. Marine mammal responses to sound stimuli have been noted to be highly dependent upon behavioral state and motivation to remain in or leave an area. Few field studies investigating behavioral response to industrial sounds have been conducted on beluga whales. These studies differ from those in the laboratory as lab based studies are usually examining hearing threshold shifts, not behavior, in a controlled environment. Reactions of beluga whales in those studies varied. For example, Awbrey and Stewart (1983) played back recordings of SEDCO 708 drilling platform noise (non-pulse) underwater at a source level of 163 dB rms. Beluga whales less than 1.5 km 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 from the noise source when playback started continued to approach (RLs approximately 109.8 dB rms). One group approached within 300 m (RLs approximately 125.8 dB rms) before all or part turned back. The other group submerged and passed within 15m of the projector (RL approximately 145.3 dB). Richardson et al. (1990) also played back drilling platform sounds (300Hz; SL: 163 dB) in the proximity of beluga whales. Broadband (20-1000Hz) RLs averaged 118dB at 200m and 112 at 400m. Most whales passed by the projector at distances ranging from 1km to 175-225m and one group (which included two mother/yearling pairs) came within 50-75m of the projector. In general, whales that migrated past the project did so without reaction until they came within a few hundred meters, although some whales did not react despite being within this distance. Interestingly, the mother/yearling pairs actually "milled" (i.e., remaining in one spot but changing orientation and circling) with one pair approximately 50-75m from the operating projector. A subset of one group of whales slowed down, milled, and in some cases reversed course temporarily when within 200-400m of the projector displaying the only instance of moderate behavioral reaction. Richardson et. al. (1991) repeated the study and found that of 16 whales in 5 groups exposed to playback sounds, only 2 reacted by increasing speed (but still approaching) and diving at approximately 40m from the projector (broadband RLs 134dB). Other whales approached the projector within 15m with no reaction. It should be noted that ambient broadband (20-1000Hz) sound levels in this environment was 85 dB and 91 dB for 1990 and 1991, respectively, lower than those of Knik Arm. As stated earlier, background noise levels in Knik Arm around the Port average 115-133dB; therefore, beluga whales while in Knik Arm are likely less sensitive to introduced sound than those in the aforementioned studies. In other studies, beluga whales exposed to seismic airguns (multiple pulse) at RLs of 100 to 120 dB rms were determined to have had no observable reaction; however, RLs between 120 and 150 dB rms were determined to have induced temporary avoidance behavior, based on vessel-based and aerial observations (Miller et al., 2005). The Thomas et al. (1999) study, as described in the physiological effects section of this chapter, found that while there was an initial flight response by some beluga whales when the SEDCO 708 drilling playbacks started, the whales quickly accommodated and showed no change in swim patterns, respiration times, or social groups.

While no studies have been conducted examining beluga response to pile driving, bottlenose dolphin and humpback dolphin (*Sousa chinensis*) behavior has been observed in relation to this activity. These species are also considered mid frequency odontocetes and have hearing capabilities similar to that of beluga whales. McIwen (2006) observed a temporary displacement of bottlenose dolphins during pile driving activities, although it could not be determined if this was a result of the pile driving noise itself or displacement of prey. Mhenni (1993) reported bottlenose dolphins appeared to be repelled by noise pulses obtained by striking an iron pipe held in the water. Wursig et al. (2000) reported Indo-Pacific humpback dolphins increased speeds of travel during pile driving and were found in lower abundance immediately after pile driving; however, no overt changes in behavior were observed. Based on all these studies, harassment to beluga whales from pile driving sounds is not expected to result in significant adverse impacts.

Masking

Masking occurs when the background noise is elevated to a level which reduces an animal's ability to detect relevant sounds. Marine mammals use sound for a vital life functions such as foraging, communicating, socializing, and predator alertness.

Interfering with any of these behaviors to a great extent could potentially result in decreased fitness or survival of an individual or, for small populations such as Cook Inlet beluga whales, the stock. Masking can also lead to impaired navigation, spatial disorientation, or a compensation for signal masking which could result in altered time budget or increased energy expenditure (extrapolated from Figure 1 in NMFS 2008).

The impacts of masking are expected to be limited by the whales' directional hearing, current habitat characteristics, and their ability to adjust vocalization amplitude, frequency, and the structured content of their signals (McIwem, 2006); however some degree of masking is likely. Beluga whales are amongst the loudest animals in the sea and have been known to, like other marine mammals, shift their vocalizations to compensate for detection loss. Beluga whales can compensate for high amplitude noise by making their own signals louder, raising the frequency to make them more directional, and reorienting themselves to take advantage of directional hearing (Thomas et al., 1990). Therefore, it is likely that masking compensation would occur and navigation, traveling, or any opportunistic feeding opportunities would not be significantly impaired. Compensation is facilitated by altering 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). For example, when a beluga whale was moved to a location with raised levels of background noise in a specific frequency band, the beluga changed the frequencies of its echolocation signals to avoid the noise (Au et al. 1985). Another adaptive method to combat masking was demonstrated in a beluga whale which reflected its sonar signal off the water surface to ensonify to an object on which it was trained to echolocate (Au et al. 1987). Due to the low frequencies of construction noise, the already high level of background noise in Knik Arm from strong currents, tides, and vessel traffic, and the ability of beluga whales to adapt to increased background noise, it is anticipated that masking, and therefore interruption of foraging, communication, and other vital life functions will be minimized.

Habituation and Sensitization

Many marine mammals, including beluga whales, perform vital functions (e.g., feeding, resting, traveling, socializing) on a diel (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, de-sensitized, and tolerant after initial exposure to these sounds, as demonstrated by beluga vessel tolerance (Richardson et al., 1995, Blackwell and Green, 2002). Habituation and sensitizing is found to be common in marine mammals faced with introduced sounds into their environment. For example, bowhead whales (*Balaena mysticetus*) have continued to use pathways where drilling ships are working (RLs: 131 dB) so that they can continue their eastward migration (Richardson et al., 1991). Harbor porpoises, dolphins, and seals have become habituated and sensitized to acoustic harassment deterrent devices such as pingers and "seal bombs" after repeated exposure (Mate and Harvey, 1987; Cox et al., 2001). After repeated exposure, many acoustic harassment devices are not longer effective due to habituation.

Although the Port is a highly industrialized area supporting a large amount of ship traffic, beluga whales are present almost year round. The Port began operations in 1961 and has since expanded to a five-berth terminal providing facilities for the movement of containerized freight, iron and steel products, bulk petroleum and cement. In 2005, more than 5 million tons of various commodities moved across the Port's docks. Yet, despite increased shipping traffic and upkeep operations (e.g., dredging), beluga whales continue to utilize waters within and surrounding the Port, interacting with tugs and cargo freight ships (Hooker et al. 2002); Markowitz and McGuire 2007, NMFS unpubl. data). During the monitoring studies conducted by LGL and Alaska Pacific University from 2005-2007, animals were consistently found in higher densities in the nearshore area (1x6km) around the Port throughout April to October each year where vessel presence was highest. These studies indicate that beluga whales have become desensitized and habituated to present level human cause disturbance. Therefore, NMFS anticipates that beluga whales will become increasingly habituated to the pile driving noise as they have to ship traffic, thereby minimizing harassment as construction continues over the years. Cook Inlet beluga whales have demonstrated a tolerance to ship traffic around the Port. Animals would be exposed to greater than current background noise levels from pile driving; however, background sound levels in Knik Arm are already higher than most other marine and estuarine systems due to strong currents, eddies, recreational vessel traffic, and commercial shipping traffic entering and leaving the Port. During the 2007 acoustic study at the Port, ambient sound levels (in absence of any vessels) were recorded between 105 and 120dB. Measurement near a tug pushing a barge raised those levels to approximately 135dB when the vessel was 200m from the hydrophone. Based on the already elevated background noise around the Port, low sound frequency, and a beluga's ability to compensate for masking, it can be reasonably expected that beluga whales would become habituated to the daily pile driving, as they have for vessel traffic. It is expected that frequency and intensity of behavioral reactions, if present, will decrease when habituation occurs.

Lack of behavioral reaction indicating habituation does not necessarily mean that the animals are not being harassed or injured. For example, in Newfoundland, seafloor blasting occurred in an area utilized by foraging humpback whales (*Megaptera novaeangliae*), yet the whales did not show any behavioral reaction to the blasting in terms of movement or residency times. Despite a lack of behavioral reaction, two humpbacks entangled in fishing gear were found in that area to have had experienced significant blast trauma to the temporal bones, although the seafloor blasting could not be determined to be causal (Ketten et al., 1993). However, NMFS must consider this concept in terms of the Port related activities. Pile driving activities do not release the same type of, or as much energy as, seafloor blasting and, due to proposed mitigation measures, marine mammals will not be exposed to such intense sounds at the Port. Therefore, injury or other physical effects will not likely occur. In addition, dredging has been occurring for decades in the action area and belugas continue to use the area without signs of distress or harassment. Therefore, while NMFS acknowledges that lack of behavioral reaction does not necessarily mean the animals are not being "annoyed" or harassed, it can be reasonably considered that dredging by the Port for the Project (as described in bullet 1 under Dredging in Section 1) would not result in harassment to beluga whales.

Age Class Disparities

As stated previously in this chapter, reactions of marine mammals to anthropogenic noise can be contextual in nature based on a number of variables including behavior of animals at time of exposure. In addition, age class and reproductive status has been identified as a factor influencing impacts to marine mammals. For example, beluga calves depend on their mother's milk as their sole source of nutrition and lactation lasts up to 23 months (Braham 1984) though young whales begin to consume prey as early as 12 months of age (Burns and Seaman 1986). Therefore, it is believed the summer feeding period, when high quality prey are consumed in greatest quantities, is critical to pregnant and lactating beluga whales (NMFS 2008). In addition, marine mammal calves are believed to be more susceptible to anthropogenic stressors (e.g., noise) than adults. McIwem (2006) suggested that pile driving operations should be avoided when bottlenose dolphins are calving as lactating females and young claves are likely to be particularly vulnerable to such sound. Frankel and Clark (1998) investigated the relative importance of natural factors such as demographic composition of humpback whale pods in response to low frequency (75Hz with a 30Hz bandwidth) M-sequenced source signal transmitted from a 4-element hydrophone array (elements were placed at depths of 10, 20, 40, and 80m). They determined that two natural variables, the number of adults in a pod and the presence of a calf, had the greatest effect upon whale behavior in response to playbacks. Pods with calves had higher blow rates, longer times at the surface, and a higher ratio of time at the surface to time submerged. The presence of a calf; however, did not affect whale speed, whale bearings, or relative orientation to the playback vessel. While no data on the vocal responses of beluga whales mother/calf pairs in response to anthropogenic sound is available, Van Parijs and Corkeron (2001) determined that Indo-Pacific humpback dolphin mother/calf pairs increased vocal behaviors when vessel passed with 1.5 m more than groups without calves. The authors concluded that mother/calf pairs appear to be more disturbed than animals of other social/age classes and that mother/calf pairs exhibit an increased need to establish vocal contact after such disturbance.

Distinct mating periods, calving dates, and calving areas for the Cook Inlet beluga population are not well documented; however, calves are present during the summer months (Huntington 2000, Hobbs et al. 2005). As stated in Chapter 3, the habitat around the Port is not identified as a calving or nursery ground; however, calves are known to be present. In 2005, monitoring at the Port reported groups with calves made up 6%, 12%, 8%,and 15% of all sightings from August to November, respectively (Ramos et al., 2006). Of the 26 groups observed in 2006 between April and November, 5 groups contained calves and these were sighted in August and September only (Markowitz and McGuire, 2007). Mean group size was significantly larger (Mann-Whitney, $U = 2.0$, $P = 0.004$) when calves were present (mean = 8, sd = 2.0) than when calves were not present (mean = 3 whales, sd = 1.6). All five groups with calves (nursery groups) were observed to enter the Marine Terminal Redevelopment Footprint, and all five were sighted at either low ebb or low slack tide. In October and November of 2007, 2 out of 20 groups sighted contained calves (Cornick and Kendall 2008). Again, groups with calves were larger than groups without calves and both groups were sighted during low tide. However, in contrast to the 2006 sightings, neither group with calves entered the Project footprint.

4.2.3.2.4. Harbor Seals, Harbor Porpoises, Killer Whales

Harbor seals, harbor porpoises, and killer whales could also potentially be impacted from the Project. All three species may be harassed in-water by construction noise if they are in the area of the Port and hauled-out harbor seals may flush into the water from in-air noise, disturbing their resting and warming behaviors. Behavioral reactions by these species are expected to be similar to beluga whales (e.g., change in direction and vocalizations, etc.). For example, despite the fact that most construction noise will emit low frequency sounds outside of harbor porpoise peak sensitivity rage, these animals have elicited behavioral responses to simulated wind turbine noise, also outside peak sensitivity range (max. Energy between 30-800 Hz; spectral density source levels of 128dB at 80 and 160Hz) (Koschinski et al., 2003). During this study, harbor porpoise were sighted at greater ranges during playbacks of simulated wind turbine noise and observed animals echolocated more frequently.

It is likely that marine mammals will be temporarily displaced or disturbed by construction activities during the terminal expansion project. As discussed previously with reference to beluga whales, there is also the potential for non-auditory effects to marine mammals exposed to anthropogenically produced sound. It could be reasonably expected that, similar to beluga whales, other marine mammals may experience increased stress levels as a result of pile driving activities. Harbor seals, harbor porpoise, and killer whales are not normally present in this area and are therefore unlikely to have become as habituated as beluga whales to Port and concentrated recreational traffic generated noise. However, any temporary displacement from this area would not be significant due to the low use habitat function and the large population sizes of these species. Takes would be by Level B harassment (behavioral disturbance) as defined in the 1994 amendments to the MMPA. No take by serious injury or death is likely, given the expected reaction of marine mammals to noise and the planned monitoring and mitigation procedures described in the application and summarized in this document.

4.2.3.2.5. Summary of Anticipated Effects

NMFS believes responses of marine mammals, including beluga whales, to pile driving activities would be behavioral in nature and could likely include altered headings, fast swimming, changes in dive, surfacing, respiration, and feeding patterns, and changes in vocalizations. Due to mitigation measures, no animals would be exposed to sound levels that would result in physical damage such as tissue damage or PTS. Masking will likely occur as animals are present and vocalizing in areas where they can hear pile driving noise; however, due to the extreme adaptability of beluga whales to combat masking, masking in this species is expected to be m minimized and it is unlikely that this will result in any significant reduced energy or time budget.

NMFS does not anticipate that marine mammals, specifically beluga whales, would be permanently displaced or undergo any short or long term adverse biologically significant behaviors. Beluga whale sighting data indicates that the area around the Port is used primarily as a migratory pathway to and between primary feeding areas. Because sound from pile driving would not ensonify across Knik Arm, the whales can swim through or use the part of Knik Arm adjacent to the Port without being exposed to sound levels above those which NMFS believes will result in harassment. In addition, beluga whales are currently known to associate with vessels emitting loud low frequency sounds, including dredging vessels, around the Port and are therefore habituated and assumed to be less sensitive to such sounds. Beluga whales, and other marine mammals, may undergo a hormonal stress response when exposed to pile driving sounds; however, NMFS believes this stress response would be short term due to habituation and sensitization and not lead to any long-term effects or impacts of fitness. Furthermore, NMFS does not anticipate that more serious effects (e.g., neurological effects, organ/tissue damage) would occur. There is no evidence of injuries occurring in marine mammals exposed to sound from pile driving. Due to proposed mitigation measures, beluga whales, and any marine mammal present, would not be exposed to sound levels above 180 or 190dB (cetacean or pinniped, respectively) thereby eliminating the chance of inury (e.g., PTS).

4.2.3.2.6. Expected Take

NMFS is proposing to authorize harassment of 34 beluga whales, 20 harbor seals, 20 harbor porpoise, and 20 killer whales for one year of construction beginning in July 2008. Supplemental beluga take numbers for the rulemaking would be calculated upon gathering further information from the Port as pile driving hours will change as well as the percentage of impact and vibratory driving. Take numbers for other marine mammals are expected to remain the same throughout the life of the Project.

As stated, monitoring of beluga presence, behavior, and group composition specifically for the Project began in 2005 and continued through 2007. Theodolite tracking and grid cell mapping were used to determine and track beluga whales sighting locations. Beluga whales were sighted during all months the Project would be conducting in-water pile driving (April-October) but most frequently around low tide and the months of August and September, coinciding with salmon runs. Parameters specifically considered to estimate take numbers were sighting month, time of day related to tidal cycle, group size and composition, behavior, vessel presence, theodolite tracking, and presence/absence in Project footprint. Theodolite data was used to calculate density in the nearshore area (or 1x 6 mile distance within the Project footprint) vs. density of animals sighted from the observer station (i.e., total observable area). Tidal influence was also examined as described in Chapter 3.

During the 2005 monitoring year (August- November), 65% of all beluga whales groups were sighted (n=20) within the project footprint, despite the average 4-km detection range. A similar pattern (79%) was noted in the 2006 monitoring year (April to November). Beluga monitoring also occurred at Cairn Point in 2004 and the beginning of 2005 for the Knik Arm Bridge Toll Authority bridge project but grid cells were not provided; therefore, these data could only be considered when calculating a density of whales for the entire sighting distance (approximately 4-km). Upon comparing nearshore vs. total area, the monthly density of whales sighted from Cairn Pt. was greater when only considering a nearshore area (i.e., 1 x 6km^2) around the Port. Therefore, to be conservative, the applicant, in collaboration with NMFS, used the more conservative higher nearshore density to calculate take numbers.

Based on 2005-2007 LGL monitoring data, the Port, in consultation with NMFS, calculated that, without tidally influenced mitigation, up to 21 Level B harassment takes (i.e., behavioral harassment) of beluga whales may occur due to Port expansion for the first year of construction (July- October 2008; April- July 2009)(Table 6). To calculate take from exposure to noise, the whale density is multiplied by the affected area within the 160 dB or 120 dB isopleths, multiplied by the number of hours of in-water pile driving per month. The calculations were derived using the following method and more detailed information, along with tables, can be found on pgs. 6-9 to 6-13 of the application:

1) The total number of whales sighted each month for each year was determined using sighting data.

2) Number of whales per hour was then calculated to correct for observation effort. For example, in May of 2005, 7 whales were sighted over 60 hours of observations; therefore, the total number of whales per hour was 0.117.

3) To obtain a density (i.e., whale/hr/km^2) the number of whales per hour was then divided by the total area within average sighting range (35.75 km^2). For example, if 0.117 whales per hour were sighted over, then whale density equals 0.0032 whales/hr/km^2 (0.117/35.75).

4) This step was also repeated to calculate density for the nearshore area around the Port, or 1 x 6km^2. For the May 2005 example above, while 7 animals were sighted that month, only 2 were seen within the nearshore area which equals 0.03 whales/hr. To calculate density, the Port then divided this number by 6 to get a density of 0.006 whales/hr/km^2.

5) The total and nearshore whale density was then averaged for each month from all years. For example, the density of whales in September 2005 was 0.047 whales/hr/km^2 and in 2006 it was 0.04 whales/hr/km^2. Therefore the average density for the month of September is 0.043 whales/hr/km^2. As predicted, the nearshore density was greater for each month than the total area; therefore, this density was used to calculate takes.

6) Next, the area impacted by each type pile driving was calculated based on the identified harassment distances, keeping in mind that a complete circular area around the pile hammer would not be impacted as the area behind the hammer

(i.e., from the hammer to the shore) would not be considered as beluga whales do not approach from land. Therefore, using the equation for the circumference of a circle, area of impact for the 350m isopleth, or 0.35 km, is 0.192 km^2 (3.14 x 0.35 x 0.35/2). The area impacted from vibratory pile driving is 1.0048 km^2 (3.14 x .8 x .8/2).

7) Number of pile driving hours, by type, was related with nearshore density of whales and area impacted by each type pile driving. For example, in August 2008, the POA anticipates that 86 hours of impact pile driving will occur. The calculated whale density for that month is 0.062 whales/hr/km^2.Using the 350m isopleth distance for impact pile driving (0.192 km^2), the estimated take number for August is 1.013 whales (86 x 0.62 x 0.192). The total estimated takes for that month for the anticipated 58 hours of vibratory pile driving is 3.63 (or 58 x 0.0623 x 1.0048).

An average of 70% of beluga occurrences in the project footprint were within 2 hours of either side of low tide. Because impact pile driving would not occur at this time (see Mitigation Measures) takes from impact pile driving are actually estimated to be lower due to the proposed requirement to prohibit impact pile-drivers within 2 hours on either side of low tide. However, to allow for the social dynamics of beluga whales (e.g., large group sizes), NMFS is proposing to authorize 34 beluga whale takes per year. For example, from sightings at the Port between August and September 2007, the average group size was 10 animals. Proposed take numbers are considered small (9%) when compared to the current population estimate of 375 individuals.

Table 6: Calculated expected take based on nearshore density of beluga whales from pile driving activities at the Port of Anchorage in 2008.

Port of Anchorage Take Table- 2008								
Month	**Impact Hours**	**Vibratory Hours**	**Avg. Whales/hr/km^2 nearshore***	**Area within 160dB Impact (350m)**	**Expected Take (impact)**	**Area within 120dB Vibratory (800m)**	**Expected Take (vibratory)**
April	86	58	0.014	0.192	0.230	1.0048	0.809
May	60	39	0.006	0.192	0.064	1.0048	0.218
June	60	39	0.011	0.192	0.125	1.0048	0.423
July	86	58	0.004	0.192	0.066	1.0048	0.231
August	86	58	0.062	0.192	1.031	1.0048	3.633
September	86	58	0.043	0.192	0.718	1.0048	2.529
October	86	58	0.020	0.192	0.335	1.0048	1.179
Total*	550	368			8		13

*The total number of authorized take is calculated by rounding up each take per month (e.g., a take of 0.230 animals in April is equal to 1 take).

Based on low sighting rates of other marine mammals around the Port, the number of other marine mammals that could be harassed from Project activities can not be derived mathematically. Instead NMFS has estimated take and is proposing to authorize a small number, relevant to the population size, of takes for harbor seals (20), harbor porpoise (20), and killer whales (20).

4.3 ADAPTIVE MANAGEMENT STRATEGY

Animal behavior in response to an anthropogenic act has been typically used to characterize "harassment" to marine mammals. In this case, NMFS has determined that harassment may occur when an individual is exposed at or above a certain sound level (i.e., 160 dB for impact pile driving and 120dB for vibratory impact driving). If reactions of animals are more severe or are showing long-term negative consequences (e.g., permanent abandonment of the area) than what has been anticipated based on the best available scientific literature and NMFS marine mammal experts (e.g., avoidance, temporary displacement, increased dive times, changes in direction or vocalization, etc.) or animals are exhibiting behavioral reactions outside of the harassment zones that are directly linked to pile driving operations, NMFS will further investigate exposure zones, refine mitigation measures, if applicable, and re-investigate its harassment authorization as provided for in 50 CFR 216.106 (e)(2).

According to 50 CFR 216.107(f), an IHA shall be modified, withdrawn, or suspended if, after notice and opportunity for public comment, the Assistant Administrator for Fisheries, NMFS (AA) determines that: (1) the conditions and requirements prescribed in the authorization are not being substantially complied with; or (2) the authorized taking, either individually or in combination with other authorizations, is having, or may have, more than a negligible impact of the species or stock, or, where relevant, an unmitigable adverse impact on the availability of the species or stock for subsistence uses. If the AA determines than an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals concerned, the requirement for notice and opportunity for public review shall not apply.

4.4 SUMMARY OF COMPLIANCE WITH LAWS, NECESSARY FEDERAL PERMITS,LICENSES, AND ENTITLEMENTS

4.4.1 Marine Mammal Protection Act

On February 20, 2008, NMFS received a complete application from the Port of Anchorage and MARAD regarding a request for a MMPA incidental take authorization. This application came after numerous revisions and discussions with the Port. The complete application identified all elements required under 50 CFR 216.104. As such, NMFS is proposing to issue the requested one-year IHA for the first year of in-water pile driving with intent to promulgate a rulemaking in 2009 for the remainder of the expansion project. All data collected from monitoring reports, acoustic reports, and opportunistic data will be analyzed in considering regulations.

4.4.2 Endangered Species Act

A Section 7 consultation under the ESA is not required for the proposed action as no endangered or threatened marine mammals or other listed species occur within the Project area; therefore, none will be affected by the proposed action. However, NMFS has proposed to list the Cook Inlet beluga whale stock as an endangered under the MMPA. The ESA provides some protection for species which are proposed to be listed as threatened or endangered. Section 7(a)(4) requires an action agency to "conference" with NMFS when its action is likely to jeopardize the continued existence of a species proposed for listing. NMFS ARK provided numerous comments and suggested mitigation measures to the USACE regarding issuance of permit POA-2003-502-N which allows the Port to undertake Project activities. The USACE incorporated these measures into their permit. As such, the NMFS AKR concurred with the USACE decision, as described in their EA, that the Project is not likely to jeopardize the continued existence of beluga whales; therefore, a conference opinion was not necessary. Because the impacts associated with the MMPA IHA are part of those already considered by the USACE and AKR, and this IHA imposes additional mitigation, NMFS OPR has determined that issuance of this IHA, which authorizes harassment to marine mammals, would not jeopardize the continued existence of the Cook Inlet beluga whale stock; therefore, a conference is not necessary.

NMFS notes that the determination on listing the Cook Inlet beluga whale is scheduled to be made by October 20, 2008 (73 FR 21578, April 22, 2008). If listed, consultation may be required for this action and issuance

4.4.3 Other Permits

The USACE issued Permit no. POA-2003-502-N to the Port on August 10, 2008. This permit authorizes work necessary for the construction of the Project to expand, reorganize, and improve existing facilities at the Port of Anchorage to replace functionally obsolete structures; increase Port capacity, efficiency, and security; and accommodate the needs of the U.S. military for rapid deployment.

On June 21, 2006, the Port received a Section 401 water quality certification from the Alaska Department of Environmental Conservation.

The State of Alaska Department of Natural Resources issued a letter of concurrence on July 7, 2006 certifying that the Project was “consistent with the Alaska Coastal Zone Management Program and affected coastal district’s enforceable policies.” This consistency response is only for the project, as described. Any changes to the approved plan, prior to or during sitting or construction may warrant a further review.

4.5 MITIGATION MEASURES

As required under the MMPA, NMFS considered mitigation to effect the least practicable adverse impact on marine mammals and has developed a series of mitigation measures, as well as monitoring and reporting procedures that would be required as part of its incidental harassment authorization.

The following measures are designed to eliminate potential for injury and minimize harassment to marine mammals, particularly beluga whales. Sound deterrent/minimization techniques such as bubble curtains were considered for mitigation; however, due to the strong current in Knik Arm (up to 11.2ft (3.4 m)/sec) these techniques would not be practicable. The Port has stated that they will work with pile driving contractors to learn of and implement new sound attenuation minimization techniques that would be applicable to the Knik Arm environment. If such technology becomes available and is implemented, NMFS may re-evaluate the potential impacts to marine mammals and adjust take numbers and mitigation accordingly, and consider these measures for future requests for incidental take authorizations. Should other mitigation measures be deemed necessary for future construction activities, these will be analyzed by NMFS and implemented after consultation and agreement with the Port. All pile driving related mitigation measures listed here apply only to in-water pile driving.

4.5.1 Shut-downs and Soft-starts

(1) Scheduling of construction activities during low use period of beluga whales around the Port

As discussed in Chapter 3, tides have been shown to be an important physical characteristic in determining beluga movement within Knik Arm. Most beluga whales are expected to be foraging well north of the Port during the flood and high tide. However, these northern areas are exposed during the ebb and low tide; therefore, animals move south toward Eagle Bay and sometimes as far south as the Knik Arm entrance to avoid being stranded by the lowering waters. Beluga whale sightings often varied significantly with tide height at and around the Port. Beluga whales were most often sighted during the period around low tide (Funk et al., 2005, Ramos et al., 2005, Markowitz and McGuire, 2007) and as the tide flooded, beluga whales typically moved into the upper reaches of the Arm (Funk et al., 2005). Opportunistic sighting data also support that highest beluga whale use near the Port is around low tide (NMFS, unpubl. data).

Due to this tidally influenced habitat use, impact pile driving, excluding work when the entire pile is out of the water due to shoreline elevation or tidal stage, shall not occur within two hours of either side of each low tide. (i.e., from two hours before low tide until two hours after low tide). For example, if low tide is at 1pm, impact pile driving will not occur from 11am to 3pm. Vibratory pile driving will be allowed to commence/continue during this time as impact pile driving is expected to result in more overt behavioral reactions due to sound type and intensity.

(2) Establishment of safety zones and shut-down requirements

NMFS acknowledges that shut-down of reduced energy vibratory pile driving during the “stabbing” phase, as described in Chapter 1, of sheet pile installation is not practicable. Therefore, the following shut-down requirements apply to all in-water pile driving except during that specific phase of the sheet pile installation process. “Stabbing” will occur with a vibratory pile driving hammer at reduced energy (i.e., lower sound source level).

a) Safety Zones

In October, 2007, the Port contracted an outside company to determine reliable estimates of distances for 190 (pinniped injury threshold), 180 (cetacean injury threshold), 160 (impact pile driving behavioral harassment threshold) and 120 dB (vibratory pile driving behavioral harassment threshold) isopleth from impact and vibratory pile driving. From this study, it has been determined that these isopleth distances are 10, 20, 350, and 800 m, respectively. All threshold isopleths will also be verified with future sound index profiling studies upon in-water pile driving operation seasonal commencement and be adjusted if necessary. Although the 190 and 180dB isopleths are within 20m for both types of pile driving, NMFS is establishing a conservative 200m mandatory shut-down safety zone which would require the Port to shut-down anytime a marine mammal enters this zone.

b) Shut-Down for Large Groups

To reduce the chance of the Port reaching or exceeding authorized take and to minimize harassment to beluga whales, if a group of more than five beluga whales is sighted within the Level B harassment isopleths, shut-down is required.

c) Shut-down for Calves

Marine mammal calves are likely more susceptible to loud anthropogenic noise than juveniles or adults; therefore, calves will not be authorized to be harassed. If a calf is sighted approaching a harassment zone, pile driving will cease and not be resumed until the calf is confirmed to be out of the harassment zone and on a path away from such zone. If a calf or the group with a calf is not re-sighted within 15 minutes, pile driving may resume.

d) Heavy machinery shut-downs

For other in-water heavy machinery operations other than pile driving, if a marine mammal comes within 50 m of the machinery, operations will cease and vessels will slow to a reduced speed while still maintaining control of the vessel and safe working conditions. Such operations would include Port controlled dredging (as described in Ch. 1.2.1.5(1)), water based dump-scows (barges capable of discharging material through the bottom), standard barges, tug boats to position and move barges, barge mounted hydraulic excavators or clamshell equipment used to place or remove material.

e) If maximum authorized take is reached or exceeded for the year, any beluga entering into the harassment isopleths will trigger mandatory shut-down.

(3) Soft start requirements for pile driving activities

A ''soft start'' technique will be used at the beginning of each pile installation to allow any marine mammal that may be in the immediate area to leave before pile driving reaches full energy. The soft start requires contractors to initiate noise from vibratory hammers for 15 seconds at reduced energy followed by 1-minute waiting period. The procedure will be repeated two additional times. If an impact hammer is used, contractors will be required to provide an initial set of three strikes from the impact hammer at 40 percent energy, followed by a one minute waiting period, then two subsequent 3–strike sets (NMFS, 2003). If any marine mammal is sighted within the safety zone (200m) prior to pile-driving, or during the soft start, the hammer operator (or other authorized individual) will delay pile-driving until the animal has moved outside the safety zone. Furthermore, if marine mammals are sighted within a Level B harassment zone prior to initiating pile driving, operations would be delayed until the animals move outside the zones in order to avoid take exceedence. Pile-driving would begin only after a qualified observer determines that the marine mammal has moved outside the safety or harassment zone, or after 15 minutes have elapsed since the last sighting of the marine mammal within the safety zone.

(4) Pile Driving Weather Delays

Adequate visibility is essential to beluga whale monitoring and determining take numbers. Pile driving will not occur when weather conditions restrict clear, visible detection of all waters within and surrounding the harassment zones. Such conditions that can impair sightability and require in-water pile driving delays include, but are not limited to, fog and a rough sea state.

5) *Notification of Commencement and Beluga Whale Sightings*

The Port of Anchorage shall formally notify the NMFS AKR and OPR prior to the seasonal commencement of pile driving and would provide weekly monitoring reports once pile driving begins. A summary monitoring report will be submitted at the end of annual construction activities and a final report will be submitted at the end of the one year post construction monitoring season.

The POA shall establish a long-term, formalized marine-mammal sighting and notification procedure for all Port users, visitors, tenants, or contractors prior to and after construction activities. The notification procedure shall clearly identify roles and responsibilities for reporting all marine mammal sightings. The POA will forward documentation of all reported marine mammal sightings to the NMFS.

6) *Public Outreach*

The POA will erect whale-notification signage in the waterfront viewing areas near the Ship Creek Public Boat Launch and within the secured Port entrance that is visible to all Port users. This signage will provide information on the beluga whale and notification procedures for reporting beluga whale sightings to the NMFS. The POA will consult with the NMFS to establish the signage criteria.

4.5.2 Monitoring

Marine mammal monitoring will be conducted at the Port during all times in-water pile driving is taking place and 30 minutes prior to pile driving commencement. All marine mammal sightings will be documented on NMFS approved marine mammal sighting sheets. If a marine mammal is located within a designated harassment zone while pile driving is taking place, it will be documented as "taken". The Port would also conduct acoustical monitoring, as decribed below. The Port would conduct a feasibility study on the use of hydrophones (or employ other effective methodologies) to detect and localize passing whales and to determine the proportion of beluga whales missed from visual surveys. These hydrophones will also allow the Port to measure and evaluate construction and operationally generated noise introduced in Knik Arm from the Project.

Marine Mammal Monitoring

Monitoring for marine mammals would take place concurrent with all pile driving activities and 30 minutes prior to daily pile driving commencement. One to two trained observers would be placed at the Port at the best advantage points practicable to monitor for marine mammals and will implement shut-down/delay procedures when applicable. These observers would be construction contractors but would have no other construction related tasks while conducting monitoring. Each observer would be properly trained in marine mammal species detection, identification and distance estimation, will be equipped with binoculars, and will be located at elevated platforms to increase sightability range. Rotating shifts would consist of 4 hours each so as not to create fatigue and eye strain. All marine mammals sighting data would be collected on NMFS approved sighting sheets and the following information, if able to be determined: group size, group composition (i.e., adult, juvenile, calf); behavior (this should include as detailed description as possible- see reporting requirements below), location at time of first sighting and last sighting; time of day first sighted, time last sighted; approach distance to pile driving hammer; and note if shut-down/delay occurred and for how long. If shut-down or delay is not implemented, an explanation of why will be provided (e.g., outside of harassment zone, entered harassment zone but shut-down restriction requirements not met (e.g., no beluga whale calves, small group, "stabbing" phase). In addition, the report would note what type of pile driving and other activities were occurring at and during time of each sighting and location of each observer. At time of each sighting, the pile hammer operator must be immediately notified that there are beluga whales in the area, their direction, and if shut-down is necessary. A monthly report, due to NMFS no later than the 5th of each month, would include all sighting sheets from the previous month.

Prior to the start of seasonal pile driving activities, the Port would require construction supervisors and crews, the marine mammal monitoring team, the acoustical monitoring team, and all project managers to attend a briefing on responsibilities of each party, defining chains of command, discussing communication procedures, providing overview of monitoring purposes, and reviewing operational procedures regarding beluga whales. During in-water construction activities, the Port shall ensure that construction contractors delegate supervisory responsibility to include on-site construction personnel to observe, record, and report marine mammal sightings and response actions taken, to include shut-down or delay.

In addition to the Port's trained marine mammal observers responsible for monitoring the harassment zones and calling for shut-down, an independent beluga whale monitoring team, consisting of one to two land based observers, shall report on (1) the frequency at which beluga whales are present in the project footprint; (2) habitat use, behavior, and group composition near the POA and correlate those data with construction activities; and (3) observed reactions of beluga whales in terms of behavior and movement during each sighting. It is likely that these observers would monitor for beluga whales 8 hours per day/ 4 days per week but scheduling may change. These observers would work in collaboration with the Port to immediately communicate any presence of beluga whales or other marine mammals in the area prior to or during pile driving. The Port would keep this monitoring team informed of all schedules for that day (e.g., beginning vibratory pile driving at 0900 for 2 hours) and any changes throughout the day.

Acoustic Monitoring

The Port would carry out an acoustic monitoring study upon commencement of seasonal in-water pile driving. This study would confirm or identify harassment isopleths for all types of piles used, including open-cell sheet piles and 36-inch steel piles, and sound propagation levels during the "stabbing" process as this phase operates at reduced energy. The acoustic study proposal shall be approved by NMFS prior to the start of seasonal in-water pile driving and must be submitted to NMFS 45 days from study completion date.

As mandated by the USACE permit, the Port shall measure and evaluate construction and operationally generated noise introduced in Knik Arm at the Port of Anchorage. The applicant shall develop a 'sound index' to accurately represent noise levels associated with Port of Anchorage operations and construction activities, which must specifically include noise levels generated from pile driving, dockside activities, vessel traffic in the channel, dredging, and docking activities. The evaluation shall characterize current baseline operational noise levels at the Port of Anchorage and develop an engineering report that identifies structural and/operational noise reduction measures, if necessary, to minimize the baseline operational noise levels at the expanded port to the maximum extent practicable. The final report would be provided to the NMFS two years prior to construction completion. While this requirement would not be in the IHA, it would likely be part of the regulations.

4.5.3 Reporting

For the 2008/2009 IHA term, the marine mammal sightings sheets prepared by Port observers would be submitted to NMFS OPR and AKR by the 5th of each month and include all sighting reports from the previous month. The final annual report, which would include acoustical data from the hydrophones, would be submitted to NMFS no later than 90 days after construction activities cease for the season. The required one-time acoustic sound study, to be conducted as soon as operations commence and involve sound measures of all types of piles expected to be used (i.e., sheet piles, H-piles, pipe piles) and sound levels during the "stabbing" phase would be due in 45 days from end of data collection. These plans would be approved or refined by NMFS prior to issuance of the IHA. While not part of the IHA, the independent beluga monitoring team would also submit a monthly or annual report to NMFS.

4.6 UNAVOIDABLE ADVERSE IMPACTS

Fill of 135 acres of marine mammal habitat is unavoidable due to the OCSP design plan. In addition, it is not possible to eliminate sound emission from pile driving. Technology such as the use of bubble curtains is not applicable in this construction setting due to strong currents. However, mitigation measures such as not impact pile driving two hours either side of low tide would reduce the amount of time animals are exposed to such sounds.

4.7 CUMULATIVE EFFECTS

To meet the requirements of NEPA, analysis of potential cumulative effects of a proposed action and its alternatives must be described and considered when evaluating environmental impacts. The CEQ guidelines for evaluating cumulative effects state that "…the most devastating environmental effects may result not from the direct effects of a particular action but from the combination of individually minor effects of multiple actions over time" (CEQ 1997).

The CEQ regulations for implementing NEPA define cumulative effects as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Cumulative impacts (or effects) can result from individually minor but collectively significant actions taking place over a period of time. The proposed Project would add an incremental contribution to the combined environmental impacts of other past, present, and reasonably foreseeable future actions (RFFAs); however, it would not raise those impacts to levels considered significant.

The Draft Cook Inlet Beluga Whale Subsistence Harvest SEIS (NMFS 2006) and the Knik Arm Crossing FEIS (KABATA 2006), describe general activities that have, are, and are expected to take place in Cook Inlet and could have adverse effects to socio-economic, physical, and biological environment, specifically beluga whales and their habitat. In summary, general categories of actions in the area which could result in cumulative effects to the aforementioned elements include subsistence hunting, oil/gas exploration, coastal development, vessel traffic, pollution, climate change, natural mortality, and scientific research. The Draft Beluga Whale Conservation Plan (NMFS 2005) comprehensively describes possible effects each of these factors may have on beluga whales and research priorities for better understanding the impacts of the various activities and actions, in addition to natural environmental components, on Cook Inlet beluga whales.

4.7.1 Past and Present Actions

Past actions in Cook Inlet and Alaska in general have produced lasting impacts and continue to shape the present-day environment, or baseline condition. These include:

• construction of the Alaska Railroad, 1913–1923
• founding of Anchorage, 1915
• founding of Wasilla, 1917
• completion of a deep-water dock near Ship Creek, 1919
• Palmer agricultural settlement, 1930s
• establishment of future Elmendorf Air Force Base and Fort Richardson, 1939
• World War II-related expansion, 1941–1945
• Eklutna hydroelectric power plant, 1956
• Alaska statehood, 1959
• development of Kenai Peninsula and upper Cook Inlet oil and natural gas, 1960s
• completion of the Kenai-Anchorage natural gas pipeline, 1961
• incorporation of the Greater Anchorage Area Borough, 1963
• incorporation of the Matanuska-Susitna Borough, 1964
• Good Friday earthquake, 1964
• discovery of oil at Prudhoe Bay, 1968
• establishment of Chugach State Park, 1970
• completion of Anchorage-Fairbanks (George Parks) Highway, 1971
• Alaska Native Claims Settlement Act (ANCSA), 1971

Recent past actions which no longer affect the physical or biological environment in Cook Inlet, but did so acoustically when being conducted, include three seismic oil/gas exploration surveys using airgun arrays. These surveys were conducted by Conoco Phillips near the Beluga River in upper Cook Inlet between April 14 and May 13, 2007 (72 FR 17118); Union Oil Company (Chevron) at Granite Point in upper Cook Inlet between September 29 and October 21, 2007 ((72 FR 56053); and Marathon Oil Company at North Nihilchik in lower Cook Inlet between October 25 and November 7, 2007 (72 FR 56053).

Conoco Phillips' annual report (August 2007) indicates the beluga whales (n=148-162 in 34 groups), harbor seals (n=128-131 in 38 groups), and harbor porpoise (n=14 in 11 groups) were observed in the project area during 184 hr of observation from the Peregrine Falcon, 425 hr from the Arctic Wolf, and 195 hrs from the land; 1,190 km of survey were flown along a trackline extending 7 miles north and south of the project area to alert the seismic vessel of approaching marine mammals and to collect data to complement that collected from the other survey platforms. A total of 9 groups of 35-39 beluga whales were observed during seismic activities compared to 25 groups of 113-123 whales during no seismic activities. All of the whales observed during seismic activities were beyond 5 km from the Peregrine Falcon, except for one single whale where data were not available to determine distance. The prominent behaviors of beluga whales during seismic activities were milling followed by traveling and traveling/milling; however, their behavior was likely little affected by seismic noise because of the long distance of the whales from the noise source. Traveling (> 66%) was by far the most common behavior observed during no seismic operations, with much lower occurrences of swimming, traveling/milling, and 26 other behaviors. Some feeding was also observed by whales swimming through the survey area.

A total of 9 groups of 76 harbor seals were observed during seismic activity compared to 29 groups of 52-55 seals during no seismic activity. Seals were recorded from 500 m to cover 10 km from the vessel during seismic activity; however the most distant animals (> 10 km) were hauled out on land. Harbor seal behavior was difficult to assess, since the number observed during seismic operations was small and most were beyond the range likely affected by noise from the airguns. During seismic activity slightly more seals were observed swimming and resting than other categories. Most (83%) seals observed during no seismic activity were swimming and/or looking. No seals were observed feeding at any time.

Similar to beluga whales and harbor seals, more harbor porpoises were observed during no seismic than seismic activity, and they were closer to the Peregrine Falcon during seismic. A total of 3 groups of 3 animals were observed during seismic activity compared to 8 groups of 11 animals during no seismic activity. All three groups of porpoises observed during seismic activity were over 1.5 km from the Peregrine Falcon, whereas three of the five groups observed during no seismic activity were closer (300-999 m) to the vessel, with the remaining animals further away (>1.5 km). Harbor porpoise behavior during seismic activity was based on too small a number to meaningfully compare with no seismic activity beyond stating the results. Behavior was equally split between travel and milling during seismic activity. During no seismic activity, half of the porpoises were observed traveling with sequentially fewer recorded milling and/or swimming. No feeding behavior was observed during the monitoring program.

Airgun arrays, such as the ones used during these surveys; emit pulsed sounds; therefore, NMFS determined that the 160 dB harassment threshold level was applicable. Isopleth distances were determined by source level and geographic information as there were for the POA. For the Conoco Phillip surveys, the harassment distances were 227m, 709m, and 3997m for the 190, 180, and 160dB levels, respectively A total of 17 beluga whales, 10 harbor seals, and 1 harbor porpoise were estimated to be taken from behavioral harassment only (i.e., 160 -180/190dB). No animals were seen within the safety zones; therefore, no mandatory shutdowns occurred.

The Union Oil Company of California's seismic surveys occurred later in the year than the Conoco Phillips Survey. Beluga whales (n= 35 in 3 groups), harbor seals (n=11 in 11 groups), and harbor porpoises (n=12 in 6 groups) were observed in the survey area during 233 hr of observation from the Peregrine Falcon and 260 hr from the Arctic Wolf; 110 km of survey were flown along a trackline located 0.25 mile off shore and paralleling the shoreline extending 4 miles east and west of the project area to alert the seismic vessel of approaching marine mammals. Beluga whales were seen infrequently (3 groups in 21 days). The two groups observed during no seismic activity were within 1 km of the Peregrine Falcon whereas the group observed during seismic activity was over 10 km from the Peregrine Falcon, well outside the 160dB behavioral harassment isopleth for this survey (4,025 m). The behavior of the one group of 17 whales observed during seismic operations was recorded as traveling whereas the two groups observed during no seismic operations were swimming and blowing. The group recorded during seismic activity was observed by the MMO from the helicopter for about a minute and the whales showed no change in behavior or direction of travel as would be expected at the long distance they were encountered from the seismic activity. The whales traveled closely together and generally parallel to the shoreline heading in a south to slightly southwest direction toward the lower inlet. Consequently, there was no indication the whales reacted to the seismic operations.

Two of the 11 groups of harbor seals were observed during seismic activity. Both groups were a considerable distance (4.7-5.2 km) from the Peregrine Falcon and beyond the 160 dB behavior disturbance zone when they were observed from the Arctic Wolf. Harbor seals recorded during no seismic activity were 50-400 m from the Peregrine Falcon. The behavior of harbor seals observed during seismic activity was traveling and looking, but their behavior would have been unaffected by seismic activity because of their distances from the Peregrine Falcon. This behavior compares to swimming, looking, and feeding, which were the primary behaviors recorded during no seismic activity. The results show the seals observed during seismic activity were beyond the influence of air gun noise, and the seals were engaged in a variety of behaviors likely unaffected by seismic activity.

A group of three harbor porpoises entered the 180 dB safety zone (716m) during seismic activity. The professional MMO did not see any unusual or erratic behavior by the porpoises as they moved through the safety radii. No beluga whales, harbor seals or other harbor porpoises were observed in the 160 dB behavioral disturbance zone used to enumerate take.

All seismic operations were completed in 2007 and NMFS has not, to date, received applications for IHAs for proposed future seismic surveys in Cook Inlet. However, it can be reasonably expected that seismic surveys would continue to occur in Cook Inlet at this rate. Each seismic operation must obtain an IHA or LOA from NMFS in order to lawfully incidentally take marine mammals under NMFS' management authority.

Pollution

The principal sources of pollution in the Cook Inlet marine environment are: 1) discharges from wastewater treatment systems; 2) discharges from industrial activities that do not enter wastewater treatment systems; 3) runoff from urban, mining, aviation, and agricultural areas; 4) accidental spills or discharges of petroleum and other products; and 5) three separate Superfund sites in Knik Arm. Natural and man-made pollutants entering Cook Inlet are diluted and dispersed by the currents associated with the tides, estuarine circulation, wind-driven waves, and currents (MMS, 1996).

Ten communities currently discharge treated wastes into Cook Inlet. The maximum permitted wastewater discharges for Anchorage are 44 million gallons per day, and the other communities have a range from 10 thousand to 1.6 million gallons per day. However, the impacts of discharge wastewater on the beluga whales are unknown. Given the relatively low levels of contaminants found in Cook Inlet beluga whale tissues, municipal discharge levels are not believed to be having a significant impact on the beluga whale population (NMFS, 2003).

The Port of Anchorage is a highly industrialized area and has been in operation for decades. Maintenance of the Port requires routine dredging. Despite dredging and other Port activities, analyses of Cook Inlet beluga tissue samples have found contaminant loads lower or equal to the other Alaska beluga whale populations (with the exception of copper levels, for which the toxicological implications are unknown) (Becker 2000). Based on these samples, there is no evidence that dredging and Port activities, as modified by the Project, would result in a higher contaminant risk.

Climate Change

The most recent analysis of climate change (IPCC, 2007) concluded that there is very strong evidence for global warming and associated weather changes and that humans have "very likely" contributed to the problems through burning fossil fuels and adding other "greenhouse gasses" to the atmosphere. This study involved numerous models to predict changes in temperature, sea level, ice pack dynamics, and other parameters under a variety of future conditions, including different scenarios for how human populations respond to the implications of the study.

Evidence of climate change in the past few decades, commonly referred to as global warming, has accumulated from a variety of geophysical, biological, oceanographic, and atmospheric sources. The scientific evidence indicates that average air, land, and sea temperatures increasing at an accelerating rate. Although climate changes have been documented over large areas of the world, the changes are not uniform and affect different areas in different ways and intensities. Arctic regions have experienced some of the largest changes, with major implications for the marine environment as well as for coastal communities. Recent assessments of climate change, conducted by international teams of scientists (Gitay et al., 2002 for the Intergovernmental Panel on Climate Change [IPCC]; Arctic Climate Impact Assessment

[ACIA], 2004; IPCC, 2007), have reached several conclusions of consequence for this SEA:

- Average arctic temperatures increased at almost twice the global average rate in the past 100 years.
- Satellite data since 1978 show that perennial arctic sea ice extent has shrunk by 2.7% per decade, with larger decreases in sea ice extent in summer of 7.4% per decade.
- Arctic sea ice thickness has declined by about 40% during the late summer and early autumn in the last three decades of the twentieth century.

Marine mammals are classified as sentinel species in that they are good indicators of environmental change. Arctic marine mammals are ideal indicator species for climate change, given their circumpolar distribution and close association with ice formation. NMFS recognizes that warming of the Arctic, which results in the diminishing of ice, could be a concern to marine mammals. In Cook Inlet, marine mammal distribution is dependent upon ice formation and prey availability, among other factors. For example, belugas often travel just along the ice pack and feed on prey beneath it (Richardson et al., 1990, 1991). Any loss of ice could result in prey distribution changes or loss. However, beluga whales do not use ice for resting, reproduction, or rearing of young like pinnipeds.

It is not clear how governments and individuals will respond or how much these future efforts will reduce greenhouse gas emissions. Although the intensity of climate changes will depend on how quickly and deeply humanity responds, the models predict that the climate changes observed in the past 30 years will continue at the same or increasing rates for at least 20 years. Although NMFS recognizes that climate change is a concern for the sustainability of the entire ecosystem in Alaska's North Slope region, it is unclear at this time the full extent to which climate change will affect marine mammal species.

The Port has acquired all necessary environmental air and water quality permits to carry out the Project. NMFS believes the effects, if any, of Port's activities on climate change are too remote and speculative at this time to conclude definitively that the Projects would contribute to climate change, and therefore a reduction in Arctic sea ice coverage.

Natural Mortality

Natural mortality of beluga whales will continue to occur despite anthropogenic intervention. Rates of strandings, disease, and predation by killer whales are unlikely to change if current conditions remain the same. Beluga stranding events in upper Cook Inlet are not uncommon. NMFS has reports of 804 stranded whales (some of which were involved in mass stranding events) in upper Cook Inlet since 1988 (Vos and Shelden 2005). Mass stranding events occurred most frequently along Turnagain Arm, and often coincided with extreme tidal fluctuations ("spring tides") and/or killer whale sighting reports (Shelden et al. 2003). Other mass strandings have been reported in the Susitna

Delta (Vos and Shelden 2005) and in Knik Arm (B. Mahoney, NMFS Alaska Region Office, unpublished data). These mass stranding events involve both adult and juvenile beluga whales that are apparently healthy, robust animals with an approximately 1:1 sex ratio. In 2003, an unusually high number of beluga live strandings (5 events) and mortalities (n = 20) occurred in Cook Inlet (Vos and Shelden 2005).

4.7.2 Reasonably Foreseeable Future Actions (RFFAs)

Alaska has been shaped both economically and environmentally from past and present actions and will continue to change with future project completions. RFFAs are those that: 1) have already been or are in the process of being funded, permitted, described in fishery, oil and gas lease sale documents, or coastal zone management plans; 2) are included as priorities in government planning documents; or 3) are likely to occur or continue based on traditional or past patterns of activity. Judgments concerning the probability of future impacts must be informed rather than based on speculation (40 CFR 1502.22(b)). These actions are taken into consideration regardless of whether they are related to the proposed project but are most likely to be of concern when the proposed action occurs in the same location or at a similar time as other environmentally impacting actions.

Specifically, there are 6 major RFFAs in upper Cook Inlet and Knik Arm which, alone or in combination with the construction activities associated with the Project and the Port's continued operations upon expansion completion, have the potential to impact Cook Inlet beluga whales. These actions were identified as such based on other recent NEPA documents that have been prepared for proposed actions in the action area (i.e., Harvest SEIS, USACE EA, and Kink Arm Crossing FEIS), their close proximity to the Port, or because they would result from Port expansion.

Subsistence Beluga Harvest

As stated previously in this EA, subsistence hunting by Alaska Native Organization is considered to be the main contributor to the recent population decline of Cook Inlet beluga whales and was unregulated until 1999. As described in Section 4.8.1 and 4.8.2.2 of the Draft Harvest SEIS, because of current abundance levels and predicted population trends, it is highly unlikely that subsistence harvests of Cook Inlet beluga whales can be authorized for the reasonably foreseeable future (2007 to 2017). The harvest model used to estimate future population trends showed a 77.5 percent probability of continued decline, even with no subsistence harvest. For all alternatives, it is highly likely that no subsistence harvest would be authorized (NOAA 2007). This would result in major adverse effects on the Alaska Native beluga whaling families and those who have previously shared in the re-distribution of beluga whale foods. The duration of this loss cannot be precisely calculated, but it is likely to extend far beyond the period considered in this analysis (i.e. 2007 to 2017). The expansion of the Port would not reduce the availability of beluga whales for subsistence needs.

Knik Arm Bridge

On May 6, 2006, KABATA submitted an application to NMFS for an MMPA incidental take authorization which identified construction of the 8,200 ft. design alternative identified in the FEIS as the proposed action. A notice of receipt was published in the *Federal Register* (71 FR 49443 August 23, 2006). At the time of this writing (July 2008), issuance of the MMPA authorization is still under consideration. The Knik Arm Bridge Crossing would consist of a pile supported bridge spanning across lower Knik Arm and require 89.4 acres of intertidal and subtidal habitat to be filled. The Bridge would be used by vehicular traffic in order to: (1) Move freight and goods between the Port of Anchorage/Ship Creek industrial areas and the Port MacKenzie district; (2) provide safety and redundant overland routes connecting area airports, military bases, orts and hospitals for emergency response; (3) provide transportation infrastructure to meet projected local population and economic growth forecasts; and (4) support economic advancement in the region.

Short-term construction activities in marine and near shore environments could affect beluga behavior, movement patterns, and foraging success through noise and visual disturbance, as well as through effects on their prey. After construction, permanent structures in the water could have some minor long-term effects on beluga whales through changes in the movement patterns of prey species (forage fish and salmon), the speed of tidal flows, ice movement patterns, and potentially the bottom topography of Knik Arm. Noise from construction and construction activities could cause short-term displacement of the beluga whales. Migrating adult salmon could be forced to move out of shallow, nearshore water into deep-water channels in Knik Arm to get around the proposed bridge approach embankment abutments. This could expose the migrating adult fish to greater risk of predation by beluga and killer whales. Sighting data indicate that beluga whale habitat use around the proposed bridge action area is considered more relevant to belugas in terms of foraging than the area around the Port (Funk et al., 2005).

Port MacKenzie Dock Expansion

Port MacKenzie currently consists of a 500-foot bulkhead and 8000 acres of adjacent uplands available for commercial lease. The barge dock was completed in 2000, the deep-draft dock was completed in 2005, and port offices and a ferry terminal are planned. There is also a rock ramp adjacent to the north wingwall which allows heavy equipment to be driven on and off the dock. Future phases will develop a deep-water dock to support a fully integrated and operational deep-water marine port and industrial complex. The Mat-Su Borough plans to provide services for bulk commodity storage, a floatplane base to serve Anchorage air taxi and private pilots, and a public boat launch ramp for commercial and private use. The Alutiiq Manufacturing Contractors (AMC) is an established business now operating in the Port District to construct HUD homes for shipment to Alaska Native communities. The key studies for these actions are *Point MacKenzie Area Which Merits Special Attention Plan* (Mat-Su Borough [MSB] 1993a) and *Point MacKenzie Port Master Plan* (MSB 1987). The Port MacKenzie dock would also facilitate a ferry system shuttling across Kink Arm. To date, NMFS has not received an application for a marine mammal incidental take authorization and therefore does not have further information on the proposed design. However, NMFS does anticipate that pile driving would potentially result in harassment to marine mammals for this dock expansion should it occur.

Cook Inlet Ferry

The Mat-Su Borough has announced plans for developing a ferry link between Port MacKenzie and the Port. The Cook Inlet Ferry (formerly known as the Knik Arm Ferry) is expected to begin operation in the near future, accommodating foot passengers, tractor-trailer, and automobiles. However, NMFS has not received an application for an incidental take authorization from ferry authorities either for expansion/building of the needed docks or operation of the ferry. According to the website (http://www.matsugov.us/administration/projects/ferry.cfm), planned improvements include parking facilities and ferry landings on both sides of Knik Arm and a terminal building at Port MacKenzie. In 2003, an EA (MSB 2003) was completed for this project and the FTA signed a Finding of No Significant Impact (FONSI). When the 2003 EA and FONSI were completed, stakeholders' plans for the Ship Creek Point area were not compatible with a ferry landing. Since that time, after MSB modified the proposed Ship Creek Point proposal, Ship Creek Point stakeholders have agreed that Ship Creek Point would work as a ferry landing location. As such, a supplemental EA was prepared which presents and analyzes changes to the project and conditions in the surrounding area since the FONSI issued in 2003, and examines whether those changes are likely to result in significant adverse environmental impacts (HDR 2006). The SEA concludes that there are still no significant adverse environmental impacts. At this time, NMFS can not confirm that this project is moving forward.

Chuitna Coal Project

The Chuitna Coal Project, proposed by the Matanuska Electric Association (MEA), is a surface coal mining and export development located in the Beluga Coal Field of Southcentral Alaska, approximately 45 miles west of Anchorage. The Project is based on the development of a 300 million ton, ultra low sulfur, subbituminous coal resource, the center of which is approximately 12 miles from the coast of Cook Inlet.

The proposed Project, according to their website (http://www.chuitnaseis.com), includes a surface coal mine and associated support facilities (Chuitna Coal Mine); mine access road, coal transport conveyor, personnel housing, air strip facility (Chuitna Project Infrastructure); a logistic center, and coal export terminal (Ladd Landing Development). The coal export terminal would include a 10,000-foot trestle constructed into Cook Inlet for the purpose of loading ocean-going coal transport ships. PacRim Coal, the project proponent, predicts a minimum 25-year mine life based on the proven reserves in one of three mining areas within the 20,571 acre coal lease area.

Because the proposed Project has the potential to cause significant impacts to the environment, the U.S. Environmental Protection Agency (EPA) determined that SEIS would be prepared (original EA written in 1990). EPA would be the lead federal agency for the SEIS process; however, the stage of this document is unknown at this time. Again, no application for an incidental take authorization has been received by NMFS and NMFS is unaware of any momentum by the MEA to move forward on construction of this coal facility.

Increased Vessel Size and Traffic Present in Knik Arm

An intended outcome of expanding the Port is accommodation of more ships at any given time. Larger vessels such as tankers and cruise ships will also be able to enter Knik Arm and dock at the Port, which before was not feasible. Currently, there are two berths at the Port. Upon completion, there will be 7 dedicated ship berths and 2 barge berths. These new accommodations will likely increase the quantity and size of ships, if available, around the Port at any given time.

Ships and boats create variable levels of noise both in frequency and intensity level. Ship traffic noise can be detected at great distances. High speed diesel-driven vessels tend to be much noisier than slow speed diesel or gasoline engines. Small commercial ships are generally diesel-driven, and the highest 1/3-octave band is in the 500 to 2,000 Hz range. Tugs can emit high levels of underwater noise at low frequencies. An acoustic study by Blackwell and Greene, Jr. (2002) suggested that beluga whales may not hear sounds produced by large ships at lower frequencies (i.e., below about 300 Hz) based on data collected by Ridgway et al. (2001).

Beluga whales have been documented using the area around the Port in the presence of large vessels. These animals have appeared to become habituated to the commercial vessel traffic. Their greatest aversion belugas demonstrate is directed toward smaller watercraft such as jet skis and recreational vessels which operate abruptly and quickly (NMFS, unpubl. data). Denial of the IHA and future LOAs would not necessarily prevent the Port from expanding. For example, if the Port could conduct activities without harassing marine mammals (e.g., employ sound minimization technology, strict mitigation), it could effectively carry out expansion construction.

While Port construction would be related to increased shipping traffic as the Port would be able to accommodate more vessels, evaluation of available data has determined that beluga whales are not repelled by these types of vessels. Contrarily, belugas are more prone to avoid fast, erratic moving watercraft such as jet skis and recreational vessels. NMFS Alaska region and non-profit organizations have developed outreach education programs and materials to make the public aware of beluga whales and how to operate personal vessels while they are in the vicinity.

Summary of Cumulative Impacts from Past, Present and RFFAs

Upper Cook Inlet supports a growing population and economy and expansion is inevitable. Development and construction activities and oil/gas exploration surveys could impact beluga whales and their habitat if such actions result in habitat loss and degradation. In combination with the Port's Project, without proper mitigation and management, any development or subsistence actions could result in adverse impacts to beluga whales, both directly from noise and indirectly if prey availability is reduced, and their habitat is degraded. However, mitigation measures are likely to be a part of any project plan with many of the projects working closely with NMFS and other Federal and state environmental agencies to ensure compliance with applicable environmental laws designed to reduce adverse environmental impacts.

Overall, the major concern to expanding development in upper Cook Inlet is introduction of increased noise and habitat degradation or loss around prime feeding areas. The Port is not located within beluga whale prime feeding territory but the area around it is used as a migratory pathway to such habitats. Availability of harassment free migration route for belugas to access could however be a concern if projects, such as the Pt. Mackenzie dock expansion and Knik Arm Crossing, move forward. In such case, NMFS would consider acting to ensure that actions are stratified so this would not occur. As stated, the Port of Anchorage IHA and future rulemaking for LOAs would incorporate an adaptive management strategy to ensure beluga whale passage to their prime feeding areas. However, both of these projects do not appear to be pressing at this time. Other marine mammal species are infrequently seen in the area and the habitat is not critical to their survival (i.e., no rookeries, mating, feeding, or calving grounds). With proper mitigation and management, NMFS expects that the Project, alone or in conjunction with other past, present, or foreseeable actions, would not result in significant impacts to Cook Inlet beluga whales. NMFS would act to stratify other projects in time and place to ensure that impacts from each project would not be additive.

4.8 CONCLUSION

Based on this evaluation, NMFS believes that the proposed project would result in the Level B harassment of small numbers of beluga whales, Pacific harbor seals, harbor porpoises, and killer whales incidental to Port expansion pile driving activities. Impacts to marine mammal prey are expected, but population level effects are not anticipated due to the availability of other, similar rearing, feeding, and migratory habitats in the region. Therefore, availability of fish as marine mammals prey would not be significantly impacted. Based on the assessment presented here and as further described in the proposed IHA (73 FR 14443, March 18, 2008), which is incorporate by reference, NMFS believes that the proposed taking would have no more than a negligible impact on such species or stocks, and that marine mammal responses, when exposed to noise from pile driving, would be limited to mild to moderate behavioral and minor physiological reactions, all considered Level B harassment. Anticipated behavioral reactions of marine mammals include altered headings, fast swimming, changes in dive, surfacing, respiration, and feeding patterns, and changes in vocalizations. These behavioral reactions are expected to be short term and decrease in frequency as animals become accustomed to pile driving sounds, as they have demonstrated with ship traffic around the Port. Masking and mild stress responses may also occur; however, these too are expected to be short term. Marine mammals are not expected to abandon the area or become injured, and no mortality is anticipated. Diligent and comprehensive acoustic and marine mammal monitoring will allow for both short term and long term analyzes of impacts, if any, to the Cook Inlet beluga population or individual marine mammal. NMFS also believes that the proposed action will not have an unmitigable adverse impact on the availability of such species or stocks for subsistence uses, as the Project is not expected to interfere with or result in decrease of availability of the Cook Inlet beluga stock or any other marine mammal for subsistence hunting. Based on these analyses, impacts to marine mammals from the Project are not expected to be significant.

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References

Abookire, A. A., and J. F. Piatt. 2005. Oceanographic conditions structure forage fishes into lipid-rich and lipid-poor communities in lower Cook Inlet, Alaska, USA. Mar. Ecol. Prog. Ser. 287:229-240.

Angliss, R.P., and R.B. Outlaw. 2007. Alaska marine mammal stock assessments, 2006. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-AFSC-168, 224 p.

Awbrey, F. T., & Stewart, B. S. (1983). Behavioral responses of wild beluga whales (Delphinapterus leucas) to noise from oil drilling. Journal of the Acoustical Society of America, 74, S54.

Awbrey, F.T., J.A. Thomas, and R.A. Kastelein. 1988. Low-frequency underwater hearing sensitivity in beluga whales, *Delphinapterus leucas*. Journal of the Acoustical Society of America 84(6):2273-2275.

Awbrey, F.T., J.A. Thomas, and R.A. Kastelein. 1988. Low-frequency underwater hearing sensitivity in belugas *Delphinapterus leucas*. Journal of the Acoustical Society of America 84:2273-2275.

Anderson, D. R., R. W. Whitmer, R. Z. Goetzel, R. J. Ozminkowski, J. Wasserman, and S. Serxner. 2000. Research - Methods, Issues, and Results in Evaluation and Research - The Relationship Between Modifiable Health Risks and Group-level Health Care Expenditures. AJHP **15**:8.

Au, W. W. L., D. A. Carder, P. R.H., and B. L. Scronce. 1985. Demonstration of adaptation in beluga whale (Delphinapterus leucas) echolocation signals. Journal of the Acoustical Society of America **77**:726-730.

Becker, P.R., Krahn, M.M., Mackey, E.A., Demiralp, R.,Schantz, M.M., Epstein, M., Donaais, M.K., Porter, B., Muir, D.G., Wise, S.A. 2000. Concentrations of polychlorinated biphenyls (PCBs), chlorinated pesticides, and heavy metals and other elements in tissues of beluga, *Delphinapterus leucas,* from Cook Inlet, Alaska. Marine Fisheries Review 62:81–98.

Bigg, M. A. 1969. The harbour seal in British Columbia. Fish. Res. Bd. Can. Bull. 172. 33 pp.

Bigg, M. A. 1981. Harbour seal, *Phoca vitulina*, Linnaeus, 1758 and *Phoca largha*, Pallas, 1811. Pp. 1-27 *In* S. H. Ridgway and R. J. Harrison (eds.), Handbook of Marine Mammals, vol.2: Seals. Academic Press, New York.

Blackwell, S.B. 2005. Underwater measurements of pile-driving sounds during the Port MacKenzie dock modifications, 13-16 August 2004. Rep. from Greeneridge Sciences, Inc., Goleta, CA, and LGL Alaska Research Associates, Inc., Anchorage, AK, in association with HDR Alaska, Inc., Anchorage, AK, for Knik Arm Bridge and Toll Authority, Anchorage, AK, Department of Transportation and Public Facilities, Anchorage, AK, and Federal Highway Administration, Juneau, AK. 33 p.

Burns JJ, Seaman GA. 1986. Investigations of belukha whales in coastal waters of western and northern Alaska, II Biology and ecology. US Dept Commer, NOAA, OCSEAP Final Rep 56(1988):221-357.

Calkins DG. 1983. Marine mammals of lower Cook Inlet and the potential for impact from outer continental shelf oil and gas exploration, development, and transport. Research Unit 243: Final report of principal investigators. US Dept Commer, NOAA, OCSEAP 20:171-263.

Calkins DG. 1989. Status of belukha whales in Cook Inlet, Chp 15; pp 109-112. In: Jarvela, LE, Thorsteinson LK editors. Proceeding of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information update meeting, Feb 7-8, 1989. OCS Study, MMS 89-0041.

Cohen, D. M., T. Inada, T. Iwamoto, and N. Scialabba. 1990. FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis 10 (125):1-442.

Cornick, L.A. and L. S. Kendall. 2007. Distribution, Habitat Use, and Behavior of Cook Inlet Beluga Whales in Knik Arm, Fall 2007. Final Annual Report for 2007. Prepared for Integrated concepts and Research Corporation, Anchorage, AK.29pp.

Cox, T.M, Read, A.J., Solow, A. & Tregenza, N. 2001. Will harbour porpoises *(Phocoena phocoena)* habituate to pingers? Journal of Cetacean Research and Management: 81-86.

Culik BM, Koschinski S, Tregenza N, Ellis G (2001) Reactions of harbour porpoises (Phocoena phocoena) and herring (Clupea harengus) to acoustic alarms. Mar Ecol Prog Ser 211:255–260

Dahlheim M., A. York, R. Towell, J. Waite, and J. Breiwick. 2000. Harbor porpoise (Phocoena phocoena) abundance in Alaska: Bristol Bay to southeast Alaska, 1991–1993. Marine Mammal Science. 16:28–45

Dames and Moore. 1983. Knik Arm Crossing. Marine Biological Studies Technical Memorandum No. 15. Prepared for the U.S. Department of Transportation, Federal Highway Administration and the Alaska Department of Transportation and Public Facilities.

Deecke, V. B., J. K. B. Ford, and P. J. B. Slater. 2005. The vocal behaviour of mammal-eating killer whales: communicating with costly calls. Animal Behaviour **69**:395-405.

Erbe, C., and D.M. Farmer. 1998. Masked hearing thresholds of a beluga whale (Delphinapterus leucas) in icebreaker noise. Deep-Sea Research II 45:1373-1388.

Ebersole, B., and L. Raad. 2004. Tidal Circulation Modeling Study To Support the Port of Anchorage Expansion. Pages 67 *in* Port of Anchorage Marine Terminal Redevelopment Environmental Assessment, Anchorage.

Eschmeyer, W. N., E. S. Herald, and H. Hammann. 1983. A field guide to Pacific coast fishes of North America. Houghton Mifflin Company, Boston, MA.

Fernández, A., Arbelo, M., Deaville, R., Patterson, I. A. P., Castro, P., Baker, J. R., et al. (2004). Pathology: Whales, sonar and decompression sickness (reply). [Brief Communications]. Nature, 428(6984), U1-2.

Fernández, A., Edwards, J. F., Rodríguez, F., Espinosa de los Monteros, A., Herráez, P., Castro, P., et al. (2005). Gas and fat embolic syndrome involving a mass stranding of beaked whales (Family Ziphiidae) exposed to anthropogenic sonar signals. Veterinary Pathology, 42, 446-457.

Finley, K.J. 1982. The estuarine habitat of the beluga or white whale, Delphinapterus leucas. Cetus 4(2):4-5.

Finneran, J. J., Schlundt, C. E., Carder, D. A., Clark, J. A., Young, J. A., Gaspin, J. B., and Ridgway, S. H. 2000. "Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions," J. Acoust. Soc. Am. 108, 417 431.

Finneran, J. J., C. E. Schlundt, D. A. Carder, and S. H. Ridgway. 2002. Auditory filter shapes for the bottlenose dolphin (*Tursiops truncatus*) and the white whale (*Delphinapterus leucas*) derived with notched noise. The Journal of the Acoustical Society of America **112**:7.

Finneran, J.J., D.A. Carder, R. Dear, J. McBain, L. Dalton, and S.H. Ridgway. 2005. Pure tone audiogram and possible aminoglycocide-induced hearing loss in belugas (Delphinapterus leucas). Journal of the Acoustical Society of America 117(6):3936-3943.

Fisher, H. D. 1952. The status of the harbour seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Bd. Can. Bull. 93. 58 pp.

Frankel, A. S. and C. W. Clark 1998. Results of low-frequency playback of M-sequence noise to humpback whales (Megaptera novaeangliae), in Hawai'i. Can. J. Zool. 76(3):521-535.

Funk, D.W., T.M. Markowitz, and R. Rodrigues (eds.) 2005. Baseline studies of beluga whale habitat use in Knik Arm, Upper Cook Inlet, Alaska, July 2004-July 2005. Rep. from LGL Alaska Research Associates, Inc., Anchorage, AK, in association with HDR Alaska, Inc., Anchorage, AK, for Knik Arm Bridge and Toll Authority, Anchorage, AK, Department of Transportation and Public Facilities, Anchorage, AK, and Federal Highway Administration, Juneau, AK.

Gisiner, R. C. 1998. Workshop on the effects of anthropogenic noise in the marine environment. U.S. Navy, Office of Naval Research, Marine Mammal Research Program, Washington, D.C.

Gitay, H., A. Suarez, R. Watson. 2002. Climate change and biodiversity. Technical paper 5, IPCC, 77 pp.

Goetz, K. T., D. J. Rugh, A. J. Read, and R. C. Hobbs. 2007. Habitat use in a marine ecosystem: Beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska. Mar. Ecol. Prog. Ser. 330:247-256.

Groot, C. and L. Margolis. 1991. Pacific salmon life histories. UBC Press, Vancouver, British Columbia, Canada: 564 pp.

Hastings, M. C., and A. N. Popper. 2005. Effects of sound on fish. Unpublished report prepared for California Department of Transportation. Available at: http://www4.trb.org/trb/crp.nsf/reference/boilerplate/Attachments/$file/EffectsOfSoundOnFish1-28-05(FINAL).pdf

Hazard K. 1988. Beluga whale, *Delphinapterus leucas*. In: Lentfer JW, editor. Selected marine mammals of Alaska: species accounts with research and management recommendations. Mar Mammal Comm, Washington, DC.

HDR. 2006. Final Cook Inlet Ferry Supplemental Environmental Assesment. Prepared by HDR Associates, Anchorage, AK. for Federal Transit Administration, Seattle, WA and Matanuska-Susitna Borough, Palmer, AK, September 2006.

HDR, and URS. 2006. Final Knik Arm Crossing Essential Fish Habitat Assessment of the Proposed Action. Prepared for the Knik Arm Crossing Final Environmental Impact Statement, Anchorage.

Hobbs, R. C., D. J. Rugh, and D. P. DeMaster. 2000a. Abundance of beluga whales, *Delphinapterus leucas,* in Cook Inlet, Alaska, 1994-2000. Mar. Fish. Rev. 62(3):37-45.

Hobbs, R. C., K. L. Laidre, D. J. Vos, B. A. Mahoney, and M. Eagleton. 2005. Movements and area use of belugas, *Delphinapterus leucas*, in a subarctic Alaskan estuary. Arctic Research of the United States **58**:331-340.

Hobbs, R. C., K. E. W. Shelden, D. J. Vos, K. T. Goetz, and D. J. Rugh. 2006. Status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2006-16, 74 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115-6349.

Hooker, S. K., I. L. Boyd, M. Jessopp, O. Cox, J. Blackwell, P. L. Boveng, and J. L. Bengtson. 2002. Monitoring the prey-field of marine predators: Combining digital imaging with datalogging tags. Marine Mammal Science **18**:18.

Houghton, J., J. Starkes, M. Chambers, and D. Ormerod. 2005a. Marine fish and benthos studies in Knik Arm, Anchorage, Alaska. Report prepared for the Knik Arm Bridge and Toll Authority, and HDR Alaska, Inc., Anchorage, AK, by Pentec Environmental, Edmonds, WA.

Houghton, J., Starkes, M. Chambers, and D. Ormerod. 2005b. 2004-2005 marine fish and benthos studies-Port of Anchorage, Anchorage, Alaska. Report prepared by Pentec Environmental, Edmonds, WA, for Integrated Concepts and Research Corporation.

Huntington HP. 2000. Traditional knowledge of the ecology of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska. Mar Fish Rev 62(3):134-40.

Jepson, P. D., M. Arbelo, R. Deaville, I. A. P. Patterson, P. Castro, J. R. Baker, E. Degollada, H. M. Ross, P. Herráez, A. M. Pocknell, F. Rodriguez, F. E. Howie, A. Espinosa, R. J. Reid, J. R. Jaber, V. Martin, A. A. Cunningham, and A. Fernández. 2003. Gas-bubble lesions in stranded cetaceans. Nature **425**:575-576.

Johnson, C.S., M.W. McManus, and D. Skaar. 1989. Masked tonal hearing thresholds in the beluga whale. Journal of the Acoustical Society of America 85(6):2651-2654.

Johnston DW (2002) The effect of acoustic harassment devices on harbour porpoises (Phocoena phocoena) in the Bay of Fundy, Canada. Biol Conserv 108:113–118

KABATA. 2007. Knik Arm Crossing: Final Environmental Impact Statement and Final Section 4(f) Evaluation. Prepared by Knik Arm Bridge and Toll Authority, Anchorage, AK, and Alaska Department of Transportation & Public Facilities, Anchorage, AK for Federal Highway Administration, Juneau, AK. Federal Project No. ACSTP-0001(277) December 18, 2007.

Kastak, D. and R.J. Schusterman. 1994. Low-frequency hearing in California sea lions and harbor seals. J. Acoust. Soc. Am. 96:5. 3521.

Kastak, D., and R.J. Schusterman. 1995. Aerial and underwater hearing thresholds for 100 Hz pure tones in two pinniped species. *In:* R.A. Kastelein, J.A. Thomas and P.E. Nachtigall (eds.). Sensory System of Aquatic Mammals. De Spil Publisher, Woerden, Netherlands.

Kastak, D., and R.J. Schusterman. 1998. Low-frequency amphibious hearing in pinnipeds: methods, measurements, noise, and ecology. Journal of the Acoustical Society of America. 103(4):2216-2228.

Katona SK, Rough V, Richardson DT. 1983. A field guide to the whales, porpoises and seals of the Gulf of Maine and eastern Canada. New York: Charles Scribner's Sons.

Kastelein R.A., A.D. Goodson, J. Lien , and D. de Haan. 1995. The effects of acoustic alarms on harbour porpoise (Phocoena phocoena) behaviour. In: Nachtigall PE, Lien J, Au WWL, Read AJ (eds) Harbour porpoises — laboratory studies to reduce bycatch. De Spil, Woerden, p 157–167

Kastelein R.A., D. de Haan, A.D. Goodson, C. Staal, and N. Vaughan. 1997. The effects of various sounds on a harbour porpoise (Phocoena phocoena). In: Read AJ, Wiepkema PR, Nachtigall PE (eds) The biology of the harbour porpoise. De Spil, Woerden, p 367–383.

Kastelein R.A., H.T. Rippe, N. Vaughan, N.M. Schooneman, W.C. Verboom, and D. de Haan. 2000. The effects of acoustic alarms on the behaviour of harbour porpoises (Phocoena phocoena) in a floating pen. Mar Mamm Sci 16:46–64.

Ketten, D. R. 1995. Estimates of blast injury and acoustic trauma zones for marine mammals from underwater explosions. In R. A. Kastelein, J. A. Thomas, and P. E. Natchigall (Editors), Sensory systems of aquatic mammals, p. 391-407. De Spil Publ., Woerden, Netherl.

Klishin, V.O., V.V. Popov, and A.Ya. Supin. 2000. Hearing capabilities of a beluga whale, Delphinapterus leucas. Aquatic Mammals 26.3:212-228.

Laist, D. W., and J. E. Reynolds, III. 2005. Influence of power plants and other warm-water refuges on Florida manatees. Marine Mammal Science **21**:739-764.

Laidre, K. L., K. E. W. Shelden, D. J. Rugh, and B. A. Mahoney. 2000. Beluga, *Delphinapterus leucas*, distribution and survey effort in the Gulf of Alaska. Mar. Fish. Rev. 62(3): 27-36.

Lesage, V., C. Barrette, M. C. S. Kingsley, and B. Sjare. 1999. The Effect of Vessel Noise on the Vocal Behavior of Belugas in the St. Lawrence River Estuary. Marine Mammal Science **15**:65-84.

LGL. 2005. Baseline Studies of Beluga Whale Habitat Use in Knik Arm, Upper Cook Inlet, Alaska. Final Progress Report., Anchorage.

Lowry, L. F., K. J. Frost, J. M. Ver Hoef, and R. A. DeLong. 2001. Movements of satellite-tagged subadult and adult harbor seals in Prince William Sound, Alaska. Marine Mammal Science **17**:835-861

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1983. Investigation of the potential effects of underwater noise from pretroleum industry activities on migrating gray whale behavior. BBN Rep. 5366. Rep. from Bolt Beranek & Newman Inc., Cambirdge, MA, for U.S. Mineral Manage. Serv., Anchorage, AK. NTIS PB86-174174.

T.M. Markowitz and T.L. McGuire (eds.) 2007. Temporal-spatial distribution, movements and behavior of beluga whales near the Port of Anchorage, Alaska. Rep. from LGL Alaska Research Associates, Inc., Anchorage, AK, for Integrated Concepts and Research Corporation and the U.S. Department of Transportation Maritime Administration.

Mate, B.R. and J.T. Harvey (eds). 1987. Acoustical deterrents in marine mammal conflicts with fisheries: a workshop held February 17-18, 1986 at Newport, Oregon. Oregon State University, Corvallis, OR. Publ. No. ORESU-W-86-001. 116 pp.

McIwem, J. A. D. 2006. Likely sensitivity of bottlenose dolphins to pile-driving sounds Water and Environment Journal **20**:46-54.

Measures, L. 2001. Lung worms of marine mammals, p. 279-300. *In* W. M. Samuel, M. J. Pybus, and A. A. Kocan (editors), Parasitic diseases of wild mammals. Iowa State Univ. Press, Ames, IA.

Mhenni, S. (1993) Interactions mammiferes marins et engins de peˆche: La dispersion des dauphins par des ondes ultra sonores. In Universit ´e de Tunis (ed.). La peˆche en Tunisie: Peˆche coˆtie`re et environment. CERES S´ er. G´eogr. 9. Cent. Etudes Rech. Econom. Soc., Tunis.

Minerals Management Service. 1996. Cook Inlet Planning Area Oil and Gas Lease Sale 149. Final Environmental Imapct Statement. U.S. Department of the Interior, Alaska OCS Region.

Møhl, B. 1968. Auditory sensitivity of the common seal in air and water. Journal of Auditory Research 8:27-38.

Moore, S. E., K. E. W. Shelden, L. K. Litzky, B. A. Mahoney, and D. J. Rugh. 2000. Beluga, Delphinapterus leucas: Habitat Associations in Cook Inlet, Alaska. Marine Fisheries Review **62** 60-80.

Moulton, M. M. 1996. Early Marine Residence, Growth, and Feeding by Juvenile Salmon in Northern Cook Inlet, Alaska. Alaska Fishery Research Bulletin **4**:154-177.

Murray, N.K., and F.H. Fay. 1979. The white whales or belukhas, Delphinapterus leucas, of Cook Inlet, Alaska. Draft prepared for the June 1979 meeting of the Sub-committee on Small Cetaceans of the Scientific Committee of the Int. Whaling Commn. College of Environmental Sciences, Univ. Alaska, Fairbanks. 7p.

Nedwell, J.R., B.Edwards, A.W.H Turnpenny,., and J. Gordon. 2004. Fish and Marine Mammal Audiograms: A summary of available information. Prepared by Fawley Aquatic Research Laboratories Ltd.; Ecologic. Subacoustech Report ref: 534R0214. September 3. 2004. Available at /www.subacoustech.com.

NMFS. 2003. Subsistence Harvest Management of Cook Inlet Beluga Whales – Final Environmental Imapct Statement. NOAA/NMFS Alaska Region, Juneau, Alaska. 180 pp.

NMFS. 2005. Draft Conservation plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). Natl Mar. Fish. Serv., Juneau, Alaska. [available from http://www.fakr.noaa.gov/protectedresources/whales/beluga/mmpa/draft/conservationplan032005.pdf].

NOAA. 2007. Cook Inlet Beluga Whale Subsistence Harvest Draft Supplemental Environmental Impact Statement. Alaska Region, National Marine Fisheries Service, December 2007, 200pp.

NMFS. 2008. Biological Opinion on the Navy's Proposal to conduct four training exercises in the Cherry Point and Jacksonville-Charleston Operating Areas off the Atlantic coast of the U.S. between spring and winter 2008. National Oceanic and Atmospheric Association, Office of Protected Resources, Silver Spring, MD, April 14, 2008. pp.163

Nowak, R. M. 1991. Walker's marine mammals of the world, 5 edition. The Johns Hopkins University Press, Baltimore.

O'Corry-Crowe, G. M., R. S. Suydam, A. Rosenberg, K. J. Frost, and A. E. Dizon. 1997. Phylogeography, population structure and dispersal patterns of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. Mol. Ecol. 6:955-970.

Olesiuk PF, Nichol LM, Sowden MJ, Ford JKB (2002) Effect of the sound generated by an acoustic deterrent device on the relative abundance and distribution of harbour porpoises (Phocoena phocoena) in Retreat Passage, British Columbia. Mar Mamm Sci 18:843–862

Payne, Susan A., B.A. Johnson, and R.S. Otto. 1999. Proximate composition of some north-eastern Pacific forage fish species. Fish Oceanogr. 8:3, 159-177.

Perry, R. W., D. J. Boness, and S. J. Insley. 1998. A study of sonic boom effects on seals breeding on Sable Island, Canada (abstract). Journal of the Acoustical Society of America **104**:4.

Pentec Environmental. 2005. Marine Fish and Benthos Studies-Knik Arm Crossing Anchorage, Alaska. Prepared for Knik Arm Bridge and Toll Authority, Anchorage Alaska.

Popper. A.N., T.J. Carlson, A.D. Hawkins, B.L. Southall, and R.L. Gentry. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper. Released May 15, 2006.

Richardson, W. J., Greene, C. R., Jr., Koski, W. R., Malme, C. I., Miller, G. W., Smultea, M. A., et al. (1990b). Acoustic effects of oil production activities on bowhead and white whales visible during spring migration near Pt. Barrow, Alaska—1989 phase (OCS Study MMS 90- 0017; NTIS PB91-105486). LGL Ltd. report for U.S. Minerals Management Service, Herndon, VA. 284 pp.

Richardson, W. J., Greene, C. R., Jr., Koski, W. R., Smultea, M. A., Cameron, G., Holdsworth, C., et al. (1991). Acoustic effects of oil production activities on bowhead and white whales visible during spring migration near Pt. Barrow, Alaska—1990 phase (OCS Study MMS 91- 0037; NTIS PB92-170430). LGL Ltd. report for U.S. Minerals Management Service, Herndon, VA. 311 pp.

Richardson, W. J., C. R. Greene Jr, C. I. Malme, and D. H. Thomson. 1995. Marine mammals and noise. Academic Press, Inc., San Diego, California.

Romano, T., M. J. Keogh, C. Kelly, P. Feng, L. Berk, C. E. Schlundt, D. A. Carder, and J. J. Finneran. 2004. Anthropogenic Sound and Marine Mammal Health: Measures of the Nervous and Immune System Before and After Intense Sound Exposure. Canadian Journal of Fisheries and Aquatic Sciences **61**:1124-1134.

Rugh, D. J., K. E. W. Shelden, and B. A. Mahoney. 2000. Distribution of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, during June/July, 1993-2000. Mar. Fish. Rev. 62(3): 6-21.

Rugh, D. J., K. E. W. Shelden, C. L. Sims, B. A. Mahoney, B. K. Smith ,L. K. Litzky, and R. C. Hobbs. 2005. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. U.S. Dep. Commer., NOAA Tech Memo. NMFS-AFSC-149.

Scheifele, P. M., S. Andrew, R. A. Cooper, M. Darre, F. E. Musiek, and L. Max. 2005. Indication of a Lombard vocal response in the St. Lawrence River beluga. Journal of the Acoustical Society of America **117** 1486-1492.

Schlundt, C. E., Finneran, J. J., Carder, D. A., & Ridgway, S. H. (2000). Temporary shift in masked hearing thresholds (MTTS) of bottlenose dolphins and white whales after exposure to intense tones. Journal of the Acoustical Society of America, 107, 3496-3508.

Seaman, G.A., K.J. Frost, and L.F. Lowry. 1985. Distribution, abundance, and movements of belukha whales in western and northern Alaska. Draft final rep. prepared for U.S. Dept. Commer., NOAA, Natl. Ocean Serv., Anchorage, Alaska. Alaska Dept. Fish and Game, Fairbanks.

Sergeant DE, Brodie PF. 1969. Body size in white whales, *Delphinapterus leucas.* J Fish Res Bd Can 26:2561-80.

Shelden, K. E. W. 1994. Beluga whales (*Delphinapterus leucas*) in Cook Inlet – a review. Unpubl. doc. 10 p. [referenced as Appendix A in Withrow et al. (1994). Beluga whale distribution and abundance in Cook Inlet, 1993, p. 128-153. *In* MMAP Status of Stocks and Impacts of Incidental Take 1993, Office of Protected Resources, NMFS, Silver Spring, MD, June 1994.].

Sheldon, K., D. J. Rugh, B. A. Mahoney, and M. E. Dahlheim. 2003. Killer Whale Predation on Belugas in Cook Inlet, Alaska: Implications for a Depleted Population. Marine Mammal Science **19**:529–544.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr.,D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W. J.Richardson, J.A. Thomas, P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4), 411-521 (2007).

St. Aubin, D.J., T.G. Smith, and J.R. Geraci. 1990. Seasonal epidermal molt in beluga whales, Delphinapterus leucas. Can. J. Zoo. 68:359-367.

Suydam, R., J. J. Burns, and G. Carroll. 1999. Age, growth, and reproduction of beluga whales from the eastern Chukchi Sea, Alaska. Paper presented to the Alaska Beluga Whale Committee workshop, March 30-April 1, 1999.

Terhune, J., and S. Turnbull. 1995. Variation in the psychometric functions and hearing thresholds of a harbour seal. *In:* R.A. Kastelein, J.A. Thomas and P.E. Nachtigall (eds.). Sensory System of Aquatic Mammals. De Spil Publisher, Woerden, Netherlands.

Thomas, J.A., R.A., Kastelein, F.T. Awbrey. 1990. behavior and Blood Catecholamines of Captive Belugas During Playbacks of Noise From an Oil Drilling Platform. Zoo. Bio. 9: 393-402.

USACE. 2007a. Port of Anchorage Intermodal Expansion Project, Phase II Permit, August 10, 2007. 11pp. Available at: http://www.portofanchorage.org/ Phase%20II%20Permit.pdf.

USACE. 2007b. Permit Evaluation and Decision Document. Prepared for issuance of Permit POA-2003-502-N to the U.S. Department of Transportation Maritime Adminstration in cooperation with the Municipality of Anchorage, Port of Anchorage, AK. August 10, 2007. 122 pp.

Watts, P.D., B.A. Draper, and J. Henrico. 1991. Preferential use of warm water habitat by adult beluga whales. J. Therm. Bio. 16(1):57-60.

White, M.J., J. Norris, D. Ljungblad, K. Baron, and G. di Sciara. 1978. Auditory thresholds for two beluga whales (Dephinapterus leucas). HSWRI Technical Report 78-109 for Naval Ocean Systems Center, San Diego, California. San Diego, California: Hubbs/Sea World Research Institute.

Van Parijs, S., and P. Corkeron. 2001. Boat traffic affects the vocal behavoiur of Pacific humpback dolphin, *Sousa chinensis*. Journal of the Marine Biological Association of the United Kingdom **81**:533-588.

Vos, D. J. 2003. Cook Inlet beluga age and growth. M.S. thesis, Alaska Pacific University, Anchorage, Alaska. 69 p.

Vos, D. J., and K. E. W. Shelden. 2005. Unusual mortality in the depleted Cook Inlet beluga population. Northwest. Nat. 86(2):59-65.