Program Management Office • 1980 Anchorage Port Road • Anchorage, Alaska 99501

May 21, 2024

Jolie Harrison
Office of Protected Resources
1315 East-West Highway
Silver Spring, Maryland

Subject: Cargo Terminals Replacement Project – Letter of Authorization and Incidental Harassment Authorization Request

Dear Ms. Harrison,

Please find attached an application for a rulemaking and Letter of Authorization (LOA) and an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act (MMPA) for the take of marine mammals incidental to construction relating to the Cargo Terminals Replacement (CTR) Project, which is a part of Phase 2B of the Port of Alaska Modernization Program (PAMP).

CTR in-water construction is scheduled to begin on 01 April 2026 and continue through 30 November of each of the 6 years, 2026 through 2031. These dates are estimates and may shift as construction details, starting dates, ice-free conditions, production rates, and other factors vary. The POA therefore requests a rulemaking and LOA for 5 years that is valid for 5 years, from 01 April 2026 through 31 March 2031, and an IHA that is valid for 1 year, from 01 April 2031 through 31 March 2032.

The POA requests a rulemaking and 5-year LOA that will be finalized and issued on or before 01 February 2025. While the Port understands that requesting an LOA a year in advance of construction may not be typical, other pending Federal "actions" are reliant upon issuance of the LOA at the earliest date possible in 2025. Permit applications have already been submitted to USACE Civil Works Division and USACE Regulatory Division for preparatory work starting in 2025, and potential federal grant awards could start as early as 2025. These other Federal "actions" require NEPA compliance, which requires a Biological Opinion (BO) under the ESA formal Section 7 consultation process, as does the LOA and IHA, inclusive of an Incidental Take Statement (ITS). Without the MMPA incidental take authorization, NMFS ESA will not be able to issue the BO with the ITS in order to complete other NEPA actions for funding and landside construction work starting in 2025.

The Port has used the best available current knowledge while preparing this LOA application based on preliminary engineering reports. Additionally, due to the logistical challenges of this Project we anticipate needing the conditions of the LOA on or before 01 February 2025, well in advance of the 2026 in-water construction season to assist the construction contractor with their scheduling, logistics, and staffing.

We look forward to working with our colleagues at the National Marine Fisheries Service and are happy to answer any questions you may have about this application. Please contact me at 907-343-6200 or via email at steve.ribuffo@anchorageak.gov or the project lead for this task, Mike Holley, at 907-885-5798 or michiel.holley@hdrinc.com.

Regards,

DocuSigned by:
Steve Ribuffo
169AD3846D4149C...

Stephen Ribuffo
Director
Port of Alaska

cc: Kerri Hancock, PM USACE-RD
Eric Adams, P.E., PAMP Program Manager (Jacobs)
Mike Holley, PAMP Permitting Lead (HDR)

PORT OF ALASKA MODERNIZATION PROGRAM

Application for a Marine Mammal Protection Act Request for a Letter of Authorization

Cargo Terminals Replacement (CTR) Project

Rev. 02

May 2024

Prepared by

Port of Alaska

2000 Anchorage Port Road
Anchorage, Alaska 99501

List of Preparers

Mallory Allgeier: HDR Environmental Scientist

Brett Carrothers: HDR Marine Scientist

Li Philips: HDR Marine Scientist

Suzann Speckman, PhD: HDR Alaska Marine Science Program Lead

James Reyff: Illingworth & Rodkin Senior Consultant

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Acronyms and Abbreviations

61N Environmental	61 North Environmental
µPa	microPascal(s)
ADF&G	Alaska Department of Fish and Game
ARRC	Alaska Railroad Corporation
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CIMMC	Cook Inlet Marine Mammal Council
CPOA	closest point of approach
CTR	Cargo Terminals Replacement
CV	coefficient of variation
dB	decibels
dB re 1 µPa	decibels referenced to a pressure of 1 microPascal
dBA	A-weighted decibels
DOR	Designer of Record
DPS	Distinct Population Segment
DSM	deep soil mixing
EFH	Essential Fish Habitat
ENP	Eastern North Pacific
ESA	Endangered Species Act
FR	*Federal Register*
ft	feet/foot
HF	high-frequency
Hz	Hertz
I&R	Illingworth & Rodkin
ICRC	Integrated Concepts & Research Corporation
IHA	Incidental Harassment Authorization
ITS	Incidental Take Statement
JBER	Joint Base Elmendorf-Richardson
KABATA	Knik Arm Bridge and Toll Authority
kHz	kilohertz
km	kilometers
km^2	square kilometers
LF	low-frequency
LOA	Letter of Authorization

L_{pk}	peak sound level
MARAD	U.S. Maritime Administration
MF	mid-frequency
MHW	Mean High Water
mi	miles
mi^2	square miles
MLLW	mean lower low water
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
MOA	Municipality of Anchorage
MTRP	Marine Terminal Redevelopment Project
NES	North Extension Stabilization
NES1	NES-Step 1
NES2	NES-Step 2
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NPRN	National Port Readiness Network
OSP	Optimum Sustainable Population
OW	otariid in water
PAMP	Port of Alaska Modernization Program
PCoD	population consequences-of-disturbance
PCT	Petroleum and Cement Terminal
POA	Port of Alaska
POL1	Petroleum, Oil, and Lubricants Terminal 1
POL2	Petroleum, Oil, and Lubricants Terminal 2
Project	General Cargo Terminals Replacement Project
PSO	Protected Species Observer
PTS	permanent threshold shift
PW	phocid in water
rms	root-mean-square
SAR	Stock Assessment Reports
SEL	sound exposure level
SEL_{cum}	Cumulative Sound Exposure Level
SFD	South Floating Dock
SPL	sound pressure level
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks Project

SSL	sound source level
SSV	sound source verification
T1	Terminal 1
T2	Terminal 2
T3	Terminal 3
TL	transmission loss
TL_c	transmission loss coefficient
TPP	Test Pile Program
TTS	temporary threshold shift
UME	Unusual Mortality Event
URS	URS Corporation
USACE	U.S. Army Corps of Engineers
WNP	Western North Pacific

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Section 1. Description of Specified Activity

1.1 Introduction

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) regulations governing the issuance of Incidental Harassment Authorizations (IHAs) and Letters of Authorization (LOAs) permitting the incidental, but not intentional, take of marine mammals under certain circumstances are codified in 50 Code of Federal Regulations Part 216, Subpart I (Sections 216.101–216.108). The Marine Mammal Protection Act (MMPA) defines take as “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (16 U.S. Code Chapter 31, Section 1362 (13). Section 216.104 sets out 14 specific items that must be addressed in applications pursuant to Section 101(a)(5) of the MMPA, and those are addressed in this application for a rulemaking and LOA.

The Port of Alaska (POA) requests authorization for the take of small numbers of marine mammals, by Level A and Level B harassment, incidental to its General Cargo Terminals Replacement (CTR) Project (Project) at the existing port facility in Anchorage, Alaska. The in-water work for the Project will occur over 6 years, and therefore the POA requests a rulemaking and an LOA that is valid for 5 years, from 01 April 2026 through 31 March 2031, and an IHA that is valid for 1 year, from 01 April 2031 through 31 March 2032. Landside construction work is scheduled to begin in 2025, including ground improvements and shoreline stabilization; however, this work is not expected to cause disturbance to marine mammals under the MMPA.

The POA, located on Knik Arm in upper Cook Inlet (Figure 1-1), provides critical infrastructure for the citizens of Anchorage and a majority of the citizens of Alaska. Marine-side infrastructure and facilities at the POA were constructed largely in the 1960s and are in need of replacement because they are substantially past their design life and in poor and deteriorating structural condition. Those facilities include three general cargo terminals, two petroleum terminals, a dry barge landing, and an upland sheet-pile-supported storage and work area. To address deficiencies, the POA is modernizing its marine terminals through the Port of Alaska Modernization Program (PAMP) to enable safe, reliable, and cost-effective Port operations. The PAMP will support infrastructure resilience in the event of a natural disaster over a 75-year design life.

The PAMP is critical to maintaining food and fuel security for the state. At the completion of the PAMP, the POA will have modern, safe, resilient, and efficient facilities through which more than 90 percent of Alaskans will continue to obtain food, supplies, tool, vehicles, and fuel. The PAMP is divided into five separate phases; these phases are designed to include projects that have independent utility yet streamline agency permitting. The projects associated with the PAMP include (Figure 1-1):

- **Phase 1:** Petroleum and Cement Terminal (PCT) and South Floating Dock (SFD) Replacement (completed in 2022)
- **Phase 2A:** North Extension Stabilization (NES) Step 1 (NES1; construction began in 2023, and in-water work is expected to take place in 2024)
- **Phase 2B:** General Cargo Terminals Replacement **(this Project; slated to begin construction in 2025)**
- **Phase 3:** Replacement of Petroleum, Oil, and Lubricants Terminal 2 (POL2)
- **Phase 4:** North Extension Stabilization Step 2 (NES2)
- **Phase 5:** Demolition of Terminal 3

This Project is Phase 2B of the PAMP, and landside construction will commence in 2025. In-water construction will commence in 2026. The Project includes new construction of Terminal 1 (T1) and Terminal 2 (T2), which include planned wharves and access trestles. The two new terminals will be located 140 feet (ft) seaward of the existing Terminals 1, 2, and 3. It is anticipated that this more seaward location of the new terminals will reduce sedimentation, improve room for handling of berthing ships, and allow construction of the new terminals while the existing terminals remain in use. The Project also includes demolition of the existing Petroleum, Oil, and Lubricants Terminal 1 (POL1) and general cargo terminals (Terminal 1, Terminal 2, and Terminal 3) as needed to advance construction of T1 and T2.

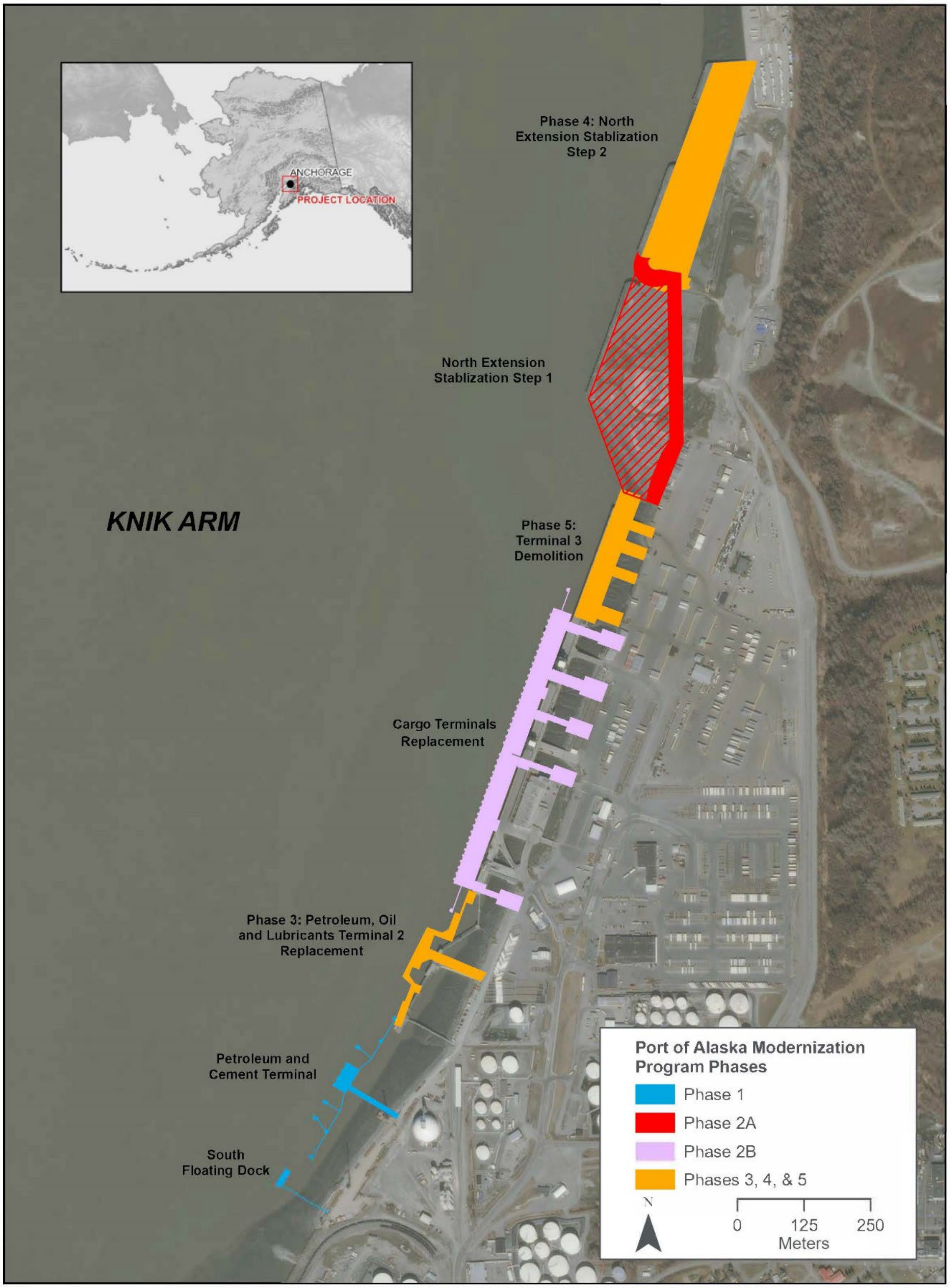

Figure 1-1. POA Modernization Program Phases

1.2 Project Purpose and Need

The purpose of the Project is to replace the existing general cargo docks. The Project will address deteriorating conditions of the existing cargo facilities; improve operational safety and efficiency; accommodate modern (existing and future) shipping operations; and improve the resiliency of the POA to extreme seismic events, all while sustaining ongoing cargo operations.

This Project is urgently needed due to severe corrosion of the foundation piles and deteriorating structural conditions at Terminals 1, 2, and 3. The existing terminals are more than 50 years old and suffer from severe damage to the foundation piles caused by corrosion and seismic forces. The piles have exceeded their useful service life, and multiple engineering investigations have highlighted the probability of wharf and trestle structure failure during a future major seismic event. The remaining service life of the cargo terminals is unknown. These facilities must be replaced with new resilient terminals for the Port to continue to meet its critical role serving Anchorage and the State of Alaska's general cargo needs as well as supporting national defense and military readiness capabilities.

The geographical isolation of Alaska and the POA's role as the containerized logistic hub and distribution center for much of the state make the cargo terminals a critical lifeline for the southcentral region and Alaska. There are no other ports with the cargo capacity, proximity to Alaska's population centers, and intermodal transportation capabilities that can support the logistic missions sustained by the POA, including commerce, national defense, and earthquake resiliency/disaster response and recovery.

1.3 Avoidance and Minimization of Project Impacts

The POA is committed to minimizing impacts of its activities, including the CTR construction, on beluga whales and other marine mammals. The following measures have been applied to the preliminary design and construction methods to reduce the amount and duration of pile installation and removal:

- Using 72-inch steel piles instead of 48-inch steel piles to reduce total number of piles
- Using 72-inch steel piles instead of 48-inch steel piles to reduce total duration of pile installation
- Minimizing the number of temporary piles
- Minimizing the duration of installation and removal of piles
- Minimizing the number of piles in the design that require proofing or splicing
- Installing piles in the dry where and when possible to minimize the number of in-water pile installations
- Leaving approximately 90 percent of the in-water temporary piles in place or removing temporary piles by cutting at the mudline where and when possible, or removal in the dry, to reduce total duration of vibratory pile removal
- Leaving existing piles in place by cutting at the mudline where and when possible for demolition of existing terminals to reduce total duration of vibratory pile removal
- Using a bubble curtain system during impact and vibratory pile installation of permanent 72- and 144-inch piles in all months and when water depth is greater than 3 meters
- Using a bubble curtain system on all piles during months with historically higher beluga whale abundance (August through October) when water depth is greater than 3 meters. Only temporary piles will be installed (and removed) without a bubble curtain during months with low beluga whale abundance (April through July and November).

Other Project design and construction methods that have been modified and refined to achieve the least practicable adverse impact on beluga whales and other marine mammals include:

- Limiting pile installation and removal to times when visibility for marine mammal presence is possible based on favorable sighting conditions
- Limiting pile installation and removal to daylight hours between civil dawn and civil dusk
- Starting in-water work as early as possible in April or May (sea-ice dependent) when beluga whale abundance historically has been low
- Prioritizing the use of impact pile driving over vibratory pile driving, when possible, to decrease the size of the ensonified area
- Employing two or three construction crews to operate multiple hammers to increase productivity during periods with low beluga whale abundance and reduce overall Project duration. At most, two vibratory hammers will be simultaneously active in water at any given time due to the larger ensonified areas associated with simultaneous use of vibratory hammers. See Section 6.4.1.1 Two Hammers.

1.4 Best Available Information

The Project Construction Contractor has not yet been identified, and therefore certain schedule details, construction means and methods, and design specifics presented herein may differ in limited degree from the work that will eventually be presented in the Contractor's Construction Work Plans. Estimates of duration for pile installation and removal were made based on prior experience with similar marine construction and demolition projects, including the recent construction of the POA PCT during 2020 and 2021. Actual durations for pile installation and removal may be longer or shorter, depending upon many variables associated with construction and the environment. Numbers of impact strikes may be greater or fewer. The sequencing of events is unknown at this time, and flexibility will be required to avoid disruption to critical day-to-day POA activities. Estimated numbers of hours and days for the different activities are not intended to be caps or limits on these activities. Descriptions of design and construction in this document are as accurate as possible at this stage of the Project but may vary slightly as design and construction advance. It is anticipated that the actual methods, including types of equipment and numbers of hours and days of each activity, will be determined based on the engineering specifications for the Project as determined by the Construction Contractor and Designer of Record (DOR). The Project description in Section 1.5 consists of conservative predictions and estimates based on the best available information at this time. It is not anticipated that the Project would change such that potential impacts on marine mammals would substantially change from those described below. If substantial changes were to occur, the POA would coordinate with NMFS.

Annual estimates of potential Level B incidental harassment (take) for Cook Inlet beluga whales, as calculated and outlined in Section 6 of this request for a rulemaking and LOA, are based on the best design and construction information available at this time. Given the inherent uncertainty in predicting the exact construction activities and sequencing of those activities for each individual year over a 6-year period, the POA requests that Level B incidental harassment (take) for Cook Inlet beluga whales is authorized in total for the 5 years of construction under the LOA and 1 year under the IHA. Authorizing a total number of Level B incidental takes (instead of prescribing a set number of takes per year) will allow the POA to better manage its risk of exceeding authorized take numbers while maintaining a consistent conservation benefit to Cook Inlet beluga whales across the 6 years.

1.5 Project Description

The POA's boundaries currently occupy an area of approximately 129 acres. Other commercial and industrial activities related to secured maritime operations are located near the POA on Alaska Railroad Corporation (ARRC) property immediately south of the POA, on approximately 111 acres. The new T1 and T2 southernmost end will be approximately 1.4 kilometers (km; 0.9 mile [mi]) north of Ship Creek, a location of heightened marine mammal activity during seasonal runs of several salmon species.

Construction of the Project will include completion of the following components:

- Component 1. Ground improvement shoreline stabilization
- Component 2. Shoreline expansion and protection
- Component 3. General cargo terminals (new Terminals 1 and 2) construction
- Component 4. Demolition of existing terminals (POL1 and general cargo terminals [existing Terminals 1, 2, and 3])
- Component 5. Onshore utilities and storm drain outfall replacement

New terminals T1 and T2 will be constructed as seismically resilient adjoining terminals on a continuous berthline with mooring features and appurtenances as required to support safe ship mooring for lift-on/lift-off and roll-on/roll-off cargo handling operations. The new T1 wharf will be 870 ft x 120 ft with two 36-ft-wide trestles of varying length. The new T2 wharf will be 932 ft x 120 ft with two 259-ft-long x 54-ft-wide trestles and one 259-ft-long x 76-ft-wide trestle. Both T1 and T2 wharves will be constructed using 72-inch-diameter steel piles. The T1 and T2 access trestles will be constructed using 48- and 72-inch-diameter steel piles. The 48-inch-diameter piles will be installed in the dry. Two 144-inch-diameter steel monopile mooring dolphins with associated mooring systems and access catwalks will be constructed, one on the south end of T1 and one on the north end of T2. Mooring dolphins, as their name implies, are used for mooring only and provide a place for a vessel to be secured by lines (ropes). Use of mooring dolphins helps control transverse and longitudinal movements of berthed vessels.

Both new terminals will be designed to accommodate lift-on/lift-off container operations serviced by rail-mounted ship-to-shore cranes. Structural, in-deck, and surface features to support operational interface for three 100-gauge rail mounted gantry cranes, and associated appurtenances along with an on-terminal combination stevedore-operations building, will be included on the wharf. Additionally, T2 will be designed to support roll-on/roll-off container operations and other multi-purpose cargo functions. The reinforced concrete deck structure for both new terminals and all new access trestles will be designed to 1,000 per square foot load capacity. Construction will also include installation of power, lighting, communications, and signal infrastructure to terminal and onshore electrically powered features; potable water service including ship's water; and fire-flow water for terminal-related operations. The on-terminal stevedore-operations building will also be constructed with a connection to the onshore, existing public utility infrastructure.

In addition to these permanent structures, temporary work including temporary pile installation and removal will be required to support construction. Temporary piles will likely be 36-inch-diameter steel, and marine mammal take calculations are based on that pile size; however, 24-inch steel piles may be used in place of some of the larger temporary piles. Various work boats and barges will be utilized and will be moored at or in the immediate vicinity of the Project.

During pile installation, it may become necessary to remove relic anode sleds. Old anode sleds are currently buried in the sediment behind the existing terminals. If an old sled is encountered in the footprint of a new pile to be installed, the anode sled will be excavated and removed. The excavated anode sled(s) will be hauled to an appropriate disposal location in an upland area. All other relic anode sleds will be abandoned in place.

Project component activities, locations, and approximate estimated quantities for 7 years (6 years of in-water construction) are summarized in Table 1-1, and each component is described in more detail below. For this Project, “in the dry” indicates a location that is above the high tide line or is in the intertidal zone but de-watered, with no standing water.

Table 1-1. Summary of Cargo Terminals Replacement Project Activities, Locations, and Quantities for 7 Years

Component Number	Type of Activity	Location	Size and Type	Total Amount or Number
1. Shoreline Stabilization				
	Placement of temporary construction work pads	In the dry In water	Granular fill and rock	61,400 cubic yards below HTL (3.5 acres)
	Ground Improvements	In the dry	Cementitious materials	Unknown
2. Shoreline Expansion and Protection				
	Excavation/dredging of silt	In the dry In water	Silt, granular fill, and rock	50,000 cubic yards
	Protect shoreline	In the dry	Granular fill and armor rock	61,400 cubic yards
3. General Cargo Terminals Construction				
	Installation of permanent piles	In water; in the dry	48-, 72-, and 144-inch steel pipe piles	363 piles
	Installation of temporary piles	In water; in the dry	36-inch steel pipe piles	674 piles
	Removal of temporary piles	In water; in the dry	36-inch steel pipe piles	236 piles
	Install concrete pile caps, deck, and utilities	Above water	Concrete, steel	281,535 square feet
4. Demolition of Existing Terminals (POL1 and Terminals 1, 2, and 3)				
	Demolish and remove concrete pile caps, deck, and utilities	POL1 and T1 Above water	Concrete, steel	173,798 square feet
	Cut piles at mudline or leave in place	POL1 and T1 In water, in the dry	16- to 42-inch steel pipe	1,508 piles
	Demolish and remove concrete pile caps, deck, and utilities	T2 and T3 Above water	Concrete, steel	159,677 square feet
	Cut piles at mudline or leave in place	T2 and T3 In water, in the dry	16- to 42-inch steel pipe	1,525 piles
5. Onshore Utilities and Storm Drain Outfall Replacement				
	Addition of electrical, water, and gas pipes and conduit	Above water, on land	Concrete, steel pipes	Unknown
	Addition of drain pipes and manholes	Above water, on land	Concrete, steel pipes	Unknown
	Addition of outflow pipe through armor rock	In water	Concrete, steel pipes	4 outfalls

Notes: HTL = high tide line; POL1 = Petroleum, Oil, and Lubricants Terminal 1; T1 = Terminal 1; T2 = Terminal 2; T3 = Terminal 3

1.5.1 Component 1. Ground Improvement Stabilization of the Shoreline

A ground improvement technique such as deep soil mixing (DSM) or a similar technique will be used to stabilize the shoreline. DSM and similar techniques mechanically mix weak soils with a cement binder, causing the soils to behave more like soft rock. This process is used to create foundations for buildings and roads and is used in earthquake-prone areas to prevent soil liquefaction. Liquefaction is a phenomenon that occurs when loosely packed water-logged sediments at or near the ground surface lose their strength in response to strong ground-shaking. Soil composition of the tidal flats adjacent to T1 and T2 exhibit potential for liquefaction and likelihood of large ground deformations during seismic events. Soil improvements at trestle abutments, and potentially between the abutments, will mitigate the potential for seismic-induced slope failure that could result in structural failure.

The first stage of construction will include installation of soil improvements in the five locations where the access trestles meet the beach to provide geotechnical stability to the embankment. Centered at each of the five trestle abutments, the ground improvement technique will create approximately 200- by 96-ft blocks of treated soil extending from the surface to the top of the clay layer approximately 85 ft deep (Figure 1-2). The size of the block is designed to create enough contact area with the clay layer to restrain and significantly reduce the overall ground movements of the liquefiable soils surrounding the trestle abutment. If deemed necessary for geotechnical stability, ground improvements will extend along the embankment in areas between the abutments.

The drilling process to conduct ground improvement will likely require containment and collection of the cement/soil slurry and spoils during construction. Drying beds will be constructed beyond the shoreline to contain the excess slurry until it can be disposed of off-site or incorporated into other portions of the Project. The drying beds will be removed once construction is completed.

During construction, a temporary soil work pad will be constructed at each of the five trestles to provide a level temporary work surface. The ground improvement panels/columns will extend approximately 100 ft seaward and shoreward of the crest of the slope and approximately 30 ft to either side of the trestle structure (Figure 1-2). Temporary armoring will protect the work pad from water forces while in use. After completion of the ground improvement work, the temporary construction work pads will be removed and the foreshore graded and armored. Placement of temporary work pads will take place on land or in the dry.

Ground improvement work will take place “in the dry,” either above the high tide line or in the intertidal zone but de-watered, with no standing water. No impacts on marine mammals are anticipated from ground improvement work. Take of marine mammals from ground improvement work and placement of temporary work pads is not requested.

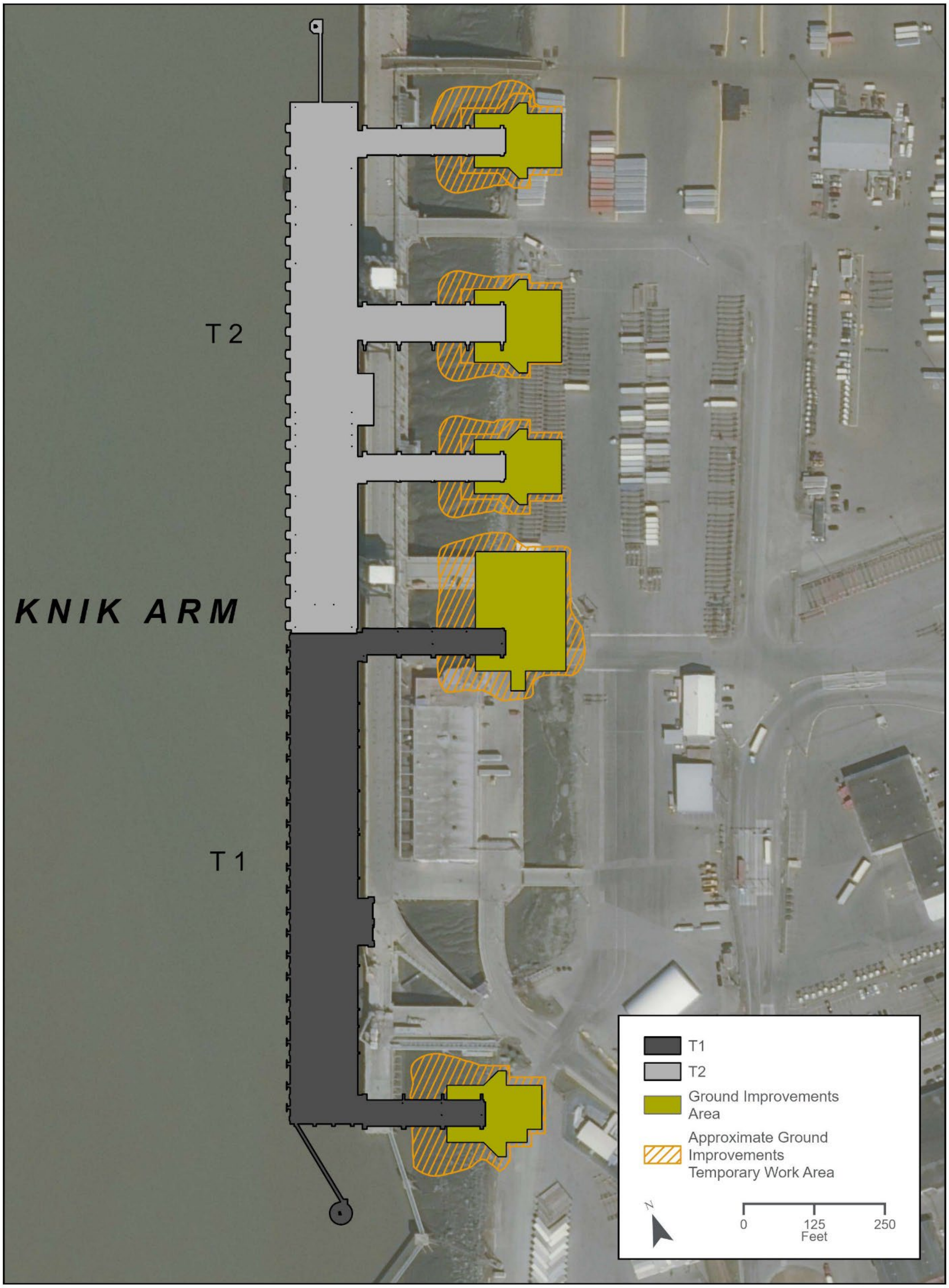

Figure 1-2. Component 1: Ground Improvement Locations and Approximate Areas

1.5.2 Component 2. Shoreline Expansion and Protection

The shoreline behind the existing Terminals 1, 2, and 3 is irregular, with two areas where the shoreline is located about 30 meters to the east of the typical shoreline (Figure 1-3). Areas that are above the high-water line or below the tide line in a dewatered state will be excavated from the landward side to remove deposited silts before the areas are then filled with more dense, stable materials such as clean granular fill and rock. If the material is unable to be excavated in the dry, it will be dredged. The filled area will provide a consistent shoreline and additional container storage area. See Table 1-1 for estimated quantities.

After ground improvement work and shoreline expansion have been completed, the slope along the shore will be secured with armor stone placed over the clean granular and rock fill. Placement of armor rock requires good visibility of the shore as each rock is placed carefully to interlock with surrounding armor rock. It is therefore anticipated that placement of most armor rock, filter rock, and granular fill will occur in the dry at low tide levels; however, some placement of armor rock, filter rock, and granular fill may occur in shallow water. After placement of armor rock, the top of the fill will be paved to match the existing backland pavements.

No impacts on marine mammals from expansion and protection of the shoreline, including excavation or dredging of silts and placement of granular fill, filter rock, and armor rock, are anticipated. Take of marine mammals from expansion and protection of the shoreline is therefore not requested.

A separate USACE permitting process is being undertaken by the POA to authorize dredging in areas affected by construction that cannot be accessed by the USACE annual maintenance dredging program.

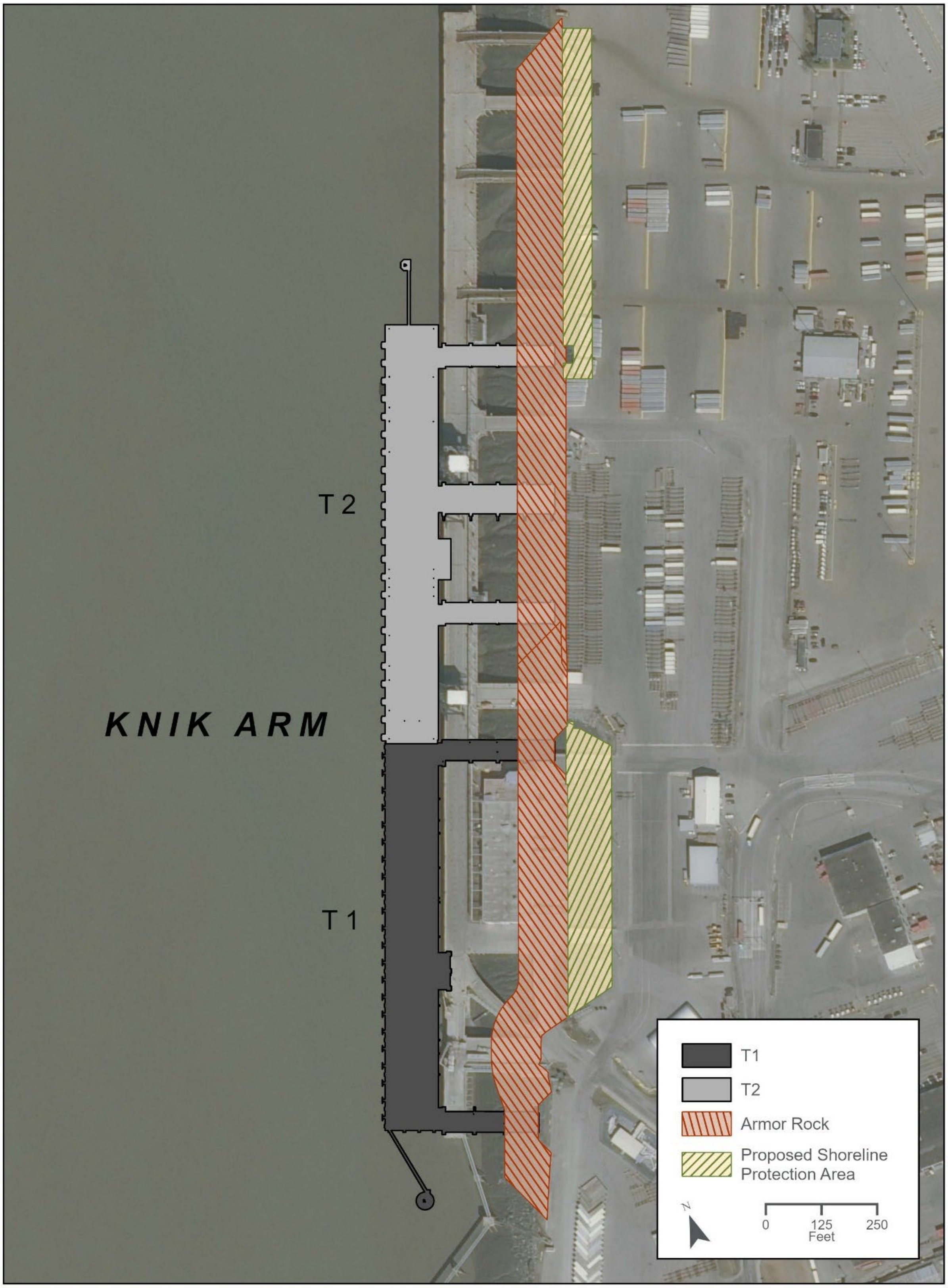

Figure 1-3. Component 2: Shoreline Expansion and Protection Areas

1.5.3 Component 3. General Cargo Terminals Construction

Two new cargo terminals will be constructed, T1 and T2, which include new wharves and access trestles (Figure 1-4). Pile installation and removal is anticipated to take place for the 6-year period starting in 2026. Other terminal construction activities above water and on land may occur year-round. Construction dates may change because of unexpected project delays, ongoing construction activities in other areas of the POA, timing of ice-out and spring breakup, and other factors. Project design and construction methods have been modified to achieve the least practicable adverse impact on marine mammals (see Section 1.3, Avoidance and Minimization of Project Impacts). Use of a bubble curtain during impact and vibratory installation of all permanent 72- and 144-inch piles, and during vibratory installation and removal of temporary piles during months with historically higher beluga whale abundance (August through October), will reduce propagation of sound in the water (see Section 1.5.3.3 Noise Mitigation for Pile Installation and Removal).

The two new terminals will be located 140 ft seaward of the existing Terminals 1, 2, and 3. New T1 and T2 will be pile-supported structures and their construction will occur over a period of six in-water construction seasons. Construction of each terminal will require installation and removal of temporary steel pipe piles, including template piles, and installation of permanent steel pipe piles. Pile installation will occur in water depths that range from a few feet or dry (dewatered) conditions nearest the shore to approximately 20 meters (70 ft) at the outer face of the wharves, depending on tidal stage; the mean diurnal tide range at the POA is approximately 8.0 meters (26 ft; NOAA 2015).

Construction activities will occur at multiple locations across the Project site simultaneously. It is anticipated that in-water pile installation and removal will occur at one or two locations; however, it is possible that installation and removal will occur at up to three locations at the same time. It is also possible that two or three hammers may be used to increase production rates, especially during months when beluga whale attendance is anticipated to be low. At most, two vibratory hammers will be simultaneously active in-water at any given time to minimize potential impacts on marine mammals due to the larger ensonified zones associated with simultaneous use of more than one vibratory hammer. Duration of active hammer use is anticipated to be brief each day (see next Section) and it is therefore anticipated that overlap in use of hammers will be uncommon. Pile installation and removal will occur intermittently over the work period, for durations of minutes to hours at a time. Use of two or three hammers (though no more than two vibratory at a time) will serve to reduce the overall duration of in-water pile installation and removal during each construction season, minimizing potential impacts on marine mammals, although this decrease cannot be quantified. One construction crane will likely be based on a floating work barge, and one will likely be based on land or on an access trestle.

It is important to note that T1 and T2 construction activities and components may change as the design is revised, construction contracts are awarded, and construction details are further refined. The Project description included in this application represents the planned approach for construction of T1 and T2. Actual field conditions may require minor adjustments to this construction approach to address issues that may arise due to constructability, construction phasing, safety, or encountering an erratic in the soil profile.

1.5.3.1 Pile Installation and Removal

Vibratory and impact hammers will be used for installation of 48-, 72-, and 144-inch permanent piles. Vibratory hammers will be used for installation and removal of 24- and/or 36-inch temporary piles. Some temporary and permanent steel pipe piles will be installed or removed in the dry, depending on construction sequencing and tide heights. To avoid potential impacts on marine mammals from in-water pile installation and removal, conducting these activities in the dry will be maximized as feasible. However, until the Construction Contractor and DOR for both terminals are under contract, the exact number of piles that may be installed and removed in the dry is unknown. It is anticipated that the permanent and temporary piles in the three bents nearest the shore for all five trestles will be installed in the dry at low tide levels. An additional bent will be installed in the dry for the northernmost trestle of T1 and for the three trestles of T2. Estimated numbers of piles of each size that will be installed and/or removed in the dry are presented in Table 1-2.

When a pile is installed or removed in the dry, it will be assumed that no exposure of marine mammals occurs to elevated sound levels that are defined as Level B harassment, and no take of marine mammals occurs. Take of marine mammals from pile installation and removal in the dry is therefore not requested, and marine mammal monitoring will not be conducted during pile installation and removal in the dry.

Although some piles will be installed or removed in the dry, it is anticipated that most piles will be installed or removed in water. The estimated total and annual numbers of in-water pile installations and removals are presented in Table 1-3 through Table 1-9. Table 1-10 presents the estimated monthly and annual distribution of in-water pile installation and removals. Installation and removal of piles in water with a vibratory or impact hammer will impart sound energy into the water that could rise to the level of harassment to marine mammals. Estimated potential take of marine mammals associated with pile installation and removal with an impact or vibratory hammer is described in Section 6. To avoid and minimize potential impacts of pile installation and removal on marine mammals, a minimum 100-meter shutdown zone will be implemented during all in-water pile installation and removal.

Estimates of installation and removal durations were calculated based on Wave Equation Analyses of Pile Driving specific to the Project as well as existing data from both PCT and SFD construction.

1.5.3.2 Pile Cutting

To avoid potential impacts on marine mammals from removal of temporary piles with a vibratory hammer, a majority of in-water temporary piles (approximately 90 percent) will be cut off at the mudline and remain in place, or will remain in place intact (without cutting). Temporary piles will be removed that conflict with construction or operations, or that can be removed in the dry. Leaving piles in place below the mudline supports stability of the soil. Also, many piles are corroded and may break during removal, with the lower part remaining in place. The existing structure is closer to shore than new construction, and many piles can be cut or removed in the dry when their location is dewatered.

The number of piles that will be cut or remain in place will be maximized as feasible. Restrictions on pile removal timing or methods will not be acceptable to the POA because progression of new construction will be contingent upon removal of some existing piles, and the details of that will be known only as construction unfolds. Additionally, the POA cannot prescribe means and methods to the Construction Contractor. Until the Construction Contractor and DOR for both terminals are under contract, the exact number of piles that may be cut or can remain in place is unknown. Impacts on marine mammals from pile cutting are not anticipated. Take of marine mammals from pile cutting is therefore not requested.

Table 1-2. Component 3: Pile Installation and Removal

Pile Diameter and Type	Number of Piles		
	In-water	In the Dry	Total Piling Events
Permanent Pile Installation			
48" Trestle	0	16	16
72" Wharf	284	0	284
72" Trestle	48	13	61
144" Monopile Mooring Dolphin	2	0	2
Total Number of Permanent Installations	334	29	363
Temporary Pile Installation and Removal			
36" Installation	513	161	674
36" Removal	75	161	236
Total Number of Temporary Installations and Removals	588	322	910
Project Total	**922**	**351**	**1,273**

Table 1-3. Component 3: Summary of Total Numbers and Types of In-water Piles to be Installed and Removed during Six Years of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal For All Years	Typical Production Rate in Piles per Day (range)
Total							
Permanent Pile Installation							
72" Wharf	284	86	5,743	10	96	169	1.7 (0.5–3)
72" Trestle	48	86	5,743	10	96	15	1.7 (0.5–3)
144" Monopile Mooring Dolphin	2	120	5,000	15	135	4	0.5 (0.2–1)
Total Number of Permanent Installations	**334**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	513	0	0	30	30	177	3 (2–4)
36" Removal	75	0	0	45	45	18	3 (2–4)
Total Number of Temporary Installations and Removals	**588**	-	-	-	-	-	-
Total	**922**	**28,792 (479.9 hours)**	**1,916,676**	**22,115 (368.6 hours)**	**50,907 (848.5 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor's means and methods.

Table 1-4. Component 3: Summary of Numbers and Types of In-water Piles to be Installed and Removed during Year 1 of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal for Year 1	Typical Production Rate in Piles per Day (range)
Year 1 (2026)							
Permanent Pile Installation							
72" Wharf	60	86	5,743	10	96	36	1.7 (0.5–3)
72" Trestle	9	86	5,743	10	96	4	1.7 (0.5–3)
144" Monopile Mooring Dolphin	0	120	5,000	15	135	0	0.5 (0.2–1)
Total Number of Permanent Installations	**69**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	75	0	0	30	30	25	3 (2–4)
36" Removal	8	0	0	45	45	3	3 (2–4)
Total Number of Temporary Installations and Removals	**83**	-	-	-	-	-	-
Total	**152**	**5,934 (98.9 hours)**	**396,267**	**3,300 (55.0 hours)**	**9,234 (153.9 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor's means and methods.

Table 1-5. Component 3: Summary of Numbers and Types of In-water Piles to be Installed and Removed during Year 2 of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal For Year 2	Typical Production Rate in Piles per Day (range)
Year 2 (2027)							
Permanent Pile Installation							
72" Wharf	61	86	5,743	10	96	36	1.7 (0.5–3)
72" Trestle	0	86	5,743	10	96	0	1.7 (0.5–3)
144" Monopile Mooring Dolphin	0	120	5,000	15	135	0	0.5 (0.2–1)
Total Number of Permanent Installations	**61**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	65	0	0	30	30	22	3 (2–4)
36" Removal	7	0	0	45	45	3	3 (2–4)
Total Number of Temporary Installations and Removals	**72**	-	-	-	-	-	-
Total	**133**	**5,246 (87.4 hours)**	**350,323**	**2,875 (47.9 hours)**	**8,121 (135.4 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor’s means and methods.

Table 1-6. Component 3: Summary of Numbers and Types of In-water Piles to be Installed and Removed during Year 3 of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal For Year 3	Typical Production Rate in Piles per Day (range)
Year 3 (2028)							
Permanent Pile Installation							
72" Wharf	18	86	5,743	10	96	11	1.7 (0.5–3)
72" Trestle	9	86	5,743	10	96	4	1.7 (0.5–3)
144" Monopile Mooring Dolphin	0	120	5,000	15	135	0	0.5 (0.2–1)
Total Number of Permanent Installations	**27**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	160	0	0	30	30	54	3 (2–4)
36" Removal	16	0	0	45	45	6	3 (2–4)
Total Number of Temporary Installations and Removals	**176**	-	-	-	-	-	-
Total	**203**	**2,322 (38.7 hours)**	**155,061**	**5,790 (96.5 hours)**	**8,112 (135.2 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor's means and methods.

Table 1-7. Component 3: Summary of Numbers and Types of In-water Piles to be Installed and Removed during Year 4 of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal For Year 4	Typical Production Rate in Piles per Day (range)
Year 4 (2029)							
Permanent Pile Installation							
72" Wharf	52	86	5,743	10	96	36	1.7 (0.5–3)
72" Trestle	9	86	5,743	10	96	3	1.7 (0.5–3)
144" Monopile Mooring Dolphin	0	120	5,000	15	135	0	0.5 (0.2–1)
Total Number of Permanent Installations	**61**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	70	0	0	30	30	24	3 (2–4)
36" Removal	7	0	0	45	45	3	3 (2–4)
Total Number of Temporary Installations and Removals	**77**	-	-	-	-	-	-
Total	**138**	**5,246 (87.4 hours)**	**350,323**	**3,025 (50.4 hours)**	**8,271 (137.9 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor’s means and methods.

Table 1-8. Component 3: Summary of Numbers and Types of In-water Piles to be Installed and Removed during Year 5 of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal For Year 5	Typical Production Rate in Piles per Day (range)
Year 5 (2030)							
Permanent Pile Installation							
72" Wharf	45	86	5,743	10	96	25	1.7 (0.5–3)
72" Trestle	12	86	5,743	10	96	4	1.7 (0.5–3)
144" Monopile Mooring Dolphin	0	120	5,000	15	135	0	0.5 (0.2–1)
Total Number of Permanent Installations	**57**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	80	0	0	30	30	34	3 (2–4)
36" Removal	8	0	0	45	45	4	3 (2–4)
Total Number of Temporary Installations and Removals	**88**	-	-	-	-	-	-
Total	**145**	**4,902 (81.7 hours)**	**327,351**	**3,330 (55.5 hours)**	**8,232 (137.2 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor's means and methods.

Table 1-9. Component 3: Summary of Numbers and Types of In-water Piles to be Installed and Removed during Year 6 of In-water Project Construction

Pile Diameter and Type	Number of Piles	Impact Duration per Pile (minutes)	Impact Strikes per Pile	Vibratory Duration per Pile (minutes)	Total Duration of Activity per Pile (impact minutes + vibratory minutes)	Total Days of Installation and Removal For Year 6	Typical Production Rate in Piles per Day (range)
Year 6 (2031)							
Permanent Pile Installation							
72" Wharf	48	86	5,743	10	96	29	1.7 (0.5–3)
72" Trestle	9	86	5,743	10	96	2	1.7 (0.5–3)
144" Monopile Mooring Dolphin	2	120	5,000	15	135	4	0.5 (0.2–1)
Total Number of Permanent Installations	**59**	-	-	-	-	-	-
Temporary Pile Installation and Removal							
36" Installation	63	0	0	30	30	20	3 (2–4)
36" Removal	29	0	0	45	45	2	3 (2–4)
Total Number of Temporary Installations and Removals	**92**	-	-	-	-	-	-
Total	**151**	**5,142 (85.7 hours)**	**337,351**	**3,795 (63.3 hours)**	**8,937 (149.0 hours)**	-	-

Note: For all years, pile sizes, and hammer types, the durations of hammer use and numbers of strikes are estimated averages and may be higher or lower based on the Contractor's means and methods.

While the exact sequence of construction is not known, Table 1-10 shows an estimated schedule of pile installation and removal. The POA is aware that August through October are months with high beluga whale abundance and plans to complete in-water work as early in the construction season as possible. The POA also recognizes that more work shutdowns for beluga whales are likely to take place in high abundance months, which provides incentive to complete work earlier in the season. This schedule is an estimate based on best available information and is not intended to be a limitation on the number of pile installation or removal hours that may occur in any given month or year. Table 1-10 has been used to estimate beluga whale potential exposure (take) in Section 6.5.5. If there are significant changes to the construction schedule, the POA will confer with NMFS to determine if modifications to the LOA/IHA or re-initiation of Section 7 consultation are necessary or required.

Table 1-10. Estimated Annual and Monthly Distribution of In-water Pile Installation and Removal for Component 3

Number of Piles									
Year 1	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
24- or 36-Inch Temporary Pile Installation	5	12	12	12	12	12	6	4	75
24- or 36-Inch Temporary Pile Removal	1	1	1	1	1	1	1	1	8
72-Inch Permanent Pile Installation	5	11	11	11	9	9	9	4	69
144-Inch Permanent Pile Installation	0	0	0	0	0	0	0	0	0
Year 2	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
24- or 36-Inch Temporary Pile Installation	6	10	10	10	10	10	5	4	65
24- or 36-Inch Temporary Pile Removal	1	1	1	1	1	1	1	0	7
72-Inch Permanent Pile Installation	5	9	9	9	9	8	8	4	61
144-Inch Permanent Pile Installation	0	0	0	0	0	0	0	0	0
Year 3	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
24- or 36-Inch Temporary Pile Installation	13	26	26	26	26	26	13	4	160
24- or 36-Inch Temporary Pile Removal	1	3	3	3	2	2	1	1	16
72-Inch Permanent Pile Installation	4	4	4	3	3	3	3	3	27
144-Inch Permanent Pile Installation	0	0	0	0	0	0	0	0	0
Year 4	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
24- or 36-Inch Temporary Pile Installation	5	11	11	12	11	11	5	4	70
24- or 36-Inch Temporary Pile Removal	1	1	1	1	1	1	1	0	7
72-Inch Permanent Pile Installation	5	9	9	9	9	8	8	4	61
144-Inch Permanent Pile Installation	0	0	0	0	0	0	0	0	0
Year 5	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
24- or 36-Inch Temporary Pile Installation	5	12	12	12	12	11	11	5	80
24- or 36-Inch Temporary Pile Removal	1	1	1	1	1	1	1	1	8
72-Inch Permanent Pile Installation	3	9	9	9	8	8	8	3	57
144-Inch Permanent Pile Installation	0	0	0	0	0	0	0	0	0
Year 6	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
24- or 36-Inch Temporary Pile Installation	5	10	10	10	10	10	4	4	63
24- or 36-Inch Temporary Pile Removal	1	1	1	1	1	4	10	10	29
72-Inch Permanent Pile Installation	3	9	9	9	8	8	8	3	57
144-Inch Permanent Pile Installation	0		2		0	0	0	0	2

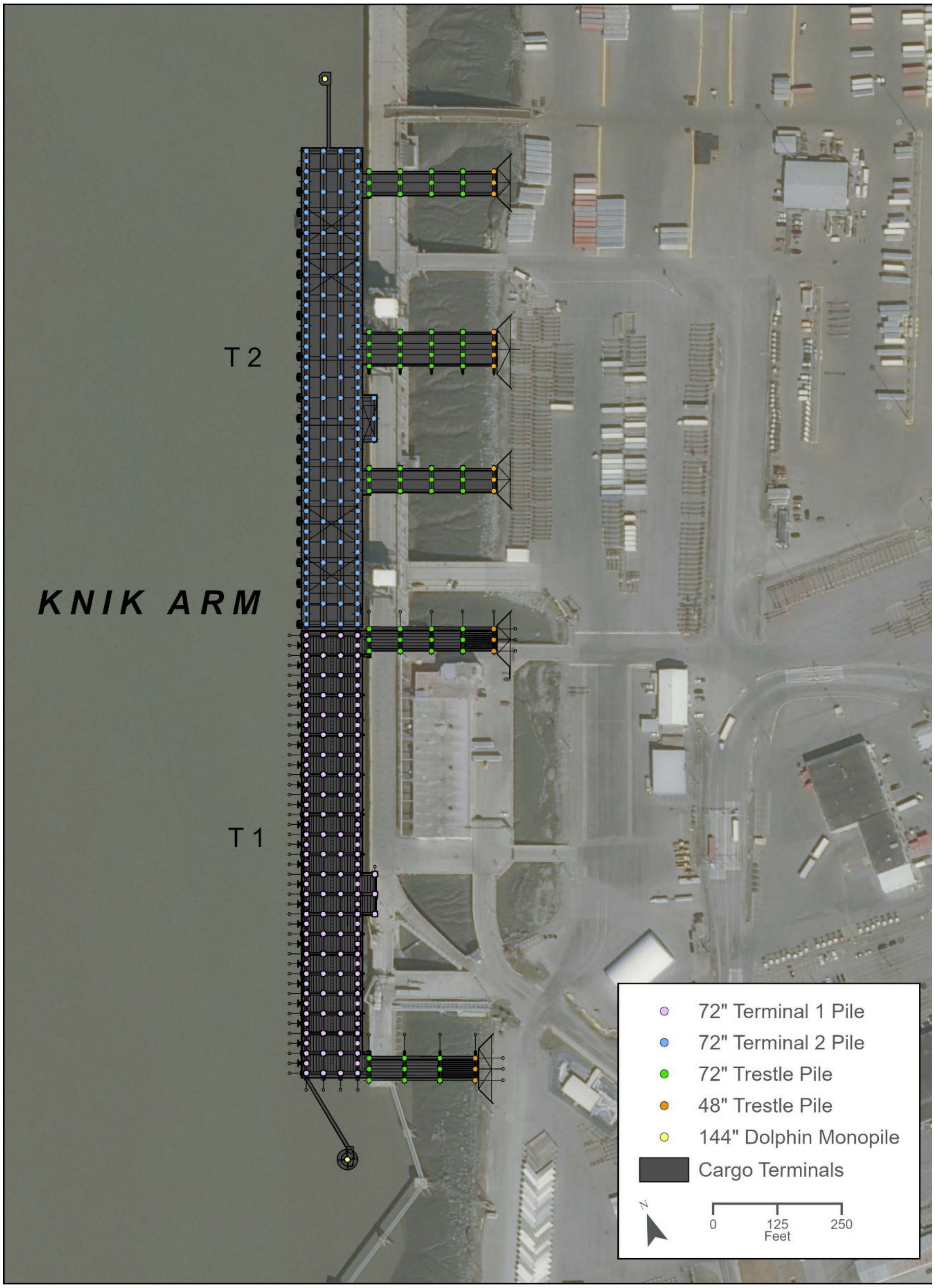

Figure 1-4. Component 3: Overview of the New Terminal 1 (T1) and Terminal 2 (T2)

1.5.3.3 Noise Mitigation for Pile Installation and Removal

The POA has collected sound measurements during pile installation and removal for 3 seasons (Austin et al. 2016; Illingworth & Rodkin [I&R] 2021a, 2021b); a summary of these data and findings can be found in Appendix A of this application. A confined air bubble curtain noise attenuation system (confined bubble curtain) was tested in 2016 during the PAMP Test Pile Program (TPP) for 48-inch piles (Austin et al. 2016). During the 2016 TPP, the POA was authorized by NMFS to measure bubble curtain performance. Two of the test piles were installed without a bubble curtain, which allowed direct comparison of sound pressure levels with those produced by piles installed with a bubble curtain. Additionally, a third test pile was installed with an on-off test, which allowed comparison of sound pressure levels between those two conditions (bubble curtain on and bubble curtain off) without the confounding effects of differences between piles. During the PCT project in 2020, a confined bubble curtain was used during installation and removal of 36-inch and installation of 48-inch plumb (vertical) piles; and in 2021, an unconfined air bubble curtain noise attenuation system (unconfined bubble curtain) was used during installation and removal of 36-inch piles and during installation of 144-inch piles (I&R 2021a, 2021b). Unfortunately, the POA was not authorized to collect data on unattenuated pile installation during the PCT project. Therefore, the efficacy of the bubble curtains used during the that project is difficult to evaluate in comparison with unattenuated piles, for which sound levels were estimated based on other project locations, but not measured for the POA.

Vibratory Driving

The TPP found that for vibratory installation of 48-inch piles, an air bubble curtain provided about a 9-decibel (dB) reduction at 10 meters. The PCT 2020 measurements indicated 2 to 8 dB reduction for the 48-inch piles at 10 meters (I&R 2021a). No apparent reduction was found in the far-field at about 2,800 meters for the PCT. An 8-dB reduction at close-in positions was estimated for vibratory pile driving that occurred during the PCT project in 2021 (I&R 2021b). Again, no apparent reduction could be confirmed at the far distances. While vibratory sounds were reduced at frequencies above 100 Hertz (Hz) in the acoustic far field, the overall distant sound levels were characterized by very low frequency sound at or below 100 Hz. There is no strong evidence that air bubble curtains reduce sound from vibratory driving effectively at very far distances when considering the very-low-frequency components of sound that make up the overall sound levels.

Use of bubble curtains during vibratory pile installation is not standard industry practice, and the POA is unaware of data or studies that demonstrate efficacy of this practice in the far-field. However, NMFS has requested that the POA use bubble curtains during vibratory pile installation and removal during the months of peak beluga whale abundance to reduce the potential exposure of beluga whales to higher frequency noise. The POA does not associate meaningful protection of beluga whales with reducing noise levels within the Level B zone for vibratory hammer use because the Level B zone is implemented as the shutdown zone for beluga whales for POA projects. Beluga whales rarely enter the Level B shutdown zone before shutdown occurs, and any potential exposure to elevated sound levels would be very minimal (i.e., barely audible sound) and very brief.

Based on the request from NMFS to use a bubble curtain during vibratory pile installation and removal during the months of peak beluga whale abundance, the POA proposes to use an air bubble curtain system on all piles, temporary and permanent, during months with historically higher beluga whale abundance (August through October) when water depth is greater than 3 meters. The POA will not plan to use an air bubble curtain system on piles installed or removed with a vibratory hammer in November, when beluga whale abundance declines in the project area (see Section 6.5.5). The POA will not plan to use an air bubble curtain on temporary piles installed or removed with a vibratory hammer during the months of April, May, June, July, and November, when beluga whale abundance in the Project area is lower.

Impact Driving

The TPP measured reductions of 9 to 12 dB for a 48-inch pile using an air bubble curtain. The PCT 2020 measurements (I&R 2021a) found reductions of about 10 dB when comparing the attenuated conditions that occurred with that project to unattenuated conditions for the TPP. As with the TPP, there appeared to be less reduction in the very far field. The TPP did not report the reduction in sound levels in the acoustic very far field; however, the computed distances to the 125 dB root-mean-square (rms) levels were essentially reduced by half with the air bubble curtain (from 1,291 to 698 meters). The PCT 2021 (I&R 2021b) measurements were conducted for impact driving of 144-inch piles. Since there was no unattenuated condition measured, the sound reduction could not be identified from the measured data.

For impact pile installation for the CTR Project, it is assumed that a well-designed and robust bubble curtain system will achieve a mean reduction of 7 dB near the source and 7 dB away from the source (i.e., beyond 500 meters). The POA plans to use an air bubble curtain system on all permanent piles, which will be installed with both vibratory and impact hammers. The bubble curtain by necessity will be installed around each permanent pile as it is stabbed and set, and therefore the bubble curtain will be available as a mitigation measure to reduce sound levels throughout each driving event for permanent 72- and 144-inch piles when water depth is greater than 3 meters.

In all previous years of the PAMP, bubble curtains were not used on battered piles (piles installed at an angle). Additionally, bubble curtains were not used on piles installed or removed in shallow water less than 3 meters deep or piles installed or removed “in the dry” (e.g., at times when the tide is low and the pile’s location is dewatered). The tides at the POA have a mean range of about 8.0 meters (26 ft; NOAA 2015), and low water levels prevent proper deployment and function of a bubble curtain system.

When a pile was installed or removed in the dry, it was assumed that no exposure to sound that is defined as incidental harassment occurred and that no take of marine mammals occurred. When the pile was in water but the water was too shallow for deployment of a bubble curtain, the harassment zones for unattenuated pile installation were monitored, and potential for exposure to elevated sound levels was documented for these zones as required by the PCT IHA (85 *Federal Register* [FR] 19294, 86 FR 50057). The same assumptions and approach to mitigation associated with use of a bubble curtain will be used for this Project (Section 11).

1.5.4 Component 4. Demolition of Existing Terminals

Once the new T1, T2, and petroleum products transfer system are complete and operational, any remaining existing Terminal 1, Terminal 2, and POL1 platforms, wharves, and trestles will be dismantled (Figure 1-5). All temporary work structures will be removed. Existing permanent piles and most temporary piles will be cut and removed or left in place to avoid potential impacts on marine mammals in lieu of removal with a vibratory hammer.

Terminal 3 may be partially demolished during Phase 2B construction of T1 and T2, especially where the existing infrastructure may interfere with new construction. Elements of T3 that persist after Phase 2B is complete will remain in place until Phase 5, when they will be removed under a separate permitting process.

The selection of construction equipment by the contractor, including cranes and barges, will determine the plans and sequencing for demolition. Portions of the existing terminals may be used for construction phasing and as support platforms for ongoing new construction, as feasible.

Demolition will take place above the water, and demolished decking, pipes, and other superstructure materials will be contained before they fall into the water following best management practices. Demolished materials will be removed by barge or truck. Because work will take place out of water with best management practices in place to limit any release of material into Cook Inlet, in addition to cutting off or leaving existing piles in place, impacts on marine mammals from demolition of the existing terminals are not anticipated. Take of marine mammals from demolition is therefore not requested.

Figure 1-5. Component 4: Demolition of Existing Terminals

1.5.5 Component 5. Onshore Utilities and Storm Drain Outfall Replacement

The replacement of onshore utilities will involve construction on land and replacement of utilities above the high tide line, on land. No in-water work is anticipated as part of this component. Impacts on marine mammals from replacement of utilities are not anticipated. Take of marine mammals from replacement of utilities is therefore not requested.

The storm drain outfall replacement will involve construction on land and replacement of four outfall pipes above the high tide line, on land. No in-water work is anticipated as part of this component. Impacts on marine mammals from storm drain outfall replacement are not anticipated. Take of marine mammals from storm drain outfall replacement is therefore not requested.

1.6 Construction and Schedule Considerations

The CTR Project will require a full construction season each year for successful completion. A typical construction season at the POA extends from approximately mid-April to mid-October (6 months) and may include November. Exact dates of ice-out in the spring and formation of new ice in the fall vary from year to year and cannot be predicted with accuracy. In-water pile installation and removal generally cannot occur during the winter months when ice is present because of the hazards associated with moving ice floes that change directions four times per day, preventing the use of tugs, barges, workboats, and other vessels. Ice movement also prevents accurate placement of piles.

Restricting the POA from completing in-water pile installation and removal in months with historically higher beluga whale abundance (August through October) is impracticable and would force the CTR Project into one or more additional seasons of in-water construction. This would have severe negative repercussions on Project and program funding, in addition to potentially impacting marine mammals over a greater number of construction seasons.

Additional in-water construction seasons would require additional mobilization and demobilization of the contractor's equipment spreads. The POA would also face added costs for price escalation and extended general conditions and overhead for both the contractor and the construction supervision team. This would require the unplanned use of funding currently earmarked for future PAMP projects. Extending the CTR Project into one or more additional construction seasons would also potentially have severe negative impacts on the overall PAMP schedule. The replacement of T1 is scheduled to begin in 2025, with in-water work beginning in 2026. The fiscal and logistical (i.e., port operations) impacts on the POA of extending the in-water CTR work into additional seasons would prevent the POA from being able to complete the T1 replacement project on schedule and would delay the start of construction on T2, which would delay funding and/or completion of both T1 and T2. Potential consequences of delay include de-rating of the structural capacity of the existing cargo terminals, a shutdown of dock operations due to deteriorated conditions, or an actual collapse of one or more dock structures. Any of these scenarios could have dire consequences for the populations of Anchorage and Alaska who are served by the POA. The potential for collapse increases with schedule delays due to both worsening deterioration and the higher probability of a significant seismic event occurring before T1 and T2 replacement.

1.7 Applicable Federal Regulations

The following federal regulations are applicable to in-water work addressed by this application:

- U.S. Army Corps of Engineers (USACE) Section 10 of the Rivers and Harbors Act of 1899
- USACE Section 404 of the Clean Water Act of 1972
- USACE Section 408 of the Rivers and Harbors Act
- Section 401 of the Clean Water Act
- Endangered Species Act (ESA) Section 7 Consultation
- MMPA
- Magnuson-Stevens Fishery Conservation and Management Act

Section 2. Dates, Durations, and Specified Geographic Region

2.1 Dates and Durations

2.1.1 Dates

The POA requests a rulemaking and 5-year LOA that will be finalized and issued on or before 01 February 2025. While the Port understands that requesting an LOA a year in advance of construction may not be typical, other pending federal "actions" are reliant upon issuance of the LOA at the earliest date possible in 2025. Permit applications have already been submitted to USACE Civil Works Division and USACE Regulatory Division for preparatory work starting in 2025, and potential federal grant awards could start as early as 2025. These other federal "actions" require NEPA compliance, which requires a Biological Opinion (BiOp) under the ESA formal Section 7 consultation process, as do the LOA and IHA, inclusive of an Incidental Take Statement (ITS). Without the MMPA incidental take authorization, NMFS ESA will not be able to issue the BiOp with the ITS in order to complete other NEPA actions for funding and landside construction work starting in 2025. The POA requests that a BiOp be issued by 29 January 2025.

The in-water work with potential impacts on marine mammals for the Project will occur over 6 years, and therefore the POA requests that the LOA is valid for 5 years, from 01 April 2026 through 31 March 2031, and that the IHA is valid for 1 year, from 01 April 2031 through 31 March 2032.

2.1.2 Durations

CTR in-water construction with potential impacts on marine mammals is scheduled to begin on 01 April 2026 and continue through 30 November of each of the 6 years, 2026 through 2031. These dates are estimates and may shift as contracting details, starting dates, ice-free conditions, production rates, and other factors vary. The POA therefore requests a rulemaking and LOA for 5 years that is valid from 01 April 2026 through 31 March 2031 and an IHA that is valid for 1 year, from 01 April 2031 through 31 March 2032.

2.2 Geographic Region

The following sections describe the overall geographical region of the CTR Project site, comprised of the physical, acoustical, and biological environments. Aspects of the biological environment considered include Essential Fish Habitat (EFH), fish, and invertebrates.

The Municipality of Anchorage (MOA) is located in the lower reaches of Knik Arm of upper Cook Inlet (Figure 2-1). The POA sits on 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). Knik Arm and Turnagain Arm are the two branches of upper Cook Inlet, and Anchorage is located where the two arms join (Figure 2-1). The POA occupies approximately 129 acres adjacent to downtown Anchorage, which is the state's largest population and transportation center.

The POA is located adjacent to Joint Base Elmendorf-Richardson (JBER; Figure 2-2) and is Alaska's only National Commercial Strategic Seaport designated by the U.S. Department of Defense, in conjunction with the U.S. Maritime Administration (MARAD), an agency of the U.S. Department of Transportation. POA is an integrated component of Department of Defense supply, mobilization, and other military activities for the region. The Commercial Strategic Seaport designation integrates the POA into MARAD's National Port Readiness Network (NPRN). The NPRN "is a cooperative designed to ensure readiness of commercial ports to support force deployment during contingencies and other national defense emergencies" (MARAD 2021).

2.2.1 Physical Environment

Cook Inlet is a large tidal estuary that exchanges waters at its mouth with the Gulf of Alaska. The inlet is roughly 20,000 square kilometers (km^2; 7,700 square miles [mi^2]) in area, with approximately 1,350 linear kilometers (840 mi) of coastline (Rugh et al. 2000) and an average depth of approximately 100 meters (330 ft). Cook Inlet is generally divided into upper and lower regions by the East and West Forelands. Freshwater input to Cook Inlet comes from snowmelt and rivers, many of which are glacially fed and carry high sediment loads. Currents throughout Cook Inlet are strong and tidally periodic, with average velocities ranging from 3 to 6 knots (Sharma and Burrell 1970). Extensive tidal mudflats occur throughout Cook Inlet, especially in the upper reaches, and are exposed at low tides.

Cook Inlet is a seismically active region susceptible to earthquakes and has some of the highest tides in North America (NOAA 2015) that drive surface circulation. Cook Inlet contains substantial quantities of mineral resources including coal, oil, and natural gas. During winter, sea, beach, and river ice are dominant physical forces within Cook Inlet. In upper Cook Inlet, sea ice generally forms in October to November and continues to develop through February or March (Moore et al. 2000).

Northern Cook Inlet bifurcates into Knik Arm to the north and Turnagain Arm to the east (Figure 2-1). Knik Arm is generally considered to begin at Point Woronzof, 7.4 km (4.6 mi) southwest of the POA. From Point Woronzof, Knik Arm extends about 48 km (30 mi) in a north-northeasterly direction to the mouths of the Matanuska and Knik rivers. At Cairn Point, just northeast of the POA, Knik Arm narrows to about 2.4 km (1.5 mi) before widening to as much as 8 km (5 mi) at the tidal flats northwest of Eagle Bay at the mouth of Eagle River.

Knik Arm comprises narrow channels flanked by large tidal flats composed of sand, mud, or gravel, depending upon location. Approximately 60 percent of Knik Arm is exposed at mean lower low water (MLLW). The intertidal (tidally influenced) areas of Knik Arm are mudflats, both vegetated and unvegetated, which consist primarily of fine, silt-sized 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. Surface waters in Cook Inlet typically carry high silt and sediment loads, particularly during summer, making Knik Arm an extremely silty, turbid waterbody with low visibility through the water column. The Matanuska and Knik rivers contribute the majority of fresh water and suspended sediment into Knik Arm during summer. Smaller rivers and creeks also enter along the sides of Knik Arm (U.S. Department of Transportation and Port of Anchorage 2008).

Tides in Cook Inlet are semidiurnal, with two unequal high and low tides per tidal day (tidal day = 24 hours, 50 minutes). Due to Knik Arm's predominantly shallow depths and narrow widths, tides near Anchorage are greater than those in the main body of Cook Inlet. The tides at the POA have a mean range of about 8.0 meters (26 ft), and the maximum water level has been measured at more than 12.5 meters (41 ft) at the Anchorage station (NOAA 2015). Maximum current speeds in Knik Arm, observed during spring ebb tide, exceed 7 knots (12 ft/second). These tides result in strong currents in alternating directions through Knik Arm and a well-mixed water column. The navigation harbor at the POA is a dredged basin in the natural tidal flat. Sediment loads in upper Cook Inlet can be high; spring thaws occur and accompanying river discharges introduce considerable amounts of sediment into the system (Ebersole and Raad 2004). Natural sedimentation processes act to continuously infill the dredged basin each spring and summer.

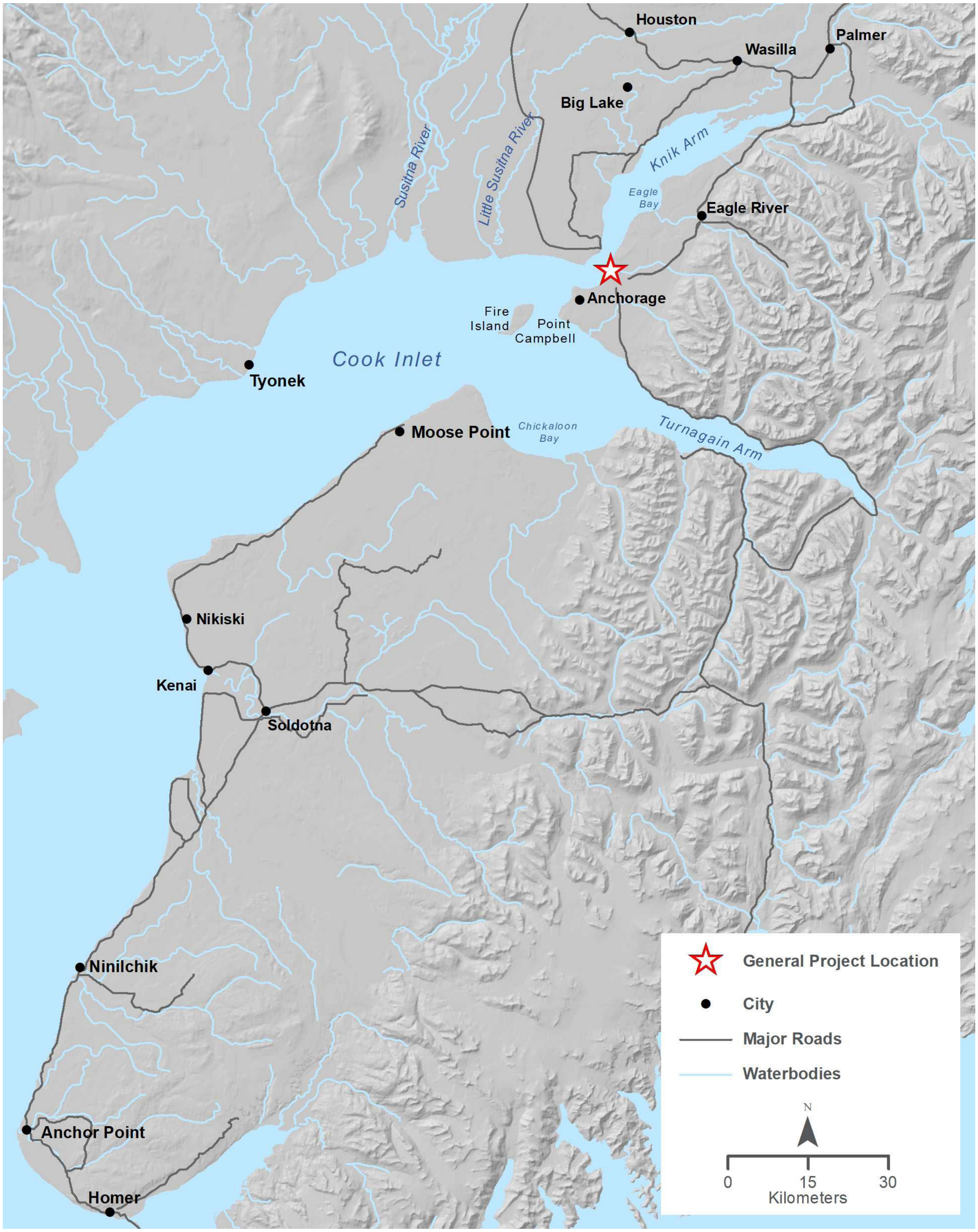

Figure 2-1. Overview of Location of Anchorage in Knik Arm and Upper Cook Inlet

Figure 2-2. Overview of Knik Arm and Location of the POA

The POA's boundaries currently occupy an area of approximately 129 acres. Other commercial and industrial activities related to secured maritime operations are located near the POA on ARRC property immediately south of the POA, on approximately 111 acres at a similar elevation. The POA is located north of Ship Creek, an area that experiences concentrated marine mammal activity during seasonal runs of several salmon species. Ship Creek serves as an important recreational fishing resource and is stocked twice each summer. Ship Creek flows into Knik Arm through the MOA industrial area. JBER is located east of the POA, approximately 30.5 meters (100 ft) higher in elevation. The U.S. Army Defense Fuel Support Point-Anchorage site is located east of the POA, south of JBER, and north of ARRC property. The perpendicular distance to the west bank directly across Knik Arm from the POA is approximately 4.2 km (2.6 mi). The distance from the POA (east side) to nearby Port MacKenzie (west side) is approximately 4.9 km (3.0 mi).

2.2.2 Acoustical Environment

The physical characteristics of Knik Arm contribute to elevated ambient sound levels due to noise produced by winds and tides (Section 2.2.1). The lower range of broadband (10 to 10,000 Hz) background sound levels obtained during underwater measurements at Port MacKenzie, located across Knik Arm from the POA, ranged from 115 to 133 dB referenced to 1 microPascal (dB re 1 µPa; Blackwell 2005). All underwater sound levels in this application are referenced to 1 µPa. Background sound levels measured during the 2007 test pile study for the POA's Marine Terminal Redevelopment Project (MTRP) site ranged from 105 to 135 dB (URS Corporation [URS] 2007). The ambient background sound pressure levels (SPLs) obtained in that study were highly variable, with most SPL recordings exceeding 120 dB. Background sound levels measured in 2008 at the MTRP site ranged from 120 to 150 dB (Scientific Fishery Systems, Inc. 2009). These measurements included industrial sounds from maritime operations, but ongoing USACE maintenance dredging and pile installation and removal from construction were not underway at the time of the study.

Ambient sound levels were measured at the POA from the PAMP 2016 TPP, when ambient sound recordings were measured at two locations during a 3-day break in pile installation. Median ambient noise levels, measured at a location just offshore of the POA SFD and at a second location about 1 km offshore, were 117.0 and 122.2 dB, respectively (Austin et al. 2016; POA 2016a). The two IHAs for Phase 1 and Phase 2 of the 2020 PCT issued by NMFS in April 2020 (85 FR 19294) and the IHA for the SFD issued by NMFS in August 2021 (86 FR 50057) both used 122.2 dB as ambient noise. A recent sound source verification (SSV) study conducted in 2020 at the PCT did not directly measure ambient noise but did not indicate that ambient noise levels were significantly different from 122.2 dB (James Reyff, personal communication, 26 August 2020).

2.2.3 Biological Environment

2.2.3.1 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act defines EFH as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Act notes that:

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

EFH is defined by textual and spatial descriptions in the fishery management plans developed by fishery management councils. In Alaska, marine EFH for salmon includes all estuarine and marine areas utilized by salmon of Alaska origin, extending from the influence of tidewater and tidally submerged habitats to the limits of the U.S. Exclusive Economic Zone; marine habitat extends from the mean high water (MHW) line to the 200-nautical-mile limit offshore; and the estuarine component includes the area within the MHW line and the salinity transition zone within nearshore waters (NMFS 2005). The North Pacific Fishery Management Council (NPFMC) identifies habitat in Cook Inlet as essential for Pacific salmon and several groundfish species (NPFMC 2020, 2021). Estuarine and marine waters in the vicinity of the Port provide EFH for all stages of Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), sockeye (*O. nerka*), and pink salmon (*O. gorbuscha*) (NPFMC 2021). Freshwater streams, lakes, ponds, wetlands, and other water bodies that support Pacific salmon, as identified by the Alaska Department of Fish and Game (ADF&G) *Anadromous Waters Catalog*, are also considered EFH. Habitat areas of particular concern are areas of special importance that may require additional protection from adverse effects. There are no designated habitat areas of particular concern in the vicinity of the POA.

Researchers have captured salmon, low numbers of Pacific cod (*Gadus macrocephalus*), walleye pollock (*Theragra chalcogramma*), eulachon (*Thaleichthys pacificus*), and saffron cod (*Eleginus gracilis*) in upper Cook Inlet, all of which are primary prey species for the Cook Inlet beluga whale (*Delphinapterus leucas*) (Houghton et al. 2005; NMFS 2016). Based on available general distribution data, estuarine and marine waters in the vicinity of the POA are designated as EFH for Pacific cod, walleye pollock, sablefish (*Anoplopoma fimbria*), yellowfin sole (*Limanda aspera*), northern rock sole (*Lepidopsetta polyxystra*), southern rock sole (*Lepidopsetta billineta*), Alaska plaice (*Pleuronectes quadrituberculatus*), rex sole (*Glyptocephalus zachirus*), and flathead sole (*Hippoglossoides elassodon*) larvae and Alaska plaice and dover sole (*Microstomus pacificus*) eggs, all of which may occur in summer; and adult Kamchatka flounder (*Atheresthes evermanni*), which may occur in spring (NPFMC 2020; NOAA 2022a). Available data are insufficient to identify EFH for species in the forage fish complex (e.g., eulachon) (M. Eagleton, personal communication, 07 September 2016; NPFMC 2020).

Details of EFH and the life stages of Fishery Management Plan-managed fish species can be found in the *Port of Alaska Modernization Program Essential Fish Habitat Technical Report – Cargo Terminals Replacement Project* (POA 2022).

2.2.3.2 Fish

All fish species in Knik Arm are important to the diets of marine mammals, and many are important to recreational sport fishing as catch or prey. The seasonal fish resources in upper Cook Inlet are generally characterized by the spring to fall availability of migratory eulachon, out-migrating salmon smolt, and returning adult salmon, with variable species abundance and distribution throughout summer (Moore et al. 2000). Survey data indicate that Knik Arm, including in the vicinity of the POA, provides migration, rearing, and foraging habitat to a wide diversity of marine and anadromous fish (Federal Highway Administration and Alaska Department of Transportation and Public Facilities 1983; Houghton et al. 2005). NMFS determined that Chinook, sockeye, chum, and coho salmon; Pacific eulachon; Pacific cod; walleye pollock; saffron cod; and yellowfin sole are primary prey species that are essential to the conservation of the Cook Inlet beluga whale (NMFS 2016).

Biologists captured a total of 19 fish species in Knik Arm during nearshore beach seine and mid-channel surface tow net surveys in 2004 and 2005 (Houghton et al. 2005). Juvenile salmon (five species combined), three-spine stickleback (*Gasterosteus aculeatus*), saffron cod, and eulachon were among the most abundant species captured (Houghton et al. 2005).

Coho salmon was the most abundant juvenile salmon species in April; abundance increased to a peak in July before declining, with smaller numbers present in the nearshore Knik Arm through November (Houghton et al. 2005). Coho, and to a lesser degree sockeye salmon, had the largest and longest presence in Knik Arm of the juvenile salmonids. Juvenile pink and chum salmon had the shortest residency time in Knik Arm compared to other salmon species. Relatively small numbers of juvenile pink and chum salmon were captured in April; numbers peaked in May and June before declining sharply (Houghton et al. 2005). Juvenile Chinook salmon were captured in April; numbers increased to a peak in June and declined in

August, with few present through October 2004. Juvenile Chinook salmon captured from between Cairn Point and Point Woronzof were primarily of William Jack Hernandez Sport Fish Hatchery origin (Houghton et al. 2005). Few sockeye were observed in Knik Arm before May, but sockeye were abundant from June through August before declining in September and October (Houghton et al. 2005).

Tow net surveys confirmed the presence of substantial numbers of juvenile salmon throughout the open waters of Knik Arm (Houghton et al. 2005). Juvenile pink and chum salmon were more abundant in mid-channel tow net sampling than nearshore beach seining, which suggests that they may not have a strong association with shorelines in Knik Arm. Higher catches of juvenile coho and Chinook salmon in beach seines, as compared to tow net survey catches, suggest a closer association with shoreline habitat in Knik Arm. The numbers of juvenile sockeye salmon captured during tow net surveys as compared to beach seine hauls did not differ substantially (Houghton et al. 2005).

Based on the spring 1983 and 2004–2005 sampling efforts, Houghton et al. (2005) suggested that the species most likely to contribute to beluga whale diets in Knik Arm include:

- April: Eulachon, saffron cod
- May: Eulachon, Chinook salmon, saffron cod
- June: Chinook salmon, saffron cod (questionable)
- July: Pink, chum, sockeye, and coho salmon
- August: Coho salmon, saffron cod
- September: Saffron cod, longfin smelt
- October: Saffron cod, longfin smelt
- November: Saffron cod

2.2.3.3 Zooplankton and Invertebrates

Fish and benthos sampling was conducted around the POA and north to Eagle Bay from July through November 2004 and from April through September 2005 (Houghton et al. 2005). These studies concluded that the area around the POA supports low benthic primary productivity, except for small patches of macroalgae (rockweed and annual green algae), which were present on occasional boulders and riprap and in tidal marshes. Plankton samples included three species of copepods, four species of amphipods, one species of mysid, and several additional classes, orders, and families of freshwater invertebrates. The zooplankton samples were generally characterized by eight primary taxonomic groups including *Crangon* shrimp (spp.), copepods, amphipods, mysids, fish and larval fish, isopods, terrestrial invertebrates, and a marine polychaete (*N. limnicola*). Overall, the most abundant group captured was 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 (Houghton et al. 2005).

Section 3. Species and Numbers of Marine Mammals

Marine mammals most likely to be observed within the upper Cook Inlet Project area include harbor seals (*Phoca vitulina*), beluga whales, and harbor porpoises (*Phocoena phocoena*; NMFS 2003; Table 3-1). Species that may be encountered rarely or occasionally within the Project area are killer whales (*Orcinus orca*), humpback whales (*Megaptera novaeangliae*), gray whales (*Eschrichtius robustus*), and Steller sea lions (*Eumetopias jubatus*; Table 3-1). Marine mammals occurring in Cook Inlet that are not expected to be observed in the Project area include minke whale (*Balaenoptera acutorostrata*) and Dall's porpoise (*Phocoenoides dalli*).

Data from the Alaska Marine Mammal Stranding Network database (NMFS unpublished data) provide additional support for the determinations. From 2011 to 2020, only three humpback whales, one minke whale, and one Dall's porpoise were documented as stranded in the portion of Cook Inlet north of Point Possession. All were dead upon discovery; it is unknown if they were alive upon their entry into upper Cook Inlet or drifted into the area with the tides. No gray whales were reported as stranded in upper Cook Inlet during this time period. For comparison, 23 beluga whale strandings were documented in upper Cook Inlet during the same time period, from a population that is currently about 331 individuals (NMFS unpublished data; Goetz et al. 2023). One dead beluga whale calf was discovered in a state of advanced decomposition in the North End (North Extension) area of the Port on 18 May 2020 during routine marine mammal observations associated with PCT Phase 1 construction. NMFS was contacted immediately to report the discovery, and a report documenting the location and details of the animal was submitted to NMFS within 24 hours. The beluga whale calf had clearly been dead for many weeks, and its death was not attributed to POA activities. With very few exceptions, minke whales and Dall's porpoises do not occur in upper Cook Inlet, and therefore take of these species is not requested in this application.

Except for the beluga whale and harbor seal, very small proportions of the populations of the five other species occur in upper Cook Inlet near the Project area. This rulemaking and LOA application assesses the potential impacts of the CTR Project on the following seven species, which are discussed more fully in Section 4:

- Harbor seal
- Steller sea lion
- Harbor porpoise
- Killer whale
- Beluga whale
- Humpback whale
- Gray whale

The potential for occurrence of the seven species of marine mammals near the Project area is based on the following criteria:

- Common – occurring consistently in moderate to large numbers;
- Uncommon – occurring in low numbers or on an irregular basis; and
- Rare – records exist for some years but are limited.

Table 3-1. Marine Mammals in or near the Project Area

Species	Abundance (Stock and/or DPS)	MMPA Designation	ESA Listing	Occurrence in Project Area
Harbor seal	28,411 (Cook Inlet/Shelikof Strait Stock)	None	None	Common
Steller sea lion	49,837[a] (Western Stock and DPS)	Depleted & Strategic	Endangered	Uncommon
Harbor porpoise	31,046 (Gulf of Alaska Stock)	Strategic	None	Uncommon
Killer whale (Orca)	1,920[a] (Eastern North Pacific Alaska Resident Stock)	None	None	Rare
	587 (Eastern North Pacific, Gulf of Alaska, Aleutian Islands, & Bering Sea Transient Stock)	None	None	
Cook Inlet beluga whale	331 (Cook Inlet Stock and DPS)	Depleted & Strategic	Endangered	Common
Gray whale	26,960 (Eastern North Pacific Stock and DPS)	None	None	Rare
Humpback whale	Mexico DPS: *Unknown abundance* (Mainland Mexico – CA-OR-WA Stock)	Depleted & Strategic	Threatened	Not known to occur in Cook Inlet
	Unknown abundance (Mexico - North Pacific Stock)			Rare
	11,278 (Hawai'i Stock and DPS)	None	None	Rare

Source: Mexico - North Pacific stock humpback whale population estimate: Martinez-Aguilar 2011. Hawai'i stock humpback whale population estimate: Becker et al. 2022. Gray whale population estimate: Durban et al. 2017; Carretta et al. 2023. Beluga whale population estimate: Goetz et al. 2023. All other population estimates: Young et al. 2023.

Notes: DPS = Distinct Population Segment; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act.

[a] N_{min} was used.

Section 4. Affected Species Status and Distribution

4.1 Harbor Seal

4.1.1 Status and Distribution

Harbor seals inhabit waters all along the western coast of the United States, British Columbia, and north through Alaska waters to the Pribilof Islands and Cape Newenham. There are 12 recognized stocks of harbor seals in Alaska. Harbor seals in the Project area are members of the Cook Inlet/Shelikof stock; no other stock is present within the Project area. Distribution of the Cook Inlet/Shelikof stock extends from Unimak Island, in the Aleutian Islands archipelago, north through all of upper and lower Cook Inlet (Young et al. 2023).

The current abundance estimate for the Cook Inlet/Shelikof stock is based on aerial survey data from 1998 through 2018 and is estimated at 28,411 individuals, with a negative population growth trend of minus 111 seals per year (Young et al. 2023). The estimated average annual subsistence harvest of the Cook Inlet/Shelikof stock was 233 individuals between 2004 and 2008, and 104 individuals in 2014 (Young et al. 2023). Harbor seals are not listed under the ESA or designated as depleted or strategic under the MMPA, but like all marine mammals, they are protected under the MMPA.

4.1.2 Foraging Ecology

Harbor seals are non-migratory; however, there is evidence of some long-distance movements in tagged animals in Alaska (Pitcher and McAllister 1981; Womble and Gende 2013). Their movements are influenced by tides, weather, season, food availability, and reproduction, as well as individual sex and age class (Lowry et al. 2001; Small et al. 2003; Boveng et al. 2012).

Harbor seals forage in marine, estuarine, and occasionally freshwater habitat. They are opportunistic feeders that adjust their local distribution to take advantage of locally and seasonally abundant prey (Baird 2001; Bjørge 2002). In Cook Inlet, harbor seals have been documented in higher concentrations near steelhead, Chinook, and salmon spawning streams during summer and may target more offshore prey species during winter (Boveng et al. 2012). Researchers have found that they complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice (Young et al. 2023).

4.1.3 Presence in Cook Inlet

Harbor seals inhabit the coastal and estuarine waters of Cook Inlet and are observed in both upper and lower Cook Inlet throughout most of the year (Boveng et al. 2012; Shelden et al. 2013). Recent research on satellite-tagged harbor seals observed several movement patterns within Cook Inlet (Boveng et al. 2012). In fall, a portion of the harbor seals appeared to move out of Cook Inlet and into Shelikof Strait, northern Kodiak Island, and coastal habitats of the Alaska Peninsula. The western coast of Cook Inlet had higher usage by harbor seals than eastern coast habitats, and seals captured in lower Cook Inlet generally exhibited site fidelity by remaining south of the Forelands in lower Cook Inlet after release (Boveng et al. 2012).

The presence of harbor seals in upper Cook Inlet is seasonal. Harbor seals are commonly observed along the Susitna River and other tributaries within upper Cook Inlet during eulachon and salmon migrations (NMFS 2003). The major haulout sites for harbor seals are in lower Cook Inlet; however, there are a few in upper Cook Inlet, including near the Little and Big Susitna rivers, Beluga River, Theodore River, and Ivan

River (Montgomery et al. 2007). During beluga whale aerial surveys of upper Cook Inlet from 1993 to 2012, harbor seals were observed 24 to 96 km (15 to 60 mi) south-southwest of Anchorage at the Chickaloon, Little Susitna, Susitna, Ivan, McArthur, and Beluga rivers (Shelden et al. 2013).

4.1.4 Presence in Project Area

Harbor seals are commonly observed within the Project area, particularly foraging near the mouth of Ship Creek (Cornick et al. 2011; Shelden et al. 2013; 61N Environmental 2021, 2022a), which is about 1,600 meters from the midpoint of CTR Project. During annual marine mammal surveys conducted by NMFS since 1994, harbor seals have been observed in Knik Arm and in the vicinity of the POA (Shelden et al. 2013) but are not known to haul out within the Project area.

Harbor seals have been observed during construction monitoring at the POA from 2005 through 2011 and in 2016; data were unpublished for years 2005 through 2007 (Table 4-1; Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick et al. 2010, 2011). Harbor seals were observed in groups of one to seven individuals (Cornick et al. 2011; Cornick and Seagars 2016). Harbor seals were also observed near the POA during construction monitoring for PCT Phase 1 in 2020 and PCT Phase 2 in 2021, NMFS marine mammal monitoring in 2021, and transitional dredging monitoring and SFD construction monitoring in 2022 (NMFS 2021 unpublished data; 61N Environmental 2021, 2022a, 2022b, 2022c; Table 4-1). Sighting rates of harbor seals have been highly variable and may have increased from MTRP monitoring between 2005 and 2011 and PCT monitoring in 2020 and 2021 (Table 4-1). It is unknown whether any potential increase was due to local population increases or habituation to ongoing construction activities. It is possible that increased sighting rates are correlated with more intensive monitoring efforts in 2020 and 2021, when the POA used 11 marine mammal observers (MMOs) spread among four monitoring stations.

During the 2020 PCT Phase 1 and 2021 PCT Phase 2 construction monitoring, harbor seals were regularly observed in the vicinity of the POA with frequent observations near the mouth of Ship Creek, southwest of the CTR location. Harbor seals were observed almost daily during 2020 PCT Phase 1 construction, with 54 individuals documented in July, 66 documented in August, and 44 sighted in September (61N Environmental 2021). During the 2021 PCT Phase 2 construction, harbor seals were observed with the highest numbers of sightings in June (87 individuals) and in September (124 individuals). Preliminary observation data indicate that the most common behavior of harbor seals documented during the 2020 PCT Phase 1 and 2021 PCT Phase 2 construction is described as “looking and sinking,” with that behavior documented throughout all hours of observation. Over the 13 days of SFD construction monitoring in May and June 2022, 27 instances of one individual harbor seal were observed (61N Environmental 2022c; Table 4-1). Seventy-two groups of harbor seals totaling 75 individuals (three groups of 2 individuals and 69 single individuals) were observed during transitional dredging monitoring in 2022 (61N Environmental 2022b).

4.1.5 Acoustics

Harbor seals respond to underwater sounds from approximately 1 to 180 kilohertz (kHz), with a functional high-frequency limit around 60 kHz and peak sensitivity at about 32 kHz (Kastak and Schusterman 1995). Hearing ability in the air is greatly reduced (by 25 to 30 dB); harbor seals respond to sounds from 1 to 22.5 kHz, with a peak sensitivity of 12 kHz (Kastak and Schusterman 1995). NMFS (2018) defines harbor seals’ hearing range in water as between 50 Hz and 86 kHz.

Table 4-1. Harbor Seals Observed in the POA during Monitoring Programs 2005–2022

Year	Monitoring Effort			Total # of Sightings	Total # of Harbor Seals Observed	Total # of Harbor Seals per Hour	Survey
	Time Frame	# of Days	# of Hours[a]				
2005	August 2–Nov. 28	51	374	NA	NA	NA	MTRP: Scientific Monitoring
2006	April 26–Nov. 3	95	564	NA	NA	NA	MTRP: Scientific Monitoring
2007	Oct. 9–Nov. 20	28	139	NA	NA	NA	MTRP: Scientific Monitoring
2008	June 24–Nov. 14	86	612	2	2	0.03	MTRP: Scientific Monitoring
2008	July 24–Nov. 26	108	607	1	1	0.0016	MTRP: Construction Monitoring
2009	May 4–Nov. 18	86	783	1	1	0.0014	MTRP: Scientific Monitoring
2009	March 28–Dec. 14	214	3,322	NA	34[b]	0.0102	MTRP: Construction Monitoring
2010	June 29–Nov. 19	87	600	0	0	0	MTRP: Scientific Monitoring
2010	July 21–Nov. 20	106	862	13	13	0.1512	MTRP: Construction Monitoring
2011	June 28–Nov. 15	104	1,202	32	57	0.0474	MTRP: Scientific Monitoring
2011	July 17–Sept. 27	16	NA	2	2	NA	MTRP: Construction Monitoring
2016	May 3–June 21	19	83.5	28	28	0.3353	TPP: Construction Monitoring
2020	April 27–Nov. 24	128	1,238.7	321	340	0.2745	PCT: Construction Monitoring
2021	April 26–Sept. 29	74	734.9	203	220	0.2994	PCT: Construction Monitoring
2021	July 9–Oct. 17	29	231.6	33	33	0.1425	NMFS 2021 unpublished data
2022	May 20–June 11	13	108.2	27	27	0.2495	SFD: Construction Monitoring
2022	May 3–May 15 June 27–August 24	70	727	72	75	0.1032	PCT/SFD: Transitional Dredging Monitoring

Source: Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick et al. 2010, 2011; Cornick and Pinney 2011; Integrated Concepts & Research Corporation (ICRC) 2009, 2010, 2011, 2012; Cornick and Seagars 2016; 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: MTRP = Marine Terminal Redevelopment Project; NA = not available; the information was not provided in the reports. Reports for monitoring in 2005, 2006, and 2007 do not indicate whether or not harbor seals were sighted. The 2009 construction monitoring report does not indicate the total number of sightings, only the total number of harbor seals observed. NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal POA = Port of Alaska; SFD = South Floating Dock; TPP = Test Pile Program.

[a] Intermittent in-water pile-driving hours.

[b] Additionally, three unidentified pinnipeds were documented.

4.2 Steller Sea Lion

4.2.1 Status and Distribution

Two Distinct Population Segments (DPSs) of Steller sea lion occur in Alaska: the western DPS and the eastern DPS. The western DPS includes animals that occur west of Cape Suckling, Alaska, and therefore includes individuals within the Project area. The western DPS was listed under the ESA as threatened in 1990, and its continued population decline resulted in a change in listing status to endangered in 1997. Since 2000, studies indicate that the population east of Samalga Pass (i.e., east of the Aleutian Islands) has increased and is potentially stable (Young et al. 2023). For the region that encompasses Cook Inlet (Central Gulf of Alaska), the annual trend in counts (annual rates of change) of western DPS Steller sea lions is 3.78 for non-pups (adults and juveniles) and 3.01 for pups for the period 2006 through 2021

(Sweeney et al. 2022; Young et al. 2023). The most recent abundance estimate for the western DPS is 12,581 pups and 40,351 non-pups, totaling 52,932 individuals (Young et al. 2023).

4.2.2 Foraging Ecology

Steller sea lions feed opportunistically on seasonally abundant prey throughout the year, predominantly on species that aggregate in schools or for spawning. They adjust their distribution based on the availability of prey species but are known to feed primarily on epipelagic and mesopelagic fishes. Principal prey include eulachon, walleye pollock, capelin, mackerel, Pacific salmon, Pacific cod, flatfishes, rockfishes, Pacific herring, sand lance, skates, squid, and octopus (Womble and Sigler 2006; Womble et al. 2009).

During the spring and summer months in Alaska, Steller sea lions feed on a less diverse array of prey, likely due to the increased availability of preferred prey species (Womble et al. 2009; Fritz et al. 2019). Diversity in prey species typically increases during the winter months, but prey species such as capelin, walleye pollock, and Pacific cod remain an integral component of sea lion diet. Capelin are an especially important winter prey species to Steller sea lions due to their high energetic density (Perez 1994; Maniscalco 2023).

Many variables drive the availability of prey species in the Pacific Ocean, including climatic variables such as marine heat waves. The northeast Pacific Marine Heatwave is of notable importance due to its persisting and compounding effects on ecosystem health in the North Pacific. The event lasted approximately 2 years and peaked in 2015 (Di Lorenzo and Mantua 2016). Following the peak of the Pacific Marine Heatwave, winter diets of Steller sea lions located at three different haulout sites in Southcentral Alaska increased in diversity by 12 percent. Their diet contained higher concentrations of benthic and demersal prey species such as polychaetes, Pacific sand lance, sculpins, skates, and snailfishes, and decreased in principal prey species such as capelin, Pacific herring, and walleye pollock (Maniscalco 2023). This shift in foraging behavior suggests that Steller sea lions are having a difficult time finding their preferred prey species and are foraging deeper and more broadly to meet their nutritional needs. Maniscalco (2023) related an increase in diet diversity during winter to a decrease in sea lion numbers on haulout sites.

4.2.3 Presence in Cook Inlet

Steller sea lions have not been documented in upper Cook Inlet during beluga whale aerial surveys conducted annually in June from 1994 through 2012 and in 2014 (Shelden et al. 2013, 2015, 2017; Shelden and Wade 2019); however, there has been an increase in individual Steller sea lion sightings near the POA in recent years, which is discussed in Section 4.2.4.

4.2.4 Presence in Project Area

Steller sea lions were observed near the POA in 2009, 2016, and 2019–2022 (ICRC 2009; Cornick and Seagars 2016; POA 2019; 61N Environmental 2021, 2022a, 2022b, 2022c; Table 4-2). In 2009, there were three Steller sea lion sightings that were believed to be the same individual (ICRC 2009). In 2016, Steller sea lions were observed on 2 separate days. On 02 May 2016, one individual was sighted. On 25 May 2016, there were five Steller Sea lion sightings within a 50-minute period, and these sightings occurred in areas relatively close to one another (Cornick and Seagars 2016). Given the proximity in time and space, it is believed these five sightings were of the same individual sea lion. In 2019, one Steller sea lion was observed in June at the POA during transitional dredging (POA 2019). There were six sightings of individual Steller sea lions near the POA in May and June 2020 during PCT Phase 1 construction monitoring that took place from 27 April through 24 November 2020 (61N Environmental 2021). In 2021, there were a total of eight sightings of individual Steller sea lions in May, June, and September near the POA during PCT Phase 2 construction monitoring (61N Environmental 2022a). During NMFS marine mammal monitoring, one Steller sea lion was observed in August 2021 in the middle of the inlet looking and diving (NMFS 2021 unpublished data). In 2022, there were three Steller sea lion sightings during the transitional dredging monitoring and three during SFD construction monitoring (61N Environmental 2022b, 2022c). All sightings occurred during summer, when the sea lions were likely attracted to ongoing salmon runs. Sea lion observations near the POA may be increasing due to more consistent observation effort or due to increased presence; observations continue to be occasional but are increasing.

Table 4-2. Steller Sea Lions Observed in the POA during Monitoring Programs 2020–2022

Year	Dates of Monitoring Effort	Monitoring Effort		Total Number of Steller Sea Lions	Steller Sea Lions per Hour	Monitoring Type
		# of Days	# of Hours[a]			
2020	April 27–Nov. 24	128	1,238.7	6	0.005	PCT: Construction Monitoring
2021	April 26–Sept. 29	74	734.9	8	0.011	PCT: Construction Monitoring
2021	July 9–Oct. 17	29	231.6	1	0.004	NMFS 2021 unpublished data
2022	May 20–June 11	13	108.2	3	0.028	SFD: Construction Monitoring
2022	May 3–15 June 27–August 24	70	727	3	0.004	PCT/SFD: Transitional Dredging Monitoring

Source: 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock; TPP = Test Pile Program.

[a] Total observation hours with intermittent in-water pile-driving.

4.2.5 Acoustics

The hearing capabilities of Steller sea lions are fairly similar to the hearing capabilities of California sea lions, with slight variations in males and females (Kastelein et al. 2005; Mulsow and Reichmuth 2008). Kastelein et al. (2005) documented that the best hearing range for Steller sea lions is 1 to 16 kHz, but they are capable of detecting sounds between 60 Hz and 39 kHz (NMFS 2018).

4.2.6 Critical Habitat

Critical habitat for the Western DPS of Steller sea lion is defined as all land and air within 3,000 ft and all marine waters within 20 nautical miles of a designated major haulout (58 FR 45269). The haulout closest to the POA is approximately 150 mi away near Homer, Alaska. Therefore, designated critical habitat for the Western DPS Steller sea lion is not part of the action area and would not be affected by the CTR Project.

4.3 Harbor Porpoise

4.3.1 Status and Distribution

In Alaska, harbor porpoises are divided into three stocks: the Bering Sea stock, the Southeast Alaska stock, and the Gulf of Alaska stock (Zerbini et al. 2022; Young et al. 2023). Studies of harbor porpoise distribution indicate that stock structure is likely more finely scaled than is reflected in the current Alaska Stock Assessment Reports (Zerbini et al. 2022). NMFS recognizes that several regional and sub-regional populations of harbor porpoise possibly exist and continues to examine population structure and connectivity of harbor porpoises in inland, coastal, and offshore waters of Alaska, with a particular focus on Southeast Alaska (Zerbini et al. 2022). Harbor porpoises are neither designated as depleted under the MMPA nor listed under the ESA, but the three Alaska stocks are denoted as “strategic” under the MMPA. The “strategic” designation indicates that the stock is declining or that human-caused mortality exceeds the potential biological removal level. The Gulf of Alaska stock, which includes individuals in Cook Inlet, is currently estimated at 31,046 individuals (Young et al. 2023). Dahlheim et al. (2000) estimated abundance and density of harbor porpoises in Cook Inlet from surveys conducted in the early 1990s. The estimated density of animals in Cook Inlet was 7.2 per 1,000 km^2, with an abundance estimate of 136 individuals (Dahlheim et al. 2000), indicating that only a small number used Cook Inlet. Hobbs and Waite (2010) estimated a harbor porpoise density in Cook Inlet of 13 per 1,000 km^2 from aerial beluga whale surveys in the late 1990s. Neither of these surveys included coastlines, which are used heavily by harbor porpoises (Shelden et al. 2014).

4.3.2 Foraging Ecology

Harbor porpoises can be opportunistic foragers but consume primarily schooling forage fish (Bowen and Siniff 1999). Due to their short, stocky bodies and tendency to reside in cold, temperate waters, harbor porpoises have a high metabolic rate, three times higher than other mammals their size (Kanwisher and Sundnes 1965). They require close proximity to food supplies and must feed frequently to maintain a healthy energy balance (Wisniewska et al. 2016). Harbor porpoises feed primarily on small pelagic schooling fishes with high lipid content such as Pacific herring, sprat, and anchovy, but also on bottom-dwelling fish. Foraging usually occurs near the surface or near the sea bottom in waters less than 200 meters (Perrin et al. 2008).

4.3.3 Presence in Cook Inlet

Harbor porpoises occur in both upper and lower Cook Inlet, and there has been an increase in harbor porpoise sightings in upper Cook Inlet over the past 2 decades (Shelden et al. 2014). Small numbers of harbor porpoises have been consistently reported in upper Cook Inlet between April and October. The highest monthly counts include 17 harbor porpoises reported between spring and fall 2006 (Prevel-Ramos et al. 2008), 14 in spring 2007 (Brueggeman et al. 2007), 12 in fall 2007 (Brueggeman et al. 2008a), and 129 between spring and fall 2007 (Prevel-Ramos et al. 2008). These observations occurred between Granite Point (near Tyonek) and the Susitna River. The number of porpoises counted more than once was unknown, indicating that the actual numbers are likely smaller than reported. The overall increase in the number of harbor porpoise sightings in upper Cook Inlet is unknown, although it may be an artifact from increased studies and marine mammal monitoring programs in upper Cook Inlet. It is also possible that the contraction in the Cook Inlet beluga whale's range has opened up previously occupied beluga whale range to harbor porpoises (Shelden et al. 2014).

Harbor porpoises have been detected during passive acoustic monitoring efforts throughout Cook Inlet, with detections especially prevalent in lower Cook Inlet. In 2009, harbor porpoises were documented by using passive acoustic monitoring in upper Cook Inlet at the Beluga River and Cairn Point (Small 2009, 2010).

4.3.4 Presence in Project Area

Harbor porpoises have been observed within Knik Arm during monitoring efforts since 2005. During POA construction from 2005 through 2011 and in 2016, harbor porpoises were reported in 2009, 2010, and 2011 (Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick et al. 2010, 2011; Cornick and Seagars 2016; Table 4-3). In 2009, a total of 20 harbor porpoises were observed during construction monitoring, with sightings in June, July, August, October, and November. Harbor porpoises were observed twice in 2010: once in July and again in August. In 2011, POA monitoring efforts documented harbor porpoises five times, with a total of six individuals, in August, October, and November at the POA (Cornick et al. 2011). During other monitoring efforts conducted in Knik Arm, there were four sightings of harbor porpoises in 2005 (Shelden et al. 2014), and a single harbor porpoise was observed within the vicinity of the POA in October 2007 (URS 2008; Table 4-3). A total of 18 harbor porpoises were observed near the POA from 27 April through 24 November 2020 during the PCT Phase 1 construction monitoring (61N Environmental 2021). In 2021, a total of 27 harbor porpoises were observed near the POA during the PCT Phase 2 construction monitoring, which took place between 26 April and 29 September 2021 (61N Environmental 2022a). During the 2021 NMFS marine mammal monitoring, one harbor porpoise was observed in August and six were observed in October (NMFS 2021 unpublished data). During 2022, five harbor porpoises were sighted during transitional dredging monitoring (61N Environmental 2022b). None were sighted during the 2022 SFD construction monitoring that occurred between May and June 2022 (61N Environmental 2022c).

Table 4-3. Harbor Porpoises Observed in the POA during Monitoring Programs 2005–2022

Year	Monitoring Effort			Total # of Sightings	Total # of Animals	Harbor Porpoises Per Hour	Survey
	Time Frame	# of Days	# of Hours[a]				
2005	April–May	NA	NA	4	NA	NA	Beluga Whale Habitat Use
2005	August 2–Nov. 28	51	374	NA	NA	NA	MTRP: Scientific Monitoring
2006	April 26–Nov. 3	95	564	NA	NA	NA	MTRP: Scientific Monitoring
2007	Oct. 9–Nov. 20	28	139	NA	NA	NA	MTRP: Scientific Monitoring
2008	June 24–Nov. 14	86	612	0	0	0	MTRP: Scientific Monitoring
2008	July 24–Nov. 26	108	607	0	0	0	MTRP: Construction Monitoring
2009	May 4–Nov. 18	86	783	0	0	0	MTRP: Scientific Monitoring
2009	March 28–Dec. 14	214	3,322	NA	20	0.006	MTRP: Construction Monitoring
2010	June 29–Nov. 19	87	600	0	0	0	MTRP: Scientific Monitoring
2010	July 21–Nov. 20	106	862	2	2	0.002	MTRP: Construction Monitoring
2011	June 28–Nov. 15	104	1,202	5	6	0.005	MTRP: Scientific Monitoring
2011	July 17–Sept. 27	16	NA	0	0	0	MTRP: Construction Monitoring
2016	May 3–June 21	19	85.3	0	0	0	TPP: Construction Monitoring
2020	April 27–Nov. 24	128	1,238.7	15	18	0.015	PCT: Construction Monitoring
2021	April 26–Sept. 29	74	734.9	22	27	0.037	PCT: Construction Monitoring
2021	July 9–Oct. 17	29	231.6	5	6	0.026	NMFS 2021 unpublished data
2022	May 20–June 11	13	108.2	0	0	0	SFD: Construction Monitoring
2022	May 3–May 15 June 27–August 24	70	727	5	5	0.007	PCT/SFD: Transitional Dredging Monitoring

Source: Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick et al. 2010, 2011; ICRC 2009, 2010, 2011, 2012; Cornick and Pinney 2011; Shelden et al. 2014; Cornick and Seagars 2016; 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: MTRP = Marine Terminal Redevelopment Project; NA = not available (the information was not provided in the reports). Reports for monitoring in 2005, 2006, and 2007 do not indicate whether or not harbor porpoises were sighted. The 2009 construction monitoring report does not indicate the total number of sightings, only the total number of harbor porpoises observed. NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock; TPP = Test Pile Program.

[a] Total observation hours with intermittent in-water pile-driving.

4.3.5 Acoustics

The harbor porpoise has the highest upper-frequency limit of all odontocetes investigated. Kastelein et al. (2002) found that the range of best hearing was from 16 to 140 kHz, with a reduced sensitivity around 64 kHz. Maximum sensitivity (about 33 dB re 1 µPa) occurred between 100 and 140 kHz. This maximum sensitivity range corresponds with the peak frequency of echolocation pulses produced by harbor porpoises (120–130 kHz; NMFS 2018).

4.4 Killer Whale

4.4.1 Status and Distribution

There are three distinct ecotypes of killer whale in the northeastern Pacific Ocean: resident, transient, and offshore killer whales. There are two stocks that have the potential to be in the Project area: the Eastern North Pacific Alaska Residents and the Gulf of Alaska, Aleutian Islands, and Bering Sea Transients. Both ecotypes overlap in the same geographic area; however, they maintain social and reproductive isolation and feed on different prey species. The population of the Eastern North Pacific Alaska Resident stock of killer whales contains an estimated 1,920 animals and the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock of killer whales is estimated to contain 587 animals (Young et al. 2023). Killer whales are rare in Cook Inlet, and most individuals are observed in lower Cook Inlet (Shelden et al. 2013).

4.4.2 Foraging Ecology

Resident killer whales are primarily fish-eaters, while transients consume marine mammals. In Cook Inlet, transient killer whales are known to feed on beluga whales and pinnipeds, and resident killer whales are known to feed on anadromous fish (Shelden et al. 2003). The infrequent sightings of killer whales that are reported in upper Cook Inlet tend to occur when their primary prey (anadromous fish for resident killer whales and beluga whales for transient killer whales) are also in the area (Shelden et al. 2003).

4.4.3 Presence in Cook Inlet

Killer whales are rare in upper Cook Inlet, and the availability of prey species largely determines the likeliest times for killer whales to be in the area. During beluga whale aerial surveys between 1993 and 2012, killer whales were sighted in lower Cook Inlet 17 times, with a total of 70 animals (Shelden et al. 2013); no killer whales were observed in upper Cook Inlet during this time. Surveys over 20 years by Shelden et al. (2003) documented an increase in beluga whale sightings and strandings in upper Cook Inlet beginning in the early 1990s. Several of these sightings and strandings reported evidence of killer whale predation on beluga whales. The pod sizes of killer whales preying on beluga whales ranged from one to six individuals (Shelden et al. 2003). Passive acoustic monitoring efforts throughout Cook Inlet documented killer whales at the Beluga River, Kenai River, and Homer Spit, although they were not encountered within Knik Arm. These detections were likely resident (fish-eating) killer whales. Transient killer whales (marine-mammal eating) likely have not been detected due to their propensity to move quietly through waters to track prey (Small 2010; Lammers et al. 2013).

4.4.4 Presence in Project Area

Few killer whales, if any, are expected to approach or be in the vicinity of the Project area during CTR. No killer whales were spotted in the vicinity of the POA during surveys by Funk et al. (2005), Ireland et al. (2005), or Brueggeman et al. (2007, 2008a, 2008b). Killer whales have also not been documented during any POA construction or scientific monitoring from 2005 to 2011, in 2016, or in 2020 (Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008; ICRC 2009, 2010, 2011, 2012; Cornick et al. 2010, 2011; Cornick and Pinney 2011; Cornick and Seagars 2016; 61N Environmental 2021). Two killer whales, one male and one juvenile of unknown sex, were sighted offshore of Point Woronzof in September 2021 during PCT Phase 2 construction monitoring (61N Environmental 2022a; Table 4-4). The pair of killer whales moved up Knik Arm, reversed direction near Cairn Point, and moved southwest out of Knik Arm toward the open water of Upper Cook Inlet. No killer whales were sighted during the 2021 NMFS marine mammal monitoring or the 2022 transitional dredging and SFD construction monitoring that occurred between May and June 2022 (NMFS 2021 unpublished data; 61N Environmental 2022b, 2022c).

Table 4-4. Killer Whales Observed in the POA during Monitoring Programs 2020–2022

Year	Dates of Monitoring Effort	Monitoring Effort		Total Number of Killer Whales	Killer Whales per Hour	Monitoring Type
		# of Days	# of Hours[a]			
2020	April 27–Nov. 24	128	1,238.7	0	0.000	PCT: Construction Monitoring
2021	April 26–Sept. 29	74	734.9	2	0.003	PCT: Construction Monitoring
2021	July 9–Oct. 17	29	231.6	0	0.000	NMFS 2021 unpublished data
2022	May 20–June 11	13	108.2	0	0.000	SFD: Construction Monitoring
2022	May 3–May 15 June 27-August 24	70	727	0	0.000	PCT/SFD: Transitional Dredging Monitoring

Source: 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock.

[a] Intermittent in-water pile-driving hours.

4.4.5 Acoustics

The hearing of killer whales is well developed. Szymanski et al. (1999) found that they responded to tones between 1 and 120 kHz, and their most sensitive range was between 18 and 42 kHz. Their greatest sensitivity was at 20 kHz, which is lower than the most sensitive range of many other odontocetes, but it matches peak spectral energy reported for killer whale echolocation clicks.

4.5 Beluga Whale

4.5.1 Status and Distribution

Beluga whales appear seasonally throughout much of Alaska, except in the Southeast region and the Aleutian Islands. Five stocks are recognized in Alaska: the Beaufort Sea stock, eastern Chukchi Sea stock, eastern Bering Sea stock, Bristol Bay stock, and Cook Inlet stock (Young et al. 2023). The Cook Inlet stock is the most isolated of the five stocks, since it is separated from the others by the Alaska Peninsula and resides year-round in Cook Inlet (Laidre et al. 2000; Castellote et al. 2020). Included in the Cook Inlet stock under the MMPA is a small group of beluga whales, fewer than 20 individuals, that is regularly observed in Yakutat Bay (O'Corry-Crowe et al. 2015). This small group of individuals is reproductively separated from individuals in Cook Inlet and is not known to enter Cook Inlet (Lucey et al. 2015, O'Corry-Crowe et al. 2015); therefore, the Yakutat Bay beluga whales are not discussed further in this rulemaking and IHA Application. Only the Cook Inlet stock inhabits the Project area.

The ADF&G conducted a survey of beluga whales in August 1979 and estimated 1,293 individuals (Calkins 1989). Although this survey did not include all of upper Cook Inlet, the area where almost all beluga whales are currently found during summer, it is the most complete survey of Cook Inlet prior to 1994 and incorporated a correction factor for beluga whales missed during the survey. Therefore, the ADF&G summary (Calkins 1989) provides the best available estimate for the historical beluga whale abundance in Cook Inlet. For management purposes, NMFS has determined that the carrying capacity of Cook Inlet is 1,300 beluga whales (65 FR 34590) based on Calkins (1989).

No systematic population estimates for Cook Inlet beluga whales were conducted prior to 1994. NMFS began comprehensive, systematic aerial surveys of beluga whales in Cook Inlet in 1994. Unlike previous efforts, these surveys included the upper, middle, and lower inlet. These surveys documented a decline in abundance of nearly 50 percent between 1994 and 1998, from an estimate of 653 to 347 whales (Rugh et al. 2000). In response to this decline, NMFS initiated a status review on the Cook Inlet beluga whale stock pursuant to the MMPA and the ESA in 1998 (63 FR 64228). Annual abundance surveys were conducted each June from 1999 through 2012. In 2013, NMFS changed the survey to a biennial schedule because a detailed analysis determined that there would be no decrease in the assessment quality if the number of surveying years was reduced (Hobbs 2013). Analysis of survey data from 1999 to 2016 indicated that the population continued to decline at an annual rate of 0.4 percent (Shelden et al. 2015, 2017). However, Shelden and Wade (2019) analyzed time-series abundance data from 2010 to 2018 using a fully Bayesian method developed by Boyd et al. (2019) that incorporates uncertainty in correction factors. The most recent surveys conducted in 2022 were also analyzed with this new methodology and produced an abundance estimate of 331 beluga whales (Goetz et al. 2023; Table 4-5). The 95 percent probability range is 290 to 386 whales (Goetz et al. 2023). This new analysis indicates that from 2012 to 2022, the Cook Inlet beluga whale population was increasing at an annual rate of 0.9 percent (Goetz et al. 2023).

Table 4-5. Annual Cook Inlet Beluga Whale Abundance Estimates

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2016	2018	2022
367	435	386	313	357	366	278	302	375	375	321	340	284	312	340	328	279	331

Source: Hobbs et al. 2000, 2011, 2012; Rugh et al. 2003, 2004a, 2004b, 2005a, 2005b, 2005c, 2006a, 2006b, 2007; Hobbs and Shelden 2008; Allen and Angliss 2010, 2011; Shelden et al. 2013, 2015, 2017; Shelden and Wade 2019; Boyd et al. 2019; Goetz et al. 2023.

Note: Abundance surveys were not completed in 2013, 2015, 2017, 2019, and 2020. An abundance estimate was not calculated from the 2021 survey data.

In 1999, NMFS received petitions to list the Cook Inlet beluga whale DPS as an endangered species under the ESA (64 FR 17347). However, NMFS determined that the population decline was due to overharvest by Alaska Native subsistence hunters and, because the Native harvest was regulated in 1999, listing this stock under the ESA was not warranted at the time (65 FR 38778). The Cook Inlet beluga whale stock was designated as depleted under the MMPA in 2000, indicating that the size of the stock was below its Optimum Sustainable Population (OSP) level (65 FR 34590). The population has remained below its OSP since the designation but would be considered recovered once the population estimate rises above the OSP.

NMFS announced initiation of another Cook Inlet beluga whale status review under the ESA in 2006 (71 FR 14836) and received another petition to list the Cook Inlet beluga whale under the ESA (71 FR 44614). NMFS issued a decision on the status review on 20 April 2007, concluding that the Cook Inlet beluga whale is a DPS that is in danger of extinction throughout its range. Subsequently, NMFS issued a proposed rule to list the Cook Inlet beluga whale as an endangered species (72 FR 19821). On 17 October 2008, NMFS announced the listing of the population as endangered under the ESA (73 FR 62919). In 2010, a Recovery Team consisting of a Science Panel and a Stakeholder Panel began meeting to develop a Recovery Plan for the Cook Inlet beluga whale. The Draft Recovery Plan was published in the *Federal Register* on 15 May 2015 (80 FR 27925), and the Final Recovery Plan was published in the *Federal Register* on 05 January 2017 (82 FR 1325). In September 2022, NOAA Fisheries completed the ESA 5-year review for the Cook Inlet beluga whale DPS and determined that the Cook Inlet beluga whale DPS should remain listed as endangered (NOAA and NMFS 2022).

4.5.2 Critical Habitat

On 11 April 2011, NMFS designated two areas of critical habitat for beluga whales in Cook Inlet (76 FR 20180). The designation includes 7,800 km^2 (3,013 mi^2) of marine and estuarine habitat within Cook Inlet, encompassing approximately 1,909 km^2 (738 mi^2) in Area 1 and 5,891 km^2 (2,275 mi^2) in Area 2 (Figure 4-1). From spring through fall, Area 1 critical habitat has the highest concentration of beluga whales due to its important foraging and calving habitat. Area 2 critical habitat has a lower concentration of beluga whales in spring and summer but is used by beluga whales in fall and winter. Critical habitat does not include two areas of military usage: the Eagle River Flats Range on Fort Richardson and military lands of JBER between Mean Higher High Water and MHW. Additionally, the POA, adjacent navigation channel, and turning basin were excluded from critical habitat designation due to national security reasons (76 FR 20180).

The designation identified the following Primary Constituent Elements, essential features important to the conservation of the Cook Inlet beluga whale:

(1) Intertidal and subtidal waters of Cook Inlet with depths of less than 30 ft (MLLW) and within 5 mi of high- and medium-flow anadromous fish streams

(2) Primary prey species, including four of the five species of Pacific salmon (chum, sockeye, Chinook, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole

(3) The absence of toxins or other agents of a type or amount harmful to beluga whales

(4) Unrestricted passage within or between the critical habitat areas

(5) The absence of in-water noise at levels resulting in the abandonment of habitat by Cook Inlet beluga whales

4.5.3 Foraging Ecology

Cook Inlet beluga whales feed on a wide variety of prey species, particularly those that are seasonally abundant. In spring, the preferred prey species are eulachon and cod. Other fish and invertebrate species found in the stomachs of beluga whales include porifera, polychaetes, mysids, amphipods, shrimp, crabs, and marine worms. Some of the species may be found in beluga whale stomachs from secondary ingestion because species such as cod feed on polychaetes, shrimp, amphipods, and mysids, as well as other fish (e.g., walleye, pollock, and flatfish) and invertebrates (Quakenbush et al. 2015).

From late spring through summer, most beluga whale stomachs sampled contained Pacific salmon, which corresponded to the timing of fish runs in the area. Anadromous smolt and adult fish aggregate at river mouths and adjacent intertidal mudflats (Calkins 1989). All five Pacific salmon species (i.e., Chinook, pink, coho, sockeye, and chum) spawn in rivers throughout Cook Inlet (Moulton 1997; Moore et al. 2000). Overall, Pacific salmon represent the highest percent frequency of occurrence of prey species in Cook Inlet beluga whale stomachs. This suggests that their spring feeding in upper Cook Inlet, principally on fat-rich fish such as salmon and eulachon, is important to the energetics of these animals (NMFS 2016).

The nutritional quality of Chinook salmon in particular is unparalleled, with an energy content four times greater than that of a coho salmon. It is suggested that the decline of the Chinook salmon population has left a nutritional void in the diet of the Cook Inlet beluga whale that no other prey species can fill in terms of quality or quantity (Norman et al. 2020, 2022).

In fall, as anadromous fish runs begin to decline, beluga whales return to consume fish species (cod and bottom fish) found in nearshore bays and estuaries. Stomach samples from Cook Inlet beluga whales are not available for winter (December through March), although dive data from beluga whales tagged with satellite transmitters suggest that they feed in deeper waters during winter (Hobbs et al. 2005), possibly on such prey species as flatfish, cod, sculpin, and pollock.

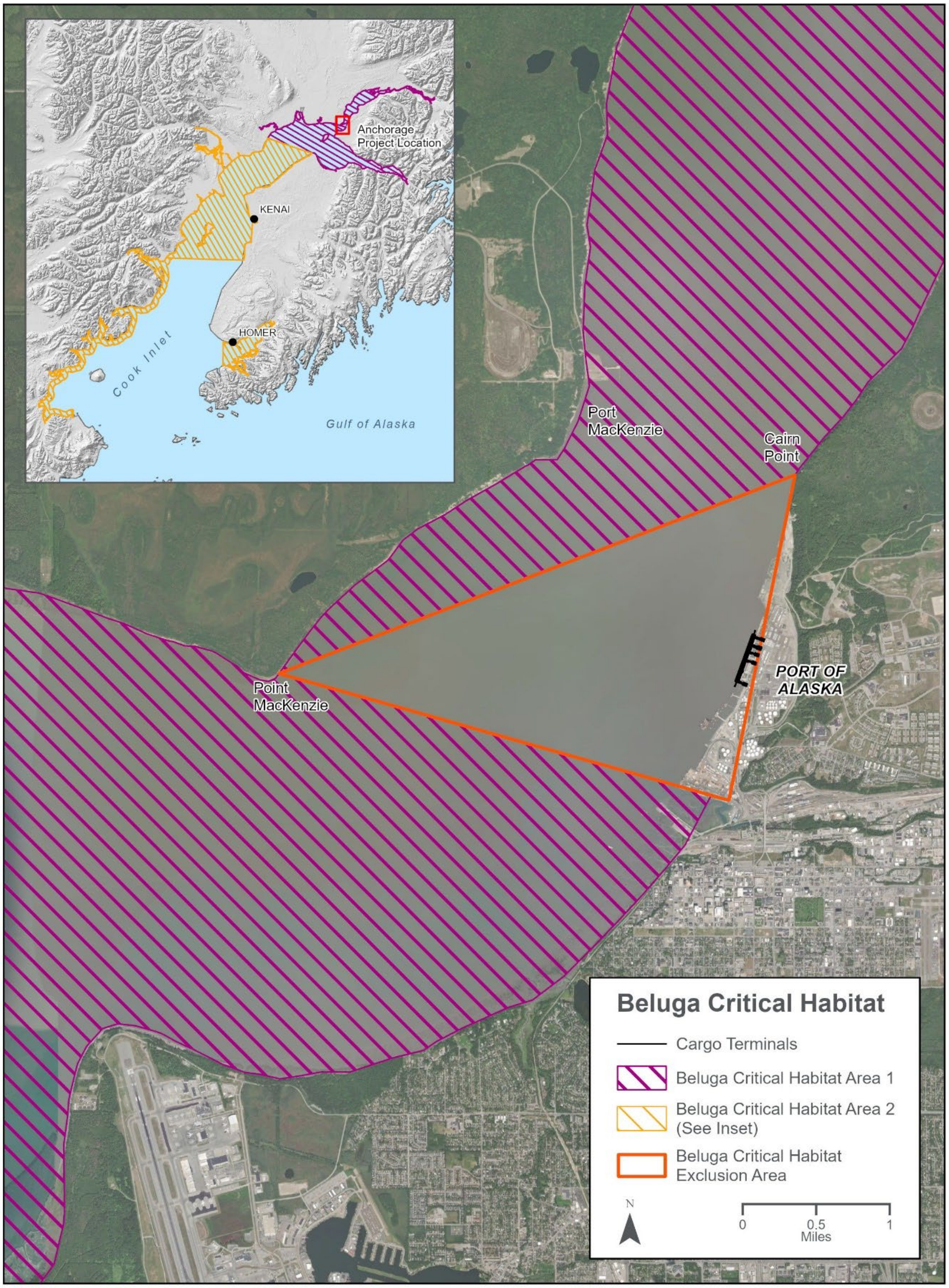

Figure 4-1. Cook Inlet Beluga Whale Critical Habitat and Exclusion Zone at POA

4.5.4 Distribution in Cook Inlet

Beluga whales are year-round residents in Cook Inlet (Rugh et al. 2000; Castellote et al. 2020), though they display seasonal movements throughout the inlet. Large aggregations of beluga whales occur near the mouths of rivers and streams when anadromous fish are present (Moore et al. 2000; Shelden and Wade 2019; Castellote et al. 2020; McGuire et al. 2020).

4.5.4.1 Spring and Summer

During spring and summer, beluga whales generally aggregate near the warmer waters of river mouths where prey availability is high and predator occurrence is low (Moore et al. 2000; Shelden and Wade 2019; McGuire et al. 2020). In particular, beluga whale groups are seen in the Susitna River Delta, the Beluga River and along the shore to the Little Susitna River, Knik Arm, and along the shores of Chickaloon Bay. Small groups were recorded farther south in Kachemak Bay, Redoubt Bay (Big River), and Trading Bay (McArthur River) prior to 1996, but rarely thereafter. Since the mid-1990s, most beluga whales (96 to 100 percent) aggregate in shallow areas near river mouths in upper Cook Inlet, and they are rarely sighted in the central or southern portions of Cook Inlet during summer (Hobbs et al. 2008). Important calving grounds are located near the river mouths of upper Cook Inlet, and peak calving occurs between July and October (McGuire et al. 2016).

4.5.4.2 Fall and Winter

Data from tagged whales (14 tags between July 2000 through March 2003) show that beluga whales continue to use upper Cook Inlet intensively between summer and late autumn (Hobbs et al. 2005). Beluga whales tagged with satellite transmitters continue to use Knik Arm, Turnagain Arm, and Chickaloon Bay as late as October, but some range into lower Cook Inlet to Chinitna Bay, Tuxedni Bay, and Trading Bay (McArthur River) in fall (Hobbs et al. 2005, 2012). From September through November, beluga whales move between Knik Arm, Turnagain Arm, and Chickaloon Bay (Hobbs et al. 2005; Goetz et al. 2012a). By December, beluga whales are distributed throughout the upper to mid-inlet. From January into March, they move as far south as Kalgin Island and slightly beyond in central offshore waters. Beluga whales make occasional excursions into Knik Arm and Turnagain Arm in February and March in spite of ice cover (Hobbs et al. 2005). Although tagged beluga whales move widely around Cook Inlet throughout the year, there is no indication of seasonal migration in and out of Cook Inlet (Hobbs et al. 2005). Data from NMFS aerial surveys, opportunistic sighting reports, and corrected satellite-tagged beluga whales confirm that they are more widely dispersed throughout Cook Inlet during winter (November–April), with animals found between Kalgin Island and Point Possession. Generally fewer observations of beluga whales are reported from the Anchorage and Knik Arm area from November through April (76 FR 20180; Rugh et al. 2000, 2004a).

4.5.5 Presence in Project Area

Knik Arm is one of three areas in upper Cook Inlet where beluga whales are concentrated during spring, summer, and early fall (Section 4.5.1). Most beluga whales observed in or near the POA are transiting between upper Knik Arm and other portions of Cook Inlet, and the POA itself is not considered high-quality foraging habitat. Beluga whales tend to follow their anadromous prey and travel in and out of Knik Arm with the tides. Use of Knik Arm is concentrated between August and October and may be highest in October (61N Environmental 2021, 2022a, 2022c). Use of Knik Arm is lowest in winter (December through February) and remains low in spring and early summer (March–July; Rugh et al. 2000, 2004a, 2005a, 2006a, 2007; Funk et al. 2005; U.S. Army Garrison Fort Richardson 2009; Hobbs et al. 2011, 2012).

Goetz et al. (2012b) used distribution and group size data collected during annual aerial surveys between 1994 and 2008 to develop a predictive habitat model. This predictive model maps beluga whale density from 0 to 1.12 whales per km^2 in Cook Inlet. The highest predicted densities of beluga whales are in Knik Arm, near the mouth of the Susitna River, and in Chickaloon Bay. The model suggests that the density of beluga whales at the mouth of Knik Arm, near the POA, ranges between approximately 0.013 and 0.062 whales per km^2. The distribution presented by Goetz et al. (2012b) is generally consistent with beluga whale distribution documented in upper Cook Inlet throughout ice-free months (NMFS 2016).

Several marine mammal monitoring programs and studies have been conducted at or near the POA during the last 17 years. These studies, summarized below, offer some of the best available information on the abundance of beluga whales in the Project area.

4.5.5.1 SFD Construction Monitoring and Transitional Dredging (2022)

In 2022, a marine mammal monitoring program identical to that used during PCT construction was implemented during construction of the SFD. Marine mammal monitoring was conducted during 13 non-consecutive days, with a total of 108.2 hours of monitoring observation from 20 May through 11 June 2022 (61N Environmental 2022c; Table 4-6).

During SFD construction, the position of the Ship Creek station at the end of the promontory allowed monitoring of a portion of the shoreline north of Cairn Point that could not be seen by the station at the northern end of the POA (61N Environmental 2022c). Eleven MMOs worked from four monitoring stations located along a 9-km stretch of coastline surrounding the POA. The monitoring effort and data collection were conducted at the following four locations: (1) Point Woronzof approximately 6.5 km southwest of the SFD, (2) the promontory near the boat launch at Ship Creek, (3) the SFD project site, and (4) the northern end of the POA (61N Environmental 2022c).

During 13 days of SFD construction monitoring in late May and early June, 41 individual beluga whales across nine groups were sighted (61N Environmental 2022c; Table 4-6). Ninety groups comprised of 529 beluga whales were sighted during the transitional dredging monitoring that occurred from 03 to 15 May 2022 and 27 June to 24 August 2022 (61N Environmental 2022b; Table 4-7). Of the nine groups of belugas whales sighted during SFD construction, traveling was recorded as the primary behavior for each group (61N Environmental 2022c). Beluga whales traveled and milled between the SFD construction area, Ship Creek, and areas to the south of the POA for more than an hour at a time. During vibratory pile driving, belugas displayed no observable reactions and sometimes continued their trajectory towards the SFD despite the large Level B zones (61N Environmental 2022c).

4.5.5.2 PCT Construction Monitoring (2020–2021)

A marine mammal monitoring program was implemented during construction of the PCT in 2020 and 2021. Marine mammal monitoring in 2020 occurred during 128 non-consecutive days, with a total of 1,238.7 hours of monitoring from 27 April to 24 November 2020 (61N Environmental 2021). Marine mammal monitoring in 2021 occurred during 74 non-consecutive days, with a total of 734.9 hours of monitoring from 26 April to 24 June and 07 to 29 September 2021 (61N Environmental 2022a). A total of 1,504 individual beluga whales across 377 groups were sighted during PCT construction monitoring (Table 4-6; also summarized by year in Table 4-7).

The monitoring effort and data collection were conducted at four locations: (1) the Anchorage Public Boat Dock by Ship Creek, (2) the Anchorage Downtown Viewpoint near Point Woronzof, (3) the PCT construction site, and (4) the North End (North Extension) at the north end of the POA, near Cairn Point. Marine mammal sighting data from April to September indicate that beluga whales swam into the clearance zone and lingered there for periods of time ranging from a few minutes to a few hours. Beluga whales were most often seen traveling at a slow or moderate pace through the monitoring zone, either from the north near Cairn Point or from the south or milling at the mouth of Ship Creek. Groups of beluga whales were also observed swimming north and south in front of the PCT construction site after in-water work was shut down and did not appear to exhibit avoidance behaviors. Beluga whale sightings in June were concentrated on the west side of Knik Arm from the Little Susitna River Delta to Port MacKenzie. From July through September, beluga whales were most often seen milling and traveling on the east side of Knik Arm from Point Woronzof to Cairn Point (61N Environmental 2021, 2022a).

Table 4-6. Beluga Whales Observed in the POA Area during PCT Construction Monitoring 2020–2022

Month	Hours			Whales (Individuals)			Whales (Groups)			Average Group Size		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
April	40.5	47.4	0	33	29	-	11	12	-	3	2.4	-
May	301.4	272.8	40.7	168	49	21	35	11	3	4.8	4.5	7
June	318.1	186	67.5	114	38	20	33	16	6	3.5	2.4	3.3
July	192.5	0	0	25	-	-	12	-	-	2.1	-	-
August	151.2	0	0	274	-	-	56	-	-	4.9	-	-
September	85.6	228.6	0	276	401	-	73	93	-	3.8	4.3	-
October	17.6	0	0	0	-	-	0	-	-	0	-	-
November	132	0	0	97	-	-	25	-	-	3.9	-	-
Totals[a]	**1,238.7**	**734.9**	**108.2**	**987**	**517**	**41**	**245**	**132**	**9**	-	-	-

Source: 61N Environmental 2021, 2022a, 2022b, 2022c.

Note: PCT = Petroleum and Cement Terminal; POA = Port of Alaska.

[a] Numbers may not sum due to rounding.

4.5.5.3 2016 Test Pile Program Monitoring

In 2016, a marine mammal monitoring program was implemented during the TPP. Marine mammal monitoring was conducted during 19 non-consecutive days, with a total of 85.3 hours of monitoring observation from 03 May through 21 June 2016 (Cornick and Seagars 2016; Table 4-7). During the TPP, nine groups comprised of a total of 10 beluga whales were sighted (Cornick and Seagars 2016).

The monitoring effort and data collection were conducted at three locations: (1) the Anchorage Public Boat Dock by Ship Creek, (2) the North End, which is located just above shore level at the north end of the POA, and (3) a roving observer with primary responsibility for the mandatory 100-meter shutdown zone and areas immediately adjacent to the PAMP 2016 TPP in-water activity that were not observable from other stations under all scenarios (Cornick and Seagars 2016).

4.5.5.4 POA Monitoring 2005 to 2011

The POA conducted NMFS-approved monitoring programs for beluga whales and other marine mammals focused at the POA from 2005 to 2011 (Table 4-7). Data from that time period on beluga whale sighting rates, groupings, behavior, and movements indicated that the POA was a relatively low-use area, in that beluga whales did not linger in the area but passed through en route to other locations. They were observed most often in fall, with numbers peaking in late August to early October (Funk et al. 2005). Although groups with calves were observed entering the POA area, data did not suggest that the area was an important nursery.

Although the POA scientific monitoring studies indicated that beluga whales were generally passing through the area, it was also used as foraging habitat by whales traveling between lower and upper Knik Arm. Individuals and groups of beluga whales were observed passing through the area each year during monitoring efforts (Table 4-7). Diving and traveling were common behaviors, with many instances of confirmed feeding. Sighting rates at the POA during this time period ranged from 0.05 to 0.4 whales per hour (Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008; Cornick et al. 2011) as compared to 3 to 5 whales per hour at Eklutna, 20 to 30 whales per hour at Birchwood, and 3 to 8 whales per hour at Cairn Point (Funk et al. 2005), indicating that these areas were of higher use than the POA. In 2009, the mean sighting duration for 54 groups of beluga whales was 11.4 minutes (± 1.8 minutes), with a range of 1 to 61 minutes (Cornick et al. 2010). In 2011, the mean sighting duration for 62 groups of beluga whales was 16.4 minutes (± 3.5 minutes), with a range of 1 to 144 minutes. There were two observations that had long sighting durations of 144 minutes and 90 minutes; the remaining 60 observations had sighting durations of less than 64 minutes (Cornick et al. 2011).

Table 4-7. Beluga Whales Observed in the POA Area during Monitoring Programs 2005–2022

Year	Dates of Monitoring Effort	Monitoring Effort		Total Number of Beluga Whale Groups[b] Sighted	Total Number of Beluga Whales	Monitoring Type
		# of Days	# of Hours[a]			
2005	August 2–Nov. 28	51	374	21	157	MTRP: Scientific Monitoring
2006	April 26–Nov. 3	95	564	25	82	MTRP: Scientific Monitoring
2007	Oct. 9–Nov. 20	28	139	14	61	MTRP: Scientific Monitoring
2008	June 24–Nov. 14	86	612	74	283	MTRP: Scientific Monitoring
	July 24–Dec. 2	108	607	59	431	MTRP: Construction Monitoring
2009	May 4–Nov. 18	86	783	54	166	MTRP: Scientific Monitoring
	March 28–Dec. 14	214	3,322	NA	1,221	MTRP: Construction Monitoring
2010	June 29–Nov. 19	87	600	42	115	MTRP: Scientific Monitoring
	July 21–Nov. 20	106	862	103	731	MTRP: Construction Monitoring
2011	June 28–Nov. 15	104	1,202	62	290	MTRP: Scientific Monitoring
	July 17–Sept. 27	16	NA	5	48	MTRP: Construction Monitoring
2016	May 3–June 21	19	85.3	9	10	TPP: Construction Monitoring
2019	May 8–Sept. 17	133	NA	66	797	PCT: Transitional Dredging Monitoring
2020	April 27–Nov. 24	128	1,238.7	245	987	PCT: Construction Monitoring
2021	April 26–Sept. 29	74	734.9	132	517	PCT: Construction Monitoring
2021	July 9–Oct. 17	29	231.6	113	578	NMFS 2021 unpublished data
2022	May 20–June 11	13	108.2	9	41	SFD: Construction Monitoring
2022	May 3–May 15 June 27–August 24	70	727	90	529	PCT/SFD: Transitional Dredging Monitoring

Source: Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick and Pinney 2011; Cornick et al. 2010, 2011; ICRC 2009, 2010, 2011, 2012; Cornick and Seagars 2016; POA 2019; 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: MTRP = Marine Terminal Redevelopment Project; NA = not available; the information was not provided in the report. The 2009 construction monitoring report does not indicate the total number of sightings, only the total number of beluga whales observed. NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock; TPP = Test Pile Program.

[a] Total observation hours with intermittent in-water pile-driving.

[b] Group can be one or more individuals.

Data collected annually during monitoring efforts from 2005 to 2011 demonstrated that few beluga whales were observed in July and early August; numbers of sightings increased in mid-August, with the highest numbers observed in late August to mid-September. In all years, beluga whales were observed entering the Project area while construction activities were taking place, including in-water pile installation and removal and dredging. No apparent behavioral changes or reactions to in-water construction activities (e.g., displacement or abandonment of feeding behavior) were observed by either the construction workers or the scientific observers (Cornick et al. 2011).

4.5.5.5 Knik Arm Bridge and Toll Authority Baseline Study, 2004–2005

To assist in the evaluation of the potential impact of a proposed bridge crossing of Knik Arm north of Cairn Point, Knik Arm Bridge and Toll Authority (KABATA) initiated a study to collect baseline environmental data on beluga whale activity and the ecology of Knik Arm (Funk et al. 2005). Vessel- and land-based observations were conducted in Knik Arm from July 2004 through July 2005. Land-based observations were conducted from nine stations along the shore of Knik Arm. The three primary stations were located at Cairn Point, Point Woronzof, and Birchwood. The majority of beluga whales were observed north of Cairn Point. Temporal use of Knik Arm by beluga whales was related to tide height, with most whale sightings at Cairn Point occurring at low tide. During the study period, most beluga whales using Knik Arm stayed in the upper portion of Knik Arm north of Cairn Point. Approximately 90 percent of observations occurred during the months of August through November, and only during this time were whales consistently sighted in Knik Arm. The relatively low number of sightings in Knik Arm throughout the rest of the year suggested that the whales were using other portions of Cook Inlet. In addition, relatively few beluga whales were sighted in spring and early to mid-summer. Beluga whales predominantly frequented Eagle Bay (mouth of Eagle River), Eklutna, and the stretch of coastline in between, particularly when they were present in high numbers (Funk et al. 2005).

4.5.5.6 Cook Inlet Beluga Whale Photo-ID Project

Beluga whales have persistent distinct natural markings that can be used to identify individuals. The Cook Inlet Beluga Whale Photo-ID Project has surveyed beluga whales in several areas throughout Cook Inlet. Knik Arm and the Susitna River Delta have been surveyed annually since 2005 (McGuire et al. 2013a). These annual surveys have indicated that beluga whales with calves and newborns use Knik Arm and Eagle Bay seasonally (McGuire et al. 2013b). In 2011, McGuire et al. (2013b) documented that 78 percent of the 307 beluga whales identified in Cook Inlet traveled to the Eagle Bay area. Sixteen field seasons (542 surveys) from 2005 through 2020 have been conducted of the Susitna River Delta, Knik Arm, the Kenai River Delta, and Turnagain Arm (McGuire et al. 2022). The project catalog contains compiled photographs of 487 whales identified by right-side markings, 519 whales identified by left-side markings, and 185 whales identified as "dual" whales (both left- and right-side markings) (McGuire et al. 2022).

These annual vessel- and land-based surveys have indicated that beluga whales with calves and newborns use Knik Arm and Eagle Bay seasonally (McGuire et al. 2013b). In 2011, McGuire et al. (2013b) documented that 78 percent of the 307 beluga whales identified in Cook Inlet traveled to the Eagle Bay area. These data provided evidence that most, if not all, of the population visited this area at least once in their lifetime. Groups containing calves or neonates were more likely to be seen in Knik Arm, Eagle Bay, and the Susitna River Delta than other areas studied in upper Cook Inlet during the photo-ID project (McGuire et al. 2011, 2016, 2021).

4.5.6 Acoustics

In terms of hearing abilities, beluga whales are one of the most studied odontocetes because they are a common marine mammal in public aquariums around the world. Although they are known to hear a wide range of frequencies, their greatest sensitivity is around 10 to 100 kHz (Richardson et al. 1995), well above sounds produced by most industrial activities (less than 100 Hz or 0.1 kHz) recorded in Cook Inlet. Average hearing thresholds for captive beluga whales have been measured at 65 and 120.6 dB re 1 µPa at frequencies of 8 kHz and 125 Hz, respectively (Awbrey et al. 1988). Masked hearing thresholds were measured at approximately 120 dB re 1 µPa for a captive beluga whale at three frequencies between 1.2 and 2.4 kHz (Finneran et al. 2002). Beluga whales do have some limited hearing ability down to approximately 35 Hz, where their hearing threshold is about 140 dB re 1 µPa (Richardson et al. 1995).

Their thresholds for pulsed sounds are higher, depending on the specific durations and other characteristics of the pulses (Johnson 1991).

A study conducted by Vergara et al. (2021) estimated the acoustic source level and communication range of different beluga whale age classes in captivity and in the wild in the St. Lawrence Estuary. Adults and sub-adults in wild beluga whale populations had a median communication range of 6.7 km in an environment without boats and a median communication range of 2.9 km in an environment with boats. A captive female and newborn beluga whales had respective median communication ranges of 2.3 km and 0.4 km without boats and a range of 1.5 km and 0.2 km with boats.

4.6 Humpback Whale

4.6.1 Status and Distribution

Humpback whales, a highly migratory species, are found in all oceans (Young et al. 2023). Commercial whaling operations in the early twentieth century resulted in significantly decreased populations of whales worldwide. Prior to commercial whaling exploitation, humpback whale abundance in the North Pacific was estimated to be 15,000 whales (Rice 1978). Non-subsistence hunting was banned in 1966 when the population of humpback whales was as few as 1,000–1,200 individuals (Rice 1978; Barlow 2003). The population in the North Pacific grew to 6,000–8,000 by the mid-1990s. Current threats to humpback whales include vessel strikes, releases of chemicals or hydrocarbons into the marine environment, climate change, and commercial fishing operations (Young et al. 2023).

Humpback whales worldwide were listed as endangered under the Endangered Species Conservation Act in 1970 (35 FR 18319) and under the ESA at its inception in 1973. However, on 08 September 2016, NMFS published a final decision that changed the status of humpback whales under the ESA (81 FR 62259), effective 11 October 2016. The decision recognized the existence of 14 DPSs based on distinct breeding areas in tropical and temperate waters. Five of the 14 DPSs were classified under the ESA (4 endangered and 1 threatened), while the other 9 DPSs were delisted (81 FR 62260). Three DPSs of humpback whales are found in waters off the coast of Alaska: the Western North Pacific DPS (endangered), the Mexico DPS (threatened), and the Hawaii DPS (recovered; not ESA-listed).

The Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) Project, conducted from 2004 to 2006, was the largest and most comprehensive study of humpback whales throughout the North Pacific (Young et al. 2023). SPLASH data suggest that the majority of humpback whales in the Gulf of Alaska are from the Hawaii DPS (89 percent), followed by whales from the Mexico DPS (11 percent), and very few from the Western North Pacific DPS (less than 1 percent; Wade 2021; NMFS 2022a; Young et al. 2023). Whales of different DPSs intermix at both summer feeding grounds (NMFS AK 2021) and winter breeding grounds (Darling et al. 2022); therefore, all waters off the coast of Alaska should be considered to have ESA-listed humpback whales. Abundance estimates derived from SPLASH data for whales that summer in the Gulf of Alaska are N=2,129, coefficient of variation (CV)=0.081 (multistate model; Wade 2021) and N=3,148, CV=0.062 (Chapman-Peterson summer-summer model; Wade 2021).

The Western North Pacific stock/DPS is described as those humpback whales that breed off Okinawa, Japan, the Philippines, and another unidentified breeding area (inferred from sightings of whales in the Aleutian Islands area feeding grounds) and those whales transiting the Ogasawara area (Oleson et al. 2022). Humpback whales in the Western North Pacific DPS migrate to feeding grounds in the northern Pacific Ocean, primarily off the Russian coast, but also to feeding grounds in the western and central Aleutian Islands (81 FR 62260; Oleson et al. 2022). Abundance estimates for whales that winter in Asia range from N= 1,084, CV=0.088 using a multistate model to N=1,907, CV=0.165 using the Chao winter-winter model (Wade et al. 2021).

The Mexico DPS consists of humpbacks that breed along the Pacific coast of Mexico, the Baja California peninsula, and the Revillagigedo Islands (Bettridge 2015) and feed from California to the Kamchatka Peninsula, Russia, with concentrations in the California-Oregon, northern Washington-southern British Columbia, northern and western Gulf of Alaska, and Bering Sea feeding grounds (Martien et al. 2021). The Mexico DPS consists of two stocks: Mainland Mexico – CA-OR-WA stock and Mexico-North Pacific stock. The Mainland Mexico – CA-OR-WA stock winters off the coast of Mainland Mexico states of Nayarit, Jalisco, Colima, and Michoacán and summers along the U.S. West Coast, Southern British Columbia, Alaska, and the Bering Sea (Young et al. 2023). The Mexico-North Pacific stock winters off Mexico and the Revillagigedo Archipelago and summers primarily in Alaska waters (Martien et al. 2021). Abundance estimates for whales that winter in Mexico range from N= 2,352, CV=0.075 using the Chao m(th) model abundance estimate for 2003–2006 (Martinez-Aguilar 2011) to N=2,913, CV=0.066 using a multistate model to N=4,910, CV=0.095 using the Chao winter-winter model (Wade et al. 2021).

The Hawaii stock/DPS consists of humpbacks that breed within the main Hawaiian Islands (Bettridge et al. 2015) and feed in waters off the coast of Northern British Columbia, Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Calambokidis 1997). Abundance estimates for whales that winter in Hawaii range from N=8,097, CV=0.055 using the Chapman-Peterson winter-winter model to N=11,540, CV=0.042 using a multistate model (Wade et al. 2021).

4.6.2 Critical Habitat

On 09 October 2019, NMFS proposed to designate critical habitat for the Western North Pacific, Mexico, and Central America DPSs of humpback whales (84 FR 54354). NMFS issued a *Federal Register* notice on 21 May 2021 to designate critical habitat for the endangered Western North Pacific DPS, the endangered Central America DPS, and the threatened Mexico DPS of humpback whales pursuant to Section 4 of the ESA (86 FR 21082). Critical habitat for the Western North Pacific and Mexico DPSs includes portions of marine waters in Alaska; however, Unit 6 (Cook Inlet Area) is not included in the final critical habitat designation for the Mexico DPS. Only proposed critical habitat for the Mexico DPS would include Unit 6; the western North Pacific DPS does not include Cook Inlet (84 FR 54354). Therefore, proposed critical habitat for humpback whales does not include the Project area.

4.6.3 Foraging Ecology

Humpback whales target aggregations of krill (Euphausiidae; Nemoto 1957) and small schooling fish including herring (Krieger and Wing 1984), capelin (Witteveen et al. 2008), sand lance (Hazen et al. 2009), and juvenile salmon (Chenoweth et al. 2017). In Alaska waters, the species composition of prey taken by humpback whales varies, likely due to prey availability and individual preference (Witteveen et al. 2011).

4.6.4 Presence in Cook Inlet

Humpback whales are encountered regularly in lower Cook Inlet and occasionally in mid-Cook Inlet; however, sightings are rare in upper Cook Inlet. During aerial surveys conducted in summers between 2005 and 2012, Shelden et al. (2013) reported dozens of sightings in lower Cook Inlet, a handful of sightings in the vicinity of Anchor Point and in lower Cook Inlet, and no sightings north of 60° N latitude (approximately the latitude of the town of Ninilchik). Biennial surveys began in 2014, although no survey took place in 2020 due to Covid-19. Instead, the planned 2020 survey was postponed to 2021, so consecutive surveys took place in 2021 and 2022 (Shelden et al. 2022). During the 2014–2022 aerial surveys, sightings of humpback whales were recorded in lower Cook Inlet and mid-Cook Inlet, but none were observed in upper Cook Inlet (Shelden et al. 2015, 2017, 2019, 2022). Vessel-based observers participating in the Apache Corporation's 2014 survey operations recorded three humpback whale sightings near Moose Point in upper Cook Inlet and two sightings near Anchor Point, while aerial and land-based observers recorded no humpback whale sightings, including in the upper inlet (Lomac-MacNair et al. 2014). Observers monitoring waters between Point Campbell and Fire Island during summer and fall 2011 and spring and summer 2012 recorded no humpback whale sightings (Brueggeman et al. 2013). Monitoring of Turnagain Arm during ice-free months between 2006 and 2014 yielded one humpback whale sighting (McGuire, unpublished data; cited in LGL Alaska Research Associates, Inc., and DOWL 2015).

4.6.5 Presence in Project Area

There have been few sightings of humpback whales in the vicinity of the Project area (Table 4-8). Humpback whales were not documented during POA construction or scientific monitoring from 2005 to 2011, in 2016, or during 2020 (Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick et al. 2010, 2011; ICRC 2009, 2010, 2011, 2012; Cornick and Pinney 2011; Cornick and Seagars 2016; 61N Environmental 2021). Observers monitoring the Ship Creek Small Boat Launch from 23 August to 11 September 2017 recorded two sightings, each of a single humpback whale, which was presumed to be the same individual (POA 2017). In 2017, an event involved a stranded whale that was sighted near a number of locations in upper Cook Inlet before washing ashore at Kincaid Park; it is unclear as to whether the humpback whale was alive or deceased upon entering Cook Inlet waters. One humpback whale was observed in July during 2022 transitional dredging monitoring (61N Environmental 2022b). No humpback whales were observed during the 2020 to 2021 PCT construction monitoring, the NMFS marine mammal monitoring, or the 2022 SFD construction monitoring from April to June (61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data).

Table 4-8. Humpback Whales Observed in the POA during Monitoring Programs 2020–2022

Year	Dates of Monitoring Effort	Monitoring Effort		Total Number of Humpback Whales	Humpback Whales per Hour	Monitoring Type
		# of Days	# of Hours[a]			
2020	April 27–Nov. 24	128	1,238.7	0	0.000	PCT: Construction Monitoring
2021	April 26–Sept. 29	74	734.9	0	0.000	PCT: Construction Monitoring
2021	July 9–Oct. 17	29	231.6	0	0.000	NMFS 2021 unpublished data
2022	May 20–June 11	13	108.2	0	0.000	SFD: Construction Monitoring
2022	May 3–May 15 June 27-August 24	70	727	1	0.001	PCT/SFD: Transitional Dredging Monitoring

Source: 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock

[a] Total observation hours with intermittent in-water pile-driving.

4.6.6 Acoustics

There are no directly measured data for humpback whale hearing sensitivity. Recordings of vocalizations indicate that humpback whales produce sounds at frequencies between 20 Hz and 2 kHz (Thompson et al. 1986; Darling 2015). Au et al. (2006) recorded humpback vocalizations with harmonics up to 24 kHz. The hearing range of low-frequency (LF) cetaceans, including the humpback whale, is estimated at 7 Hz to 35 kHz (NMFS 2018).

4.7 Gray Whale

4.7.1 Status and Distribution

There are two genetically distinct populations of gray whales present in the North Pacific: the Western North Pacific (WNP) DPS and the Eastern North Pacific (ENP) DPS (Carretta et al. 2023). The WNP DPS of gray whales is listed as endangered under the ESA and the stock is considered depleted under the MMPA. The ENP DPS recovered from whaling exploitation and was delisted under the ESA in 1994, and the stock is not considered depleted under the MMPA (Carretta et al. 2023). The stock structure for gray whales in the Pacific has been studied for a number of years and remains uncertain as of the most recent (2021) Pacific Stock Assessment Reports (SAR; Carretta et al. 2023), and currently the WNP and ENP DPSs and stocks align. Gray whale population structure is not determined by simple geography and may be in flux due to evolving migratory dynamics (Carretta et al. 2023).

The majority of the ENP DPS can be found in the Chukchi, Beaufort, and northwestern Bering seas during the summer and fall (Carretta et al. 2023). During that time, a small group of gray whales belonging to the ENP DPS, known as the Pacific Coast Feeding Group, can be found along the North Pacific coast, between Alaska and Northern California (Weller et al. 2013). This subset of the ENP DPS has been identified as far north as Kodiak Island, Alaska (Gosho et al. 2011; Calambokidis et al. 2017; Carretta et al. 2023) and has generated uncertainty regarding the ENP DPS population structure (Weller et al. 2013). In winter, ENP gray whales migrate to the southern Gulf of California and Baja, and a few individuals remain year-round off the coast of California or between Washington and Vancouver Island (ADF&G 2022). The population for the ENP DPS of gray whales is estimated to be 20,580 individuals (Stewart & Weller 2021), which is less than the previous estimate of 26,960 individuals from a 2015–2016 southbound survey (Durban et al. 2017; Carretta et al. 2023).

The WNP Stock feeds in the Okhotsk Sea off northeast Sakhalin Island, Russia, and off southeastern Kamchatka in the Bering Sea during summer and fall (Burdin et al. 2017; Carretta et al. 2023). Some gray whales that feed off Sakhalin Island migrate east across the Pacific to the west coast of North America in winter, while others migrate south to waters off Japan and China (Weller et al. 2016; Carretta et al. 2023). WNP gray whales are not known to feed in or travel to upper Cook Inlet (Conant and Lohe 2023; Weller et al. 2023).

The estimated population size for the WNP Stock is 290 individuals based off a 2016 photo-ID study for Sakhalin and Kamchatka (Cooke et al. 2017; Carretta et al. 2023).

An Unusual Mortality Event (UME) along the West Coast and in Alaska was declared for gray whales in January 2019 (NOAA Fisheries 2022). Since 2019, 135 gray whales have stranded off the coast of Alaska, and 307 (NMFS 2022b) total have stranded off the coast of the U.S. Preliminary findings for several of the whales indicate evidence of emaciation, but the UME still under investigation, and the cause of the mortalities remains unknown (NOAA Fisheries 2022).

4.7.2 Foraging Ecology

Gray whales are mainly bottom feeders. They obtain their food by scraping the sides of their head along the ocean floor and scooping up sediments. They capture small invertebrates on their baleen by expelling the sediment and other particles through the baleen fringes (ADF&G 2022). In Alaska waters, gray whales eat primarily amphipod crustaceans, although a wide variety of species was reported from gray whale stomachs, such as amphipods (e.g., *Anonyx*, *Atylus*, *Lembos*, *Pontoporeia*), decapods (e.g., *Chionoecetes, Nectocrangdon, Nephrops*), and other invertebrates (molluscs, polychaete worms, and even sponges; Moore et al. 2003; ADF&G 2022).

4.7.3 Presence in Cook Inlet

Gray whales are infrequent visitors to Cook Inlet and can be seasonally present during spring and fall in the lower inlet (Carretta et al. 2019; Bureau of Ocean Energy Management [BOEM] 2021). Migrating gray whales pass through the lower inlet during their spring and fall migrations to and from their primary summer feeding areas in the Bering, Chukchi, and Beaufort seas (Swartz 2018; Carretta et al. 2019; BOEM 2021; Silber et al. 2021).

Gray whales are rarely documented in upper Cook Inlet. In 2020, an individual swam upstream in Cook Inlet during a very high tide and was trapped when the water receded (George 2020). The gray whale was first encountered in May near the Seward Highway Bridge and, a week later, the tide finally pushed it into Turnagain Arm. On 12 June, a dead whale was spotted near the mouth of the Susitna River. It is suspected that this was the same gray whale seen in May (George 2020).

Gray whales from the WNP Stock and DPS are not known to occur in upper Cook Inlet (Conant and Lohe 2023; Weller et al. 2023); therefore, it will be assumed that any gray whales observed in upper Cook Inlet near the POA are from the ENP stock and DPS.

4.7.4 Presence in Project Area

Gray whales are rarely encountered in the Project Area (Table 4-9). Gray whales were not documented during POA construction or scientific monitoring from 2005 to 2011 or during 2016 (Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; ICRC 2009, 2010, 2011, 2012; Cornick et al. 2010, 2011; Cornick and Pinney 2011; Cornick and Seagars 2016). One gray whale was observed near Port MacKenzie during 2020 PCT construction (61N Environmental 2021), and a second was observed off of Ship Creek during 2021 PCT construction monitoring (61N Environmental 2022a). During NMFS marine mammal monitoring in 2021, on 10 August, one gray whale surfaced directly in front of the Point Woronzof MMO station traveling west out of the inlet approximately 700 meters offshore (NMFS 2021 unpublished data). No gray whales were observed during 2022 transitional dredging or SFD construction monitoring from May to August (61N Environmental 2022b, 2022c).

Table 4-9. Gray Whales Observed in the POA during Monitoring Programs 2020–2022

<table>
<tr><th rowspan="2">Year</th><th rowspan="2">Dates of Monitoring Effort</th><th colspan="2">Monitoring Effort</th><th rowspan="2">Total Number of Gray Whales</th><th rowspan="2">Gray Whales per Hour</th><th rowspan="2">Monitoring Type</th></tr>
<tr><th># of Days</th><th># of Hours[a]</th></tr>
<tr><td>2020</td><td>April 27–Nov. 24</td><td>128</td><td>1,238.7</td><td>1</td><td>0.001</td><td>PCT: Construction Monitoring</td></tr>
<tr><td>2021</td><td>April 26–Sept. 29</td><td>74</td><td>734.9</td><td>1</td><td>0.001</td><td>PCT: Construction Monitoring</td></tr>
<tr><td>2021</td><td>July 9–Oct. 17</td><td>29</td><td>231.6</td><td>1</td><td>0.004</td><td>NMFS 2021 unpublished data</td></tr>
<tr><td>2022</td><td>May 20–June 11</td><td>13</td><td>108.2</td><td>0</td><td>0.000</td><td>SFD: Construction Monitoring</td></tr>
<tr><td rowspan="2">2022</td><td>May 3–May 15</td><td rowspan="2">70</td><td rowspan="2">727</td><td rowspan="2">0</td><td rowspan="2">0.000</td><td rowspan="2">PCT/SFD: Transitional Dredging Monitoring</td></tr>
<tr><td>June 27-August 24</td></tr>
</table>

Source: 61N Environmental 2021, 2022a, 2022b, 2022c; NMFS 2021 unpublished data.

Notes: NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock.

[a] Intermittent in-water pile-driving hours.

4.7.5 Acoustics

Gray whales are in the LF cetacean functional hearing group and produce sounds at frequencies generally ranging between 100 and 2,000 Hz (Dahlheim and Castellote 2016). Gray whales have a limited call repertoire that contains six distinct calls; however, they alter their calling behavior to compensate for increasing levels of noise to improve their chances of being heard by other gray whales (Dahlheim and Castellote 2016). Dahlheim and Castellote (2016) found that gray whales did not alter the frequency range of their calls or length of their calls under any of the noise conditions measured.

Section 5. Type of Incidental Taking Authorization Requested

5.1 Incidental Harassment Authorization

Under Section 101(a)(5)(D) of the MMPA, the POA requests authorization for the take of small numbers of marine mammals, by Level A and Level B harassment, incidental to pile installation and removal associated with the Cargo Terminals Project in Anchorage, Alaska. The POA requests a rulemaking and LOA that is valid for 5 years, from 01 April 2026 through 31 March 2031 and an IHA that is valid for 1 year, from 01 April 2031 through 31 March 2032.

5.2 Take Authorization Request

The exposure assessment methodology used in this LOA application quantifies potential noise exposures of marine mammals resulting from pile installation and removal in the marine environment (see Section 6). Results from this approach tend to overestimate exposures because all individuals are assumed to be available to be exposed 100 percent of the time, and the formulas used to estimate sound propagation distances use idealized parameters. Additionally, this approach assumes that all exposed individuals are harassed, contributing to overestimation of "take."

The analysis for the 6 years of in-water construction of the CTR Project predicts a total of 1,981 potential marine mammal exposures to sound from pile installation and removal (see Section 6 for estimates of exposures by species and year) that could be classified as Level A or Level B harassment as defined under the MMPA. The POA's mitigation measures for construction of the CTR Project, described in Section 11, include monitoring of harassment zones to avoid and minimize take during pile installation and removal. These mitigation measures decrease the likelihood that marine mammals will be exposed to sound pressure levels or disturbance that would cause Level A or Level B harassment, although the amount of that decrease cannot be quantified.

The POA does not expect that 1,981 harassment incidents will result from construction of the CTR Project. However, to allow for uncertainty regarding the exact mechanisms of the physical and behavioral effects, the POA is requesting authorization for take of 841 marine mammals by Level A harassment and 1,140 marine mammals by Level B harassment over a 6-year period in this LOA and IHA application.

5.3 Method of Incidental Taking

In-water pile installation and removal associated with construction of the CTR Project, as outlined in Section 1, has the potential to disturb or displace small numbers of marine mammals. Specifically, the proposed action may result in "take" in the form of Level A and Level B harassment from underwater noise generated from pile installation and removal. See Section 11 for more details on the impact minimization and avoidance measures proposed.

Section 6. Take Estimates for Marine Mammals

The NMFS application process for a rulemaking and LOA requires applicants to determine the number of marine mammals by species that are expected to be incidentally harassed by an action and the nature of the harassment (Level A or Level B). The CTR Project, as outlined in Section 1, has the potential to incidentally take marine mammals by harassment through exposure to sound associated with in-water pile installation and removal.

6.1 Underwater Sound Descriptors

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium such as air or water. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the sound's pitch and is measured in Hertz (Hz), while intensity describes the sound's loudness and is measured in decibels (dB). Decibels are measured using a logarithmic scale.

The method commonly used to quantify in-air sounds consists of evaluating all frequencies of a sound according to a weighting system reflecting that human hearing is less sensitive at low frequencies and extremely high frequencies than at mid-range frequencies. This is called A-weighting, and the decibel level measured is called the A-weighted sound level (dBA). A filtering method to reflect in-air hearing of marine mammals such as hauled-out pinnipeds has not been developed for regulatory purposes.

Underwater sounds are described by a number of terms that are commonly used and specific to this field of study (Table 6-1). Two common descriptors are the root-mean-square SPL (dB rms) during the pulse or over a defined averaging period, and sound exposure level (SEL). The rms level is the square root of the energy divided by a defined time period and referenced to a pressure of 1 microPascal (dB re 1 µPa). Unless otherwise indicated, in-water sound levels throughout this report are presented in dB re 1 µPa.

Spreading loss in marine waters is generally between 10 dB (cylindrical spreading) and 20 dB (spherical spreading), typically referred to as 10 log and 20 log, respectively. Cylindrical spreading occurs when sound energy spreads outward in a cylindrical fashion bounded by the bottom sediment and water surface, such as shallow water, resulting in a 3-dB reduction in noise level per doubling of distance. Spherical spreading occurs when the source encounters little to no refraction or reflection from boundaries (e.g., bottom, surface), such as in deep water, resulting in a 6-dB reduction in noise level per doubling of distance.

Table 6-1. Definitions of Some Common Acoustical Terms

Term	Definition
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for water is 1 microPascal (µPa) and for air is 20 µPa (approximate threshold of human audibility).
Sound Pressure Level (SPL)	Sound pressure is the force per unit area, usually expressed in µPa (or 20 microNewtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressure exerted by the sound to a reference sound pressure. Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency (Hz)	Frequency is expressed in terms of oscillations, or cycles, per second. Cycles per second are commonly referred to as Hertz (Hz). Typical human hearing ranges from 20 to 20,000 Hz.

Table 6-1. Definitions of Some Common Acoustical Terms

Term	Definition
Root Mean Square (rms), dB re 1 µPa	The rms level is the square root of the energy divided by a defined time period. For pulses, the rms has been defined as the average of the squared pressures over the time that comprises that portion of waveform containing 90 percent of the sound energy for one impact pile-driving impulse.
Background Sound Level	A composite measurement of natural and anthropogenic sound from all sources, near and far, at a given location.
Ambient Noise Level	A composite measurement of natural sound from all sources, near and far, at a given location.
Sound Exposure Level (SEL), dB re 1 µPa^2-s	Proportionally equivalent to the time integral of the pressure squared in terms of dB re 1 µPa^2-s over the duration of the impulse. Similar to the unweighted SEL standardized in in-air acoustics to study noise from single events.
Cumulative SEL (SEL_{cum})	Measure of the total energy received during pile installation and/or removal, defined here as occurring within a single day.
Transmission Loss (TL)	Underwater TL is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water chemistry, and bottom composition and topography.

6.2 Applicable Noise Criteria

The MMPA defines Level A harassment as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." The MMPA defines Level B harassment as "any act of pursuit, torment, or annoyance which has the potential to 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."

NMFS published updated *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal hearing (Version 2.0): Underwater thresholds for onset of permanent and temporary threshold shifts* (Technical Guidance; NMFS 2018) that is currently used to assess potential effects of exposure to underwater anthropogenic sound on the hearing of marine mammals.

The Technical Guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience permanent changes (e.g., a permanent threshold shift [PTS]) in their hearing sensitivity from incidental exposure to underwater anthropogenic sound sources (NMFS 2018). NMFS considers the Technical Guidance to represent the best available scientific information and, on this basis, suggests that these thresholds and weighting functions be used to assess the potential for PTS in marine mammals, which equates to Level A harassment under the MMPA. The models used to derive the acoustic thresholds for onset of PTS incorporate marine mammal auditory weighting functions in recognition of the variability found among marine mammal species in their hearing sensitivity. The auditory weighting functions are defined for five functional hearing groups: low-frequency (LF), mid-frequency (MF), and high-frequency (HF) cetaceans; and otariid in water (OW) and phocid in water (PW) pinnipeds (Table 6-2). Additionally, the models used to derive the PTS onset acoustic thresholds incorporate a time component in the form of a cumulative sound exposure level (SEL_{cum}) for both impulsive and non-impulsive sound, and a sound pressure level component by using peak sound level (L_{pk}) for impulsive sounds (NMFS 2018).

Table 6-2. Marine Mammal Functional Hearing Groups and Representatives of Each Group That Are Found Near the POA

Functional Hearing Group		Species	Generalized Hearing Range
Cetaceans	LF cetaceans	Humpback whales, gray whales	7 Hz to 35 kHz
	MF cetaceans	Beluga whales, killer whales	150 Hz to 160 kHz
	HF cetaceans	Harbor porpoises	275 Hz to 160 kHz
Pinnipeds	PW pinnipeds underwater	Harbor seals	50 Hz to 86 kHz
	OW pinnipeds underwater	Steller sea lions	60 Hz to 39 kHz

Source: NMFS 2018

Notes: HF = high-frequency; Hz = Hertz; kHz = kilohertz; LF = low-frequency; MF = mid-frequency; OW = otariid in water; PW = phocid in water.

NMFS continues to use its interim criteria to assess Level B harassment levels. Under the interim guidance, Level B harassment by impulsive sounds, such as impact pile installation, occurs with exposure to an SPL of 160 dB rms for all marine mammals. Level B harassment by non-impulsive sounds, such as vibratory pile installation and removal, occurs with exposure to an SPL of 120 dB rms for all marine mammals unless empirical ambient sound level data exist to justify a higher threshold, which will be 122.2 dB for the CTR Project (see Section 6.3.1).

This application uses the Technical Guidance acoustic thresholds to calculate Level A harassment isopleths and the NMFS interim criteria to calculate Level B harassment isopleths (Table 6-3). The NMFS Companion User Spreadsheet (Version 2.2, 2020), provided by NMFS for use with the Technical Guidance (NMFS 2018), was used as a basis to predict zones where the onset of a PTS in marine mammal hearing could occur. Because the onset of PTS based on SEL_{cum} is computed as farther from the pile than it would be using peak sound pressure computations, the onset of PTS is based on SEL computations; therefore, the onset of PTS based on peak sound levels is not provided in this assessment. Estimation of acoustic thresholds was conducted for pile installation and removal (temporary piles only) with a vibratory hammer with and without a sound-attenuating bubble curtain, and for pile installation with an impact hammer with and without a sound-attenuating bubble curtain (Section 6.3.3.1).

6.3 Description of Noise Sources

For the purposes of this LOA and IHA application, the sound field in Knik Arm is the existing ambient sound plus additional construction noise from the CTR Project. Pile installation and removal are anticipated to produce the highest in-water sound pressure levels (Section 6.3.3). A number of project activities will take place above marine waters (including welding, cutting, wiring, concrete work, and setting of a prefabricated gangway and ramp), and no in-water noise is anticipated in association with their installation. Some pile installation and removal will take place out of water (in the dry), in areas that are de-watered, and this is not expected to produce elevated in-water sound pressure levels. Vessel noise will be generated by tugs and barges; however, noise from project vessels is not anticipated to have more than a negligible effect on beluga whales and other marine mammals.

Table 6-3. Summary of PTS Onset Acoustic Thresholds for Assessing Level A Harassment, and Acoustic Criteria for Assessing Level B Harassment, of Marine Mammals from Exposure to Noise from Impulsive (Pulsed) and Non-impulsive (Continuous) Underwater Sound Sources

<table>
<tr><th rowspan="2">Species Group</th><th colspan="4">PTS Onset Acoustic Thresholds (Received Level)</th></tr>
<tr><th>Hearing Group</th><th colspan="2">Impulsive (Pulsed or Intermittent)</th><th>Non-impulsive (Continuous)</th></tr>
<tr><td colspan="5">Level A Harassment</td></tr>
<tr><td rowspan="6">Cetaceans</td><td rowspan="2">LF</td><td>$L_{pk,flat}$</td><td>219 dB</td><td rowspan="2">$L_{E, LF, 24h}$: 199 dB</td></tr>
<tr><td>$L_{E, LF, 24h}$</td><td>183 dB</td></tr>
<tr><td rowspan="2">MF</td><td>$L_{pk,flat}$</td><td>230 dB</td><td rowspan="2">$L_{E, MF, 24h}$: 198 dB</td></tr>
<tr><td>$L_{E, MF, 24h}$</td><td>185 dB</td></tr>
<tr><td rowspan="2">HF</td><td>$L_{pk,flat}$</td><td>202 dB</td><td rowspan="2">$L_{E, HF, 24h}$: 173 dB</td></tr>
<tr><td>$L_{E, HF, 24h}$</td><td>155 dB</td></tr>
<tr><td rowspan="4">Pinnipeds</td><td rowspan="2">PW phocids underwater</td><td>$L_{pk,flat}$</td><td>218 dB</td><td rowspan="2">$L_{E, PW, 24h}$: 201 dB</td></tr>
<tr><td>$L_{E, PW, 24h}$</td><td>185 dB</td></tr>
<tr><td rowspan="2">OW otariids underwater</td><td>$L_{pk,flat}$</td><td>232 dB</td><td rowspan="2">$L_{E, OW, 24h}$: 219 dB</td></tr>
<tr><td>$L_{E, OW, 24h}$</td><td>203 dB</td></tr>
<tr><td colspan="5">Level B Harassment</td></tr>
<tr><td rowspan="3">Cetaceans</td><td>LF</td><td colspan="2" rowspan="5">160 dB rms</td><td rowspan="5">120 dB rms or ambient level</td></tr>
<tr><td>MF</td></tr>
<tr><td>HF</td></tr>
<tr><td rowspan="2">Pinnipeds</td><td>PW pinnipeds</td></tr>
<tr><td>OW pinnipeds</td></tr>
</table>

Source: NMFS 2018

Note: dB = decibels; HF = high-frequency; $L_{pk,flat}$ = peak sound pressure level (unweighted); $L_{E,24h}$ = sound exposure level, cumulative 24 hours; LF = low-frequency; MF = mid-frequency; OW = otariid in water; PTS = permanent threshold shift; PW = phocid in water; rms = root mean square.

6.3.1 Ambient Noise

Ambient noise is background noise that is comprised of many sources from multiple locations (Richardson et al. 1995). Ambient noise can vary with location, time of day, tide, weather, season, and frequency on scales ranging from 1 second to 1 year (Richardson et al. 1995). Ambient underwater noise levels in the Project area are both variable and relatively high, primarily because of extreme tidal activity, elevated sediment loads in the water column, periodic high winds, the seasonal presence of ice, and anthropogenic activities. Sources of anthropogenic noise in the Project area consist of dredging operations, boats, ships, oil and gas operations, construction noise, and aircraft overflights from JBER, all of which contribute to the high underwater noise levels in upper Cook Inlet (e.g., Blackwell and Greene 2002; KABATA 2011). These levels are consistent with other measurements conducted in Cook Inlet by Blackwell (2005).

Ambient levels were measured near the POA in 2016 at two locations, one within the POA and one about 1 km offshore of the POA, during a 3-day break in pile installation during the POA TPP (Austin et al. 2016). The median values of the background sound pressure levels from continuous 60-second sample averages were 117.0 dB at the nearshore location within the POA and 122.2 dB at the offshore location (POA 2016a). During the measurements, some typical sound signals were noted, such as noise from current flow and the passage of vessels. Throughout the data set, the offshore levels were consistently higher than those closer to the POA by 3 to 5 dB. Although different sound metrics were measured, the median levels are thought to be the most appropriate characterization of the nominal ambient conditions. A diurnal pattern to the ambient sound data was not apparent. The two IHAs for PCT Phase 1 and Phase 2 issued by NMFS in April 2020 (85 FR 19294) and the IHA for the SFD issued by NMFS in August 2021 (86 FR 50057) used 122.2 dB as ambient noise. A recent SSV study conducted in 2020 at the PCT did not directly measure ambient noise but did not indicate that ambient noise levels were significantly different from 122.2 dB (James Reyff, personal communication, 26 August 2020). Based on these measurements and the application of 122.2 dB for other POA projects, the ambient noise level of 122.2 dB will be used for the Project.

6.3.2 Sound Propagation

6.3.2.1 Sound Source Levels

The primary sound-generating activities associated with construction of the Project will be impact hammer installation and vibratory hammer installation and removal of steel pipe piles. Impact hammer pile installation produces impulsive sounds that typically have differing potential to cause physical effects to marine mammals, particularly with regard to hearing. Such sounds have the potential to result in physical injury because they are characterized by a relatively rapid rise in ambient pressure, followed by a period of diminishing, oscillating maximal and minimal pressures. Vibratory hammer installation and removal of steel pipe piles that will primarily be used to build temporary construction components will also take place during construction of the Project.

The most accurate sound source levels (SSLs) were determined for the Project based on site- and Project-specific data when available (Appendix A; Table 6-4). Data to verify SSLs were collected at the POA during 3 different years and for a number of pile sizes, hammer types, and sound attenuation types and configurations (Austin et al. 2016; I&R 2021a, 2021b). Unfortunately, the POA was not allowed to collect data on unattenuated pile installation, and measurements were obtained from only a small number of unattenuated piles with authorization from NMFS when extenuating circumstances prevented use of the bubble curtain (Table 6-4).

Vibratory Hammer

U.S. Navy (2015) data were selected as proxies for unattenuated vibratory installation of 24- and 36-inch piles in the POA environment because piles were installed at similar depths (for a more detailed discussion, see Appendix A). The source level for unattenuated vibratory installation of 72-inch piles was determined from existing unpublished data (Appendix A), and the source level for unattenuated vibratory installation of 144-inch piles was based on an assumed 7-dB reduction with a bubble curtain from the measured value during PCT 2021 construction (I&R 2021b; Table 6-4).

Source levels for unattenuated vibratory removal of 24- and 36-inch piles were determined for POA projects by NMFS as part of the IHA process for the NES1 project, slated for earlier construction at a neighboring location at the POA. For NES1, the POA proposed to use project- and site-specific SSLs for unattenuated vibratory removal of 24- and 36-inch temporary piles as collected during PCT 2020 construction and reported in I&R (2021a). However, NMFS did not accept those values and chose to evaluate all available data related to unattenuated vibratory removal of 24- and 36-inch steel pipe piles, including data submitted by the POA and measured during the PCT project. NMFS gathered available data from publicly available reports that reported driving conditions and specified vibratory removal for certain piles. If vibratory removal was not specifically noted for a given pile, it was excluded from the analysis. Mean rms SPLs were converted into pressure values, and pressure values for piles from each project were averaged to give a single value for each project. The calculated project means were then averaged and converted back into units of decibels to give a single recommended SPL for each pile type. The guidance document from NMFS is dated 18 May 2023 and was provided to the POA in an email on the same day.

For 24-inch pile removal, NMFS included 10 pile measurements: 3 from Columbia Crossing in Oregon; 5 from Joint Expeditionary Base Little Creek in Norfolk, Virginia; and 2 from the PCT project at the POA. NMFS calculated an average SPL for vibratory removal of 24-inch steel pipe piles of 168 dB rms, whereas POA data indicate a value of 167 dB rms (I&R 2021a).

For 36-inch pile removal, NMFS included 40 pile measurements: 38 from the U.S. Navy Test Pile Program at Naval Base Kitsap in Bangor, Washington, and 2 from the PCT project at the POA. NMFS calculated an average SPL for vibratory removal of 36-inch steel pipe piles of 159 dB rms, whereas POA data indicate a value of 155 dB rms (I&R 2021a; Table 6-4).

Source levels for attenuated vibratory installation and removal of 24-, 36-, and 144-inch piles were measured during PCT construction (I&R 2021a, 2021b). The source level for attenuated vibratory installation of 72-inch piles was based on an assumed 7 dB reduction with a bubble curtain (Table 6-4).

Impact Hammer

U.S. Navy (2015) data were selected as proxies for unattenuated impact installation of 24- and 36-inch piles (Appendix A). Source levels for unattenuated impact installation of 72- and 144-inch piles were estimated by I&R (Appendix A). Source levels for attenuated impact installation of 24-, 36-, and 72-inch piles were was based on an assumed 7 dB reduction with a bubble curtain (Table 6-4). The source level for unattenuated impact installation of 144-inch piles was extrapolated from existing data (Appendix A), and the attenuated value for impact installation of 144-inch piles was measured during PCT construction (I&R 2121b).

6.3.2.2 Transmission Loss for Pile Installation and Removal

In the PCT Final IHA for Phase 2 of that project (85 FR 19294), the POA proposed and NMFS applied a transmission loss (TL) coefficient of 16.5 for assessing potential for Level A and B harassment from unattenuated vibratory pile installation and removal, and 16.5 will be used for the CTR Project. This TL value is supported by site-specific data collected during unattenuated vibratory pile installation (Austin et al. 2016; Appendix A). The POA has applied a practical spreading loss model (15log) for attenuated vibratory pile installation and removal, and for SEL and rms for both unattenuated and attenuated impact pile installation (Table 6-4). The 15 TL coefficient falls within the range of TL coefficients reported in I&R (2021a, 2021b) for PCT Phase 1 and also serves as the NMFS default transmission loss value.

Table 6-4. Estimates of Unweighted Underwater Sound Levels Generated during Vibratory and Impact Pile Installation With and Without a Bubble Curtain

Method and Pile Type	Unweighted Sound Level at 10 Meters									
Vibratory Hammer	Unattenuated (Without Bubble Curtain)					Attenuated (With Bubble Curtain)				
	dB rms			TL Coefficient	Data Source for Source Levels	dB rms			TL Coefficient	Data Source for Source Levels
24-inch steel installation	161			16.5[a]	U.S. Navy 2015	158.5			15.0[c] (rms)	I&R 2021a
24-inch steel removal	168				NMFS average 2023[b]	157				I&R 2021a
36-inch steel installation	166				U.S. Navy 2015	160.5				I&R 2021a, 2021b
36-inch steel removal	159				NMFS average 2023[b]	154				I&R 2021a
72-inch steel	171				I&R 2003, unpublished data for Castrol Oil berthing dolphin in Richmond, CA	164				Assumed 7-dB reduction supported by I&R 2021a
144-inch steel	160				Added 7 dB to measured result of 153 dB from attenuated 144-inch piles as reported in I&R 2021b	153				I&R 2021b
Impact Hammer	Unattenuated (Without Bubble Curtain)					Attenuated (With Bubble Curtain)				
	dB rms	dB SEL	dB peak	TL Coefficient	Data Source for Source Levels	dB rms	dB SEL	dB peak	TL Coefficient	Data Source for Source Levels
24-inch steel	193	181	210	15.0[c] (rms) 15.0[c] (SEL)	U.S. Navy 2015	186	174	203	15.0[c] (rms) 15.0[c] (SEL)	Assumed 7-dB reduction supported by I&R 2021a
36-inch steel	193	184	211		U.S. Navy 2015	186	177	204		Assumed 7-dB reduction supported by I&R 2021a
72-inch steel	203	191	217		I&R model. Estimate based on interpolation of data for piles 24 to 144 inches in diameter.	196	184	210		Assumed 7-dB reduction supported by Caltrans Compendium (2020)
144-inch steel	209	198	221		I&R model. Estimate based on interpolation of data for 24-, 36-, 48-, and 96-inch piles.	207	193	219		I&R 2021b

Note: dB = decibels; I&R = Illingworth & Rodkin, LLC; rms = root mean square; SEL = sound exposure level; TL = transmission loss.

[a] Austin et al. 2016

[b] NMFS-developed values (see text for details)

[c] NMFS default value (Practical Spreading Loss)

6.3.2.3 In-Air Sound Levels

To assess exposure of hauled-out pinnipeds to in-air sound, NMFS uses disturbance criteria for Level B harassment of 90 dB rms re 20 µPa for harbor seals, and 100 dB rms re 20 µPa for all other types of pinnipeds, including Steller sea lions. Note that all in-air sound discussed in this document is referenced to 20 µPa unless otherwise noted. Measurements of in-air sound resulting from impact installation of 48-inch piles were collected during the 2016 TPP for both diesel and hydraulic hammers (Table 6-5). No other site-specific in-air noise measurements associated with pile installation are available, and no in-air measurements for 72- or 144-inch piles are available. The type of impact hammer that will be used during the CTR Project is not known at this time. In-air noise levels during the 2016 TPP were higher during impact installation with the hydraulic hammer, and it is assumed that 102.5 dB is the highest anticipated in-air SSL for the Project.

Table 6-5. Estimates for In-air Sound Levels (decibels) Generated during Pile Installation

Method and Pile Type	Sound Level (dB) at 15 meters
Diesel Impact Hammer 48-inch permanent steel pipe	101.0
Hydraulic Impact Hammer 48-inch permanent steel pipe	102.5

Source: POA 2016b

Notes: dB = decibels.

No pinniped haulouts are known to occur near the POA, and the nearest identified harbor seal haulout is more than 20 km from the Project in the Little Susitna River delta (see Section 4.1.3). Therefore, it is unlikely that harbor seals or Steller sea lions will be impacted by in-air noise from pile installation or removal.

6.4 Distances to Sound Thresholds and Areas

6.4.1 In-water Sound

Sound propagation and the distances to the sound isopleths at which a marine mammal exposed to those values would potentially experience a PTS (Level A harassment) based on the Technical Guidance were estimated using the User Spreadsheet developed by NMFS (NMFS 2018). The NMFS User Spreadsheet computes the distances to isopleths for the different functional hearing groups based on an unweighted sound level with corresponding distance. The model applies simple Weighting Factor Adjustments for the five functional hearing groups and incorporates a duty cycle to account for the number of pile strikes (NMFS 2018).

The simple spreading loss to account for sound propagation and the distances to the sound isopleths defined by NMFS for onset of PTS (Level A harassment) and Level B harassment of marine mammals were estimated based on the following formula for transmission loss (TL):

$$TL = TL_c * \log10^{(R/D)}$$

Where

- TL_c is the transmission loss coefficient, typically the NMFS default of 15 and for this Project, 16.5 for unattenuated vibratory pile installation and removal;
- R is the estimated distance to where the sound level is equal to the Level B harassment threshold (122.2 dB for continuous sound and 160 dB for impulsive sound); and
- D is the distance at which the SSL was measured.

The estimated distance to the onset of Level B harassment isopleths can be calculated by rearranging the terms in the above equation to the following:

$$R = D * 10^{(TL/TL_c)}$$

Where

- TL is the difference between the reference SSL in dB rms and the Level B threshold in dB rms (122.2 dB rms for continuous sound or 160 dB rms for impulsive sound); and
- TL_c is the transmission loss coefficient, typically the NMFS default of 15 and for this Project, 16.5 for unattenuated vibratory pile installation and removal.

For estimated distances to the onset of PTS, the SSL is based on the SEL_{cum} over time, which is computed based on the following for continuous sound such as vibratory pile driving:

$$SEL_{cum} = SEL + 10Log_{10}(seconds)$$

And the following for impulsive sound such as impact pile driving:

$$SEL_{cum} = \text{Single-Strike SEL} + 10\ Log_{10}(\text{number of events})$$

Where number of events is expressed as seconds for vibratory pile driving or pile strikes for impact pile driving.

These models were used to predict distances to underwater Level A (PTS) and Level B isopleths generated by pile installation and removal as part of the Project (Table 6-6). Isopleths were calculated for each combination of pile size, hammer, and use of a bubble curtain; and for the number of piles and duration that could be installed each day as identified in Table 1-3 through Table 1-9 (Section 1.5.3).

Isopleths were calculated for some pile combinations that are not expected to be used but that could become necessary if an unexpected or high-risk situation arises. For example, it is anticipated that all temporary piles will be installed with a vibratory hammer; however, if an obstruction is encountered that prevents advancement of a temporary pile, use of an impact hammer on that temporary pile may become necessary. Similarly, it is anticipated that a bubble curtain will be used with an impact hammer for all pile sizes when water depths exceed 3 meters, but if a human safety risk materializes, it may be necessary to stabilize the pile by partially installing it. It may not be possible to lift and lay down these large, heavy piles on a barge once they have been stabbed and the impact hammer has been attached. The POA will coordinate with NMFS as soon as possible if construction methods differ significantly from what is proposed here.

The pile combinations that are planned construction methods are indicated in **bold font** in Table 6-6. Pile combinations that are not planned construction methods are not in bold font in Table 6-6. Level A and Level B isopleths for planned construction methods are shown in Figure 6-1 through Figure 6-10.

Calculated Level A zones for all combinations of functional hearing group, pile size, number of piles per day, and vibratory hammer are smaller than the 100-meter shutdown zone that will be implemented by the POA during pile installation and removal (Table 6-6).

Table 6-6. Distances to Calculated Level A and Level B Harassment Isopleths for Pile Installation and Removal

Pile Size	Bubble Curtain	Number of Piles (Duration in Minutes or Strikes per Pile) Per Day	Calculated Level A Zone (m)					Calculated Level B Zone
			LF	MF	HF	PW	OW	
			Humpback and Gray Whale	Beluga and Killer Whale	Harbor Porpoise	Harbor Seal	Steller Sea Lion	
Vibratory Hammer								
24-inch installation	Unattenuated	**4 (30 minutes)**	**11**	**2**	**16**	**7**	**1**	**2,247**
	Attenuated		**8**	**1**	**11**	**5**	**1**	**2,630**
24-inch removal	Unattenuated	**4 (45 minutes)**	**37**	**5**	**53**	**24**	**3**	**5,967**
	Attenuated		**8**	**1**	**12**	**5**	**1**	**2,089**
36-inch installation	Unattenuated	**4 (30 minutes)**	**22**	**3**	**31**	**14**	**2**	**4,514**
	Attenuated		**11**	**1**	**15**	**7**	**1**	**3,575**
36-inch removal	Unattenuated	**4 (45 minutes)**	**11**	**2**	**15**	**7**	**1**	**1,699**
	Attenuated		**5**	**1**	**8**	**3**	**1**	**1,318**
72-inch installation	Unattenuated	**3 (10 minutes)**	**19**	**3**	**27**	**12**	**2**	**9,069**
	Attenuated		**7**	**1**	**11**	**5**	**1**	**6,119**
144-inch installation	Unattenuated	**1 (15 minutes)**	**3**	**1**	**4**	**2**	**1**	**1,954**
	Attenuated		**1**	**1**	**2**	**1**	**1**	**1,131**
Impact Hammer								
24-inch installation	Unattenuated	1 (1000 strikes)	735	27	876	394	29	1,585
	Attenuated	1 (1000 strikes)	251	9	299	135	10	541
36-inch installation	Unattenuated	1 (1000 strikes)	1,165	42	1,387	624	46	1,585
	Attenuated	1 (1000 strikes)	398	15	474	213	16	541
72-inch installation	Unattenuated	1 (5,743 strikes)	10,936	389	13,026	5,853	427	7,356
	Attenuated	**1 (5,743 strikes)**	**3,734**	**133**	**4,448**	**1,999**	**146**	**2,512**
		2 (5,743 strikes)	**5,928**	**211**	**7,061**	**3,173**	**231**	
		3 (5,743 strikes)	**7,767**	**277**	**9,252**	**4,157**	**303**	
144-inch installation	Unattenuated	1 (5,000 strikes)	29,201	1,039	34,782	15,627	1,138	18,478
	Attenuated	**0.5 (2,500 strikes)**	**8,539**	**304**	**10,171**	**4,570**	**333**	**13,594**
		1 (5,000 strikes)	**13,554**	**483**	**16,145**	**7,254**	**529**	

Note: HF = high-frequency; LF = low-frequency; m = meters; MF = mid-frequency; PW = phocid in water; OW = otariid in water.

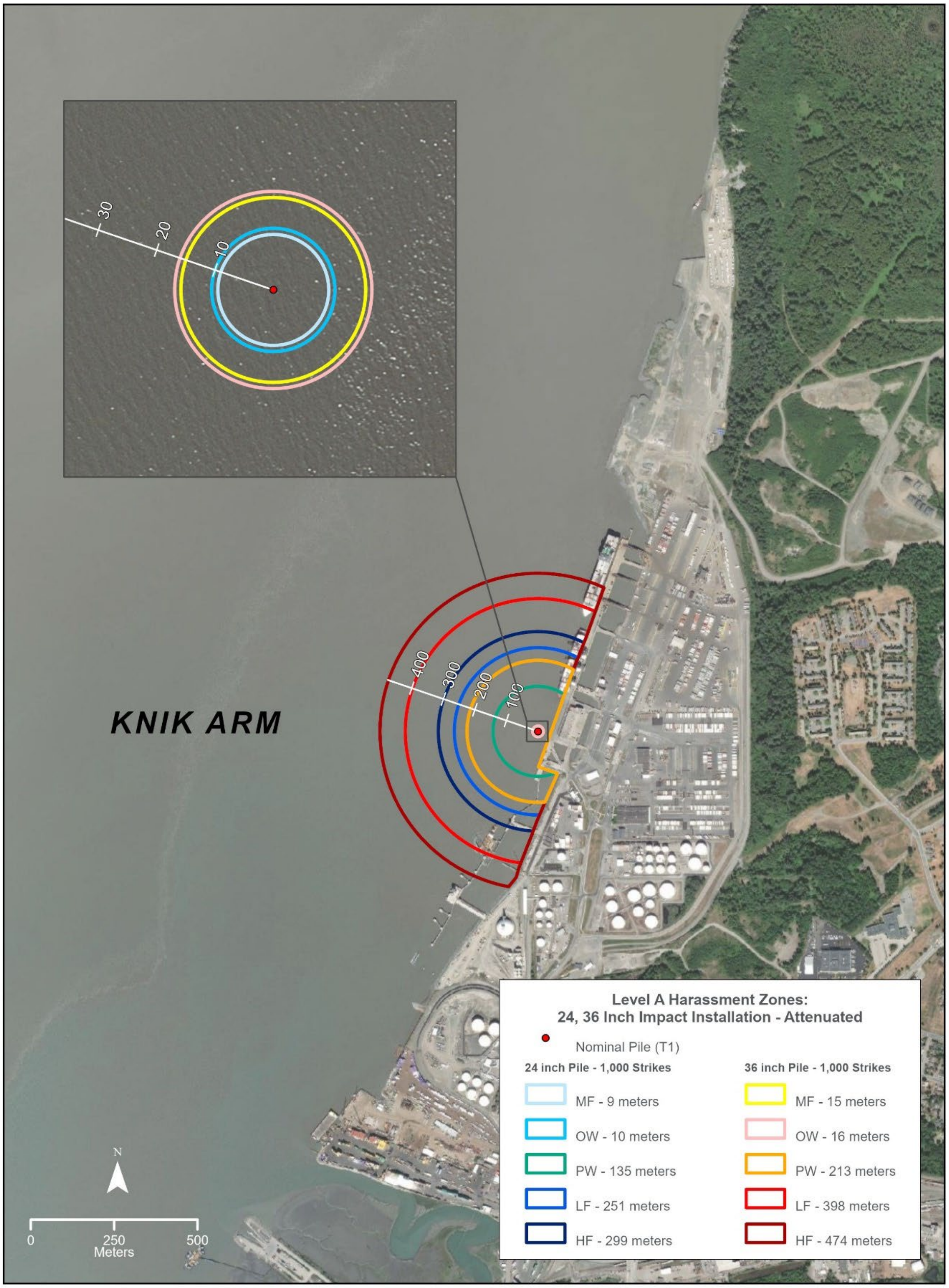

Figure 6-1. Level A Harassment Isopleths for Impact Installation of 24 and 36-Inch Piles (Attenuated) for Production Rate of 1 Pile per Day

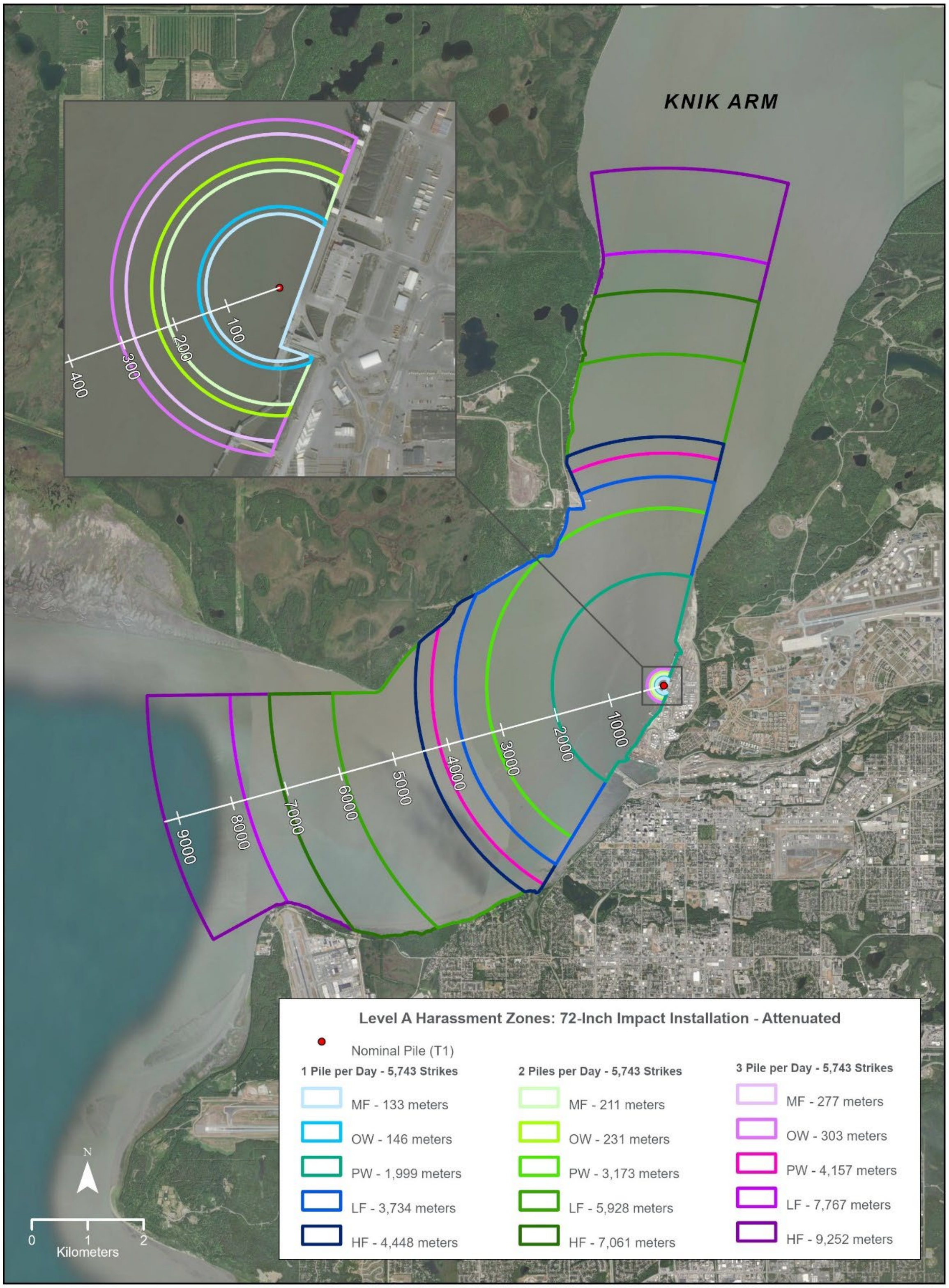

Figure 6-2. Level A Harassment Isopleths for Impact Installation of 72-Inch Piles (Attenuated) for Production Rate of 1-3 Piles per Day

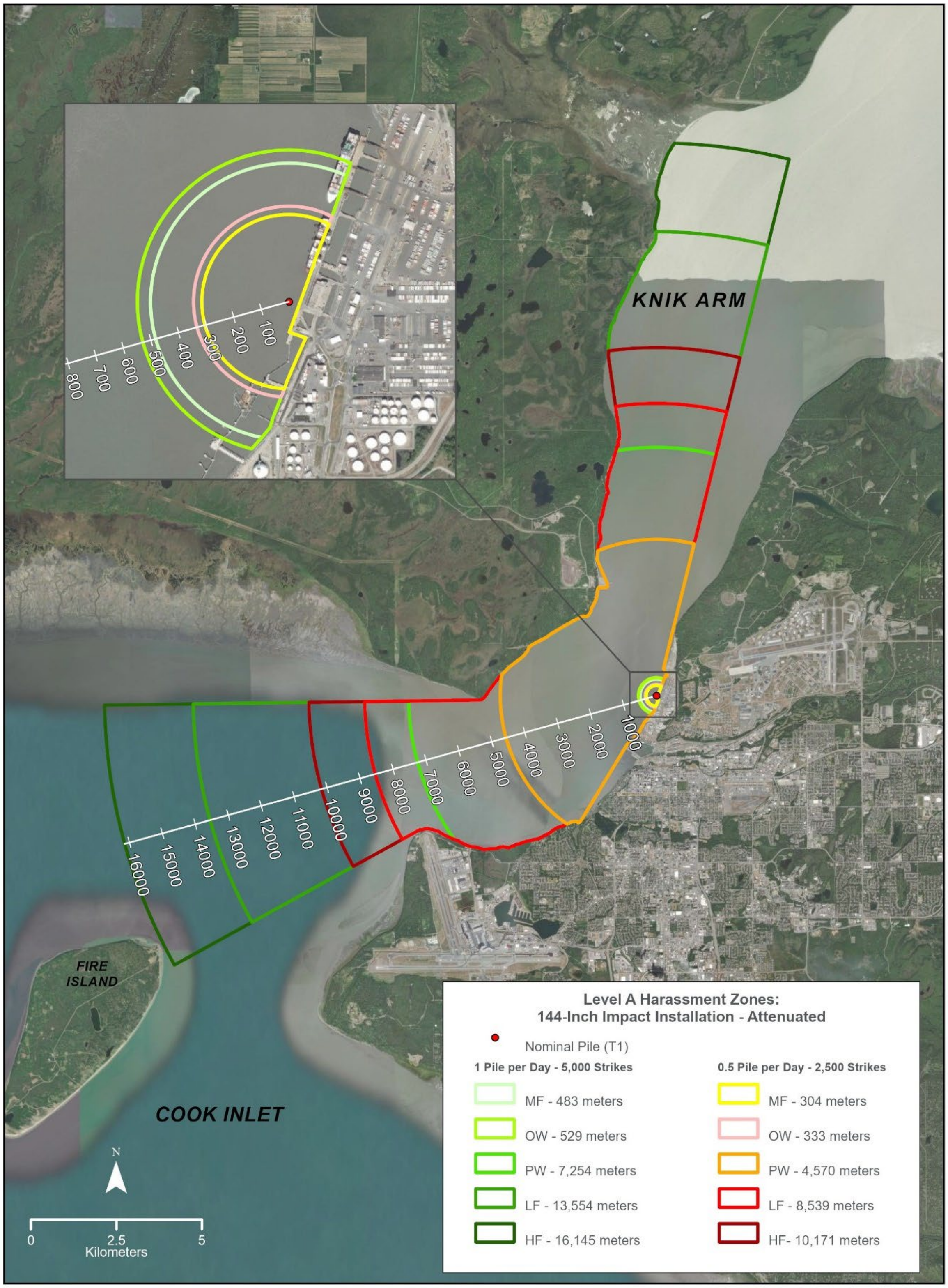

Figure 6-3. Level A Harassment Isopleths for Impact Installation of 144-Inch Piles (Attenuated) for Production Rate of 0.5 or 1 Pile per Day

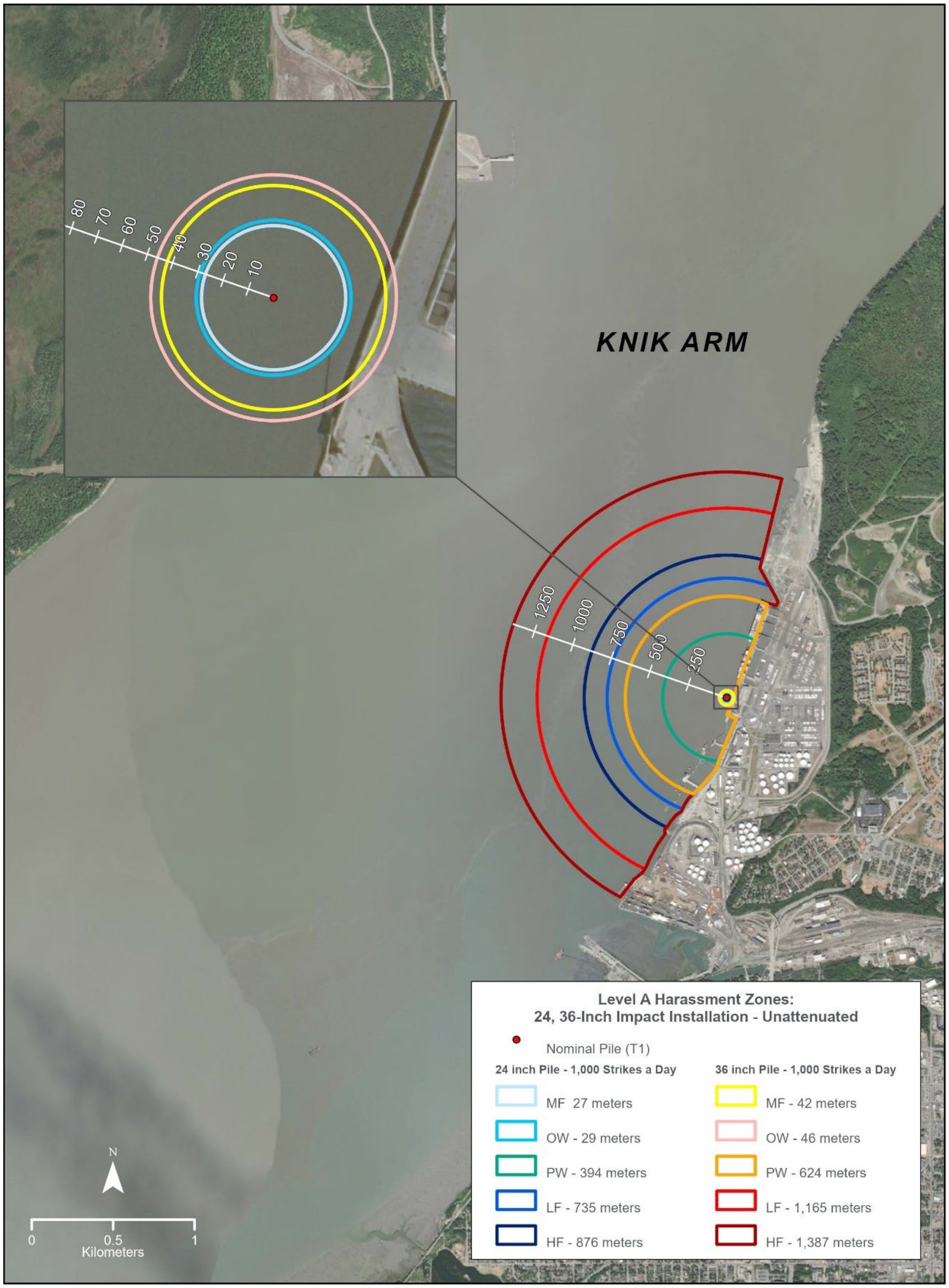

Figure 6-4. Level A Harassment Isopleths for Impact Installation of 24 and 36-Inch Piles (Unattenuated) for Production Rate of 1 Pile per Day

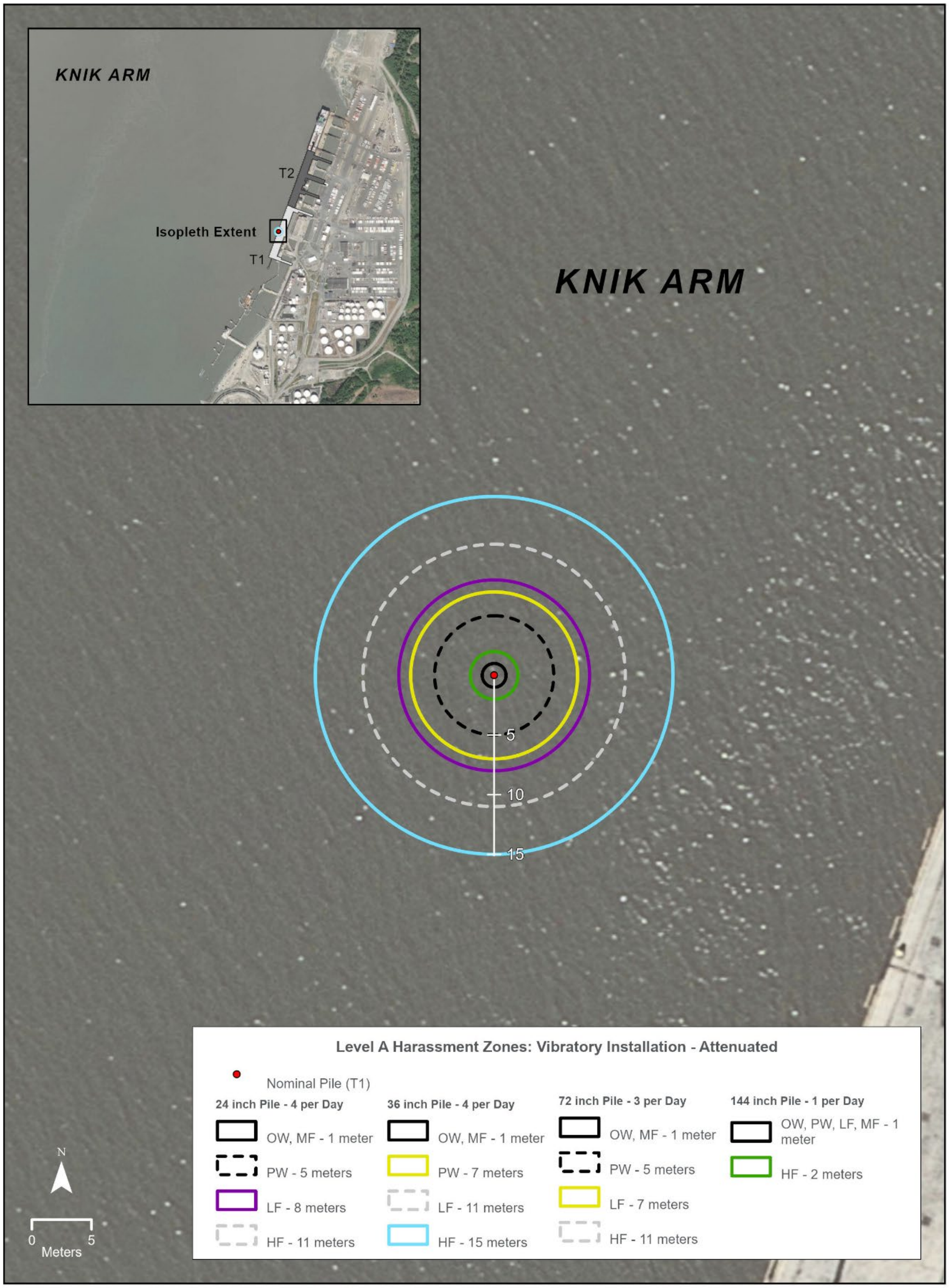

Figure 6-5. Level A Harassment Isopleths for Vibratory Pile Installation (Attenuated)

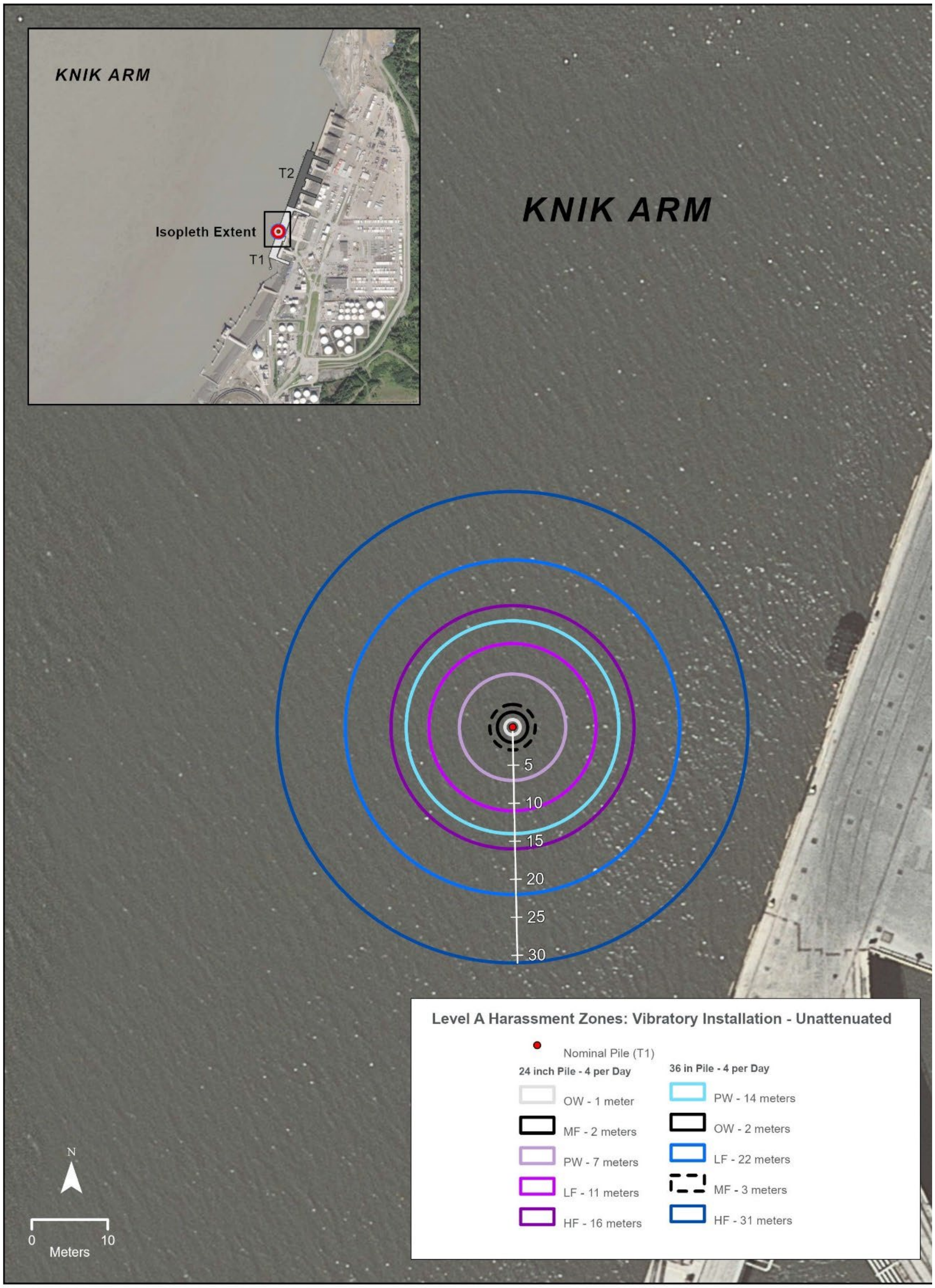

Figure 6-6. Level A Harassment Isopleths for Vibratory Pile Installation (Unattenuated)

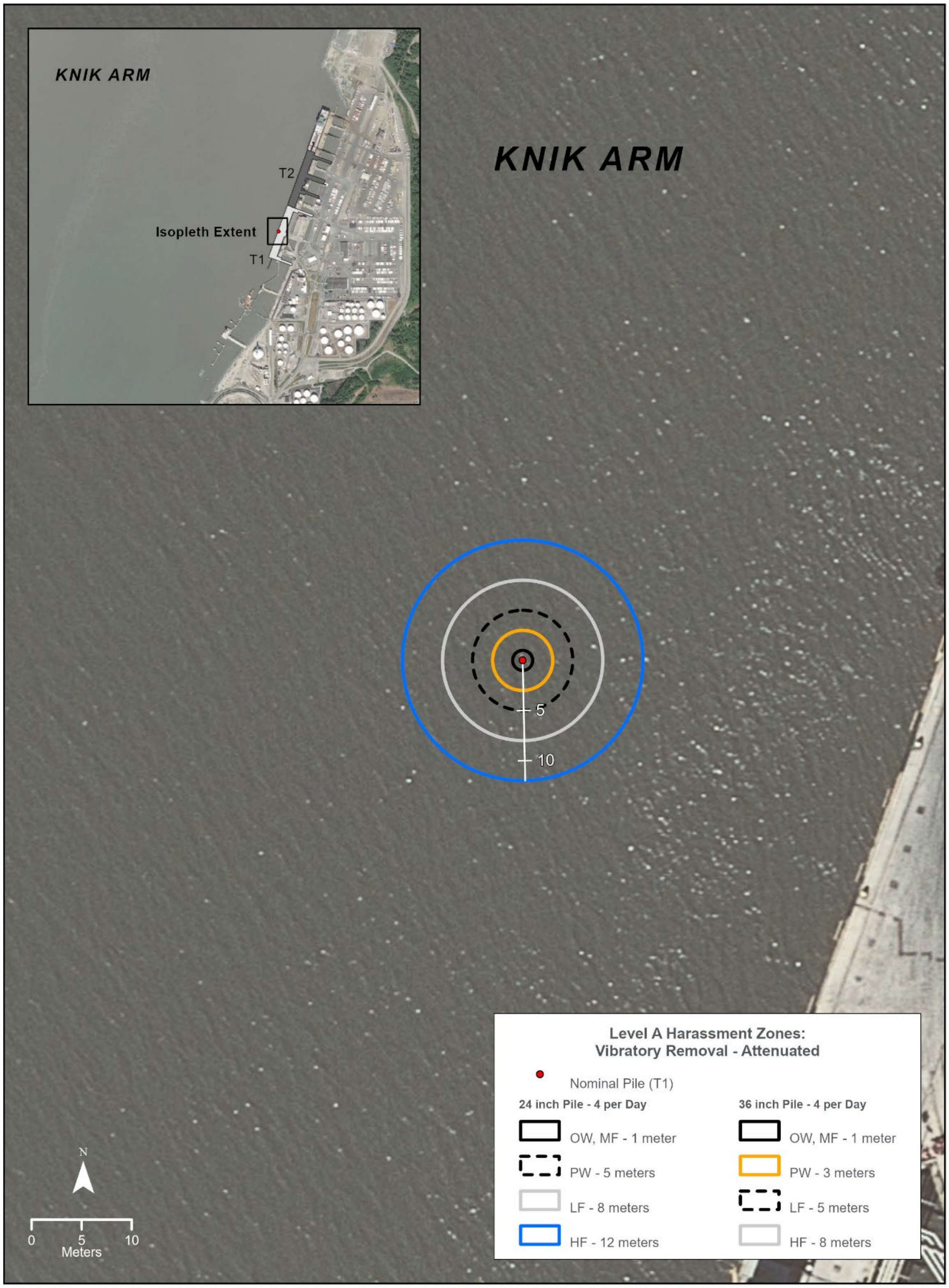

Figure 6-7. Level A Harassment Isopleths for Vibratory Pile Removal (Attenuated)

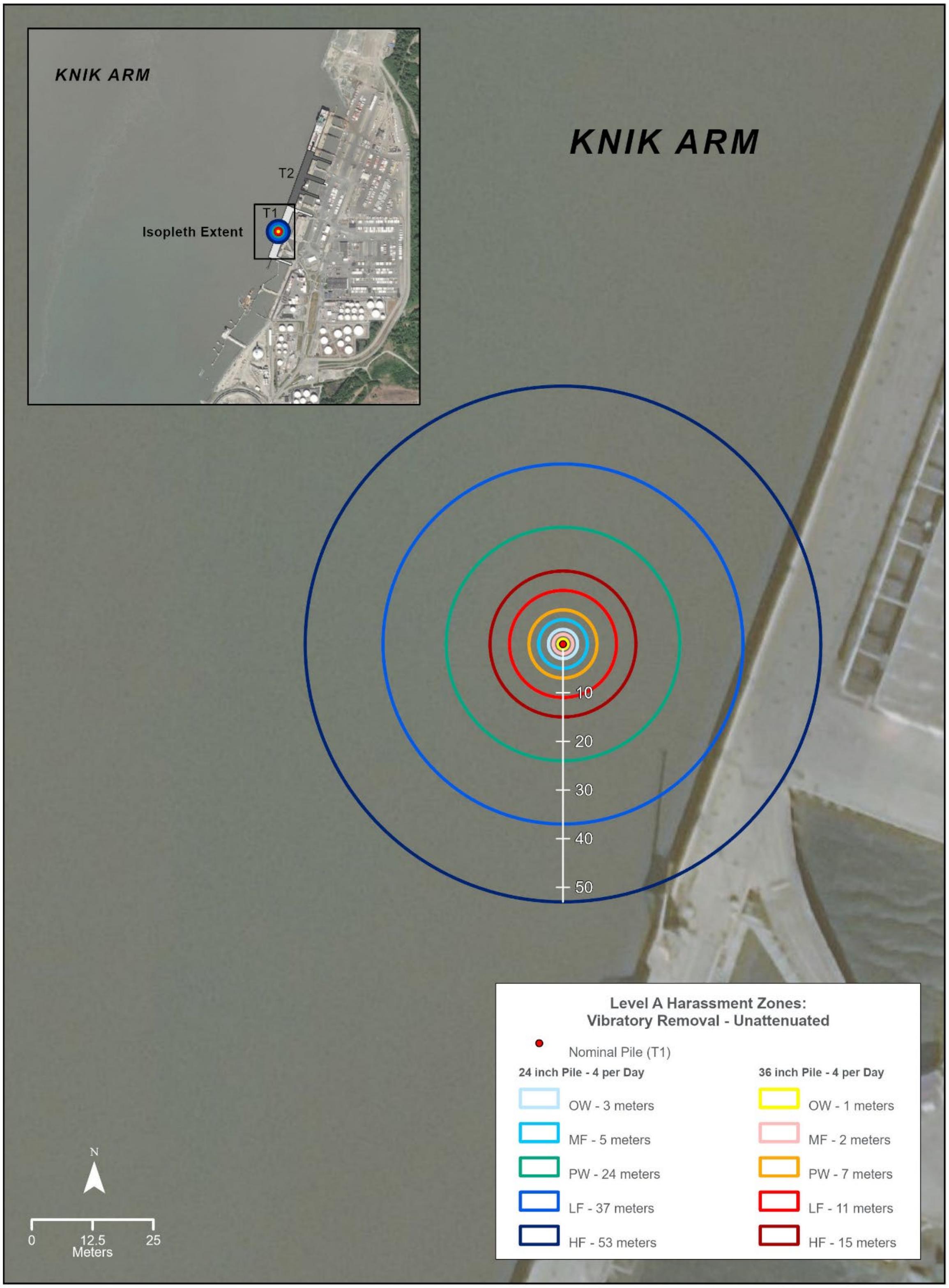

Figure 6-8. Level A Harassment Isopleths for Vibratory Pile Removal (Unattenuated)

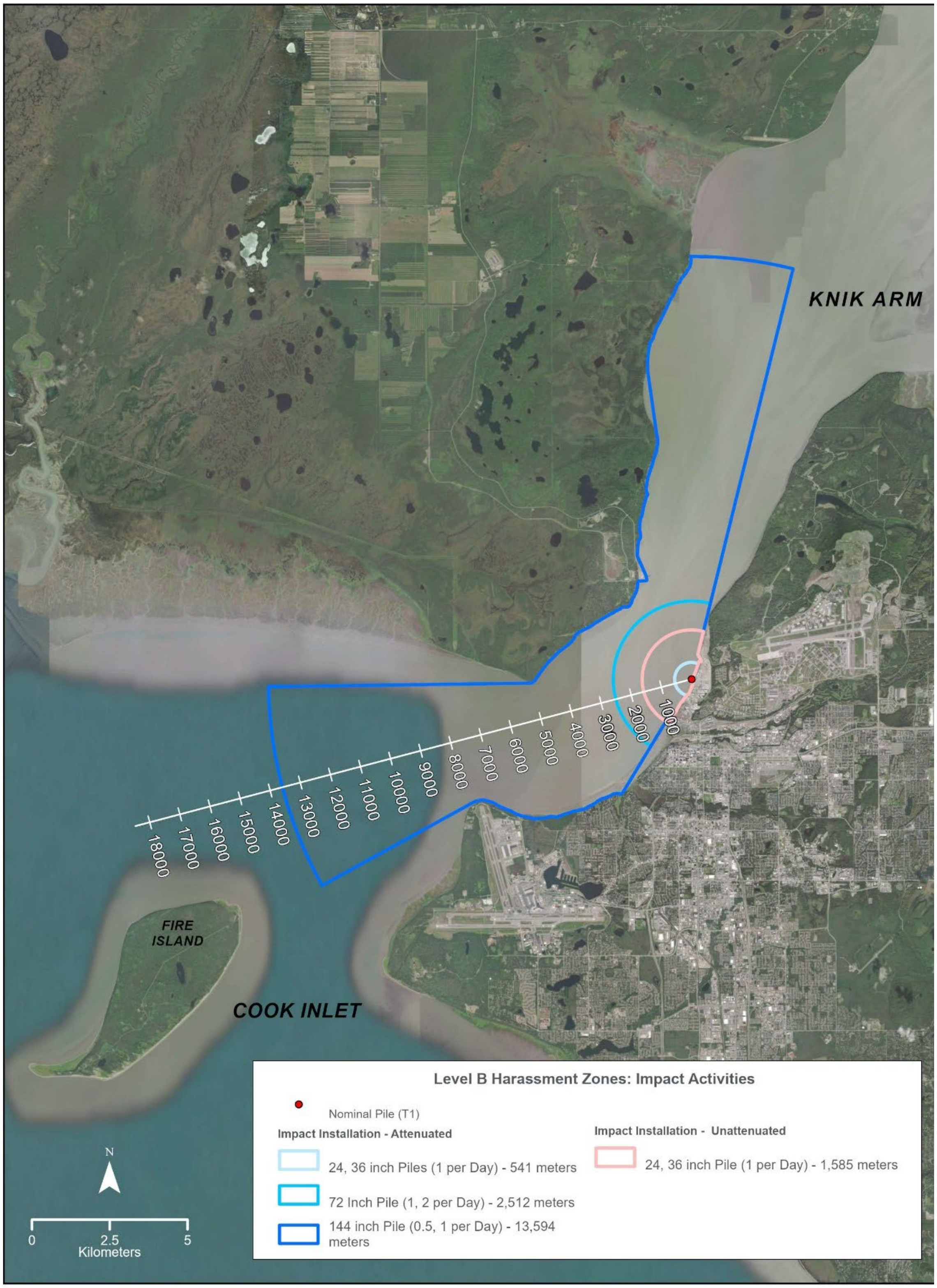

Figure 6-9. Level B Harassment Isopleths for All Pile Sizes for Impact Installation (Attenuated and Unattenuated)

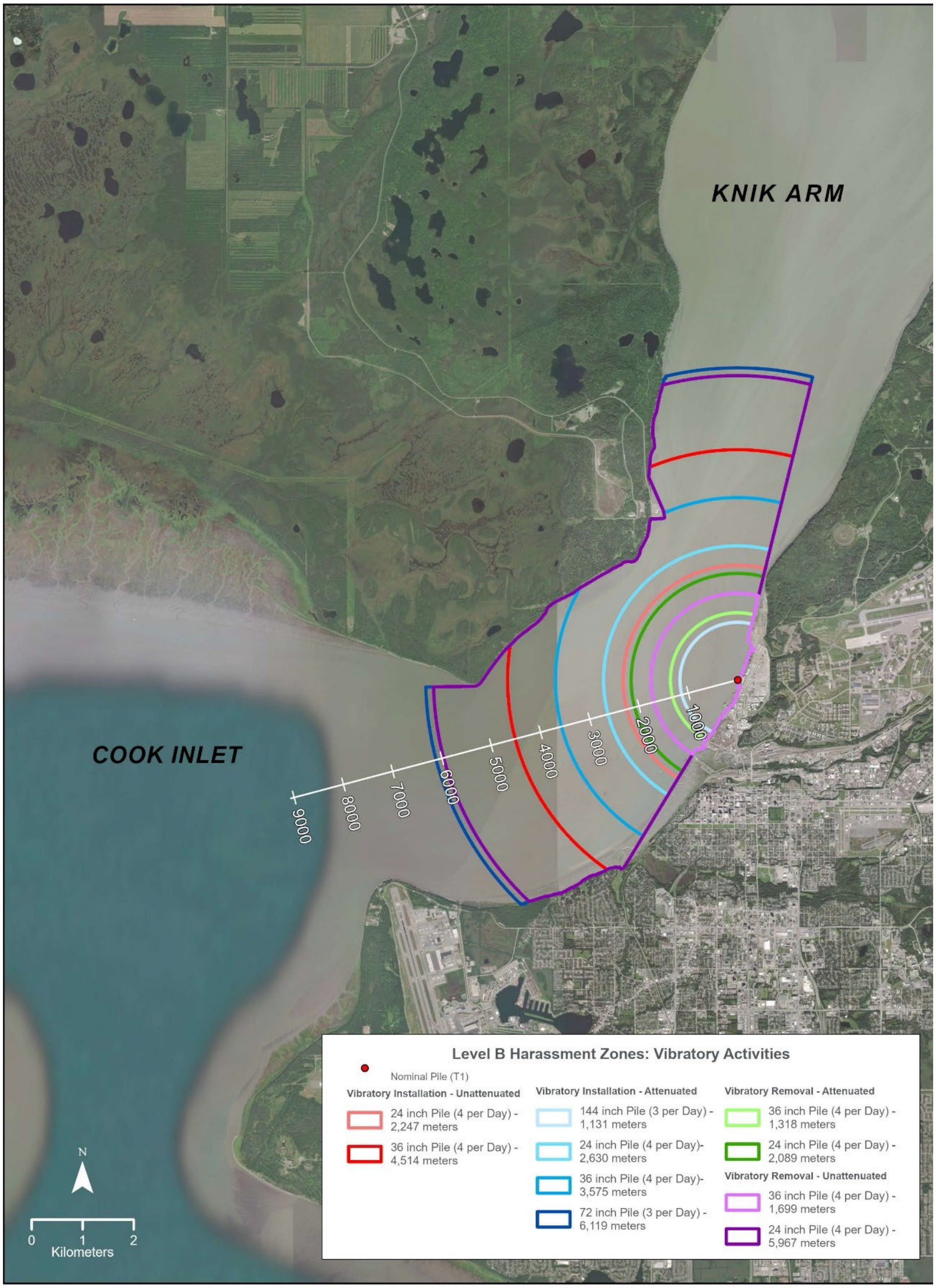

Figure 6-10. Level B Harassment Isopleths for All Pile Sizes for Vibratory Installation and Removal (Attenuated and Unattenuated)

6.4.1.1 Two Hammers

As described in Section 1.3, two or more construction crews may operate two or more hammers to increase productivity during periods with low beluga whale abundance and reduce overall Project duration. At most two vibratory hammers will be simultaneously active in water at any given time due to the larger ensonified areas associated with simultaneous use of vibratory hammers. No pile removal or installation will occur simultaneously with installation of the two 144-inch piles. Only one vibratory hammer will likely be available for installation of the 72-inch piles, and therefore the only combinations of vibratory hammers that could be used simultaneously would be for installation of an attenuated 72-inch pile and an attenuated temporary pile, an attenuated 72-inch pile and an unattenuated temporary pile, or two temporary piles. To simplify and represent temporary pile installation and removal as well as attenuated and unattenuated conditions, 160.5 dB rms was selected as the attenuated value and 168.0 dB rms was selected as the unattenuated value from Table 6-4.

Simultaneous use of two continuous noise sources such as vibratory hammers can create overlapping sound fields that result in additive effects of sound from the different hammers under certain conditions (Table 6-7; WSDOT 2020). Although the sound from two sources near the same location results in louder sound levels than from a single source, the sound levels cannot be added by standard addition because the decibel is measured on a logarithmic scale. For example, two sounds of equal level (plus or minus 1 dB) combine to raise the sound level by 3 dB. However, if two sounds differ by more than 10 dB, there is no combined increase in the sound level; the higher output covers any other sound. This approach builds upon work by the U.S. Department of Transportation (USDOT 1995) and Kinsler (2000). For marine mammal monitoring purposes, if the isopleth from one sound source encompasses a second sound source over a free sound field (i.e., no landmass separating the sound sources), then the sources are considered close enough to be a "combined sound source" and their sound levels are added (WSDOT 2020) to determine the sound isopleth. The resulting isopleth is centered on the "combined source," which is the geometric centroid of the polygon formed by the sound sources.

Table 6-7. Rules for Combining Sound Levels Generated during Pile Installation and Removal

Hammer Types	Difference in SSL	Level A Zones	Level B Zone
Vibratory, Impact	Any	Use impact zones	Use vibratory zone
Impact, Impact	Any	Use zones for each pile size and number of strikes	Use zone for each pile size
Vibratory, Vibratory	0 or 1 dB	Add 3 dB to the higher source level	Add 3 dB to the higher source level
	2 or 3 dB	Add 2 dB to the higher source level	Add 2 dB to the higher source level
	4 to 9 dB	Add 1 dB to the higher source level	Add 1 dB to the higher source level
	10 dB or more	Add 0 dB to the higher source level	Add 0 dB to the higher source level

Source: Modified from USDOT 1995, WSDOT 2020, and NMFS 2018

Note: SSL = sound source level; dB = decibels

At this stage in project planning, it is impossible to predict when or where each of the two construction crews may be working and which combinations of hammers and pile sizes might occur simultaneously and for how long. Therefore, sound source levels and their resultant Level B zone sizes were calculated for the possible combinations of pile sizes for two vibratory hammers (Table 6-8). For calculations, a transmission loss coefficient of 15 was used for combinations when both piles would be attenuated with a bubble curtain; 16.5 was used when both piles would be unattenuated; and the mean TL of 15.75 was used when one pile would be attenuated with a bubble curtain and one would not (Table 6-8).

Level A zones for all combinations of vibratory hammers, including use of the highest combined SSL of 171 dB rms, TL of 15, and 45 minutes of installation per pile for 4 pile installations (8 piles total with complete overlap for four 45-minute durations with the largest possible combined SSL, a scenario that would be impossible to realize) remain below 100 meters for all functional hearing groups. Therefore, to simplify management of Level A zones for use of two vibratory hammers simultaneously, the 100-meter shutdown zone will continue to be implemented.

Based on the WSDOT (2020) guidance for use of two impact hammers simultaneously, it is unlikely that the two hammers would operate in synchrony, and therefore, the sound pressure levels are not adjusted regardless of the distance between the hammers. In this case, each impact hammer is considered to have its own independent harassment zones (Table 6-8). During simultaneous use of an impact hammer and a vibratory hammer, the Level A zones for the impact hammer (Figure 6-11) and the Level B zone for the vibratory hammer are implemented (Table 6-8; WSDOT 2020).

Based on the impossibility of predicting how much overlap in hammer use, if any, could occur over each construction season of the 6 years of planned in-water construction, no adjustments to marine mammal take estimates were made for simultaneous use of two hammers.

Table 6-8. Combined Sound Levels Generated During Pile Installation and Removal for Combinations of Two Hammers; Transmission Loss (TL); and Level B Zone Sizes in Meters

Method			Vibratory			Impact
	Pile Diameter		24- or 36-inch temporary attenuated	24- or 36-inch temporary unattenuated	72-inch attenuated	All
		SSL	160.5	168	164	
Vibratory	24- or 36-inch temporary attenuated	160.5	Added: 163.5 dB TL: 15 5,667 meters	Added: 169 dB TL: 15.75 9,363 meters	Added: 166 dB TL: 15 8,318 meters	No Addition (Level B = Vibratory, Level A = Impact)
	24- or 36-inch temporary unattenuated	168	Added: 169 dB TL: 15.75 9,363 meters	Added: 171 TL: 16.5 9,069 meters	Added: 169 dB TL: 15.75 9,363 meters	
	72-inch attenuated	164	Added: 166 dB TL: 15 8,318 meters	Added: 169 dB TL: 15.75 9,363 meters	NA	
Impact	All		No Addition (Level B = Vibratory, Level A = Impact)			No Addition

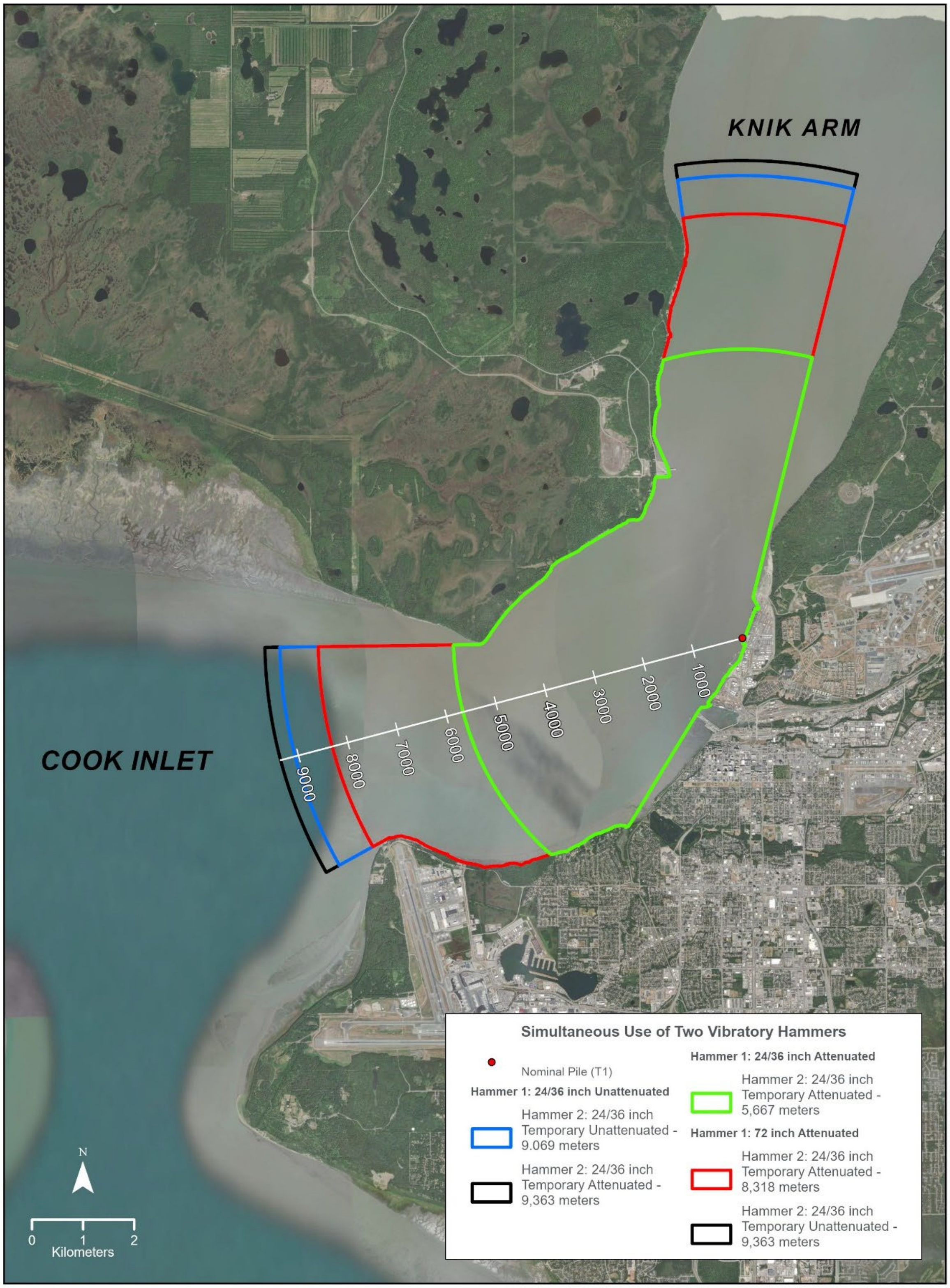

Figure 6-11. Harassment Isopleths for Simultaneous Use of Two Vibratory Hammers (Attenuated and Unattenuated)

6.4.2 In-air Sound

The spherical spreading model with sound transmission loss of 6.0 dB per doubling distance for a hard surface ($D = D_o * 10^{[(\text{Construction Noise} - \text{Ambient Sound Level in dBA})/\alpha]}$; WSDOT 2020) was used to estimate noise threshold distances from the mean source levels. In the model,

D = the distance from the noise source

D_o = the reference measurement distance (15 meters [50 ft] in this case)

α = 20 for hard ground or water, which assumes a 6 dBA reduction per doubling distance

The distance to the in-air sound level threshold for impact installation of 48-inch steel piles is 20 meters for all pinnipeds except harbor seals, and 64 meters for harbor seals (Table 6-9).

Table 6-9. Distances from Impact Installation where In-air Sound will Attenuate to NMFS Threshold for Level B Harassment

Method, Pile Type	Harbor Seals (90 dB)	Other Pinnipeds (100 dB)
Impact Installation, 48-inch piles	64 m	20 m

Note: dB = decibels; m = meters.

Although in-air sound from installation of 144-inch piles is likely louder than that produced by installation of 48-inch piles, the estimates of the distances that in-air sound could travel and exceed the harassment threshold for in-air disturbance fall far short of the distance to the nearest known pinniped haulout (24 to 96 km [15 to 60 mi] south-southwest of Anchorage for harbor seals; Section 4.1.3). Therefore, in-air sound is not considered further for CTR construction, and no incidental take of marine mammals from in-air sound is requested.

6.5 Estimated Numbers Exposed to Sound

Exposure rates of marine mammals to elevated sound levels that may be considered Level A and Level B harassment under the MMPA were estimated using hourly sighting rates when possible for each year of Project construction. Sufficient data for calculating sighting rates are available for harbor seals, Steller sea lions, harbor porpoises, and beluga whales. Hourly sighting rates were adjusted for each species based on additional information such as potential changes in abundance patterns—especially increases in abundance—and the likelihood that individuals may be counted more than once. Hourly sighting rates (number of individuals per hour) were multiplied by the anticipated number of hours of impact and vibratory hammering each year to estimate total number of exposures per month and per year (Table 6-10).

Table 6-10. Estimated Predicted Number of Hours of Impact and Vibratory Hammer Use for Each Construction Year

Year	Impact Duration (hrs)	Vibratory Duration (hrs)	Total Duration (hrs)	Proportion of Hammer Use That is Impact
Year 1	98.90	55.00	153.90	0.64
Year 2	87.43	47.92	135.35	0.65
Year 3	38.70	96.50	135.20	0.29
Year 4	87.43	50.42	137.85	0.63
Year 5	81.70	55.50	137.20	0.60
Year 6	85.70	63.25	148.95	0.58

Note: hrs = hours.

Sighting rates for beluga whales were calculated by calendar month and then adjusted based on the isopleth distances from the Project site. Hourly sighting rates (number of individuals per hour per calendar month) were multiplied by the anticipated number of hours of impact and vibratory hammering each month to estimate total number of exposures per month and per year (see Section 6.5.5).

6.5.1 Harbor Seal

No known harbor seal haulout or pupping sites occur in the vicinity of the POA; therefore, exposure of harbor seals to in-air noise is not considered in this application, and no take for in-air exposure is requested.

Marine mammal monitoring data were used to examine hourly in-water sighting rates for harbor seals in the Project area (Table 4-1). Sighting rates of harbor seals were highly variable and appeared to have increased during monitoring between 2005 and 2020 (Table 4-1). It is unknown whether any increase was due to local population increases or habituation to ongoing construction activities. The highest individual hourly sighting rate occurred in 2020 during PCT Phase 1 construction, when harbor seals were observed at an average rate of 0.27 harbor seal sightings per hour. The maximum monthly sighting rate occurred in September and was 0.51 harbor seal sightings per hour. Of the 524 harbor seal sightings in 2020 and 2021 combined, 93.7 percent of the sightings were of single individuals; only 5.7 percent of sightings were of two individual harbor seals, and only 0.6 percent of sightings reported three harbor seals. These data indicate that a single individual may linger near the POA, especially near Ship Creek, and be counted multiple times each day as it moves around and resurfaces in different locations. Based on these data and interannual variability in attendance patterns, it is estimated that approximately one harbor seal may be observed per hour of hammer use. The number of individual harbor seals actually taken will be smaller than the number of potential exposures that is reported.

Harbor seals often are curious of onshore activities and may choose to approach closely. Additionally, given the potential difficulty of tracking individual harbor seals for hours and their consistent use of the area, Level A take for a small number of harbor seals is requested. It is assumed that all Level A takes of harbor seals would occur during impact pile installation when the Level A zones are larger than the 100-meter minimum shutdown zone. The proportion of active hammer time each year that is anticipated to involve use of an impact hammer was used to estimate the number of harbor seals that could potentially be exposed to Level A harassment levels (Table 6-11).

Table 6-11. Estimated Number of Potential Exposures (Takes) of Harbor Seals for Each Construction Year

Year	Total Hammer Duration (hrs)	Proportion of Hammer Use That is Impact	Estimated Potential Exposures			Population Size	% of Population
			Total	Level A	Level B		
Year 1	153.9	0.64	154	99	55	28,411	0.54
Year 2	135.4	0.65	136	88	48		0.48
Year 3	135.2	0.29	136	39	97		0.48
Year 4	137.9	0.63	138	88	50		0.49
Year 5	137.2	0.60	138	83	55		0.49
Year 6	149.0	0.58	149	86	63		0.52

Note: Population estimates used in calculations are presented in Section 3. hrs = hours.

6.5.2 Steller Sea Lion

Steller sea lions are anticipated to occur in low numbers within the Project area as summarized in Section 4.2.4. However, no known Steller sea lion haulout or pupping sites occur in the vicinity of the POA; therefore, exposure of Steller sea lions to in-air noise is not considered in this application, and no take for in-air exposure is requested.

The in-water sighting rate for Steller sea lions was about 0.028 individuals sighted for each hour of observations during SFD construction in 2022 (see Table 4-2). Sighting rates for this species appear to be increasing near the POA. Additionally, POA data indicate that a single individual may linger near the POA and be counted as many as five times per day as it moves around and resurfaces in different locations. To account for increasing sighting rates, the risk of each individual being counted multiple times, and interannual variability in attendance patterns, it is estimated that potential exposures of Steller's sea lions could be as much as five times greater than previously realized (e.g., 0.028 * 5 = 0.14 Steller sea lions/hour). This value therefore was used to calculate potential exposure of Steller sea lions for each year (Table 6-12). The number of individual Steller sea lions actually taken will likely be smaller than the number of potential exposures that is reported.

Steller sea lions often are curious of onshore activities and may choose to approach closely. Additionally, given the potential difficulty of tracking individual Steller sea lions, Level A take for a small number of Steller sea lions is requested. It is assumed that all Level A takes of Steller sea lions would occur during impact pile installation when the Level A zones are larger than the 100-meter minimum shutdown zone. The proportion of active hammer time each year that is anticipated to involve use of an impact hammer was used to estimate the number of Steller sea lions that could potentially be exposed to Level A harassment levels.

Table 6-12. Estimated Number of Potential Exposures (Takes) of Steller Sea Lions for Each Construction Year

Year	Total Hammer Duration (hrs)	Proportion of Hammer Use That is Impact	Estimated Potential Exposures			Population Size	% of Population
			Total	Level A	Level B		
Year 1	153.9	0.64	22	15	7	49,837	0.04
Year 2	135.4	0.65	19	13	6		0.04
Year 3	135.2	0.29	19	6	13		0.04
Year 4	137.9	0.63	20	13	7		0.04
Year 5	137.2	0.60	20	12	8		0.04
Year 6	149.0	0.58	21	13	8		0.04

Note: Population estimates used in calculations are presented in Section 3. hrs = hours.

6.5.3 Harbor Porpoise

Monitoring data recorded from 2005 through 2021 were used to evaluate daily sighting rates for harbor porpoises in the Project area (Table 4-3). During most years of monitoring, no harbor porpoises were observed. The highest sighting rate for any recorded year during in-water pile installation and removal was an average of 0.037 harbor porpoises per hour during PCT construction in 2021. Overall, marine mammal monitoring data from the POA indicate that harbor porpoise presence near the POA may be increasing (Section 4.3.4). Other data sets also indicate that there has been an increase in harbor porpoise sightings in upper Cook Inlet over the past 2 decades (Table 4-3; Shelden et al. 2014). Based on these data and interannual variability in attendance patterns, it is estimated that approximately 0.5 harbor porpoises may be observed per hour of hammer use (Table 6-13). This precautionary approach also covers the possibility that larger groups of harbor porpoises could occur less frequently.

Large Level A zones associated with impact pile installation may make it difficult to detect and track harbor porpoises during impact hammer use. A small number of Level A exposures (takes) is therefore requested. It is assumed that all Level A takes of harbor porpoises would occur during impact pile installation when the Level A zones are larger than the 100-meter minimum shutdown zone. The proportion of active hammer time each year that is anticipated to involve use of an impact hammer was used to estimate the number of harbor porpoises that could potentially be exposed to Level A harassment levels (Table 6-13).

Table 6-13. Estimated Number of Potential Exposures (Takes) of Harbor Porpoises for Each Construction Year

Year	Total Hammer Duration (hrs)	Proportion of Hammer Use That is Impact	Estimated Potential Exposures			Population Size	% of Population
			Total	Level A	Level B		
Year 1	153.9	0.64	77	50	27	31,046	0.25
Year 2	135.4	0.65	68	44	24		0.22
Year 3	135.2	0.29	68	20	48		0.22
Year 4	137.9	0.63	69	44	25		0.22
Year 5	137.2	0.60	69	42	27		0.22
Year 6	149.0	0.58	75	44	31		0.24

Note: Population estimates used in calculations are presented in Section 3. hrs = hours.

6.5.4 Killer Whale

Few, if any, killer whales are expected to approach the Project area. No killer whales were sighted during previous monitoring programs for the Knik Arm Crossing and POA construction projects, including the 2016 TPP and 2020 and 2021 PCT projects (Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Cornick et al. 2010, 2011; ICRC 2009, 2010, 2011, 2012; Cornick and Pinney 2011; Cornick and Seagars 2016; 61N Environmental 2021) until PCT construction in 2021, when two killer whales were sighted (61N Environmental 2022a). Previous sightings of transient killer whales have documented pod sizes in upper Cook Inlet between one and six individuals (Shelden et al. 2003).

The potential for exposure of killer whales within the Level B harassment isopleth is anticipated to be extremely low for the CTR Project. Level B take is conservatively estimated at no more than one small pod of six individuals (Section 4.4.3) per construction year (Table 6-14). No Level A take of killer whales is anticipated or requested given the small Level A zone sizes.

Table 6-14. Estimated Number of Potential Exposures (Takes) of Killer Whales for Each Construction Year

Year	Total Hammer Duration (hrs)	Proportion of Hammer Use That is Impact	Estimated Potential Exposures			Population Size	% of Population
			Total	Level A	Level B		
Year 1	153.9	0.64	6	0	6	1,920 (E. North Pacific AK Resident Stock) or 587 (E. North Pacific, Gulf of AK, Aleutian Islands, & Bering Sea Transient Stock)	0.31 or 1.02
Year 2	135.4	0.65	6	0	6		
Year 3	135.2	0.29	6	0	6		
Year 4	137.9	0.63	6	0	6		
Year 5	137.2	0.60	6	0	6		
Year 6	149.0	0.58	6	0	6		

Note: Population estimates used in calculations are presented in Section 3. Percentages assume that all potential exposures come from each stock; thus, each percentage should be adjusted down if multiple stocks are actually affected. hrs = hours.

6.5.5 Beluga Whale

6.5.5.1 Background

In the past few years of marine construction at the POA, a sighting rate methodology was used by NMFS to calculate potential exposure (take) of beluga whales to elevated sound levels for the PCT (85 FR 19294) and SFD (86 FR 50057) projects. The NMFS sighting rate methodology used data collected during marine mammal observations from 2005 to 2009 (84 FR 72154; Kendall and Cornick 2016; Table 6-15) to calculate hourly sighting rates per calendar month by dividing the total number of beluga whales observed by the total number of observation hours for each given month. For the SFD project in 2022, observation data from 2020 PCT construction were also incorporated (86 FR 50057; 61N Environmental 2021; Table 6-15).

The original sighting rate methodology used by NMFS combined all beluga whale observations from the monitoring efforts between 2005 and 2009 into a monthly sighting rate of beluga whales per hour per calendar month, regardless of the whales' distance from the Project site. At the time, this was an acceptable way to estimate exposure of beluga whales to elevated sound levels using data collected from 2005 to 2009, when one to two MMOs worked simultaneously to locate and track marine mammals from a single location near the POA terminals, sighting distances were limited, and observations were assigned to 1-km^2 grid cells on paper maps. NMFS also found the 2005–2009 monitoring data (Kendall and Cornick 2016) to be the best available data on beluga whale occurrence in upper Cook Inlet at that time and selected this data set for POA use over the data used by Goetz et al. (2012b), which was used for TPP take calculations in 2015 (80 FR 78176).

During 3 successful years of marine construction at the POA (PCT 2020–2021 and SFD 2022), the marine mammal monitoring programs were expanded from previous programs to include 11 MMOs working from four elevated, specially designed monitoring stations located along a 9-km stretch of coastline surrounding the POA. The number of days of data collected varied among years and project (Table 6-15). MMOs used 25-power "big-eye" and hand-held binoculars to detect and identify marine mammals, and theodolites to track movements of beluga whale groups over time and collect location data while they remained in view. Distances from beluga whale sightings to the project site from 2020 to 2022 ranged from less than 10 meters up to nearly 15 km. This robust marine mammal monitoring program in place from 2020 through 2022 undoubtedly located, identified, and tracked beluga whales at greater distances from the Project site than previous data collection programs and has contributed to a better understanding of beluga whale movements in upper Cook Inlet.

The expanded marine mammal monitoring programs for the PCT and SFD projects produced a unique and comprehensive data set of beluga whale locations and movements (61N Environmental 2021, 2022a, 2022c) that is the most current data set available for Knik Arm. This data set also includes observations collected over a larger area than the area monitored between 2005 and 2009. Given the evolution of the best available data of beluga whale presence in upper Cook Inlet, particularly regarding the distances at which beluga whales were being observed and documented in more recent monitoring efforts, the original sighting rate methodology was no longer an appropriate approach in calculating take estimates due to its lack of inclusion of a spatial component.

Lack of a geographic or spatial component to the previous methodology means that every observation of beluga whales in Knik Arm was used to produce a single sighting rate that was then used to calculate potential beluga whale take for all activities, regardless of the size of the ensonified area. This method can overestimate potential beluga whale exposures when harassment zones are small because distant whales that never approached the project site are included in the sighting rate. This method also results in exposure estimates that are identical for installation and removal of all pile sizes, with or without a bubble curtain, for all hammer types and areas of ensonification, assuming equal hours of installation.

The new sighting rate methodology allows for more accurate estimation of potential take of beluga whales and therefore allows differentiation of potential effects from these different activities.

The recent and comprehensive data set of beluga whale locations and movements (61N Environmental 2021, 2022a, 2022c) provided the opportunity for refinement of the original sighting rate methodology with the introduction of a new, spatially explicit component using ArcGIS. A spatially modified sighting rate methodology reflects the increased ability of the MMOs implementing the POA's marine mammal monitoring programs to detect, identify, and track beluga whale groups at greater distances from the Project work site when compared with previous years. Collection of multiple locations of beluga whale groups enabled the creation of tracklines for many groups, and determination of a closest point of approach (CPOA) for each group based on the tracklines or a single recorded location. With the new method, accuracy of the sighting rates is increased because beluga whale groups that did not approach, and were not likely to have approached, the project site close enough to become a Level B exposure were excluded.

Table 6-15. Marine Mammal Monitoring Data Used for Various Beluga Whale Sighting Rate Calculations

Year	Dates of Monitoring Effort	Monitoring Effort			Total Number of Beluga Whale Groups Sighted	Total Number of Beluga Whales	Monitoring Type and Data Source
		# of Days	# of Hours	# of Observers			
2005	Aug. 2–Nov. 28	51	374.4	2	23	156	Pre-Construction Monitoring Kendall and Cornick 2016
2006	April 26–Nov. 3	95	563.8	1	26	82	Pre-Construction Monitoring Kendall and Cornick 2016
2008	June 24–Nov. 14	91	611.5	2	74	283	MTRP: Construction Monitoring Kendall and Cornick 2016
2009	May 4–Nov. 18	112	779.4	2	54	166	MTRP: Construction Monitoring Kendall and Cornick 2016
2020	April 27–Nov. 24	128	1,238.7	11	245	987	PCT: Construction Monitoring 61N Environmental 2021
2021	July 9–Oct. 17	29	231.6	4	113	575	NMFS 2021 unpublished data
	April 26–June 24 Sept. 7–Sept. 29	74	734.9	11	132	517	PCT: Construction Monitoring 61N Environmental 2022a
2022	May 20–June 11	13	108.2	11	9	41	SFD: Construction Monitoring 61N Environmental 2022c

Source: Kendall and Cornick 2016; 61N Environmental 2021, 2022a, 2022c.

Notes: 61N Environmental = 61 North Environmental; MTRP = Marine Terminals Redevelopment Project; NMFS = National Marine Fisheries Service; PCT = Petroleum and Cement Terminal; POA = Port of Alaska; SFD = South Floating Dock.

6.5.5.2 Data Source Considerations

Data for 2020, 2021, and 2022 were selected for the updated sighting rate analysis for the CTR Project because they are the most current data available and are therefore more likely to accurately represent future beluga whale attendance at the Project site, which may be affected by beluga whale population size, beluga whale movement patterns through Knik Arm, environmental change including climate change, differences in salmon and other prey abundance among years, and other factors.

To provide information about beluga attendance near the POA during periods when construction monitoring was not occurring, data collected by NMFS on days when PCT Phase 2 construction was not occurring were used to augment the PCT construction data set. The NMFS dataset included 231.6 hours of observation over 47 non-consecutive days from 09 July to 17 October 2021 (NMFS 2021 unpublished data). Effort associated with the NMFS-collected data differed from the POA programs, as the NMFS-funded program utilized only four MMOs and two observation stations along with shorter (4- to 8-hour) observation periods compared to PCT or SFD data collection, which included 11 MMOs, four observation stations, and most observation days lasting close to 10 hours. Despite the differences in effort, the NMFS dataset fills in gaps during the 2021 season when beluga whale presence began to increase from low presence in July and is thus valuable in this analysis.

The older data from 2005 to 2009 published in Kendall and Cornick (2016) (and used by NMFS for sighting rate analyses for the PCT and SFD) were not included in this analysis due to the changes in observation programs and age of the data collected. Monitoring data from the 2016 TPP (Cornick and Seagars 2016) were not included in the analysis because of limited hours observed, limited seasonal coverage, and differences in the observation programs.

6.5.5.3 CPOA Methodology for Calculating Sighting Rates

The POA, under guidance from and in collaboration with NMFS, has developed a sighting rate methodology for the CTR Project that includes a spatial component to more accurately estimate the number of potential beluga whale exposures based on the sound levels of specific in-water activities and the time of year the activity is expected to occur. Instead of including all beluga whale sightings regardless of distance from the Project site, data from the marine mammal observation programs associated with each year of construction (61N Environmental 2021, 2022a, 2022c), and data collected during PCT 2021 construction by a NMFS-funded non-construction observation effort (NMFS 2021 unpublished data), were used to create hourly sighting rates. The revised hourly sightings rates were calculated per calendar month (beluga whales per hour per month) for each Project activity based on the CPOA to the project site of each beluga whale group observed (see Section 6.5.5.2, Data Source Considerations). This same methodology was used for the POA's NES1 Project.

The CPOA for each beluga whale group was calculated in ArcGIS software using the GPS coordinates provided for documented sightings of each group (for details on data collection methods, see 61N Environmental 2021, 2022a, 2022c) and the CTR location midpoint, centered on the Project site between T1 and T2. A group was defined as a sighting of one or more beluga whales as determined during data collection. When more than one documented sighting for a given beluga whale group was available, a trackline was produced that connected each sighting for each group with straight lines. The nearest distance of either the trackline or single point to the midpoint of CTR was then calculated. If a group only had one documented sighting, that single sighting location was used as the CPOA. The most distant CPOA to the Project was 11,138 meters, and the closest CPOA was 6 meters.

During the NES1 permitting process, the POA initially proposed to calculate beluga whale sighting rates based on the CPOA and the radius of the calculated acoustic Level B harassment zone. For example, with the NES1 Project, the Level B harassment zone for sheet pile removal is 1,954 meters, and the sighting rate proposed by the POA included all beluga whale groups with a CPOA within that radius of the NES1 Project site plus a 500-meter buffer. However, NMFS preferred an alternative analysis that they believed would align more closely with beluga whale behavior. The POA proposed, and NMFS accepted, a piecewise regression model that detected breakpoints in the cumulative density distribution of the CPOA locations that related to known beluga whale distribution and behavior. This methodology, refined during the NES1 process, has been continued here.

To determine the distance thresholds at which the sighting rate, in beluga whales per linear distance from the Project site, statistically changed, a piecewise regression model was run in R version 4.2 (R Core Team 2022). Using the "Segmented" package (Muggeo 2020), the breakpoint value of each two segments was identified following this equation:

$$y_i = \begin{cases} \beta_0 + \beta_i + e_i, & x_i \leq \alpha \\ \beta_0 + \beta_i x_i + \beta_{i+1}(x_i - \alpha) + e_i, & x_i > \alpha \end{cases}$$

where y is cumulative density, x is the distance from the shoreline to the CPOA of each beluga group, α is the breakpoint between two segments (the threshold), e is the error, β_0 is the slope intercept, β_i is the slope of the line, and β_{i+1} is the difference in slopes between lines (Toms and Lesperance 2003). This analysis identified breakpoints at 195.7 meters, 2,337.0 meters, 3,154.7 meters, and 6,973.9 meters (Figure 6-12).

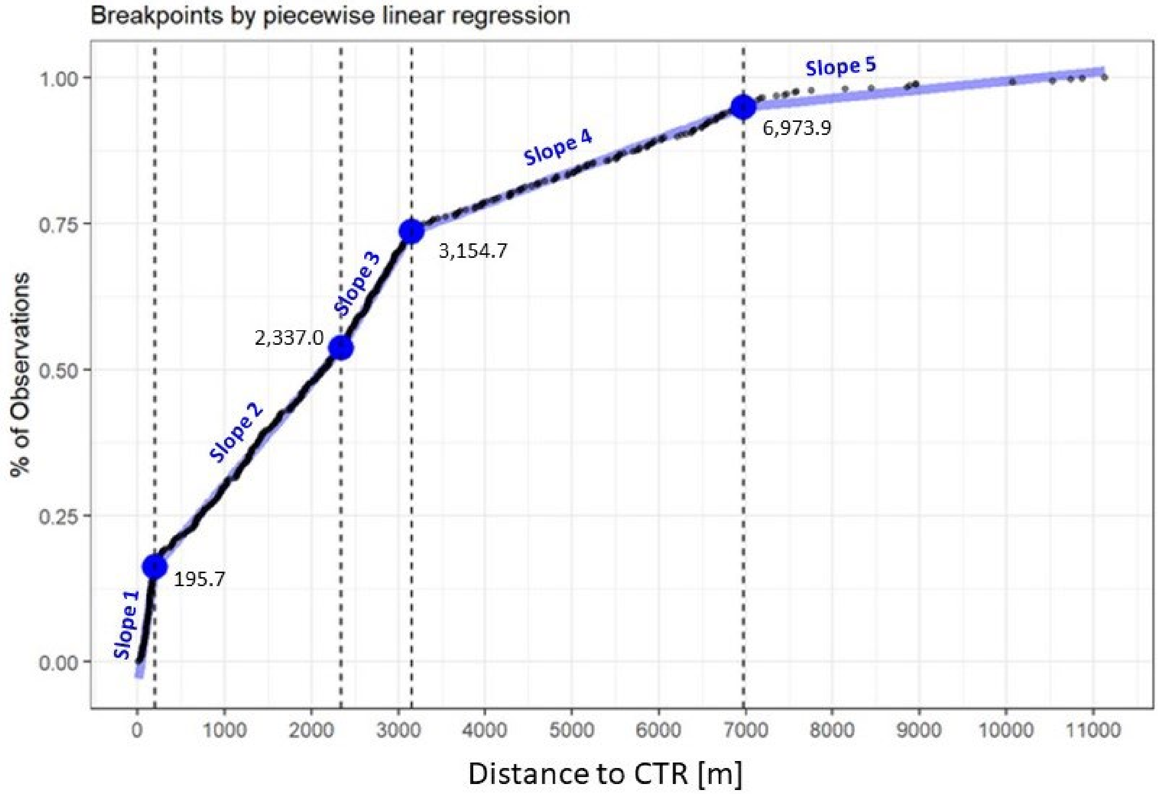

Figure 6-12. CPOA Observations Sorted Using the Empirical Cumulative Distribution Function and Associated Breakpoints Determined by Piecewise Linear Regression

Piecewise regression is a common tool for modeling ecological thresholds (Atwood et al. 2016; Whitehead 2016; Lopez et al. 2020). In a scenario similar to the one outlined above, Mayette et al. (2022) used piecewise regression to model the distances between two individual beluga whales in a group in a nearshore and a far shore environment. For the POA's analysis, the breakpoints detect a change in the frequency of beluga whale groups sighted, and the slope of the line between two points indicates the magnitude of change. A greater positive slope indicates a greater accumulation of sightings over the linear distance (x-axis) between the defining breakpoints, whereas a more level slope (i.e., closer to zero) indicates a lower accumulation of sightings over that linear distance (x-axis) between those defining breakpoints (Figure 6-12.; Table 6-16).

Table 6-16. Slope Estimates for Empirical Cumulative Distribution Function

Slope	Estimate	Standard Error	Upper CI (95%)	Lower CI (95%)
Slope 1	0.0010131	1.30E-05	0.0009876	0.0010387
Slope 2	0.0001747	7.00E-07	0.0001734	0.0001760
Slope 3	0.0002455	2.40E-06	0.0002407	0.0002502
Slope 4	0.0000557	4.00E-07	0.0000548	0.0000566
Slope 5	0.0000148	8.00E-07	0.0000132	0.0000164

Note: CI = Confidence Interval.

The breakpoints identified by the piecewise regression analysis match what is known about beluga whale behavior in Knik Arm. Observation location data collected during POA monitoring programs indicate that beluga whales were consistently found in higher numbers in the nearshore areas, along both shorelines, and were found in lower numbers in the open waters in the center of the Arm. Tracklines of beluga whale group movements collected from 2020 to 2022 show that detected beluga groups displayed a variety of movement patterns that included swimming close to shore past the POA on the east side of Knik Arm (defined by breakpoint 1 at 195.7 meters), with fewer beluga whales swimming in the center of Knik Arm (breakpoints 1 to 2, 195.7 to 2,337.0 meters). Beluga whales commonly swam past the POA close to shore on the west side of Knik Arm, with no beluga whales able to swim farther from the POA in that area than the far shore (breakpoints 2 to 3, 2,337.0 to 3,154.7 meters). Behaviors and locations beyond breakpoint 4 (6,973.9 meters) include swimming past the mouth of Knik Arm between the Susitna River area and Turnagain Arm; milling at the mouth of Knik Arm but not entering the Arm; and milling to the northwest of the POA without exiting Knik Arm. The shallowness of slope 5, at distances greater than 6,973.9 meters, could be due to detection falloff from a proximity (distance) bias, which would occur when MMOs are less likely to detect beluga whale groups that are farther away than groups that are closer.

The distances from the CTR Project site detected by the breakpoint analysis were used to define five sighting rate distance bins for calculation of beluga whale exposure (take). Each breakpoint (195.7 meters, 2,337.0 meters, 3,154.7 meters, and 6,973.9 meters, and the complete data set of observations [greater than 6,973.9 meters]) was rounded up to the nearest meter and considered the outermost limit of each sighting rate bin, resulting in five identified bins (Table 6-17).

Table 6-17. Beluga Whale Monthly Sighting Rates for Different Bin Sizes

Bin Number	Distance (m)	Beluga Whales/Hour							
		April	May	June	July	August	Sept.	Oct.	Nov.
1	196	0.05	0.06	0.10	0.04	0.82	0.59	0.51	0.10
2	2,338	0.34	0.16	0.15	0.09	1.55	1.42	1.09	0.65
3	3,155	0.36	0.22	0.21	0.09	2.02	1.89	1.98	0.72
4	6,974	0.67	0.33	0.29	0.13	2.24	2.18	2.42	0.73
5	>6,974	0.71	0.39	0.30	0.13	2.29	2.23	2.56	0.73

Note: m = meters.

To determine the number of marine mammal Level B takes required for the project, Level B harassment isopleths were calculated for each pile size and hammer expected to create elevated noise levels (Table 6-18). For beluga whales, the sighting rate for each Level B isopleth was determined by identifying the sighting rate distance bin with the distance closest to and not exceeding the corresponding Level B harassment isopleth (i.e., the sighting rate distance bin that the Level B isopleth falls within was selected). All of the beluga whales sighted within that sighting rate distance bin for all years was summed and divided by the number of hours of observation for all years, giving beluga whales per hour per month for each sighting rate distance bin (Table 6-18). The number of hours expected from each activity was then multiplied by the sighting rate to determine the number of beluga whales expected to be seen that could potentially be exposed to elevated sound levels during the specified activity.

6.5.5.4 Beluga Whale Take Estimates

Take estimates for Cook Inlet beluga whales were calculated by multiplying the total number of vibratory and impact installation or removal hours per month for each activity based on the anticipated construction schedule (Table 1-10) with the corresponding sighting rate (beluga whales per hour per month) and sighting rate distance bin (Table 6-18). Calculations were based on using a bubble curtain system during impact and vibratory pile installation of permanent 72- and 144-inch piles in all months and when water depth is greater than 3 meters; and using a bubble curtain system on all piles during months with historically higher beluga whale abundance (August through October) when water depth is greater than 3 meters. Only temporary piles will be installed (and removed) without a bubble curtain during months with low beluga whale abundance (April through July and November).

Table 6-18. Beluga Whale Monthly Sighting Rates by Isopleth Distance for Different Pile Sizes and Hammer Types

Activity	Level B Isopleth Distance (m)	Sighting Rate Bin Number and Distance	Belugas/Hour							
			April	May	June	July	Aug.	Sept.	Oct.	Nov.
Unattenuated Values (without the use of a bubble curtain)										
36-Inch Vibratory Installation	4,514	4 (6,974 m)	0.67	0.33	0.29	0.13	2.24	2.18	2.42	0.73
36-Inch Vibratory Removal	1,699	2 (2,338 m)	0.34	0.16	0.15	0.09	1.55	1.42	1.09	0.65
Attenuated Values (with the use of a bubble curtain)										
36-Inch Vibratory Installation	3,575	4 (6,974 m)	0.67	0.33	0.29	0.13	2.24	2.18	2.42	0.73
36-Inch Vibratory Removal	1,318	2 (2,338 m)	0.34	0.16	0.15	0.09	1.55	1.42	1.09	0.65
36-Inch Impact Installation	541	2 (2,338 m)	0.34	0.16	0.15	0.09	1.55	1.42	1.09	0.65
72-Inch Vibratory Installation	6,119	4 6,974 m)	0.67	0.33	0.29	0.13	2.24	2.18	2.42	0.73
72-Inch Impact Installation	2,512	3 (3,155 m)	0.36	0.22	0.21	0.09	2.02	1.89	1.98	0.72
144-Inch Vibratory Installation	1,131	2 (2,338 m)	0.34	0.16	0.15	0.09	1.55	1.42	1.09	0.65
144-Inch Impact Installation	13,594	5 (>6,974 m)	0.71	0.39	0.30	0.13	2.29	2.23	2.56	0.73
Observation Hours/Month[a]			87.9	615.1	571.6	246.9	224.5	326.2	109.5	132.0

Note: m = meters.

[a] Observation hours have been totaled from the PCT 2020 and 2021 programs, the NMFS 2021 data collection effort, and the SFD 2022 construction (61N Environmental 2021, 2022a, 2022c, and NMFS 2021 unpublished data). November sighting rates were not used in calculations but are included here for completeness.

As described in Section 2, CTR construction is anticipated to take place from April through November, 2025–2031. Although the allocation of work effort among months is not known with certainty, the hours for installation and removal of piles have been approximately evenly distributed between construction months (Table 1-10). The total hours of impact pile installation and vibratory pile installation or removal for each month were then multiplied by the sighting rate for that month and bin, and the resulting estimated beluga whale exposures were totaled for all activities in each month (Table 6-19). Using the monthly activity estimates in hours and monthly beluga whales/hour calculated rate, it is estimated that up to 801.09 (rounded up to 802) beluga whales potentially may be exposed to Level B harassment over the 6 years of in-water construction (Table 6-19).

Table 6-19. Estimated Number of Potential Exposures (Level B Takes) of Beluga Whales for Each Construction Year

Beluga Whale Monthly and Total Estimated Level B Take									
Year 1	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
36-Inch Vibratory Installation and Removal	1.93	2.13	1.88	0.85	14.63	14.16	8.08	1.96	43.66
72-Inch Vibratory and Impact Installation	3.17	4.13	3.88	1.71	29.45	27.67	29.19	4.62	99.20
								Year 1 Total	**142.86**
Year 2	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
36-Inch Vibratory Installation and Removal	2.27	1.80	1.58	0.72	12.39	11.98	6.87	1.47	37.60
72-Inch Vibratory and Impact Installation	3.17	3.38	3.17	1.40	29.45	24.60	25.95	4.62	91.12
								Year 2 Total	**128.71**
Year 3	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
36-Inch Vibratory Installation and Removal	4.62	4.72	4.16	1.89	31.51	30.50	16.55	1.96	93.95
72-Inch Vibratory and Impact Installation	2.53	1.50	1.41	0.47	9.82	9.22	9.73	3.46	34.68
								Year 3 Total	**128.64**
Year 4	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
36-Inch Vibratory Installation and Removal	1.93	1.97	1.73	0.85	13.51	13.07	6.87	1.47	39.92
72-Inch Vibratory and Impact Installation	3.17	3.38	3.17	1.40	29.45	24.60	25.95	4.62	91.12
								Year 4 Total	**131.03**
Year 5	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
36-Inch Vibratory Installation and Removal	1.93	2.13	1.88	0.85	14.63	13.07	14.13	2.33	48.62
72-Inch Vibratory and Impact Installation	1.90	3.38	3.17	1.40	26.18	24.60	25.95	3.46	86.58
								Year 5 Total	**135.19**
Year 6	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Total**
36-Inch Vibratory Installation and Removal	1.93	1.80	1.58	0.72	12.39	15.16	12.99	6.36	46.57
72-Inch Vibratory and Impact Installation	1.90	3.38	3.17	1.40	26.18	24.60	25.95	3.46	86.58
144-Inch Vibratory and Impact Installation[a]	0.00	1.51	1.19	0.53	0.00	0.00	0.00	0.00	1.51
								Year 6 Total	**134.66**

Note: Numbers may not sum due to rounding.

[a] It is unknown in which month the 144-inch monopile dolphins will be installed, and therefore, the highest value for two piles driven in the highest density month (May) of the low density months (May – July) was used for the total for Year 6**.** POA has committed to not installing 144-inch piles in the highest beluga density months.

For the PCT and SFD projects, NMFS accounted for the implementation of mitigation measures by applying an adjustment factor to beluga whale take estimates since some Level B harassment takes would likely be avoided based on required shutdowns for beluga whales at the Level B harassment zones. For the PCT project, NMFS compared the number of realized takes at the POA to the number of authorized takes for previous projects from 2008 to 2017 and found that the percentage of realized takes ranged from 12 to 59 percent with an average of 36 percent (84 FR 72154; Table 6-20). NMFS then applied the highest percentage of previous realized takes (59 percent during the 2009–2010 season) to ensure potential impacts on beluga whales were fully evaluated and to provide the POA with an adequate number of authorized beluga whale takes. In doing so, NMFS assumed that approximately 59 percent of the takes calculated would be realized during PCT and SFD construction (84 FR 72154 and 86 FR 50057). It was also assumed that 41 percent of the expected beluga whale Level B harassment takes would be avoided by successful implementation of required mitigation measures.

The adjustment for successful implementation of mitigation measures for the CTR Project was calculated using the percentage of realized takes for the PCT project (Table 6-20). The recent data from PCT Phase 1 and PCT Phase 2 most accurately reflect the current marine mammal monitoring program, the current program's effectiveness, and beluga whale attendance in the Project area. Between the two phases of the PCT project, 90 total Level B takes were authorized and 53 were potentially realized, equating to an overall percentage realized of 59 percent. The SFD Project, during which only 7 percent of authorized take occurred, represents installation of only 12 piles during a limited time period and does not represent the much higher number of piles and longer construction season anticipated for this Project (Table 1-10).

Table 6-20. Comparison of Reported and Authorized Takes for Cook Inlet Beluga Whales

Project	Valid Dates of Incidental Harassment Authorization	Reported Takes	Authorized Takes	Percentage of Takes That Occurred
MTRP	15 July 2008 to 14 July 2009	12	34	35
MTRP	15 July 2009 to 14 July 2010	20	34	59
MTRP	15 July 2010 to 14 July 2011	13	34	38
MTRP	15 July 2011 to 14 July 2012	4	34	12
TPP	01 April 2016 to 31 March 2017	1	15	7
PCT Phase 1	01 April 2020 to 31 March 2021	26	55	47
PCT Phase 2	01 April 2021 to 31 March 2022	27	35	77
SFD	08 August 2021 to 07 August 2022	2	24	8

Notes: MTRP = Marine Terminal Redevelopment Project; PCT = Petroleum and Cement Terminal; SFD = South Floating Dock; TPP = Test Pile Program.

NMFS and the POA agree that the 59 percent adjustment accurately accounts for the efficacy of the POA's marine mammal monitoring program and shutdown protocol. It was therefore assumed that approximately 59 percent of the takes calculated for this Project will actually be realized. This adjusts the calculated potential exposures of beluga whales from 801.09 to 472.65, which is rounded up for each year to 475 total Level B beluga whale takes for the 6 years of in-water construction (beluga take estimates are rounded up annually and then summed; Table 6-21).

Table 6-21. Summary Table of Annual Beluga Potential Take Exposures

Year	Beluga Whale Take Estimate			Percent of Cook Inlet Beluga Whale Population
	Without AF	With 59% AF	With 59% AF (rounded up)	
Year 1	142.86	84.29	85	25.68
Year 2	128.71	75.94	76	22.96
Year 3	128.64	75.90	76	22.96
Year 4	131.03	77.31	78	23.56
Year 5	135.19	79.76	80	24.17
Year 6	134.66	79.45	80	24.17
Total	**801.09**	**472.65**	**475[a]**	-

Notes: AF = adjustment factor. Numbers may not sum due to rounding.

[a] Beluga take estimates are rounded up annually and then summed.

No Level A take of beluga whales is anticipated or requested. This small number of potential beluga whale exposures to Level B harassment is anticipated to have no measurable effect on individuals or the population as a whole.

The POA is committed to implementing the same robust marine mammal monitoring program for the CTR Project to maintain consistency moving forward in both data collection and analysis, including estimation of potential exposure to elevated sound levels.

6.5.6 Humpback Whale

Sightings of humpback whales in the Project area are rare, and the potential risk of exposure of a humpback whale to sounds exceeding the Level B harassment threshold is low. Few, if any, humpback whales are expected to approach the Project area. However, based on two sightings in 2017 of what was likely a single individual at the Anchorage Public Boat Dock at Ship Creek (ABR Inc. 2017) south of the Project area, it is anticipated that exposure of up to six individuals could occur during each construction year of pile installation and removal for the Project (Table 6-22). This could include three sightings of a cow-calf pair or six sightings of single humpback whales.

It is assumed that all Level A takes of humpback whales would occur during impact pile installation when the Level A zones are large. The proportion of active hammer time each year that is anticipated to involve use of an impact hammer was used to estimate the number of humpback whales that could potentially be exposed to Level A harassment levels (Table 6-22).

Table 6-22. Estimated Number of Potential Exposures (Takes) of Humpback Whales for Each Construction Year

Year	Total Hammer Duration (hrs)	Proportion of Hammer Use That is Impact	Estimated Potential Exposures			Population Size	% of Population
			Total	Level A	Level B		
Year 1	153.9	0.64	6	4	2	*Unknown* (Mexico - North Pacific Stock) or 11,278 (Hawaiʻi Stock)	*NA* or 0.05
Year 2	135.4	0.65	6	4	2		
Year 3	135.2	0.29	6	2	4		
Year 4	137.9	0.63	6	4	2		
Year 5	137.2	0.60	6	4	2		
Year 6	149.0	0.58	6	3	3		

Notes: Population estimates used in calculations are presented in Section 3. Percentages assume that all potential exposures come from each stock; thus, each percentage should be adjusted down if multiple stocks are actually affected. hrs = hours; NA = not applicable.

6.5.7 Gray Whale

Sightings of gray whales in the Project area are rare, and the potential risk of exposure of a gray whale to sounds exceeding the Level B harassment threshold is low. Few, if any, gray whales are expected to approach the Project area. However, based on three separate sightings of a single gray whale near the POA in 2021 (61N Environmental 2021, 2022a; NMFS 2021 unpublished data), it is anticipated that exposure of up to six individuals could occur during each construction year of pile installation and removal for the Project (Table 6-23). This could include three sightings of a cow-calf pair or six sightings of single gray whales.

It is assumed that all Level A takes of gray whales would occur during impact pile installation when the Level A zones are large. The proportion of active hammer time each year that is anticipated to involve use of an impact hammer was used to estimate the number of gray whales that could potentially be exposed to Level A harassment levels (Table 6-23).

Table 6-23. Estimated Number of Potential Exposures (Takes) of Gray Whales for Each Construction Year

Year	Total Hammer Duration (hrs)	Proportion of Hammer Use That is Impact	Estimated Potential Exposures			Population Size	% of Population
			Total	Level A	Level B		
Year 1	153.9	0.64	6	4	2	290 (Western North Pacific Stock) or 26,960 (Eastern North Pacific Stock)	2.07 or 0.02
Year 2	135.4	0.65	6	4	2		
Year 3	135.2	0.29	6	2	4		
Year 4	137.9	0.63	6	4	2		
Year 5	137.2	0.60	6	4	2		
Year 6	149.0	0.58	6	3	3		

Note: Population estimates used in calculations are presented in Section 3. Percentages assume that all potential exposures come from each stock; thus, each percentage should be adjusted down if multiple stocks are actually affected. hrs = hours.

6.6 All Marine Mammal Takes Requested

The analysis of pile installation and removal associated with the CTR Project predicts potential exposures of marine mammals to noise from vibratory and impact pile installation and removal that could be classified as Level A and Level B harassment under the MMPA (Table 6-24). Small numbers of Level A takes are requested for harbor seals, Steller sea lions, harbor porpoises, humpback whales, and gray whales. These small numbers of potential exposures for each species of marine mammal are anticipated to have no measurable effect on individuals or their populations as a whole. No Level A take of beluga whales or killer whales is requested. Small numbers of Level B takes are requested for all species (Table 6-24).

Table 6-24. Total Estimated Number of Level A and Level B Potential Exposures For All Species

Species	Harbor Seal	Steller Sea Lion	Harbor Porpoise	Killer Whale		Beluga Whale	Humpback Whale		Gray Whale	
Stock	**Cook Inlet/Shelikof Strait Stock**	**Western Stock and DPS**	**Gulf of Alaska Stock**	**Eastern North Pacific Alaska Resident Stock**	**Eastern North Pacific, Gulf of Alaska, Aleutian Islands, & Bering Sea Transient Stock**	**Cook Inlet Stock and DPS**	**Mexico - North Pacific Stock**	**Hawai'i Stock**	**Western North Pacific Stock**	**Eastern North Pacific Stock**
Population Estimate[a]	28,411	49,837	31,046	1,920	587	331	*Unknown*	11,278	290	26,960
Estimated Number of Exposures - Level B Harassment										
Year 1	55	7	27	6		85	2		2	
Year 2	48	6	24	6		76	2		2	
Year 3	97	13	48	6		76	4		4	
Year 4	50	7	25	6		78	2		2	
Year 5	55	8	27	6		80	2		2	
Year 6	63	8	31	6		80	3		3	
6-Year Total	**368**	**49**	**182**	**36**		**475**	**15**		**15**	
Estimated Number of Exposures - Level A Harassment										
Year 1	99	15	50	0		0	4		4	
Year 2	88	13	44				4		4	
Year 3	39	6	20				2		2	
Year 4	88	13	44				4		4	
Year 5	83	12	42				4		4	
Year 6	86	13	44				3		3	
6-Year Total	**483**	**72**	**244**	**0**		**0**	**21**		**21**	

Species	Harbor Seal	Steller Sea Lion	Harbor Porpoise	Killer Whale		Beluga Whale	Humpback Whale		Gray Whale	
Stock	**Cook Inlet/Shelikof Strait Stock**	**Western Stock and DPS**	**Gulf of Alaska Stock**	**Eastern North Pacific Alaska Resident Stock**	**Eastern North Pacific, Gulf of Alaska, Aleutian Islands, & Bering Sea Transient Stock**	**Cook Inlet Stock and DPS**	**Mexico - North Pacific Stock**	**Hawai'i Stock**	**Western North Pacific Stock**	**Eastern North Pacific Stock**
Total Estimated Number of Exposures										
Year 1	154	22	77	6		85	6		6	
Year 2	136	19	68	6		76	6		6	
Year 3	136	19	68	6		76	6		6	
Year 4	138	20	69	6		78	6		6	
Year 5	138	20	69	6		80	6		6	
Year 6	149	21	75	6		80	6		6	
6-Year Total	**851**	**121**	**426**	**36**		**475**	**36**		**36**	
Percent of Population Potentially Exposed[b]										
Year 1	0.54	0.04	0.25	0.31	1.02	25.68	*NA*	0.05	2.07	0.02
Year 2	0.48	0.04	0.22			22.96				
Year 3	0.48	0.04	0.22			22.96				
Year 4	0.49	0.04	0.22			23.56				
Year 5	0.49	0.04	0.22			24.17				
Year 6	0.52	0.04	0.24			24.17				

Note: NA = not applicable.

[a] Population estimates used in calculations are presented in Section 3.

[b] These percentages assume that all potential exposures come from each stock; thus, each percentage should be adjusted down if multiple stocks are actually affected.

Section 7. Anticipated Impact of the Activity

Marine mammals use hearing and sound transmission to perform vital life functions. Sound (hearing, vocalization, and echolocation) serves four primary functions for marine mammals: (1) providing information about their environment, (2) communication, (3) prey detection, and (4) predator detection. The distances to which sounds associated with in-water pile installation and removal from the construction of the CTR Project are audible will depend upon source levels, frequency, ambient noise levels, propagation characteristics of the environment, and sensitivity of the receptors (Richardson et al. 1995). In-water pile installation and removal will temporarily increase the local underwater and in-air noise environment in the vicinity of the construction of the CTR Project.

Research suggests that increased noise may impact marine mammals in several ways (e.g., behaviorally and physiologically). The effects of in-water pile installation and removal on marine mammals are dependent on several factors, including the size, type, and depth of the animal; the depth, intensity, and duration of the in-water pile installation and removal sound; the depth of the water column; the substrate of the habitat; the distance between the pile and the animal; and the sound propagation properties of the environment.

7.1 Zones of Noise Influence

The effects of sounds from in-water pile installation and removal on marine mammals might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment, and non-auditory physical effects (Richardson et al. 1995). In assessing potential effects of noise, Richardson et al. (1995) have suggested four criteria for defining zones of influence. These zones are described below from greatest influence to least:

> ***Zone of hearing loss, discomfort, or injury*** – the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. This includes PTS (loss in hearing at specific frequencies or deafness). 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.
>
> ***Zone of masking*** – the area within which the noise may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.
>
> ***Zone of responsiveness*** – the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound are dependent upon a number of factors, including (1) acoustic characteristics of the noise source of interest, (2) physical and behavioral state of the animals at the time of exposure, (3) ambient acoustic and ecological characteristics of the environment, and (4) context of the sound (e.g., whether it sounds similar to a predator; Richardson et al. 1995; Southall et al. 2007). However, 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).
>
> ***Zone of audibility*** – the area within which the marine mammal might hear the noise. Marine mammals as a group have functional hearing ranges of 7 Hz to 180 kHz, with best thresholds near 40 dB (Ketten 1998; Southall et al. 2007; NMFS 2018). Hearing capabilities of the species included in this application are discussed in Section 4. There are no applicable criteria for the zone of audibility due to difficulties in human ability to determine the audibility of a particular noise for a particular species. The audibility zone does not fall in the sound range of a "take" as defined by NMFS and is not discussed below.

7.2 Assessment of Acoustic Impacts

The exposure to noise from in-water pile installation and removal could result in behavioral and mild physiological changes in marine mammals. Some age and sex classes are more sensitive to noise disturbance, and such disturbance may be more detrimental to young animals (e.g., National Research Council 2003). David (2006) suggested that pile installation should be avoided when bottlenose dolphins (*Tursiops truncatus*) are calving, since lactating females and young calves are likely to be particularly vulnerable to such sound. Distinct mating periods, calving dates, and calving areas for the Cook Inlet beluga whale are not well documented; however, calves are present during summer (Huntington 2000; Hobbs et al. 2005; Lomac-MacNair et al. 2016; Shelden et al. 2019; McGuire et al. 2016, 2020). Monitoring and mitigation measures will be implemented during construction of the CTR Project to avoid and minimize take by Level B disturbance caused by in-water pile installation and removal, including use of shutdowns when beluga whales approach the proposed Level B harassment zone (see Section 11).

7.2.1 Zone of Hearing Loss, Discomfort, or Injury

Strong sounds can cause temporary or permanent reduction in hearing sensitivity. No studies have determined levels that cause PTS in beluga whales. Laboratory experiments investigating temporary threshold shift (TTS) onset for beluga whales have been conducted. 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 SELs (179 dB re 1 μPa^2-s; approximately 199 dB rms); 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 water guns with a single acoustic pulse. Masked hearing TTSs were 7 and 6 dB at 0.4 and 30 kHz, respectively, after exposure to intense single pulses (186 dB SEL; 208 dB rms). Schlundt et al. (2000) demonstrated temporary shifts in masked hearing thresholds for beluga whales occurring generally between 192 and 201 dB rms (192 to 201 dB SEL) after exposure to intense, non-pulse, 1-second tones at 3, 10, and 20 kHz. TTS onset occurred at mean SEL of 195 dB rms (195 dB SEL). Popov et al. (2013) conducted studies of TTS in a captive male and a captive female beluga whale. The fatiguing noise had a 0.5-octave bandwidth, with center frequencies ranging from 11.2 to 90 kHz, a level of 165 dB re 1 μPa, and exposure lasting 1 to 30 minutes. The highest TTS with the longest recovery duration was produced by noises of lower frequencies (11.2 and 22.5 kHz) and appeared at a test frequency of +0.5 octave. At higher noise frequencies (45 and 90 kHz), the TTS decreased. The TTS effect gradually increased with prolonged exposures ranging from 1 to 30 minutes. In a variety of exposure and recording conditions, TTS in the female subject was higher and longer than in the male subject, further illustrating that inter-individual difference must be taken into consideration when possible impacts to hearing are assessed. Popov et al. (2013) measured a TTS onset of 158 dB maximum SEL_{cum} from a female beluga whale.

Kastelein et al. (2013a) determined that the hearing threshold was lower when a harbor porpoise was exposed to multiple strike sounds than when it was exposed to only a single strike sound. Using a psychophysical technique, a harbor porpoise's hearing thresholds were obtained for a series of five pile-driving sounds (inter-pulse interval 1.2 to 1.3 seconds) recorded at 100 and 800 meters from the pile-driving site and played back in a pool. The 50 percent detection threshold SELs for the first sound of the series (no masking) were 72 (100 meters) and 74 (800 meters) dB re 1 μPa^2-s. Multiple sounds in succession (series) caused a 5-dB decrease in hearing threshold.

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 hours of intermittent exposure per day. When the harbor seal was tested immediately upon cessation of the noise, a TTS of 8 dB at 100 Hz was evident. Following 1 week of recovery, the subject's hearing threshold was within 2 dB of its original level. Pure-tone sound detection thresholds were obtained in water for a harbor seal before and immediately following exposure to octave-band noise (Kastak et al. 1999). Test frequencies ranged from 100 Hz to 2 kHz, and octave-band exposure levels were approximately 60 to 75 dB source level. The subject was trained to dive into a noise field and remain stationed underwater during a noise-exposure period that lasted a total of 20 to 22 minutes. Following exposure, the harbor seal showed threshold shifts averaging 4.8 dB. The average threshold shift relative to baseline thresholds following noise exposure was 4.8 dB, and the average shift following the recovery period was 20.8 dB (Kastak et al. 1999).

Noise may affect physiology and developmental, stress, reproductive, or immune functions. Norman (2011) reviewed environmental and anthropogenic stressors for Cook Inlet beluga whales. Lyamin et al. (2011) determined that the heart rate of a beluga whale increases in response to noise, depending on the frequency and intensity. Acceleration of heart rate in the beluga whale is the first component of the "acoustic startle response." Romano et al. (2004) demonstrated that captive beluga whales exposed to high-level impulsive sounds (i.e., seismic airgun 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 oil-drilling platform in operation ("Sedco 708," 40 Hz–20 kHz; source level 153 dB). Ambient SPL at ambient conditions in the pool before playbacks was 106 dB and 134 to 137 dB during playbacks at the monitoring hydrophone across the pool. 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) studies could be the differences in the type of sound (oil drilling versus simulated underwater explosion), the 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 sounds in the Thomas et al. (1990) study would be more similar to those of pile installation than those in the study investigating stress response to water guns and pure tones. Therefore, no more than short-term, low-hormone stress responses, if any, of beluga whales or other marine mammals are expected as a result of exposure to in-water pile installation and removal.

Some species of odontocetes may have the ability to dampen hearing sensitivity in expectation of loud noise. Dampening has been observed in captive bottlenose dolphins (Nachtigall et al. 2016a), false killer whales (Nachtigall and Supin 2013), beluga whales (Nachtigall et al. 2016a), and, to a lesser degree, harbor porpoises (Nachtigall et al. 2016b). When animals were given a series of warning pips in advance of a louder noise, hearing threshold shifted. For false killer whales, bottlenose dolphins, and beluga whales, the magnitudes, durations, and timing of both threshold shift and recovery in relation to the warning and loud sounds indicated a conditioned dampening response rather than noise-induced threshold shift (Nachtigall and Supin 2013; Nachtigall et al. 2016a). For harbor porpoises, data suggested that both a conditioned response and a noise-induced threshold shift contributed to the observed threshold shifts (Nachtigall et al. 2016b).

PTS and TTS as a result of the CTR Project are not expected to occur in any marine mammal species, because no animal is anticipated to remain within the Level A zone for the amount of time it would take to accumulate the injury, and implementation of mitigation measures, such as ramp-up procedures and monitoring the harassment zones (Section 11), will help avoid potential close approaches of animals to in-water pile installation and removal that could result in Level A takes, Level B takes, and serious injury or mortality.

7.2.2 Zone of Masking

In-water pile installation and removal could result in minor masking through overlapping frequencies of the marine mammal signals or by increasing sound levels such that animals are unable to detect important signals over the increased noise. A passive acoustic study in the vicinity of the MTRP during its 2009 construction season measured noise to be less than 10 kHz, with one exception of impact pile installation, which extended to 20 kHz (Širović and Kendall 2009). Impact pile installation is less likely to mask beluga whale vocalizations than vibratory pile installation, because the frequency bandwidth from vibratory methods is within the range of whistles and noisy vocalizations (up to 10 kHz; Kendall 2010). Beluga whale whistles have dominant frequencies in the 2 to 6 kHz range; other beluga whale call types include sounds at mean frequencies ranging upward from 1 kHz (Sjare and Smith 1986a, 1986b). The acoustic data from 2009 did not include any vocalizations other than echolocation clicks, indicating that beluga whales in the area may be focused on foraging as opposed to social behaviors (Saxon-Kendall et al. 2013). In response to loud noise, beluga whales may shift the frequency of their echolocation clicks to prevent masking by anthropogenic noise (Tyack 2000; Eickmeier and Vallarta 2022).

Baleen whales produce sounds to communicate and possibly navigate in the frequency range from 10 Hz to 10 kHz, whereas toothed whales produce sounds for echolocation and to communicate in the frequency range from 1 to 150 kHz (Richardson et al. 1995; Madsen et al. 2006). Beluga whale echolocation has peak frequencies from 40 to 150,000 Hz (Eickmeier and Vallarta 2022) and broadband source levels of up to 219 dB at 1 meter (Au et al. 1985). Killer whales produce whistles between 1.5 and 18 kHz, and pulsed calls between 500 Hz and 25 kHz (Ford and Fischer 1983 *as cited in* Richardson et al. 1995). Harbor porpoises produce acoustic signals in a very broad frequency range, from less than 100 Hz to 160 kHz (Verboom and Kastelein 2004). The echolocation clicks produced by the aforementioned marine mammals are far above the frequency range of the sounds produced by vibratory pile driving and other construction sounds (e.g., dredging and gravel fill). Harbor seals produce social calls at 500 to 3,500 Hz and clicks from 8 to 150 kHz (reviewed in Richardson et al. 1995).

Increased noise levels could also result in minor masking of some marine mammal signals. Blackwell (2005) and URS (2007) reported that background noise at the POA (physical environment and maritime operations) contributed more to received levels than pile installation did at distances greater than 1,300 meters from the source. Therefore, beluga whales and other marine mammals in the POA area have likely become habituated to increased noise levels.

Implementation of the proposed mitigation measures will reduce impacts on marine mammals (Section 11), with any minor masking occurring close to the sound source, if it at all. The area of the Project is a small area of ensonification relative to the width and size of Knik Arm, further reducing any effects on marine mammals. Beluga whales are able to adjust vocalization amplitude and frequency in response to increased noise levels (Scheifele et al. 2005). However, the energetic costs of adjusting vocalizations in response to increased noise levels is poorly understood, and it is uncertain how this will affect individual animals. The intermittent nature of pile installation and removal at the Project area, the likelihood of in-water pile installation and removal operations masking beluga whale social calls or echolocation clicks is low.

7.2.3 Zone of Responsiveness

Responses from marine mammals in the presence of in-water pile installation and removal might include a reduction of acoustic activity, a reduction in the number of individuals in the area, and avoidance of the area (e.g., Brandt et al. 2011; Tougaard et al. 2012; Dähne et al. 2013). Of these, temporary avoidance of the noise-impacted area is the most common response of marine mammals. Avoidance responses may be initially strong if the marine mammals move rapidly away from the source or weak if animal movement is deflected only slightly away from the source. Noise from in-water pile installation and removal could potentially displace marine mammals from the immediate area of the activity. However, marine mammals will likely return after completion of in-water pile installation and removal, as demonstrated by a variety of studies about temporary displacement of marine mammals by industrial activity (reviewed in Richardson et al. 1995).

Beluga whales in Cook Inlet have continued to utilize the habitat in the POA vicinity and Knik Arm, despite it being heavily disturbed from maritime operations, maintenance dredging, and aircraft. Cook Inlet beluga whales did not abandon the area of the POA or Knik Arm during the 2016 TPP, the MTRP or the PCT and SFD construction (Kendall 2010; Cornick and Seagars 2016; 61N Environmental 2021, 2022b, 2022c). Cook Inlet beluga whales were continually observed in the MTRP area, even in the presence of pile installation (Section 7.2.4). Sonobuoy data collected near the MTRP site in 2009 indicated fewer beluga whale echolocation clicks per hour during construction activities than when no construction was being performed; however, this difference was not statistically significant (Saxon-Kendall et al. 2013). Any masking event that could possibly rise to Level B harassment under the MMPA will occur concurrently within the zones of behavioral harassment already estimated for in-water pile installation and removal and have already been taken into account in the exposure analysis.

The presence of beluga whales during marine mammal monitoring for the MTRP, PCT, and SFD followed a pattern similar to what has been observed prior to commencement of construction at the POA, including similar behaviors (diving and feeding) and peak abundance in late August through October, suggesting that pile driving has not affected overall beluga whale behavior. Implementation of the mitigation measures during the MTRP, PCT, and SFD reduced impacts on individual beluga whales to short-term, temporary disturbances (i.e., Level B takes) of small numbers of individuals; and resulted in the avoidance of disturbance to many others. Beluga whales have been observed during the same time period (peaking in August through October) in the POA area despite the presence of in-water construction and other maritime activities (Prevel-Ramos et al. 2006; Cornick and Saxon-Kendall 2008, 2009; Kendall 2010; Cornick et al. 2011; Cornick and Pinney 2011; 61N Environmental 2021, 2022a).

There is no evidence to suggest that in-water pile installation and removal at the POA affected beluga whale use of Knik Arm as a whole, as evidenced by the consistency of timing, location, and numbers of beluga whales (including calves; Prevel-Ramos et al. 2006; Markowitz and McGuire 2007; Cornick and Saxon-Kendall 2008, 2009; Kendall 2010; Cornick and Pinney 2011; Cornick et al. 2011). Further, monitoring data conducted during PCT Phase 1 and Phase 2 construction in 2020 and 2021 indicated that traveling, milling, and diving were the primary beluga whale behaviors observed (61N Environmental 2021, 2022a). Beluga whales frequently approached and transited through the project site after in-water pile installation or removal was shut down, often lingering for extended periods of time (61N Environmental 2021, 2022a). These reports indicate that beluga whales are primarily transiting through the POA area while opportunistically foraging, and that project construction, harbor dredging, and other maritime activities are not blocking this transit. Therefore, impacts on the Cook Inlet beluga whale population from the proposed CTR in-water construction activities, would be short-term and temporary with negligible long-term impacts.

To estimate the discomfort threshold of pile-driving sounds on a harbor porpoise, Kastelein et al. (2013a) exposed a captive individual to playbacks (46 strikes/minute) at five SPLs (6-dB steps: 130 to 154 dB re 1 μPa). At and above a received broadband SPL of 136 dB re 1 μPa (zero-peak SPL: 151 dB re 1 μPa; t90: 126 milliseconds; SEL of a single strike: 127 dB re 1 μPa^2-s), the porpoise's respiration rate increased in response to the pile-driving sounds. At higher levels, the individual also jumped out of the water more often (Kastelein et al. 2013b). The effects of pile-driving noise were studied by Tougaard et al. (2003) during the construction of the offshore wind farms at Horns Reef (North Sea) and Nysted (Baltic). At Horns Reef, the acoustic activity of harbor porpoises decreased shortly after each pile-driving event and went back to baseline conditions after 3 to 4 hours. However, harbor porpoises in Cook Inlet are currently exposed to a variety of industrial sounds and return to upper Cook Inlet each year, suggesting a level of habituation.

There are no studies that have focused on the effects of pile-driving noise on killer whales. However, since killer whales are rarely sighted near the POA, it is unlikely that killer whales will be exposed to in-water pile installation and removal noise that masks acoustic communication.

A study by Kastelein et al. (2013c) showed that the hearing threshold for harbor seals exposed to playbacks of pile-driving noise was lower when the animals were exposed to multiple strike sounds than it would be if they were exposed to a single strike sound. The harbor seal's unmasked hearing threshold level for pile-driving sounds was found to be many orders of magnitude (approximately 130 dB) lower than the level measured at a distance of 800 meters from an offshore pile-driving location. Kastelein et al. (2013c) noted that this suggests that pile-driving sounds are audible to harbor seals at distances on the order of hundreds of kilometers from pile-driving sites, depending on the actual propagation conditions and the masking of the sounds by ambient noise. Kastak et al. (1999) reported that pinniped behavior was often altered during experiments to assess TTS, reflected in hauling out, aggression directed at the apparatus and at the trainer, and refusal to station at the apparatus during noise exposure. Kastak et al. (1999) noted that these altered behaviors in the form of increased levels of aggression and/or avoidance of a location at which food had been received prior to noise exposure should be considered in the context of free-ranging seals that might respond similarly to uncomfortable noise exposures.

It is important to understand that there is variation among individual animals in behavioral reactions to sounds. For example, during in-water pile driving at Hood Canal, Washington, during fall 2011, harbor seals (particularly juveniles) appeared to be attracted to pile-driving, and often moved toward the construction area when pile driving was initiated (Ampela et al. 2014).

7.2.4 Zone of Audibility

The most extensive of the four zones, the zone of audibility, is the area within which the animal might hear the noise. Marine mammals as a group have functional hearing ranges of 10 Hz to 180 kHz, with thresholds of best hearing near 40 dB (Ketten 1998; Southall et al. 2007). Marine mammals can typically be divided into five groups that have consistent patterns of hearing sensitivity (see Section 6.2). Difficulties in human ability to determine the audibility of a particular noise for other species has so far precluded development of applicable criteria for the zone of audibility. This zone does not fall in the sound range of a “take” as defined by NMFS.

Repeated or sustained disruption of important behaviors (such as feeding, resting, traveling, and socializing) 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 will become habituated, desensitized, and tolerant after initial exposure to these sounds, as demonstrated by beluga whale tolerance of larger vessels in industrialized areas such as the St. Lawrence River and Beaufort Sea (reviewed by Richardson et al. 1995; Southall et al. 2007).

Marine mammals residing in and transiting through this area are routinely exposed to sounds louder than 120 dB, and continue to use this area; therefore, it appears they have become habituated and are not harassed by these sounds.

Cook Inlet beluga whales are familiar with, and likely habituated to, the presence of large and small vessels. Beluga whales are frequently sighted in and around the POA, the Port MacKenzie Dock, and the small boat launch adjacent to the outlet of Ship Creek (Blackwell and Greene 2002; Funk et al. 2005; Ireland et al. 2005; NMFS 2008a). For example, Cook Inlet beluga whales did not appear to be bothered by the sounds from a passing cargo freight ship (Blackwell and Greene 2002).

Although the POA area is a highly industrialized area supporting a large amount of ship traffic, beluga whales are present almost year-round. Despite increased shipping traffic and upkeep operations (e.g., dredging), beluga whales continue to utilize waters within and surrounding the POA area, interacting with tugs and cargo freight ships (Markowitz and McGuire 2007; NMFS 2008a). During the POA monitoring studies, animals were consistently found in higher densities in the nearshore area (6 km^2) around the POA area throughout April to October each year where vessel presence was highest. Cook Inlet beluga whales were continually observed in the MTRP area, even in the presence of driving. In comparing pre- and post-pile-driving observations, Kendall (2010) reported a decrease in sighting duration of beluga whales; the increase in travel and the increased sightings near Port MacKenzie may indicate avoidance behavior by beluga whales in the area around the MTRP. It should be noted that Cornick et al. (2011) remarked that, during 2011 monitoring, beluga whales in the area of the MTRP appeared to have returned to similar habitat use, behavior, and group structure patterns that were in place prior to 2010, which may have been related to the reduced occurrence of pile driving and other in-water construction activities.

These studies indicate that beluga whales have become desensitized and habituated to the present level of human-caused disturbance. Therefore, it is anticipated that beluga whales are likely to become habituated to noise from in-water pile installation and removal noise. Cook Inlet beluga whales have demonstrated a tolerance to ship traffic around the POA. Animals will be exposed to greater than current background noise levels from in-water pile installation and removal; however, background sound levels in Knik Arm are already high due to strong currents, eddies, recreational vessel traffic, U.S. Coast Guard patrols, dredging, and commercial and military shipping traffic entering and leaving the POA (Blackwell and Greene 2002; Blackwell 2005; URS 2007; KABATA 2011). Based upon the already-elevated background noise around the POA area and a beluga whale's ability to compensate for masking, it can be reasonably expected that beluga whales are likely to become habituated to in-water pile installation and removal as they have to vessel traffic. It is expected that the frequency and intensity of behavioral reactions, if present, will decrease when habituation occurs.

Carstensen et al. (2006) and Brandt et al. (2011) observed a decrease in harbor porpoises in the presence of pile-driving activity during the construction of offshore wind turbines near Denmark. Harbor porpoises returned to the construction area between pile-driving events; however, the return time occasionally took several days (Carstensen et al. 2006). Brandt et al. (2011) observed the reduction of harbor porpoise activity and density at the construction area over the entire period during which pile driving took place (5 months), also documenting increased use of areas 20 km away from the construction site.

7.3 Assessment of Impacts on Cook Inlet Beluga Whale Stock

Anthropogenic noise is ranked as one of three threats of "high relative concern" to the recovery of Cook Inlet beluga whales (NMFS 2016). As discussed above, anthropogenic noise can affect beluga whale communication, behavior, and echolocation, and can alter the distribution or abundance of prey resources. Chronic exposure to anthropogenic noise may decrease survival and reproduction, with population-level consequences. However, the magnitude of this impact on Cook Inlet beluga whales and the potential for increasing exposure enough to result in population-level effects is currently unknown. In order to address whether noise is limiting the recovery of the Cook Inlet beluga whale population, Tollit et al. (2016) developed an interim-population consequences-of-disturbance (PCoD) model. This model builds on the concept that species perceive human disturbance as a threat, which results in behavioral and physiological responses that adversely affect individual health (Tollit et al. 2016). Currently, there are limited empirical data to explain how and to what extent anthropogenic noise in Cook Inlet results in changes to beluga whale behavior, reproduction, or individual survival. To fill this data gap, Tollit et al. (2016) convened a workshop in April 2016 in which expert knowledge was gathered and incorporated in the interim PCoD model. The model was then used to assess population-level impacts from a hypothetical pile-installation project with different levels of beluga whale exposure over multiple years. Under all scenarios, the effect of anthropogenic noise disturbance on vital rates was so small that it was considered unlikely to result in population-level effects (Tollit et al. 2016).

7.4 Conclusions Regarding Impacts to Species or Stocks

Individual marine mammals may be exposed to SPLs during in-water pile installation and removal associated with the CTR Project that may exceed Level B harassment thresholds. In addition, small numbers of harbor seals may be exposed to Level A harassment. Marine mammals that are "taken" (i.e., harassed) may change their normal behavior patterns (e.g., swimming speed or foraging habits) or be temporarily displaced from the area of in-water pile installation and removal. Any "takes" will likely have only a minor effect on individuals due to the short-term, temporary nature of the noise and the CTR Project. No measurable effect on Cook Inlet beluga whale, harbor seal, Steller sea lion, killer whale, harbor porpoise, gray whale, or humpback whale populations is anticipated. Implementation of mitigation measures proposed in Section 11 is likely to avoid most potential adverse underwater impacts to marine mammals from in-water pile installation or removal. Nevertheless, some level of impact is unavoidable. The expected level of unavoidable impact (defined as an acoustic or harassment “take”) is described in Section 6.

Section 8. Anticipated Impacts on Subsistence Uses

While no significant subsistence activity currently occurs within or near the POA, Alaska Natives have traditionally harvested subsistence resources, including marine mammals, in upper Cook Inlet for millennia. Beluga whales are more than a food source; they are important to the cultural and spiritual practices of Cook Inlet Native communities (NMFS 2008b). Dena'ina Athabascans, currently living in the communities of Eklutna, Knik, Tyonek, and elsewhere, occupied settlements in Cook Inlet for the last 1,500 years and were the primary traditional users of this area into the present.

NMFS estimated that 65 whales per year (range 21–123) were killed between 1994 and 1998, including those successfully harvested and those struck and lost. NMFS concluded that this number was high enough to account for the estimated 14 percent annual decline in population during this time (Hobbs et al. 2008); however, given the difficulty of estimating the number of whales struck and lost during the hunts, actual mortality may have been higher. During this same period, population abundance surveys indicated a population decline of 47 percent, although the reason for this decline should not be associated solely with subsistence hunting and likely began well before 1994 (Rugh et al. 2000).

In 1999, a moratorium was enacted (Public Law 106-31) prohibiting the subsistence harvest of Cook Inlet beluga whales except through a cooperative agreement between NMFS and the affected Alaska Native organizations. NMFS began working cooperatively with the Cook Inlet Marine Mammal Council (CIMMC), a group of tribes that traditionally hunted Cook Inlet beluga whales, to establish sustainable harvests. CIMMC voluntarily curtailed its harvests in 1999. In 2000, NMFS designated the Cook Inlet stock of beluga whales as depleted under the MMPA (65 FR 34590). NMFS and CIMMC signed *Co-Management of the Cook Inlet Stock of Beluga Whales* agreements in 2000, 2001, 2002, 2003, 2005, and 2006. Beluga whale harvests between 1999 and 2006 resulted in the strike and harvest of five whales, including one whale each in 2001, 2002, and 2003, and two whales in 2005 (NMFS 2008b). No hunt occurred in 2004 due to higher-than-normal mortality of beluga whales in 2003, and the Native Village of Tyonek agreed to not hunt in 2007. Since 2008, NMFS has examined how many beluga whales could be harvested during 5-year intervals based on estimates of population size and growth rate and determined that no harvests would occur between 2008 and 2012 and between 2013 and 2017 (see NMFS 2008b for equations). The CIMMC was disbanded by unanimous vote of the CIMMC member Tribes' representatives in June 2012, and a replacement group of Tribal members has not been formed to date. There has been no subsistence harvest of beluga whales since 2005 (NMFS 2016).

Harvests of harbor seals for traditional and subsistence uses by Native peoples are low in upper Cook Inlet (Table 8-1).

Table 8-1. Harbor Seal Harvest Data From Tyonek

Year of Harvest	Total # of Harbor Seals Harvested
1983	0
1996	4
1997	2
1998	0
2000	0
2001	0
2002	3
2003	5
2004	0
2005	0
2006	4
2007	0
2008	9
2013	6

Source: Fall et al. 1983; ADF&G 2018.

Residents of the Native Village of Tyonek are the primary subsistence users in the upper Cook Inlet area. As Project activities will take place within the immediate vicinity of the POA, no activities will occur in or near Tyonek's identified traditional subsistence hunting areas. As the harvest of marine mammals in upper Cook Inlet is historically a small portion of the total subsistence harvest and the number of marine mammals using upper Cook Inlet is proportionately small, the number of marine mammals harvested in upper Cook Inlet is expected to remain low. As the proposed Project will likely result in temporary disturbances to small numbers of marine mammals during construction, the CTR Project will not impact the availability of these other marine mammal species for subsistence uses.

Section 9. Anticipated Impacts on Habitat

9.1 Effects of Project Activities on Marine Mammal Habitat

Habitat is the locality or environment that is essential for an animal's survival, where it feeds, rests, travels, socializes, breeds, and raises its young. For cetaceans, these are in-water areas, whereas for pinnipeds, habitat also includes haulout sites or rookeries. In addition to physical locations, habitat also includes the prey upon which a marine mammal feeds.

There are no known pinniped haulouts near the POA. The Cook Inlet beluga whale is the only marine mammal species in the Project area with critical habitat designated in Cook Inlet. The area around the POA (Figure 4-1) was excluded from the critical habitat designation for national security reasons (76 FR 20180). Beluga whales swim past the POA to access feeding areas to the north, and their use of Knik Arm and the POA is described in detail in Sections 4.5, 7.2, and 7.3. In summary, although the POA is a highly industrialized area supporting ship traffic and industrial activities including construction, beluga whales are present almost year-round. Despite increased shipping traffic and upkeep operations such as dredging, beluga whales continue to utilize waters within and surrounding the POA area. Additionally, an interim PCoD modeling effort indicated that under all scenarios, the effect of anthropogenic noise disturbance on vital rates was so small that it was considered unlikely to result in population-level effects (Tollit et al. 2016).

Habitat degradation or loss is a threat of medium concern for Cook Inlet beluga whales (NMFS 2016), and habitat restoration would improve one of the current threats. Degradation or loss of habitat in areas known to be important to Cook Inlet beluga whales for foraging and reproduction is of concern. Degradation or loss of habitat could result in the reduction in the carrying capacity of Cook Inlet for beluga whales and limit areas important for foraging or reproduction (NMFS 2016). Although anthropogenic activities tend to be localized in coastal areas, seasonal, and increasing in frequency, most of the beluga whale habitat in Cook Inlet is not degraded to the point that adverse effects to Cook Inlet beluga whales are apparent (NMFS 2016). Nearshore marine and freshwater habitat restoration, such as at Ship Creek, which improved fish passage in the tidal reach of Lower Ship Creek (NOAA 2022b), can refine and newly create access to miles of upstream, subtidal, and intertidal habitat for Cook Inlet beluga whales and their prey.

Removal of the North Extension bulkhead and impounded fill will result in restoration of subtidal and intertidal habitats that were lost when that structure was constructed in 2005–2011. Removal of approximately 1.35 million cubic yards of fill material from below the high tide line will re-create approximately 13 acres of intertidal and subtidal habitat, returning them to their approximate original slope and shoreline configuration. The Project area has not been considered to be high-quality habitat for marine mammals or marine mammal prey, such as fish, and it is anticipated that removal of the North Extension bulkhead will increase the amount of available habitat for both marine mammals and fish because they will be able to swim through the water that will be present in the area at higher water levels. The area will be of higher quality to marine mammals and fish as it returns to its natural state and is colonized by marine organisms. Restoration of this habitat at the POA may serve to mitigate some effects of CTR construction on marine mammals and their prey.

9.2 Effects of Project Activities on Marine Mammal Prey

Adults and juveniles of five Pacific salmon species, eulachon, longfin smelt, saffron cod, and other species use habitat throughout Knik Arm, and waters surrounding the POA provide habitat for migrating, rearing, and foraging (Moulton 1997; Houghton et al. 2005).

Currently, there are no criteria to evaluate underwater noise impacts to fish from a vibratory hammer. However, since vibratory hammers do not produce impulsive noise, and SSLs are lower than those produced from an impact hammer, it is not expected that in-water pile installation or removal of piles for the CTR Project will have an impact on local fish species. Additionally, in-water pile installation and removal will be intermittent and temporary, further reducing the potential for impacts on fish.

During the MTRP, the effects of impact and vibratory installation of 30-inch steel sheet piles at the POA on 133 caged juvenile coho salmon in Knik Arm were studied (Hart Crowser Incorporated et al. 2009; Houghton et al. 2010). Acute or delayed mortalities, or behavioral abnormalities were not observed in any of the coho salmon. Furthermore, results indicated that the pile driving had no adverse effect on feeding ability or the ability of the fish to respond normally to threatening stimuli (Hart Crowser Incorporated et al. 2009; Houghton et al. 2010).

As described in Section 4, Cook Inlet beluga whales, harbor seals, harbor porpoises, Steller sea lions, killer whales, gray whales, and humpback whales can be found in or may use the area around the POA. The diets of Cook Inlet beluga whales in Knik Arm can be generalized, based on a comparison of fishes found in stomach analyses of beluga whales and fish species observed in Knik Arm (Houghton et al. 2005). Common prey species in Knik Arm include Pacific salmon, eulachon, and Pacific cod (Houghton et al. 2005; Rodrigues et al. 2006, 2007; Quakenbush et al. 2015). The preferred diet of the harbor seal in the Gulf of Alaska consists of pollock, octopus, Pacific capelin (*Mallotus villosus*), eulachon, and Pacific herring (Sease 1992). Other prey species include cod, flat fishes, shrimp, salmon, and squid (Hoover 1988). Harbor seals in lower Cook Inlet move in response to local steelhead trout and salmon runs (Montgomery et al. 2007) and have been documented feeding on salmon in proximity to beluga whales in upper Cook Inlet (Easley-Appleyard et al. 2011). Harbor porpoise forage on prey similar to that of Cook Inlet beluga whales (Shelden et al. 2014): Pacific herring, other schooling fish, and cephalopods (Leatherwood et al. 1982). Killer whales feed on either fish or other marine mammals, depending on ecotype (resident versus transient, respectively). Occasional occurrences of killer whales in Knik Arm are typically of the transient ecotype (Shelden et al. 2003); transients feed on beluga whales and other marine mammals such as harbor seals and harbor porpoises.

Fish species in Knik Arm, including those that are prey for marine mammals, will benefit from removal of the North Extension bulkhead and availability of the resulting exposed subtidal and intertidal habitat, which will occur before the CTR Project. The CTR Project is not anticipated to impede migration of adult or juvenile salmon or to adversely affect the health and survival of the affected species at the population level. Once in-water pile installation and removal has ceased and the CTR Project is complete, the newly available habitat is expected to continue to transition back to its original, more natural condition and provide foraging, migrating, and rearing habitats to fish and foraging habitat to marine mammals.

Section 10. Anticipated Effects of Habitat Impacts on Marine Mammals

Descriptions of the potential impacts on habitat resulting from the CTR Project are discussed in Section 9. The effects from construction of the CTR on marine mammal habitat are expected to be temporary and minor (Section 9.1). An extremely small amount of low-quality marine habitat will be replaced by steel piles, such that the permanent impacts to marine habitat are discountable. The greatest impact on marine mammals associated with the CTR Project will be a temporary loss of habitat because of elevated sound levels. Displacement of marine mammals by elevated sound levels will not be permanent, and there will be no long-term effects to their habitat. Any displacement of marine mammals by sound from in-water pile installation and removal would be short-term and temporary. In-water pile installation and removal will occur only for a relatively small portion of each day, allowing an ample recovery period should displacement or modification of behavior occur. The CTR Project is not expected to result in any habitat-related effects that could cause significant or long-term negative consequences for individual marine mammals or their populations, since installation and removal of in-water piles will be temporary and intermittent, and the re-creation of intertidal and subtidal habitats will be permanent.

Section 11. Minimization Measures to Protect Marine Mammals and Their Habitat

The POA is committed to minimizing the impacts of its activities through implementation of avoidance and minimization measures summarized in this section to eliminate the potential for injury and to minimize disturbance harassment of marine mammals. The avoidance and minimization measures presented in this application are components of the proposed action and requirements of contractors during construction of the CTR Project. To mitigate potential impacts on marine mammals, the mitigation described in the pending Final LOA will be implemented. MMOs (sometimes referred to as Protected Species Observers or PSOs) will be contracted through the Construction Contractor and will carry out marine mammal observations during all in-water pile installation and removal.

11.1 Minimization and Mitigation Measures

A partial list of avoidance and minimization measures that have already been carried out or are in the process of being carried out as part of the Project design and construction methods can be found in Section 1.3 Avoidance and Minimization of Project Impacts.

11.1.1 Pre-activity Monitoring and Startup Procedures

Additional mitigation measures and startup procedures include the following, modeled after the stipulations outlined in the Final IHAs for PCT Phase 1 and Phase 2 construction (85 FR 19294) and SFD construction (86 FR 50057):

- The POA will conduct briefings for construction supervisors and crews, the monitoring team, and POA staff prior to the start of all in-water pile installation and removal, and when new personnel join the work, in order to explain responsibilities, communication procedures, the marine mammal monitoring protocol, and operational procedures.
- Marine mammal monitoring will take place from 30 minutes prior to initiation of in-water pile installation and removal through 30 minutes post-completion of pile installation and removal.
- For beluga whales, the Level B zone for in-water pile installation and removal must be fully visible for 30 minutes before the zone can be considered clear of beluga whales. Pile installation and removal will commence when MMOs have declared the Level B zone clear of beluga whales or the mitigation measures developed specifically for beluga whales (below) are satisfied.
- For species other than beluga whales, in-water pile installation and removal will not commence until the Level A zone is clear of marine mammals for 15 minutes.
- In the event of a delay or shutdown of activity, marine mammal behavior will be monitored and documented until the marine mammals leave the shutdown zones of their own volition, at which time pile installation or removal or the previous activity will commence or recommence.
- All MMO observations will occur between civil dawn and civil dusk.

11.1.2 During Activity Monitoring and Shutdown Procedures

The following activity monitoring and shutdown procedures were modeled after the stipulations outlined in the Final IHA for Phases 1 and 2 PCT construction (85 FR 19294) and SFD construction (86 FR 50057):

- For in-water construction involving heavy machinery other than pile installation or removal (e.g., use of barge-mounted excavators or dredging), if a marine mammal comes within 10 meters, the POA will cease operations and reduce vessel speed to the minimum level required to maintain steerage and safe working conditions.

- The POA will use soft start techniques when impact pile driving. A soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a 30-second waiting period, followed by two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day's impact pile driving, any time impact pile driving has been shut down or delayed due the presence of a marine mammal, or at any time following cessation of impact pile driving for a period of 30 minutes or longer.
- The POA will employ MMOs per the Marine Mammal Monitoring Plan (Appendix B).
- On a given day, if marine mammal monitoring ceases but in-water pile installation and removal is scheduled to resume, MMOs will follow the pre-pile driving monitoring protocol as described above, including a 30-minute clearance scan of the Level B zone for beluga whales.
- If a marine mammal is observed entering or within an established Level A zone or shutdown zone, in-water pile installation and removal will be halted or delayed. In-water pile installation and removal will not commence or resume until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone and on a path away from such zone, or 15 minutes (species other than beluga whales) or 30 minutes (beluga whales) have passed without subsequent detection.
- If a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized takes are met, is observed approaching or within the Level B zone, in-water pile installation and removal will shut down immediately. In-water pile installation and removal will not resume until the animal has been confirmed to have left the area or 30 minutes have elapsed.
- In-water pile installation and removal delay and shutdown protocol for Cook Inlet beluga whales (but not other species of marine mammals) include the following:
    - Prior to the onset of in-water pile installation and removal, should a beluga whale(s) be observed within the Level B zone, in-water pile installation or removal will be delayed. In-water pile installation and removal will not commence until the animal has voluntarily traveled beyond the Level B harassment zone and is on a path away from such zone, or the beluga whale has not been re-sighted within 30 minutes.
    - If in-water pile installation or removal has commenced and a beluga whale(s) is observed within or likely to enter the Level B harassment zone, in-water pile installation and removal will be delayed. In-water pile installation and removal will not commence until the beluga whale has voluntarily traveled beyond the Level B harassment zone and is on a path away from such zone, or the whale has not been re-sighted within 30 minutes.
    - If during in-water installation and removal of piles, MMOs can no longer effectively monitor the entirety of the Cook Inlet beluga whale Level B shutdown zone due to environmental conditions (e.g., fog, rain, wind), in-water pile installation and removal will continue only until the current segment of pile is installed or removed; no additional sections of an in-water pile may be installed or removed until conditions improve such that the monitoring zone can be effectively monitored. If the Level B harassment zone cannot be monitored for more than 15 minutes, the entire Level B harassment zone will be cleared again for 30 minutes prior to in-water pile installation and removal.

11.2 Shutdown Zones

Modeling results for Level A and Level B harassment zones discussed in Section 6 were used to develop avoidance and minimization measures for pile installation and removal. To provide additional protection to marine mammals, a minimum 100-meter shutdown zone will be implemented for all marine mammals during in-water pile installation and removal. Although every effort will be made to shut down when a marine mammal reaches the 100-meter isopleth, a potential Level A exposure will not be documented unless the animal enters the relevant calculated Level A isopleth (Section 6).

A 100-meter minimum shutdown zone will also be implemented during simultaneous use of two vibratory hammers.

For beluga whales, the Level B zone will be implemented as the shutdown zone and potential harassment take will be avoided as feasible. Shutdown zones (Table 11-1) will be implemented based on the rounded Level A zones for harbor seals, Steller sea lions, harbor porpoises, killer whales, gray whales, and humpback whales if they are larger than the 100-meter minimum shutdown zone. The shutdown zones have been determined by rounding up the Level A zones for non-beluga whale species and rounding up the Level B zone for beluga whales to simplify management of monitoring and minimize or avoid take.

Table 11-1. Rounded Level A and Level B Harassment Zones and Shutdown Zones for Impact Pile Installation and Vibratory Pile Installation and Removal

Pile Size	Hammer Type	Number of Piles (Duration in Minutes or Strikes per Pile) Per Day	Minimum Shutdown and Level A Zones (m)												Level B Zone (m)
			LF		MF				HF		PW		OW		
			Humpback and Gray Whale		Beluga Whale		Killer Whale		Harbor Porpoise		Harbor Seal		Steller Sea Lion		All Species Except Beluga Whale
			Level A Take Authorized		No Take		No Level A Take		Level A Take Authorized		Level A Take Authorized		Level A Take Authorized		
			Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	
24-inch installation	Vibratory (Unattenuated)	4 (30 minutes)	100	11	2,250	2	100	2	100	16	100	7	100	1	2,250
24-inch installation	Vibratory (Attenuated)	4 (30 minutes)	100	8	2,630	1	100	1	100	11	100	5	100	1	2,630
24-inch removal	Vibratory (Unattenuated)	4 (45 minutes)	100	37	5,970	5	100	5	100	53	100	24	100	3	5,970
24-inch removal	Vibratory (Attenuated)	4 (45 minutes)	100	8	2,100	1	100	1	100	12	100	5	100	1	2,100
36-inch installation	Vibratory (Unattenuated)	4 (30 minutes)	100	22	4,520	3	100	3	100	31	100	14	100	2	4,520
36-inch installation	Vibratory (Attenuated)	4 (30 minutes)	100	11	3,580	1	100	1	100	15	100	7	100	1	3,580
36-inch removal	Vibratory (Unattenuated)	4 (45 minutes)	100	11	1,700	2	100	2	100	15	100	7	100	1	1,700
36-inch removal	Vibratory (Attenuated)	4 (45 minutes)	100	5	1,320	1	100	1	100	8	100	3	100	1	1,320
72-inch installation	Vibratory (Attenuated)	3 (10 minutes)	100	7	6,120	1	100	1	100	11	100	5	100	1	6,120
144-inch installation	Vibratory (Attenuated)	1 (15 minutes)	100	1	1,140	1	100	1	100	2	100	1	100	1	1,140

Pile Size	Hammer Type	Number of Piles (Duration in Minutes or Strikes per Pile) Per Day	Minimum Shutdown and Level A Zones (m)												Level B Zone (m)
			LF		MF				HF		PW		OW		
			Humpback and Gray Whale		Beluga Whale		Killer Whale		Harbor Porpoise		Harbor Seal		Steller Sea Lion		All Species Except Beluga Whale
			Level A Take Authorized		No Take		No Level A Take		Level A Take Authorized		Level A Take Authorized		Level A Take Authorized		
			Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	
24-inch installation	Impact (Unattenuated)	1 (1,000 strikes)	500	735	1,600	27	100	27	500	876	100	394	100	29	1,600
24-inch installation	Impact (Attenuated)	1 (1,000 strikes)	100	251	550	9	100	9	100	299	100	135	100	10	550
36-inch installation	Impact (Unattenuated)	1 (1,000 strikes)	500	1,165	1,590	42	100	42	500	1,387	100	624	100	46	1,590
36-inch installation	Impact (Attenuated)	1 (1,000 strikes)	100	398	550	15	100	15	100	474	100	213	100	16	550
72-inch installation	Impact (Unattenuated)	1 (5,743 strikes)	500	10,936	7,360	389	400	389	500	13,026	100	5,853	100	427	7,360
72-inch installation	Impact (Attenuated)	1 (5,743 strikes)	500	3,734		133	140	133	500	4,448	100	1,999	100	146	
72-inch installation	Impact (Attenuated)	2 (5,743 strikes)	500	5,928	2,520	211	220	211	500	7,061	100	3,173	100	231	2,520
72-inch installation	Impact (Attenuated)	3 (5,743 strikes)	500	7,767		277	280	277	500	9,252	100	4,157	100	303	
144-inch installation	Impact (Unattenuated)	1 (5,000 strikes)	500	29,201	18,500	1,039	1,100	1,039	500	34,782	100	15,627	100	1,138	18,500
144-inch installation	Impact (Attenuated)	0.5 (5,000 strikes)	500	8,539	13,600	304	310	304	500	10,171	100	4,570	100	333	13,600
144-inch installation	Impact (Attenuated)	1 (5,000 strikes)	500	13,554		483	500	483	500	16,145	100	7,254	100	529	

Notes: HF = high-frequency; LF = low-frequency; m = meters; MF = mid-frequency; OW = otariid in water; PW = phocid in water.

Section 12. Mitigation Measures to Protect Subsistence Uses

The CTR Project will occur in or near a traditional subsistence hunting area and could affect the availability of marine mammals for subsistence uses. Therefore, the POA will communicate with representative Alaska Native subsistence users and Tribal members to identify and explain the measures that have been taken or will be taken to avoid and minimize any adverse effects of the CTR Project on the availability of marine mammals for subsistence uses.

The POA will adhere to the following procedures during Tribal consultation regarding marine mammal subsistence use within the Project area:

(1) Send letters to the Kenaitze, Tyonek, Knik, Eklutna, Ninilchik, Seldovia, Salamatof, and Chickaloon Tribes informing them of the CTR Project (i.e., timing, location, and features). Include a map of the Project area; identify potential impacts to marine mammals and mitigation efforts, if needed, to avoid or minimize impacts; and inquire about possible marine mammal subsistence concerns they have.

(2) Follow up with a phone call to the environmental departments of the eight Tribal entities to ensure that they received the letter, understand the CTR Project, and have a chance to ask questions. Inquire about any concerns they might have about potential impacts to subsistence hunting of marine mammals.

(3) Document all communication between the POA and Tribes.

(4) If any Tribes express concerns regarding Project impacts to subsistence hunting of marine mammals, propose a Plan of Cooperation between the POA and the concerned Tribe(s).

The CTR Project features and activities, in combination with a number of actions to be taken by the POA during Project implementation, should avoid or mitigate any potential adverse effects on the availability of marine mammals for subsistence uses. Furthermore, although construction will occur within the traditional area for hunting marine mammals, the Project area is not currently used for subsistence activities. In-water pile installation and removal will follow mitigation procedures to minimize effects on the behavior of marine mammals, and impacts will be temporary.

If desired, regional subsistence representatives may support Project marine mammal biologists during the monitoring program by assisting with collection of marine mammal observations and may request copies of marine mammal monitoring reports.

It is anticipated that the CTR Project location, small size of the affected area, mitigation measures, and input from Tribal entities will result in Project construction having no effect on subsistence use of marine mammals.

Section 13. Monitoring and Reporting

The POA will implement a marine mammal monitoring and mitigation strategy intended to avoid and minimize impacts on marine mammals (Appendix B). The marine mammal monitoring and mitigation program that is planned for CTR construction will be the same as for Phase 1 and Phase 2 construction of the PCT. The POA will collect electronic data on marine mammal sightings and any behavioral responses to in-water pile installation or removal for species observed during in-water pile installation and removal associated with the CTR Project. Four MMO teams will work concurrently to provide full coverage for marine mammal monitoring in rotating shifts during in-water pile installation and removal. All MMOs will be trained in marine mammal identification and behaviors. Field experience and/or training may be substituted for a biological degree. NMFS will review submitted MMO curricula vitae and indicate approval as warranted. Approval must be granted by NMFS within 14 days; if no notice is received from NMFS within 15 days, it will be considered tacit approval.

Eleven MMOs for the CTR Project will be stationed at the Anchorage Downtown Viewpoint near Point Woronzof (sometimes called City View), the Anchorage Public Boat Dock at Ship Creek, the CTR Project site, and the north end of POA property (see Figure 13-1). MMOs will have no other construction-related tasks or responsibilities while conducting monitoring for marine mammals. Observations will be carried out using combinations of equipment that include 7-by-50 binoculars, 20x/40x tripod-mounted binoculars, 25-by-150 “big eye” tripod-mounted binoculars (North End, Ship Creek, and Woronzof), and theodolites.

Trained MMOs will be responsible for monitoring the 100-meter shutdown zone, the Level A harassment zones, and the Level B harassment zones, as well as effectively documenting Level A and Level B potential exposures (take). They will also (1) report on the frequency at which marine mammals are present in the project area, (2) report on behavior and group composition near the POA, (3) record all construction activities, and (4) report on observed reactions (changes in behavior or movement) of marine mammals during each sighting. Observers will work in collaboration with the POA to immediately communicate the presence of marine mammals prior to or during pile installation or removal. A report that includes electronic data collected and summarized from all monitoring locations will be submitted to NMFS within 90 days of the completion of the marine mammal monitoring program. The marine mammal monitoring approach is described in further detail in the Marine Mammal Monitoring and Mitigation Plan (Appendix B).

Figure 13-1. Potential MMO Station Locations for the CTR Project

Section 14. Suggested Means of Coordination

To minimize the likelihood that impacts will occur on the species, stocks, and subsistence use of marine mammals, in-water pile installation and removal associated with the CTR Project will be conducted in accordance with all federal, state, and local regulations. To further minimize potential impacts from the CTR Project, the POA will continue to cooperate with NMFS and other appropriate federal agencies (i.e., U.S. Fish and Wildlife Service, U.S. Coast Guard, U.S. Environmental Protection Agency, and USACE), JBER, and the State of Alaska. Potential impacts on subsistence use of marine mammals will be minimized through ongoing cooperation with Alaska Native leadership in Cook Inlet communities, as discussed in Section 12.

The POA will cooperate with other marine mammal monitoring and research programs taking place in Cook Inlet to coordinate research opportunities when feasible. The POA will also assess mitigation measures that can be implemented to eliminate or minimize any impacts from its activities. The POA will make its field data and behavioral observations of marine mammals that occur in the Project area during construction of the CTR Project available to NMFS. Results of monitoring efforts during the CTR Project will be provided to NMFS in a summary report within 90 days of the conclusion of monitoring. This information could be made available to regional, state, and federal resource agencies, universities, and other interested private parties upon written request to NMFS.

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Appendix A
Pile Driving Sound Source Levels, Sound Transmission Loss, and Air Bubble Curtain Performance Memorandum
(Illingworth & Rodkin)

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

429 E. Cotati Ave
Cotati, CA 94931
Tel: 707-794-0400
Fax: 707-794-0405
www.illingworthrodkin.com
illro@illingworthrodkin.com

M E M O

Date: November 3, 2022

To: Suzann Speckman
HDR

From: James A. Reyff
Illingworth & Rodkin, Inc.

RE: Port of Alaska Modernization Program – Phase 2

SUBJECT: **Pile Driving Sound Source Levels, Sound Transmission Loss, and Air Bubble Curtain Performance** #22-101

This memo presents potential sound levels for pile-driving activities that may occur as part of the Phase 2 Port of Alaska Modernization Program (PAMP), including Phase 2A for the North Extension Stabilization Project- Step 1 (NES1) and Phase 2B for the replacement of the existing cargo terminals with a new Terminal 1 and Terminal 2. Near-source sound levels are described as those sounds measured from various piles at a distance of 10 meters from the pile. The primary sources of data used to develop this data set were from measurements conducted in the vicinity of the Port of Alaska (POA), the compendium of pile-driving sound levels published in the 2020 California Department of Transportation (Caltrans) Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish (also known as the Caltrans Compendium), and sound levels measured in the Puget Sound that were published by the U.S. Navy (2015).

The following reports were used to develop these data:

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24-Inch-Diameter Piles

Vibratory Installation

The vibratory installation of 24-inch-diameter piles was conducted during Phase 1 of the PAMP, which involved construction of the new Petroleum and Cement Terminal (PCT). Measurements were conducted when a confined air bubble curtain system was operating. Measurements included piles that were installed and removed. Unattenuated measurements were made only during pile removal. Measurements were limited to those that extended from the pile driving directly across Knik Arm (east-west orientation). There was a considerable amount of variation in sound levels measured. Results below for monitoring in the Knik Arm represent the mean near-source levels.

<table>
<tr><th colspan="2">Pile Condition</th><th>dB rms</th><th>dB SEL</th><th>dB Peak</th><th>Data Source</th></tr>
<tr><td rowspan="8">24-inch Trestle & Template</td><td>Unattenuated</td><td>--</td><td></td><td></td><td rowspan="2">I&R 2021a
Template pile installation</td></tr>
<tr><td>Attenuated</td><td>158</td><td></td><td></td></tr>
<tr><td>Unattenuated</td><td>--</td><td></td><td></td><td rowspan="2">I&R 2021a
Trestle pile installation</td></tr>
<tr><td>Attenuated</td><td>163</td><td></td><td></td></tr>
<tr><td>Unattenuated</td><td>167</td><td></td><td></td><td rowspan="2">I&R 2021a
Trestle pile removal</td></tr>
<tr><td>Attenuated</td><td>157*</td><td></td><td></td></tr>
<tr><td>Unattenuated</td><td>161</td><td></td><td></td><td rowspan="2">U.S. Navy 2015</td></tr>
<tr><td>Attenuated</td><td>--</td><td></td><td></td></tr>
</table>

*During pile removal, the air bubble curtain provided 10-11 dB reduction at 10 meters and 5 dB at 30 meters, with no real reduction noted at positions 1 to 3 kilometers west.

Note: (1.) dB = decibels; rms = root-mean-square; SEL = sound exposure level.
(2.) rms for vibratory driving is based on a 1-second time constant and equivalent to the Leq[sec] level
(3.) rms for impact driving is based on the pulse level, measured over the duration that contains 90% of energy.

Impact Driving

There has been no impact driving of 24-inch-diameter piles in water at POA. Sound levels reported in the Caltrans Compendium (2020) and by the U.S. Navy (2015) are summarized below.

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
24-inch Trestle	Unattenuated	189	175	208	Caltrans Compendium 2020 summary of Amorco, Kitsap-Bangor Navy, Crescent City. Unattenuated in 10-meter or deeper water
	Unattenuated	193	181	210	U.S. Navy 2015

36-Inch-Diameter Piles

Similar to 24-inch-diameter piles, 36-inch piles were vibrated during construction of Phase 1 of the PAMP. There were 36-inch-diameter piles vibrated in both the 2020 and 2021 seasons. No impact driving of these piles occurred.

Vibratory Installation

Piles were vibrated during construction of the temporary trestle in 2020 and construction of mooring/dolphin pile templates in 2021. Measurements were also conducted when these piles were removed. Vibrating of these piles was considerably quieter during removal both with and without an air bubble curtain. Unattenuated sounds were not measured during installation in 2020, although the air bubble curtain performance may not have been optimal for some piles. The air bubble curtain did not affect the sound levels during pile removal; however, the sounds were considerably lower than those measured under any other condition.

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
36-inch	Unattenuated	--			I&R 2021a Trestle pile installation and removal
	Attenuated	161			
	Unattenuated	155			
	Attenuated	154*			
	Unattenuated	--			I&R 2021b Template pile installation
	Attenuated	160			
	Unattenuated	166			U.S. Navy 2015
	Attenuated	--			

*During pile removal, the air bubble curtain provided 1 dB reduction at 10 and 30 meters, with no real reduction noted at positions 1 to 3 kilometers west.

Impact Driving

There has been no impact driving of 36-inch-diameter piles in water at POA. Sound levels reported in the Caltrans Compendium (2020) and by the U.S. Navy (2015) are summarized below.

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
36-inch	Unattenuated	193	183	210	Caltrans Compendium 2020 summary of Humboldt Bay, unattenuated in 10-meter or deeper water
	Unattenuated	193	184	211	U.S. Navy 2015

48-Inch-Diameter Piles

Vibratory pile installation and impact pile driving was conducted at POA in 2016 for a Test Pile

Program (TPP) and then during Phase 1 construction in 2020. The TPP included unattenuated and attenuated (using a confined bubble curtain and proprietary noise-reduction system) for both vibratory and impact pile driving. Production pile driving included a confined air bubble curtain system. Only one pile was vibrated unattenuated during production pile driving; otherwise, all driving of 48-inch piles was attenuated.

Vibratory Driving

Vibratory sounds for unattenuated conditions from the TPP and PCT production pile driving are summarized below. There were no representative data in the Caltrans Compendium (2020) or by the U.S. Navy (2015).

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
48-inch	Unattenuated	168	--	--	POA 2016
	Attenuated	160	--	--	
	Unattenuated	174*	--	--	I&R 2021a
	Attenuated	166	--	--	

*Pile obstructed; likely produced higher sound levels.

Impact Driving

Impact pile driving was conducted at POA during the TPP and the PCT 2020 construction. The TPP included testing of various attenuation systems. There were no representative data for unattenuated sound levels in the Caltrans Compendium (2020) or by the U.S. Navy (2015).

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
48-inch	Unattenuated	200	187	215	POA 2016
	Attenuated	191	--*	--*	
	Unattenuated	--	--	--	I&R 2020a
	Attenuated	189	177	205	
	Unattenuated	--	--	--	Caltrans 2020. Compendium summary of Kitsap-Bangor Navy, unattenuated in 10-meter or deeper water (2019)
	Attenuated	190	177	213	

*Not specifically reported; however, SPLs were reduced by about 10 dB at 10 meters and 8 dB at 1 kilometer.

144-Inch-Diameter Piles

Vibratory and impact pile installation of two dolphin mono piles was conducted at POA in 2021 with an air bubble curtain operating. The first vibratory driving event was not representative since the driver was not properly coupled to the pile. The Caltrans Compendium (2020) includes data on impact driving of similarly sized piles; however, these piles were driven to provide lateral support and not driven deep into the substrates.

Vibratory Driving

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
144-inch	Unattenuated	--			I&R 2021b
	Attenuated	153			

Impact Driving

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
144-inch	Unattenuated	--	--	--	I&R 2021b
	Attenuated	207	193	219	
	Unattenuated	211	--	220	Caltrans 2020. Compendium summary of Kitsap-Bangor Navy, unattenuated in 10-meter or deeper water (2019)
	Attenuated	183	170	199	

72-Inch-Diameter Piles

There are no published data available for 72-inch-diameter piles for vibratory installation. One set of unpublished measurements describes sounds for vibratory installation of a pile.

Vibratory Driving

A 72-inch pile was driven with three different vibratory drivers to obtain the greatest penetration without using an impact hammer (I&R unpublished data). The level below is based on the most representative condition, as one driving event resulted in poor hammer coupling that caused higher sound levels and damaged the pile (this was considered atypical). The air bubble casings for the PCT 2020 pile driving were 72 inches in diameter. These were placed using a vibratory driver but only to set the casing; in other words, there was no hard driving conducted. The driving of these casings produced unattenuated sound pressure levels that were about 155 dB.

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
72-inch	Unattenuated	171			Unpublished data for Castrol Oil berthing dolphin in Richmond, CA, 2013
	Attenuated	--			

Impact Driving

There is one set of data for impact driving of 72-inch-diameter piles. These were attenuated levels; however, the air bubble curtain system did not work correctly at first, so the range of sound levels likely includes an unattenuated condition.

Pile Condition		dB rms	dB SEL	dB Peak	Data Source
72-inch	Unattenuated	203	191	217	Interpolation of unattenuated piles from 24 to 144 inches diameter
	Attenuated	--	--	--	
	Unattenuated	190	186	214	Caltrans Compendium 2020 summary of Martinez, CA, Avon Wharf in 10-meter or deeper water
	Attenuated	181	169	202	

Transmission Loss

Transmission loss (TL) is expressed as a 10-based logarithmic function, where the coefficient represents the change in sound level for a tenfold change in distance. The National Marine Fisheries Service (NMFS) generally applies a coefficient of 15 for vibratory and impact pile driving where site-specific data are not available. TLs were computed for various pile-driving activities during the TPP and PCT construction. Sound level TL in the Knik Arm was found to be complex and apparently varies with direction. Unattenuated TLs were only measured for the TPP when 48-inch-diameter piles were vibrated and impacted.

The TPP measured sounds mainly from 10 to about 1,000 meters with spot measurements out to about 4 kilometers. TPP measurements were generally in direction to the southwest or northwest. During PCT construction, measurements were conducted at fixed positions that ranged from 10 meters to about 2,800 meters in an east-to-west direction only. The Knik Arm is about 3 kilometers wide at the POA. The TPP generally measured higher TLs, likely because the directions were to the northwest and southwest. When measurements were conducted for the PCT to the south, the TLs were much higher.

Vibratory Driving

TL coefficients were computed for the unattenuated TPP results for 48-inch-diameter piles and summarized as 16.50 dB per each tenfold increase in distance (i.e., 16.50 Log[distance]). With the air bubble curtain operating, the TL was less.

Vibratory driving during PCT construction yielded varying results. Almost all measurements were made for attenuated conditions and were conducted in a direction that was directly across the Knik Arm. Attenuated results indicated low TL coefficients, while one unattenuated driving event had a high TL. However, the acoustic reports described this effect to be quite complex. Attenuated sound levels near the pile were much lower than predicted. At greater distances, levels were not reduced as much due to the presence of very low-frequency sounds present below 100 Hertz (Hz). This resulted in a lower TL coefficient. Results for the TPP did not reveal such low TLs for attenuated conditions. This may be attributed to the difference in directions measured. The TPP measured in generally southwest and northwest orientations, while the PCT measurements were made directly west into the deepest water in the Knik Arm.

Impact Driving

TL coefficients were computed for the unattenuated TPP results for 48-inch-diameter piles and summarized as 18.35 dB per each tenfold increase in distance (i.e., 18.35 Log[distance]). With the air bubble curtain operating, the TL was less, at about 16 Log[distance].

Impact driving for the PCT 2020 was conducted only for attenuated conditions and revealed a lower TL coefficient and lower source levels. This indicated that the bubble curtain was quite effective at reducing sound near the pile but not in the far distances in the direction crossing the Knik Arm.

The PCT measurement program was expanded during the 2021 construction season to include an additional position 6,000 meters south to better define the impact zones. The Knik Arm is only about 3,000 meters wide at the POA, so the additional measurement position had to be added to the south. Impact pile driving of two 144-inch-diameter piles was conducted during PCT 2021. Results indicated a much higher TL coefficient of 19.6 Log[distance] when the measurements to the south were included. However, the direction effect on TL coefficients has to be considered when including these data. Under-predictions of sound levels occur when solving for sound levels using the computed sound source level and TL coefficients in the direction across the Knik Arm. Otherwise, sounds transmitting across the Knik Arm (east to west) could be underpredicted.

Air Bubble Curtain Performance

The Caltrans Compendium (2020) reports that an air bubble curtain used on a steel or concrete pile with a maximum cross-section dimension of 24 inches or less will provide approximately 5 dB of sound reduction (assumed to be for impact pile driving). Sound reduction tends to increase as pile size increases. It is reasonable to assume that a bubble curtain for any size of pile will provide at least 5 dB of sound reduction. The NMFS calculator for predicting acoustic impacts to fish recommends 10 dB for piles 25 to 48 inches and up to 20 dB for larger piles (see Acoustics Tool for SERO[1]).

Vibratory Driving

There is no documentation by Caltrans or the Navy regarding noise reduction for vibratory pile driving using attenuation systems. The NMFS Calculator is based on data included in the Caltrans Compendium (2020). The TPP found that for vibratory pile installation of 48-inch-diameter piles, an air bubble curtain provided 9 dB and a passive resonator system (AdBm system) provided 8 dB reduction at 10 meters. The PCT 2020 measurements indicated 2 to 8 dB reduction close to the 48-inch piles at 10 meters (I&R 2021a). No apparent reduction was found in the far-field at about 2,800 meters for the PCT. An 8-dB reduction at close-in positions was estimated for pile driving that occurred during the PCT 2021 measurements (I&R 2021b). Again, no apparent reduction could be confirmed at the far distances. While vibratory sounds were reduced at frequencies above 100 Hz in the acoustic far field, the overall distant sound levels were characterized by very low frequency sound at or below 100 Hz. There is no strong evidence that air bubble curtains reduce sound from vibratory driving effectively at very far distances when considering the very-low-frequency components of sound that make up the overall sound levels.

Impact Driving

As described above, sound reductions for air bubble curtain systems are described as 5 to 20 dB, depending on pile size. The TPP measured reductions of 9 to 12 dB for a 48-inch-diameter pile using an air bubble curtain. This is consistent with the Caltrans (2020)/NMFS (2015) recommendations. The PCT 2020 measurements (I&R 2021a) found reductions of about 10 dB when comparing the attenuated conditions that occurred with that project to unattenuated conditions for the TPP. As with the TPP, there appeared to be less reduction in the very far field. The TPP did not report the reduction in sound levels in the acoustic very far field; however, the computed distances to the 125 dB rms levels were essentially reduced by half with the air bubble curtain (from 1,291 to 698 meters). The PCT 2021 (I&R 2021b) measurements were conducted for impact driving of 144-inch piles. Since there was no unattenuated condition measured, the sound reduction could not be identified from the measured data.

Sheet Pile Removal

The primary sound-generating activity associated with NES1 will be vibratory removal of sheet piles and installation of temporary 24- or 36-inch piles to assist with demolition of the previously

[1] https://media.fisheries.noaa.gov/2021-05/SERO%20Pile%20Driving%20Noise%20Calculator.xlsx?null

constructed and failed NES project. Data for removal of sheet piles are limited but it is expected that, typically, sound levels during vibratory sheet pile installation and removal are similar. Sound levels produced by vibratory removal of sheet piles for this project are likely to be quieter than installation because the preceding excavation of the surrounding sediments is intended to reduce frictional forces exerted on the piles, specifically to reduce the power required for sheet pile removal so they do not tear or break off. Preceding excavation will also make pile removal quieter.

Underwater sound was measured in 2008 at the Port of Anchorage (now the Port of Alaska) for the Marine Terminal Redevelopment Project during installation of sheet piles to assess potential impacts of sound on marine species. Sound levels for installation of sheet piles measured at 10 meters typically ranged from 147 to 161 dB rms, with a mean of about 155 dB rms (James Reyff, unpublished data). A sound level of 162 dB rms at 10 meters was reported in the Caltrans Compendium (2020) summary tables for 24-inch AZ steel sheet piles. This is a more rigid type of sheet pile that requires a large vibratory driver (James Reyff, personal communication). Based on the 2008 measurements at the POA and the Caltrans data, a value of 160 dB rms should be assumed for vibratory removal of sheet pile. NMFS has concurred that this value is an acceptable proxy for other projects in Alaska (e.g., 85 *Federal Register* 673).

Sheet piles may be dislodged with an impact hammer if they are seized in the sediments and cannot be loosened or broken free with a vibratory hammer. Anticipated sound levels for use of an impact hammer on sheet pile were selected from Caltrans (2020).

Pile Condition		**dB rms**	**dB SEL**	**dB Peak**	**Data Source**
Sheet	Vibratory POA	~155			Port of Anchorage 2009, James Reyff, personal communication
	Vibratory	162			Caltrans 2020
Sheet	Impact	189	179	205	Caltrans 2020

Appendix B
Marine Mammal Monitoring and Mitigation Plan

PORT OF ALASKA MODERNIZATION PROGRAM

Marine Mammal Monitoring and Mitigation Plan

Cargo Terminals Replacement (CTR) Project

Rev. 02

May 2024

Prepared by

Port of Alaska

2000 Anchorage Port Road
Anchorage, Alaska 99501

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Acronyms and Abbreviations

BA	Biological Assessment
CTR	Cargo Terminals Replacement
DPS	Distinct Population Segment
ESA	Endangered Species Act
FR	*Federal Register*
HF	high-frequency
IHA	Incidental Harassment Authorization
LF	low-frequency
LOA	Letter of Authorization
MF	mid-frequency
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
Monitoring Plan	Marine Mammal Monitoring and Mitigation Plan
NMFS	National Marine Fisheries Service
OW	otariid in water
PAMP	Port of Alaska Modernization Program
PCT	Petroleum and Cement Terminal
POA	Port of Alaska
POC	Point of Contact
PSO	Protected Species Observer(s)
PW	phocid in water
QA	Quality Assurance
QC	Quality Control
SFD	South Floating Dock
T1	Terminal 1
T2	Terminal 2

Section 1. Introduction

The Port of Alaska (POA), located on Knik Arm in upper Cook Inlet, is requesting a rulemaking and Letter of Authorization (LOA) and an Incidental Harassment Authorization (IHA) for the take of small numbers of marine mammals by Level A and Level B harassment incidental to construction of the Cargo Terminals Replacement (CTR) Project (Project) at the existing port facility in Anchorage, Alaska. The LOA is requested for a period of 5 years, from 01 April 2026 through 31 March 2031 and the IHA for a period of 1 year, from 01 April 2031 through 31 March 2032. This Marine Mammal Monitoring and Mitigation Plan (Monitoring Plan) was prepared as Appendix B to the request for incidental take authorization under the Marine Mammal Protection Act (MMPA), and in support of the Biological Assessment (BA) for formal Section 7 consultation with the National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA). This Monitoring Plan incorporates NMFS' best practices and definitions for standardizing data collection and entry for marine mammal sightings, including sightings of the Cook Inlet beluga whale (*Delphinapterus leucas*).

The CTR Project is Phase 2B of the overall reconstruction plan for the POA referred to as the Port of Alaska Modernization Program (PAMP; Figure 1-1). The Project will commence landside construction in 2025 and in-water construction in 2026. The Project includes new construction of Terminal 1 (T1) and Terminal 2 (T2), which include planned wharves and access trestles. The two new terminals will be located 140 feet seaward of the existing Terminals 1, 2, and 3. It is anticipated that the more seaward location of T1 and T2 will reduce sedimentation, improve room for handling of berthing ships, and allow construction of the new terminals while the existing terminals remain in use. The Project also includes demolition of the existing Petroleum, Oil and Lubricants Terminal 1; general cargo terminals Terminal 1 and Terminal 2; and partial demolition of Terminal 3.

Located within the Municipality of Anchorage on Knik Arm in upper Cook Inlet, the existing infrastructure and support facilities were constructed largely in the 1960s. Port facilities are substantially past their design life, have degraded to levels of marginal safety, and are in many cases functionally obsolete, especially in regard to seismic design criteria and condition. The newly-constructed T1 and T2, pile-supported wharves and trestles to the south and west of the existing terminals, will have a planned design life of 75 years.

The CTR Project is expected to produce noise levels that could meet or exceed Level A (injury) and Level B (disturbance) harassment thresholds established by NMFS for marine mammals under the MMPA (70 *Federal Register* [FR] 1871–1875). Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment means any act of pursuit, torment, or annoyance that has the potential to 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, and sheltering, but that does not have the potential to injure a marine mammal or marine mammal stock in the wild.

Seven marine mammal species may occur in or near the Project area:

- Beluga whale
- Humpback whale (*Megaptera novaeangliae*)
- Gray whale (*Eschrichtius robustus*)
- Killer whale (*Orcinus orca*)
- Steller sea lion (*Eumetopias jubatus*)
- Harbor porpoise (*Phocoena phocoena*)

- Harbor seal (*Phoca vitulina*)

A small number of Level B takes was requested for all seven species of marine mammals, and a small number of Level A takes was also requested for harbor seals, Steller sea lions, harbor porpoises, humpback whales, and gray whales. All marine mammals are protected under the MMPA; the Cook Inlet beluga whale, the Mexico Distinct Population Segment (DPS) of humpback whales, the Western North Pacific DPS of gray whales, and the western DPS of Steller sea lions are also listed under the ESA of 1973 (35 FR 12222; 73 FR 12024).

Final authorized take numbers for each species are listed in the Project LOA and IHA (pending).

The overall goal of this Monitoring Plan is to comply with the MMPA and ESA during in-water pile installation and removal associated with the CTR Project. Please refer to the LOA and IHA application for detailed information on the CTR Project, potential effects on marine mammals, and a complete list of mitigation measures.

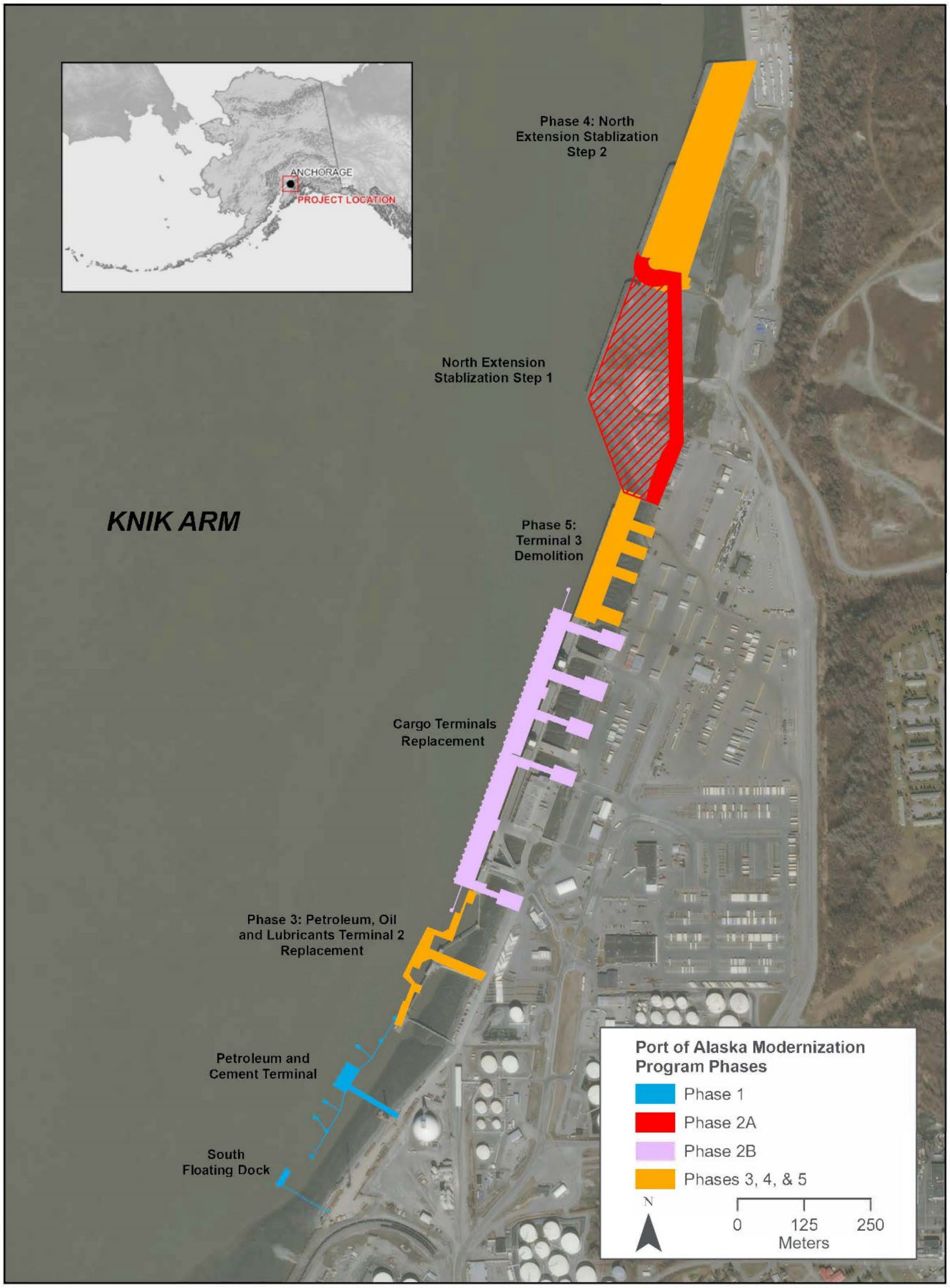


Figure 1-1. Port of Alaska Modernization Program Phases

Section 2. Marine Mammal Monitoring Overview

To minimize impacts of construction noise on marine mammals, Marine Mammal Observers (MMOs; sometimes called Protected Species Observers or PSOs) will be on-site during all in-water pile installation and removal associated with the CTR Project. MMOs will search for, monitor, document, and track marine mammals around and within the Level A and Level B harassment zones and the 100-meter minimum shutdown zone (Section 3.2.1).

It is anticipated that in-water CTR construction activities will begin in April 2026 and extend through 31 March 2032. These dates are estimates and may shift as contracting details, starting dates, ice-free conditions, production rates, and other factors vary. Construction dates also may change because of unexpected Project delays.

2.1 Marine Mammal Observer Qualifications and Training

All MMOs will undergo Project-specific training, which will include training in monitoring, data collection, theodolite operation, and mitigation procedures specific to the CTR Project. This training will also include site-specific health and safety procedures, communication protocols, and supplemental training in marine mammal identification and data collection. Training will include hands-on use of required field equipment to ensure that all equipment is working and MMOs know how to use it correctly.

All MMOs must be capable of spotting and identifying marine mammals and documenting applicable data during all types of weather, including rain, sleet, snow, and wind. At a minimum, all MMOs must have or meet the following qualifications:

- Ability to act as independent MMOs (i.e., not construction personnel) who have no other assigned tasks during monitoring periods.
- Ability to conduct field observations and collect data according to assigned protocols.
- Experience or training in the field identification of marine mammals, including the identification of behaviors.
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
- Ability to observe and record environmental and marine mammal sighting data, including but not limited to the number and species of marine mammals observed; dates and times when in-water Project activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior.
- Ability to communicate orally, by radio or in person, with Project personnel to provide real-time information on marine mammals observed in the area as necessary.

A designated Lead MMO for the entire Project will always be on-site and will remain responsible for implementing the Monitoring Plan for all in-water pile installation and removal. Additionally, each monitoring team will have a designated Lead MMO specific to that station and shift.

In addition to the above required qualifications, the Lead MMO must have education and experience that demonstrate their qualifications to serve as Lead MMO, including the following minimum requirements:

- Prior experience working as an MMO during in-water construction.

- Education in wildlife observation techniques from a university, college, or other formal education program.

The POA will submit MMO curricula vitae (CVs) to NMFS for approval prior to the onset of in-water pile installation or removal. Field experience and/or training may be substituted for a biological degree. NMFS will review submitted MMO CVs and indicate approval as warranted. Approval must be granted by NMFS within 14 days; if no notice is received from NMFS, it will be considered tacit approval.

2.2 Roles and Responsibilities

The Monitoring Coordinator is the individual managing the entire marine mammal monitoring program under the Construction Contractor. A single Point of Contact (POC) will be identified by the Construction Contractor daily on both the MMO and construction crews to provide the lead authority. The single POC for the MMO crew also will be the designated Lead MMO, and for the construction crew will be identified as the Construction Contractor POC. MMOs are responsible for understanding all Project-specific MMPA and ESA requirements. When a marine mammal is sighted approaching or within a Level B or Level A harassment zone, the Lead MMO will contact the Construction Contractor POC to advise them on shutdown protocols to comply with MMPA and ESA requirements. The Construction Contractor POC will assess the in-water pile installation or removal, including safety considerations, to determine if a shutdown will occur immediately. See Section 3.2.2 for more information on shutdown procedures.

2.3 Communication Systems

A clear authorization and communication system will be in place to ensure that MMO and construction crews understand their roles and responsibilities before construction begins. The Construction Contractor POC will communicate to the Lead MMO the locations and numbers of piles that will be installed and removed on a daily basis and describe any other in-water construction activities that are planned for that day. It is important that any changes be communicated from the Construction Contractor POC to the Lead MMO, as this may influence the harassment zone sizes.

Each MMO will be trained and provided with reference materials (i.e., observation and communication protocol) to support standardized communication systems and accurate observations and data collection. MMOs will be in real-time communication with each other and with construction crews to convey information about marine mammal sightings, locations, and directions of movement as well as communicate calls for shutdowns or delays. If the POA is conducting non-CTR-related in-water work that includes MMOs, the CTR Project MMOs will be in contact with those MMOs, and both sets of MMOs will share all information regarding marine mammal sightings with each other.

2.4 Equipment

The following equipment and information will be required on-site for marine mammal monitoring:

- Portable radios for the MMOs to communicate with the Construction Contractor POC and other MMOs.
- Cellular phones and phone numbers for all MMOs, the Monitoring Coordinator, and the Construction Contractor POC.
- Daily tide tables.
- Large-aperture binoculars (25X or better) must be at each outer (northern and southern) station, as well as Ship Creek, or where MMOs feel they are most useful for detecting marine mammals (at least 3 total 25x binoculars).

- Hand-held binoculars (7X or better) with built-in rangefinder or reticles must be at each station (if binoculars do not include rangefinders or reticles, then rangefinders and compasses must be available).
- Theodolites for determining locations and tracking marine mammals must be available at all four MMO stations.
- Electronic data collection system (e.g., Toughbook, iPad, or laptop) at each MMO station and backup paper forms.

2.5 Observation Locations

It is anticipated that the marine mammal monitoring program will be essentially identical to the program implemented for the Petroleum and Cement Terminal (PCT). MMOs will be positioned at the best practical vantage points that are determined to be safe (Figure 2-1). Each of the four locations will be outfitted with an elevated platform constructed on top of a shipping container or a similar base that is at least 8’ 6” high and can support two to three MMOs and their equipment. Each platform must be stable enough to support use of a theodolite and must be located to optimize the MMOs’ ability to observe marine mammals and the applicable harassment and shutdown zones. The additional elevation provided by the platforms will enable better viewing conditions for seeing distant marine mammals than from ground level, and the supporting structure and roof will provide the MMOs with protection from weather. Each station will also have a power source and a protected area or data shack on the platform, where MMOs can record collected data into an electronic system.

The eleven MMOs will work in two- to four-person teams at each observation station. MMOs will have no other construction-related tasks or responsibilities while conducting monitoring for marine mammals.

It is possible that two of the eleven MMOs may be stationed at Port MacKenzie or north of Cairn Point during some pile installation and removal. Areas near Cairn Point or Port MacKenzie have safety, security, and logistical issues, so they may not be feasible; their availability is not known at this time. Cairn Point proper is located on military land and has bear presence, and restricted access does not allow for the location of an observation station at this site. Tidelands along Cairn Point are accessible only during low tide conditions and have inherent safety concerns of being trapped by rising tides. Port MacKenzie is a secure port that is relatively remote, creating safety, logistical, and physical staffing limitations due to lack of nearby lodging and other facilities. The roadway travel time between port sites is approximately 2–3 hours.

An adaptive management measure may be proposed for a monitoring location north of the Project site, once the Construction Contractor has been selected and more detailed discussions can occur. Additional factors for consideration may include rate of takes incurred (high or low) once construction has commenced, or temporary staffing of Port MacKenzie or a northerly monitoring station during peak marine mammal presence time periods.

Figure 2-1. Marine Mammal Monitoring Stations for the CTR Project

Section 3. Marine Mammal Monitoring and Mitigation

The two outer observation stations will monitor the Level B zones. A station at the Anchorage Public Boat Dock at Ship Creek and a station more central to the CTR construction site will focus on monitoring the Level A and shutdown zones. The station at Ship Creek will monitor beluga whale and harbor seal activity at Ship Creek and provide a different vantage point to the CTR construction site. To provide the best view of Ship Creek and to the north, this station will be located as close to the end of the promontory at Ship Creek as possible. MMOs at the Anchorage Downtown Viewpoint station will collect observations of beluga whales at the mouth of Knik Arm and the Point MacKenzie area to determine whether beluga whales are moving into Knik Arm. MMOs at the North End (North Extension) will focus on beluga whales that may be leaving Knik Arm from the north. MMOs will document observed changes of direction or other behaviors. If possible, behaviors will be correlated with construction activities.

MMOs will work in two- to four-person teams at each observation station to increase the probability of detecting marine mammals and to confirm sightings. At least two MMOs will be on watch at each station at any given time, scanning the Level A and Level B harassment zones surrounding in-water pile installation and removal for marine mammals by using large-aperture binoculars (25X), hand-held binoculars (7X), and the naked eye. MMOs will rotate through these three active monitoring methods to reduce eye strain and increase observer alertness, and one MMO will record data on the computer in the data shack, a less-strenuous activity that will provide the opportunity for rest. MMOs will be in real-time communication with each other and with the construction crews to convey information about marine mammal sightings, locations, and directions of movement.

An MMO may observe for no more than 4 hours at a time without a break and no more than 12 hours per day. MMOs will be able to take comfort breaks as needed by each individual. Pile installation and removal is an intermittent activity, and MMOs will be able to take breaks as accommodated by the work schedule and their preferences. Given intermittent Project activity and teams of MMOs at each station, it is unlikely that an MMO would observe 4 hours continuously without a break.

3.1 Pre-activity Monitoring and Startup Procedures

Mitigation measures and startup procedures include the following, modeled after the stipulations outlined in the Final IHA for Phase 1 and Phase 2 Petroleum and Cement Terminal (PCT) construction (85 FR 19294) and South Floating Dock (SFD) construction (86 FR 50057) and listed in Section 11 of the IHA and LOA application:

- The POA will conduct briefings for construction supervisors and crews, the monitoring team, and POA staff prior to the start of all in-water pile installation and removal, and when new personnel join the work, in order to explain responsibilities, communication procedures, the marine mammal monitoring protocol, and operational procedures.
- Marine mammal monitoring will take place from 30 minutes prior to initiation of in-water pile installation and removal through 30 minutes post-completion of pile installation and removal.
- For beluga whales, the Level B zone for in-water pile installation and removal must be fully visible for 30 minutes before the zone can be considered clear of beluga whales. Pile installation and removal will commence when MMOs have declared the Level B zone clear of beluga whales or the mitigation measures developed specifically for beluga whales (below) are satisfied.

- For species other than beluga whales, in-water pile installation and removal will not commence until the Level A zone is clear of marine mammals for 15 minutes.
- In the event of a delay or shutdown of activity, marine mammal behavior will be monitored and documented until the marine mammals leave the shutdown zones of their own volition, at which time pile installation or removal will commence or recommence.
- All MMO observations of in-water pile installation and removal will occur between civil dawn and civil dusk.

3.2 During Activity Monitoring and Shutdown Procedures

The following activity monitoring and shutdown procedures were modeled after the stipulations outlined in the Final IHA for Phases 1 and 2 PCT construction (85 FR 19294) and SFD construction (86 FR 50057) and listed in Section 11 of the LOA application:

- For in-water construction, including heavy machinery activities other than pile installation and removal (e.g., use of barge-mounted excavators or dredging), if a marine mammal comes within 10 meters, the POA will cease operations and reduce vessel speed to the minimum level required to maintain steerage and safe working conditions.
- The POA will use soft start techniques when impact pile driving. A soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, followed by two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day's impact pile driving, any time impact pile driving has been shut down or delayed due the presence of a marine mammal, or at any time following cessation of impact pile driving for a period of thirty minutes or longer.
- On a given day, if marine mammal monitoring ceases but in-water pile installation and removal is scheduled to resume, MMOs will follow the pre-pile driving monitoring protocol as described above, including a 30-minute clearance scan of the Level B zone for beluga whales.
- If a species other than a beluga whale is observed entering or within an established Level A zone or shutdown zone, in-water pile installation and removal will be halted or delayed; or a potential Level A exposure (take) will be documented. Pile installation or removal will continue until the species other than a beluga whale approaches the relevant shut-down zone, and will cease before the animal crosses the shutdown isopleth. In-water pile installation and removal will not commence or resume until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone and on a path away from such zone, or 15 minutes have passed without subsequent detections.
- A minimum 100-meter shutdown zone will be implemented for all marine mammals, if larger than the calculated Level A zones. Larger shutdown zones will be implemented as calculated.
- If a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized takes are met, is observed approaching or within the Level B zone, in-water pile installation and removal will shut down immediately. In-water pile installation and removal will not resume until the animal has been confirmed to have left the area or the 30 minutes have elapsed.
- In-water pile installation and removal delay and shutdown protocol for Cook Inlet beluga whales (but not other species of marine mammals) includes the following:
  - Prior to the onset of in-water pile installation and removal, should a beluga whale(s) be observed within the Level B zone, in-water pile installation or removal will be delayed. In-water pile installation and removal will not commence until the animal has voluntarily traveled at least 100

meters beyond the Level B harassment zone and is on a path away from such zone, or the beluga whale has not been re-sighted within 30 minutes.

- If in-water pile installation or removal has commenced, and a beluga whale(s) is observed within or likely to enter the Level B harassment zone, in-water pile installation or removal will be delayed. In-water pile installation and removal will not commence until the animal has voluntarily traveled at least 100 meters beyond the Level B harassment zone and is on a path away from such zone, or the beluga whale has not been re-sighted within 30 minutes.
- If, during in-water installation and removal of piles, MMOs can no longer effectively monitor the entirety of the beluga whale Level B shutdown zone due to environmental conditions (e.g., fog, rain, wind), in-water pile installation and removal will continue only until the current segment of pile is driven; no additional sections of a pile or additional piles may be installed or removed until conditions improve such that the monitoring zone can be effectively monitored. If the Level B harassment zone cannot be monitored for more than 15 minutes, the entire Level B harassment zone will be cleared again for 30 minutes prior to in-water pile installation and removal.

3.2.1 Harassment and Shutdown Zones

Distances to the harassment thresholds, as defined by sound isopleths for in-water pile installation and removal, vary by functional hearing group (Level A only), pile size, duration of installation and removal, and pile installation method. Methods used to estimate distances to the Level A and Level B harassment isopleths for the CTR Project are outlined in the IHA application. Table 3-1 provides distances to Level A and Level B harassment zones and shutdown zones that will be used for the CTR Project. Figures illustrating the corresponding Level A and Level B harassment zones in Table 3-1 can be found in Attachment A.

The Level B zone for beluga whales will be implemented as the shutdown zone (Table 3-1).

The POA will avoid and minimize Level A take by implementing a minimum 100-meter shutdown zone for all species other than beluga whales and all combinations of pile sizes and hammers. Level A take is being requested for Steller sea lions, harbor seals, harbor porpoise, gray whales, and humpback whales; however, the 100-meter minimum shutdown zone will avoid some exposure of marine mammals to sound levels that could reach the Level A threshold. Although every effort will be made to shut down before marine mammals enter the 100-meter zone, if the Level A isopleth for a species is smaller than 100 meters, potential Level A take of that species would not occur unless individuals move across their respective Level A isopleths as defined in Table 3-1.

Note that Level A take has both a location and time component. Simply crossing the Level A harassment isopleth does not cause a Level A take; the animal must be present in the Level A zone for a specified amount of time before a Level A take can occur. If a marine mammal crosses a Level A isopleth, how long the animal was present in the zone as well as the shutdown time will be documented to determine if a Level A exposure (take) may have occurred.

Table 3-1. Rounded Level A and B Harassment and Shutdown Zones based on Project Activities

Pile Size	Hammer Type	Number of Piles (Duration in Minutes or Strikes per Pile) Per Day	Minimum Shutdown and Level A Zones (m)												Level B Zone (m)
			LF		MF				HF		PW		OW		
			Humpback and Gray Whale		Beluga Whale		Killer Whale		Harbor Porpoise		Harbor Seal		Steller Sea Lion		All Species Except Beluga Whale
			Level A Take Authorized		No Take		No Level A Take		Level A Take Authorized		Level A Take Authorized		Level A Take Authorized		
			Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	
24-inch installation	Vibratory (Unattenuated)	4 (30 minutes)	100	11	2,250	2	100	2	100	16	100	7	100	1	2,250
24-inch installation	Vibratory (Attenuated)	4 (30 minutes)	100	8	2,630	1	100	1	100	11	100	5	100	1	2,630
24-inch removal	Vibratory (Unattenuated)	4 (45 minutes)	100	37	5,970	5	100	5	100	53	100	24	100	3	5,970
24-inch removal	Vibratory (Attenuated)	4 (45 minutes)	100	8	2,100	1	100	1	100	12	100	5	100	1	2,100
36-inch installation	Vibratory (Unattenuated)	4 (30 minutes)	100	22	4,520	3	100	3	100	31	100	14	100	2	4,520
36-inch installation	Vibratory (Attenuated)	4 (30 minutes)	100	11	3,580	1	100	1	100	15	100	7	100	1	3,580
36-inch removal	Vibratory (Unattenuated)	4 (45 minutes)	100	11	1,700	2	100	2	100	15	100	7	100	1	1,700
36-inch removal	Vibratory (Attenuated)	4 (45 minutes)	100	5	1,320	1	100	1	100	8	100	3	100	1	1,320
72-inch installation	Vibratory (Attenuated)	3 (10 minutes)	100	7	6,120	1	100	1	100	11	100	5	100	1	6,120
144-inch installation	Vibratory (Attenuated)	1 (15 minutes)	100	1	1,140	1	100	1	100	2	100	1	100	1	1,140
24-inch installation	Impact (Unattenuated)	1 (1000 strikes)	500	735	1,600	27	100	27	500	876	100	394	100	29	1,600

Pile Size	Hammer Type	Number of Piles (Duration in Minutes or Strikes per Pile) Per Day	Minimum Shutdown and Level A Zones (m)												Level B Zone (m)
			LF		MF				HF		PW		OW		
			Humpback and Gray Whale		Beluga Whale		Killer Whale		Harbor Porpoise		Harbor Seal		Steller Sea Lion		All Species Except Beluga Whale
			Level A Take Authorized		No Take		No Level A Take		Level A Take Authorized		Level A Take Authorized		Level A Take Authorized		
			Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	Shutdown Zone	Level A Zone	
24-inch installation	Impact (Attenuated)	1 (1000 strikes)	100	251	550	9	100	9	100	299	100	135	100	10	550
36-inch installation	Impact (Unattenuated)	1 (1000 strikes)	500	1,165	1,590	42	100	42	500	1,387	100	624	100	46	1,590
36-inch installation	Impact (Attenuated)	1 (1000 strikes)	100	398	550	15	100	15	100	474	100	213	100	16	550
72-inch installation	Impact (Unattenuated)	1 (5,743 strikes)	500	10,936	7,360	389	400	389	500	13,026	100	5,853	100	427	7,360
72-inch installation	Impact (Attenuated)	1 (5,743 strikes)	500	3,734		133	140	133	500	4,448	100	1,999	100	146	
72-inch installation	Impact (Attenuated)	2 (5,743 strikes)	500	5,928	2,520	211	220	211	500	7,061	100	3,173	100	231	2,520
72-inch installation	Impact (Attenuated)	3 (5,743 strikes)	500	7,767		277	280	277	500	9,252	100	4,157	100	303	
144-inch installation	Impact (Unattenuated)	1 (5,000 strikes)	500	29,201	18,500	1,039	1,100	1,039	500	34,782	100	15,627	100	1,138	18,500
144-inch installation	Impact (Attenuated)	0.5 (5,000 strikes)	500	8,539	13,600	304	310	304	500	10,171	100	4,570	100	333	13,600
144-inch installation	Impact (Attenuated)	1 (5,000 strikes)	500	13,554		483	500	483	500	16,145	100	7,254	100	529	

Note: HF = high-frequency; LF = low-frequency; m = meters; MF = mid-frequency; OW = otariid in water; PW = phocid in water.

3.2.2 Shutdown Procedures

If a marine mammal that is not a beluga whale is traveling along a trajectory that could take it into the Level B harassment zone, the Lead MMO will notify the Construction Contractor POC, who will decide to either (1) immediately shut down all in-water pile installation and removal before the marine mammal enters the Level B harassment zone, thereby avoiding a take (shutdown will occur for all marine mammals for which Level B take was not authorized under the LOA and IHA); or (2) document the marine mammal as a take upon its entry into the Level B harassment zone. For safety and operational reasons, the immediate shutdown of in-water pile installation or removal may not be possible. The MMOs will document the reason(s) behind each shutdown or non-shutdown decision. However, if in-water pile installation or removal has commenced, and a beluga whale(s) is observed within or likely to enter the Level B harassment zone, an MMO will call for a shutdown. Pile installation or removal will shut down as soon as possible, as long as the Construction Contractor POC deems the situation safe to do so, and will not re-commence until the whale(s) is out of and on a path away from the Level B harassment zone or until no beluga whale(s) has been observed in the Level B harassment zone for 30 minutes immediately prior to resumption of in-water pile installation and removal. The Project will avoid Level B take of beluga whales to the maximum extent possible. Exceptions that may cause a nominal delay in shutting down could include concerns for human safety or imminent equipment damage. See the CTR LOA and IHA application for an explanation of anticipated safety concerns.

If the Construction Contractor POC decides to continue in-water pile installation or removal while a non-beluga marine mammal is within the Level B harassment zone, that pile segment will be completed without cessation and a potential Level B exposure or take will be recorded. The determination of Level A or Level B take will not be made in the field by the MMOs. Potential takes will be documented and reported to NMFS.

The MMOs will determine when a marine mammal(s) has left the harassment zone or has not been resighted for a period of 15 minutes (non-beluga whales) or 30 minutes (beluga whales) and will determine when in-water pile installation and removal may recommence.

In-water pile installation and removal will take place only when the Level B harassment zones can be adequately monitored. If, during in-water pile installation or removal, MMOs can no longer effectively monitor waters within the Level B harassment zone for the presence of marine mammals due to environmental conditions (e.g., fog, rain, wind), in-water pile installation and removal may continue only until the current segment of pile is driven; no additional sections of a pile or additional piles may be driven until conditions improve such that the Level B harassment zone can be effectively monitored. If pile driving ceases for more than 15 minutes, the entire Level B zone must be cleared as in the condition above.

If a marine mammal comes within 10 meters of in-water, heavy machinery, or work other than in-water pile installation or removal (e.g., standard barges, tugboats, skiffs), operations will cease, and vessels will reduce speed to the minimum level required to maintain steerage and safe working conditions. Construction crew members can enforce this shutdown zone.

The Lead MMO and the Port Construction Manager will maintain a running tally of all takes that occur for each species. If the project reaches 80 percent of its allotted take for any species, NMFS will be notified for discussion and guidance. At such time, NMFS and the POA will develop an adaptive management strategy to manage the remaining number of authorized take. If a species for which authorization of take has not been granted, or a species for which authorization has been granted but the authorized takes are met, is observed approaching or within the Level B zone (Table 3-1), in-water pile installation and removal will shut down immediately. In-water pile installation and removal will not resume until the animal has been confirmed to have left the area or 30 minutes have elapsed.

3.3 Post-activity Monitoring

Monitoring of the Level A and Level B harassment zones will continue during pile installation and removal. Once pile installation and removal are completed for the day, marine mammal observations will continue for 30 minutes. Data collection will indicate whether the marine mammal(s) were still present in the area when marine mammal monitoring was completed.

3.4 Data Collection

Data regarding environmental conditions, marine mammal sightings, communication with the Construction Contractor POC, and in-water Project activities will be collected electronically through a computerized software system. Hardcopy paper forms (see Attachment B for examples) will be available in case there are technical difficulties with equipment. Data entry will be checked for quality assurance and quality control by the Lead MMO daily. As previously stated, NMFS data collection best practices and definitions for standardizing data collection and entry for Cook Inlet beluga whale sightings have been incorporated into this Monitoring Plan. Because other marine mammals besides beluga whales are likely to be sighted during the CTR Project, definitions are expanded upon to include behaviors from all marine mammal species.

3.4.1 Environmental Conditions, Project Activities, and Communication

The MMOs will document monitoring efforts, environmental conditions, types of Project activities, and communications between MMOs, hydroacoustic personnel, and construction personnel. MMOs will document the start and stop times of all monitoring efforts. Environmental conditions will be documented at the beginning and end of every monitoring period and every 30 minutes, or as conditions change. Data collected will include MMO names, location of the observation station, time and date of the observation, weather conditions, air temperature, sea state, cloud cover, visibility, glare, tide, and ice coverage (if applicable). See Table 3-2 for more information on each of these attributes.

The MMOs will document Project activities, including size of pile, method of in-water pile installation and removal, whether a bubble curtain was used, and time of startup (or soft start) and shutdown. All shutdowns of in-water pile installation and removal will be documented, including the reason for each shutdown. MMOs will also document other, non-Project-related activities that could disturb marine mammals in the area, such as the presence of vessels or aircraft. The Lead MMO and the Construction Contractor POC will communicate information regarding startups, shutdowns, and marine mammal sightings.

Table 3-2. Environmental, Project Activities, and Communication Data Attributes

Data Attribute	Attribute Definition and Units Collected
Monitoring effort (start and end times)	Format 24-hour clock, which covers the entire amount of monitoring in a given day. If there is a break in the middle of the day when monitoring does not occur, the end time should be recorded. After the break, a new data sheet should be used to record the new monitoring effort start and end times
Observers' names	Provide the full names of the MMOs
Environmental Conditions (collected every 30 minutes or when conditions change)	
Overall conditions	Scale 1 to 10; 1= poor, 5 = moderate, 10 = excellent
Weather conditions	Sunny (S), partly cloudy (PC), light rain (LR), steady rain (SR), fog (F), overcast (OC), light snow (LS), snow (SN)
Light conditions	Light, twilight, dark

Table 3-2. Environmental, Project Activities, and Communication Data Attributes

Data Attribute	Attribute Definition and Units Collected
Monitoring effort (start and end times)	Format 24-hour clock, which covers the entire amount of monitoring in a given day. If there is a break in the middle of the day when monitoring does not occur, the end time should be recorded. After the break, a new datasheet should be used to record the new monitoring effort start and end times.
Observers' names	Provide the full names of the MMOs.
Environmental Conditions (collected every 30 minutes or when conditions change)	
Overall conditions	Scale 1 to 10; 1= poor, 5 = moderate, 10 = excellent
Weather conditions	Sunny (S), partly cloudy (PC), light rain (LR), steady rain (SR), fog (F), overcast (OC), light snow (LS), snow (SN)
Light conditions	Light, twilight, dark
Air temperature	Celsius
Wind speed	Knots
Wind direction	From the north (N), northeast (NE), east (E), southeast (SE), south (S), southwest (SW), west (W), northwest (NW)
Sea state	(0) Mirror-like, calm; (1) ripples (up to 4 inches) without foam crests; (2) small wavelets (up to 8 inches); (3) large wavelets (up to 2 feet), perhaps scattered white horses; (4) small waves (up to 3 feet), fairly frequent white horses; (5) moderate waves (up to 6 feet)
Cloud cover	0–100%; percentage of cloud cover
Glare	0–100%; percentage of water obstructed by glare and grid cells affected by glare or the direction of glare
Tide	Predicted hourly data information gathered from National Oceanic and Atmospheric Administration will be available on site and reported in the 90-Day Technical Report
Ice coverage	0–100%; percentage of ice cover and type of ice (no ice present, new, brash, or pancake ice and floes)
Other activity	Number, type, and general location of vessels or other sources of in-water disturbance
Project and Communication Activities	
Time of communication or project activity	Time that in-water project activities and all communications between MMOs and construction crews take place
Type of project activity and duration	Soft start, shutdown, impact pile installation, vibratory pile installation or removal, all pile work start and stop times, and sound attenuation method used. If shutdown occurs, document the reason for the shutdown.
Use of a bubble curtain and type	Type of bubble curtain; times it is turned on and off
Individuals communicating	Names of individuals involved in any communication
Communication	Information communicated between the Lead MMO and Construction Contractor POC

3.4.2 Sightings

All marine mammals observed will be documented. The data collected will include a unique group identifier specific to that day, start and end times of the sighting, species sighted, number of individuals (group size), age class, color classification (only for beluga whales), behavior and movement, distance at first observation from active pile work, location of active pile work, closest observed distance from Project activities, type of in-water Project activity at the time of sighting, and whether and when in-water pile installation or removal was stopped in response to the sighting (see Table 3-3). The MMO will also note observed behavior changes that may be due to Project activities.

A color classification system will be used for beluga whales only. Beluga whales will be documented as white, gray, dark gray calf, or dark gray neonate. This color classification will help estimate the age class of each animal. Adults are typically white, juveniles are generally gray, and calves/neonates are dark gray; however, the age at which a beluga whale’s color matures to white is variable. The proximity of calves to the mother will also be documented. Calves, especially neonates, typically remain in direct contact with the mother. When known, sex and age classes for all other marine mammals will be documented.

The use of a surveyor’s theodolite will be the primary method to track marine mammals once they have been observed. The theodolite will be connected directly to the electronic data collection application or software system. The software system will use the data collected (horizontal and vertical angles to each individual or group of marine mammals) from the theodolite to determine the distance between the marine mammals and the Project activity, and their positions relative to the Level A and Level B harassment zones. The software system will also have the ability to determine the geographic location of a group of marine mammals by entering the reticles and bearing, to be used as a backup if the theodolite is malfunctioning. The MMOs will continue to track or focal-follow the marine mammals’ movements using the theodolite during the entire sighting period and while the marine mammals remain within the harassment zones. Locations will be measured every 5–15 minutes or when the animal’s direction of movement or behavior changes.

The MMO will also track the marine mammals’ behavior with every sighting of the group, including perceived reactions caused by CTR Project activities or other human activities in the area (see Table 3-4). Potential indicators of negative responses to noise include an individual or group approaching and then leaving, changes in swimming speed or direction, and abrupt dives or dispersal. MMOs will also record group descriptors such as spread, group spread, and formation. Other activity to which the marine mammal could be responding will also be documented when possible.

Hardcopy data forms may be used as a backup to document and track marine mammals if there are equipment difficulties. The use of a 500-meter by 500-meter grid system to track marine mammals is consistent with previous POA monitoring programs. Tracking marine mammals using the theodolite is the preferred method because it is more accurate than the grid system and eliminates manual data entry. If the grid system becomes necessary, MMOs will use binoculars, rangefinders, and landmarks to determine marine mammal locations. The MMO will use a map overlain with a 500-meter by 500-meter grid and the harassment zones for the specific location. The MMO will draw the location of the initial and last sightings, the point of closest approach, and a line to show the path of the animal(s) during the sighting to track marine mammals. The 500-meter by 500-meter grid may also be placed over theodolite tracks during data post-processing and analysis for consistency with previous monitoring programs.

When marine mammals are sighted, MMOs will delegate responsibilities so that one or more MMOs continue to scan the water to identify other marine mammals potentially entering the area, while another MMO continues to monitor and track the first sighting.

Table 3-3. Marine Mammal Observation Data Attributes

Data Attribute	Attribute Definition and Units Collected
Group identification code	Each group of marine mammals will be given a unique group identification code. This group identification code is **not species specific**. This identifier can also be used to identify a group whose location, behaviors, and other variables have changed, requiring the use of multiple datasheets
Time of initial and last sighting	Time the group is initially sighted and last sighted
Time animals entered and exited harassment zones	Time the group entered and exited harassment zones, if applicable
Species observed	Identify species observed: beluga whale, harbor seal, harbor porpoise, Steller sea lion, killer whale, humpback whale, or other species
Sighting cue	First observation behavior or body part: head, fluke, dorsal fin, body, splash, blow, birds feeding, porpoise, or other
Group size	Minimum and maximum number of animals counted; record the count the MMO believes to be the most accurate
Color classification	Beluga whale color classifications: ***White –*** Large, bright white to dull white ***Gray*** - Large (larger than calves), light to medium gray ***Dark gray:*** Calf – Dark gray, relatively small (<2/3 the total length of white belugas), almost always swimming within 1 body length of larger whale Neonate – Newborns (estimated to be hours to days old, based on extremely small size (~1.5 meter [5 feet]), a wrinkled appearance due to the presence of fetal folds, and uncoordinated swimming and surfacing patterns ***Unknown color*** – Any beluga not confidently identified in above categories
Sex and age, if possible	Generally, it will be difficult to make this determination; however, sometimes numbers of females with pups or calves can be determined
Initial and final heading	Cardinal direction animals are headed during initial and last sightings
General pace	Sedate, moderate, or vigorous
Tracking movement and theodolite readings	The movements and changes in locations should be documented for each sighting, including the horizontal and vertical angles used to determine location and distance from in-water project activities
Distances from marine mammal to in-water project activities and observation station	Approximate distance in meters or kilometers from a marine mammal to in-water project activities when initially sighted, at closest approach to activities, and at final sighting
In-water project activities at time of sighting	Type of project activities occurring at time of sighting; indicate shutdown times for pile installation or removal, if shutdown occurs
Other activities at time of sighting	Description of nearby activities occurring at time of sighting, such as presence, number, and activity of vessels nearby
Behavior	Indicate primary and secondary behaviors (see Table 3-4). Primary behavior is the behavior most commonly exhibited by the group; secondary behavior is the next most commonly exhibited behavior of the group
Change in behavior	Describe previous and new behavior and whether the change in behavior is correlated with project activities; record time

Table 3-3. Marine Mammal Observation Data Attributes

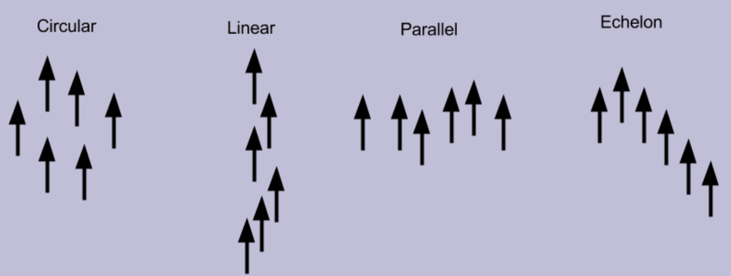
Data Attribute	Attribute Definition and Units Collected
Formation (for beluga whales only)	The formation of the group references how the individual beluga whales are distributed within the group. Enter the formation code that best reflects the distribution pattern of the group: **Circular** (C) – arranged in a circular group while moving in one direction **Parallel** (P) – alongside each other, spread perpendicular to direction of movement **Linear** (L) – forming a line, spread along direction of movement **Echelon** (E) – Arranged diagonally, each beluga whale to the side and behind beluga ahead of it; also includes “V” formation **No Formation** (NF) – Random or un-patterned formation 
Group Spread	The distance in meters or kilometers between the lead whale and the last whale, measured or estimated along the direction of travel.
Spread (for beluga whales only)	The spread of the whales is defined as the mean distance between beluga whales in body lengths (e.g., a spread of 2 indicates that the whales are spaced out, on average, 2 body lengths apart). This may be hard to estimate and may change frequently; MMOs should do their best to choose a representative integer for each sighting
Number of animals taken	Indicate the number of animals potentially exposed to Level A and Level B harassment during the sighting

Table 3-4. Behavior Definitions

Activity	Code	Definition
Avoiding predation	AP	Moving with speed and/or abrupt changes in direction in response to an observed predator
Bubbling	BU	Producing many bubbles while submerged, not including normal subsurface exhalation associated with surfacing
Breach	B	Cetacean leaping or jumping clear of the water
Calving/Birthing	CS	Provide detailed comments to justify use of this code
Diving	D	Moving downward through the water column (rapidly or slowly), often showing tail fluke or hind flippers before dive
Feeding (observed)	FO	Observed with prey in mouth
Feeding (suspected)	FS	Diving, chasing, or pursuing prey or lunging, which suggest foraging; could also be suggested by proxy events (e.g., jumping fish, associating birds and/or seals, etc.)
Mating suspected	MS	Two or more cetaceans or pinnipeds swimming in ventral-to-ventral contact slowly in same direction or rolling around in one place
Milling	M	Moving in a non-linear, weaving, or circular pattern within an area
Porpoising	P	A cetacean or pinniped making low, arching leaps as it travels rapidly near the surface
Resting	R	Floating at or near surface, with little or no movement for several minutes or more with no other suspected behavior
Side scanning	SS	Cetacean swimming (often very slowly) at the surface with lateral aspect (pectoral flipper, tail fluke, or side surface of body) visible, often for 30 seconds; may be followed by explosive prey pursuit
Sink	SI	Seal sinks straight back down underwater, hind flippers first, with upright posture
Snorkeling	SN	Surfacing showing a low profile, with only blowhole, melon, and small portion of dorsal just posterior to blowhole visible. Pinnipeds would have nose and head skimming the water surface
Socializing	S	Interacting with other cetaceans or pinnipeds, indicated by milling, bubbling, tail slapping, physical contact, or audible vocalizations
Spyhopping	SH	Holding body vertically with head out of water for several seconds or more
Startling	ST	Rapidly changing behavior, dispersing, or travelling that indicates a response to external event (not including avoiding predation)
Tail slapping	TS	Hitting tail fluke vigorously against water surface, producing a splash
Tail waving	TW	Holding body vertically with tail out of water for several seconds or more, often slowly waving tail but not tail slapping
Travelling	T	Moving in a linear or near-linear direction without interruption
Vocalizing	V	Snorting, whistling, or chirping
Other	O	Unclassified behavior – must provide a comment
Unknown	U	Behavior indistinguishable due to monitoring conditions and/or lack of ability to watch whale for length of time to determine – no comment is necessary

3.4.3 Quality Assurance (QA) and Quality Control (QC)

Electronic data collection or data sheets will undergo QA/QC review by the Lead MMO at the end of each monitoring day. No cells or information will be left blank. If information is not available or not applicable, the field will be indicated with an "NA" or dash. The data will also undergo QA/QC review once it is entered into the monitoring data collection system (Section 3.4.4).

3.4.4 Marine Mammal Monitoring Database

All marine mammal monitoring data collected will be stored in a database. The database will be set up and structured for easy access and management of data and will be used to develop marine mammal monitoring reports (Section 4.3).

Section 4. Reporting

4.1 Daily Reports

The Contractor Project Manager will provide a daily monitoring summary to the POA Construction Manager that will include a summary of marine mammals sighted and any Project shutdowns.

4.2 Weekly and Monthly Reports

Weekly and monthly reports will be submitted to NMFS' MMPA office for each week and calendar month in which in-water pile installation and removal occurs. Each weekly and monthly report will contain and summarize the following information:

- Monitoring effort (date, start time, end time, duration)
- Marine mammal sightings (date; sighting start and end times; duration of sighting; species; group size; age class or color classification; and behaviors, including any observed behaviors correlated with project activities)
- Marine mammal potential exposures (takes) by species
- In-water activities before and during marine mammal sightings
- Project shutdowns (date, start time, end time, duration, and reason for shutdown)

Revisions to written weekly and monthly reports will not be made. Comments from NMFS or requested revisions to the written reports will be addressed in the annual report for that year. Specific questions will be answered in email form.

4.3 Draft and Final Technical Reports

A draft report, including all electronic data collected and summarized from all monitoring locations, will be submitted to NMFS' MMPA program within 90 days of the completion of monitoring efforts each year. A final marine mammal monitoring report will be prepared and submitted to NMFS within 30 days following receipt of comments on the draft report from NMFS. The final report will include the following information:

- Monitoring effort (date, start time, end time, duration)
- Summary of environmental conditions
- Marine mammal sightings (date; sighting start and end times; duration of sighting; species; group size; age class or color classification; locations relative to pile work; and behaviors, including any observed behaviors correlated with project activities)
- Marine mammal potential exposures (takes) by species
- In-water activities before and during marine mammal sighting
- Project shutdowns (date, start time, end time, duration, and reason for shutdown)
- Number of days of observations
- Lengths of observation periods
- Locations of observation station(s) used and dates of when each location was used
- Numbers, species, dates, group sizes, and locations of marine mammals observed

- Distances to marine mammal sightings, including closest approach to construction activities
- Descriptions of any observable marine mammal behavior in the Level A and Level B harassment zones
- Times of shutdown events, including when work was stopped and resumed due to the presence of marine mammals or other reasons
- Descriptions of the type and duration of any pile installation work occurring, and soft start procedures used while marine mammals were being observed
- Details of all shutdown events, and whether they were due to presence of marine mammals, inability to clear the hazard area due to low visibility, or other reasons
- Tables, text, and maps to clarify observations

4.4 Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified activity (pile installation and removal) clearly causes the take of a marine mammal for which authorization has not been granted, such as a potential Level A take of a beluga whale, the POA will immediately cease in-water pile installation and removal and report the incident to the Office of Protected Resources (301-427-8401) and NMFS. The report will include the following information:

- Time, date, and location (latitude/longitude) of the incident
- Detailed description of the incident
- Description of vessel involved (if applicable), including the name, type of vessel, and vessel speed before and during the incident
- Status of all sound source use in the 24 hours preceding the incident
- Environmental conditions (wind speed and direction, wave height, cloud cover, and visibility)
- Description of marine mammal observations in the 24 hours preceding the incident
- Species identification, description, and fate of animal(s) involved
- Photographs or video footage of animals or equipment (if available)

In-water pile installation and removal will not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with the POA to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The POA may not resume in-water pile installation and removal until notified by NMFS' MMPA program via letter, email, or telephone.

If the POA discovers a stranded, injured, or dead marine mammal, regardless of the cause, the POA will immediately report the incident to the Alaska Marine Mammal Stranding Hotline (877-925-7773).

The report will include applicable information listed above. If the cause of stranding, injury, or death is unknown, activities may continue while NMFS reviews the circumstances of the incident. NMFS would work with the POA to determine whether modifications to the activities are appropriate.

Attachment A
Level A and Level B Harassment Zones

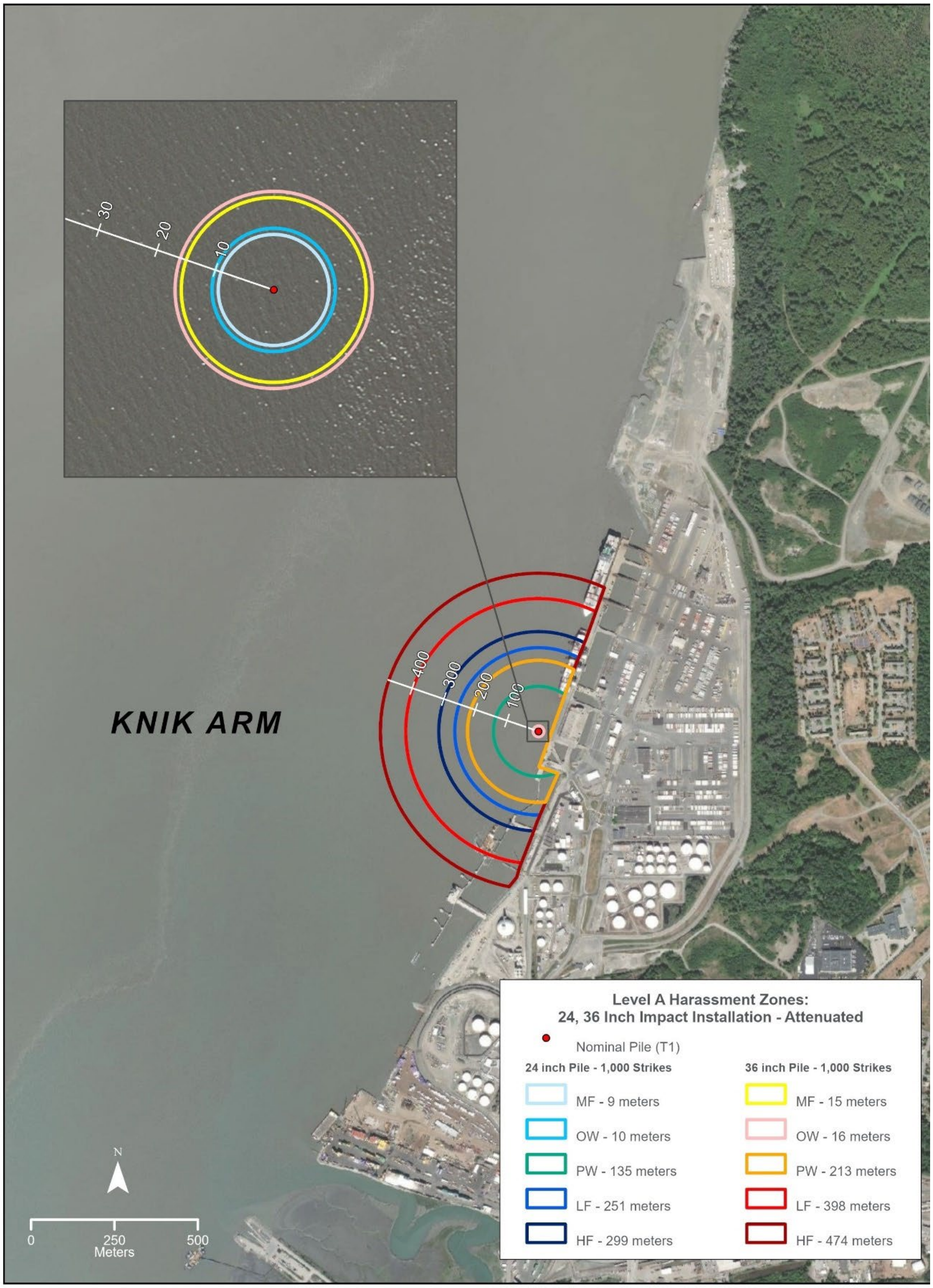


Figure A-1. Level A Harassment Isopleths for Impact Installation of 24 and 36-Inch Piles (Attenuated) for Production Rate of 1 Pile per Day

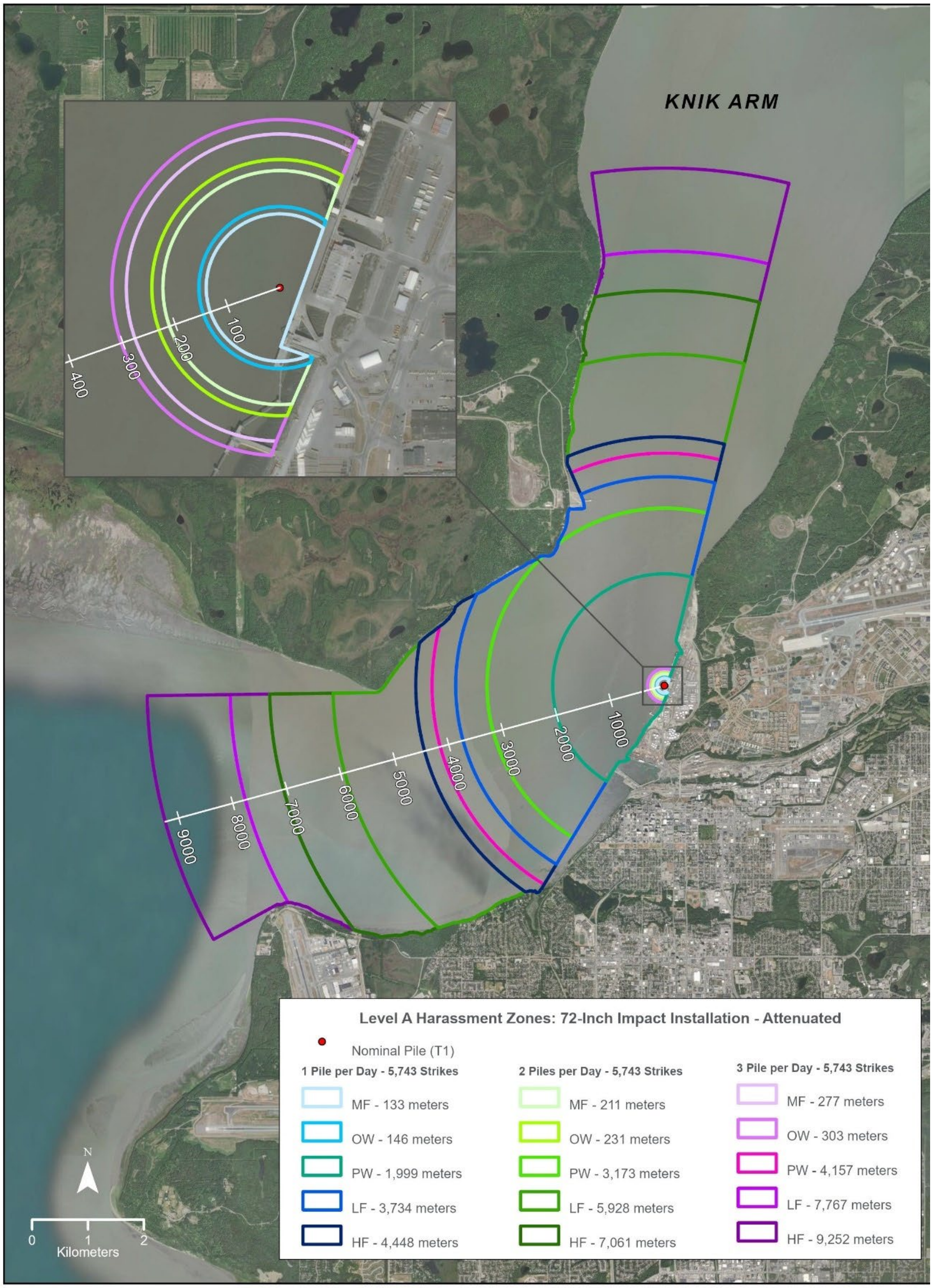


Figure A-2. Level A Harassment Isopleths for Impact Installation of 72-Inch Piles (Attenuated) for Production Rate of 1-3 Piles per Day

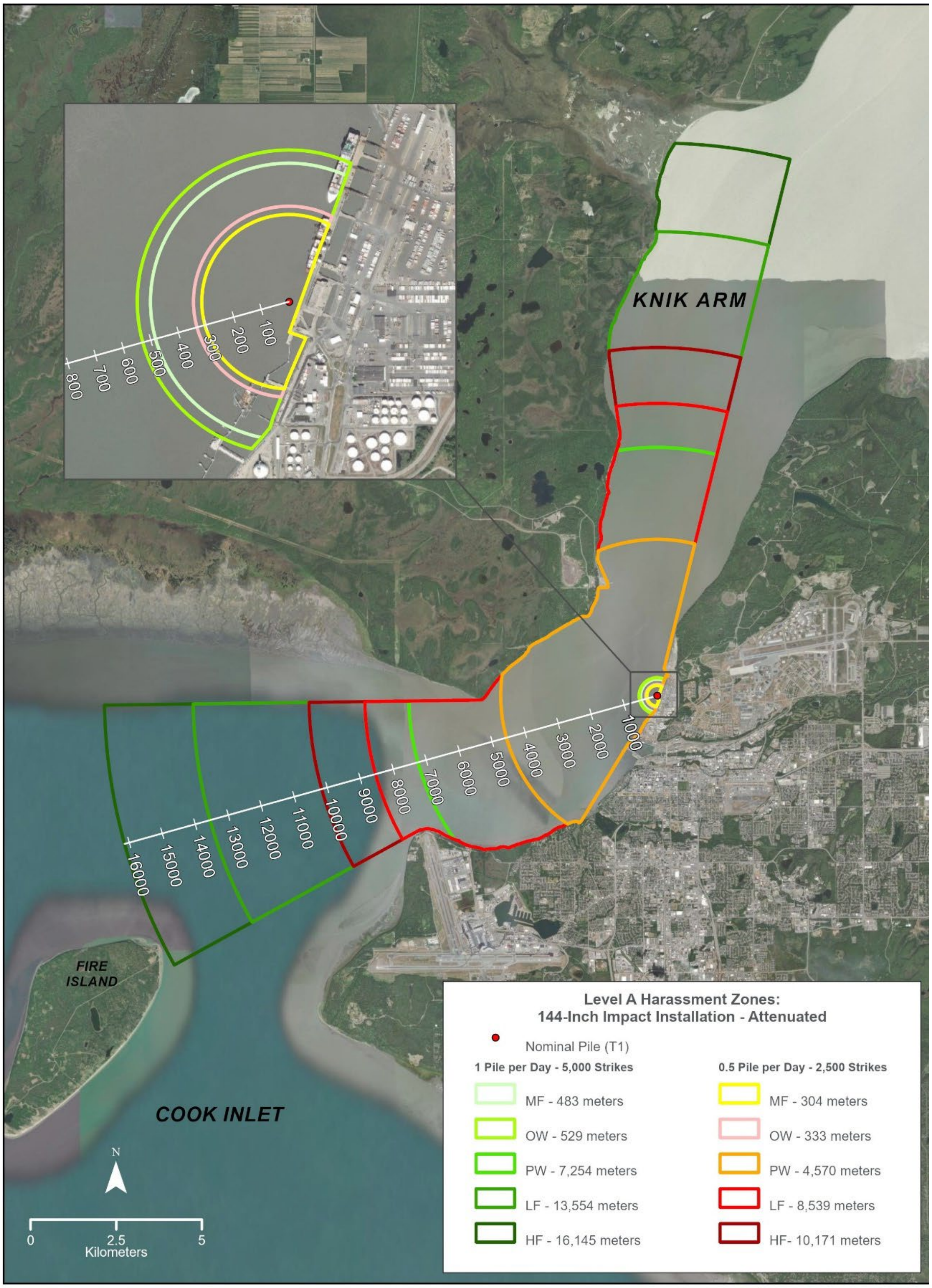


Figure A-3. Level A Harassment Isopleths for Impact Installation of 144-Inch Piles (Attenuated) for Production Rate of 0.5 or 1 Pile per Day

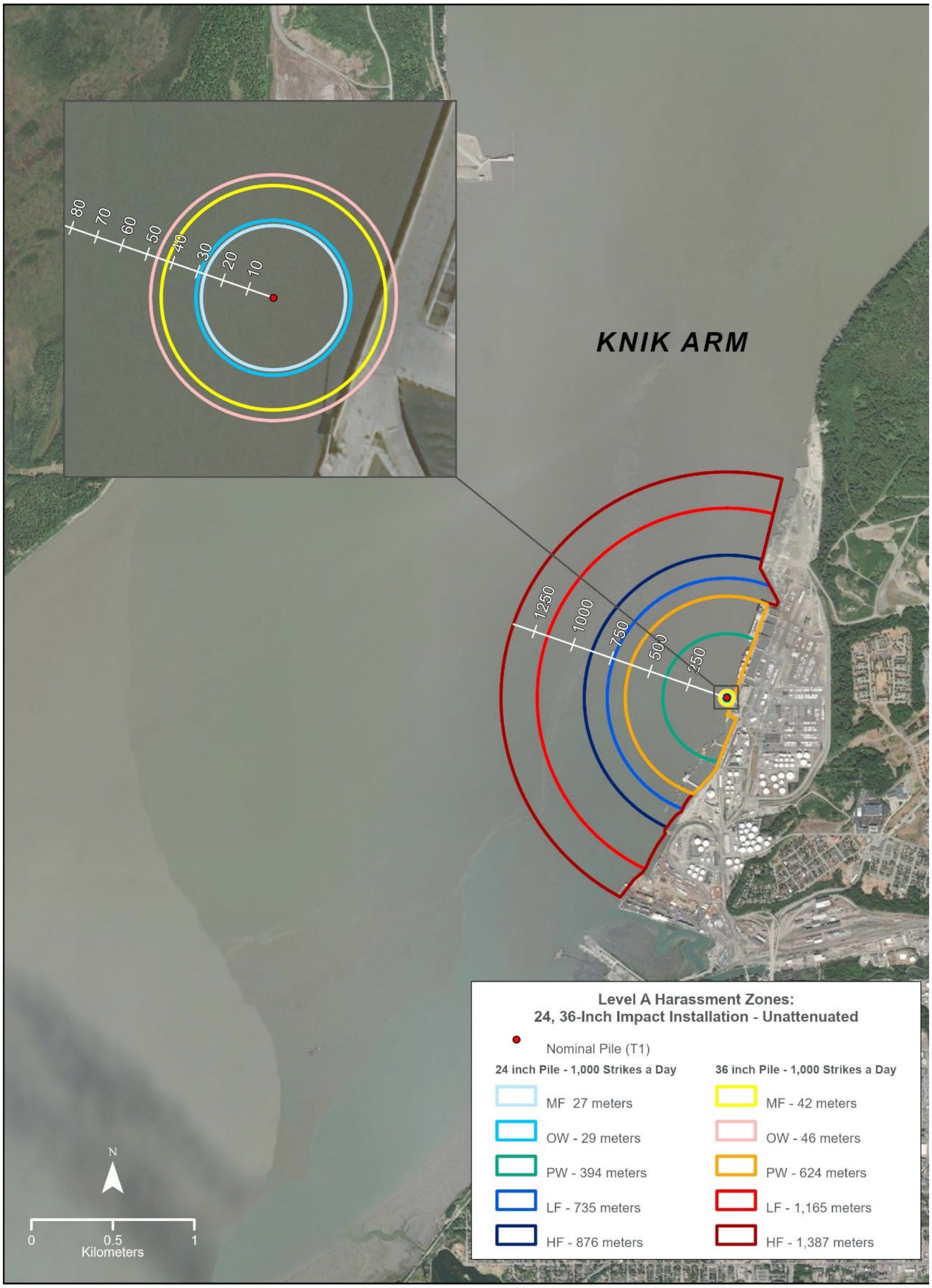


Figure A-4. Level A Harassment Isopleths for Impact Installation of 24 and 36-Inch Piles (Unattenuated) for Production Rate of 1 Pile per Day

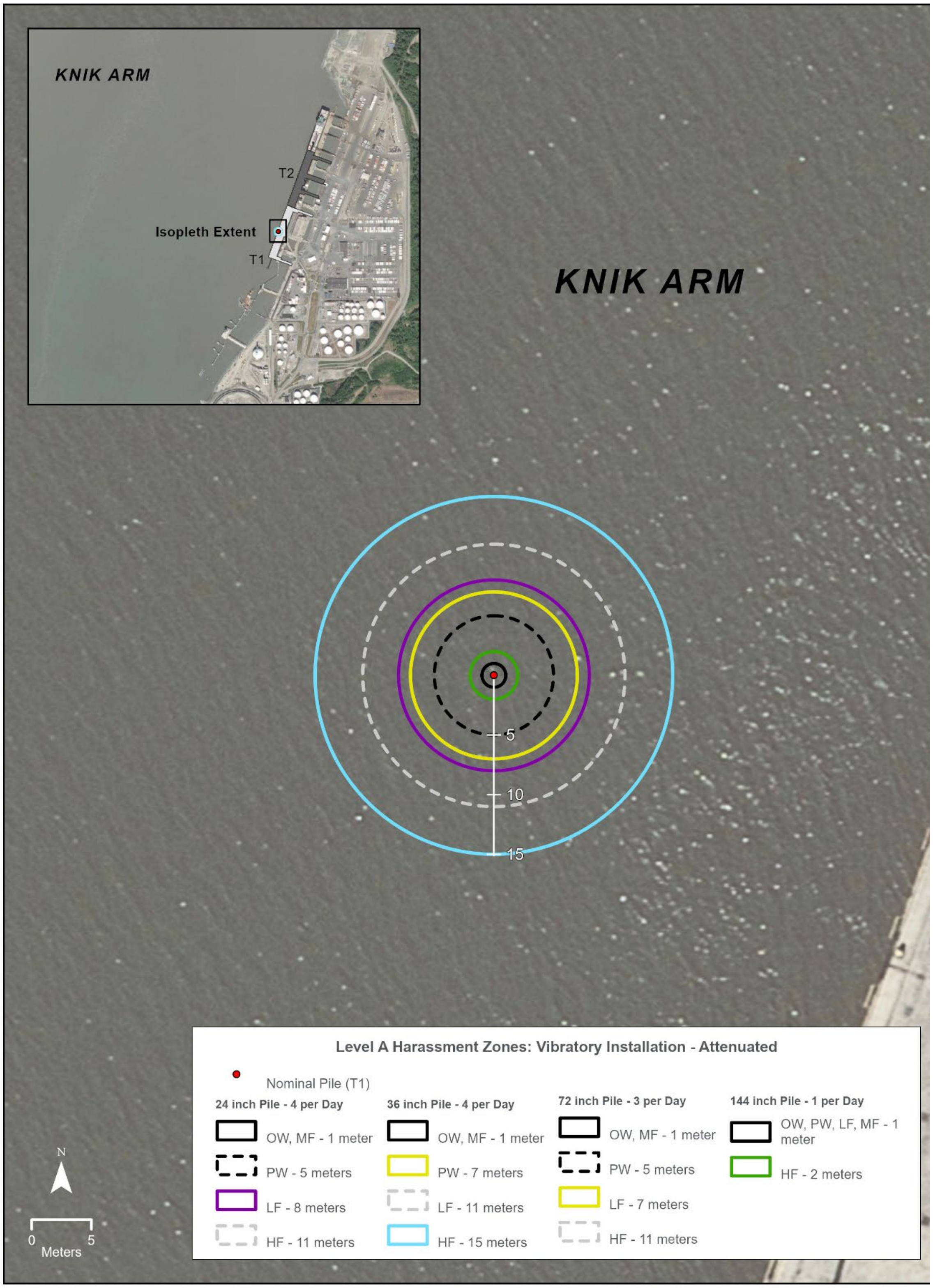


Figure A-5. Level A Harassment Isopleths for Vibratory Pile Installation (Attenuated)

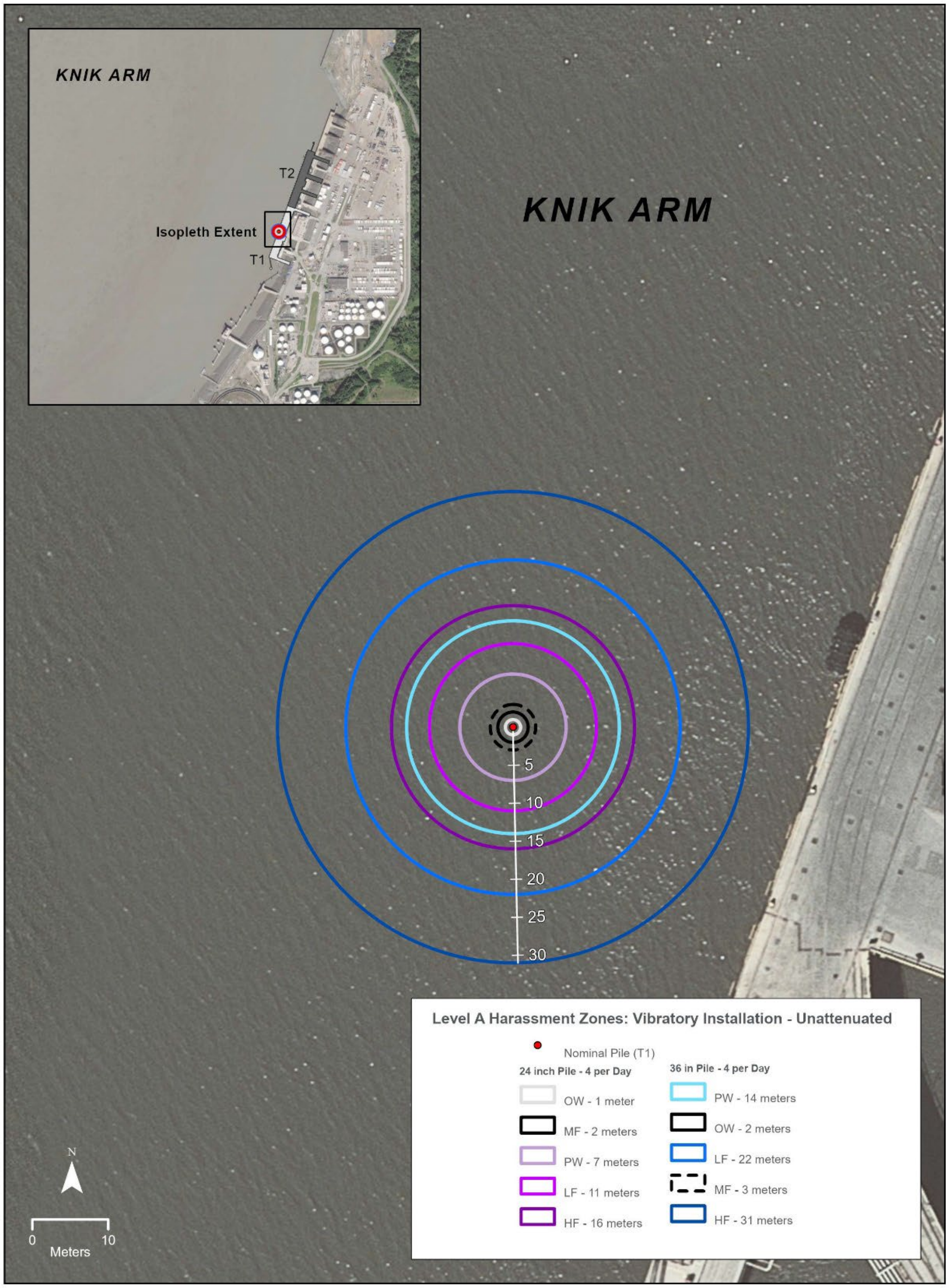


Figure A-6. Level A Harassment Isopleths for Vibratory Pile Installation (Unattenuated)

Figure A-7. Level A Harassment Isopleths for Vibratory Pile Removal (Attenuated)

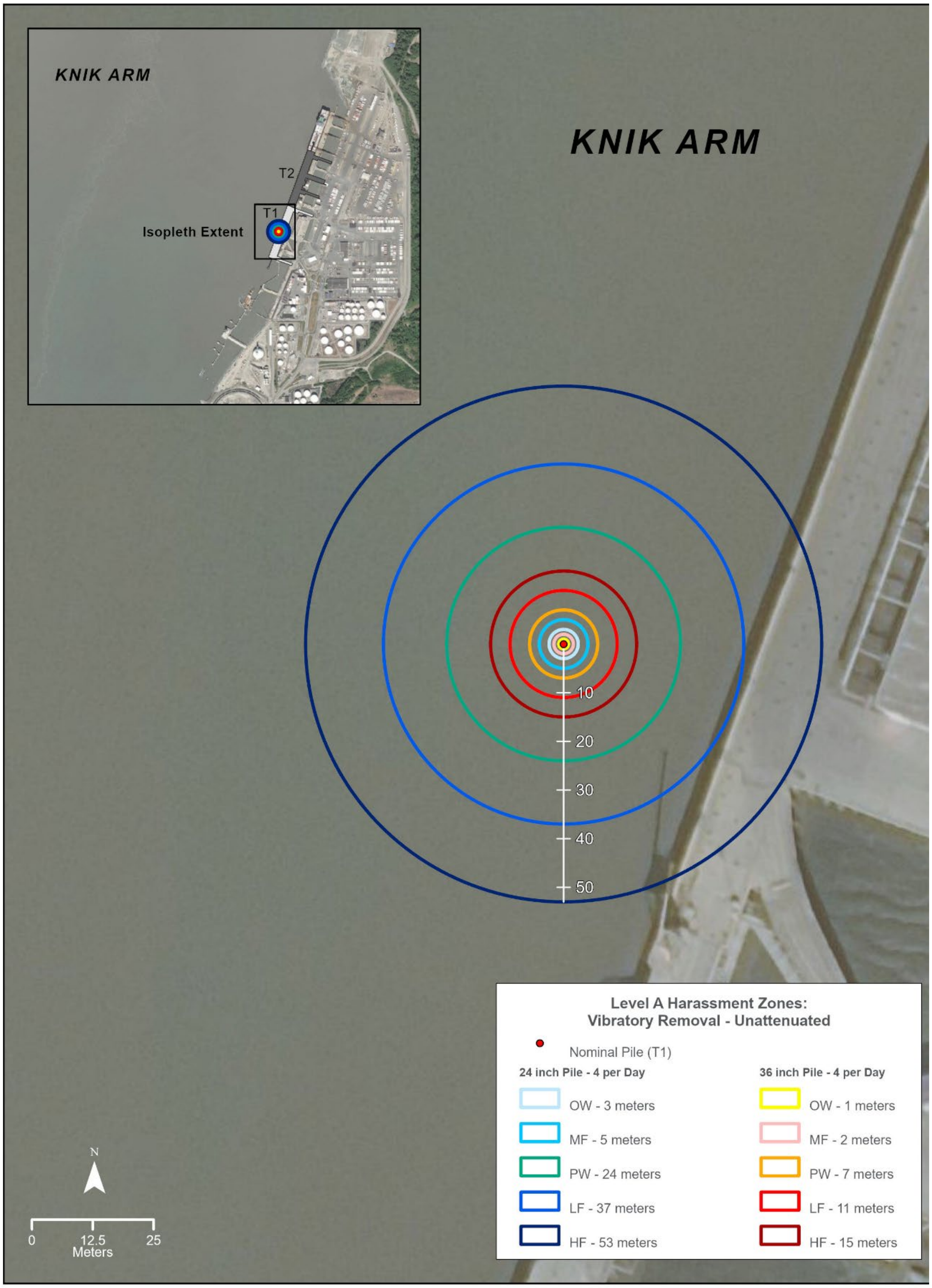


Figure A-8. Level A Harassment Isopleths for Vibratory Pile Removal (Unattenuated)

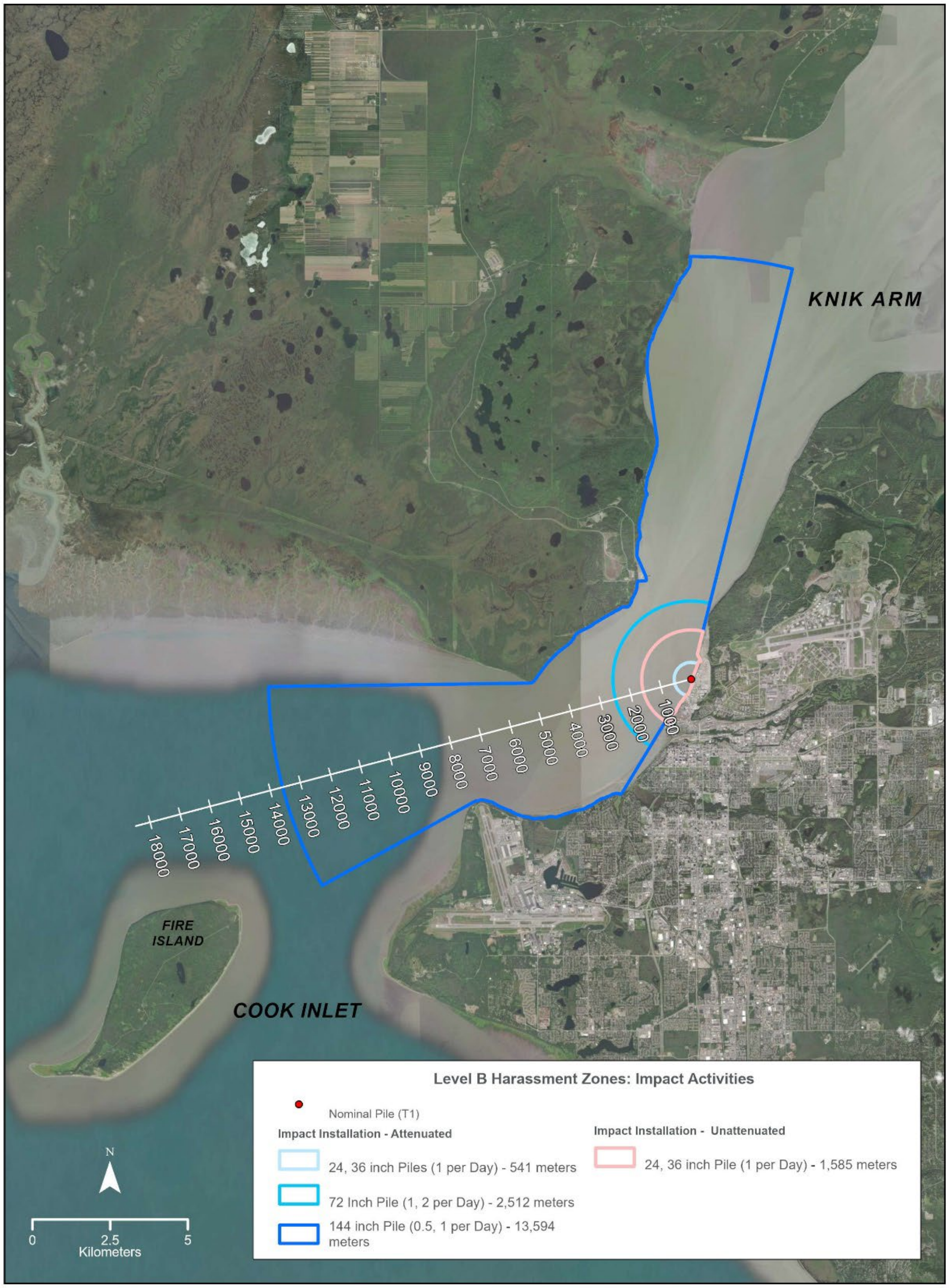


Figure A-9. Level B Harassment Isopleths for All Pile Sizes for Impact Installation (Attenuated and Unattenuated)

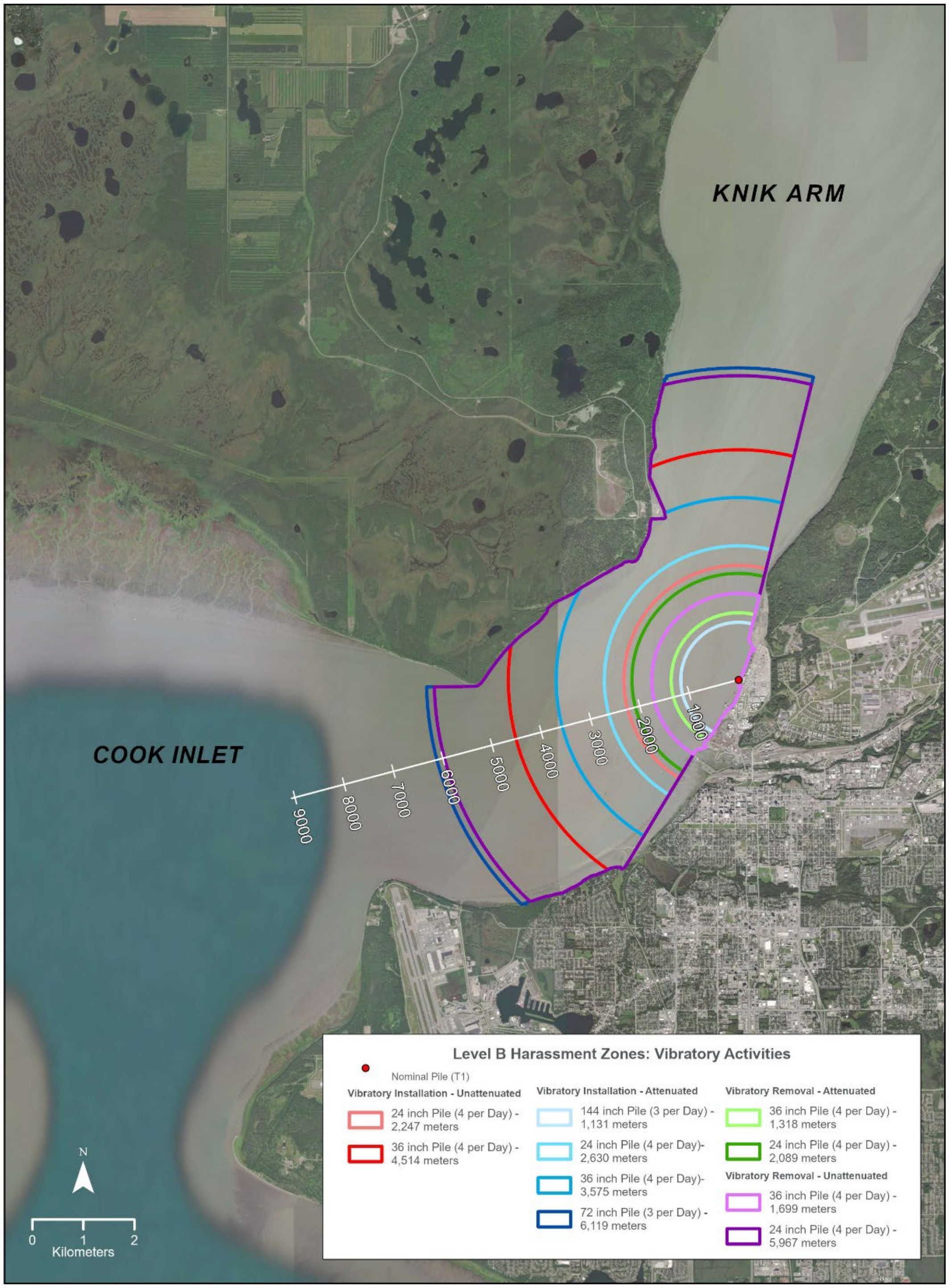


Figure A-10. Level B Harassment Isopleths for All Pile Sizes for All Vibratory Activities (Attenuated and Unattenuated)

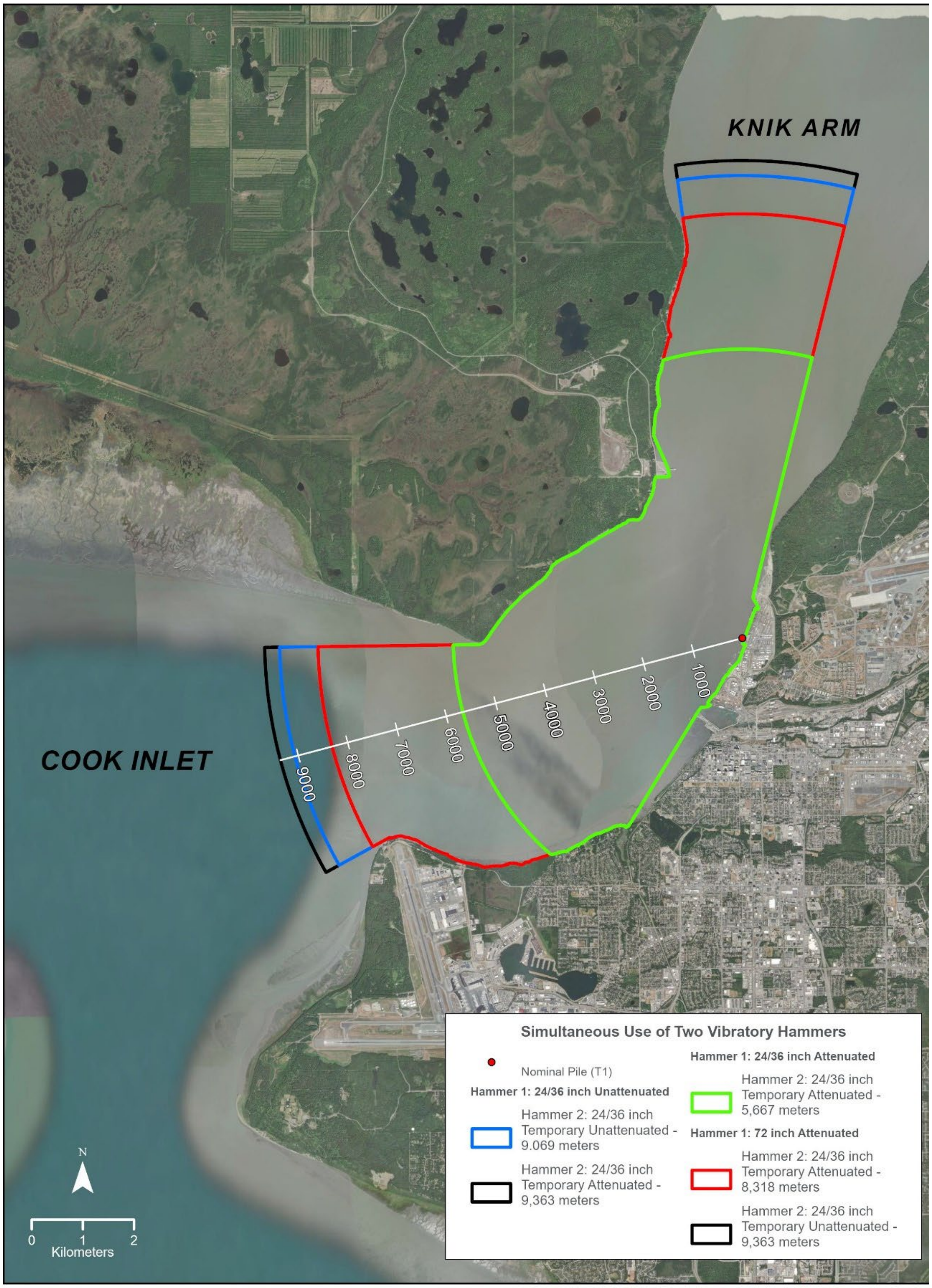


Figure A-11. Harassment Isopleths for Simultaneous Use of Two Vibratory Hammers (Attenuated and Unattenuated)

Attachment B
Environmental and Marine Mammal Observation Datasheets

Marine Mammal Sighting Form - CTR

Date: **Location:** **Take Count, Level A:** **Level B:**

(DD MMM YY, Example 06 JUN 22) *(Specific to sighting, Report immediately to Contractor POC)*

Group Letter: **Observer(s):** **Data Collector:**

(1st sighting of the day is Group A, letter is unique by day and not by species)

Time *(military)*		**Species** *(circle)*	**Distance** *(meters, animal to noise source)*		**Number of Animals**		**Number of Animals in Each Class**			
Initial Sighting Time		Beluga Whale	Initial Distance		Min Count		*Color classification for belugas only:*			
Final Sighting Time		Harbor Seal	Closest Distance		Max Count		White		Dark Gray Calf	
Entered H-Zone B: Y or N							Gray		Dark Gray Neonate	
Time Entered H-Zone B		Harbor Porpoise	Final Distance		Best Count		*Classifications for other species:*		Unknown Color	
Time Exited H-Zone B		Steller Sea Lion	**Initial Heading** *(circle)*		**Number of Animals Entered H-Zone**		Male			
Entered H-Zone A: Y or N		Killer Whale	N NE NW W S SE SW E		H-Zone B		Female		Unknown Sex	
Time Entered H-Zone A		other:	**Final Heading** *(circle)*				Adults		Calves/ Pups	
Time Exited H-Zone A		__________	N NE NW W S SE SW E		H-Zone A		Juveniles		Unkn. Age	

Behavior of Marine Mammal(s) *place a 1 next to primary, 2 next to secondary activity (etc.), indicate all behaviors observed:*

___(AP) Avoiding Predation ___(BU) Bubbling ___(CS) Calving ___(D) Diving ___(FO) Feeding Observed

___(FS) Feeding Suspected ___(MS) Mating Suspected ___(M) Milling ___(R) Resting ___(SS) Side-scanning

___(SN) Snorkeling ___(S) Socializing ___(SH) Spyhopping ___(ST) Startled ___(TS) Tail Slapping

___(TW) Tail waving ___(T) Traveling ___(V) Vocalizing ___(O) Other, describe under additional information ___(U) Unknown

Sighting & Behavior Timeline*: **Initial Sighting cue:** ______________________________

Time	*Theodolite Reading*	*Behavior Code*	*Brief Notes* *(additional space below)*	*Time*	*Theodolite Reading*	*Behavior Code*	*Brief Notes* *(additional space below)*
	Y or N				Y or N		
	Y or N				Y or N		
	Y or N				Y or N		
	Y or N				Y or N		
	Y or N				Y or N		

**ALL behavioral changes caused by Project activities or other activities MUST be described under additional information.*

Initial Formation: **Final Formation:** **Spread** (average):

Project Activities

In-Water Work was occurring at initial sighting time? Y or N

In-Water Project Activities (circle): No in-water soft-start shutdown shearing vibratory pile removal

NO SHUT DOWN, EXPLANATION REQUIRED:

SHUT DOWN or DELAYED from ________ to ________ (time)

Additional Information (if applicable include more detailed information on behaviors or other information):

Draw locations on hardcopy maps

QC Reviewer____________________QC Date____________

Daily Environmental Conditions Log - CTR

Page _____ of _____

(Recorded every 30 minutes or as conditions change)

Date:____________________ Observer(s):______________________________ Location: ________________________

(DD MMM YY, Example 06 JUN 22)

Time (hh:mm)	Overall Conditions (Scale 1-10; 1 Poor, 5 Mod., 10 Exc.)	Weather Conditions	Light Conditions (1 Light, 2 Twilight, 3 Dark)	Air Temperature (°C)	Wind Speed (knots)	Wind Direction	Sea State	Cloud Cover (%)	Visibility (km)	Glare (%)	Ice Coverage (%)	Type of Ice	Other Activity (Number, type, and general location of vessels or other sources of in-water disturbance)	Comments

Weather Conditions: (S) Sunny, (PC) Partly Cloudy, (L) Light Rain, (R) Steady Rain, (F) Fog, (OC) Overcast, (LS) Light Snow, (SN) Snow

Sea State: (0) Mirror like, calm; (1) ripples (up to 4 in) without foam crests; (2) small wavelets (up to 8 in); (3) large wavelets (up to 2 ft), perhaps scattered white horses; (4) small waves (up to 3 ft), fairly frequent white horses; (5) moderate waves (up to 6 ft); (6) large waves (up to 9 ft)

Type of ice: (N) New, (B) Brash, (PA) Pancake, (SF) Small Floes, (MF) Medium Floes, (LF) Large Floes, (BT) Belts, (S) Strips, (PI) Pack Ice, (NI) No Ice Present

Daily Project Activities and Communication Log - CTR

Page _____ of _____

Date: ____________ Monitoring Start Time:_____ End Time: _____ Observer(s):_________________________ Location:____________

(DD MMM YY, Example 06 JUN 22) *(military time)*

In-Water Project Activities				
Start Time (hh:mm)	Stop Time (hh:mm)	Type of Project Activity	Location	Comments (explain the reason for all shut downs)

Communication				
Time of Communication	MMO (Initials)	Cons. Crew Member	Type of Comm.	Information Communicated

Type of Project Activities: No in-water, soft-start, shutdown, vibratory pile removal, direct pull, shearing

Location: in water, in the dry

Type of Communication: Shutdown Notification, Start Up Authorization, General Communication