



## SUBMITTAL COVER SHEET

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Is this a deviation from Contract Documents (Yes/No)? NO

CQCSM / or Others Verification:

- Review by CQCSM not performed/required
- (a) We have verified that the material or equipment contained in this submittal meets all the requirements specified or shown (no exceptions), and the submittal is required by the Contract Documents.
- (b) We have verified that the material or equipment contained in this submittal meets all the requirements specified or shown, except for the following deviations (list deviations; attach a separate sheet as necessary), and the submittal is required by the Contract Documents

CQCSM / or Others Verification: Jim Page - CQCSM 10-07-2022

Owner's Representative Review:

- No Exceptions Taken  
 Exceptions Noted  
 Revise and Resubmit  
 Rejected  
 Review Not Required

Notes (additional notes/comments may be attached):

Owner's Representative Signature: \_\_\_\_\_

Corrections or Comments made relative to submittals during this review do not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. This submittal is only for review of general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades; and performing his work in a safe and satisfactory manner.

# 2022 Port of Alaska South Float Dock Construction Marine Mammal Monitoring



**Final Report  
October 2022**

Prepared for  
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## ACRONYMS AND ABBREVIATIONS

%	percent
b-hr/hr <sub>o</sub>	beluga-hours per hour of observation
b/km <sup>2</sup>	belugas per square kilometer
km <sup>2</sup>	square kilometers
61N	61 North Environmental
B <sub>A</sub>	beluga attendance
BiOp	biological opinion
CP	Cairn Point monitoring location
DPS	distinct population segment
ESA	Endangered Species Act of 1973, as amended
HDR	HDR, Inc.
HF	high frequency
hr	hour
IHA	incidental harassment authorization
ITS	incidental take statement
LF	low frequency
MF	mid frequency
MMO	marine mammal observers
MMPA	Marine Mammal Protection Act
MOA	Municipality of Anchorage
MS	Microsoft
NEX	Northern PSO Station
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PCT	Petroleum and Cement Terminal
PCTS	PCT PSO Station
POA	Port of Alaska
POC	points of contact
PPM	Pacific Pile and Marine
PSO	protected species observers
PW	phocids in water
PWS	Point Woronzof PSO Station
SCS	Ship Creek PSO Station
SQL	Structured Query Language
VHF	very-high frequency

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## EXECUTIVE SUMMARY

The Port of Alaska (POA) consulted with the National Marine Fisheries Service (NMFS) to obtain authorization to take a limited number of marine mammals under the Marine Mammal Protection Act of 1972, as amended (MMPA; 70 Federal Register [FR] 1871-1875) and the Endangered Species Act of 1973, as amended (ESA) incidental to the construction of the South Float Dock (SFD) at the POA. NMFS issued a biological opinion (BiOp), an incidental take statement (ITS), and an incidental harassment authorization (IHA) for the SFD allowing for incidental take of marine mammals.

The BiOp and IHA required protected species observers (PSO) to monitor a portion of Knik Arm in Upper Cook Inlet, Alaska near the POA for marine mammal species and document their location relative to the SFD and behavioral reactions. The PSOs were also required to monitor in-water construction activities and document environmental conditions.

The POA contracted with Pacific Pile and Marine (PPM) to construct the SFD and PPM sub-contracted the marine mammal monitoring to 61 North Environmental (61N) of Anchorage, Alaska. A team of PSOs was hired by 61N to conduct marine mammal monitoring. The IHA and BiOp required four monitoring stations located along 9 kilometers of the southeastern shore near the entrance to Knik Arm. Eleven PSOs observed the in-water pile installation from four monitoring stations over 13 non-consecutive days between 20 May and 11 June 2022, totaling 108.2 hours of observation.

During the monitoring, PSOs documented 39 groups of 71 individual animals. The sightings consisted of:

- 9 groups of belugas (*Delphinapterus leucas*) comprised of 41 individual animals
- 27 individual harbor seals (*Phoca vitulina*)
- 3 sightings of individual Steller sea lions (*Eumetopias jubatus*)

Of the nine beluga groups, five were sighted during or very near in time to pile installation. No obvious disturbance-related behaviors were documented. Of the five events evaluated where belugas were present during pile installation, two groups were moving away from the SFD prior to vibratory installation and maintained their trajectory moving away. Two of the groups moved toward the pile installation. During one event, the trajectory of a single beluga was difficult to track. It is unknown if it moved toward or away during pile driving; therefore, it was categorized as a “potential” reaction, even though no reaction was observed. Two belugas and 13 harbor seals were observed inside of the Level B harassment zone during or very near in time to active pile driving and were reported as potential exposures to Level B harassment thresholds. No Level A exposures were recorded. The number of authorized takes and the number of recorded takes are presented in Table E-1.

**Table E-1. Number of Authorized Takes and Number of Recorded Takes**

<i>Species or DPS</i>	<i>Number of Level A Takes Authorized</i>	<i>Number of Level B Takes Authorized</i>	<i>Number of Level A Takes Recorded</i>	<i>Number of Level B Takes Recorded</i>
<i>Cook Inlet beluga whale (Delphinapterus leucas)</i>	0	24	0	2
<i>Western DPS Steller sea lion (Eumetopias jubatus)</i>	2	2	0	0
<i>Humpback whale (Megaptera novaeangliae)</i>	0	2	0	0
<i>Harbor seal (Phoca vitulina)</i>	2	19	0	13
<i>Harbor porpoise (Phocoena phocoena)</i>	0	12	0	0
<i>Killer whale (Orcinus orca)</i>	0	6	0	0

Pile installation was delayed 8 times for a total work stoppage of 11.2 hours over 13 days of in-water work. The monitoring and mitigation measures were successful in minimizing the total number and duration of Level B exposures for endangered Cook Inlet belugas. Level A exposures of beluga whales and all other species were avoided.

This report summarizes the marine mammal monitoring and mitigation required by the IHA and BiOp to minimize the impacts to the protected marine mammal species present in Cook Inlet, during construction of the SFD project.

# 1 INTRODUCTION

The Marine Mammal Protection Act of 1972, as amended (MMPA; 70 Federal Register [FR] 1871-1875), protects all marine mammals and prohibits the unauthorized “take”<sup>1</sup> of marine mammals, including disturbance from underwater sound. Additionally, the Endangered Species Act of 1973, as amended (ESA), also prohibits take of threatened or endangered marine mammals. The National Marine Fisheries Service (NMFS) administers the MMPA and the ESA for the marine mammal species that occur near the Port of Alaska (POA).

The POA sought authorization to take a limited number of marine mammals under the MMPA and ESA incidental to the construction of the South Float Dock (SFD) at the POA. NMFS issued the POA an Incidental Harassment Authorization (IHA) under the MMPA on 27 August 2021, for construction of the SFD (NMFS 2021b). The SFD is a component of the POA Modernization Program (PAMP). Under PAMP, a new Petroleum and Cement Terminal (PCT) was constructed at the POA in 2020 and 2021 to replace the aging Petroleum Oil and Lubricants Terminal (referred to as POL 1). To accommodate the PCT, the existing SFD, constructed in 2004, required relocation to the south of the PCT. The new SFD was constructed under the same contract as the PCT, therefore, the marine mammal compliance methodologies used for the SFD are a continuation of those developed for the PCT.

The Municipality of Anchorage (MOA) owns the POA and is the PCT/SFD project owner. Pacific Pile and Marine (PPM) was the prime contractor for SFD construction work in 2022 and 61 North Environmental (61N) was a subcontractor to PPM. The MOA contracted with CH2M Hill, Inc. (now a subsidiary of Jacobs Engineering Group) and HDR, Inc. (HDR) to provide contract management, permitting, and compliance services for the PAMP project.

NMFS also completed a consultation under Section 7 of the ESA and issued a Biological Opinion (BiOp) of the effect the project may have to threatened and endangered species. The BiOp contains an incidental take statement (ITS) that mirrors and complements the IHA for ESA-listed species (NMFS 2021a). The BiOp and the IHA contained Level A, Level B, and shutdown zones for various pile driving scenarios and species present.

This report summarizes the marine mammal monitoring and mitigation required by the IHA and BiOp to minimize the impacts to the protected marine mammal species present in Cook Inlet, near the SFD project.

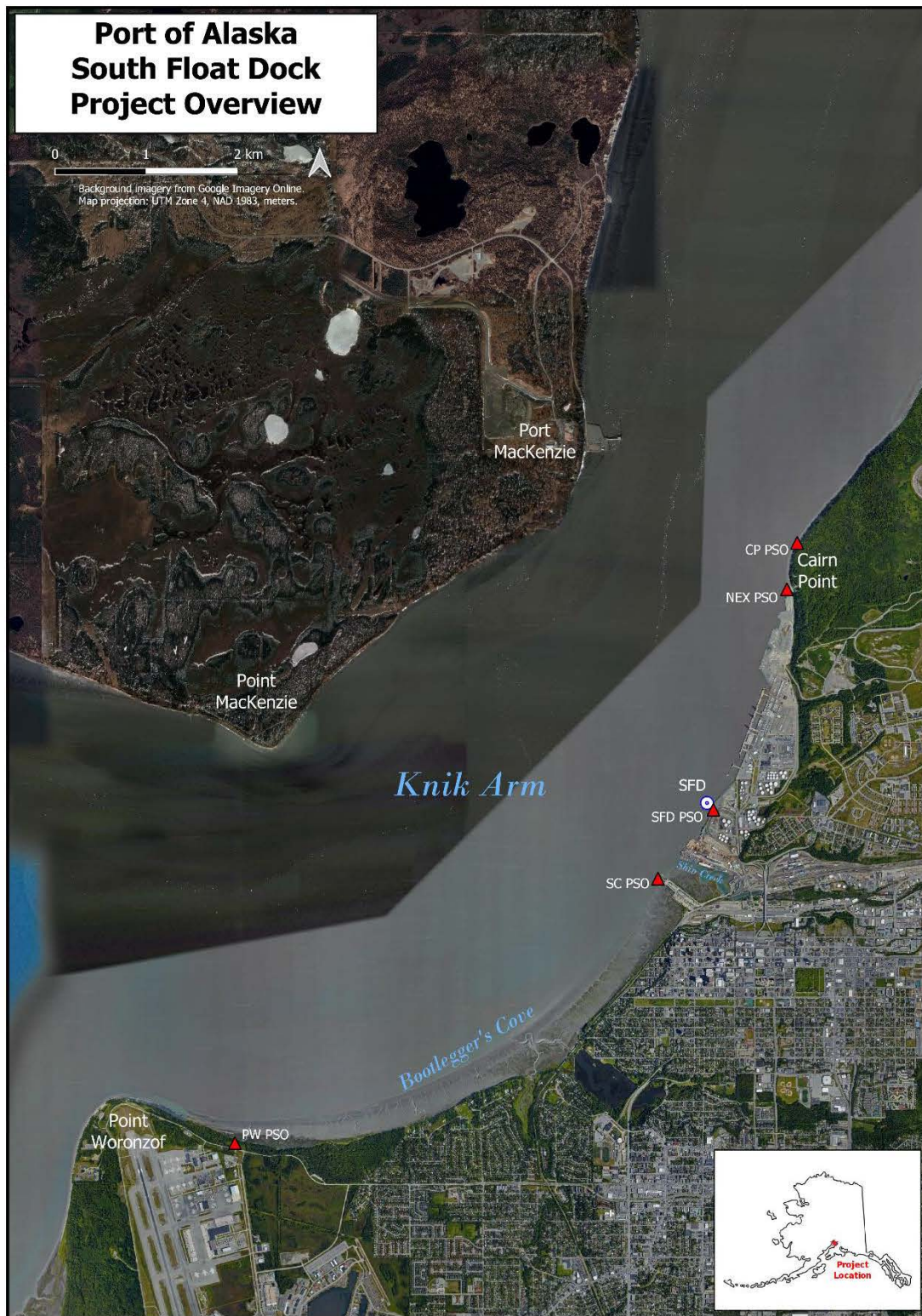
## 1.1 Project Description

The SFD is a small, multi-purpose floating dock designed for mooring smaller vessels such as first responder (e.g., Anchorage Fire Department, U.S. Coast Guard) rescue craft at the POA. Construction of the SFD included installation of 12 permanent 36-inch steel piles: 10 plumb and 2 battered. During planning for construction of the SFD, installation of temporary 24-inch and 36-inch piles was considered, but no temporary piles were needed during the SFD construction. An attenuation device known as a “bubble curtain” was used to reduce the propagation of underwater sound during installation of the plumb piles. The angle of the battered piles did not allow for use of a bubble curtain during installation. The piles were installed from the floating work barge Redemption, using a vibratory hammer. An impact hammer was not needed for installation. The 12 piles were

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<sup>1</sup> “Take” means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. “Harassment” is statutorily defined as, any act of pursuit, torment, or annoyance which: A) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment), or B) 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 but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B Harassment).

installed over 13 non-consecutive days, between 20 May and 11 June 2022. The project location and regional landmarks are presented in Figure 1.



**Figure 1. SFD Project Location and Regional Landmarks**

## 1.2 Marine Mammal Species

Marine mammal species that occur in Upper Cook Inlet, near the POA are presented in Table 1. The IHA authorized the POA to take, by both Level A and Level B harassment,<sup>2</sup> marine mammals incidental to the construction of SFD under the MMPA. The authorized number and type of take for each species is presented in Table 1.

**Table 1. Marine mammals in or near the project area and numbers of authorized take allowed by the IHA and BiOp incidental to construction of the SFD project**

<i>Species or DPS</i>	<i>Abundance (Population/Stock)</i>	<i>MMPA Designation</i>	<i>ESA Listing</i>	<i>Number of Level A Takes Authorized</i>	<i>Number of Level B Takes Authorized</i>
<i>Cook Inlet beluga whale (Delphinapterus leucas)</i>	279 <sup>1</sup> (Cook Inlet)	Depleted & Strategic	Endangered	0	24
<i>Western DPS Steller sea lion (Eumetopias jubatus)</i>	52,932 (Western DPS)	Depleted & Strategic	Endangered	2	2
<i>Humpback whale (Megaptera novaeangliae)</i>	11,398 (Hawaii DPS)	Depleted & Strategic	None	0	2
	3,264 (Mexico DPS)	Depleted & Strategic	Threatened		
	1,059 (Western N. Pacific DPS)	Depleted & Strategic	Endangered		
<i>Harbor seal (Phoca vitulina)</i>	28,411 (Cook Inlet/Shelikof)	None	None	2	19
<i>Harbor porpoise (Phocoena phocoena)</i>	31,046 (Gulf of Alaska)	Strategic	None	0	12
<i>Killer whale (Orcinus orca)</i>	2,347 (Eastern North Pacific Alaska Resident)	None	None	0	6
	587 (Gulf of Alaska, Aleutian Islands, & Bering Sea Transient)	None	None		

**Notes:**<sup>1</sup>  $N_{best} = 279$ . The 95 percent probability range is 250–317 whales (Shelden and Wade 2019).

Sources: Humpback whale population estimates: Wade et al. 2016. Gray whale population estimate: Carretta et al. 2021. All other population estimates: Muto et al. 2020a and Muto et al. 2020b.

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

<sup>2</sup> “Harassment” is statutorily defined as, any act of pursuit, torment, or annoyance which:

- has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment) or,
- 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 but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B Harassment).



### **1.3 Mitigation and Monitoring Measures**

The IHA and BiOp (NMFS 2021a, b) contain mitigation and monitoring measures that include:

- Training for the construction crew, monitoring team, and POA staff on responsibilities, communication, and operational procedures
- Limits on the timing and type of pile installation and requirements for bubble curtain use
- Specific monitoring locations, numbers of protected species observers (PSOs; also known as marine mammal observers [MMO]), and equipment to maximize visibility of the affected area and accurately track marine mammal locations
- Monitoring requirements 30 minutes prior to the start of pile driving, during all pile driving, and 30 minutes after pile driving
- Delay or shutdown of in-water work if marine mammals are sighted within or approaching applicable shutdown zones
- Specific mitigation measures for beluga whales
- Training and qualification requirements for PSOs
- Monthly and final reporting requirements

### **1.4 Monitoring Zones**

Three types of monitoring zones were required by the IHA and BiOp during the 2022 SFD construction:

- a pre-pile driving clearance zone (hereafter the “pre-clearance zone”)
- shutdown zones
- harassment zones (Level A and Level B)

#### **1.4.1 Pre-clearance Zone**

One of the beluga-specific mitigation measures was monitoring of the pre-clearance zone between inbound and outbound lines defined in the IHA and BiOp (Figure 2). As described in the mitigation measures, the pre-clearance zone was monitored for 30 minutes prior to pile installation. If any belugas were sighted within the pre-clearance zone, pile installation could not begin until belugas were at least 100-meters outside of the applicable Level B zone and on a trajectory away from the Level B zone.



Figure 2. Boundaries of the Pre-clearance Area as defined in the IHA and BiOp.

#### 1.4.2 Shutdown Zones

The IHA and BiOp required the shutdown of vibratory pile installation if any non-beluga marine mammal species approached within 100-meters of the pile. This shutdown zone was enforced regardless of the authorization of takes for a given species in the IHA and BiOp. For belugas, the IHA and BiOp required a delay or shut down of pile installation if belugas were sighted within or approaching the applicable Level B zone. Therefore, the applicable Level B zone for a given activity was equal to shutdown zone for belugas (Table 2).

#### 1.4.3 Level A and Level B Harassment Zones

The isopleths for Level A and Level B harassment were calculated in the IHA application for the sound levels expected from the in-water construction activities. These are sound levels at which harassment by injury (Level A) or harassment by behavioral disturbance (Level B) may occur. During SFD construction, the impact hammer was not used, therefore, only the Level A and Level B zones associated with vibratory installation were applicable. In addition, all the Level A zones for vibratory pile installation were less than the 100-meter minimum shutdown zone. No marine mammals were sighted within the 100-meter shutdown zone; therefore, none were exposed to sound level exceeding the Level A threshold. The applicable Level A and Level B zones for the SFD construction are presented in Table 2 and Table 3, respectively. The applicable Level B zones are displayed on Figure 3.

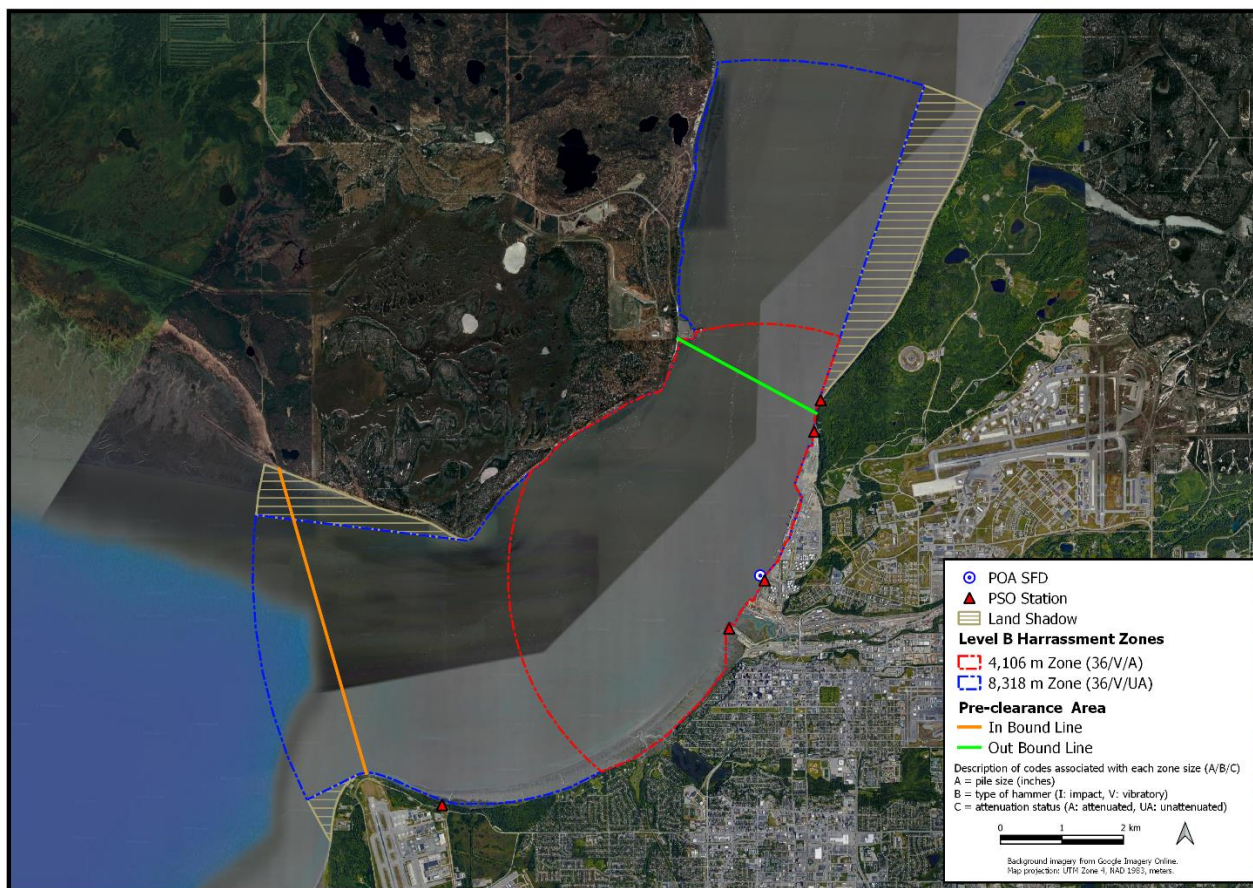
**Table 2. Level A harassment zones authorized by the NMFS IHA (NMFS 2021b)**

Pile Size	Hammer Type	Attenuation	Piles installed/day	Level A harassment zone (meters) <sup>1</sup>				
				LF	MF	HF	PW	OW
36-inch	Vibratory	Bubble Curtain	1	6	1	9	4	1
			2	10	1	15	6	1
			3	13	2	19	8	1
		Unattenuated	1	13	2	18	8	1

**Notes:** <sup>1</sup> The abbreviations for the functional hearing groups in the NMFS Technical Guidance (NMFS 2018) are as follows: LF=low-frequency cetaceans, MF=mid-frequency cetaceans, HF=high-frequency cetaceans, PW=phocids in water, OW=otariids in water.

**Table 3. Applicable Level B Harassment Zones and Beluga Shutdown Zones in 2021**

Pile Size	Hammer Type	Attenuation	Shutdown Zone for Non-Beluga Species	Level B/Beluga Shutdown Zone (meters)
36-inch	Vibratory	Bubble Curtain	100	4,106
		Unattenuated	100	8,318



**Figure 3. Level B Harassment and Beluga Shutdown Zones**

## 1.5 Protected Species Observers

The IHA and BiOp required PSOs to monitor the pre-clearance, harassment, and shutdown zones within the project area for marine mammals and record their locations, group composition, and behaviors; to record the in-water construction activities and call for shutdowns and delays of in-water construction as needed; and to record environmental and visibility conditions.

Prior to the beginning of in-water construction work, 61N conducted a web-based training for a team of PSOs, many of which were part of the 2021 team at the POA. All PSOs were approved by NMFS as meeting or exceeding the minimum qualifications contained in the IHA. The training included an overview of the project, the pile installation methods, a regulatory review, a review of the noise thresholds and monitoring zones, a review of the IHA and mitigation measures, a discussion of communication protocols and shutdowns, a review of the equipment, the data collection protocol, and marine mammal identification and behavior.

A few days prior to the start of in-water work, PSOs received training in the field to set up and use the equipment including: the solar power and rechargeable battery installations, the mobile data connection and computers, digital theodolite, the Fujinon™ 25X150 “bigeye” binoculars and range finders. After meeting initially as a group to review equipment, the PSOs split into two groups to practice at two separate monitoring stations. The PSOs tested radio communications, and practiced monitoring, communication, and shutdown scenarios.

The PSOs assisted PPM in implementation of the mitigation measures by alerting the construction crew when marine mammals were within or approaching the pre-clearance, harassment, or shutdown zones. The PSOs communicated with PPM superintendents, foremen, and crane operators by radio and mobile phone. The PSOs documented in-water construction activities including the start and stop of the vibratory hammer during pile installation; sightings of marine mammals, group composition, behaviors, and location; and environmental and visibility conditions. The observation stations were equipped with laptops, computer monitors, and high-speed data connections. All data was entered into Microsoft (MS) Access forms and saved instantaneously to a cloud-hosted, structured query language (SQL) server.

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## 2 MONITORING LOCATIONS AND EFFORT

The IHA and BiOp (NMFS 2021a, b) prescribed the four monitoring locations near the POA along the southern and eastern coast of Knik Arm in Upper Cook Inlet. Because of the larger Level B zones for work in 2022, a location on the beach on the north side of Cairn Point was also staffed at various times, depending on the activity and tidal stage. Eleven PSOs were on duty during all pile installation events. Monitoring for protected species was conducted for 108.2 hours over 13 days between 20 May and 11 June. The dates, times, and durations of monitoring are presented in Appendix A.

### 2.1 Monitoring Locations and Personnel

The IHA and BiOp required monitoring locations as follows:

- At Point Woronzof approximately 6.5 kilometers southwest of the SFD
- At the promontory near the boat launch at Ship Creek
- At the SFD project site, and
- At the northern end of the POA

The Point Woronzof PSO station (PWS) was the same location used in 2020 and 2021 – the parking lot of the Downtown Anchorage Viewpoint, on land owned and managed by the MOA and Ted Stevens International Airport. The Ship Creek PSO station (SCS) was maintained at the end of the promontory south of the Ship Creek boat launch on land owned by the POA. The SFD was constructed very near the PCT PSO station (PCTS), located at the south end of the PCT construction area, near the cement dome. The PCTS was used by PSOs to monitor during the PCT construction in 2020 and 2021. The northern PSO station (NEX) was located at the northernmost portion of the POA known as the “north expansion.” The four standard monitoring locations (NEX, PCTS, SCS, and PWS) are presented on Figure 2. The IHA and BiOp prescribed a minimum of three PSOs at both the northern (NEX), southern (PWS), and a minimum of two PSOs at the PCTS station. Three PSOs were stationed at SCS, resulting in 11 total PSOs on duty for all monitoring and pile installation events.

The IHA and BiOp required designation of a PSO field lead with prior PSO experience in Cook Inlet during monitoring. The PSO field lead for the SFD construction worked as a PSO for the PCT construction in both 2020 and 2021 and was a field lead in 2021. Each monitoring day, the field lead was assigned to the PCTS station to coordinate sightings and communicate with the construction crew. The second PSO assigned to the PCTS station was also always an experienced PSO to provide relief to the field lead PSO during breaks. Several of the other PSOs also had prior experience on the PCT project in 2020 and 2021. Experienced PSOs were assigned as station leads at each of the other stations. Station leads provided mentorship and training, and mediated differences of opinion on marine mammal counts, behaviors, and other issues as needed.

During unattenuated vibratory installation of the 36-inch battered piles (8,318-meter Level B zone), two PSOs were occasionally positioned on the beach on the north side of Cairn Point during outgoing tides to monitor the eastern shoreline of Knik Arm that is not visible to the NEX station. The Cairn Point monitoring location (CP) was utilized to provide “early warning” for beluga groups that often travel in this area, and which could not be seen by the NEX station until they were already within the Level B zones. Because of known bear activity on the beach north of the POA, two PSOs always traveled together out to the CP location. One PSO from SCS would drive over to the NEX

station, leaving two PSOs at NEX and SCS (PWS and PCTS remained unchanged), resulting in the 11 PSOs staffing five locations.

Occasionally, small groups of belugas would travel south of NEX and mill in front of the POA in an area blocked from view by both the PCTS and NEX stations. During some of these sightings, one PSO would drive to the southern portion of the north expansion backlands to monitor the group. During these instances, the PSO would only be equipped with a radio and 7X50 binoculars and would radio information to the other stations. No paper forms were used at this informal location.

During the times that the 4,106-meter and 8,318-meter zones were active, the environmental conditions allowed for monitoring of the entire zone. No delays were caused due to poor visibility or sea state conditions.

Small portions of the 8,318-meter zone were not visible north of Cairn Point and west of Point Woronzof due to obstruction of trees or landforms. PSOs were placed on the beach north of Cairn Point for one of the four battered pile installation events on an outgoing tide to monitor the obstructed area. During the other three events, the tide was either rising or at high slack, limiting both the safety and effectiveness of placing PSOs at the location. Use of the big eyes at the SCS station allowed for some visibility beyond the west side of Point Woronzof. In total, the two areas that were either unobserved or had limited visibility comprised 8 km<sup>2</sup> or less of the 56 km<sup>2</sup> zone.

## 2.2 PSO Stations and Equipment

Each of the four standard PSO stations consisted of a covered platform constructed on top an 8-foot by 8-foot by 20-foot shipping container (photos 2, 6, 7, 10, and 16 in Appendix B). The platforms have open sides above 4-foot walls, which, except for the vertical roof supports, allowed for unobstructed viewing in all directions. A 4-foot by 6-foot shed was constructed on each platform to house a table and chair, a laptop computer, an extra monitor, a mobile data connection device, a dedicated mobile phone, a range finder, a small heater, a printed PSO handbook, backup paper data forms, notebooks, writing utensils, and other miscellaneous equipment (photo 12 in Appendix B).

The monitoring requirements in the IHA and BiOp required one digital theodolite (photos 10 and 13 in Appendix B) at one PSO station to accurately measure the locations of marine mammals within or near the Level B zones. During SFD construction, a theodolite was used at all four standard stations. The theodolites were linked directly to the laptop computers via a data cable to avoid entry mistakes. At the beginning of each monitoring period, the theodolites were setup on the surveyed locations on the platforms, leveled, and back sighted to a known reference location to “zero” the horizontal angle measurement. After setup, each station would sight in and enter one or more test fixes of known landmarks that were visible on aerial imagery to verify the proper operation of the theodolite and software. The estimated measurement error from theodolite use was discussed in depth in the 2021 final marine mammal monitoring report for the PCT construction (POA 2022). In general, the distance measurement error ranged from less than 1 percent (%) to more than 10% at long distances (i.e., greater than 3,000 meters) depending on the elevation of the PSO station, the tide height, and error from instability in the platform floors.

The IHA and BiOp also required the use of large-aperture binoculars with a minimum 25X magnification at the PWS, SCS, and NEX stations. The position of the SCS station, at the end of the promontory, allowed for additional monitoring of a portion of the shoreline north of Cairn Point that could not be seen by the NEX station. The three sets of large-aperture binoculars were Fujinon™ 25X150 MT-SX binoculars (colloquially called “big eyes”) mounted on height-adjustable tripods or hydraulic lifts (photo 7 in Appendix B). The PCTS station was equipped with 20-40X tripod-mounted binoculars, and a 20-60X spotting scope. Each station was also equipped with one or more sets of



marine-grade Fujinon™ 7X50 binoculars with reticle and compass. Reticles require an unobstructed view of the horizon to be useful for distance measurements. The near western shore of Knik Arm prevented the use of reticles for measuring distance. Also, because the PSO stations were atop steel shipping containers, the internal compasses of the binoculars were not reliable for determining the magnetic bearing to marine mammals and were not used.

Each of the four standard stations was equipped with two or more very-high frequency (VHF) handheld radio, to allow for instant communication between stations. The PCTS PSO station was equipped with a 25-watt fixed-mount VHF to ensure reliable reception and transmission of messages. In addition to VHF radios, each of the four stations had dedicated mobile phones for a single point of contact for phone calls and text messages. The phones were also equipped with wi-fi hotspot capabilities and a data plan, to provide backup internet access.

A MS Access application was installed on each laptop and included three data-entry forms developed by 61N specifically for the PCT and SFD projects to capture all data outlined in the IHA application, IHA, and BiOp. One form was designed for marine mammal sightings, another form collected data regarding weather observations and monitoring efforts, and the last form was used to record SFD construction activities. Visual Basic coding was utilized to calculate marine mammal group latitudes and longitudes from the horizontal and vertical angles captured from the theodolites, the distance to the active pile (or center of outer piles of SFD if no other pile was active), and the distance to the active Level B zone (if any). The port activity data-entry form contained start and stop buttons to record timestamps for tracking pile installation activity. Data validation was applied to entry fields and drop-down lists were set with default values for the most frequent attributes to allow for rapid entry of a sighting for mitigation purposes. Timestamps were recorded for initial entry and last update. Two versions of the application were loaded on to each laptop: a primary application which stored data on a cloud-hosted MS SQL server database, and a redundant application for local data storage if needed. The primary or backup internet connections were always available, therefore, the local versions of the database application were not used. Paper forms were also available at every station in the event of a computer malfunction.

The CP station was located on the beach on the north side of Cairn Point (Figure 1). Observations took place next to a large boulder which was used as a reference point for magnetic bearing and distance estimation entries. The CP PSOs carried a backpack containing Fujinon™ 7X50 marine-grade binoculars with a magnetic compass, a VHF handheld radio, safety gear, and paper sighting forms.

### **2.3 Observation Methodology**

The primary objective of the monitoring program was to implement mitigation measures (i.e., to shut down before takes occurred). Therefore, the monitoring effort was focused on the shoreline areas with more frequent beluga presence, and areas where Level B exposures were more likely (such as near Cairn Point on outgoing tides). The entire visible monitoring area was scanned regularly, but timed sweeps, randomized grids, or other research-focused methods were not generally employed.

At stations PWS, SCS, and NEX, PSOs typically rotated between three positions: the “big eyes,” the theodolite, and data entry. The PSO on the big eyes typically scanned the far shore, Port MacKenzie, Point MacKenzie, and Cairn Point to the northern end of the nearshore and Point Woronzof at the western end of the near shore. The observer assigned to the theodolite was also actively scanning, alternating between handheld 7X50 binoculars, and un-aided scanning. The narrow field of view of the theodolite does not lend itself to active scanning and was typically only operated during setup testing and sightings. The PSOs typically rotated tasks every 30 to 60 minutes. Because PSOs spent approximately one third of their shift assigned to the data shack at these stations, they were never



continuously observing for more than four hours without a break. The PSOs were also allowed a 15-minute break in the morning and afternoon, and a 30-minute lunch. These breaks were taken during the data entry rotation so the active monitoring at the big eyes and theodolite positions was always maintained.

The two PSOs at the PCTS station rotated between the data shack and monitoring construction or scanning for marine mammals if no construction was occurring. The PSO in the data shack recorded monitoring times, shutdown and delays, other port activities, and pile installation times, and communicated with the other PSO stations and construction crew. The on-watch PSO alternated between using a 20-40X tripod-mounted binoculars (or 20-60X spotting scope) and 7X50 binoculars (or un-aided scanning). During construction activities, the on-watch PSO monitored the start and stop of the pile driving hammers and relayed the information to the PSO in the data shack.

When PSOs traveled to the CP location, one was tasked with scanning with 7X50 binoculars or un-aided scanning while the other provided a “watch” for bears that were occasionally seen in the area. The PSOs at the CP station did not record environmental and visibility conditions because it was near NEX and their primary duty at this location was to provide early warning to minimize takes.

When a marine mammal group was sighted, a record was entered into the database by the PSO team that sighted the group. All the group-level characteristics (e.g., counts, behaviors, formation, spacing, pace, and sighting comments) were entered into the "parent" record of the sighting. The group-level characteristics and sighting notes could be updated as needed throughout the sighting. Once a record was created, a separate location entry form opened to capture marine mammal group locations that were joined in the database to the parent record. Locations were entered by sighting the group (or its last surface location) through the theodolite viewer and clicking a button on the MS Access form that captured the horizontal and vertical angles. The angles were converted to a latitude and longitude within the application. If there was no active pile installation, the distance (in meters) of the group was calculated to the center of the SFD (Pile D-3 of the outermost bent). If vibratory installation of a pile was actively occurring, the distance of the group was calculated to the active pile and to the applicable Level B zone. The PSOs also plotted the group positions on a mapping program to view their location relative to the Level B zones. Therefore, the PSOs had immediate knowledge of the whether a group was inside or outside of an active Level B zone if pile installation was occurring. One or several locations could be entered for each group. PSOs typically recorded locations every 5 to 15 minutes. More frequent fixes were recorded when belugas moved towards or away from Level B zones or the inbound or outbound monitoring lines. Using the increasing or decreasing distance calculations, or the mapping program, the PSO Lead could quickly determine the trajectory of the group relative to the Level B zone and make appropriate decisions whether to call for delays or shutdowns.

Because the MS Access forms at all four PSO stations were linked to a cloud-hosted database, each PSO station could refresh the data and view sighting entries made by another station in real time. Any PSO station could select a marine mammal group parent record and make new location entries. In this manner, marine mammal sightings were passed from one PSO station to another as a group moved throughout the monitoring area. Each fix location could be copied into a mapping program by any station to see the current location of a group geographically and track the movements. The PSOs also communicated frequently by radio regarding group locations relative to landmarks, group counts, behaviors, and other relevant information.

## **2.4 Monitoring Times and Duration**

PSOs began monitoring the waters of lower Knik Arm in Upper Cook Inlet from the four standard stations on 20 May 2022. Monitoring always began more than a half hour prior pile installation. Monitoring typically began around

0600 or 0700 depending on the pile installation schedule each day. If no marine mammals were present, the construction crew was cleared to begin pile installation after a half hour of monitoring. Each day, monitoring continued for at least 30 minutes after pile installation was completed. A total of 108.2 hours of marine mammal monitoring was conducted on 13 days over a 23-day period.

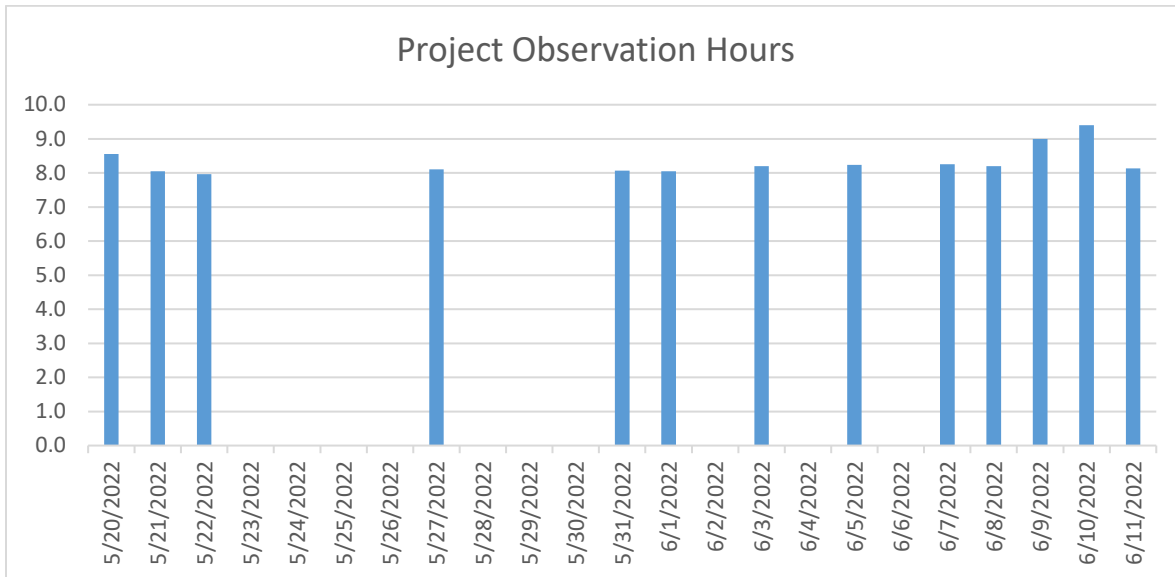
The hours of observation for each day of the project are listed in Table 4 and illustrated on Figure 4. The environmental conditions affecting observations are detailed below and in Appendix A.

**Table 4. Observation Effort**

<i>Date</i>	<i>Begin Time</i>	<i>End Time</i>	<i>Observation Hours</i>
5/20/2022	07:23	15:56	8.6
5/21/2022	07:17	15:20	8.1
5/22/2022	07:17	15:15	8.0
5/23/2022	n/a	n/a	n/a
5/24/2022	n/a	n/a	n/a
5/25/2022	n/a	n/a	n/a
5/26/2022	n/a	n/a	n/a
5/27/2022	06:09	14:15	8.1
5/28/2022	n/a	n/a	n/a
5/29/2022	n/a	n/a	n/a
5/30/2022	n/a	n/a	n/a
5/31/2022	07:11	15:15	8.1
6/1/2022	07:12	15:15	8.1
6/2/2022	n/a	n/a	n/a
6/3/2022	07:08	15:20	8.2
6/4/2022	n/a	n/a	n/a
6/5/2022	07:01	15:15	8.2
6/6/2022	n/a	n/a	n/a
6/7/2022	07:30	15:45	8.3
6/8/2022	07:08	15:20	8.2
6/9/2022	07:15	16:15	9.0
6/10/2022	07:11	16:35	9.4
6/11/2022	07:06	15:14	8.1
<b>Total Hrs Observation:<sup>1</sup></b>			<b>108.2</b>

**Notes:** <sup>1</sup> total may not equal the sum of individual days due to rounding

n/a = No in-water pile installation or removal was conducted, and no marine mammal observation occurred.



**Figure 4. Marine mammal observation hours during the SFD construction**

## 2.5 Construction Monitoring and Communication

The PCTS PSOs monitored all construction activity at the SFD and communicated regularly with the construction points of contact (POCs) including construction superintendents, construction foremen, and crane operators. All construction monitoring activity, including pile installation, non-pile driving in-water activity, marine mammal shutdowns, marine mammal delays, pre-clearance monitoring, and communications, were recorded in the database through a “Port Activity” entry form by the PSOs at the PCTS station. The database form contained a parent record with fields for the activity, the hammer type used, pile ID, and diameter (if applicable), and whether the bubble curtain was used. If the duration of an activity was relevant (e.g., for shutdowns and delays), or if it was intermittent over time, (e.g., use of an impact or vibratory hammer) the form contained a “Start Activity” and “Stop Activity” button by which the PCTS PSOs could record one or many start and stop times associated with the parent record of the activity. Times were recorded as accurately as possible and corrected as needed during quality checks. Communications and other relevant information were documented in the notes for each pile installation activity. Discussions unrelated to a specific activity were recorded in a general “communication” activity record.

The 30-minute period of pre-clearance observation began each morning when the optics were set up and PSOs began scanning from each station. The PSO field lead would communicate the start of observations to the construction POCs and typically receive a brief of the planned activities for the day.

If, after 30 minutes of observation, no belugas were sighted within or approaching the inbound and outbound pre-clearance demarcation lines identified in the IHA and BiOp, or Level B harassment zone if it was larger than the inbound and outbound pre-clearance zone, and no marine mammals were sighted within the 100-meter shutdown zone, the PSO field lead would radio or text the construction POCs that pile installation may commence. Pile installation was not delayed if harbor seals were within the Level B zone (unless within the 100-meter shutdown zone). If belugas were sighted within the pre-clearance zone and were approaching the applicable Level B zone, the PSO field lead would radio the construction POCs and call for a delay in pile installation. If belugas were within the pre-clearance zone, but outside of the applicable Level B zone and on a trajectory away from the Level B zone, clearance for in-water work was communicated.

If no pile installation was planned, but marine mammals were present, they were monitored and tracked. Delay periods were typically not measured unless the construction crew was ready for in-water work, and it could not be conducted. Prior to initiating pile installation at any point in the day, the construction POCs would notify the PSO field lead and request clearance to begin work. In addition, the PSOs at the PCTS station were constantly monitoring construction activity and would initiate contact if preparations for vibratory or impact hammering were observed.

During the 13 days of observation, visibility of the applicable Level B zones was maintained for each pile installation event. Therefore, no delays were recorded due to limited visibility caused by environmental conditions. Section 7 provides further discussion of the implementation of the mitigation measures, and the durations of each event.

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### 3 IN-WATER OPERATIONS

During construction of the SFD, PSOs recorded 18 events of vibratory hammer use to install twelve 36-inch piles, totaling 7.64 hours (458.4 minutes) over 13 days. The bubble curtain was used for installation of the ten plumb piles (5.46 hours, 327.5 minutes) and was not used for the two battered piles (2.13 hours, 127.7 minutes). The battered piles were installed in two sections which were welded together. The vibratory hammer was also used without the bubble curtain briefly three times to remove piles that became stuck in the mud. The piles settled into the mud and became stuck when they were lofted and temporarily stood up alongside the barge during rig-up of the hammer to the crane. The crane was able to deadlift most piles without vibratory removal and move them from the temporary location into the template. The bubble curtain was designed to deploy from the template and could not be safely repositioned in these temporary locations in a reasonable time frame. These three events totaled 3.2 minutes of unplanned additional unattenuated vibratory hammer use.

No temporary piles were installed to facilitate the installation of the permanent SFD piles. Instead, PPM utilized a "horn" template mounted on the bow of the construction barge for the permanent piles. This methodology is only feasible for specific and limited conditions and was possible in this instance due to the layout of the SFD piles and because a four-point anchor mooring system was in use for the construction barge. It is noteworthy that the installation method avoided the vibratory pile driving and removal of six temporary 24-inch or 36-inch piles, which eliminated an estimated 12 hours of vibratory hammer use that would have otherwise been conducted.

Table 5 presents a summary by day of in-water operations during the SFD construction. Figures C-1-1 through C-1-5 in Appendix C-1 illustrate the Level B harassment zones that were active, and the beluga group locations relative to the SFD during periods of pile installation. All port activity records are provided electronically and can be found in Appendix G of the Appendices folder of the digital submittal.

**Table 5. Daily Pile Installation Events and Associated Level B Harassment Zones**

<i>36-inch pile</i>						
	<i>Vibratory Hammer with Bubble Curtain</i>		<i>Unattenuated Vibratory Hammer</i>		<i>Daily Totals</i>	
<i>Level B Zone:</i>	4,106 meters		8,318 meters			
<i>Date</i>	<i>Pile(s)</i>	<i>Duration (mins)</i>	<i>Pile(s)</i>	<i>Duration (mins)</i>	<i># of Events</i>	<i>Duration (mins)</i>
20-May	B-7	25.9	-	-	1	25.9
21-May	B-8	41.1	-	-	1	41.1
22-May	C-7, C-8	42.1	-	-	2	42.1
27-May	D-1	35.4	-	-	1	35.4
1-Jun	D-1	20.1	-	-	1	20.1
3-Jun	-	-	D-1 (east battered)	7	1	7
5-Jun	-	-	D-1 (east and south battered)	69.1	2	69.1
7-Jun	-	-	D-1 (south battered)	51.6	1	51.6
8-Jun	D-2	20.8	D-2 (stuck in mud)	1.7	2	22.5
9-Jun	D-3, D-4	50.7	D-4 (stuck in mud)	0.6	3	51.3
10-Jun	D-5	39.4	-	-	1	39.4
11-Jun	D-6	52	D-6 (stuck in mud)	0.9	2	52.9
<b>Totals:</b>	<b>11</b>	<b>327.5</b>	<b>7</b>	<b>130.9</b>	<b>18</b>	<b>458.4</b>

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## 4 ENVIRONMENTAL AND OBSERVATION CONDITIONS

The PSOs collected 950 environmental observation records from the four stations during monitoring. PSOs at each station typically recorded the environmental conditions upon station setup and every half hour throughout the day. PSOs also made additional entries for major changes in weather and to record other relevant activity that was not related to SFD construction (i.e., dredge vessel, private vessel, etc.). All observations were conducted during daylight hours. The environmental attributes recorded include general observation conditions (a scale of 1 to 10; 1 = poor, 5 = moderate, 10 = excellent), weather condition (cloudy, sunny, raining, etc.), light conditions (light, dark, twilight), cloud cover (percent), ice cover (percent), sea state (Beaufort scale), glare (percent), and visibility (distance at which a white beluga can be sighted with optics).

The overall observation conditions were good to excellent for most of observation days in the reporting period. The average observation condition was 8.3 on a scale of 1 to 10 and was 7 or greater for 97 percent of the records entered. The average visibility was over 6,800 meters and was greater than or equal to 5,000 meters for 89 percent of the observations. Thermal distortion was mentioned 101 times as affecting visibility at long distances. Cloud cover averaged 44 percent and exceeded 50 percent about 40 percent of the time.

A summary of the predominant weather condition observed is presented in Table 6 and a summary of the Beaufort Sea State observed is presented Table 7.

**Table 6. Summary of Weather Conditions**

<i>Weather Condition</i>	<i>Percent Occurrence<sup>1</sup></i>
<i>Sun</i>	28.7%
<i>Partly Sun</i>	12.5%
<i>Partly Cloudy</i>	35.8%
<i>Cloudy</i>	22.2%
<i>Mist</i>	0.1%
<i>Light Rain</i>	0.6%

**Note:** <sup>1</sup> sum of percentages may not equal 100% due to rounding.

**Table 7. Summary of Beaufort Sea State Observed**

<i>Beaufort Sea State</i>	<i>Percent of Observations</i>
<i>0</i>	1%
<i>1</i>	46%
<i>2</i>	44%
<i>3</i>	7%
<i>4</i>	2%
<i>&gt;=5</i>	0%



The tidal elevations and stages were pre-loaded into the database and auto-populate based on the time stamp of the observation. The definitions of the tidal stages used are presented in Table 8 and the percentage of tidal stages recorded is presented in Table 9.

**Table 8. Tidal Stage Definitions**

<i>Tide Stage</i>	<i>Definition</i>
<i>Low Slack</i>	Plus or minus one hour from low tide
<i>Low Flood</i>	Begins at the end of low slack, ends half-way between <sup>1</sup> the end of low slack and the start of high slack
<i>High Flood</i>	Begins half-way between <sup>1</sup> the end of low slack and the start of high slack, ends at the start of high slack
<i>High Slack</i>	Plus or minus one hour from high tide
<i>High Ebb</i>	Begins at the end of high slack, ends half-way between <sup>1</sup> the end of high slack and the start of low slack
<i>Low Ebb</i>	Begins half-way between <sup>1</sup> the end of high slack and the start of low slack, ends at the start of low slack

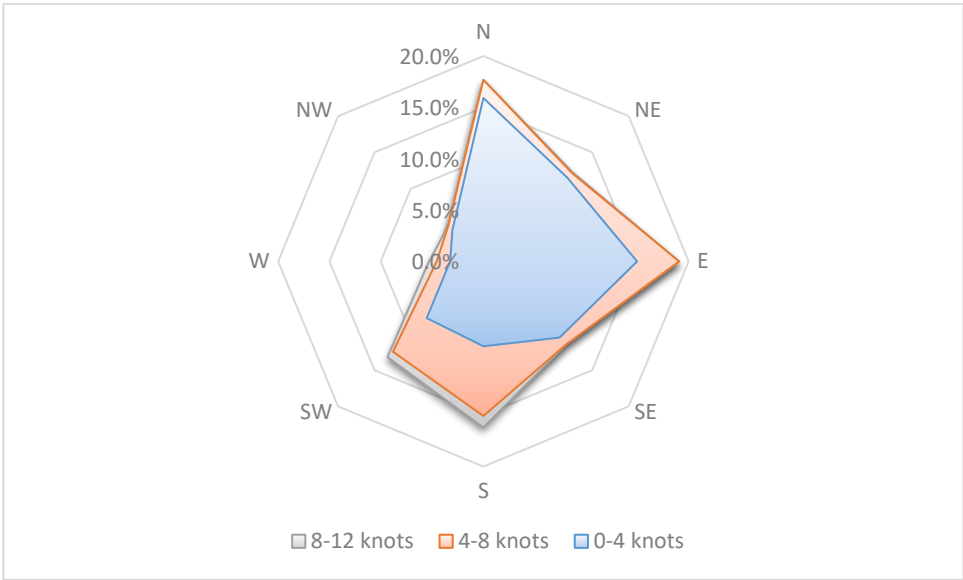
**Note:** <sup>1</sup> “half-way between” is time-based, and may not represent the actual, physical half-way point between high and low tide on the sinusoidal tidal graph. The time-based half-way point was used to simplify the calculation of tidal stage

**Table 9. Summary of Tide Stages Recorded**

<i>Tide Stage</i>	<i>Percent of Observations<sup>1</sup></i>
<i>Low Slack</i>	13%
<i>Low Flood</i>	13%
<i>High Flood</i>	16%
<i>High Slack</i>	19%
<i>High Ebb</i>	20%
<i>Low Ebb</i>	20%

**Note:** <sup>1</sup> total may not sum to 100% due to rounding

Wind speed, direction, and air temperature are not recorded by the PSOs as these meteorological data are available from the National Oceanic and Atmospheric Administration (NOAA) tide station 9455920 located at the POA, a few hundred meters from the SFD. The wind speed and direction for the 13 days worked during the reporting period were downloaded in six-minute intervals from the NOAA meteorological observations page for the Anchorage, Alaska tide station 9455920 (NOAA 2022) at the times observations were conducted. The air temperature during the reporting period was moderate with a minimum of 46.6°F, maximum of 67.8°F, and an average of 56.1°F. Approximately 77 percent of the wind speed records were between 0 to 4 knots, and 97 percent were below 8 knots. The wind data are summarized and presented as a wind rose in Figure 5, which shows that wind was variable coming nearly equally from the east, north, and south.



**Figure 5. Wind Speed Rose, NOAA Tide Station 9455920, Anchorage Alaska, During Observation Times in Reporting Period**

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## 5 MARINE MAMMAL OBSERVATIONS

During the 108.2 hours of observation over 13 days, three species of marine mammals were sighted, totaling 39 groups of 71 individual animals. The sightings consisted of

- 9 groups of belugas comprised of 41 individual animals,
- 27 individual harbor seals,
- 3 sightings of individual Steller sea lions,

The number of groups and the total counts of individual animals is presented in Table 10. The Figures C-1-1 through C-1-5 in Appendix C-1 show the locations of beluga groups sighted during pile installation, the figures in Appendix C-2 show all marine mammal sighting locations for the project. A table containing the time of first and last sighting, sighting duration, closest approach to the SFD, concurrence with pile installation, Level B zones (if applicable), and whether a take occurred or not is presented in Appendix D. All sighting data records including group composition, behaviors, sighting notes, locations, and distance to the SFD are provided electronically under Appendix G.

**Table 10. Marine Mammal Sightings and Observation Effort**

	<i>Project Total</i>	
<i>Observation Effort</i>	Days	13
	Hours	108.2
<i>Beluga</i>	Groups	9
	Individuals	41
	#/hr Observation	0.38
<i>Harbor Seal</i>	Groups	27
	Individuals	27
<i>Steller Sea Lion</i>	Groups	3
	Individuals	3
<b><i>All Marine Mammals</i></b>	<b>Groups</b>	<b>39</b>
	<b>Individuals</b>	<b>71</b>

### 5.1 Belugas

Belugas were observed on 7 of the 13 days of observation. The highest single day count occurred on 9 June 2022 when 11 belugas were sighted. Figures showing the beluga group locations relative to the SFD and active Level B zones during pile installation, shutdowns, and Level B exposures are provided in Appendix C-1. All beluga sightings and track lines for the project are presented in Appendix C-2. A heat map of beluga observation locations is presented in Figure 6. Beluga group locations were collected opportunistically, and groups located closer to the PSO stations on the eastern shore were likely measured more frequently, giving the impression of a higher apparent density than the groups located further away. However, the higher apparent density on the western shore of Knik Arm, relative to the mid-Inlet portion, is likely from actual beluga presence, and not an opportunity bias.

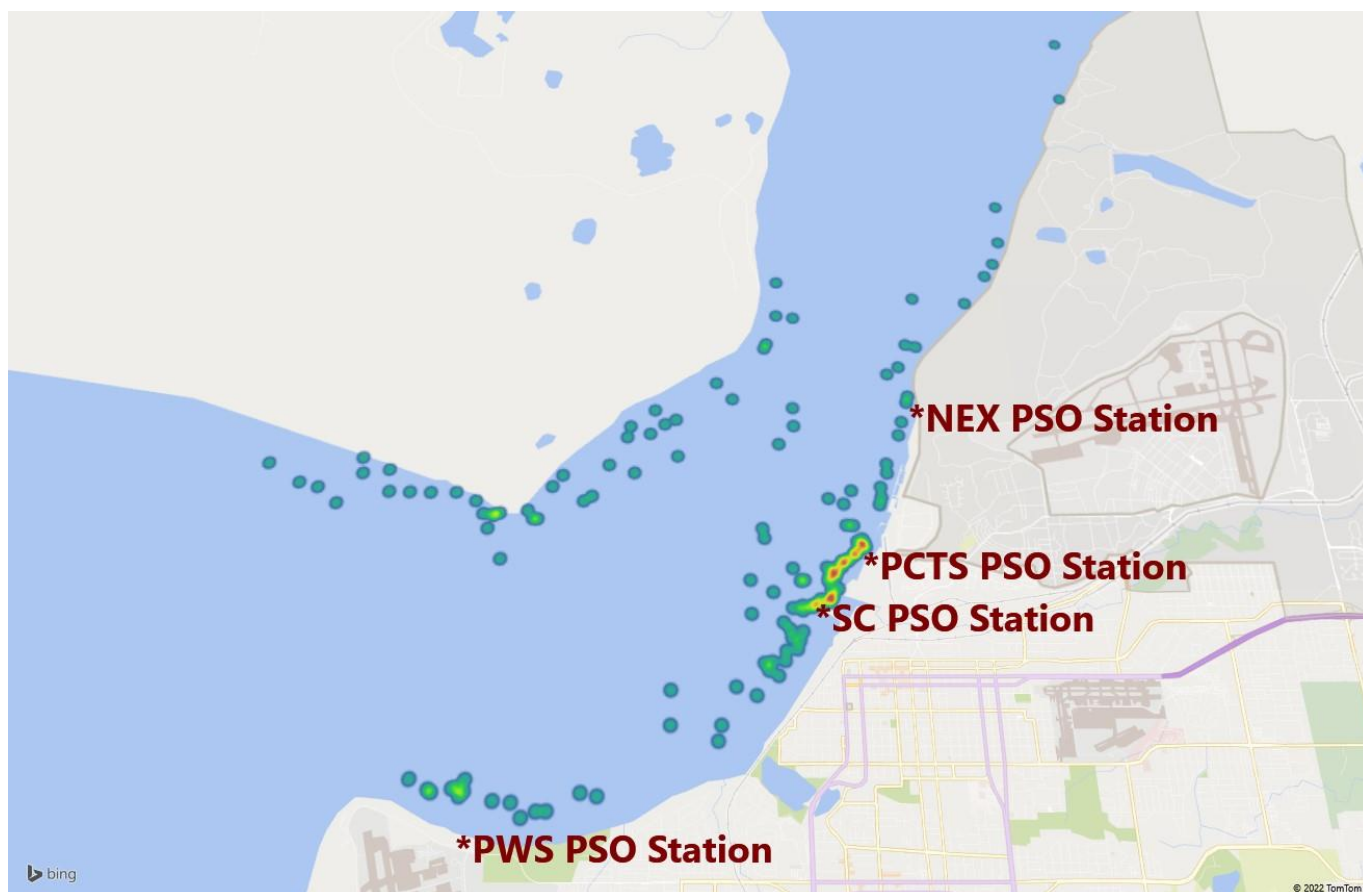


Figure 6. Heat map of beluga observation locations during SFD construction

### 5.1.1 Group Composition

The composition of each group was documented by counting the number of white, gray, and calf belugas. The PSOs did not observe any neonates and the “unknown” category was not used for any sightings. The PSOs recorded the minimum, maximum, and “best” count for each category of beluga, however only the “best” counts were used for reporting of potential takes and data analysis. The minimum and maximum counts are provided in the electronic records in Appendix G. The total belugas counted, and percentages of each category are presented in Table 11.

The definitions of the color classifications are as follows:

- **White:** Large, bright white to dull white
- **Gray:** Large (larger than calves), light to medium gray
- **Calf:** Dark gray, 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 meters [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

**Table 11. Beluga Group Age Class Composition by Month**

	<i>White</i>		<i>Gray</i>		<i>Calves</i>		<i>Total Belugas</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
<i>Belugas per Color Category</i>	36	87.8%	4	9.8%	1	2.4%	<b>41</b>

### 5.1.2 Behaviors

The electronic sighting form allowed for entry of a primary and secondary behavior for each group observed, indicating the predominant and second-most predominant behaviors observed during the sighting. The pace of movement and the group formation (orientation relative to other group members) was also recorded, providing additional qualitative information. Additional behaviors were noted in the comments of sightings as needed. The silty waters of Upper Cook Inlet obscure marine mammals when they are below surface, therefore, behaviors can only be observed during short intervals at the surface. No visible or overt avoidance behaviors or reactions such as startling or splashing were recorded. Behaviors were determined primarily from the speed of movement and the general orientation of the animals within the group. For example, parallel or linear group formations and a moderate pace may indicate traveling behavior while a random orientation and sedate pace may indicate milling behavior. Of the nine groups of belugas sighted during the SFD construction, “traveling” was recorded as the primary behavior for each group. The behavior “milling” was recorded as the secondary behavior for eight of the nine groups. No secondary behavior was recorded for one of the groups as it maintained a traveling behavior throughout the sighting. Because of the small number of beluga groups, and the uniformity of the behaviors documented, no additional analysis of behavioral data was conducted.

Marine mammal sightings in 2020 and 2021 were categorized based on their timing relative to in-water pile installation or removal (IPIR) (POA 2021, 2022). Sightings during the SFD construction were categorized in the same manner. The events were segregated into one of five periods:

- **Non-IPIR** for sightings that occurred on days with no IPIR.
- **Before IPIR** for sightings that occurred prior to IPIR on a given day.
- **During IPIR** for sightings that occurred during (or within minutes of) IPIR.
  - Sightings in this category may overlap at the beginning, end, or briefly in the middle of IPIR, or in some instances, several short periods of IPIR would occur during marine mammal sightings that were tracked for several hours.
  - Some groups were sighted several minutes before or after IPIR but were reported as potential exposures because the distance required to be outside of the zone at the time of IPIR could not realistically be traversed in time. Every potential exposure was considered “during IPIR” even if the sighting times did not overlap with actual IPIR events.
- **Between IPIR** for sightings that occurred between instances of IPIR, ranging from a few minutes to several hours.
- **After IPIR** for sightings that occurred after IPIR was completed for the day.

Of the nine beluga groups sighted during construction of the SFD, one occurred on a non-IPIR day, three occurred before IPIR, and five occurred during IPIR.

## BEHAVIORAL REACTIONS

In 2020 and 2021, the travel patterns of beluga groups sighted in the monitoring area during IPIR were evaluated for reactive or avoidance behavior (POA 2021, 2022). The travel patterns were placed into three categories of reaction:

- 1) **None:** No reaction was discernible. Many groups in this category were already moving away when IPIR began, often because IPIR had been delayed until the group moved out of a Level B zone.
- 2) **Toward:** A group was observed moving toward active IPIR or is believed to have moved towards it based on the circumstances. For example, if IPIR was occurring for a long period of time prior to the group appearing in the monitoring area, it would indicate it approached the area despite the ongoing sound source. Many of the shutdown events and potential exposure events are examples of beluga groups moving “toward” active IPIR.
- 3) **Potential:** A “potential reaction” is one where:
  - a. a group reversed its trajectory shortly after the start of IPIR.
  - b. reversed trajectory as it got closer to the sound source during active IPIR.
  - c. upon the initial sighting the group was already moving away from IPIR, raising the possibility that it had been moving towards, but was only sighted after they turned away.

Narratives of each of the events are in the Appendices of the 2020 and 2021 reports (POA 2021, 2022).

Five groups of belugas were sighted during SFD vibratory pile installation. No definitive behavioral reactions to the vibratory pile installation were documented. The travel patterns of the beluga groups were evaluated for behavioral reactions in the same manner as the previous years. Two groups (1314 and 1317) were moving away from the SFD prior to vibratory installation and maintained their trajectory moving away. The behavioral reaction for these two groups was categorized as *none*. Two of the groups (1344 and 1369) were classified as moving *toward* the pile installation. One single beluga (group 1358) was classified as having a *potential* reaction because its position and trajectory was difficult to track. It is unknown if it moved toward or away from the SFD during the period in which the vibratory hammer operated. Narratives of these events during SFD construction are contained in Appendix F.

A total of 66 events have been evaluated over the three seasons of construction, which include PCT Phase 1 (2020), PCT Phase 2 (2021) and the SFD (2022). Of these, 56 occurred during vibratory pile driving. Thirteen of the 56 events were classified as a *potential* reaction to vibratory IPIR. However, 9 of the 13 groups were traveling away from the PCT/SFD when first sighted and were only classified as *potential* reactions because their trajectory during IPIR was unknown. The remaining four groups that displayed a *potential* reaction were more difficult to classify but were also not clear reversals or other changes in trajectory.

Ten of the events analyzed occurred during impact pile driving. Six of these were classified as a *potential* reaction. In one of the six, the belugas (group 956 in 2021) reversed direction as they approached the Level B zone for impact pile driving. One group was milling outside of a Level B zone, but then began to travel away after impact pile driving started (group 167 in 2020). During one reaction that was classified as moving *toward* impact pile driving (groups 415 and 416 in 2020), one of the three belugas in the initial group split off and continued toward the sound source, but two of the original group reversed direction and moved away. While anecdotal, these narratives indicate that impact hammering may cause behavioral reactions more readily than vibratory hammering.

Evaluation of the movements relative to pile installation timing is subjective, and other analysts may categorize some events differently. Some of the sightings evaluated are also “incomplete” – meaning that the group was not tracked through the entire monitoring area from start to finish. Some groups were within the monitoring area when first sighted, and movements prior to the sighting are unknown. Some groups were not seen leaving the monitoring area. Table 12 summarizes the 66 beluga sightings that occurred during IPIR since 2020.

**Table 12. Beluga Reactions During IPIR 2020 through 2022**

<i>Reaction</i>	<i>Impact</i>		<i>Vibratory</i>		<i>Total</i>	
	No.	%	No.	%	No.	%
<i>Potential</i>	6	60.0%	13	23.2%	19	28.8%
<i>None</i>	3	30.0%	22	39.3%	25	37.9%
<i>Towards</i>	1	10.0%	21	37.5%	22	33.3%
<b><i>Total</i></b>	<b>10</b>		<b>56</b>		<b>66</b>	

### 5.1.3 Sighting Rates

Beluga sighting rates during construction of the SFD were comparable to the sighting rates documented in May and June of 2020 and 2021. To normalize for differences in hours of observation each day, beluga sighting rates were determined based on the number of belugas sighted per hour of observation (b/hr<sub>o</sub>). The beluga sighting rate from 20 May to 11 June 2022 during construction of the SFD was 0.38 b/hr<sub>o</sub>. In May and June 2020 and 2021, the sighting rate ranged between 0.18 and 0.56 b/hr<sub>o</sub>.

Table 13 presents the number of observation days, observation hours, belugas sighted, and sighting rates (b/hr<sub>o</sub>).

**Table 13. Observation Days, Observation Hours, Belugas Sighted, and Beluga Sighting Rate by Month**

	<i>SFD</i> <i>(20 May to</i> <i>11 June 2022)</i>	<i>May</i> <i>2022</i>	<i>June</i> <i>2022</i>	<i>May</i> <i>2020</i>	<i>June</i> <i>2020</i>	<i>May</i> <i>2021</i>	<i>June</i> <i>2021</i>
<i>Observation Days</i>	13	5	8	30	30	28	18
<i>Observation Hours</i>	108.2	40.7	67.5	301.4	318.1	272.8	186.0
<i>Belugas Sighted</i>	41	21	20	168	114	49	38
<i>Belugas per Hour of Observation (b/hr<sub>o</sub>)</i>	0.38	0.52	0.31	0.56	0.36	0.18	0.20

## 5.2 Harbor Seals

Harbor seals were the second-most abundant marine mammal in the monitoring area. Harbor seals are not gregarious or social and most sightings were of individual animals. Over the monitoring period, 27 individual harbor seals were sighted, resulting in 0.25 seals/hr<sub>o</sub>. All of the sightings were of individual adult seals; no juveniles or pups



were sighted. Harbor seals were observed near the NEX, PCTS, and SCS PSO stations and were commonly sighted near the mouth of Ship Creek (Figure C-2-2 in Appendix C-2).

The predominant behaviors for harbor seals were “looking” and “sink,” accounting for 59.3% and 63.0% of the primary and secondary behaviors recorded, respectively. Feeding was observed or suspected in over 20% of the sightings. No behavioral reactions in response to pile installation were recorded. Table 14 presents the primary and secondary behaviors recorded for harbor seals.

**Table 14. Harbor Seal Primary and Secondary Behaviors**

	<i>Primary Behavior</i>	<i>Secondary Behavior</i>
<i>Looking</i>	59.3%	18.5%
<i>Feeding Observed</i>	14.8%	0.0%
<i>Milling</i>	11.1%	14.8%
<i>Traveling</i>	7.4%	0.0%
<i>Feeding Suspected</i>	7.4%	0.0%
<i>Sink</i>	0.0%	63.0%
<i>Porpoising</i>	0.0%	3.7%

### 5.3 Steller Sea Lions

Three individual Steller sea lions were observed during SFD construction. Two were observed on the same day, approximately three hours apart, and in the same vicinity (near Port MacKenzie). Given the relative rarity of Steller sea lion sightings in Knik Arm, it is likely that the second was a resighting of the first. In all three sightings, the primary behavior was “traveling,” with the secondary behavior or “milling” or “none.” The locations of Steller sea lion sightings are presented on Figure C-2-2 in Appendix C-2.

## 6 MARINE MAMMAL EXPOSURES

During SFD construction, potential Level B exposures of 2 belugas and 13 harbor seals were reported, representing 4.9% and 48% of the numbers of each species sighted, and 8.3% and 68.4% of the authorized Level B takes for each species, respectively. No marine mammals were sighted within the Level A zones for vibratory pile driving. No impact pile driving was conducted. For both beluga exposures, the sightings occurred after vibratory pile installation had ceased, but they were likely within the Level B zone during the activity because of their proximity upon sighting them.

Because of the number of Level B harbor seal takes allowed and their regular presence at the mouth of Ship Creek, shutdowns were not initiated for harbor seals. Had any harbor seals been seen within or approaching the 100-meter shutdown zone, a shutdown of pile installation would have been initiated, but the situation did not arise. Table 15 presents the number of Level B takes recorded for each species. Additional details of the potential Level B exposures of belugas are presented in Table 16.

**Table 15. Number of Level A and Level B Takes Authorized and Recorded During the SFD Project**

<i>Species or DPS</i>	<i>Number of Level A Takes Authorized</i>	<i>Number of Level B Takes Authorized</i>	<i>Number of Level A Takes Recorded</i>	<i>Number of Level B Takes Recorded</i>
<i>Cook Inlet beluga whale</i>	0	24	0	2
<i>Western DPS Steller sea lion</i>	2	2	0	0
<i>Humpback whale</i>	0	2	0	0
<i>Harbor seal</i>	2	19	0	13
<i>Harbor porpoise</i>	0	12	0	0
<i>Killer whale</i>	0	6	0	0

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**Table 16. Potential Beluga Exposures**

Group	Group Count	First - Last Sighted	Sighting Duration (hh:mm)	Closest Approach (meters)	Hammer	Time of First Sighting in Level B Zone	Pile Installation Times	Estimated Duration w/in Harassment Zone
					Attenuation			
					Pile Size			
					Level B Zone (meters)			
Group 1358	1	6/10/2022 0800 – 6/10/2022 1401	6:01	86	Vibratory	1322	1311 - 1311	30 seconds
					Bubble Curtain			
					36			
					4,106			
<p><b>Potential Exposure Description:</b> At 0800 a single beluga was sighted near Ship Creek. Between 0800 and 1222 it traveled and milled near Ship Creek, the SFD and Bootleggers Cove. At 0928 the construction crew was ready to begin pile driving, and a delay was started because the beluga remained within the Level B zone. From 1106 to 1232 the beluga was milling in Bootleggers Cove, and when it was not resighted for more than 30 minutes, the delay was ended at 1302. At 1311 PPM operated the vibratory hammer with a bubble curtain for approximately 30 seconds. The Level B zone was 4,106 meters. At 1322 the beluga was resighted in Bootleggers Cove approximately 1,600 meters from the SFD. It was therefore likely that it was within the Level B zone during the brief period during which the hammer was used. At the end of the sighting the beluga traveled north past Ship Creek, then near the SFD, then offshore away from the POA where it was not resighted. Additional sighting details are provided in the electronic records (Appendix G) and a track line of the beluga sighting is provided in Figure C-1-4 in Appendix C-1.</p>								
Group 1369	1	6/11/22 1100 – 6/11/22 1252	1:52	56	Vibratory	1100	0858 – 1054 (intermittent)	<14.8 minutes
					Bubble Curtain			
					36			
					4,106 / 8,318			
<p><b>Potential Exposure Description:</b> From 0952 to 1054, the construction crew intermittently conducted 14.8 minutes of vibratory installation of a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. At 11:00, six minutes after the hammer was deactivated, a single beluga was first observed 56 meters from the pile. It is possible that the beluga traveled from outside of the zone to within 56 meters of the pile in less than one hour, thereby not being exposed to the entire 14.8 minutes of vibratory hammering, but it is unlikely that it was not within the Level B zone for at least some portion of the use of the hammer. The beluga remained near the SFD and was last sighted between Ship Creek and the SFD. Additional sighting details are provided in the electronic records (Appendix G) and a track line of the beluga sighting is provided in Figure C-1-5 in Appendix C-1.</p>								

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## 7 IMPLEMENTATION AND EFFECTIVENESS OF MITIGATION MEASURES

Nearly all mitigation measures outlined in the IHA and BiOp were applicable during the SFD construction season. Overall, the measures were successful in minimizing the total number and duration of Level B exposures for endangered Cook Inlet belugas. No Level A exposures of belugas occurred. No Level A or Level B exposures of Steller sea lions were recorded. No humpback whales, killer whales, or harbor porpoises were observed during the monitoring program.

Classroom and field training of PSOs and briefing of the construction crew regarding the monitoring and mitigation measures were the primary means of implementing the marine mammal monitoring and mitigation plan (POA 2020) to minimize the effect to protected species. Immediate communication of sightings to the construction crew, and the rapid shutdown of pile installation (when it was safe to do so) was effective in minimizing the effect to endangered species. The observation of the monitoring area from four stations, with two or three PSOs at each station, and use of large-aperture binoculars were effective in monitoring the large zones. However, beluga groups were not always sighted prior to entering the Level B zones and were not always viewed leaving the zones. The addition of more stations or more PSOs would likely only provide marginal benefit. Monitoring 30 minutes prior to pile installation was effective in avoiding takes, as beluga groups were sometimes present at the start of monitoring each day. Monitoring for 30 minutes after pile installation did not minimize the effect to endangered species but did provide additional data on whether marine mammals return to potentially abandoned areas upon cessation of pile installation. For additional context see Table 12 in Section 5.1.2 summarizing beluga reactions based on travel patterns which found that 39.3% of belugas had no reaction, 37.5% moved toward vibratory pile driving, and 23.2% had a potential reaction (these classification categories are also defined in Section 5.1.2).

It is not clear whether adverse effects were significantly minimized by delaying vibratory pile installation when belugas were sighted within or approaching the pre-pile driving clearance zones. During vibratory pile driving, belugas displayed no observable reactions and sometimes continued their trajectory towards the SFD despite the large Level B zones. Non-detectable effects, reactions, or behavioral changes may be prevented by the mitigation measure. Delaying vibratory pile driving when belugas were within the pre-pile driving clearance area, but outside of the Level B zone, may reduce adverse effects, but the reduction is not readily apparent in the observation data. The requirement to conduct pile installation only during daylight hours and when visibility allowed for monitoring of the Level B zones had the obvious effect of avoiding disturbance to animals that could not be observed if present.

Implementing delays of the start of pile installation were effective in minimizing the adverse effect to belugas. No delays were caused from a lack of visibility or sea state. Eight delays were caused due to the presence of belugas totaling 11.2 hours. The delays of pile installation are detailed in Table 17.

Several other mitigation measures were employed during the project including:

- On 27 April 2022, a classroom training and briefing was held for the PSOs to discuss responsibilities, communication procedures, the marine mammal monitoring protocol, operational procedures, marine mammal identification and behaviors, and data-entry protocols.
- On 28 April 2022, field training was held for the PSOs to practice setting up and using equipment, data entry, radio use, and monitoring.
- On 13 May, a briefing was held for the SFD construction personnel, POA staff, and 61N project manager.
- Every day that pile installation work was conducted, 11 PSO were stationed on watch:

- 3 at PWS
  - 3 at SCS
  - 2 at the PCTS
  - 3 at NEX
  - Occasionally 2 were stationed at the CP beach (one from SCS, one from NEX)
- Pile installation occurred only during daylight hours.
  - Marine mammal monitoring occurred for 30 minutes prior to the start of pile installation each morning. Monitoring did not cease until the end of the scheduled day, or until no additional pile installation was planned.
  - Monitoring was conducted for at least 30 minutes after pile installation each day.
  - No shutdowns of pile installation were required because no belugas were sighted within or approaching the applicable Level B zone and no other marine mammals were sighted within or approaching the 100-meter shutdown zone.
  - The pre-clearance zone between the inbound and outbound demarcation lines identified in the IHA and BiOp was monitored for beluga whales prior to the start of all pile installation. If belugas were present inside of the pre-clearance zone, and on a trajectory towards the Level B zone, pile installation was delayed until belugas were on a trajectory away from the Level B zone.
  - The construction crew used an open ring bubble curtain that met the specifications of the IHA and BiOp for installation of all plumb (vertical) piles during SFD construction.
  - The construction crew did not operate two vibratory hammers concurrently.
  - No species for which takes were not authorized were sighted during pile installation, requiring shutdowns for unauthorized takes.
  - The four PSO stations identified in the IHA and BiOp were staffed as required and equipped beyond the minimum requirements. Four digital theodolites were used, one at each PSO station. Fujinon™ 25X150 large-aperture binoculars were used at PWS, SCS, and NEX. High-powered (20-40X) tripod-mounted binoculars and/or a 20–60X spotting scope were used at the PCTS. Handheld marine-grade 7X50 Fujinon™ binoculars with reticle and compass were provided at each PSO station. Range finders were provided at each PSO station, but in practice, the digital theodolites were used for testing and estimating distances.
  - The PSOs were independent and did not have additional duties. All PSO resumes were approved by NMFS prior to the start of the program. Many had prior experience in marine mammal observation, and several had prior Cook Inlet marine mammal monitoring experience, including all the designated PSO field lead and the 61N project managers.

**Table 17. Shutdowns and Delays Implemented in During SFD Construction**

<i>Delay/ Shutdown Type</i>	<i>Start Time</i>	<i>End Time</i>	<i>Marine Mammal Group ID</i>	<i>Mitigation Duration (minutes)</i>	<i>Description</i>
<i>Delay, marine mammal</i>	5/21/2022 1009	5/21/2022 1031	1314	22.4	At approximately 0850, the SCS station radioed that they were observing a group of beluga whales heading northeast toward Port MacKenzie from Point MacKenzie. The construction crew was notified right away as they were starting to loft a 36-inch pile for location B-8. The group of nine whales reached Port MacKenzie and milled for approximately thirty minutes. They then traveled southwest and departed the 4,106-meter Level B zone and on a trajectory away from the zone at 1028 AM (see Figure C-1-1 in Appendix C-1). A marine mammal delay was started at 1009 and ended at 1031. The delay was started when the pile was positioned, the vibratory hammer was placed on top of the pile, and the construction crew indicated they were ready to drive pile B-8. No exposures occurred.
<i>Delay, marine mammal</i>	5/22/2022 0949	5/22/2022 1103	1317	74.3	At approximately 0830, the SCS station radioed that they observed a group of beluga whales traveling east along the near shore coming from near Point Woronzof, within the in-bound demarcation line, but outside of the Level B zone. The construction crew was notified about the group and were placed on a marine mammal delay at 0949 when they had pile C-7 in position with the hammer resting on the pile. The group traveled northeast along the near shore from Point Woronzof to the PCTS station where they then traveled across Knik Arm. The group continued across and were then observed milling at Port MacKenzie. They then began traveling south and west along the far shore from Port MacKenzie (see Figure C-1-2 in Appendix C-1). The delay was ended at 1103 when the group was observed leaving the Level B zone and maintaining a trajectory away from the SFD. No exposures occurred.



**Table 17. Shutdowns and Delays Implemented During SFD Construction (continued)**

<i>Delay/ Shutdown Type</i>	<i>Start Time</i>	<i>End Time</i>	<i>Marine Mammal Group ID</i>	<i>Mitigation Duration (minutes)</i>	<i>Description</i>
<i>Delay, marine mammal</i>	5/27/2022 1012	5/27/2022 1015	1321	3.4	At 0959, the NEX station observed one Steller sea lion traveling north near Port MacKenzie near the boundary of the 4,106-meter Level B zone. The fix showed the Steller sea lion approximately 73 meters outside of the Level B zone. The Steller sea lion was last sighted at 1001 traveling north and away from the Level B zone. The construction crew had the hammer on a 36-inch pile with a bubble curtain in place when the sighting occurred. The PCTS station radioed construction crew and placed them on a delay until it could be determined if the sea lion was in the zone since only two Level B takes were authorized. The delay was ended at 1015. No exposures occurred.
<i>Delay, marine mammal</i>	6/8/2022 1127	6/8/2022 1228	1344	61.4	At 1114, the construction crew was using a vibratory hammer to drive a 36-inch pile with a bubble curtain at the D-2 location. The Level B zone was 4,106 meters. At 1116 the beluga group was initially observed outside of the inbound line pre-clearance line, 4,247 meters outside of the level B zone but on a trajectory towards the SFD. The construction crew was notified of the presence of inbound belugas and that a delay was probable. A delay was initiated at 1127 when the group was observed inside of the inbound line. The group traveled through the Level B zone and continued north, ending the delay at 1228 (see Figure C-1-3 in Appendix C-1). No exposures occurred.
<i>Delay, marine mammal</i>	6/9/2022 0857	6/9/2022 1006	1347	69.2	During preclearance observations, belugas were observed within the 4,106-meter Level B zone. At 0746, the construction crew was notified of beluga presence within this zone. No in water work was ready to begin at the time. At 0852, the construction crew was apprised of the continued beluga presence within the Level B zone and the potential for a delay. At 0857, the vibratory hammer was seated atop the 36-inch pile for the D-4 position and a delay was started. Group 1347 was last observed in the zone at 0935. After 30 minutes elapsed without sighting this group, the construction crew was given clearance to begin pile driving at 1006. No exposures occurred.

**Table 17. Shutdowns and Delays Implemented During SFD Construction (continued)**

<i>Delay/ Shutdown Type</i>	<i>Start Time</i>	<i>End Time</i>	<i>Marine Mammal Group ID</i>	<i>Mitigation Duration (minutes)</i>	<i>Description</i>
<i>Delay, marine mammal</i>	Delay 1: 6/10/2022 0928  Delay 2: 6/10/2022 1322	Delay 1: 6/10/2022 1302  Delay 2: 6/10/2022 1448	1358	Delay 1: 214.2  Delay 2: 86.6	At 0800, a single beluga was observed within the 4,106-meter Level B zone and the construction crew was notified. No in water work was ready to commence at the time. At 0829, the vibratory hammer was seated atop of the 36-inch pile to move into position. At 0928, the construction crew was ready to begin hammer operation, but beluga was still present, so a delay was initiated. The beluga traveled and milled throughout the Level B zone for the following several hours. At 1230 the beluga was sighted in Bootleggers Cove, approximately 3,200 meters away from the pile. Thirty minutes passed without resighting and the lead PSO informed the construction crew that pile driving could commence, but that a shutdown was possible if the beluga was resighted. The first delay lasted 214 minutes. At 1310, the construction crew used the vibratory hammer with a bubble curtain on a 36-inch pile for less than one minute. The Level B zone was 4,106 meters. At 1322 the beluga was sighted again (fix was taken at 1326) approximately 2,500 meters inside the Level B zone. The hammer was not active at 1322. The construction crew was notified that a second delay was required. The beluga was last seen at 1417 offshore of the POA (see Figure C-1-4 in Appendix C-1). After 30 minutes of no further beluga sightings, the lead PSO notified the construction crew of end of delay at 1448. This delay lasted 98 minutes and the driving of the D-5 pile began at 1459. This event was reported as a potential exposure.
<i>Delay, marine mammal</i>	6/11/2022 1102	6/11/2022 1323	1369	140.8	At 1100, a single beluga whale was observed near the construction barge and the D-6 pile driving slot. Prior to the sighting the construction crew was intermittently driving the 36-inch pile with a bubble curtain. The hammer had been deactivated for six minutes prior to the initial sighting. The event was reported as a potential exposure. A delay was immediately started. The beluga remained inside the 4,106-meter Level B zone for several hours (see Figure C-1-5 in Appendix C-1). The construction crew was cleared to resume pile driving at 1323 when 30 minutes had elapsed since the last sighted time.
<i>Total Mitigation Duration (minutes)</i>				672.3	
<i>Total Mitigation Duration (hours)</i>				11.2	

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## **APPENDIX A**

Daily Monitoring Effort, Weather, Visibility, and Sea Conditions

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Appendix A. Daily monitoring effort, weather, visibility, and sea conditions, South Float Dock, Anchorage AK, 20 May to 11 June 2022.

Date	Observation Effort			Weather/Precipitation Conditions; Percent Observed									Beaufort Sea State; Percent Observed						Visibility (meters); Percent of Distance Category			
	Observation Start Time	Observation End Time	Observation Duration (hrs)	Sun	Partly Sun	Partly Cloudy	Cloudy	Mist	Light Rain	Rain	Fog	Snow	0	1	2	3	4	>4	0-2499	2500-4999	5000-7499	7500-10000
20-May	07:23	15:56	8.6	87%	0%	13%	0%	0%	0%	0%	0%	0%	3%	75%	22%	0%	0%	0%	1%	1%	57%	40%
21-May	07:17	15:20	8.1	8%	29%	63%	0%	0%	0%	0%	0%	0%	0%	38%	62%	0%	0%	0%	0%	28%	37%	35%
22-May	07:17	15:15	8.0	13%	16%	62%	9%	0%	0%	0%	0%	0%	0%	62%	36%	1%	0%	0%	0%	20%	35%	45%
27-May	06:09	14:15	8.1	94%	0%	6%	0%	0%	0%	0%	0%	0%	3%	91%	6%	0%	0%	0%	0%	0%	41%	59%
31-May	07:11	15:15	8.1	0%	20%	80%	0%	0%	0%	0%	0%	0%	1%	55%	43%	0%	0%	0%	0%	1%	58%	41%
<b>May Summary</b>	<b>n/a</b>	<b>n/a</b>	<b>40.7</b>	<b>40%</b>	<b>13%</b>	<b>45%</b>	<b>2%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>1%</b>	<b>64%</b>	<b>34%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>10%</b>	<b>46%</b>	<b>44%</b>
1-Jun	07:12	15:15	8.1	82%	0%	18%	0%	0%	0%	0%	0%	0%	0%	15%	83%	1%	0%	1%	0%	0%	57%	43%
3-Jun	07:08	15:20	8.2	84%	0%	16%	0%	0%	0%	0%	0%	0%	4%	49%	45%	1%	0%	0%	0%	0%	48%	52%
5-Jun	07:01	15:15	8.2	11%	12%	77%	0%	0%	0%	0%	0%	0%	0%	27%	56%	13%	4%	0%	0%	7%	46%	46%
7-Jun	07:30	15:45	8.3	0%	0%	4%	91%	1%	3%	0%	0%	0%	2%	24%	53%	17%	4%	0%	0%	23%	43%	34%
8-Jun	07:08	15:20	8.2	4%	30%	29%	37%	0%	0%	0%	0%	0%	0%	63%	33%	4%	0%	0%	0%	1%	51%	47%
9-Jun	07:15	16:15	9.0	0%	8%	16%	72%	0%	4%	0%	0%	0%	0%	44%	55%	1%	0%	0%	1%	19%	11%	69%
10-Jun	07:11	16:35	9.4	4%	31%	43%	23%	0%	0%	0%	0%	0%	1%	61%	37%	0%	0%	0%	0%	12%	40%	48%
11-Jun	07:06	15:14	8.1	0%	22%	44%	34%	0%	0%	0%	0%	0%	0%	6%	35%	44%	15%	0%	0%	21%	28%	51%
<b>Jun Summary</b>	<b>n/a</b>	<b>n/a</b>	<b>67.5</b>	<b>22%</b>	<b>12%</b>	<b>31%</b>	<b>33%</b>	<b>0%</b>	<b>1%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>1%</b>	<b>36%</b>	<b>50%</b>	<b>10%</b>	<b>3%</b>	<b>0%</b>	<b>0%</b>	<b>11%</b>	<b>41%</b>	<b>49%</b>
<b>Project Total</b>	<b>n/a</b>	<b>n/a</b>	<b>108.2</b>	<b>29%</b>	<b>13%</b>	<b>36%</b>	<b>22%</b>	<b>0%</b>	<b>1%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>1%</b>	<b>46%</b>	<b>44%</b>	<b>7%</b>	<b>2%</b>	<b>0%</b>	<b>0%</b>	<b>10%</b>	<b>42%</b>	<b>47%</b>



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## **APPENDIX B**

Project Photos



Photo 1. View of SFD construction from PCT PSO Station



Photo 2. PSO monitoring construction at the PCT PSO station



Photo 3. View towards Ship Creek from PCT PSO station



Photo 4. View of Port Mackenzie from the PCT PSO station





Photo 5. Point Woronzof PSO station on bluff



Photo 6. Point Woronzof PSO station



Photo 7. Fujinon 25X150 MT-SX “big eye” binoculars at Point Woronzof



Photo 8. View of In-bound Pre-clearance Line from Point Woronzof PSO Station





Photo 9. View of Port of Alaska from Point Woronzof PSO station (Photo Credit: Kristina Smolenski – The Photo Gecko)



Photo 10. PSO using the digital theodolite at Ship Creek PSO station



Photo 11. View towards NEX PSO station from Ship Creek PSO station

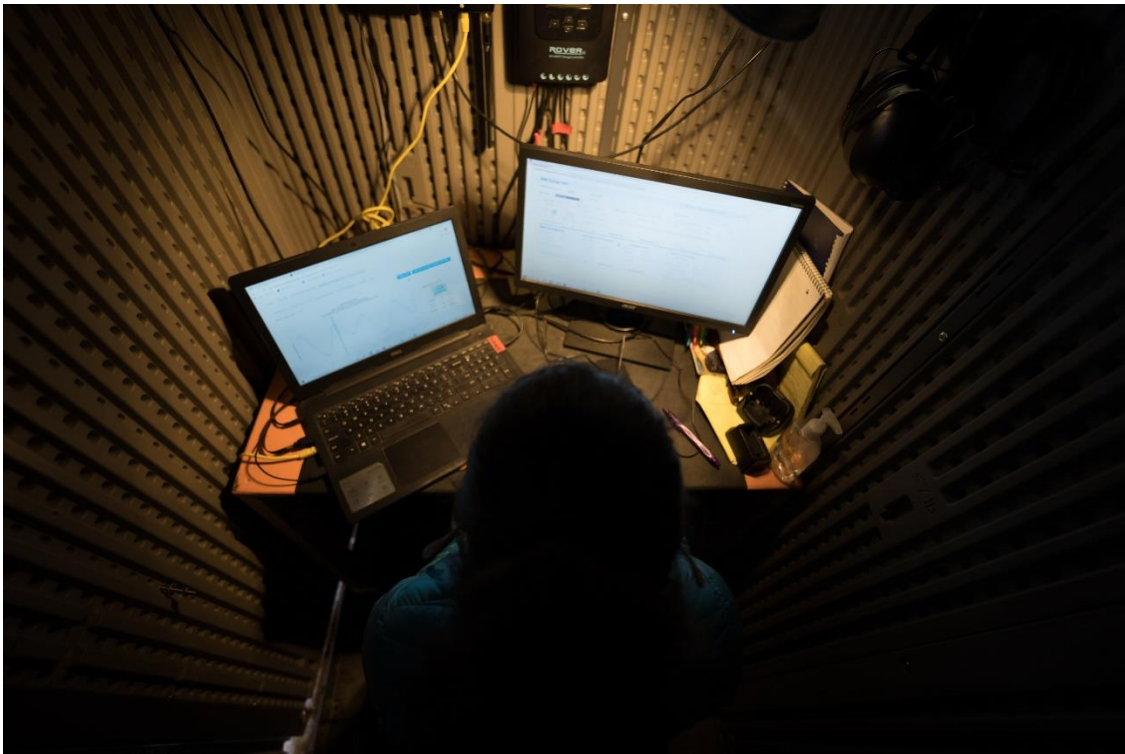


Photo 12. PSO entering data in the “data shack” at the NEX PSO station (Photo Credit: Kristina Smolenski – The Photo Gecko)





Photo 13. PSO using Topcon DT-205 digital theodolite (Photo Credit: Kristina Smolenski – The Photo Gecko)



Photo 14. Preparing to install battered pile. View towards SFD from Ship Creek PSO station through Fujinon 25X150 MT-SX “big eyes”



Photo 15. View towards SFD from NEX PSO station



Photo 16. NEX PSO Station





Photo 17. View north towards Cairn Point from NEX PSO station



Photo 18. PSO at the CP remote station, Cairn Point Beach (Photo Credit: Kristina Smolenski – The Photo Gecko)

## **APPENDIX C-1**

Figures -Beluga Groups Sighted During Pile Installation

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Figure C-1-1. Beluga Group 1314; 21 May 2022 Pile Installation Event





Figure C-1-2. Beluga Group 1317; 22 May 2022 Pile Installation Event





Figure C-1-3. Beluga Group 1344; 8 June 2022 Pile Installation Event



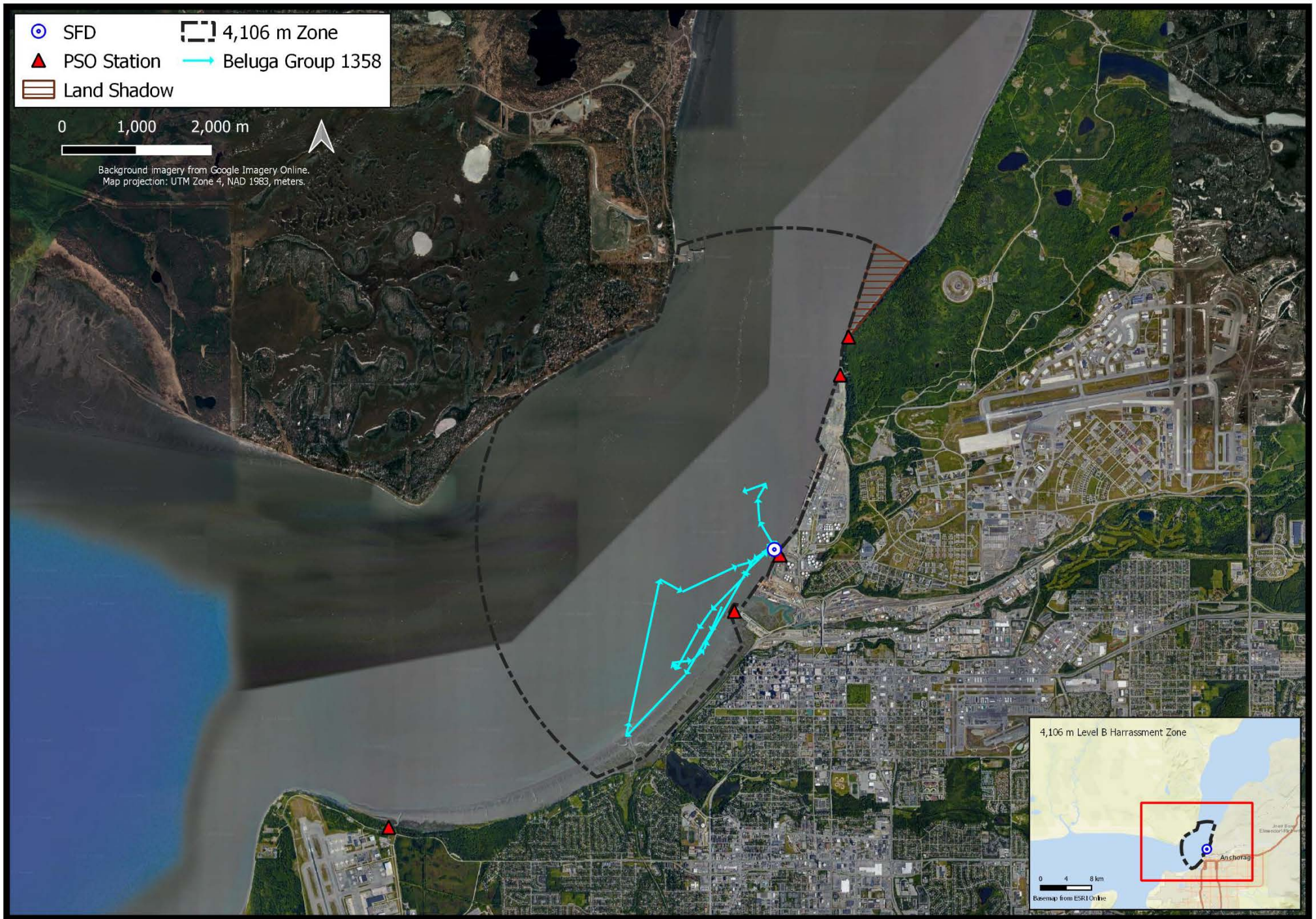


Figure C-1-4. Beluga Group 1358; 10 June 2022 Pile Installation Event



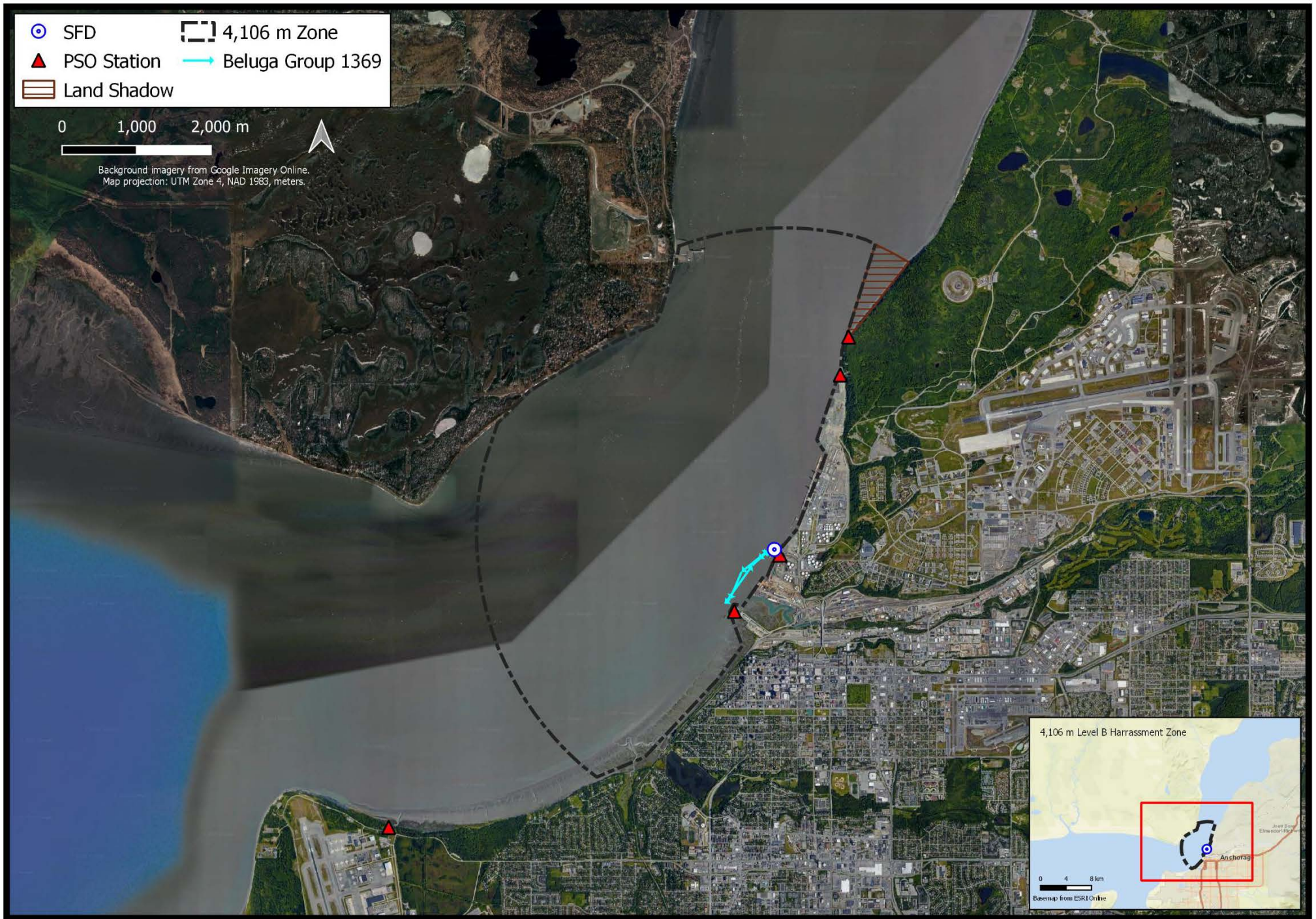


Figure C-1-5. Beluga Group 1369; 11 June 2022 Pile Installation Event

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## **APPENDIX C-2**

Figures - All Marine Mammal Sightings During SFD Project

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**2022 POA SFD  
Beluga Sightings  
May 20 - June 11**

- ⊙ POA SFD
- ▲ PSO Stations
- ⊙ Dredge Bouy

**Beluga Track Lines**

- Group 1314
- Group 1317
- Group 1325
- Group 1344
- Group 1347
- Group 1349
- Group 1350
- Group 1358
- Group 1369

0 1 2 km

61|N  
61 North Environmental



Background imagery from Google Imagery Online.  
Map projection: UTM Zone 4, NAD 1983, meters.



Figure C-2-1. Beluga Sightings and Track Lines During SFD Project



**2022 POA SFD  
Marine Mammal Sightings  
Overview - Non-Beluga Species  
May 20 - June 11**

- ⊙ POA SFD
- ▲ PSO Stations

**Marine Mammal Groups**

- Group 1318 Harbor Seal
- Group 1319 Steller Sea Lion
- Group 1321 Steller Sea Lion
- Group 1324 Harbor Seal
- Group 1327 Harbor Seal
- Group 1329 Harbor Seal
- Group 1330 Steller Sea Lion
- Group 1331 Harbor Seal
- Group 1333 Harbor Seal
- Group 1334 Harbor Seal
- Group 1336 Harbor Seal
- Group 1338 Harbor Seal
- Group 1339 Harbor Seal
- Group 1342 Harbor Seal
- Group 1343 Harbor Seal
- Group 1345 Harbor Seal
- Group 1348 Harbor Seal
- Group 1351 Harbor Seal
- Group 1354 Harbor Seal
- Group 1355 Harbor Seal
- Group 1356 Harbor Seal
- Group 1359 Harbor Seal
- Group 1360 Harbor Seal
- Group 1361 Harbor Seal
- Group 1362 Harbor Seal
- Group 1363 Harbor Seal
- Group 1365 Harbor Seal
- Group 1366 Harbor Seal
- Group 1367 Harbor Seal
- Group 1368 Harbor Seal

0 1,000 2,000 m



**61|N**  
61 North Environmental



Background imagery from Google Imagery Online.  
Map projection: UTM Zone 4, NAD 1983, meters.



Figure C-2-2. Steller Sea Lion and Harbor Seal Locations During SFD Project

## **APPENDIX D**

### Marine Mammal Sighting Times and Exposures



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**Appendix D. Marine Mammal Sighting Times and Exposures**

Species	Group ID	Number in Group	First Sighted	Last Sighted	Sighting Duration (HH:MM)	Closest Approach (meters)	Concurrence with Pile Installation	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Beluga	1314	9	5/21/22 8:50	5/21/22 11:08	2:18	2,873	During	n/a	n/a	n/a	n/a	No	
Beluga	1317	7	5/22/22 8:30	5/22/22 11:34	3:04	391	During	n/a	n/a	n/a	n/a	No	
Harbor Seal	1318	1	5/22/22 12:35	5/22/22 12:46	0:11	96	During	4,106	Vibratory	Bubble Curtain	36	B	
Steller Sea Lion	1319	1	5/27/22 6:15	5/27/22 6:17	0:02	4,401	Before	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	1321	1	5/27/22 9:59	5/27/22 10:01	0:02	4,180	Between	n/a	n/a	n/a	n/a	No	
Harbor Seal	1324	1	5/31/22 9:40	5/31/22 11:16	1:36	2,282	Non-pile	n/a	n/a	n/a	n/a	No	
Beluga	1325	5	5/31/22 12:03	5/31/22 14:58	2:55	156	Non-pile	n/a	n/a	n/a	n/a	No	
Harbor Seal	1327	1	6/1/22 10:28	6/1/22 12:08	1:40	2,197	After	n/a	n/a	n/a	n/a	No	
Harbor Seal	1329	1	6/3/22 9:28	6/3/22 9:33	0:05	3,809	During	8,318	Vibratory	Unattenuated	36	B	
Steller Sea Lion	1330	1	6/3/22 12:06	6/3/22 12:34	0:28	1,693	After	n/a	n/a	n/a	n/a	No	
Harbor Seal	1331	1	6/3/22 13:00	6/3/22 15:16	2:16	709	After	n/a	n/a	n/a	n/a	No	
Harbor Seal	1333	1	6/5/22 7:33	6/5/22 7:39	0:06	2,835	After	n/a	n/a	n/a	n/a	No	
Harbor Seal	1334	1	6/5/22 15:38	6/5/22 16:49	1:11	2,426	During	8,318	Vibratory	Unattenuated	36	B	
Harbor Seal	1336	1	6/7/22 7:21	6/7/22 14:08	6:47	298	During	8,318	Vibratory	Unattenuated	36	B	
Harbor Seal	1338	1	6/7/22 12:10	6/7/22 12:10	0:00	2,556	During	8,318	Vibratory	Unattenuated	36	B	
Harbor Seal	1339	1	6/7/22 15:19	6/7/22 15:36	0:17	2,612	After	n/a	n/a	n/a	n/a	No	
Harbor Seal	1342	1	6/8/22 7:37	6/8/22 8:12	0:35	681	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1343	1	6/8/22 8:45	6/8/22 8:53	0:08	3,126	Before	n/a	n/a	n/a	n/a	No	
Beluga	1344	7	6/8/22 11:16	6/8/22 13:26	2:10	2,320	During	n/a	n/a	n/a	n/a	No	
Harbor Seal	1345	1	6/8/22 14:36	6/8/22 14:36	0:00	2,486	After	n/a	n/a	n/a	n/a	No	
Beluga	1347	2	6/9/22 6:55	6/9/22 9:35	2:40	179	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1348	1	6/9/22 7:18	6/9/22 7:34	0:16	702	Before	n/a	n/a	n/a	n/a	No	
Beluga	1349	7	6/9/22 7:40	6/9/22 8:23	0:43	4,522	Before	n/a	n/a	n/a	n/a	No	
Beluga	1350	2	6/9/22 6:55	6/9/22 9:46	2:51	1,738	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1351	1	6/9/22 9:51	6/9/22 10:47	0:56	486	During	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1354	1	6/9/22 9:55	6/9/22 9:57	0:02	2,670	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1355	1	6/9/22 13:23	6/9/22 13:23	0:00	1,600	During	8,318	Vibratory	Unattenuated	36	B	
Harbor Seal	1356	1	6/9/22 13:59	6/9/22 16:11	2:12	133	During	8,318	Vibratory	Unattenuated	36	B	
Beluga	1358	1	6/10/22 8:00	6/10/22 14:01	6:01	86	During	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1359	1	6/10/22 8:10	6/10/22 8:20	0:10	1,716	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1360	1	6/10/22 8:21	6/10/22 9:20	0:59	2,422	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1361	1	6/10/22 10:11	6/10/22 11:00	0:49	736	Before	n/a	n/a	n/a	n/a	No	
Harbor Seal	1362	1	6/10/22 12:06	6/10/22 12:50	0:44	861	During	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1363	1	6/10/22 14:20	6/10/22 14:20	0:00	760	Between	n/a	n/a	n/a	n/a	No	
Harbor Seal	1365	1	6/11/22 7:50	6/11/22 11:55	4:05	685	During	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1366	1	6/11/22 8:53	6/11/22 8:53	0:00	5,165	During	8,318	Vibratory	Unattenuated	36	B	
Harbor Seal	1367	1	6/11/22 10:11	6/11/22 11:29	1:18	2,312	During	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1368	1	6/11/22 10:51	6/11/22 13:06	2:15	109	During	4,106	Vibratory	Bubble Curtain	36	B	
Beluga	1369	1	6/11/22 11:00	6/11/22 12:52	1:52	46	During	4,106	Vibratory	Bubble Curtain	36	B	

Notes: **Bold** = pile installation or removal occurred during sighting.

**Blue** = potential Level B take. **Red** = potential Level A take.

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## **APPENDIX E**

Data Collection Attribute Definitions

*excerpted from POA 2019, Appendix A*

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## Appendix E. Data Collection Attribute Definitions (excerpted from POA 2019, Appendix A)

Table 3-5. Marine Mammal Observation Data Attributes

Data Attribute	Attribute Definition and Units Collected
<b>Marine Mammal Sighting Data</b>	
Group identification code	Each group of marine mammals will be given a unique group identification code. This group identification code is <b>not species specific</b> . 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: <b>White</b> - Large, bright white to dull white <b>Gray</b> - Large (larger than calves), light to medium gray <b>Dark gray</b> - <u>Calf</u> - Dark gray, relatively small (<2/3 the total length of white belugas), almost always swimming within 1 body length of larger whale <u>Neonate</u> - Newborns (estimated to be hours to days old, based on extremely small size (~1.5 m [5 ft]), a wrinkled appearance due to the presence of fetal folds, and uncoordinated swimming and surfacing patterns <b>Unknown color</b> - 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 3-6). 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

**Appendix E. Data Collection Attribute Definitions (excerpted from POA 2019, Appendix A)**

Data Attribute	Attribute Definition and Units Collected
Formation (for beluga whales only)	<p>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:</p> <p><b>Circular (C)</b> – arranged in a circular group while moving in one direction</p> <p><b>Parallel (P)</b> – alongside each other, spread perpendicular to direction of movement</p> <p><b>Linear (L)</b> – forming a line, spread along direction of movement</p> <p><b>Echelon (E)</b> – Arranged diagonally, each beluga whale to the side and behind beluga ahead of it; also includes “V” formation</p> <p><b>No Formation (NF)</b> – Random or un-patterned formation</p>
Spread (for beluga whales only)	<p>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.</p>
Number of animals taken	<p>Indicate the number of animals potentially exposed to Level A and Level B harassment during the sighting</p>

Table 3-6. 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



## Appendix E. Data Collection Attribute Definitions (excerpted from POA 2019, Appendix A)

Activity	Code	Definition
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



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## **APPENDIX F**

Beluga Reactions to Pile Installation and Removal

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**Appendix F. Beluga Reactions to Pile Installation and Removal**

Group	Date	Reaction	Hammer	Mitigation	Narrative of Event
1314	21 May 2022	None	Vibratory	Delay	Beluga group 1314 was first sighted at 0850 before the crew was ready to begin pile installation. At 1009, the crew was ready to begin vibratory installation of a 36-inch pile, but the group was within the 4,106-meter Level B zone, and the installation was delayed. The group continued a trajectory southwest near the far shore towards Point Mackenzie. At 1028, the group was sighted outside of the zone and on a continued trajectory away. The delay was ended at 1031, and pile installation began at 1041. The group continued its trajectory toward, and then around Point Mackenzie. The group was last sighted at 1108 heading west towards the Little Susitna River.
1317	22 May 2022	None	Vibratory	Delay	Beluga group 1317 was first sighted at 0830 near Point Woronzof, traveling northeast along the near shore, within the in-bound demarcation line, but outside of the Level B zone. At 0949 the construction crew was ready to begin vibratory installation of a 36-inch pile, but the group was within the 4,106-meter Level B zone, and the installation was delayed. The belugas crossed over toward Port Mackenzie where they milled for a period before traveling southwest towards Point Mackenzie. The exited the Level B zone and continued on a trajectory away from the SFD. The delay was ended at 1103. Pile installation began at 1116, at which point the belugas rounded Point Mackenzie and were traveling west towards the Little Susitna River. They maintained their westward trajectory after pile installation began.
1344	08 Jun 2022	Toward	Vibratory	Delay	At 1114, the construction crew began installation of a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. At 1116, beluga group 1344 was sighted west of Point Mackenzie, over 8,000 meters from the SFD. The vibratory hammer was used intermittently between 1114 and 1123. During this time the group continued its trajectory towards the SFD, along the shore near Point Mackenzie. At 1127, the PSOs notified the construction crew that the beluga group was nearing the Level B zone, and a delay was initiated. The beluga group traveled east/northeast crossing over towards Cairn Point, then traveling north along the eastern shore of Knik Arm towards Sixmile Creek and Eagle River. Vibratory hammering was resumed at 1237, and the belugas maintained their trajectory north.
1358	10 Jun 2022	Potential	Vibratory	Delay	A single beluga (group 1358) was first sighted at 0800, near Ship Creek. No in-water work was occurring. By 0928, the crew was ready to begin pile installation, but the beluga remained within the 4,106-meter zone, and delay was initiated. The beluga milled between the SFD construction area, Ship Creek, and Bootleggers Cove for several hours. The beluga was last observed at 1230 in Bootleggers Cove, approximately 3,200 meters from the SFD. After 30 minutes passed without a resighting, the delay was lifted. Vibratory hammering began at 1310 for less than one minute. At 1322, the beluga was resighted about 1,600 meters from the SFD. This was reported as a potential exposure. The construction crew was placed on another delay. The beluga continued milling near the SFD and POA until it was last sighted at 1417. After 30 minutes without resighting the beluga, the delay was lifted at 1448. Pile installation resumed at 1459.
1369	11 Jun 2022	Toward	Vibratory	Delay	From 0858 to 1054 the construction crew was installing a 36-inch pile with a vibratory hammer, attenuated by a bubble curtain. At 1100, six minutes after vibratory pile driving ceased, a single beluga (group 1369) was sighted approximately 150 meters from the SFD. The crew was ready to resume pile driving, but a delay was initiated at 1102. The beluga remained milling between the SFD and Ship Creek for more than 2 hours. At 1323, the beluga had not been resighted for 30 minutes, and the delay was lifted. Vibratory installation with a bubble curtain resumed at 1331 and continued until 1443. The beluga was not resighted during this time.

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## **APPENDIX G**

Electronic Deliverables