SUBMITTAL COVER SHEET

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PCT-2021- Marine Mammal Monitoring Final Report

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: Stewart Willis

Owner's Respresentative Review:

☒ No Exceptions Taken
☐ Exceptions Noted
☐ Revise and Resubmit
☐ Rejected
☐ Review Not Required

Notes (additional notes/comments may be attached):

Owner's Representative Signature: SC for Simeon Brubaker

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.

2021 Petroleum and Cement Terminal Construction Marine Mammal Monitoring

Final Report

February 2022

Prepared for

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ACKNOWLEDGMENTS

The success of this project would not be possible without the dedicated professional protected species observers who spent long days in the field in extreme weather conditions: Terra Hanks (PSO field lead), Dennis Moore (PSO field lead), Duncan Allen (PSO field lead), Cara Hesselbach (PSO field lead), Cassie Andrus, David Besh, Joe Brazil, Krista Brown, Corina Cabrera, Thomas Droz, Katherine du Plessis, Arika Garcia, Mackenzie Garner, Drew Hamilton, Tori Horsley, Olivia Kavanaugh, Araceli Lucks, Deb Marchione, Courtney Neumann, Kori Orion, Kellie Richmond, Jessica Roberts, Emily Romero, Erich Schrader, Kristina Smolenski, Lisa Vitale, Dan Vos, Neil Walsh, Grace Wyatt, and Katherine Yahnke.

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ACRONYMS AND ABBREVIATIONS

%	percent
b-hr/hr_o	beluga-hours per hour of observation
b/km^2	belugas per square kilometer
km^2	square kilometers
4MP	Marine Mammal Monitoring and Mitigation Plan
61N	61 North Environmental
B_A	beluga attendance
BiOp	biological opinion
Cm	centimeter
CP	Cairn Point
DPS	distinct population segment
ESA	Endangered Species Act of 1973, as amended
HDR	HDR, Inc.
HF	high frequency
hr	hour
IHA	incidental harassment authorization
IPIR	in-water pile installation or removal
ITS	incidental take statement
LF	low frequency
MF	mid frequency
MM	marine mammal
MMO	marine mammal observers
MMPA	Marine Mammal Protection Act
MOA	Municipality of Anchorage
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
POL1	Petroleum Oil Lubricants Terminal 1
PPM	Pacific Pile and Marine
PSO	protected species observers
PW	phocids in water
PWS	Point Woronzof PSO Station
SC	Ship Creek
SCS	Ship Creek PSO Station
SQL	Structured Query Language
USACE	U.S. Army Corps of Engineers
VHF	very-high frequency
WPW	Western Point Woronzof

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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 Petroleum and Cement Terminal (PCT) at the POA. NMFS issued a biological opinion (BiOp), an incidental take statement (ITS), and an incidental harassment authorization (IHA) for Phase 2 of the PCT 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 PCT 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 PCT 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. Two additional locations were staffed to monitor larger zones associated with vibratory installation of 144-inch diameter breasting and mooring dolphins. In-water pile installation or removal (IPIR) occurred on 38 days, and eleven PSOs observed from the four or six PSO stations, totaling 735 hours of observation over 74 days between 26 April and 29 September 2021.

During the monitoring, PSOs documented 368 groups of marine mammals totaling 776 individual animals consisting of:

- 132 groups of belugas (*Delphinapterus leucas*) comprised of 517 individual animals
- 203 groups of harbor seals (*Phoca vitulina*) comprised of 220 individual animals
- 22 groups of harbor porpoises (*Phocoena phocoena*) comprised of 27 animals
- 8 sightings of individual Steller sea lions (*Eumetopias jubatus*)
- 1 group of 2 killer whales (*Orcinus orca*)
- 1 individual pinniped not identified to species, and
- 1 gray whale (Eschrichtius robustus)

Of these 132 beluga groups, 17 were sighted during or very near in time to IPIR. No obvious disturbance-related behaviors were documented. Of the 17 events evaluated where belugas were present during IPIR, 7 maintained their trajectory towards the PCT, 4 exhibited no discernible reaction, and 6 groups either were first sighted traveling away from the PCT or were observed changing direction to move away shortly after IPIR began. A total of 49 marine mammal groups comprised of 68 animals were observed inside of the Level B harassment zone. Level B exposures were recorded for 9 groups of belugas totaling 27 animals, 38 groups of harbor seals totaling 39 animals, and 2 individual harbor porpoises. Five potential Level A exposures of individual harbor seals were recorded. The number of allowed 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

Species or DPS	*Number of Level A Takes Authorized*	*Number of Level B Takes Authorized*	*Number of Level A Takes Recorded*	*Number of Level B Takes Recorded*
Cook Inlet beluga whale (Delphinapterus leucas)	0	35	0	27
Western DPS Steller sea lion (Eumetopias jubatus)	2	6	0	0
Humpback whale (Megaptera novaeangliae)	2	3	0	0
Harbor seal (Phoca vitulina)	180	420	5	39
Harbor porpoise (Phocoena phocoena)	13	25	0	2
Killer whale (Orcinus orca)	0	12	0	0

Dredging activity was shut down twice and IPIR was delayed or shutdown 31 times for a total work stoppage of 97 hours (nearly 10 full workdays). 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 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 PCT 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"[1] 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 Petroleum and Cement Terminal (PCT) at the POA. NMFS issued an incidental harassment authorization (IHA) under Section 101(a)(5)(D) of the MMPA for Phase 2 of the PCT on 31 March 2020, effective 1 April 2021 (NMFS 2020b) as described in the Federal Register, Volume 85, Number 66, page 19294 (85 FR 19294). The POA also sought and received authorization from the U.S. Army Corps of Engineers (USACE) to construct the PCT in navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899 (Permit POA-2003-00502). Because of the dual federal actions – e.g., issuance of a Section 10 permit by USACE and issuance of an IHA by the NMFS Office of Protected Resources, Permits and Conservation Division (referred to as "the Permits Division") – consultation between the federal agencies was also required under Section 7 of the ESA. NMFS issued a biological opinion (BiOp, NMFS 2020a) of the effect the project may have to threatened and endangered species and an incidental take statement (ITS) under the ESA that mirrors and complements the IHA for ESA-listed species.

On 6 May 2021, NMFS issued an update to the Phase 2 IHA (NMFS 2021), incorporating revisions to the Level B zones based on hydroacoustic data collected and reported in 2020 in accordance with the Phase 1 IHA. Marine mammal monitoring began on 26 April 2021, but the first pile was not installed until 14 May 2021, after the issuance of the amended IHA.

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 PCT project.

1.1 Project Description

The PCT is a component of the POA Modernization Program. The POA is owned and operated by the Municipality of Anchorage (MOA) and is located on Knik Arm in Upper Cook Inlet. The MOA is the PCT project owner. Pacific Pile and Marine (PPM) was the prime contractor for PCT construction work in 2020 and 2021, and 61 North Environmental (61N) was a subcontractor to PPM for the marine mammal compliance work. The MOA contracted with CH2M Hill, Inc. (now a subsidiary of Jacobs Engineering Group) and HDR, Inc. (HDR) to provide program management and permitting and compliance services for the PCT project. The PCT is a pile-supported dock, comprised of an access trestle, loading platform, monopile breasting dolphins, monopile mooring

[1] "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).

dolphins, and related superstructure. The construction of the PCT was phased over two seasons, the first completed in 2020 and the second in 2021.

Approximately 50 percent (%) of the freight shipped to Alaska crosses the docks at the POA and reaches 90 % of Alaska's population through marine, road, rail, pipeline and air cargo transport to communities and military bases throughout Alaska. The POA is Alaska's only National Strategic Seaport, one of 23 nationwide, and is critical to the defense of the United States. The PCT replaces the aging Petroleum Oil Lubricants Terminal 1 (POL1), the primary fuel terminal at the POA and the only bulk cement terminal in Alaska. The military, transportation, and construction sectors all rely upon the fuel and cement that arrive at and are stored at the POA. Jet fuel is transported via pipeline from the POA to Joint Base Elmendorf Richardson, which is relied upon by the United States Air Force and Army for all flight activities. Fuel and cement are also transported by rail, barge, and road from the POA to interior and coastal cities and towns throughout Alaska.

The second phase of construction included installation of three breasting dolphin monopiles and six mooring dolphin monopiles, walkways, fenders, piping, and utilities. To install the nine monopiles, templates were constructed to support and guide the placement. Thirty-six temporary 36-inch piles (four per monopile) were first installed with a combination of vibratory and impact hammers to hold the templates. The barge *Redemption* was used to install the temporary piles. The largest derrick-barge on the U.S. West Coast – the *Pacific Lifter* (formerly the *Stor Kran*) – was utilized to install the monopiles. The monopiles were installed using a vibratory hammer for up to 30 minutes and then completed with an impact hammer. An attenuation device known colloquially as a "bubble curtain" was used for all pile installations to dampen the underwater sound associated with in-water pile installation or removal (IPIR). The project location and regional landmarks are presented in Figure 1.

Figure 1. PCT 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,[2] marine mammals incidental to the construction of Phase 2 of the PCT 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 Phase 2 of the PCT project

Species or DPS	*Abundance (Population/Stock)*	*MMPA Designation*	*ESA Listing*	*Number of Level A Takes Authorized*	*Number of Level B Takes Authorized*
Cook Inlet beluga whale (Delphinapterus leucas)	279[1] (Cook Inlet)	Depleted & Strategic	Endangered	0	35
Western DPS Steller sea lion (Eumetopias jubatus)	52,932 (Western DPS)	Depleted & Strategic	Endangered	2	6
Humpback whale (Megaptera novaeangliae)	11,398 (Hawaii DPS)	Depleted & Strategic	None	2	3
	3,264 (Mexico DPS)	Depleted & Strategic	Threatened		
	1,059 (Western N. Pacific DPS)	Depleted & Strategic	Endangered		
Harbor seal (Phoca vitulina)	28,411 (Cook Inlet/Shelikof)	None	None	180	420
Harbor porpoise (Phocoena phocoena)	31,046 (Gulf of Alaska)	Strategic	None	13	25
Killer whale (Orcinus orca)	2,347 (Eastern North Pacific Alaska Resident)	None	None	0	12
	587 (Gulf of Alaska, Aleutian Islands, & Bering Sea Transient)	None	None		
Gray whale (Eschrichtius robustus)	26,960 (Eastern North Pacific)	None	None	0	0

Notes: *[1] N_{best} = 279. The 95 percent probability range is 250–317 whales (Shelden and Wade 2019). Source: 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.

[2] "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 Guidance Documents

In addition to the IHA and BiOp issued by NMFS, other planning documents detail the means of implementation of the mitigation measures. The POA submitted an IHA application to NMFS in October 2019 (POA 2019) after several years of prior planning and coordination. The IHA application contained a description of both phases of the project, with particular focus on the potential sources of underwater sound, the species of marine mammals that may be affected by the project, the type of impacts and potential takes that may occur, the number of each type of takes that may occur, and mitigation measures the POA would employ to minimize the impact to protected marine mammal species. The IHA application also included a detailed summary of the types and numbers of piles and the planned installation and removal techniques. The IHA application included underwater sound level measurements of various pile sizes conducted in 2016 during a test pile program (POA 2016), along with other sound source data, to estimate the number and type of takes that might occur. Sound source verification testing was also conducted in 2020 on 24-, 36-, and 48-inch piles. The results of the hydroacoustic measurements and analysis were used to update the harassment zones for the 2021 work (NMFS 2021).

The installation and removal of the piles with a vibratory hammer was expected to result in continuous underwater sound exceeding the 122.2-decibel (dB) threshold, determined by NMFS to potentially cause a behavioral disturbance of marine mammals (Level B harassment). The impact installation of piles was also expected to cause sound energy exceeding the 160-dB threshold for impulsive sound determined by NMFS to cause Level B harassment and sound energy capable of causing permanent injury to marine mammal hearing abilities (Level A harassment), depending on the duration of exposure. The radial distances from the sound source (pile) to the harassment thresholds are typically represented as continuous arcs, or isopleths, over the open-water areas near the project that are not obstructed by landforms. The isopleths demarcate the Level A and Level B zones which are monitored for potential effects to marine mammals, and whether authorized (or unauthorized) takes have occurred.

The IHA application included a Marine Mammal Monitoring and Mitigation Plan (4MP), detailing the specific mitigation strategies and suggested means of implementation (POA 2019). In earlier planning, the POA worked with other contractors to develop a 4MP (POA 2018), included in the bid documents for construction of the PCT, that suggested monitoring locations and methods to implement the plan. Upon receipt of the IHA, a third 4MP (POA 2020) was drafted to incorporate the additional monitoring locations, specific equipment required, detailed communication strategy, and protocols to monitor the pre-pile driving clearance zone defined in the IHA by NMFS. The primary objective of the three 4MPs was to comply with the MMPA and ESA, to minimize disturbance of marine mammals during construction of the PCT.

1.4 Mitigation and Monitoring Measures

The IHA and BiOp (NMFS 2020a, b) contained the following mitigation measures, combined with minor modification for inclusion here:

1. IPIR may occur during daylight hours only.

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

3. POA is required to conduct briefings for construction supervisors and crews, the monitoring team, and POA staff prior to the start of all IPIR activity, and when new personnel join the work, to explain responsibilities, communication procedures, the marine mammal monitoring protocol, and operational procedures.

4. POA is required to employ protected species observers (PSOs; also known as, and interchangeable with, marine mammal observers [MMOs] or "observers") per the 4MP.

5. Marine mammal monitoring must take place from 30 minutes prior to initiation of IPIR through 30 minutes post-completion of IPIR. IPIR may commence when PSOs have declared the shutdown zone clear of marine mammals or the beluga whale mitigation measures (#8) are satisfied. In the event of a delay or shutdown of activity resulting from marine mammals, animals must be allowed to leave on their own volition and their behavior must be monitored and documented.

6. On a given day, if PSO monitoring ceases but IPIR is scheduled to resume, PSOs must follow pre-pile driving monitoring protocol as described above.

7. If a marine mammal is entering or is observed within an established shutdown zone (Table 2), IPIR must be halted or delayed. IPIR may not commence or resume until either the animal has voluntarily left and been visually confirmed 100 meters beyond the shutdown zone and on a path away from such zone or 15 minutes (non-beluga whales) or 30 minutes (beluga whales) have passed without subsequent detections. NMFS may adjust the shutdown zones pending review and approval of an acoustic monitoring report.

8. POA must implement the following IPIR Delay/Shutdown Protocol for Cook Inlet beluga whales:

- Prior to the onset of IPIR, should a beluga whale(s) be observed within the inbound or outbound clearance zone (Figure 2), IPIR must be delayed. IPIR may not commence until the animal has voluntarily traveled at least 100 meters beyond the Level B harassment zone (Table 2) and is on a path away from such zone, or the whale has not been resighted within 30 minutes.
- If IPIR has commenced, and a beluga whale(s) is observed within or likely to enter the Level B harassment zone, a PSO must call for a shutdown of IPIR. IPIR will shut down as soon as possible and may not commence until the animal has voluntarily traveled at least 100 meters beyond the Level B harassment zone (Table 2) and is on a path away from such zone, or the whale has not been resighted within 30 minutes.
- If a vibratory hammer is required on a 144-inch pile, it may not be possible to monitor the entire Level B harassment zone and this zone may extend beyond the pre-clearance zones. In this case, the pre-clearance zone remains applicable.

9. If PSOs can no longer effectively monitor all waters within the Level B harassment zone (Table 2) for the presence of marine mammals due to environmental conditions (e.g., fog, rain, wind), IPIR may continue only until the current segment of pile is driven; no additional sections of pile or additional piles may be driven until conditions improve such that the Level B harassment zone can be effectively monitored.

10. POA must use soft-start techniques when impact pile driving. A soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day's impact pile driving,

any time pile driving has been shut down or delayed due the presence of a marine mammal, or at any time following cessation of impact pile driving for a period of thirty minutes or longer.

11. POA is required to employ a confined bubble curtain during all IPIR and operate it in a manner consistent with the performance standards defined in the IHA.

12. POA must not install 144-inch piles with a vibratory hammer in August.

13. POA must not install unattenuated plumb piles in water depths greater than 3 meters.

14. POA must not operate two vibratory hammers concurrently.

15. If a species for which take authorization has not been granted, or a species for which take authorization has been granted but the authorized takes are met, is observed approaching or within the monitoring zone (Table 2), IPIR must shut down immediately using shutdown procedures. IPIR must not resume until the animal has been confirmed to have left the area or the observation period, as indicated in condition mitigation measure 7 (see above) has elapsed.

16. If the POA is conducting non-PCT related in-water work which require PSOs, the PCT PSOs must be in real-time contact with those PSOs, relaying all information regarding marine mammal sightings.

The IHA and BiOp also contained the following monitoring measures:

17. Marine mammal monitoring must be conducted in accordance with the Marine Mammal Monitoring Plan and the following measures:

- PSOs will be positioned at four stations during all IPIR to maximize marine mammal detection: one station will be at the PCT site, one at Ship Creek, one at Point Woronzof or nearby location, and one location north of the PCT site (e.g., northern end of POA, Port Mackenzie).
- PSOs will work in three- to four-person teams at each outer (southern and northern) observation station. The station at the PCT site will have at least two PSOs. At least two PSOs will be on watch at any given time at each station. A third PSO will be available to record data at the southern and northern stations.
- Each outer (southern and northern) station must be equipped with large-aperture binoculars (25X), handheld binoculars (at least 7X), and range finders. A theodolite must be available at one station. The central station must be equipped with handheld binoculars (at least 7X) and range finders.

18. Marine mammal monitoring during IPIR must be conducted by NMFS-approved PSOs in a manner consistent with the 4MP and the following:

- Independent PSOs (i.e., not construction personnel) who have no other assigned tasks during monitoring periods must be used.
- A lead observer or monitoring coordinator must be designated. The lead observer must have prior experience working as a marine mammal observer during construction.
- POA must submit PSO CVs for approval by NMFS prior to the onset of IPIR.

- PSOs must be in constant real-time communication with each other and with construction crews to convey information about marine mammal sightings, locations, directions of movement, and communicate calls for IPIR shutdowns or delays.
- A PSO must observe for no more than 4 hours at a time and no more than 12 hours per day.

19. PSOs must have the following additional qualifications:
    - Ability to conduct field observations and collect data according to assigned protocols.
    - Experience or training in the field identification of marine mammals, including the identification of behaviors.
    - Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
    - Ability to observe and record environmental and marine mammal sighting data, including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior.
    - Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area, as necessary.

1.5 Monitoring Zones

Three types of monitoring zones were required by the IHA and BiOp during the 2021 PCT construction:

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

1.5.1 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 IPIR. If any belugas were sighted within the pre-clearance zone, IPIR could not begin until belugas were at least 100-meters outside of the applicable Level B zone and on a trajectory away from the zone. If belugas were sighted within or approaching the pre-clearance zone, and were also approaching a Level B zone, a delay in IPIR was required.

1.5.2 Shutdown Zones

The IHA and BiOp required the shutdown of any IPIR if any marine mammal came 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 IPIR if belugas were sighted within or

approaching the applicable Level B zone. Therefore, the applicable Level B zone for a given activity was enforced as a shutdown zone for belugas (Table 2).

1.5.3 Level A and Level B Harassment Zones

In the IHA application, the POA calculated the isopleths for the expected sound levels from the planned in-water construction activities at which harassment by injury (Level A) or harassment by behavioral disturbance (Level B) may occur. NMFS accepted most of the POA's proposed zones and incorporated them into the IHA as the applicable Level A and B harassment zones. NMFS modified some Level A zones based on the number of piles installed in a day. On 6 May 2021, NMFS modified the Level B zones after receiving the report of hydroacoustic data collected in 2020. The construction crew did not install or remove 36-inch piles with an unattenuated vibratory hammer and did not use an impact hammer on 36-inch piles. The Level B zones applicable to IPIR in 2021, are presented in Table 2. The applicable Level B zones are displayed on Figure 3.

Table 2. Applicable Level B Harassment Zones and Beluga Shutdown Zones in 2021

Pile Size	*Hammer Type*	*Attenuation*	*Level B /Beluga Shutdown Zone (meters)*
36-inch	Vibratory	Bubble Curtain	4,106
144-inch	Impact	Bubble Curtain	6,309
	Vibratory		18,000

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

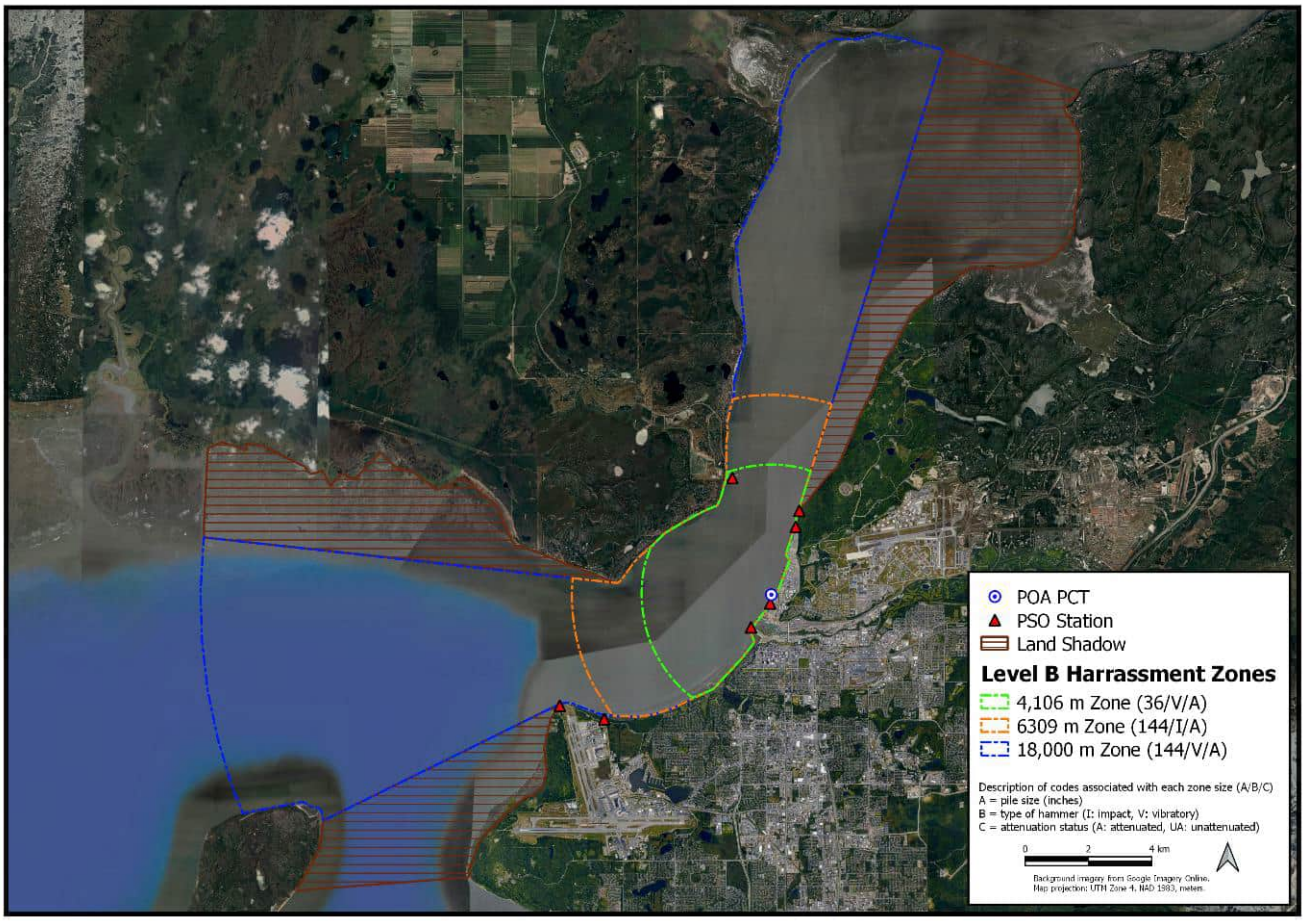

Figure 3. Level B Harassment and Beluga Shutdown Zones

NMFS issued revised technical guidance (NMFS 2018) to calculate the received sound levels at which individual marine mammals are predicted to experience a reduction in hearing sensitivity from acute exposure to underwater anthropogenic sounds. A permanent threshold shift in hearing sensitivity is considered an "injury" and qualifies as a Level A harassment under the MMPA. The Level A harassment isopleths are determined through combination of several factors, including the intensity of the sound, the nature of the sound (impulsive or continuous), the duration or number of received impulses of the sound, the environmental factors that determine the rate of transmission loss of the sound over distance, and the frequency profile of the sound. The technical guidance segregates marine mammal species into five "functional hearing groups" that account for variability in sensitivity to sound frequencies. As a result, for any given sound source, there are up to five different Level A isopleths.

The POA conducted analysis of 12 potential in-water construction activities in the IHA application for Phase 2, including the type of piles, potential installation methods (vibratory or impact), and a range in the number of piles of each type installed per day. Level A zones for these scenarios and other potential scenarios (such as impact installation of 36-inch piles) were evaluated for each functional hearing group in the IHA which contained 80 potential Level A harassment zones for Phase 2 work in 2021 (Table 3). Fifty-eight of the 80 Level A zones approved

in the IHA are smaller than the 100-meter shutdown zone, and therefore would only be applicable in rare and unusual circumstances3.

Belugas are the most abundant marine mammal species in Upper Cook Inlet and are also in the mid-frequency (MF) cetacean functional hearing group. Because shutdowns of IPIR were required if belugas were sighted within or approaching the larger Level B zones, and no other MF species were sighted during IPIR, the Level A zones for MF cetaceans did not apply to any sightings during the 2021 season. Many of the larger Level A zones were for species with low abundance in Upper Cook Inlet, such as low-frequency (LF) cetaceans (e.g., humpbacks and gray whales) and high-frequency (HF) cetaceans (e.g., harbor porpoises). These species were not sighted within applicable Level A zones in 2021. Despite the substantial number of Level A zones, the Level A zone for phocids in water (PW) during impact installation of 144-inch piles were the only Level A zones that became applicable during the 2021 monitoring (**bold** in Table 3). The event during which the zone was applied is described in Section 6.

Table 3. Level A harassment zones authorized by the NMFS IHA (NMFS 2020)

Pile Size	*Hammer Type*	*Attenuation*	*Piles installed/day*	*Level A harassment zone (meters)*[1]				
				LF	MF	HF	PW	OW
36-inch	Vibratory	Bubble Curtain	3	12	1	17	8	1
			4	14	2	20	9	1
	Impact		1	509	26	595	292	28
			2	768	39	898	440	43
			3	978	50	1,142	560	54
24-inch	Vibratory	Bubble Curtain	3	3	0	5	2	0
			4	7	1	10	4	0
		Unattenuated	3	16	2	22	10	1
			4	19	2	27	12	1
	Impact	Bubble Curtain	1	30	2	35	17	2
			4	68	4	79	39	4
		Unattenuated	1	78	4	91	44	4
			4	176	9	206	101	9
144-inch	Impact	Bubble Curtain	0.3	2,286	117	2,672	**1,311**	127
			0.7	3,787	194	4,418	**2,167**	210
	Vibratory		1	24	3	34	15	1

Notes: [1] 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.

Bold values are the Level A harassment zones that became applicable in during the 2021 season.

[3] For a Level A take to occur in a zone smaller than the 100-meter shutdown zone, a marine mammal would have to enter the shutdown zone and Level A zone undetected and remain within the specified Level A zone for the specified number of piles, strikes (e.g., 2,300 pile strikes), or duration required to experience the Level A harassment.

1.6 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, most of which were part of the 2020 team and/or had prior experience as PSOs in Cook Inlet. 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 types of piles, installation and removal 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. The event could not be held in person due to the Covid-19 pandemic and therefore had to be conducted via the internet.

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 four groups and set up all four monitoring stations, tested radio communications, and practiced monitoring, communication, and shutdown scenarios. After the initial training session, additional web-based trainings, followed by similar field training sessions were held for new PSOs in July and September.

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 and impact hammers during IPIR, dredging, vessel traffic, anchor handling, and other relevant activity; 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.

2 MONITORING LOCATIONS AND EFFORT

The IHA and BiOp (NMFS 2020a, 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 2021, additional "remote" monitoring locations were also staffed at various times, depending on the IPIR activity and tidal stage. Eleven PSOs were on duty during all IPIR events. Monitoring for protected species was conducted for 735 hours over 74 days during two periods of IPIR: between 26 April and 24 June, and between 7 and 29 September. 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 PCT
- At the promontory near the boat launch at Ship Creek
- At the PCT, and
- At the northern end of the POA or at Port Mackenzie

The location chosen for the Point Woronzof PSO station (PWS) was the parking lot of the Downtown Anchorage Viewpoint, on land owned and managed by the MOA and Ted Stevens International Airport. The location for the Ship Creek PSO station (SCS) was at the end of the promontory south of the Ship Creek boat launch on land owned by the POA. The PCT PSO station (PCTS) was at the southwestern end of the "south backlands" area of the POA, located 120 meters from the southernmost pile, and 400 meters from northernmost pile of the PCT dock. 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, BiOp, and 4MP prescribed a minimum of three PSOs at both the northern (NEX), southern (PWS), and SC PSO stations, and a minimum of two PSOs at the PCTS station for a total of 11 PSOs. During regular monitoring, the NEX, SC, and PWS stations were staffed with three PSOs and the PCT station was staffed with two PSOs (one of which was the PSO field lead). Eleven PSOs were on duty for all monitoring and IPIR events.

The IHA and BiOp required designation of a PSO field lead, with prior PSO experience in Cook Inlet, during monitoring. Four of the most experienced PSOs, all with prior Cook Inlet experience, rotated through the PSO field lead position. 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 in 2020. 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.

To better monitor the large 18,000-meter Level B zones during vibratory installation of the 144-inch monopiles, one monitoring location was added at the west end of the monitoring area and one was added at the north end. The western station (WPW) was located on the west side of Point Woronzof. The WPW station had visibility to the west towards Fire Island, and to the shoreline across Knik Arm to the north between Point Mackenzie and the Little Susitna River. PSOs were also positioned at the Port Mackenzie (PM) station to view the eastern shoreline, north of

Cairn Point, and areas north of the port during installation of the monopiles. On days when vibratory installation of the 144-inch monopiles was planned, two PSOs would drive to the PM station on the western shore of Knik Arm. Approximately one hour before monopile installation, one PSO would travel from PWS to WPW, resulting in two PSOs at PW, two at SC, two at PCT, and two at NEX. During these instances, the 11 PSOs would monitor from six locations instead of the standard four locations.

For the 6,309-meter or 4,106-meter Level B zones, 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 SC would drive over to the NEX station, leaving two PSOs at NEX and SC (PWS and PCTS remained unchanged). Again, the 11 PSOs would staff the 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.

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 3, 8, 12, and 19 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 (photo 15 in Appendix B) 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.

The monitoring requirements in the IHA and BiOp required one digital theodolite (photos 13 and 16 in Appendix B) at one PSO station to accurately measure the locations of marine mammals within or near the Level B zones. In 2021, a theodolite was used at all four standard stations, except for a two-week period in September when one theodolite needed repair. During this period, a theodolite was not used at the PCT station. Marine mammal group locations were recorded by the NEX or SC station while the PCT station was without a theodolite.

Prior to use, the elevation and geographic coordinates of each theodolite setup point were surveyed to an accuracy of 10 centimeters (cm) or less and entered in the MS Access database. The elevations were referenced to mean sea level, as defined by the benchmarks associated with the National Oceanic and Atmospheric Administration (NOAA) Tide Station Anchorage 9455920 (NOAA 2019). The 1-minute interval tide level predictions, relative to mean sea level, were pre-loaded into the MS Access database for April through November 2021. At the moment a group location was recorded, the database retrieved the predicted tide level for the time of the sighting and calculated the theodolite height above sea level. 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 accuracy of the distance measured by the theodolite to the marine mammal group is affected by several potential sources of error. The most significant sources of error are the measurement of the vertical angle, and the estimated elevation of the theodolite above the sea level at the moment the measurement is made. The error in distance measurement increases exponentially at greater distance, and when the height of the theodolite above the surface of the water decreases (e.g., at high tide).

The theodolites are accurate to 5 arc seconds (approximately 0.001°), however, despite reinforcement to minimize movement, the platform floors flexed to some degree atop the shipping containers. The theodolites have automatic tilt compensation, but slight movements, such as stepping away from the theodolite before the shot was captured, could cause an "under shoot" of the animal. In addition, simple misalignment to the animal at the waterline may cause error. These issues were addressed during training and PSOs would routinely practice using stationary landmarks that are visible on aerial imagery to hone their skills. It is important to note that the field of view of theodolite optics is narrow and optimized for surveying static objects, not marine mammals moving in open water. While most positions were recorded when the animal were visible in the optics, it was not always possible to sight the animal (or its surface footprint). In these instances, the PSOs would use shoreline objects, or variations in color on the water's surface (i.e., wind or current bands), along with the sighting collimator above the objective lens to align their shots. It is therefore impossible to estimate the true accuracy of the vertical angle measurement by the PSOs for every instance. During practice at NEX, PSOs were typically able to shoot the piles 2,300 meters away at Port Mackenzie within about 100 to 200 meters. This translates to a vertical angle accuracy of approximately 0.01° (at high tide), which is assumed to be a practical estimate of the accuracy of the theodolite given the conditions described.

The difference between the predicted tide height (used in the calculation), and actual tide height can vary by more than a half meter (in rare instances). Comparing verified tide values during pile driving days to the predicted tide values found that approximately 75 percent varied by 30 cm or less. Variations greater than 50 cm were typically short in duration (an hour or less) and were over predictions rather than under predictions. Over-predicted tide elevations would cause the calculated distance to be less than the actual distance (which is preferable for a mitigation scenario). While it is possible, the likelihood is low that a significant tide elevation under-prediction (which would cause an over estimation of a marine mammal group's distance) coincided with IPIR or a shutdown event. The height of the theodolites was surveyed to within approximately 5 to 10 cm, introducing additional potential error.

Error in measurement of the horizontal angle can cause also cause slight location error but the effect is minimal compared to the errors in the vertical angle or tide height. The error also increases linearly with distance rather than exponentially. For example, a 0.1° error in horizontal angle causes an 8.7-meter error at 5,000 meters and a 17.5-meter error at 10,000 meters. The actual error of the horizontal angle measurement when marine mammals were visible in the optics was likely 0.1° or less.

The NEX, PCTS, and SC stations were all similar elevations (9.94, 10.02, and 10.99 meters above MSL, respectively). At mean higher high water (i.e., high tide), the theodolite at the NEX station was approximately 6.1 meters above the surface of the water, and represents the lowest elevation, and most opportunity for error. At the opposite extreme, at mean lower low water (i.e., low tide) the theodolite at the PWS station was approximately 33.5 meters above the surface of the water. Therefore, the exponential nature of increasing error in the distance measurement is most pronounced at the NEX station at high tide. Figure 4 presents the estimated distance measurement error that would result from a 0.01° error in the vertical angle and a 0.3-meter error in the estimated height above the

surface of the water, plotted against the measured distance at the NEX station at high tide. Figure 5 presents the same variables for the PWS station at low tide, representing a much higher degree of accuracy due to the elevation.

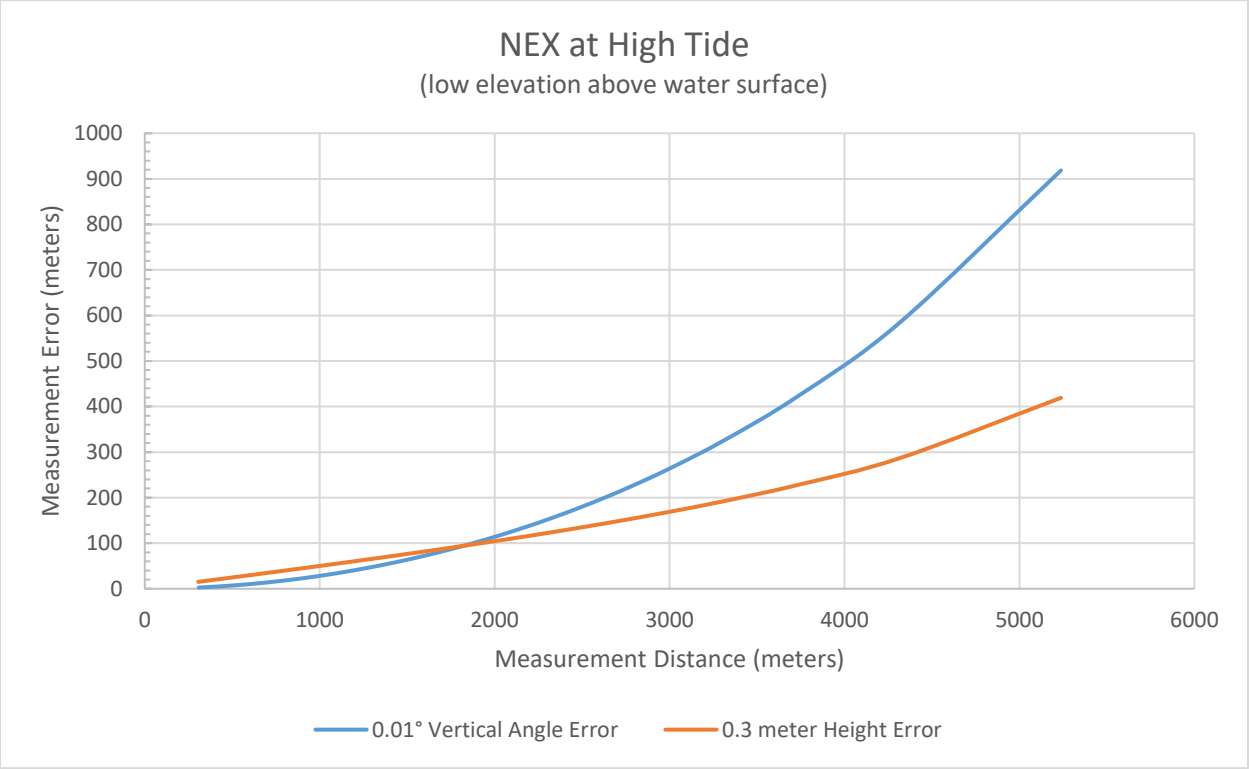

Figure 4. Theodolite distance measurement error at NEX station at high tide

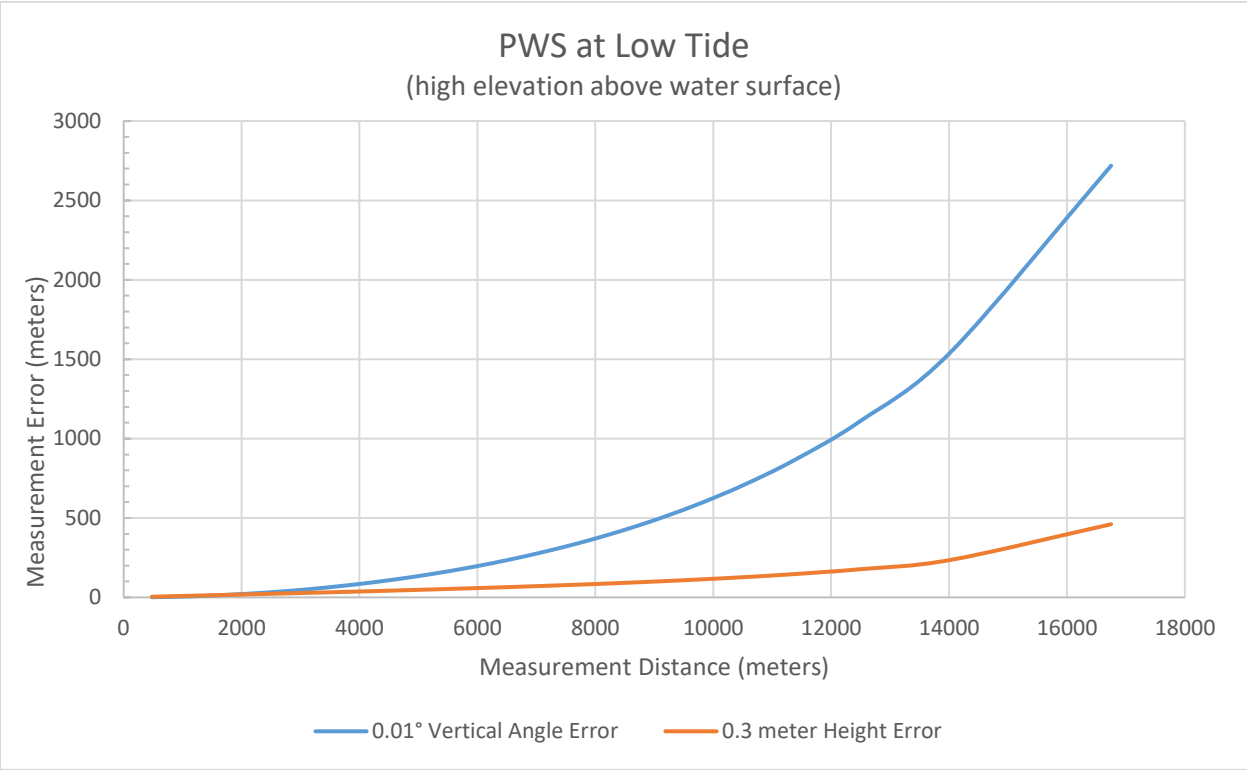

Figure 5. Theodolite distance measurement error at PWS station at low tide

The IHA and BiOp also required the use of large-aperture binoculars with a minimum 25X magnification at the PWS and NEX stations. In 2021, PPM requested to use the vibratory hammer on the 144-inch piles for a longer duration than had been presented in the IHA application. To help mitigate the effects of the additional duration, PPM agreed to add a set of large-aperture binoculars at the SC station. The position of the SC 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 mounted on height-adjustable tripods or hydraulic lifts (photo 9 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 at these stations. The compass was used for some sightings at the WPW and CP locations, which did not have steel structures that interfered with the magnetic compass.

Each of the four standard stations was equipped with one or more 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. The PCTS station was also equipped with two additional handheld VHFs, one for direct communication with the PPM crew onshore, and another for direct communication with the PPM crew onboard the *Pacific Lifter* or *Redemption* barges. 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 Microsoft Access application was installed on each laptop and included three data-entry forms developed by 61N specifically for the PCT project to capture all data outlined in the IHA application. 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 PCT 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 PCT in general), 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 IPIR 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 very-high frequency (VHF) handheld radio, safety gear, and paper sighting forms.

The WPW station was located on the bluff at the Point Woronzof Park and Overlook. The WPW station was equipped with a backpack that contained marine-grade Fujinon™ 7X50 binoculars with a magnetic compass, a VHF handheld radio, and paper sighting forms. It was also equipped with a tripod-mounted 20-60X spotting scope. Initially, the bearings to marine mammal group sightings were recorded using the compass in the binoculars. Magnetic bearings were corrected to “true” bearings by adding the local magnetic declination angle of 15.45°. To improve the true bearing measurement, a surveyor’s transit was utilized from 18 June onward. The transit was directed at a landmark with a known bearing as a reference, and the transit dial was set to the known bearing. During sightings, the true bearing could then be measured by the transit.

The PM station was located on an elevated balcony on the east side of the Port Mackenzie terminal building. The PM station was equipped with marine-grade Fujinon™ 7X50 binoculars with a magnetic compass, a VHF handheld radio, and paper sighting forms. It was also equipped with a tripod-mounted 20-40X binoculars and a surveyor’s transit. The transit at PM was set up and referenced in a manner similar to the WPW transit.

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 occurred more easily (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.

PSO shifts were typically 11 hours, with a 15-minute break in the morning, a 30-minute unpaid lunch, and a 15-minute break in the afternoon. At stations PWS, SCS, and NEX, two of the three PSOs were on watch, while the third PSO was either recording data in the “data shack” or on break. One PSO was always stationed at the Fujinon™ 25X150 "big eye" binoculars at these stations. One observer was assigned to alternating between handheld 7X50 binoculars, un-aided scanning, and theodolite operation during 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 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 IPIR 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 vibratory pile driving was being conducted at the far end of the PCT, the second PSO would often move closer to the pile location and then radio the start and stop times to the lead PSO at the PCTS station.

The two PSOs at PM alternated between scanning with 20-40X tripod-mounted binoculars and 7X50 binoculars or un-aided scanning. Weather and visibility data, and marine mammal sightings were recorded by either PSO on paper data sheets as needed. The PM PSOs took breaks as needed to not exceed four hours of continuous observation.

The WPW PSO worked alone and alternated between scanning with a 20-60X spotting scope and 7X50 binoculars or un-aided scanning. Weather and visibility data, and marine mammal sightings were recorded on paper data sheets as needed. The WPW PSO was replaced by a PSO from the PW station if a 4-hour observation period was reached. The WPW station is about a 5-minute drive from the PW station.

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.

Once a marine mammal group was sighted, a record was entered into the database by the PSO team that sighted the group. All of 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 Microsoft Access form that captured the horizontal and vertical angles. The angles were converted to a latitude and longitude within the application and the group's distance from the Level B zone, and the active pile (if any) at the PCT were calculated. 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. Locations for harbor seals that remained within the mouth of Ship Creek for hours were recorded less frequently.

Because the Microsoft Access forms at all four PSO stations were linked to a cloud-hosted database, each PSO station could "see" a sighting entry 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 could be "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.

When the PM first sighted marine mammal groups, WPW, or CP PSOs, they would radio the information to one of the standard stations, so a parent record for the marine mammal group could be initiated in the Microsoft Access database application. The group-level data, such as species, counts, behaviors, spread, formation, and pace were recorded in the header of the paper form, and later updated in the database. Individual sighting location data such as the sighting time, true or magnetic bearing, and estimated distance from the observer were recorded on the lower half of the data form. The sighting forms also had a map where location data was recorded. The latitude and longitudes of each location fix were calculated either by the bearing and distance, or by digitizing the marks on the map. In some instances, groups were sighted by the remote stations, but were able to be tracked with the theodolite at one of the standard stations. In these instances, the estimated locations recorded on the paper form were less accurate and/or redundant and were not post-processed for entry into the database.

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 26 April 2021. PPM established the monitoring start date to ensure that PSOs were hired, trained, and available at the earliest date IPIR work might commence. After six days of monitoring, construction work was stopped due to a contractual issue. During this period, monitoring was maintained at 8 hours per day to continue the collection of data. During normal construction, a typical monitoring day was designed to give the construction crew approximately 9.5 hours of work readiness. For example, if the construction crew planned to be ready to install or remove piles by 0730, the PSO crew would arrive at 0645 to begin setting up the stations. Monitoring usually began between 0650 and 0700 and if no marine mammals were present that would prevent the start of IPIR, the “all clear” was typically given between 0720 and 0730. At the end of the day, the construction crew would have until about 1700 to complete IPIR activities to allow for a 30-minute post-IPIR period of monitoring required by the IHA. On some days when IPIR was planned to start later in the day (e.g. to wait for ideal tide conditions), the start of monitoring was delayed minimizing overtime hours. On several days, IPIR was conducted past the typical ending time (or marine mammals delayed work until the evening), and monitoring continued for at least 30 minutes after IPIR.

After the installation of the temporary 36-inch piles was complete, the IPIR days became more intermittent. During this period, the PSOs monitored for a minimum of five days per week to continue data collection. Between 26 April and 24 June, monitoring was conducted on 51 of the 60 days.

Between 25 June and 6 September, no in-water construction was conducted, and no monitoring was conducted during this period. From 7 to 29 September, monitoring was conducted every day adding 23 more days of observation, bringing the total for the season to 74 days.

In the middle of September, the observations had to begin later due to the sunrise times. The hours of observation for each day of the project are illustrated on Figure 4. The environmental conditions affecting observations are detailed below and in Appendix A.

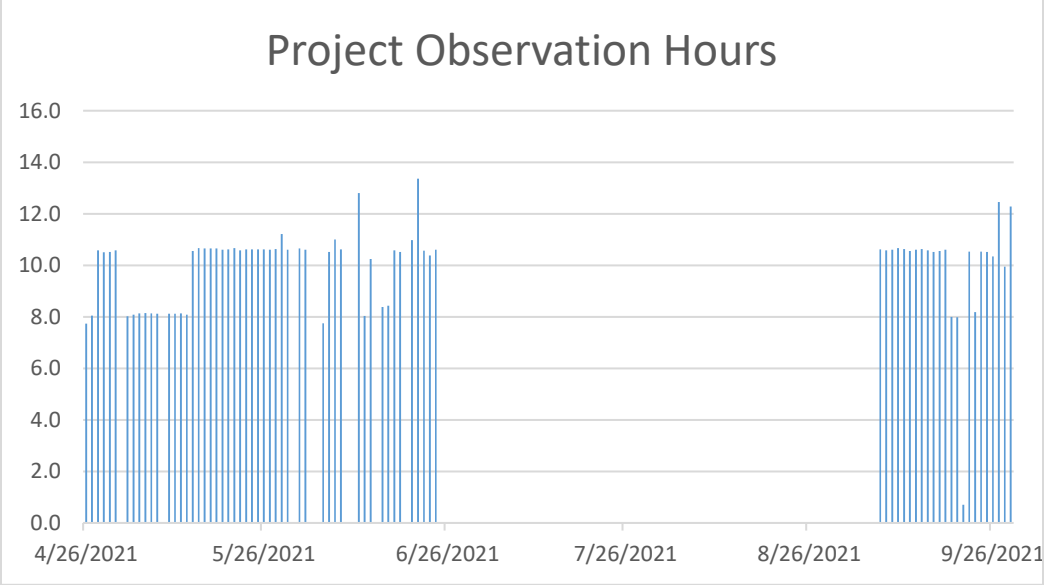

Figure 6. Marine mammal observation hours during the Phase 2 of the PCT construction

2.5 Construction Monitoring and Communication

The PCTS PSOs monitored all construction activity at the PCT and communicated regularly with the construction points of contact (POCs) including construction superintendents, construction foremen, and crane operators. All construction monitoring activity, including IPIR, non-pile driving in-water activity, marine mammal shutdowns, marine mammal delays, weather 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,[4] and diameter (if applicable), 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.[5] 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 IPIR activity. Discussions unrelated to a specific activity were recorded in a general "communication" activity record.

Because of the distance from the PCTS station to the construction area, the PSOs could not always hear the vibratory hammer in operation. The PSOs monitored radio traffic and observed visual clues such as vibrations in the hydraulic lines leading to the hammer with binoculars and spotting scopes to determine activity start and stop times. However, instances of pile driving were also recorded by POA inspectors nearer to the construction location and would supersede in the case of discrepancy. If obstructions limited the view of the base of the pile, one PSO would take a position closer to the pile being installed or removed and radio the information to the PSO at the PCTS station.

[4] The pile IDs for the 144-inch monopiles were the same as identified on engineering drawings. The temporary 36-inch template piles were within 15 to 20 feet of the center of the monopiles. The PSOs would select monopile nearest to the 36-inch pile that was being installed or removed.

[5] Over 700 start and stop times were recorded for various activities. They were recorded as accurately as possible, and were corrected as needed during quality checks, but they may not be representative of actual IPIR times in every instance.

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, and no marine mammals were sighted within the 100-meter shutdown zone, the PSO field lead would radio or text the construction POCs that IPIR may commence. IPIR was not typically delayed if harbor seals were within the Level B zone (unless within the 100-meter shutdown zone), due to the substantial number of Level B takes authorized. 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 IPIR. 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 IPIR was planned, but marine mammals were present, they were monitored and tracked. Delay periods were typically not measured unless in-water work was planned and could not be conducted. Prior to initiating IPIR 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.

When environmental conditions prevented full visibility of the applicable Level B zone, the PSO field lead would notify the construction POCs that IPIR could not commence or may not continue after a pile was completed. If IPIR was planned, the period of lost visibility was documented as a weather delay by the PSO field lead. Section 7 provides further discussion of the implementation of the mitigation measures, and the durations of each event.

3 IN-WATER OPERATIONS

During Phase 2 of the PCT construction, PSOs recorded 14.9 hours of impact installation of 144-inch piles over 10 days, 1.8 hours of vibratory installation of 144-inch piles over 8 days, and 13.7 hours of vibratory installation or removal of 36-inch temporary piles over 30 days.

The construction crew conducted dredging from a barge with excavator for portions of April and May to provided construction access necessary to complete the PCT project. Spoils were placed onto a scow barge and dumped offshore. Marine mammal monitoring by the PSOs was not required for this activity. However, while the PSOs were on watch, they maintained radio contact with the dredge and barge operators to alert them of approaching belugas. During one instance, the tug moving the scow barge slowed its speed to just stem the current to allow a beluga group to pass, and during another, the excavator ceased activity to allow a group to pass. These events are described further in Section 7. The duration of dredging activity was not tracked by the PSOs, because it was often already underway when they arrived and continued after PSOs left for the day.

Table 4 presents a summary of in-water operations during the 2021 construction season.

Table 4. Summary of In-Water Operations for Phase 2 PCT Construction

Hammer	*Attenuation*	*Pile Diameter*	*Level B Zone (meters)*	*Number of In-Water Events*	*Hours of Activity*
Impact	Bubble Curtain	144-inch	6,309	10	14.9
Vibratory	Bubble Curtain	36-inch	4,106	73	13.7
		144-inch	18,000	8	1.8
			Total of All IPIR Events	**91**	**30.4**

Table 5 presents a summary by do of the in-water operations and the Level B harassment zone associated with each activity. Figures C-1-1 through C-1-13 in Appendix C-1 illustrate the Level B harassment zones were active, and the beluga group locations relative to the PCT during periods of IPIR. 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 IPIR Events and Associated Level B Harassment Zones

	144-inch pile				***36-inch pile***		*Daily Totals*	
	Impact Hammer		*Vibratory Hammer*		*Vibratory Hammer*			
Level B Zone:	6,309 meters		18,000 meters		4,106 meters			
Date	*# of Events*	*Duration (mins)*	*# of Events*	*Duration (mins)*	*# of Events*	*Duration (mins)*	*# of Events*	*Duration (mins)*
14-May					2	24.7	**2**	**24.7**
15-May					2	14.6	**2**	**14.6**
16-May					3	27.9	**3**	**27.9**
17-May					3	21.0	**3**	**21.0**
18-May					2	17.4	**2**	**17.4**
19-May					2	11.3	**2**	**11.3**
20-May					2	16.3	**2**	**16.3**
23-May					4	50.3	**4**	**50.3**
25-May					2	34.7	**2**	**34.7**
26-May			1	1.4	3	21.3	**4**	**22.6**
27-May	2	100.8			3	12.4	**5**	**113.2**
29-May	1	85.7	1	7.2			**2**	**92.9**
5-Jun					2	15.2	**2**	**15.2**
6-Jun			1	31.8	2	13.0	**3**	**44.8**
7-Jun	2	133.1			2	13.8	**4**	**146.9**
11-Jun	1	90.4	1	14.0			**2**	**104.4**
13-Jun	4	87.8					**4**	**87.8**
15-Jun	1	83.3	1	16.7			**2**	**100.0**
16-Jun					2	16.4	**2**	**16.4**
17-Jun					2	13.4	**2**	**13.4**
18-Jun	1	134.9	1	8.7			**2**	**143.6**
20-Jun	1	91.3	1	12.3			**2**	**103.6**
21-Jun	1	35.3	1	14.7			**2**	**50.0**
22-Jun	1	51.6					**1**	**51.6**
7-Sep					2	61.3	**2**	**61.3**
8-Sep					1	41.3	**1**	**41.3**
10-Sep					1	27.2	**1**	**27.2**
11-Sep					2	15.9	**2**	**15.9**
12-Sep					2	17.8	**2**	**17.8**
15-Sep					1	4.7	**1**	**4.7**
17-Sep					5	38.0	**5**	**38.0**
23-Sep					1	19.1	**1**	**19.1**
24-Sep					2	22.2	**2**	**22.2**
25-Sep					2	29.6	**2**	**29.6**
26-Sep					4	28.7	**4**	**28.7**
27-Sep					7	81.5	**7**	**81.5**
28-Sep					5	75.8	**5**	**75.8**
29-Sep					4	36.8	**4**	**36.8**
Totals:	**15**	**894.2**	**8**	**106.8**	**77**	**823.6**	**100**	**1824.7**

4 ENVIRONMENTAL AND OBSERVATION CONDITIONS

The PSOs collected 5,995 environmental observation records from the four stations during monitoring, and 375 records on paper forms at PM and WPW. Observation conditions were recorded every half hour, or more frequently if conditions changed significantly. The observations included cloud cover and precipitation conditions (Figure 7), sea state (Figure 8), visibility distance (Figure 9) and the general observation conditions on a scale of 1 to 10 (Figure 10). The PSOs also recorded the % cloud cover, % glare, % ice cover, and light conditions. A summary of conditions for each day of observation is presented in Appendix A. All environmental records are provided electronically under Appendix G.

Air temperature (Figure 11) and wind data (Figure 12) for the observation periods were obtained from the meteorological station associated with NOAA tide station 9455920 at the POA. The predicted tide levels from NOAA tide station 9455920 were also obtained and were pre-loaded into the MS Access database to auto populate the tide level and stage for each environmental record entry. An algorithm was developed to separate the predicted tide levels into tide stages in accordance with the rules defined in Table 6. The average interval between high slack and low slack and the average interval between low slack and high slack in Upper Cook Inlet are not equal, averaging 6.73 hours and 5.70 hours, respectively. Therefore, high ebb and low ebb occur for longer than high flood and low flood. Table 6 provides the proportion of each tidal stage that results from the algorithm. Additionally, the construction crew scheduled some work during specific tides for constructability reasons, and therefore slightly more work occurred during the lower stages collectively than during the higher stages. Table 6 also presents the proportion of tidal stages that were recorded during the observation periods.

Table 6. Tidal stage definitions, proportions of each stage, and proportions observed.

Tidal stage	*Definition*	*Proportion of Tidal Stages During Project Derived by Algorithm[1,2]*	*Proportion of Tidal Stage During Observations[2]*
Low slack	*Plus or minus one hour from low tide*	16.1%	16.2%
Low flood	*From the end of low slack to half-way between[3] the end of low slack and the beginning of high slack*	15.0%	12.2%
High flood	*From half-way between[3] the end of low slack and the beginning of high slack, to the beginning of high slack*	14.9%	13.5%
High slack	*Plus or minus one hour from high tide*	16.0%	15.4%
High ebb	*From the end of high slack to half-way between[3] the end of high slack and the beginning of low slack*	18.9%	20.7%
Low ebb	*From half-way between[3] the end of high slack and the beginning of low slack to the beginning of low slack*	18.9%	21.9%

Notes:

[1] High ebb and low ebb occur more often than low flood and high flood because the average time between high slack and low slack (6.73 hrs) is greater than the average time between low slack and high slack (5.70 hrs) in Upper Cook Inlet. The project dates are from 26 April to 24 June and 7 to 29 Sept 2021.

[2] Percentages do not total 100% due to rounding.

[3]"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 for over 300,000 tide prediction records.

Beluga presence in the monitoring area (also known as “attendance”) varied with tide stage. The relationship between beluga sighting rates and tidal stages are presented in Section 5.1.3.

Observation conditions were good to excellent for most of the project duration. The observation conditions in September were good most of the time but deteriorated relative to earlier months in several categories – precipitation, visibility, wind, and temperature. A daily and monthly summary of environmental conditions is presented in Appendix A. All environmental observation data is provided electronically in Appendix G.

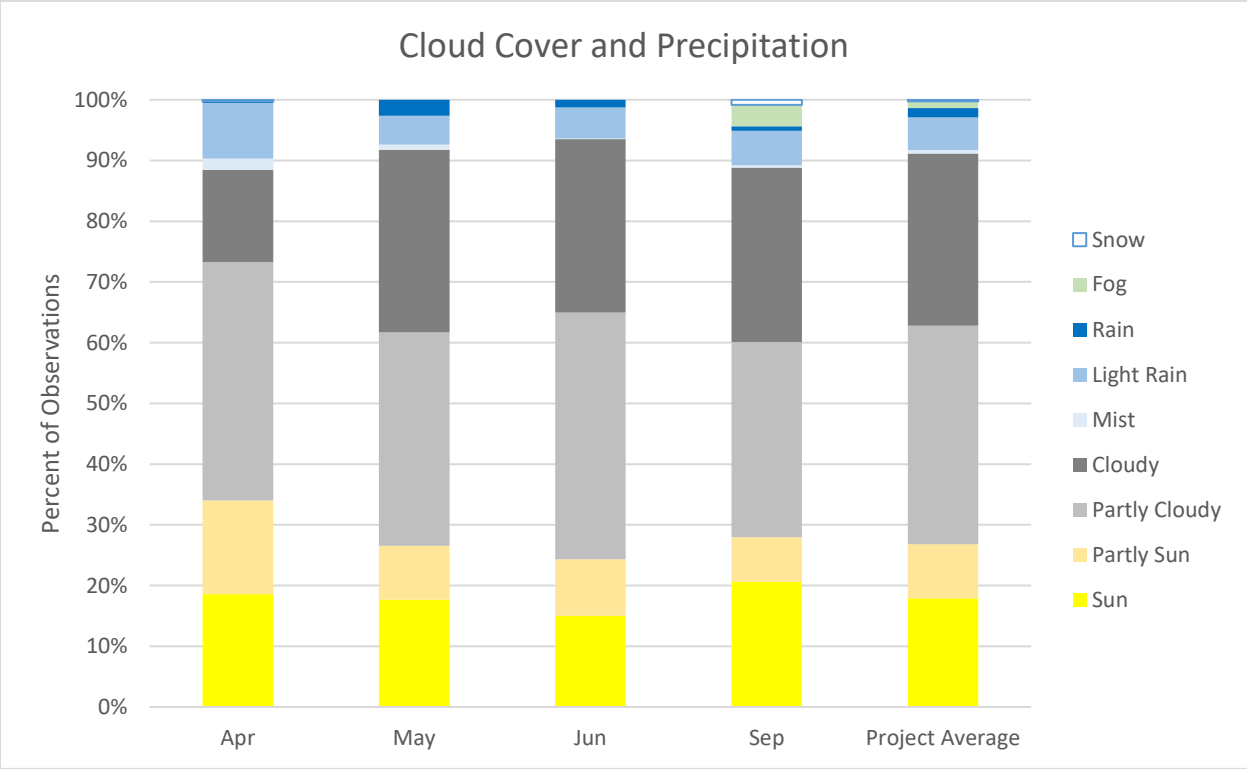

Figure 7. Cloud cover and precipitation conditions by month

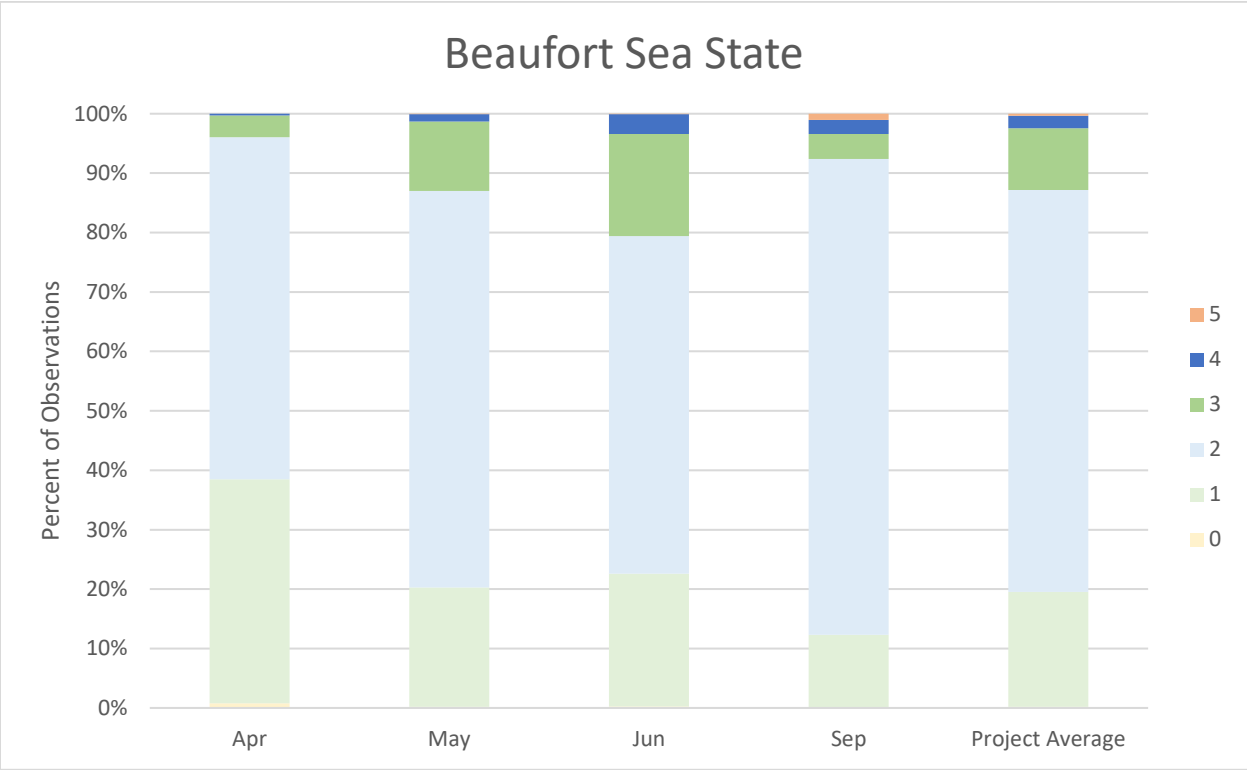

Figure 8. Beaufort Sea state conditions by month

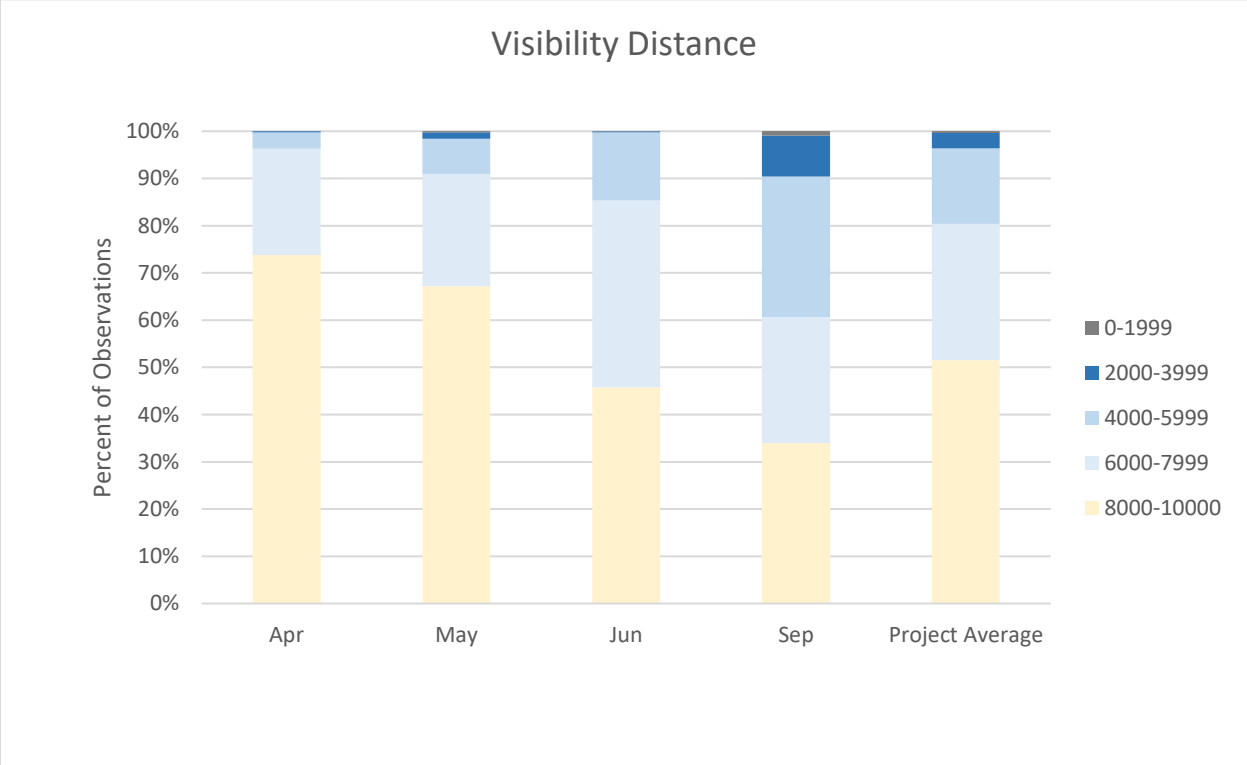

Figure 9. Visibility distance by month

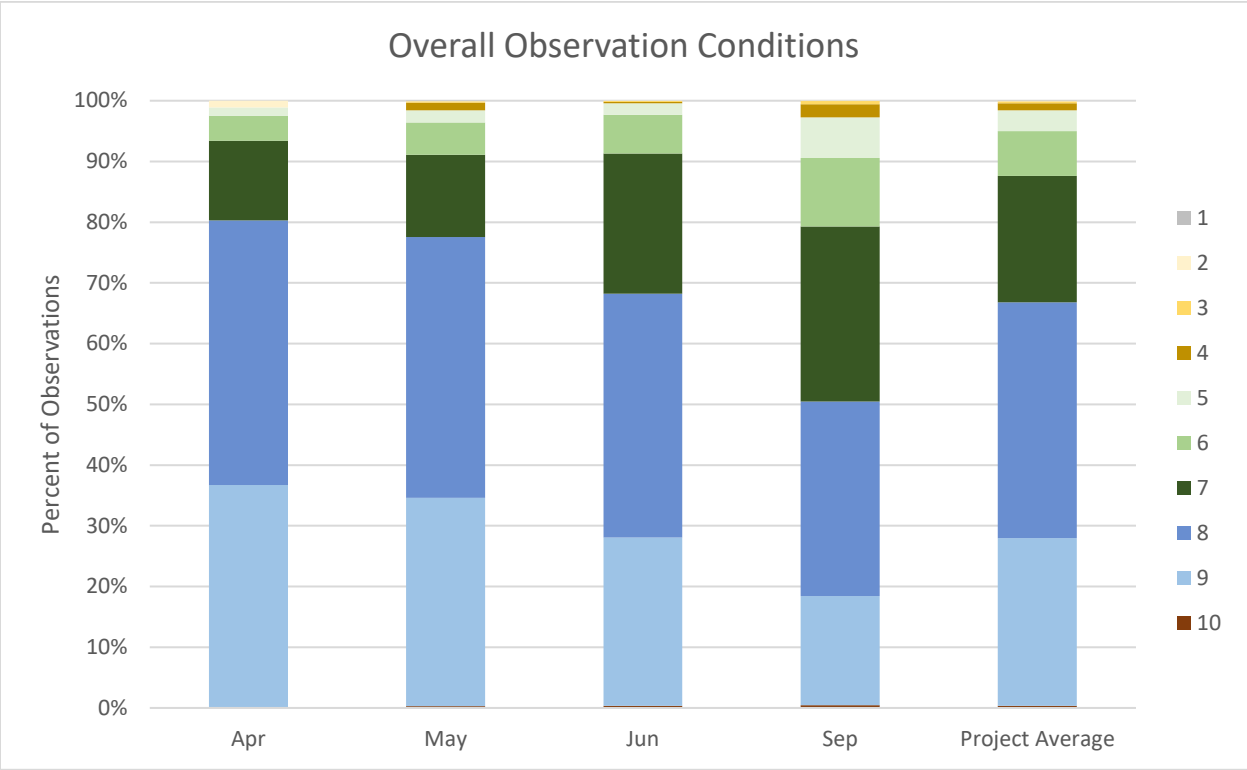

Figure 10. Overall observation conditions by month (scale of 1 to 10, worst to best conditions)

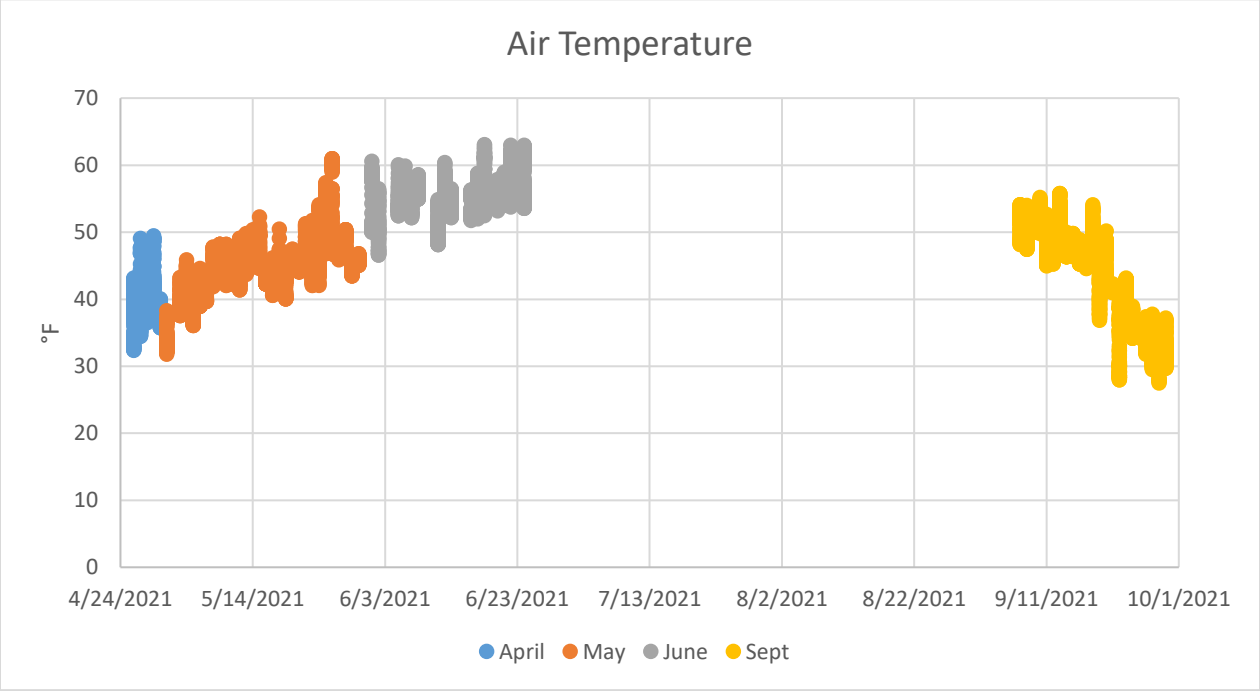

Figure 11. Air Temperature (°F) during observation periods

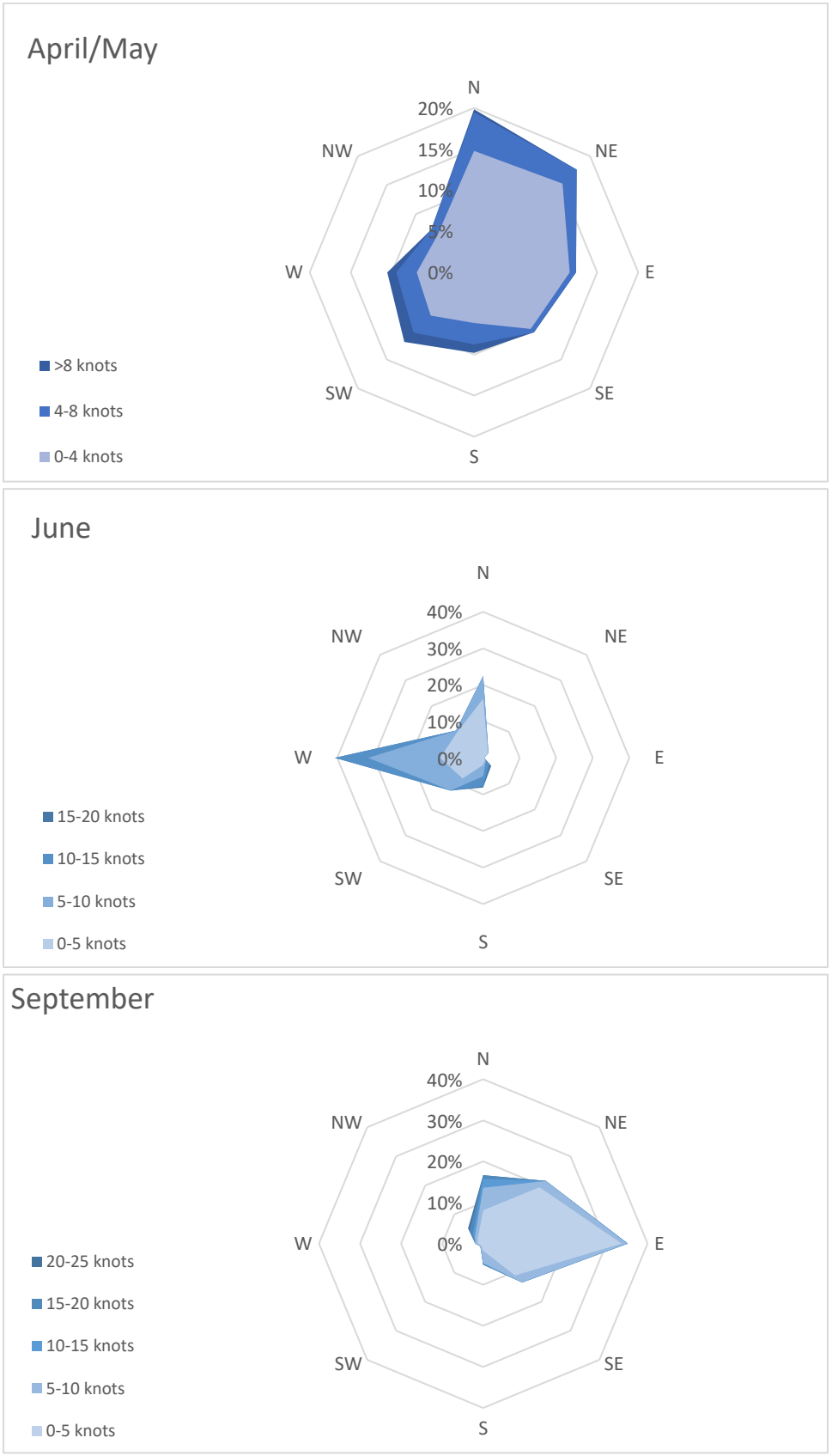

Figure 12. Wind velocity and direction by month

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5 MARINE MAMMAL OBSERVATIONS

During the 735 hours of observation over 74 days, marine mammals from seven species categories were sighted, totaling 368 groups of 776 individual animals. The sightings consisted of

- 132 groups of belugas comprised of 517 individual animals,
- 203 groups of harbor seals comprised of 220 individual animals,
- 22 groups of harbor porpoises comprised of 27 animals,
- 8 sightings of individual Steller sea lions,
- 1 individual pinniped not identified to species (likely a Steller sea lion or harbor seal),
- 1 gray whale, and
- 1 group of 2 killer whales.

All species except for the gray whale were species identified in the IHA. The number of groups and the total counts of individual animals is presented in Table 7. The Figures C-1-1 through C-1-13 in Appendix C-1 show the locations of beluga groups sighted during IPIR, the figures in Appendix C-2 show all marine mammal sighting locations by month. A table containing the time of first and last sighting, sighting duration, closest approach to the PCT, concurrence with IPIR, 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 PCT are provided electronically under Appendix G.

Table 7. Marine Mammal Sightings and Observation Effort

		Apr	*May*	*Jun*	*Sep*	***Project Total***
Observation Effort	Days	5	28	18	23	**74**
	Hours	47.4	272.8	186.0	228.6	**734.9**[1]
Beluga	Groups	12	11	16	93	**132**
	Individuals	29	49	38	401	**517**
	#/hr Observation	0.61	0.18	0.20	1.75	**0.70**
Gray Whale	Groups	-	1	-	-	**1**
	Individuals	-	1	-	-	**1**
Harbor Porpoise	Groups	-	9	5	8	**22**
	Individuals	-	11	5	11	**27**
Harbor Seal	Groups	1	8	85	109	**203**
	Individuals	1	8	87	124	**220**
Killer Whale	Groups	-	-	-	1	**1**
	Individuals	-	-	-	2	**2**
Pinniped Unidentified	Groups	-	-	1	-	**1**
	Individuals	-	-	1	-	**1**
Steller Sea Lion	Groups	-	3	2	3	**8**
	Individuals	-	3	2	3	**8**
All Marine Mammals	**Groups**	**13**	**32**	**109**	**214**	**368**
	Individuals	**30**	**72**	**133**	**541**	**776**

Note: [1] Sum of hours is not equal due to rounding

5.1 Belugas

Belugas were observed in every month of the project with the highest abundance occurring in September. The highest single-day count of belugas occurred on 19 September 2021, when 57 belugas were sighted. Figures showing the beluga group locations relative to the PCT and active Level B zones during IPIR, shutdowns, and Level B exposures are provided in Appendix C-1. All beluga sightings and track lines are presented by month in Appendix D and Appendix C-2, respectively. A heat map of beluga observation locations is presented in Figure 13. 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.

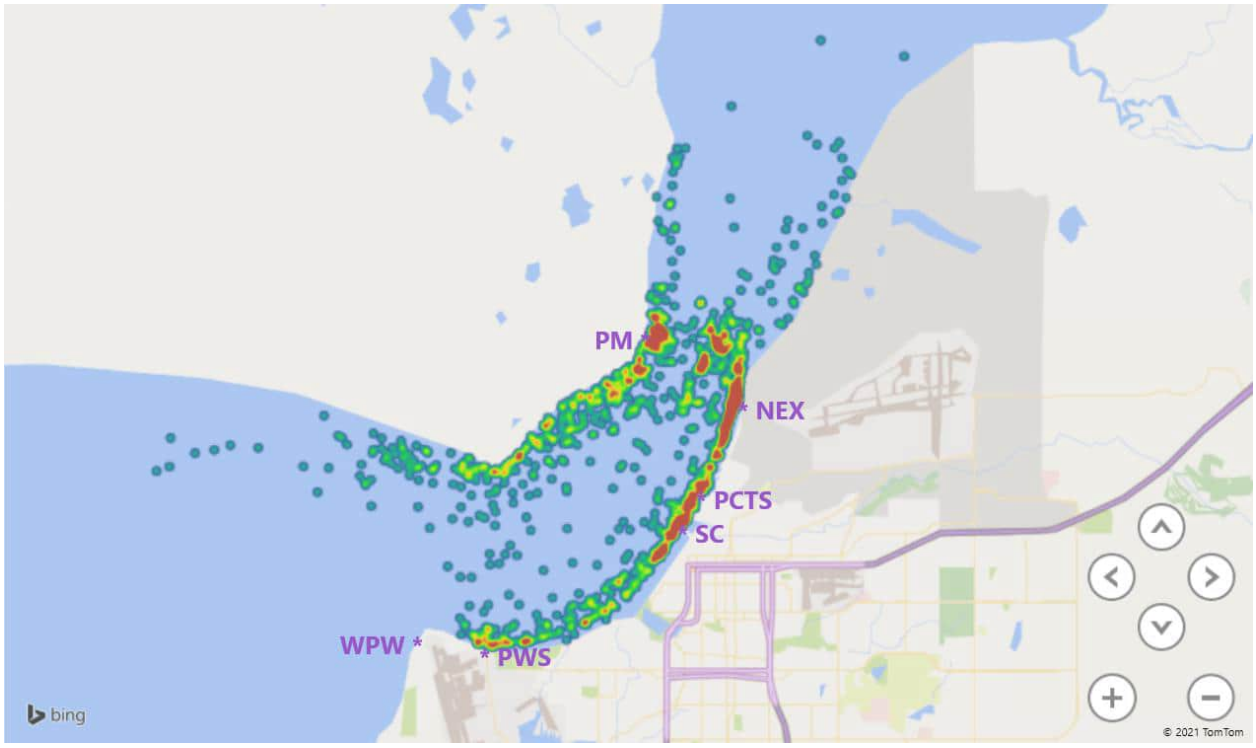

Figure 13. Heat map of 2021 beluga observation locations

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 used for one sighting. The total belugas counted and percentages of each category by month are presented in Table 8 and Figure 14.

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 8. Beluga Group Age Class Composition by Month

	White		*Gray*		*Calves*		*Unknown*		*Total Belugas*
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	
Apr	13	45%	16	55%	0	0%	0	0%	**29**
May	33	67%	14	29%	1	2%	1	2%	**49**
Jun	36	95%	2	5%	0	0%	0	0%	**38**
Sep	278	69%	75	19%	48	12%	0	0%	**401**
Total	**360**	**70%**	**107**	**21%**	**49**	**9%**	**1**	**0%**	**517**

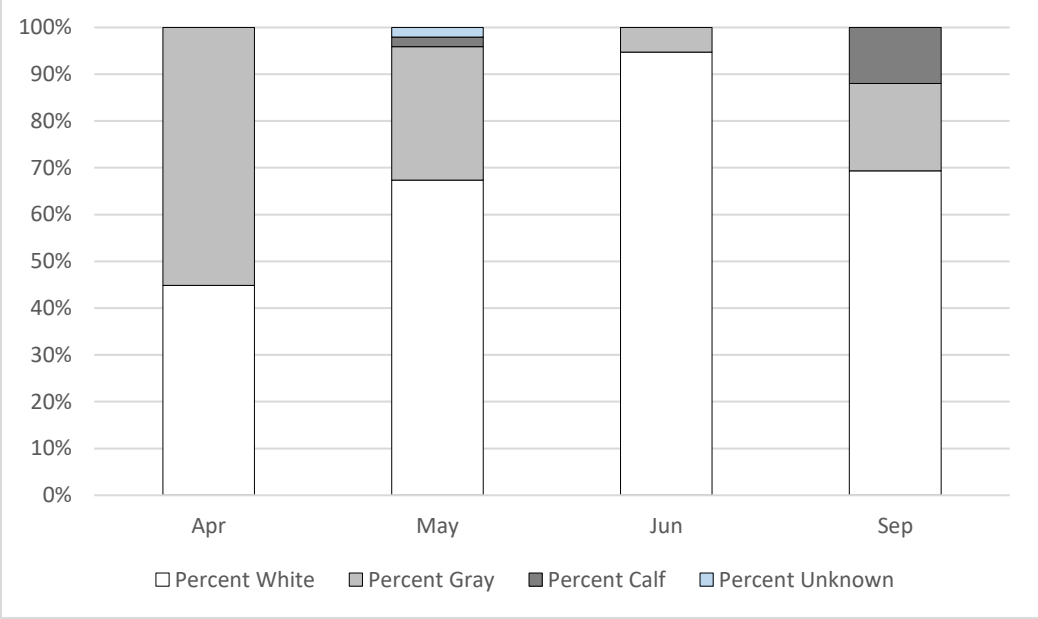

Figure 14. Age class composition of beluga groups

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. Because of the docile nature of belugas, avoidance behaviors

or reactions to disturbance are difficult to discern and none 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. Traveling and milling were the beluga behaviors recorded most often.[6]

To compare and evaluate if certain behaviors were observed more often during IPIR, all marine mammal sightings were categorized in five periods:

- **Non-IPIR** periods 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 in-water work 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.

Sixty-seven percent of beluga observations occurred on non-IPIR days or before IPIR occurred on a given day. Several delays of IPIR occurred due to the presence of belugas within the pre-clearance or Level B zone. Some of the delays lasted for significant portions of the day (refer to Section 7) which likely skewed the sighting counts in these categories.

Behaviors of beluga groups were compared by month, and by construction activity category. "Traveling" was the predominant behavior for all months and all categories of construction activity, recorded as the primary behavior for 86 % of all sightings. "Traveling" was either the primary or secondary behavior in 95 % of all beluga sightings. "Milling" was the secondary or primary behavior in 71 % of sightings. "Diving" was listed as the secondary behavior for 3 out of 132 groups. The diving behavior was noted for Groups 1171 and 1172 that spent several hours diving in the area offshore between Cairn Point and Port Mackenzie, and for Group 1189, sighted west of Point Mackenzie. All three groups were observed in September.

Other than the handful of groups in September observed diving, little variability was evident in the behaviors recorded from month to month, or between sightings that coincided with IPIR and those that did not. The primary and secondary beluga behaviors are presented as a percent of observations by month in Table 9 and Figure 15 and by construction activity category in Figure 16.

[6] "Traveling" was the default primary behavior and "milling" was the default secondary behavior in the dropdown menus within the sighting entry form, which may have biased the behavior observations. The sighting form entry was streamlined to allow for rapid initiation of a group sighting and capture of the initial position for mitigation enforcement, with a secondary goal of data collection for future management decisions.

Table 9. Beluga Behavior Categories (Primary-Secondary) by Month

	Apr		*May*		*Jun*		*Sep*		*Total*	
Primary-Secondary Behavior	# of Groups	%	# of Groups	%	# of Groups	%	# of Groups	%	Total Groups	Total %
Traveling-Milling	9	75.0%	7	63.6%	9	56.3%	51	54.8%	76	57.6%
Traveling-None	3	25.0%	3	27.3%	5	31.3%	26	28.0%	37	28.0%
Milling-Traveling	0	0.0%	1	9.1%	2	12.5%	9	9.7%	12	9.1%
Milling-None	0	0.0%	0	0.0%	0	0.0%	4	4.3%	4	3.0%
Milling-Diving	0	0.0%	0	0.0%	0	0.0%	2	2.2%	2	1.5%
Traveling-Diving	0	0.0%	0	0.0%	0	0.0%	1	1.1%	1	0.8%

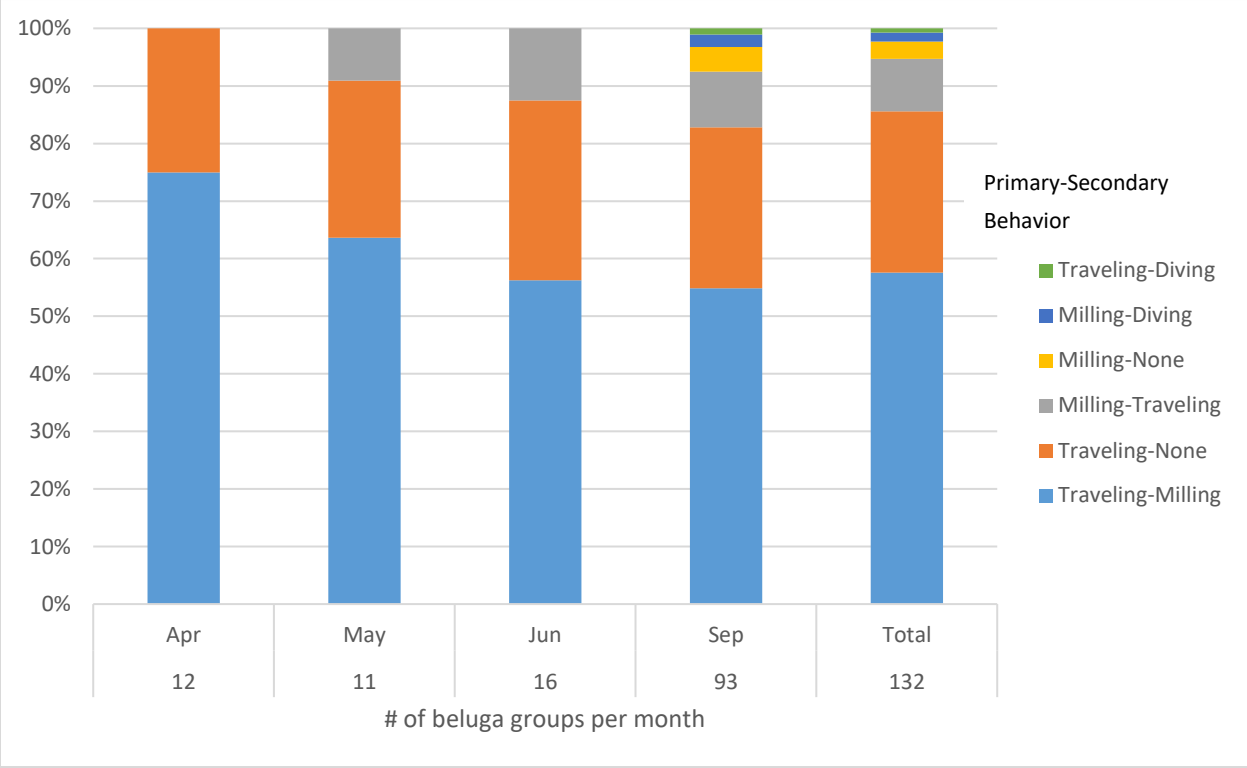

Figure 15. Primary and secondary beluga behaviors by month

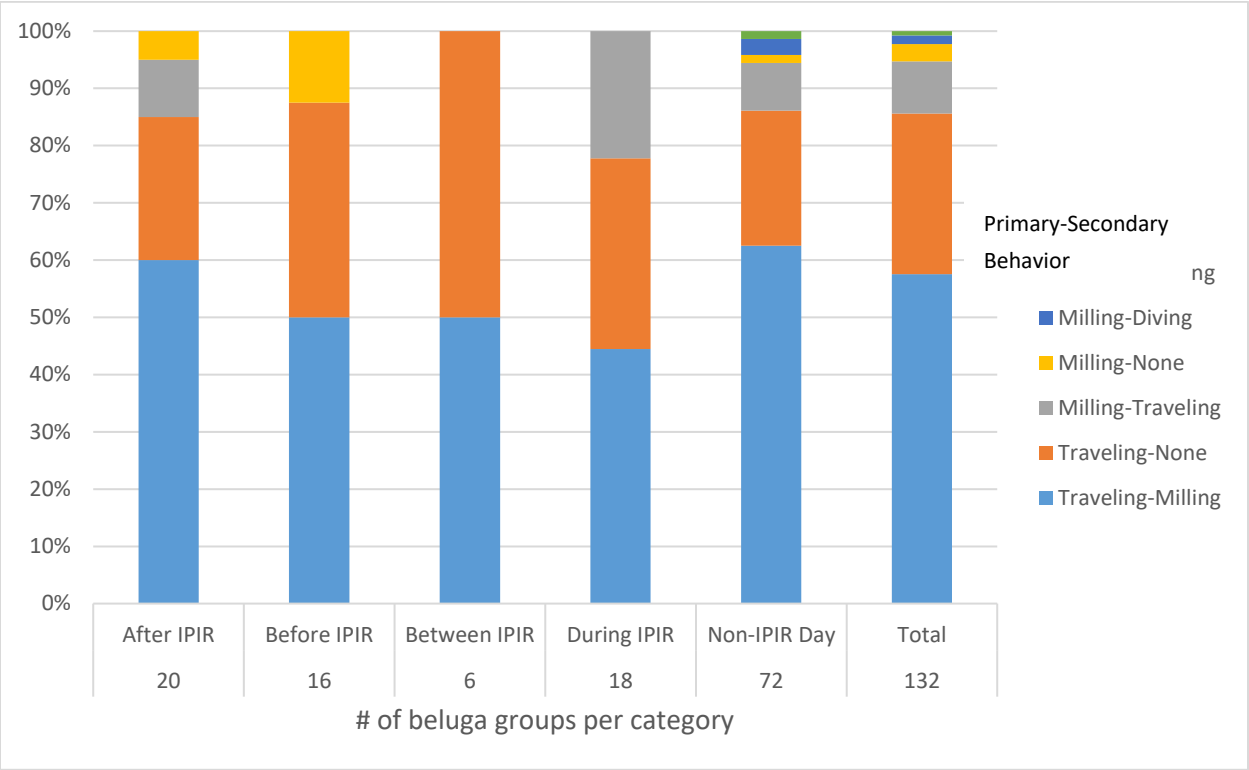

Figure 16. Primary and secondary beluga behaviors by construction activity category

Further grouping the sightings into "undisturbed" and "potentially-disturbed" categories also did not elicit distinct differences. Belugas sighted in the Non-IPIR and Before-IPIR periods were placed in the "undisturbed" category and sightings in the During-IPIR, Between-IPIR, or After-IPIR periods were grouped into the "potentially-disturbed" category. One minor difference was a slightly higher incidence of both milling and diving behavior during the "undisturbed" periods of no IPIR and slightly higher rates of "traveling" behavior in the "potentially-disturbed" category. A comparison of undisturbed and potentially disturbed behavior patterns is presented in Figure 17.

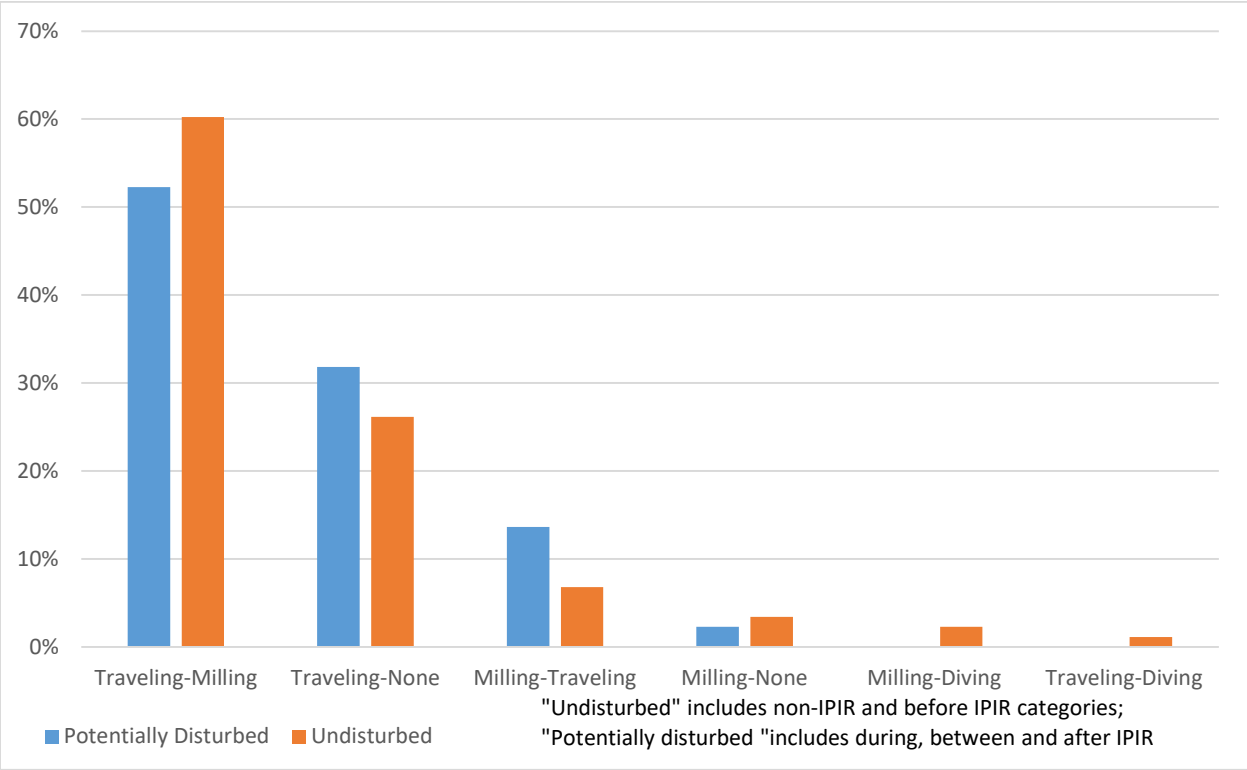

Figure 17. Beluga behaviors during "undisturbed" and "potentially-disturbed" periods.

Of the 132 beluga groups sighted, 18 were observed during or within minutes of IPIR. No definitive behavioral reactions to the in-water activity or avoidance behaviors were documented. To further evaluate whether belugas displayed reactive or avoidance behavior, the travel patterns during IPIR were evaluated for response patterns. One of the 18 groups split from another observed at the same time resulting in the evaluation of 17 total events. The travel patterns were categorized as no reaction ("none"), moving toward IPIR ("toward"), or moving away immediately after IPIR started or increasing speed as "potential" reactions. During several of the instances classified as a "potential" reaction, the group's initial trajectory was traveling away from the PCT. Since the trajectory prior to IPIR is not known in these instances, the movement away may or may not indicate a reaction. Narratives of each of the 17 events are presented in Appendix F. Table 10 presents a summary of the findings.

Table 10. 2021 Beluga Reactions During IPIR

Reaction	*Impact*	*Vibratory*	*Total*
Potential	3	3	6
None	0	4	4
Towards	0	7	7
Total	**3**	**14**	**17**

In 2020, 44 events were evaluated in a comparable manner. These were combined with the 2021 events and are summarized in Table 11. Belugas moved away or were already moving away and displayed a possible increase in travel speed upon the start of impact pile driving and were categorized as "potential" reactions for six of the ten

impact events. Three groups showed no reaction, and one group continued moving towards impact pile installation. Of the 51 vibratory events, 12 groups displayed a potential reaction, 20 displayed no reaction and 19 continued a trajectory towards the PCT. In general, belugas were more likely to display no reaction or to continue to move towards the PCT during use of the vibratory hammer. Only 23.5 % displayed a potential reaction. Belugas displayed a potential reaction to impact installation 6 of the 10 events analyzed, indicating impact hammering may cause avoidance behavior more readily.

Evaluation of the movements relative to IPIR 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 well 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 11. 2020 and 2021 Combined Beluga Reactions During IPIR

	Impact		*Vibratory*		*Total*	
Reaction	No.	%	No.	%	No.	%
Potential	6	60.0%	12	23.5%	18	29.5%
None	3	30.0%	20	39.2%	23	37.7%
Towards	1	10.0%	19	37.3%	20	32.8%
Total	**10**		**51**		**61**	

Beluga Movements Relative to Tidal Currents

Beluga movement was also compared to generalized tidal current directions to evaluate whether belugas typically travel with or against the tides. Beluga groups were tracked throughout each sighting, and most sightings contain several locations or "fixes." The bearing was calculated between successive fixes and then compared to the predominant current directions from the ebb or flood tides. Sighting fixes during slack tides were not evaluated. Beluga movements were classified as "with" the current if the calculated bearing was within 60 degrees plus or minus of the predominant current direction, they were classified as "across" if the calculated bearing was offset between 60 and 120 degrees of the predominant current direction and classified as "against" if they were greater than 120 degrees plus or minus of the predominant current direction.

For the purposes of the evaluation, it was assumed that the predominant current bearing parallels the shorelines during ebb and flood tides. The monitoring area in the lower portion of Knik Arm near the POA is "J" shaped. To account for the "bend" in current direction, the monitoring area was divided into three regions: west, middle, and north. If the pair of sighting locations ended west of Point Mackenzie (i.e., west of -149.986 degrees longitude), the ebb current was assumed to flow at a bearing of 280 degrees and the flood was assumed to flow at a bearing of 100 degrees. If the pair of sighting locations ended east of Point Mackenzie (i.e., -149.986 degrees longitude) and south of Cairn Point (i.e., 61.257 degrees latitude), the ebb current was assumed to flow at a bearing of 220 degrees and the flood current was assumed to flow at a bearing of 40 degrees. If the pair of sighting locations ended north of Cairn Point (i.e., 61.257 degrees latitude) the ebb current was assumed to flow at a bearing of 200 degrees, and the flood current was assumed to flow at a bearing of 20 degrees. Figure 18 presents generalized directions of current for flood and ebb tides for the west, middle, and north sections.

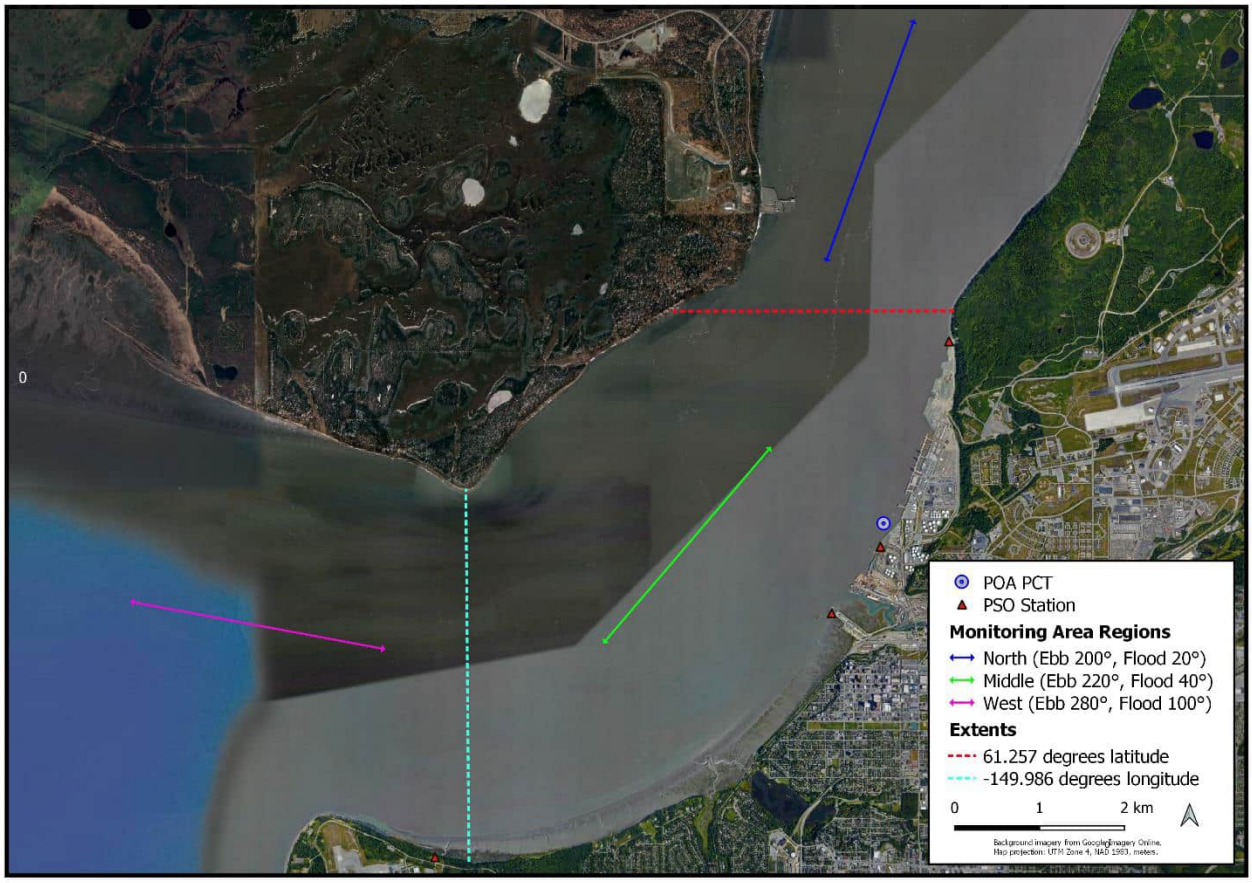

Figure 18. Generalized current directions for sightings in the west, middle, and north portions of the monitoring area.

Analysis of more than 2,200 pairs of sighting locations in 2020 and 2021 suggest that belugas travel in the same direction as the ebb and flood tides more often than not, but they also travel against and across the predominant current directions in moderately high proportions. It is important to note that when PSOs track groups, they typically take fixes on the animal closest to the PCT. However, when groups are larger and not cohesive, some fixes may show the lead animal in a group that is spread over a large area, followed by a fix on the trailing animal. The latter fix may cause it to appear as if the group reversed direction, but it may instead be showing the spread of the group, not the direction of the group. Nevertheless, in general, the fixes show the trajectory of the groups. The proportion of movements in each category in 2021 was remarkably similar to the proportions in 2020. Table 12 presents the number and proportion of beluga movements relative to generalized tidal currents.

Table 12. Beluga Movements Relative to Predominant Tidal Current Direction

	No. of Beluga Movements Evaluated	*Proportion of Total*	*No. of Beluga Movements Evaluated*	*Proportion of Total*
	2020		*2021*	
With Current	929	56%	377	60%
Against Current	527	32%	182	29%

Across Current	195	12%	67	11%

5.1.3 Sighting Rates

The beluga sighting rates varied throughout the project. In 2020, belugas were present on the first morning of observation (27 April 2020) and were sighted every day until 8 May when a period of 14 days without a beluga sighting began. A remarkably similar pattern was observed in 2021; belugas were present on the first morning of the project (26 April 2021) and were sighted every observation day except one through 5 May. Then no belugas were seen for 19 observation days, until 26 May. In 2020, a small number of sightings occurred at the end of May, and then none again until mid- to late-June. In 2021, five groups were sighted between 26 May and 1 June, and then none were sighted for nine observation days until 16 June. In late August to early September 2020, beluga sightings increased significantly, with larger and more frequent groups that remained in the monitoring area for longer durations. The trend continued into the first part of September when another long break in observation began. In 2021, observations ceased 24 June and when they resumed from 7 to 29 September, sighting rates were high, and durations were longer.

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_o). Table 13 presents the number of observation days, observation hours, belugas sighted, and sighting rates (b/hr_o). Figure 19 through Figure 21 present the number of belugas sighted per hour of observation on a daily basis, paired with the total hours of observation each day.

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

	Apr	*May*	*Jun*	*Sep*
Observation Days	5	28	18	23
Observation Hours	40.5	301.4	318.1	85.6
Belugas Sighted	33	168	114	276
Belugas per Hour of Observation (b/hr_o)	0.61	0.18	0.20	1.75

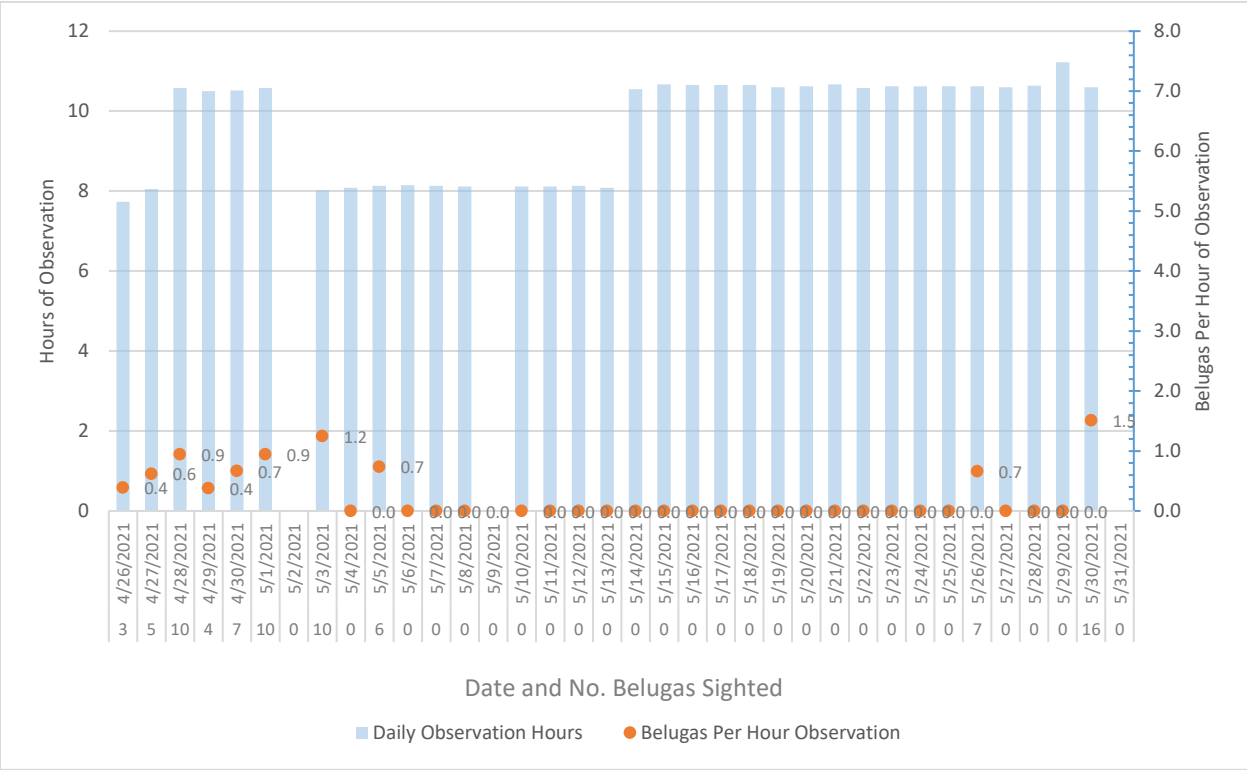

Figure 19. Beluga sighting rates April and May 2021

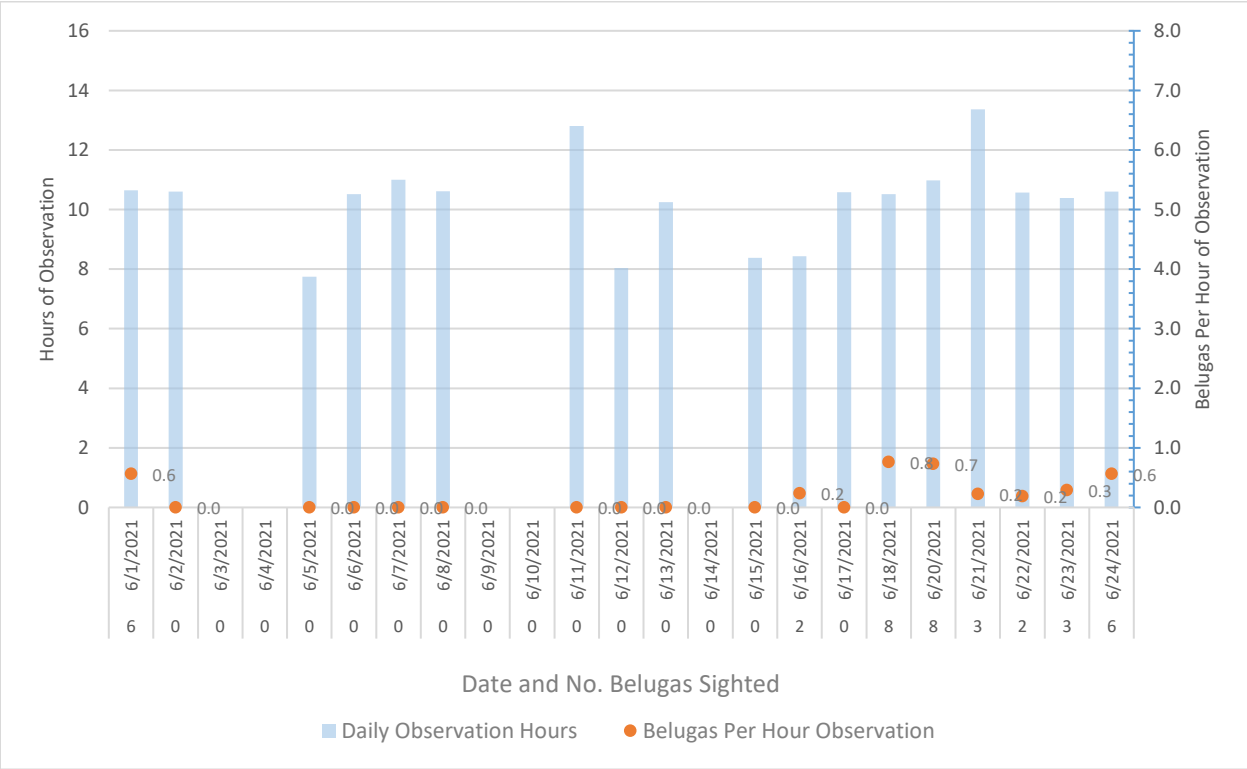

Figure 20. Beluga sighting rates June 2021

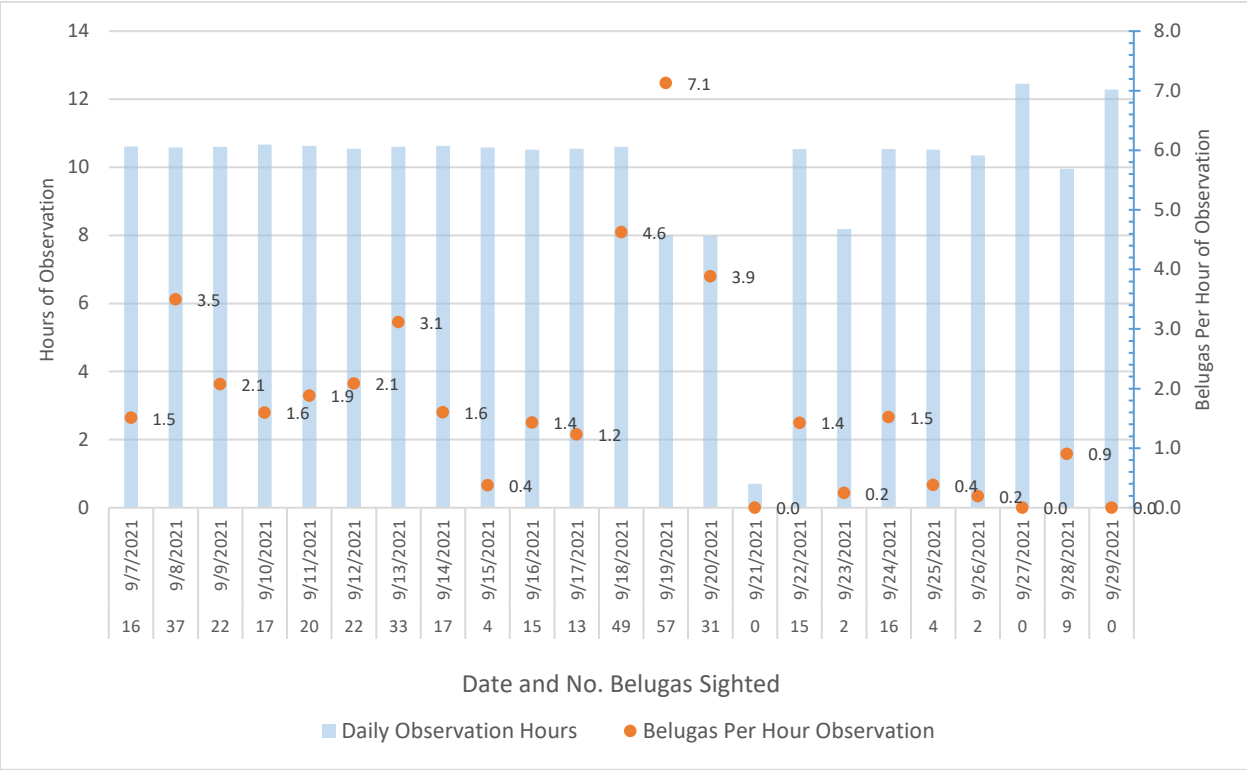

Figure 21. Beluga sighting rates September 2021

Beluga Sightings and Tidal Stage

In 2020, the duration of each beluga group sighting was segregated and compiled by the tidal stages that occurred during the sighting to evaluate the relationship of tidal stage to beluga presence. The analysis showed that beluga presence was roughly proportional to percentage of observations at each tidal stage. Though not evaluated for statistical significance, belugas were present slightly more than predicted during the lower half of the tide and slightly less than predicted during the higher half.

For the 2021 data, a similar, but simpler analysis was conducted. The tide stage at the initial sighting time of each group was determined, and the proportion of tide stages at the initial sighting was compared to the proportion of tide stages during all observations. Beluga groups that were already present in the monitoring area (or within the first 30 minutes of monitoring) were excluded from the analysis. The comparison of tidal stages during observations and tidal stages at the initial sighting of beluga groups is presented in Table 14. The proportion of tide stages occurring at the time of the initial sightings of beluga groups was roughly equivalent to the proportion of tide stages derived by the algorithm for all observation periods (refer to Table 6 for a description of the tide stage algorithm). Tidal stage was not a strong predictor of beluga presence in 2020 or 2021.

Table 14. Comparison of the Proportion of Tidal Stages During Observations to Proportion at Initial Sighting of Beluga Groups

Tidal Stage	*Proportion of Tidal Stage During Observations*	*Proportion of Tidal Stage at Initial Sighting of Beluga Group*	*Difference*
LE	21.90%	26.1%	4.15%
LS	16.20%	14.3%	-1.91%
LF	12.20%	12.6%	0.41%
HF	13.50%	11.8%	-1.74%
HS	15.40%	11.8%	-3.64%
HE	20.70%	23.5%	2.83%

5.1.4 Beluga Attendance and Density in the Monitoring Area

In addition to the total numbers of belugas present during the observation periods, the duration of each sighting also affected beluga attendance in the monitoring area at different periods. The average sighting duration varied in 2021, with higher average durations in May and September. However, the increase in beluga numbers in September, along with an increase in duration, amplified the numbers of belugas present near the POA for a given duration in September. The speed at which the beluga groups passed through the monitoring area affected the durations of delays and shutdowns (further discussed in Section 7). The delays and shutdowns affected construction progress during the periods of high attendance. To incorporate the sighting durations, an attendance metric of "beluga-hours per hour of observation" (b-hr/hr$_o$) was developed by multiplying the number of belugas in each group by the duration of each sighting and then dividing by the hours of observation to normalize across days. The "attendance" metric is presented in Equation 1[7].

Equation 1: $\boldsymbol{B_A = \frac{\sum_{i=1}^{n} b_i \times d_i \; (b_1 \times d_1 + b_2 \times d_2 + \cdots b_n \times d_n)}{\sum hr_o}}$

where:

$\boldsymbol{B_A}$ = beluga attendance $\left(\frac{b-hr}{hr_O}\right)$

$\boldsymbol{d}$ = beluga sighting duration ($\boldsymbol{hr}$)

$\boldsymbol{b}$ = beluga group count

$\boldsymbol{hr_o}$ = hours of observation

The surface area of the region of Knik Arm between the pre-clearance inbound and outbound lines is approximately 35.8 square kilometers (km^2)[8]. Using the attendance metric, an approximation of beluga density was determined from the observations by dividing the attendance by the surface area of the monitoring area (35.8 km^2). The density in belugas per square kilometer (b/km^2) can then be derived for any chosen period of observation (e.g., daily, weekly, monthly, etc.). The beluga density was calculated according to Equation 2.

[7] The same equation was presented in the 2020 Petroleum and Cement Terminal Construction Marine Mammal Monitoring Final Report but has been clarified here.

[8] An error was made in the measurement of the monitoring area in 2020 where the perimeter of the polygon (27 km) was mistakenly substituted for the area. The monitoring area of 35.8 km^2 is correct and should have been used in the 2020 report. The error caused the density to be overestimated by a factor of 1.33 in the 2020 report.

Equation 2: $$\textbf{\textit{Beluga Density}} = \frac{B_A}{35.8\ (km^2)}$$

Table 15 presents the number of observation days, number of observation hours, number of beluga groups, average sighting duration, attendance, and beluga density by month. The average sighting durations by month are presented graphically in Figure 22, the attendance estimates (b-hr/hr$_o$) are presented in Figure 23, and the attendance estimate (b-hr/hr$_o$) is presented on a daily basis in Figure 24.

Table 15. Beluga Attendance and Density Metrics by Month

	Apr	*May*	*Jun*	*Sep*
Observation Days	5	28	18	23
Observation Hours	47.4	272.8	186.0	228.6
Number of Beluga Groups	12	11	16	93
Number of Belugas	29	49	38	401
Average Sighting Duration (hr)	1.06	2.46	1.42	2.23
Beluga Attendance (b-hr/hr$_o$)	0.67	0.43	0.28	3.97
Beluga density in monitoring area (b/km^2)	0.0247	0.0160	0.0105	0.1472

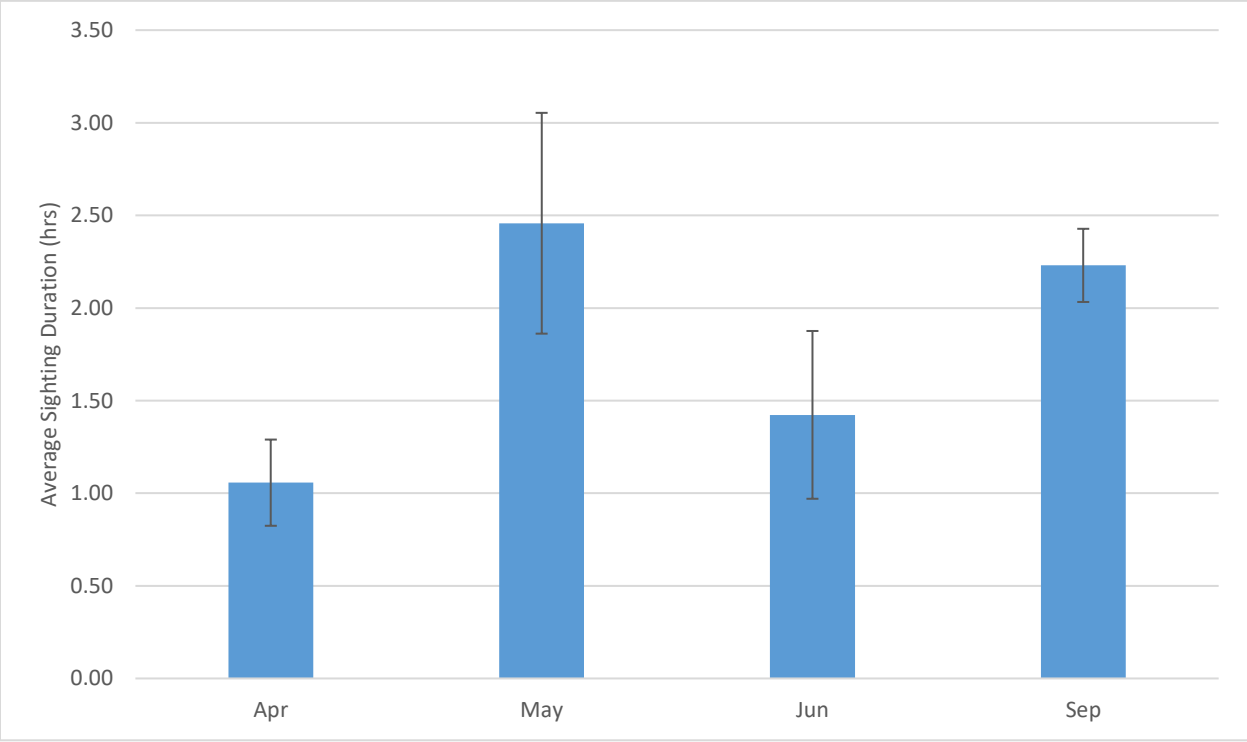

Figure 22. Average beluga sighting durations (hours)

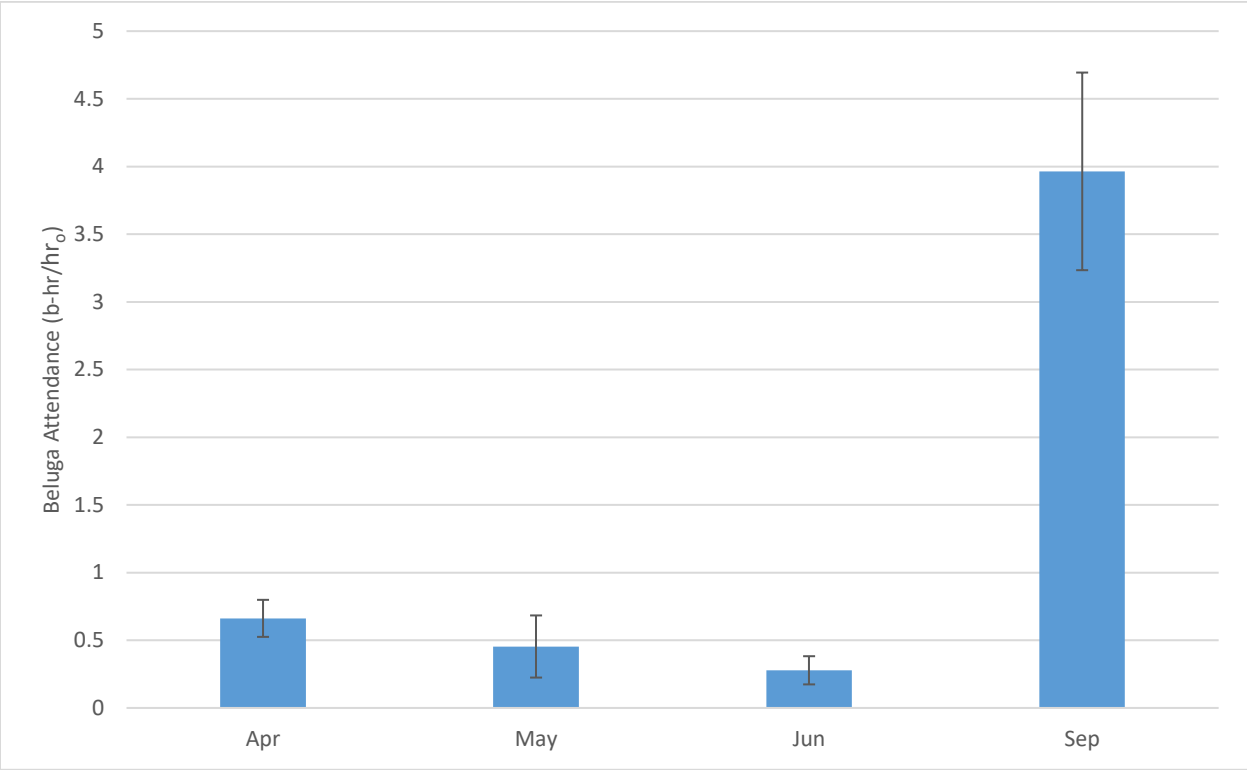

Figure 23. Beluga attendance (b-hr/hr$_o$) by month

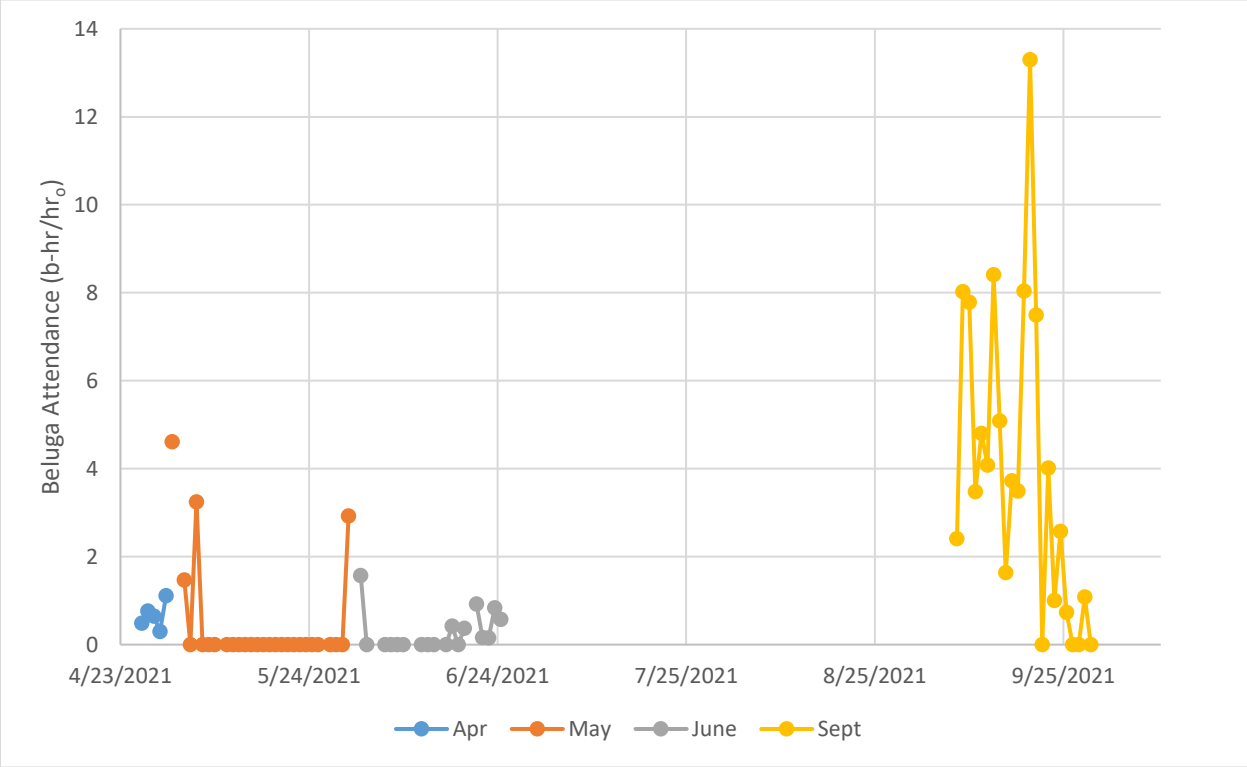

Figure 24. Beluga attendance (b-hr/hr$_o$) by observation day

Several biases in both the attendance metric and the rough approximation of beluga density are notable. For example, some sightings occurred completely or partially outside of the 35.8 km^2 monitoring area defined above. Their inclusion biases the density values higher. In 2021, monitoring was conducted from Port Mackenzie and the west side of Point Woronzof at various times, extending the monitoring area beyond the four standard stations. To ensure the data remained comparable to 2020, the portion of beluga sightings attributed only to the stations was not counted in calculation of b-hr/hr_o or beluga density.

Many other factors affect the detection rate of belugas, all of which bias the estimates lower. No observation methods can count every beluga present, and land-based observations have certain limits. Observations un-aided by optics allow for a wider field of view but cannot detect marine mammals at great distances. Conversely, the field of view of high-powered binoculars is limited, and only a portion of distant areas can be monitored at any given moment. The land-based detection rate is improved by increasing the number of PSOs and monitoring locations, but there are practical limits to suitable observation locations and the number of PSOs an observation program can employ. The POA employed 11 PSOs, seven (or more) of which were on watch for nearly all observation hours, from four or more locations.

In, addition, the monitoring stations are all located on the eastern/southern shore of lower Knik Arm, and there is a higher probability of seeing animals closer to the stations. If belugas are present on the western/northern shore more frequently or for longer durations, this pattern may not be evident in the data.

Upper Cook Inlet is silty from glacial flour and belugas are capable of diving for more than 15 minutes. While not typical, belugas may travel long distances underwater, and smaller groups or individuals may pass undetected. Some groups are first sighted well within the monitoring area and some are not observed leaving. Some portions of the monitoring area are over 5 kilometers across, and the sighting rates fall with increased distance from the observation stations, even with high-powered binoculars. Precipitation and sea state conditions affect visibility, especially at greater distances, further reducing the detection rate.

While acknowledging the uncertainty inherent in the monitoring program, no correction factor was applied to account for potentially missed sightings. Reasonable estimates of missed sightings could be made but would be speculative without a robust verification.

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, 203 groups of harbor seals were sighted comprising 220 animals. There were 13 groups of two animals, and two groups of three animals. No juveniles or pups were sighted. Harbor seals were observed in each month of the project, with the highest sighting rates (harbor seals per hour of observation) in June (0.47 seals/hr_o) and September (0.51 seals/hr_o). When factoring the duration of the sightings, harbor seal attendance (harbor seal hours per hour of observation) the average was higher in September (0.83 seal-hr/hr_o) compared to June (0.37 seal-hrs/hr_o). This indicates that a similar number of harbor seals were seen in the monitoring area each day in June and September, but the average duration of the sightings in September was nearly three times longer than June. Harbor seals were observed near each of the four monitoring stations and were commonly sighted near the mouth of Ship Creek (Figures C-2-4 through C-2-6).

The predominant behaviors for harbor seals were “looking” and “sink,” accounting for 76.4 % and 75.4 % of the primary and secondary behaviors recorded, respectively. “Traveling” was the primary behavior in 17.7 % of the

sightings, and “milling” was 1.5 % of primary and 4.4 % of secondary behaviors. Spyhopping was observed in 1.5 % of the sightings. Feeding was observed or suspected in 7 harbor seal sightings. Seven sightings contain notes of harbor seals with fish or salmon in the mouth of the harbor seal. No behavioral reactions in response to IPIR were recorded. Table 16 presents the primary and secondary behaviors recorded for harbor seals and a heat map of harbor seal sightings is shown in Figure 25.

Table 16. Harbor Seal Primary and Secondary Behaviors

	Primary Behavior	*Secondary Behavior*
Looking	76.4%	7.4%
Traveling	17.7%	3.0%
Feeding Observed	2.0%	1.0%
Milling	1.5%	4.4%
Spyhopping	1.5%	0.0%
Sink	1.0%	75.4%
Diving	0.0%	5.4%
None	0.0%	2.0%
Feeding Suspected	0.0%	0.5%
Multiple-see comments	0.0%	0.5%
Other	0.0%	0.5%

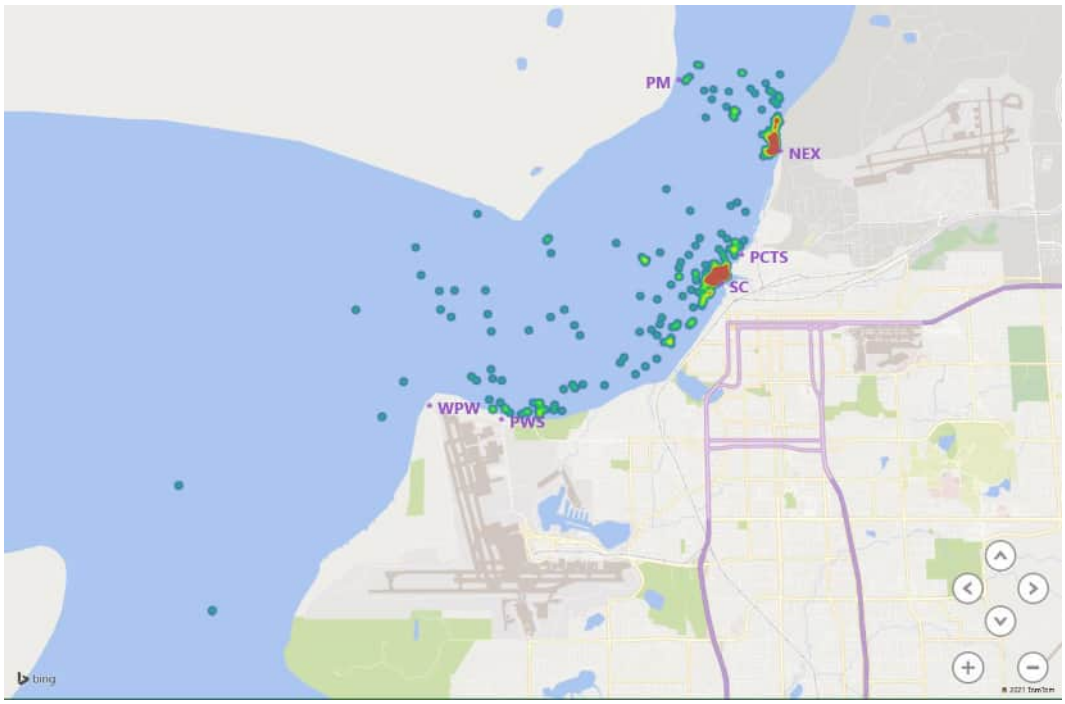

Figure 25. Heat map of harbor seal sighting locations

5.3 Other Marine Mammals

Other marine mammals that were observed in the monitoring area included:

- 22 groups of harbor porpoises comprised of 27 animals
- 8 sightings of individual Steller sea lions
- 1 group of 2 killer whales
- 1 individual pinniped not identified to species, and
- 1 gray whale

Steller sea lions were sighted beginning at the end of May, in mid-June, and in September. The most common behavior was traveling followed by diving and milling. One unidentified pinniped was observed traveling offshore of Point Woronzof for 32 minutes. The notes do not indicate if it was more likely a harbor seal or Steller sea lion. The locations of Steller sea lion sightings are presented in Figures C-1-7 through C- 1-9.

Of the 22 harbor porpoises observed, 6 were in pairs, 3 were in one group, and the remaining were single animals. The most common behavior was traveling, followed by milling, none, and a single instance of porpoising. Most of the observations were short, but five sightings were exceeded 45 minutes. Harbor porpoise sightings are presented on Figures C-1-7 through C-1-9.

One small and lethargic gray whale was sighted 3 May offshore of Ship Creek, moving southwest toward Point Woronzof. During the initial sighting, it was not clear if the sighting was a marine mammal or not. The blow was not visible, and the animal sank slowly. The whale was last observed offshore of the PWS station (Figure C-2-7).

One male and one juvenile killer whale of unknown sex were sighted offshore of Point Woronzof on 15 September. The pair moved up Knik Arm, and reversed direction about midway between Cairn Point and Port Mackenzie. During the sighting, a cow and calf beluga were milling near the south side of Port Mackenzie. The pair of killer whales moved southwest, out of Knik Arm toward the open water of Upper Cook Inlet (Figure C-2-9).

6 MARINE MAMMAL EXPOSURES

During Phase 2 of the PCT project in 2021, 27 belugas, 39 harbor seals, and 2 harbor porpoises were sighted within or extremely near the Level B harassment zone while IPIR was occurring; in these incidents an exposure is believed to have occurred. Five harbor seals were within the applicable Level A zone for impact installation of the 144-inch piles with a bubble curtain (1,311 meters for 30 percent installation or 2,167 for 70 percent). In every case where one or more belugas were observed within a Level B monitoring zone, a shutdown was called immediately.

In most cases, IPIR ceased in less than a minute; however, there were incidents when safety concerns did not allow IPIR to stop immediately. For example, during the installation of the first large mooring dolphin (the 144-inch pile, MD5) on 25 May, a short duration of vibratory hammering was required to safely seat the pile prior to impact hammering. Beluga Group 877 was sighted by the WPW PSO, approximately 12,500 meters from the PCT, but within the 18,000-meter Level B zone for vibratory hammering of a 144-inch pile. The WPW PSO radioed the PCT PSO who then contacted the construction crew. The construction crew stated that they needed to proceed to set the pile in the mud. The hammer was turned on and off in several short bursts, totaling 1.4 minutes of use, from 1548 to 1616. Similarly, on 11 September, a 36-inch temporary pile was being removed with a vibratory hammer from 0752 to 0758. At 0757, beluga Group 1078 was sighted, and a shutdown was called. The pile was nearly free from the seafloor and the construction crew was not able to stop the hammer immediately. The hammer continued for approximately one minute until the pile was safely out of the substrate.

Harbor seal Groups 970 and 983 were identified in the preliminary monthly reports as potential exposures. After a detailed review of the timing and locations of the sightings relative to the Level B zones (including “land shadows”) the groups were determined not to be exposures. For Group 970, it was determined that the seal had enough time from the last sighting to the onset of pile driving to traverse the distance needed to exit the Level B zone. For Group 983, it was determined that the seal’s proximity to the land shadow behind Cairn Point when it was first sighted meant it was likely outside of the Level B zone while pile driving was occurring.

Three other harbor seal groups (1254, 1263, and 1270) were not identified as Level B exposures in the preliminary reports. However, these groups were either last sighted shortly before pile removal or first sighted short after pile removal such that that were likely within the Level B zone.

Beluga exposures occurred during vibratory installation of the 144-inch monopiles (7 belugas), during the impact hammering of the monopiles (3 belugas), and during vibratory removal of the 36-inch temporary piles (17 belugas). The 17 exposures during removal of 36-inch piles occurred in September when beluga attendance in the area was high.

Of the potential exposures, three groups of belugas totaling 13 animals (Groups 1099, 1133, and 1220 [which 1222 later split from]), were first sighted near the NEX station, just off or south of Cairn Point. Two events (Groups 1099 and 1220/1222) occurred at high slack when the beach to access the CP station was not accessible. For Group 1133, the tide was at low ebb and PSOs began watch at CP at 0750, nine minutes before the first sighting at 0759. The placement of PSOs at Port Mackenzie and Cairn Point prevented at least 8 additional beluga takes (e.g. Group 956 on 18 June and Group 1072 on 10 September).

Of the remaining potential exposures, three small groups (2 animals each in Groups 958, 1078, and 1157) were first sighted on the far shore. One individual animal (Group 978) was first sighted near Ship Creek. One group of seven belugas (Group 877) was first sighted by the WPW PSO with a spotting scope on the far shore west of Point

Mackenzie, 12,500 meters from the PCT. Beluga exposures occurred during low slack (9 belugas), low flood (2 belugas), high slack (11 belugas), high ebb (1 beluga), and low ebb (4 belugas), and none at high flood.

Level B exposures of harbor seals occurred during vibratory installation of 144-inch piles (7), impact installation of 144-piles (3) and vibratory installation or removal of 36-inch piles (29). Five harbor seals were potentially exposed to Level A sound during impact installation of the 144-inch piles.

Because of the number of Level A and Level B harbor seal takes allowed and their regular presence at the mouth of Ship Creek, shutdowns were not instigated for harbor seals. Had any harbor seals been seen within or approaching the 100-meter shutdown zone, a shutdown of IPIR would have been called, but it was not required. The numbers of potential Level B takes for belugas and harbor seals are presented by month in Table 17 and in the table in Appendix D. The incidents where belugas were observed within the Level B zone and shutdowns were enforced are presented in Table 18.

Table 17. Potential Beluga Level B Takes and Harbor Seal Level A and B Takes and Sightings by Month

Month	*Belugas Sighted*	*Potential Level B Take*	*Percent Exposed*	*Harbor Seals Sighted*	*Level B Take*	*Level A Take*	*Percent Exposed*
Apr	29	0	0.0%	1	0	0	0.0%
May	49	7	14.3%	8	1	0	12.5%
Jun	38	3	7.9%	87	12	5	19.5%
Sep	401	17	4.2%	124	26	0	21.0%
Total	**517**	**27**	**5.2%**	**220**	**39**	**5**	**20.0%**

Two single harbor porpoises (one in May, one in June) were sighted within the Level B zone for vibratory installation of a 36-inch pile with a bubble curtain (4,106 meters). All exposures are listed in the table in Appendix D.

Table 18. Beluga Sightings Inside the Level B Zone During IPIR

Group ID	*No. of Belugas*	*First Sighted*	*Last Sighted*	*Sighting Duration (hh:mm)*	*Distance from PCT Upon Sighting in Level B Zone (meters)*	*Closest Approach (meters)*	*Activity Hammer Attenuation Pile Size Level B Zone (meters)*	*Time of First Sighting in Level B Zone*	*IPIR Times*	*Notes*
877	7	5/26/21 1525	5/26/21 1656	1:31	12,672	10,609	Vibratory Bubble Curtain 144 18,000	1548	1548 – 1616 (int.)	Belugas were first sighted 12,700 meters from the PCT on far shore west of Point Mackenzie by the WPW PSO. (Figure C-1-1). The belugas were reported to the construction crew, but they needed to proceed with installation of the first 144-inch monopile to prevent a safety incident. The vibratory hammer was operated briefly seven times, for a total of 1.4 minutes of use. The tide was low slack.
958	2	6/18/21 1925	6/18/21 1936	0:11	3,556	3,556	Impact Bubble Curtain 144 6,309	1925	1642 – 1905	The two belugas were first sighted on the far shore, between Point Mackenzie and Port Makenzie 20 minutes after pile driving ceased. They were not sighted within the Level B zone during impact installation of the 144-inch pile, but it was determined that it was unlikely for them to have traversed 3,500 meters (swimming distance) into the Level B zone at the time of first sighting (Figure C-1-2). The tide was low slack.
978	1	6/21/21 2024	6/21/21 2217	1:53	1,773	404	Impact Bubble Curtain 144 6,309	2024	1946 – 2024	A single beluga was sighted at 2024 near Ship Creek, 1,773 meters from the PCT (Figure C-1-3). A shutdown was called, and impact installation of the 144-inch pile ceased immediately. The tide was high ebb.

Table 18. Beluga Sightings Inside the Level B Zone During IPIR (continued)

Group ID	*No. of Belugas*	*First Sighted*	*Last Sighted*	*Sighting Duration (hh:mm)*	*Distance from PCT Upon Sighting in Level B Zone (meters)*	*Closest Approach (meters)*	*Activity Hammer Attenuation Pile Size Level B Zone (meters)*	*Time of First Sighting in Level B Zone*	*IPIR Times*	*Notes*
1078	2	9/11/21 0757	9/11/21 0828	0:31	2,862	2,862	Vibratory Bubble Curtain 36 4,106	0757	0752-0758	Two belugas were sighted 2,862 meters from the PCT, near the far shore, about half-way between Point Mackenzie and Port Mackenzie at 0757 (Figure C-1-6). A shutdown was called. The construction crew could not immediately cease pile removal, but shutdown after about a minute when the pile was fully removed (Figure C-23). The tide was at low flood.
1099	4	9/12/21 1237	9/12/21 1412	1:31	2,183	116	Vibratory Bubble Curtain 36 4,106	1237	1234 - 1237	At 1237 one beluga was initially sighted in front of NEX approximately 1,923 meters in the Level B zone and 2,183 meters away from PCT (Figure C-1-7). The pile removal was halted immediately upon sighting the beluga group within the Level B zone. The count was later updated to 4 belugas. Tide was at high slack.
1133	2	9/15/21 0759	9/15/21 0855	0:56	3,309	3,046	Vibratory Bubble Curtain 36 4,106	0759	0753 - 0758	One white beluga was first sighted at 0759 near Cairn Point, 3,309 meters from the PCT, and 797 meters inside of the Level B zone (Figure C-1-8). The pile removal was complete at 0758, but the group was likely within the Level B zone before the hammer was turned off. A second beluga was added to the group at 0818. The tide was at low ebb.

Table 18. Beluga Sightings Inside the Level B Zone During IPIR (continued)

Group ID	*No. of Belugas*	*First Sighted*	*Last Sighted*	*Sighting Duration (hh:mm)*	*Distance from PCT Upon Sighting in Level B Zone (meters)*	*Closest Approach (meters)*	*Activity Hammer Attenuation Pile Size Level B Zone (meters)*	*Time of First Sighting in Level B Zone*	*IPIR Times*	*Notes*
1157	2	9/17/21 0837	9/17/21 0930	0:53	2,948	1,980	Vibratory Bubble Curtain 36 4,106	0837	0925-0931	Two belugas were first sighted offshore between NEX and Port Mackenzie at 0837. The construction crew was ready to begin pile driving at 0853. The belugas were not resighted for more than 30 minutes and the delay ended. From 0925 to 0931 the construction crew was used a vibratory hammer on a 36-inch pile with a bubble curtain; the Level B zone was 4,106 meters. At 0930 NEX station radioed to the PSO field lead that one white beluga was sighted 2,127 meters inside of the Level B zone and traveling towards the PCT. It was assumed that both belugas from group were present during the pile removal (Figure C-1-9). Pile removal ceased at 0931. Tide was at low ebb.
1220/1222	5/2	9/24/21 1056	9/24/21 1222	1:26	2,700	2,043	Vibratory Bubble Curtain 36 4,106	1056	1053 - 1056	Three white, three gray and one calf beluga were first sighted near Cairn Point, 2,700 meters from PCT and 1,350 meters within the Level B zone. A shutdown was called, and the hammer was deactivated at 1056. Two belugas later split from Group 1220 and were tracked under Group 1222. The total counts of Groups 1220 and 1222 reflect the original count of Group 1220. (Figure C-1-10). The tide was at high slack.

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6.1 Extrapolated Exposures

The IHA for Phase 2 construction of the PCT requires an estimate of marine mammal exposures in areas of the 18,000-meter Level B zone for vibratory installation of a 144-inch pile that are beyond the distance that can be effectively monitored by the PSOs. Vibratory installation of 144-inch piles was conducted eight times between 26 May and 21 June. To estimate beluga exposures during these eight events, the monthly densities were calculated using Equations 1 and 2 in Section 5.1.4 and extrapolated to the non-visible areas of the 18-000-meter Level B zone. The densities for harbor seals were developed using the same equations and exposures were extrapolated (Section 6.1.3). The densities of other marine mammal species observed (harbor porpoises, Steller sea lions, killer whales, and gray whales) are low and extrapolate to zero exposures.

The extrapolated exposures discussed in this section were not observed exposures. All observed exposures during the project were recorded and reported. Because marine mammals could not be observed in the non-visible areas, there may have been fewer or more than the extrapolated numbers of belugas or harbor seals within the zone during IPIR. Because of the methodology used, extrapolated exposures always exceed zero (i.e. there are no "zero" events).

The observed beluga densities in May 2021 (0.0121 b/km^2) and June 2021 (0.00793 b/km^2) were lower than the observed densities in May 2020 (0.0193 b/km^2) and June 2020 (0.0160 b/km^2). Therefore, extrapolated beluga exposures were also calculated using blended 2020 and 2021 densities calculated from the summed 2020 and 2021 beluga hours (by month) and the summed 2020 and 2021 hours of observation (by month). The extrapolated exposures from the blended 2020-2021 densities are compared to the extrapolated exposures from the 2021 densities alone as discussed Section 6.1.2.

The 18,000-meter Level B zone associated with attenuated vibratory installation of the 144-inch monopiles encompasses an area of approximately 165 km^2 at high tide. The area was determined by using GIS tools to digitize a polygon of the area of Knik Arm ensonified by the vibratory installation, excluding "land shadows" behind Point Mackenzie, Point Woronzof, and Cairn Point (Figures C-3-1 to C-3-8 in Appendix C-3).

During each period of vibratory installation of the 144-inch monopiles, the PSOs at the PM station and at the WPW station estimated the distance at which they can detect belugas with optics (the current standard used by the PSOs for visibility estimates). For each vibratory installation event, polygons of the non-visible areas to the west of Point Woronzof and to the north of Port Mackenzie were mapped and measured in km^2.

With PSOs stationed at PM and WPW, the monitoring area is larger than it was in 2020, extending to the north and west. As described in Section 5.1.4, sighting durations were truncated to include only the portion that was tracked by the standard stations to maintain consistency with the 2020 density data. As such, the counts and duration of presence of the beluga groups initially sighted by the PM or WPW PSOs in 2021 are not included in the density estimate, unless and until they became visible by one of the four "standard" stations. For example, the 7 belugas in Group 877 were observed for 1.52 hours by the WPW observer only. The group stayed west of Point Mackenzie, was not visible to the PW station, and did not enter the pre-clearance zone. Therefore, the group count and duration were not included in the density calculation for 2021. These 7 belugas were reported as potential exposures. Similarly, the single beluga in Group 973 was first sighted by the PM PSOs before the NEX PSOs were able to sight it and track it. Therefore, the first 6 minutes of that observation were excluded from the duration calculation.

6.1.1 Visibility and Non-Visible Area Estimates

Vibratory installation of the 144-inch monopile mooring and breasting dolphins took place on eight non-consecutive days beginning 26 May and ending 21 June. One of the nine monopiles did not require vibratory installation resulting in only eight vibratory events. During installation, PSOs were stationed at the four standard observation stations: PWS, SCS, PCTS, and at NEX. PSOs were also stationed at PM and WPW. Using the visibility estimates from WPW and PM, arcs of the visibility radii were overlaid on the Level B zone and polygons of the non-visible areas were digitized (Appendix C-3, Figures C-3-1 through C-3-8). On 29 May, visibility was poor throughout the monitoring area, and the visibility estimates from SC and PW were also incorporated into the derivation of the non-visible areas. Table 19 shows the visibility estimates recorded by the PSOs and the surface area of the non-visible zones in km^2 during pile installations.

Table 19. Visibility and Non-Visible Area Estimates During Vibratory Installation of Monopiles

			Visibility (meters)						*Non-Visible Area (km^2)*		
Pile	*Date*	*Times*	WPW	PM	PW	SC	PCT	NEX	Western	Northern	Total
MD5	5/26/21	1547 - 1616	7,000	5,000	full	full	full	full	37.1	40.1	77.2
MD6	5/29/21	1454 - 1503	1,000	3,500	2,700	4,500	4,500[1]	3,000	77.7	45.0	122.7
MD4	6/6/21	1305 - 1350	7,000	6,500	full	full	full	full	37.1	34.4	71.5
MD3	6/11/21	1614 - 1633	6,750	4,500	full	full	full	full	39.2	41.8	81
MD1	6/15/21	1325 - 1346	5,750	6,500	full	full	full	full	47.0	34.4	81.4
BD3	6/18/21	1540 - 1554	6,750	6,500	full	full	full	full	39.2	34.4	73.6
BD2	6/20/21	1652 - 1712	6,000	6,500	full	full	full	full	45.1	34.4	79.5
BD1	6/21/21	1759 - 1815	6,750	6,500	full	full	full	full	39.2	34.4	73.6

Notes:
[1] PCT did not record an observation during this vibratory event. The visibility recorded by SC was used as a proxy
"full" = complete visibility across Knik Arm, encompassing the area between the inbound and outbound demarcation lines

6.1.2 Extrapolated Beluga Exposures

The monthly beluga density estimates were derived by combining the 2020 and 2021 data. In the 2020 monitoring report for Phase 1 of the PCT, a beluga attendance metric was developed, multiplying the number of belugas by the duration of the sightings. Beluga attendance is therefore the number of beluga-hours per hour of observation (Equation 1 in Section 5.1.4).

To combine the 2020 and 2021 data, the b-hr for each month in 2020 was added to the b-hr for the same month in 2021 and divided by the sum of observation hours for those months. For example, in May 2020, 208.3 b-hrs were

recorded and in May 2021, 118.0 b-hrs were recorded (excluding sightings by PM and WPW), totaling to 326.3 b-hrs. The sum of monitoring hours in May 2020 (301.4 hr_o) was added to the sum of May 2021 (272.8 hr_o) for a combined total of 574.2 hours of monitoring. Therefore, the combined B_A for 2020 and 2021 is 326.3 b-hrs divided by 574.2 hr_o, equal to 0.57 b-hr/hr_o.

The surface area of the region of Knik Arm between the pre-clearance inbound and outbound lines is approximately 35.8 km^2. In 2020, an approximation of beluga density was determined from the observations by dividing the B_A by the surface area of the monitoring area (35.8 km^2). The beluga density was calculated according to Equation 2 in Section 5.1.4.

Using the combined May 2020-2021 B_A of 0.57 b-hr/hr_o and dividing by 35.8 km^2 yields density of 0.0159 b/km^2. Using these methods, Table 20 presents the beluga hours, observation hours, combined B_A, and combined 2020-2021 density estimates for May and June.

Table 20. Beluga Density Estimates

	May	*June*
2020 (b-hr)	208.3	182.0
2020 Observation Hours (hr_o)	301.4	318.1
2020 B_A (b-hr/hr_o)	0.69	0.57
Monitoring Area (km^2)	35.8	35.8
2020 Density Estimate (b/km^2)[1]	**0.0193**	**0.0160**
2021 (b-hr)	128.6	55.5
WPW or PM Only (b-hr)	10.6	2.7
2021 Standard-Station (b-hr)	118.0	52.8
2021 Observation Hours (hr_o)	272.8	186.0
2021 B_A (b-hr/hr_o)	0.43	0.28
Monitoring Area (km^2*)*	35.8	35.8
2021 Density Estimate (b/km^2)	**0.0121**	**0.00793**
2020-2021 Standard-Station (b-hr)	326.3	234.8
2020-2021 Observation Hours (hr_o)	574.2	504.1
2020-2021 B_A (b-hr/hr_o)	0.57	0.47
Monitoring Area (km^2*)*	35.8	35.8
2020-2021 Blended Density Estimate (b/km^2)	**0.0159**	**0.0130**

Note: [1] An error in calculating the 2020 densities was identified in the 2020 monitoring report. The corrected monthly densities for May and June 2020 are reported here.

Table 21 presents the extrapolated beluga exposures for each of the 8 vibratory pile installation events using the blended 2020-2021 observed density estimates for May and June and the observed density estimates using only 2021 data.

Table 21. Extrapolated Beluga Exposure Estimates

			2020-2021 Blended Data			*2021 Data*		
				Extrapolated Exposures			*Extrapolated Exposures*	
Pile	*Date*	*Non-Visible Area (km^2)*	*Density (b/km^2)*	*Fractional Belugas*	*Whole Belugas*	*Density (b/km^2)*	*Fractional Belugas*	*Whole Belugas*
MD5	5/26/21	77.2	0.0159	1.23	1	0.0121	0.933	1
MD6	5/29/21	122.7	0.0159	1.95	2	0.0121	1.48	1
MD4	6/6/21	71.5	0.0130	0.930	1	0.00793	0.567	1
MD3	6/11/21	81	0.0130	1.05	1	0.00793	0.642	1
MD1	6/15/21	81.4	0.0130	1.06	1	0.00793	0.645	1
BD3	6/18/21	73.6	0.0130	0.958	1	0.00793	0.583	1
BD2	6/20/21	79.5	0.0130	1.03	1	0.00793	0.630	1
BD1	6/21/21	73.6	0.0130	0.958	1	0.00793	0.583	1
			Totals:	**9.17**	**9**	***Totals:***	**6.07**	**8**

The total extrapolated beluga exposures for the eight events using a blend of 2020 and 2021 data is 9.17 belugas. If the extrapolations are first rounded to whole belugas for each event, the eight vibratory installation events may have exposed an estimated 9 belugas. Using densities derived from the 2021 data alone, the total extrapolated beluga exposures for the eight events is 6.07 belugas. If these extrapolations are first rounded to whole belugas, an estimated 8 belugas may have been exposed.

Belugas in Group 877 were sighted within the visible portion of the 18,000-meter Level B zone on 26 May during the installation of the first 144-inch pile and were reported as potential exposures. No belugas were sighted on the days 29 May, 6 June, 11 June, and 15 June. Belugas were sighted on 18, 20, and 21 June, but not during the installation of the 144-inch monopiles.

There are advantages and disadvantages to using either the blended 2020-2021 data or the 2021 data alone. The 2021 density is potentially more representative of the beluga use patterns occurring at the time of the installation events. However, using the blended density more than doubles the number of hours of observation from which the densities are derived. Therefore, using the blended data may give a more accurate picture of typical density in the non-visible areas.

It is also important to note that beluga density within the monitoring area used to derive the density estimates is not uniform. Belugas display a clear affinity to shallow nearshore areas, and typically avoid deeper offshore areas. However, the non-visible areas west and north of the monitoring area also have a mix of shallow nearshore and deeper offshore zones similar to the monitoring area. In addition, those areas are adjacent to the monitoring area and are expected to have similar densities to the monitoring area.

6.1.3 Extrapolated Harbor Seal Exposures

Extrapolated exposures of harbor seals were calculated in the same manner as belugas. Exposures were extrapolated using a blended 2020 – 2021 data set and using the 2021 data alone for comparison. The duration of each harbor seal sighting was multiplied by the number of harbor seals in each sighting to obtain "harbor seal hours." To obtain the blended 2020 – 2021 densities, the sum of harbor seal hours in May 2020 was added to the sum of harbor seal hours in May 2021 and was divided by the sum of hours of observation in May 2020 and May 2021. The same was repeated for June 2020 and 2021 harbor seal and observation data. The harbor seal attendance (seal-hr/hr_o) is obtained by dividing the harbor seal hours by observation hours. To obtain the observed density, the (seal-hr/hr_o) metric is then divided by surface area of the monitoring area (35.8 km^2). Table 22 presents the extrapolated exposures of harbor seals using the observed densities.

Table 22. Extrapolated Harbor Seal and Harbor Porpoise Exposure Estimates

			2020-2021 Blended Data			*2021 Data*		
				Extrapolated Exposures			*Extrapolated Exposures*	
Pile	*Date*	*Non-Visible Area (km^2)*	*Density (seals /km^2)*	*Fractional Seals*	*Whole Seals*	*Density (seals /km^2)*	*Fractional Seals*	*Whole Seals*
MD5	5/26/21	77.2	0.00220	0.170	0	0.000171	0.0132	0
MD6	5/29/21	122.7	0.00220	0.270	0	0.000171	0.0209	0
MD4	6/6/21	71.5	0.0104	0.740	1	0.00983	0.703	1
MD3	6/11/21	81	0.0104	0.839	1	0.00983	0.796	1
MD1	6/15/21	81.4	0.0104	0.843	1	0.00983	0.800	1
BD3	6/18/21	73.6	0.0104	0.762	1	0.00983	0.723	1
BD2	6/20/21	79.5	0.0104	0.823	1	0.00983	0.781	1
BD1	6/21/21	73.6	0.0104	0.762	1	0.00983	0.723	1
			Totals:	**5.21**	**6**	***Totals:***	**4.56**	**6**

Because of their small body size and small group size, the detection rate of harbor seals in the 35.8 km^2 monitoring area is probably less than 50 percent. As with belugas, and for the reasons stated in Section 5.1.4, there are several biases that affect the detection rate. In addition to the likelihood that individuals or groups of harbor seals or porpoises were missed altogether, it is also certain that the durations of the sightings (from which the density is calculated) do not represent the full time periods the animals were present within the 35.8 km^2 area in many or most instances. Using the observed density to extrapolate potential exposures in the non-visible portions of the

18,000-meter Level B zone for vibratory installation of the 144-inch monopiles with a bubble curtain likely underestimates the true exposures. A correction factor (e.g. double or 5X the observed density) may be appropriate to derive an estimate that is closer to the true exposure rate for smaller species.

No harbor seals were sighted on the days 26 and 29 May. Harbor seal exposures were documented during installation of the 144-inch monopiles on 6, 15, 18, 20, and 21 June. A harbor seal was sighted on 11 June, but not during the installation of the 144-inch monopiles.

It should be noted that the 165 km^2 area encompassed by the 18,000-meter Level B zone is the maximum area that only occurs at high tide. At low tide, the Level B zone is 36 percent smaller area (106 km^2) because of the extreme tidal fluctuation in Knik Arm and extensive, shallow mud flats. The estimated areas of the non-visible zones in Table 19, Table 21, and Table 22 assume that the full area at high tide was ensonified. The area at low tide is presented in Figure C-3-9 in Appendix C-3 for comparison and to note that the extrapolation area may be overestimated.

7 IMPLEMENTATION AND EFFECTIVENESS OF MITIGATION MEASURES

Nearly all mitigation measures outlined in the IHA and BiOp were applicable during the 2021 PCT construction season. The reporting requirements of the BiOp include a qualitative assessment of the effectiveness of the mitigation measures in minimizing adverse effects to ESA-listed species. 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 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 4MP to minimize the effect to protected species. Immediate communication of sightings to the construction crew, and the rapid shutdown of IPIR (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. The stationing of PSOs on the beach north of Cairn Point during outgoing tides was successful in providing early warning of incoming beluga groups in some instances. Monitoring 30 minutes prior to IPIR was effective in avoiding takes, as beluga groups were often present at the start of monitoring each day. Monitoring for 30 minutes after IPIR 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 IPIR. There are natural breaks between piles that already provide this data. The added labor cost for an additional half-hour each day is significant given its redundancy.

It is not clear whether adverse effects were significantly minimized by delaying IPIR when belugas were sighted within or approaching the pre-pile driving clearance zones. During vibratory pile driving, belugas often displayed no reaction, or continued their trajectory towards the PCT despite the large Level B zones. It is therefore unclear that implementing delays when the belugas were well outside of a Level B zone reduced adverse effect. Though statistical analysis and comparison to a control (i.e., groups observed during periods of no IPIR) was not conducted, there is some evidence to suggest that beluga groups may have reacted more strongly to impact hammering than vibratory hammering. If true, then the delay of impact hammering when belugas were within the pre-pile driving clearance zone was effective in minimizing adverse effect. The requirement to conduct IPIR 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.

Shutdowns and delays were effective in minimizing the adverse effect to belugas. Dredging activity was shut down twice and IPIR was delayed or shutdown 31 times. The delays were due to the presence of belugas or due to a lack of visibility of the Level B zone. This resulted in 97 hours of delays or shutdowns – nearly 10 full workdays. The shutdowns and delays of IPIR are detailed in Table 23.

Several other mitigation measures were employed during the project including:

- On 22 April 2021, 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. The same training and briefing were held for new PSOs hired subsequently.

- On 23 April 2021, field training was held for the PSOs to practice setting up and using equipment, data entry, radio use, and monitoring.
- On 30 April, a briefing was held for the PCT construction personnel, POA staff, and 61N project manager.
- Every day that IPIR 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)
    - Occasionally 2 were stationed at PM (one from SCS, one from NEX)
    - Occasional 1 was stationed at WPW (from PWS)
- IPIR occurred only during daylight hours.
- Marine mammal monitoring occurred for 30 minutes prior to the start of IPIR each morning. Monitoring did not cease until the end of the scheduled day, or until no additional IPIR was planned.
- Monitoring was conducted for at least 30 minutes after IPIR each day.
- Shutdowns of IPIR were initiated if any belugas were sighted within or approaching the applicable Level B zone or if any marine mammal was 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 IPIR. If belugas were present inside of the pre-clearance zone, and on a trajectory towards the Level B zone, IPIR was delayed until belugas were on a trajectory away from the Level B zone.
- When weather conditions prevented full visibility of the applicable Level B zone, IPIR only continued until the completion of the pile or section. No new piles or sections were started until visibility of the zone was regained[9]. PSOs remained on watch, even during low visibility to maintain continuous monitoring of the visible portions of the large Level B zones.
- The construction crew used a soft-start technique, outlined in the IHA and BiOp, using lower energy strikes, followed by periods of no strikes, to begin impact pile installation.
- The construction crew used an open ring bubble curtain casing that met the specifications of the IHA and BiOp for all piles installed and removed in 2021.
- The construction crew did not operate two vibratory hammers concurrently.
- No species for which takes were not authorized were sighted during IPIR, requiring shutdowns for unauthorized takes. One gray whale was observed, and no takes were authorized, but no IPIR was planned during the time of the sighting and no delay or shutdown was required.

[9] On 29 May 2021, the construction crew was preparing to install a 144-inch pile (18,000-meter Level B zone). No matter the visibility, the PSOs were unable to monitor the entire zone (see Section 6.1). However, visibility was reduced within the pre-pile driving clearance area (between the inbound and outbound lines). The POA management team and construction crew determined for safety reasons that they could not delay installation of the 144-inch pile due to weather. The extrapolation of exposures for the event accounted for the reduced visibility.

- 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 station WPW and PM. 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 beginning watch. Many had prior experience in marine mammal observation, and several had prior Cook Inlet marine mammal monitoring experience, including all three designated PSO field leads and the 61N project managers.

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Table 23. Shutdowns and Delays Implemented in 2021

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Shutdown marine mammal	4/30/2021 1149	4/30/2021 1159	816	10	At 1141 the dredge scow began moving from the dock near Ship Creek. One white and three gray belugas were sighted over 1,000 meters north of the vessel, heading south towards Ship Creek. The scow was moving west and north. At 1142 the scow began moving north toward the belugas (which were still more than 1,000 meters from vessel). At 1148 one white and one gray beluga were sighted approximately 260 meters from the bow of the scow. The scow captain was in communication with scow crew about the belugas on channel 69. At 1149 the scow captain hailed the PCT PSOs on channel 69 to inform them he saw the two belugas in the 100-meter shutdown zone and had taken the vessel to idle while waiting to continue operations. The PCT PSO corroborated that one white and one gray beluga were within the 100-meter shutdown zone and that the other two gray belugas had not been resighted. At 1153 the PCT PSO hailed the scow to inform them that the one white and one gray beluga were more than 800 meters beyond the zone and that the two other gray belugas were not resighted. At 1159 the PCT PSO radioed the scow captain to give the "all clear" since it had been more than 10 minutes since the two other gray belugas had been sighted. The shutdown lasted 10 minutes from the time since belugas were first seen in the zone. No exposures occurred.
Shutdown marine mammal	5/5/2021 0855	5/5/2021 0905	831	10	At 0853, the PCT PSO contacted the dredge barge on channel 69 to notify them of belugas (Group 831) approaching their stern from the south 300 meters away. The dredge barge asked the PCT PSO to inform them when they were getting closer. At 0855 the PCT PSO radioed the dredge barge again when the group was 100 meters from their stern, and they stopped dredging. At 0858, one beluga passed the dredge barge within 50 meters. The remaining belugas passed the dredge barge 300 meters to the west. At 0905, the PCT PSO contacted dredge barge to notifying them that the whales were 500 meters to the west of their position heading north and gave them the "all clear." The shutdown lasted 10 minutes from the time the belugas were within 100 meters of the barge. At 0907, they began dredging again. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Weather delay	5/29/2021 1433	5/29/2021 1452	n/a	10	At 1433 the Pacific Lifter began raising the vibratory hammer to the 144-inch pile MD6. At that time, the PSO field lead radioed the pile driving foreman to inform him that they were not clear to start pile driving because portions of the 18,000-meter Level B zone between the inbound and outbound lines of the pre-pile driving clearance zone were not visible. At 1435 the PPM superintendent communicated to the PSO field lead that the POA management team authorized PPM to proceed with vibratory installation with a bubble curtain to secure the free-standing pile out of concern for safety. The weather delay was ended at 1452 when vibratory installation began. The delay lasted for a total of 18.4 minutes. Vibratory installation was conducted intermittently for 7.3 minutes between 1454 and 1503. Between 1457 and 1531 PW recorded visibility of 2,700 meters, indicating that the shoreline area west of Point Mackenzie inside of the inbound line was not visible. The SC station recorded visibility of 4,500 meters at 1500 indicating they had visibility to approximately Point Mackenzie.
Delay, marine mammal	6/21/2021 1902	6/21/2021 1945	977	43	At 1859 the Pacific Lifter secured the impact hammer to a 144-inch pile (BD1). At that time, a beluga was observed 5,064 meters inside the Level B zone (6,309 meters). The PCT PSO radioed the pile driving foreman of the Pacific Lifter to inform them that belugas were within Level B zone and pile driving must be delayed. At 1945, the beluga group had not been seen for more than 30 minutes. The “all clear” was radioed to the pile driving foreman. No exposures occurred.
Shutdown marine mammal	6/21/2021 2024	6/21/2021 2214	978	110	From 1946 to 2024 the construction crew was using an impact hammer on a 144-inch pile with a bubble curtain. The Level B zone was 6,309 meters and the Level A zone was 117 to 194 meters (depending on the duration of 0.3 or 0.7 pile installed per day). A single beluga in Group 978 was first sighted at 2024 near Ship Creek, 1,773 meters from the PCT, which is 4,536 meters inside of the Level B zone and over 1,500 meters outside of the Level A zone. The PCT PSO radioed the pile driving foreman of the Pacific Lifter, and the hammer was turned off at 2024. The beluga milled in the area in front of Ship

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
					Creek and then began traveling north. At 2214 the shutdown was ended when the construction crew ended work for the night due to lack of daylight.
Delay, marine mammal	9/7/2021 1355	9/7/2021 1555	1031 and 1032	120	Group 1031 was 840 meters inside Level B zone when the construction crew was preparing to remove a 36-inch pile with a vibratory hammer. A marine mammal delay was initiated at 1355. Group 1032 was initially sighted outside of Level B zone at 1314. During the delay, PSOs at Cairn Point observed this group move inside the Level B zone where it remained until 15:46. The marine mammal delay was ended at 1555 when all active beluga groups had traveled out of Level B zone and remained on a trajectory away from zone. No exposures occurred.
Delay, marine mammal	9/8/2021 1101	9/8/2021 1713	1044, 1045, 1047, and 1048	372	Group 1044 was sighted traveling down from the north and was 2,000 meters inside the Level B zone when the vibratory hammer was placed on top of southwest temporary pile associated with BD3, as the construction crew was preparing to remove it. A marine mammal delay was initiated at 1101. Group 1044 left the Level B zone to the south at 1305. Group 1045 was established after two belugas split from Group 1044 while Group 1044 was in the Level B zone. The two belugas from this group eventually joined with Group 1047 to make a combined group. Group 1047 was first observed in the mouth of Ship Creek at 1344 with two belugas. They traveled north where they combined with Group 1045 in the vicinity of the template pile removal area. Group 1047 then traveled south and stayed within the Level B zone for the remainder of the observation day/period. An additional group (Group 1048) comprised of two belugas also were within the Level B zone near Port Mackenzie at the end of the observation day/period. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Delay, marine mammal	9/9/2021 0743	9/9/2021 1745	1051, 1052, 1054, 1056, and 1058	602	Groups 1051 and 1052 were both observed during the 30-minute pre-clearance monitoring time in or near the Level B zone. The construction crew was notified, and a marine mammal delay was started by at 0742 as they prepared to place the vibratory hammer on top of a 36-inch temporary pile near permanent pile BD3. Group 1052 was first observed at 0711, 651 meters inside of the Level B zone near Port Mackenzie and was last observed at 1116. Group 1051 was outside of the Level B zone but on a trajectory toward the POA coming from the south near the Point Woronzof observation station. This group did not cross into the Level B zone and returned south and away from the POA. Group 1054 was initially observed at 0735 traveling north along the far shore and was 190 meters inside of the Level B zone. They were not observed after 0737. Group 1056 was initially observed at 0959 at a distance of 1,771 meters inside the Level B zone directly north of the NEX station near Cairn Point. This group traveled through the POA, into Ship Creek, and proceeded south and past the PW station where it was lost to sight by obstructions at 1130. Shortly after at 1136, the group turned around and headed back toward the POA crossing the Level B zone at 1225. Group 1056 then merged with Group 1058 at 1235. Group 1058 was initially observed milling around Ship Creek and was 3203 meters inside the Level B zone. The makeup of Group 1058 (two white belugas and one calf) was possibly the same group making up the Group 1052 that also had two white belugas and a calf that were last observed at 1116 near the template removal area. This combined group (consolidated as Group 1056) slowly made their way north and within 204 meters of departing the Level B zone past Cairn Point. After milling for over an hour, Group 1056 returned south around 1530, passing the NEX station and milling off the seawall south of NEX for the remainder of the observation period/day. Total length of the marine mammal delay was ten hours and two minutes. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Delay, marine mammal	9/10/2021 0751	9/10/2021 1130	1063, 1064, and 1065	219	Group 1063 was observed at 0746 and within the Level B zone by 2,408 meters when PPM prepared to initiate in-water work. Group 1063 was only observed once. A delay was started at 0751. At 0805, Group 1064 was observed traveling in a trajectory toward the POA. This group did not cross into the Level B zone but at 0826 came to within 392 meters of the Level B zone keeping the marine mammal delay active due to its trajectory toward the POA. This group eventually traveled south and away from the POA. Group 1065 was observed 2,684 meters inside the Level B zone at 0827. Once Group 1064 traveled south and away from the POA, Group 1065 became the only group continuing the MM delay. Group 1065 timed out (30 minutes since last sight time) but the PCT field lead decided to continue the MM delay because Group 1065 was close to timing out twice prior before being resighted. The day prior, PSOs also documented similar instances of lengthy periods (close to 30 minutes) between some re-sightings. For example, one group was observed ten minutes after it had timed out in the mouth of Ship Creek. The Level B zone was cleared after the additional ten minutes elapsed and the MM delay ended at 1130. PCT PSO Lead communicated with the construction superintendent and gave the "all clear" to begin work at 1130. No exposures occurred.
Delay, marine mammal	9/10/2021 1132	9/10/2021 1243	1071	71	At 1130 the bubble curtain was started. At 1131 two white belugas were observed near Ship Creek station creating Group 1071. Group 1065 was also made up of two white belugas and it is possible that these were the same whales. The PSO Lead radioed construction crew to delay vibratory hammering and a second marine mammal delay was started at 1132. Group 1071 left the Level B zone, and at 1243 the delay was ended. No exposures occurred.
Shutdown marine mammal	9/10/2021 1310	9/10/2021 1715	1072, 1074, and 1075	245	At 1243 PPM began removing a 36-inch temporary pile near the BD3 monopile using a vibratory hammer. The Level B zone was 4,106 meters. At 1255 a PSO stationed at Carin Point called the PCT PSO to inform them of a sighting of two white belugas traveling south towards the Level B zone. The Carin Point PSO estimated that the whales were approximately 1,000 meters north of zone. The PCT PSO called the PWS to confirm this

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
					sighting and Group 1072 was created. The sighting of this group by PWS was 1,384 meters north of the Level B zone. At 1309 the Carin Point observer called the PCT PSO and stated that the group now consisted of four white belugas and appeared close to the Level B zone. A shutdown was called at 1310 and vibratory hammering ceased. A fix taken by PWS located whales approximately 600 meters north of the Level B zone when the shutdown was called, and the hammer was deactivated. Two additional groups (1074 and 1075) were sighted within or near the Level B zone, keeping the shutdown in place until the construction crew decided to remove the vibratory hammer from the pile for the day at 1715. No exposures occurred.
Delay, marine mammal	9/11/2021 0802	9/11/2021 0859	1078	57	From 0752 to 0758 the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. At 0757 one beluga was observed 1,243 meters inside the Level B zone and 2,862 meters from PCT. A call for a shutdown was made, but due to safety reasons, the construction crew needed to complete removal of the pile, and pile removal continued until 0758. At 0808 a second beluga was observed in this group. These exposures are reported as potential takes. As the construction crew prepared to remove another 36-inch pile, a marine mammal delay was initiated at 0802. Group 1078 was observed until 0828 and the delay was ended 30 minutes after the last sight time of Group 1078 (0859).
Delay, marine mammal	9/11/2021 1210	9/11/2021 1319	1083	69	At 1210 the construction crew lifted the vibratory hammer to place it on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. Group 1083, consisting of two belugas, was initially observed at 1140 and was the only active sighting when in-water work was initiated. At 1209 the whales were observed 3,600 meters inside the zone and 525 meters from the PCT. The PCT PSO Lead informed the construction crew they were not clear to begin in-water work and a delay was started at 1210. The delay ended at 1319 as Group 1083 exited the zone on a trajectory away from PCT. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Delay, marine mammal	9/11/2021 1426	9/11/2021 1545	1084 and 1086	79	At 1402 the NEX station radioed the PCT PSO Lead to inform them of a beluga roughly 4,700 meters north of the 4,106-meter Level B zone and was traveling south (Group 1084). At 1424 the construction crew placed the vibratory hammer onto a 36-inch pile with a bubble curtain to prepare removal. At 1426 three belugas were observed 650 meters inside the Level B zone and 3,300 meters from the PCT. At 1426 the PCT PSO Lead radioed the construction crew to delay removal. The vibratory hammer had not been activated. The delay ended at 1545 when the construction crew removed the vibratory from the pile for the night. Group 1084 and Group 1086 were still active beluga sightings inside the Level B zone when the delay was ended. No exposures occurred.
Delay, marine mammal	9/12/2021 0743	9/12/2021 1118	1090, 1093, 1095, and 1096	215	0705 the NEX station radioed PCT that belugas were observed off the NEX station. Ship Creek station created Group 1090 as the lead beluga was observed just north of the Ship Creek station. At 0731, Ship Creek station observed a total of ten belugas milling in the mouth of Ship Creek. At 0743, the vibratory hammer was placed on a 36-inch pile with a bubble curtain. The PCT PSO field lead informed the construction crew of the presence of Group 1090 in the Level B zone and a delay was initiated at 0743. Group 1090 traveled south and was observed 2,074 meters outside of the Level B zone at 0911 on a trajectory away from the POA. However, three other groups (1093, 1095 and 1096) were also observed in the Level B zone, maintaining the delay. A beluga from Group 1096 was last observed at inside the Level B zone at 1021. When the beluga had not been resighted for 30 minutes, the PCT PSO field lead extended the time ten minutes based on past observations including diving and milling for lengthy periods of time in the Level B zone. At the same time, a beluga was observed by the PW station at the northern portion of the monitoring area, and a determination had to be made about the location and direction of the whale relative to the Level B zone which took additional time. The delay was ended at 1118 after no belugas were observed in the Level B zone. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Shutdown marine mammal	9/12/2021 1237	9/12/2021 1354	1099	77	From 1234 to 1237 the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. At 1237 one beluga (Group 1099) was sighted approximately 1,923 meters in the Level B zone, 2,183 meters away from PCT. A shutdown was called, and the vibratory hammer was stopped at 1237. The NEX station added three more belugas to Group 1099 at 1240. A Level B exposure of four belugas was reported.
Delay, marine mammal	9/13/2021 0807	9/13/2021 1602	1107, 1108, 1109, 1110, 1112, and 1116	475	At 0811 the construction crew placed the vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. Beluga Group 1107 was observed at 0757 by the Cairn Point observers and a fix from a theodolite was taken by the NEX station at 0800 showing the group to be 1,266 meters inside the Level B zone and 2,725 meters from the PCT. The construction crew was alerted by the PCT PSO Lead at 0807 and a marine mammal delay was started. Throughout the day, five additional beluga groups (1108, 1109, 1110, 1112, and 1116) entered the Level B zone, maintaining the delay. No exposures occurred.
Delay, marine mammal	9/14/2021 0738	9/14/2021 1029	1123 and 1127	171	At 0738 (the end of pre-clearance) the construction crew had already placed the vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. Group 1123 was observed at 0704 by NEX station at 197 meters outside of the Level B zone on a trajectory towards the PCT. AT 0738 the PSO field lead radioed the construction crew that beluga whales were present in the Level B zone. A delay was started at 0738. Group 1127 crossed the Level B zone from the south at 0919 and toward the PCT. AT 1029 Group 1127 was observed by Cairn Point observers leaving the Level B zone and, on a trajectory, away from the PCT. PSO field lead then gave the construction crew the “all clear” and ended the delay. No exposures occurred.
Delay, marine mammal	9/14/2021 1033	9/14/2021 1635	1128	362	At 1033 beluga Group 1128 was observed inside the Level B zone by SC station and the PSO field lead notified the construction crew of the start of another delay. The hammer was never activated. Group 1128 milled in the Level B zone near Port Mackenzie for 4.5

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
					hours. At 1635 the vibratory hammer was removed from the pile ending the delay as Group 1128 was still in the Level B zone. No exposures occurred.
Delay, marine mammal	9/15/2021 0947	9/15/2021 1344	1135 and 1137	237	At 0947 Group 1135 (beluga cow and calf) was first observed 457 meters inside the Level B zone and 3,649 meters away from the PCT. AT 0956 the PSO field lead radioed to the construction crew that belugas were present inside the Level B zone. At 1010 the construction crew notified the PSO field lead that the vibratory hammer had been placed atop the 36-inch pile and requested to start the marine mammal delay. At 1323 two killer whales (Group 1137) were observed entering the Level B zone and traveling north. The PSO field lead updated the superintendent of the construction crew on the status of Groups 1135 and 1137. The vibratory hammer was removed at 1344, ending the delay. No exposures occurred.
Delay, marine mammal	9/16/2021 0755	9/16/2021 1630	1142, 1147, 1148, and 1150	515	At 0743 Group 1142 (beluga cow and calf) was first observed 3,367 meters away from the PCT and 731 meters inside of the Level B zone. At 0746 the PSO field lead radioed the construction crew that belugas were present inside the Level B zone. At 0755 the construction crew notified the PSO field lead that the vibratory hammer had been placed atop the 36-inch pile and requested to start a marine mammal delay. Group 1142 milled in the Level B zone off Port Mackenzie for most of the day. It is presumed that this cow and calf is the same cow and calf that have milled off Port Mackenzie for the last several days, multiple hours per day. Two other beluga groups (1147 and 1148) also passed into the Level B zone from the south on the far shoreline about 1.5 hours apart from each other. Group 1147 passed quickly through Port Mackenzie and headed north out of the Level B zone. Group 1148 milled near Port Mackenzie and combined with the cow and calf of Group 1142. Group 1148 traveled north and out of the Level B zone at 1435. The presumed same cow and calf of Group 1142 (now Group 1150) remained at Port Mackenzie and inside the Level B zone. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Delay, marine mammal	9/17/2021 0853	9/17/2021 0923	1157	30	At 0837 two white belugas (Group 1157) were observed 2,947 meters away from PCT and 1,159 meters inside the Level B zone. At 0848 PSO field lead radioed to construction that belugas were present inside the Level B zone. A marine mammal delay started at 0853 when the vibratory hammer was placed atop the 36-inch pile. The delay ended at 0923, 40 minutes after last sighting of Group 1157. No exposures occurred during the delay, however, the group returned during pile driving and a shutdown was called (see below).
Shutdown marine mammal	9/17/2021 0931	9/17/2021 1425	1157, 1158, 1160, and 1161	294	From 0925 to 0931 the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain; the Level B zone was 4,106 meters. At 0930 NEX station radioed to the PSO field lead that there was one white beluga (Group 1157) inside the Level B zone. PSO field lead then radioed the construction crew that a beluga was present in the Level B zone and to shut down. The vibratory hammer was turned off at 0931. Group 1157 was reported as a Level B exposure. The shutdown was continued as 3 other beluga groups (1158, 1160, and 1161) traveled into the Level B zone. Groups 1158 and 1161 were last seen milling inside of the Level B zone. The PSO field lead radioed to the construction crew that the delay ended 40 minutes after last sighting.
Delay, marine mammal	9/18/2021 0937	9/18/2021 1522	1171, 1172, 1174, and 1178	345	Delay began at 0937 when the vibratory hammer was attached to a 36-inch pile and 3 beluga whales (Groups 1171 and 1172) were milling within the Level B zone. At 1052, 8 more beluga whales (Group 1174) entered the Level B zone. At 1120, Group 1174 was observed outside the zone traveling away to the north. At 1406, 30 beluga whales (Group 1178) entered the Level B zone. At 1525, Group 1178 was observed departing the Level B zone to the north. At 1518, Group 1171 was observed leaving the Level B zone. The delay was ended at 1522 when the vibratory hammer was removed from the pile and the construction crew stated they did not intend attempt additional in-water work. Group 1172 was still milling in the Level B zone at the end of the delay. No exposures occurred.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Delay, marine mammal	9/22/2021 1218	9/22/2021 1630	1211, 1212, and 1214	252	The delay began at 1218 when vibratory hammer was attached to the pile and 10 beluga whales (Groups 1211 and 1212) were milling inside the Level B zone. At 1250, two belugas (Group 1214) observed traveling inside the Level B zone. At 1255, Group 1212 (2 belugas) traveled out and away from the Level B zone. At 1330, Group 1211 (7 belugas) traveled out and away from the Level B zone. Delay continues with Group 1214 still milling in the Level B zone. The delay ended at 1630 when the vibratory hammer was removed from pile and the construction crew confirmed there would be no further in-water work. Group 1214 was still inside the Level B zone at the end of the delay. No exposures occurred.
Weather delay	9/24/2021 0834	9/24/2021 0851	n/a	17	During both weather delays, parts of the 4,106-meter Level B zone for attenuated removal of a 36-inch pile were obscured by fog, distortion, and/or precipitation. No exposures occurred.
Weather delay	9/24/2021 1018	9/24/2021 1053	n/a	35	During both weather delays, parts of the 4,106-meter Level B zone for attenuated removal of a 36-inch pile were obscured by fog, distortion, and/or precipitation. No exposures occurred.
Shutdown marine mammal	9/24/2021 1056	9/24/2021 1624	1220, 1221, 1222, 1223, 1225, and 1226	328	From 1053 to 1056 the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. Three white, three gray and one calf beluga (Group 1220) were first sighted 2744.70 meters from PCT and 1350 meters within the Level B zone. The PCT lead PSO called for a shutdown and the hammer was deactivated at 1056. This event was also reported as a potential take. The shutdown continued throughout the day due to additional beluga sightings in the Level B zone. The shutdown ended when the hammer was removed from the pile at 1624. Total shutdown time was 5 hours and 28 minutes.

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
Delay, marine mammal	9/25/2021 1009	9/25/2021 1315	1235	186	At 1009 a delay was initiated due to high tide preventing PSOs from deploying to Cairn Point. The potential exposure of 7 belugas the day prior raised the total potential takes for the season to 27 of the 35 authorized. This additional precaution was taken after communication with the construction team. A delay was started until PSOs could be deployed to Cairn Point observers when the tide had sufficiently retreated. At 1130, two belugas (Group 1235) were first sighted within the Level B zone coming from Cairn Point and traveling south toward the PCT, prompting an extension of this delay. The group was observed leaving the Level B zone at 1256, but the delay was maintained until 1315 to confirm that the belugas were on a trajectory away from the Level B zone and the PCT. No exposures occurred.
Shutdown marine mammal	9/26/2021 0929	9/26/2021 1012	1242	43	From 0927-0929, the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. One beluga whale (Group 1242) was sighted at 0929 near the Level B zone and on a trajectory toward the PCT. A shutdown was called, and the hammer was deactivated at 0929. The theodolite fix showed the beluga was 146 meters outside of the Level B zone and was therefore not recorded as a potential take. The beluga was not resighted for 30 minutes. The shutdown was extended a short duration beyond the 30-minute time out by request of construction team to ensure the whale was not within the Level B zone. The whale was not sighted again, and pile removal recommenced.
Delay, marine mammal	9/28/2021 1044	9/28/2021 1124	1258	40	The delay began at 1044 when the vibratory hammer was attached to the pile and 3 beluga whales (Group 1258) were inside the Level B zone traveling SW towards PCT. The delay ended 1124 when 30 minutes had passed since the last sighting of group. No exposures occurred.
Delay, marine mammal	9/28/2021 1216	9/28/2021 1220	1259	4	The delay began at 1216 when the vibratory hammer was attached to the pile and 3 beluga whales (Group 1259) was traveling inside the Level B zone. The delay was ended

Table 23. Shutdowns and Delays Implemented in 2021 (continued)

Delay/ Shutdown Type	*Start Time*	*End Time*	*Marine Mammal Group ID*	*Mitigation Duration (minutes)*	*Description*
					at 1220 when the group was observed traveling outside of and away from the Level B zone. No exposures occurred.
Delay, marine mammal	9/28/2021 1435	9/28/2021 1724	1260	169	The delay began at 1436 when vibratory hammer was attached to the pile and 2 beluga whales (Group 1260) were traveling inside the Level B zone. The group remained within the Level B zone for several hours. The delay ended at 1724 when the group was observed traveling outside of and away from the Level B zone. No exposures occurred.
		Total Mitigation Duration (minutes)		5,821	
		Total Mitigation Duration (hours)		97.0	

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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, Phase 2 Construction, Petroleum and Cement Terminal Anchorage AK, April 26 – June 24; Sept. 7 – Sept 29 2021.

	Observation Effort			Weather/Precipitation Conditions; Percent Observed									Beafort Sea State; Percent Observed						Visibility (meters); Percent of Distance Category				Ice Cover (percent); Percent of Coverage Category			
Date	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	5	0-2499	2500-4999	5000-7499	7500-10000	0%	1%-10%	11%-20%	21%-35%
26-Apr	07:31	15:15	7.7	3%	33%	64%	0%	0%	0%	0%	0%	0%	1%	52%	46%	0%	0%	0%	0%	9%	13%	78%	12%	64%	21%	3%
27-Apr	07:12	15:15	8.1	26%	14%	60%	0%	0%	0%	0%	0%	0%	3%	49%	48%	0%	0%	0%	0%	0%	8%	92%	3%	92%	5%	0%
28-Apr	06:55	17:30	10.6	54%	10%	37%	0%	0%	0%	0%	0%	0%	0%	33%	64%	2%	0%	0%	0%	1%	24%	75%	1%	94%	2%	2%
29-Apr	07:00	17:30	10.5	0%	0%	7%	40%	9%	43%	1%	0%	0%	0%	52%	46%	1%	0%	0%	0%	0%	37%	63%	2%	91%	6%	0%
30-Apr	06:59	17:30	10.5	8%	24%	37%	30%	0%	0%	0%	0%	1%	0%	7%	79%	13%	1%	0%	0%	1%	8%	90%	1%	99%	0%	0%
Apr Summary	**n/a**	**n/a**	**47.4**	**19%**	**15%**	**39%**	**15%**	**2%**	**9%**	**0%**	**0%**	**0%**	**1%**	**38%**	**58%**	**4%**	**0%**		**0%**	**2%**	**19%**	**79%**	**4%**	**89%**	**6%**	**1%**
1-May	06:55	17:30	10.6	8%	17%	75%	0%	0%	0%	0%	0%	0%	0%	11%	89%	0%	0%	0%	0%	3%	3%	95%	9%	91%	0%	0%
3-May	07:14	15:15	8.0	0%	13%	54%	33%	0%	0%	0%	0%	0%	0%	19%	73%	7%	0%	0%	0%	3%	22%	75%	58%	42%	0%	0%
4-May	07:10	15:15	8.1	0%	21%	37%	41%	0%	0%	0%	0%	0%	1%	70%	13%	10%	6%	0%	0%	9%	7%	84%	77%	23%	0%	0%
5-May	07:07	15:15	8.1	0%	0%	41%	59%	0%	0%	0%	0%	0%	0%	52%	48%	0%	0%	0%	0%	0%	6%	94%	95%	5%	0%	0%
6-May	07:06	15:15	8.2	0%	10%	55%	34%	0%	0%	0%	0%	0%	0%	1%	96%	3%	0%	0%	0%	0%	0%	100%	100%	0%	0%	0%
7-May	07:07	15:15	8.1	0%	18%	68%	13%	1%	0%	0%	0%	0%	0%	53%	47%	0%	0%	0%	0%	0%	9%	91%	100%	0%	0%	0%
8-May	07:08	15:15	8.1	0%	0%	19%	81%	0%	0%	0%	0%	0%	4%	85%	10%	0%	0%	0%	0%	0%	1%	99%	100%	0%	0%	0%
10-May	07:08	15:15	8.1	0%	0%	17%	83%	0%	0%	0%	0%	0%	0%	41%	59%	0%	0%	0%	0%	0%	3%	97%	100%	0%	0%	0%
11-May	07:08	15:15	8.1	0%	28%	33%	39%	0%	0%	0%	0%	0%	0%	13%	84%	3%	0%	0%	0%	0%	1%	99%	100%	0%	0%	0%
12-May	07:07	15:15	8.1	2%	26%	47%	26%	0%	0%	0%	0%	0%	0%	9%	91%	0%	0%	0%	0%	0%	0%	100%	100%	0%	0%	0%
13-May	07:10	15:15	8.1	37%	19%	44%	0%	0%	0%	0%	0%	0%	0%	0%	87%	13%	0%	0%	0%	0%	0%	100%	100%	0%	0%	0%
14-May	06:27	17:00	10.6	37%	12%	48%	2%	0%	0%	0%	0%	0%	0%	22%	69%	10%	0%	0%	0%	0%	16%	84%	100%	0%	0%	0%
15-May	06:20	17:00	10.7	0%	10%	31%	36%	3%	17%	2%	0%	0%	0%	18%	82%	0%	0%	0%	0%	0%	9%	91%	100%	0%	0%	0%
16-May	06:51	17:30	10.7	0%	21%	41%	37%	0%	0%	0%	0%	0%	0%	0%	92%	8%	0%	0%	1%	0%	7%	92%	100%	0%	0%	0%
17-May	06:51	17:30	10.7	58%	1%	39%	1%	0%	0%	0%	0%	0%	0%	5%	89%	5%	0%	0%	0%	0%	9%	91%	100%	0%	0%	0%
18-May	06:51	17:30	10.7	23%	10%	61%	6%	0%	0%	0%	0%	0%	0%	23%	66%	11%	0%	0%	0%	0%	34%	66%	100%	0%	0%	0%
19-May	06:54	17:30	10.6	0%	6%	24%	70%	0%	0%	0%	0%	0%	0%	29%	36%	29%	6%	0%	0%	13%	6%	81%	100%	0%	0%	0%
20-May	06:53	17:30	10.6	0%	0%	5%	61%	0%	27%	7%	0%	0%	0%	1%	88%	11%	0%	0%	0%	4%	35%	61%	100%	0%	0%	0%
21-May	06:50	17:30	10.7	5%	3%	17%	71%	1%	3%	0%	0%	0%	0%	22%	61%	17%	0%	0%	1%	0%	48%	51%	100%	0%	0%	0%
22-May	06:55	17:30	10.6	2%	18%	40%	40%	0%	0%	0%	0%	0%	0%	0%	46%	44%	11%	0%	0%	8%	18%	74%	100%	0%	0%	0%
23-May	06:53	17:30	10.6	29%	8%	62%	0%	0%	0%	0%	0%	0%	0%	25%	47%	28%	0%	0%	0%	2%	48%	49%	100%	0%	0%	0%
24-May	06:53	17:30	10.6	84%	1%	14%	2%	0%	0%	0%	0%	0%	0%	20%	66%	15%	0%	0%	0%	9%	50%	41%	100%	0%	0%	0%
25-May	06:23	17:00	10.6	83%	3%	14%	0%	0%	0%	0%	0%	0%	0%	41%	47%	11%	0%	0%	1%	7%	51%	41%	100%	0%	0%	0%
26-May	06:53	17:30	10.6	72%	6%	22%	0%	0%	0%	0%	0%	0%	0%	6%	84%	9%	0%	0%	0%	4%	38%	59%	100%	0%	0%	0%
27-May	06:54	17:30	10.6	0%	4%	66%	30%	0%	0%	0%	0%	0%	0%	1%	62%	27%	8%	2%	0%	1%	50%	49%	100%	0%	0%	0%
28-May	06:52	17:30	10.6	0%	0%	1%	32%	10%	46%	10%	0%	0%	0%	0%	87%	11%	1%	0%	0%	5%	62%	33%	100%	0%	0%	0%
29-May	06:53	18:06	11.2	0%	0%	2%	34%	4%	24%	36%	0%	0%	0%	3%	75%	21%	1%	0%	1%	25%	44%	30%	100%	0%	0%	0%
30-May	06:54	17:30	10.6	0%	13%	51%	36%	0%	0%	0%	0%	0%	0%	30%	65%	5%	0%	0%	1%	0%	31%	68%	100%	0%	0%	0%
May Summary	**n/a**	**n/a**	**272.8**	**18%**	**9%**	**35%**	**30%**	**1%**	**5%**	**3%**	**0%**	**0%**	**0%**	**20%**	**67%**	**12%**	**1%**	**0%**	**0%**	**4%**	**25%**	**71%**	**95%**	**5%**	**0%**	**0%**

Appendix A. Daily monitoring effort, weather, visibility, and sea conditions, Phase 2 Construction, Petroleum and Cement Terminal Anchorage AK, April 26 – June 24; Sept. 7 – Sept 29 2021.

	Observation Effort			Weather/Precipitation Conditions; Percent Observed									Beafort Sea State; Percent Observed						Visibility (meters); Percent of Distance Category				Ice Cover (percent); Percent of Coverage Category			
Date	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	5	0-2499	2500-4999	5000-7499	7500-10000	0%	1%-10%	11%-20%	21%-35%
1-Jun	06:51	17:30	10.7	1%	10%	56%	19%	0%	11%	3%	0%	0%	0%	17%	23%	20%	39%	1%	0%	11%	53%	36%	100%	0%	0%	0%
2-Jun	06:54	17:30	10.6	27%	11%	26%	32%	0%	3%	0%	0%	0%	0%	14%	86%	0%	0%	0%	0%	0%	31%	69%	100%	0%	0%	0%
5-Jun	09:08	16:53	7.8	32%	6%	62%	0%	0%	0%	0%	0%	0%	0%	38%	49%	13%	0%	0%	0%	0%	62%	38%	100%	0%	0%	0%
6-Jun	06:56	17:27	10.5	60%	16%	24%	0%	0%	0%	0%	0%	0%	0%	15%	70%	15%	0%	0%	1%	3%	70%	26%	100%	0%	0%	0%
7-Jun	06:50	17:50	11.0	28%	9%	63%	0%	0%	0%	0%	0%	0%	0%	3%	55%	38%	3%	0%	0%	0%	24%	76%	100%	0%	0%	0%
8-Jun	06:53	17:30	10.6	1%	0%	13%	86%	0%	0%	0%	0%	0%	0%	7%	48%	40%	5%	0%	0%	0%	32%	68%	100%	0%	0%	0%
11-Jun	06:55	19:43	12.8	5%	11%	84%	0%	0%	0%	0%	0%	0%	0%	0%	73%	26%	2%	0%	0%	14%	26%	60%	100%	0%	0%	0%
12-Jun	09:28	17:30	8.0	0%	26%	71%	3%	0%	0%	0%	0%	0%	0%	38%	60%	3%	0%	0%	0%	11%	33%	56%	100%	0%	0%	0%
13-Jun	09:05	19:20	10.3	30%	8%	61%	0%	0%	0%	0%	0%	0%	0%	0%	66%	32%	2%	0%	0%	7%	38%	56%	100%	0%	0%	0%
15-Jun	09:07	17:30	8.4	84%	1%	14%	0%	0%	0%	0%	0%	0%	0%	0%	57%	43%	0%	0%	0%	8%	49%	43%	100%	0%	0%	0%
16-Jun	09:04	17:30	8.4	0%	0%	6%	63%	1%	21%	8%	0%	0%	0%	1%	80%	18%	0%	0%	0%	3%	45%	52%	100%	0%	0%	0%
17-Jun	06:55	17:30	10.6	0%	18%	78%	3%	0%	0%	0%	0%	0%	0%	23%	76%	1%	0%	0%	0%	0%	22%	78%	100%	0%	0%	0%
18-Jun	09:05	19:36	10.5	0%	0%	11%	83%	0%	6%	0%	0%	0%	3%	67%	30%	0%	0%	0%	0%	0%	58%	42%	100%	0%	0%	0%
20-Jun	09:04	20:03	11.0	0%	0%	1%	52%	1%	37%	9%	0%	0%	1%	96%	4%	0%	0%	0%	0%	0%	65%	35%	100%	0%	0%	0%
21-Jun	09:08	22:30	13.4	0%	13%	63%	24%	0%	0%	0%	0%	0%	0%	6%	58%	33%	3%	0%	0%	3%	82%	16%	100%	0%	0%	0%
22-Jun	07:26	18:00	10.6	0%	17%	31%	51%	0%	0%	0%	0%	0%	0%	19%	81%	0%	0%	0%	0%	1%	45%	53%	100%	0%	0%	0%
23-Jun	08:22	18:45	10.4	0%	13%	25%	62%	0%	0%	0%	0%	0%	0%	47%	53%	0%	0%	0%	0%	0%	32%	68%	100%	0%	0%	0%
24-Jun	07:09	17:45	10.6	0%	10%	22%	53%	0%	11%	4%	0%	0%	0%	16%	74%	10%	0%	0%	0%	4%	46%	51%	100%	0%	0%	0%
Jun Summary	**n/a**	**n/a**	**186.0**	**15%**	**9%**	**41%**	**29%**	**0%**	**5%**	**1%**	**0%**	**0%**	**0%**	**22%**	**57%**	**17%**	**3%**	**0%**	**0%**	**4%**	**47%**	**49%**	**100%**	**0%**	**0%**	**0%**
7-Sep	08:08	18:45	10.6	0%	0%	95%	5%	0%	0%	0%	0%	0%	0%	8%	92%	0%	0%	0%	0%	1%	36%	63%	100%	0%	0%	0%
8-Sep	07:10	17:45	10.6	0%	3%	13%	71%	0%	12%	1%	0%	0%	0%	70%	30%	0%	0%	0%	0%	3%	34%	63%	100%	0%	0%	0%
9-Sep	07:09	17:45	10.6	0%	31%	36%	33%	0%	0%	0%	0%	0%	0%	22%	76%	3%	0%	0%	0%	6%	29%	64%	100%	0%	0%	0%
10-Sep	07:05	17:45	10.7	0%	0%	7%	48%	0%	33%	12%	0%	0%	0%	21%	79%	0%	0%	0%	0%	6%	46%	48%	100%	0%	0%	0%
11-Sep	07:07	17:45	10.6	2%	5%	70%	3%	0%	0%	0%	20%	0%	0%	2%	98%	0%	0%	0%	8%	19%	31%	41%	100%	0%	0%	0%
12-Sep	07:12	17:45	10.6	0%	16%	54%	29%	0%	0%	0%	0%	0%	0%	6%	93%	1%	0%	0%	0%	15%	35%	49%	100%	0%	0%	0%
13-Sep	07:09	17:45	10.6	1%	7%	44%	38%	1%	9%	0%	0%	0%	0%	1%	88%	11%	0%	0%	0%	21%	44%	35%	100%	0%	0%	0%
14-Sep	07:07	17:45	10.6	0%	23%	60%	8%	0%	8%	0%	0%	0%	0%	0%	95%	5%	0%	0%	0%	13%	45%	42%	100%	0%	0%	0%
15-Sep	07:10	17:45	10.6	0%	15%	34%	45%	2%	3%	0%	0%	0%	0%	0%	90%	10%	0%	0%	1%	6%	41%	52%	100%	0%	0%	0%
16-Sep	07:14	17:45	10.5	0%	0%	4%	87%	4%	6%	0%	0%	0%	0%	0%	96%	4%	0%	0%	1%	9%	41%	48%	100%	0%	0%	0%
17-Sep	07:12	17:45	10.6	3%	23%	58%	16%	0%	0%	0%	0%	0%	0%	27%	73%	0%	0%	0%	1%	3%	27%	69%	100%	0%	0%	0%
18-Sep	07:09	17:45	10.6	33%	7%	59%	1%	0%	0%	0%	0%	0%	0%	21%	78%	1%	0%	0%	1%	9%	32%	58%	100%	0%	0%	0%
19-Sep	07:30	15:30	8.0	40%	8%	33%	0%	0%	0%	0%	19%	0%	0%	7%	93%	0%	0%	0%	3%	32%	34%	32%	100%	0%	0%	0%
20-Sep	07:31	15:30	8.0	0%	0%	15%	77%	3%	5%	0%	0%	0%	0%	3%	97%	0%	0%	0%	2%	11%	52%	35%	100%	0%	0%	0%
21-Sep	07:28	08:10	0.7	0%	0%	17%	83%	0%	0%	0%	0%	0%	0%	0%	0%	42%	33%	25%	42%	58%	0%	0%	100%	0%	0%	0%
22-Sep	07:28	18:00	10.5	32%	7%	23%	38%	0%	0%	0%	0%	0%	0%	6%	91%	3%	0%	0%	0%	25%	45%	30%	100%	0%	0%	0%
23-Sep	07:29	15:40	8.2	0%	0%	6%	94%	0%	0%	0%	0%	0%	0%	0%	7%	29%	45%	18%	2%	64%	28%	5%	100%	0%	0%	0%
24-Sep	07:28	18:00	10.5	0%	0%	3%	4%	0%	44%	3%	31%	15%	0%	0%	96%	4%	0%	0%	4%	90%	4%	2%	100%	0%	0%	0%
25-Sep	07:44	18:15	10.5	1%	7%	26%	66%	0%	0%	0%	0%	0%	0%	10%	90%	0%	0%	0%	1%	39%	26%	34%	100%	0%	0%	0%

Appendix A. Daily monitoring effort, weather, visibility, and sea conditions, Phase 2 Construction, Petroleum and Cement Terminal Anchorage AK, April 26 – June 24; Sept. 7 – Sept 29 2021.

	Observation Effort			Weather/Precipitation Conditions; Percent Observed									Beafort Sea State; Percent Observed						Visibility (meters); Percent of Distance Category				Ice Cover (percent); Percent of Coverage Category			
Date	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	5	0-2499	2500-4999	5000-7499	7500-10000	0%	1%-10%	11%-20%	21%-35%
26-Sep	07:54	18:15	10.4	82%	0%	18%	0%	0%	0%	0%	0%	0%	1%	22%	67%	10%	0%	0%	1%	30%	26%	43%	100%	0%	0%	0%
27-Sep	07:47	20:14	12.5	83%	3%	13%	1%	0%	0%	0%	0%	0%	2%	24%	75%	0%	0%	0%	2%	27%	23%	48%	100%	0%	0%	0%
28-Sep	08:18	18:15	10.0	38%	13%	48%	1%	0%	0%	0%	0%	0%	0%	8%	91%	1%	0%	0%	0%	29%	50%	21%	100%	0%	0%	0%
29-Sep	07:43	20:00	12.3	91%	0%	9%	0%	0%	0%	0%	0%	0%	0%	19%	78%	3%	0%	0%	0%	16%	61%	23%	100%	0%	0%	0%
Sep Summary	**n/a**	**n/a**	**228.6**	**21%**	**7%**	**32%**	**29%**	**0%**	**6%**	**1%**	**4%**	**1%**	**0%**	**12%**	**80%**	**4%**	**2%**	**1%**	**2%**	**23%**	**36%**	**39%**	**100%**	**0%**	**0%**	**0%**
Project Total	**n/a**	**n/a**	**734.9**	**28%**	**5%**	**36%**	**9%**	**2%**	**18%**	**1%**	**1%**	**0%**	**0%**	**19%**	**68%**	**10%**	**2%**	**0%**	**1%**	**10%**	**34%**	**56%**	**92%**	**7%**	**0%**	**0%**

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APPENDIX B

Project Photos

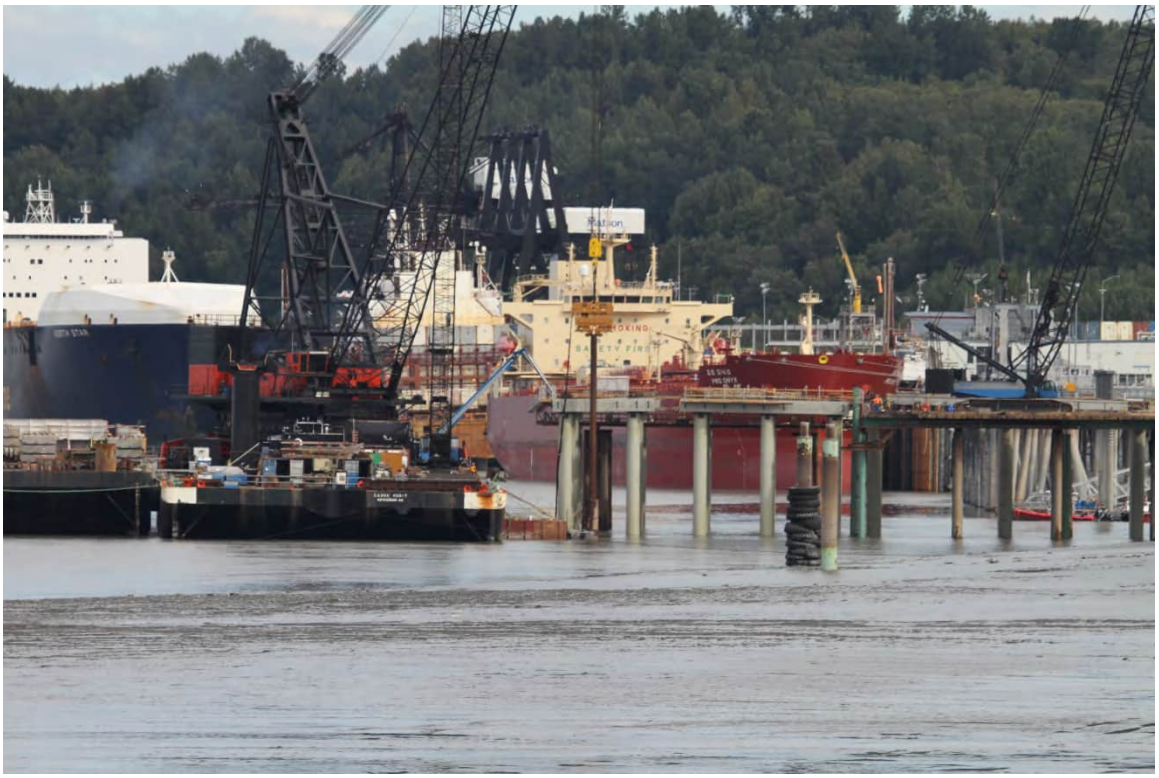

Photo 1. View of PCT project area from Ship Creek PSO Station

Photo 2. View of PCT construction from PCT PSO Station

Photo 3. PSO monitoring construction at the PCT PSO station

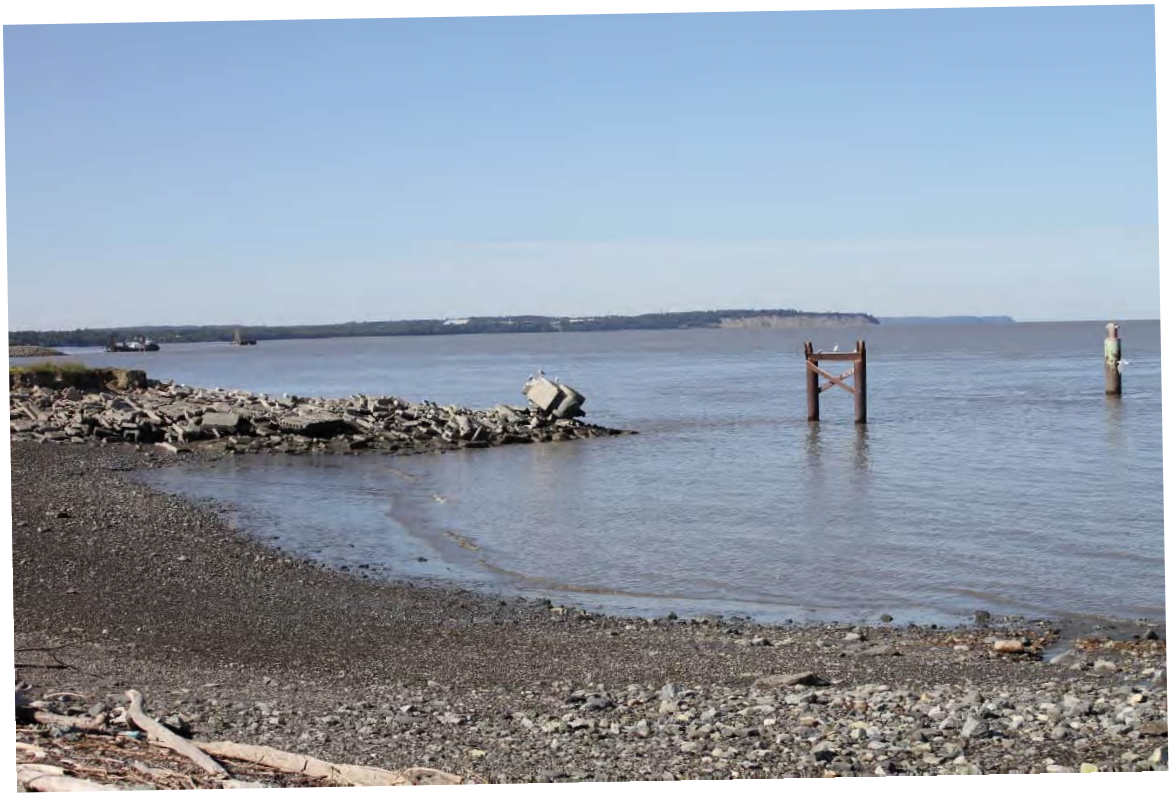

Photo 4. View towards Ship Creek from PCT PSO station

Photo 5. Beluga whale in front of POA (Photo credit: Kristina Smolenski – The Photo Gecko)

Photo 6. View of Port Mackenzie from the PCT PSO station

Photo 7. Point Woronzof PSO station on bluff

Photo 8. Point Woronzof PSO station

Photo 9. Fujinon 7X150 MT-SX “big eye” binoculars at Point Woronzof

Photo 10. View of In-bound Pre-clearance Line from Point Woronzof PSO Station

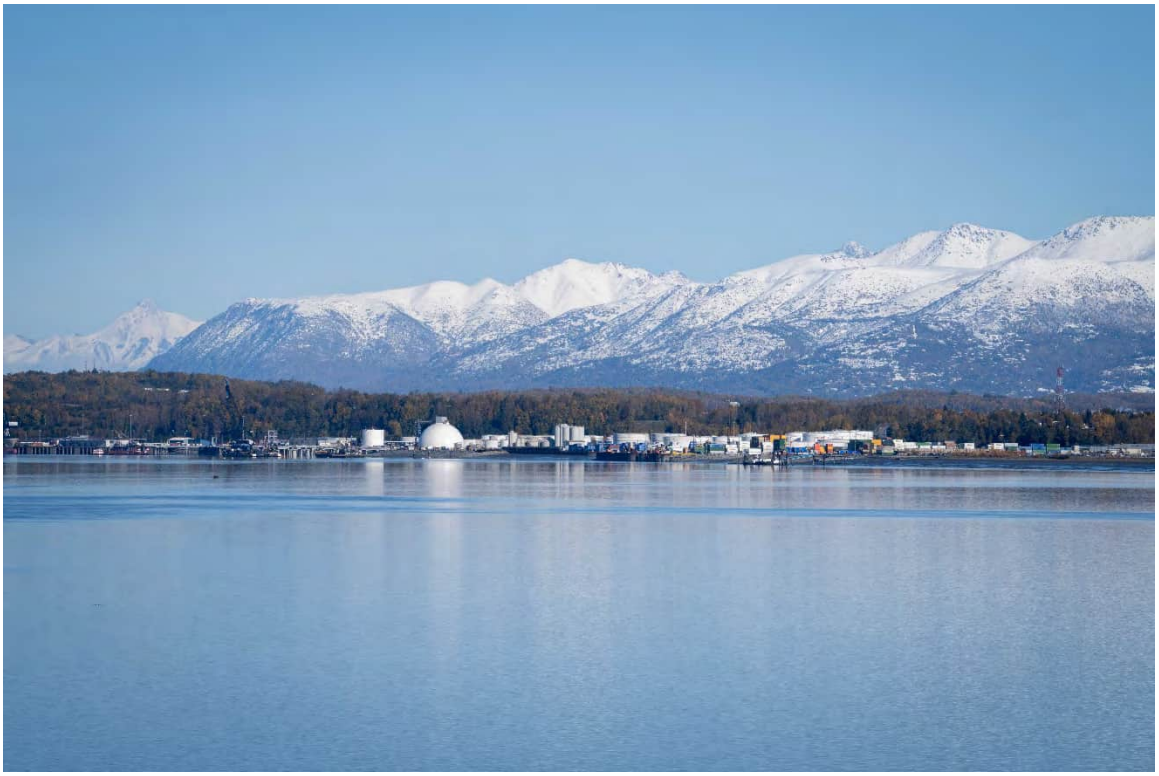

Photo 11. View of Port of Alaska from Point Woronzof PSO station (Photo Credit: Kristina Smolenski – The Photo Gecko)

Photo 12. Ship Creek PSO station

Photo 13. PSO using the digital theodolite at Ship Creek PSO station

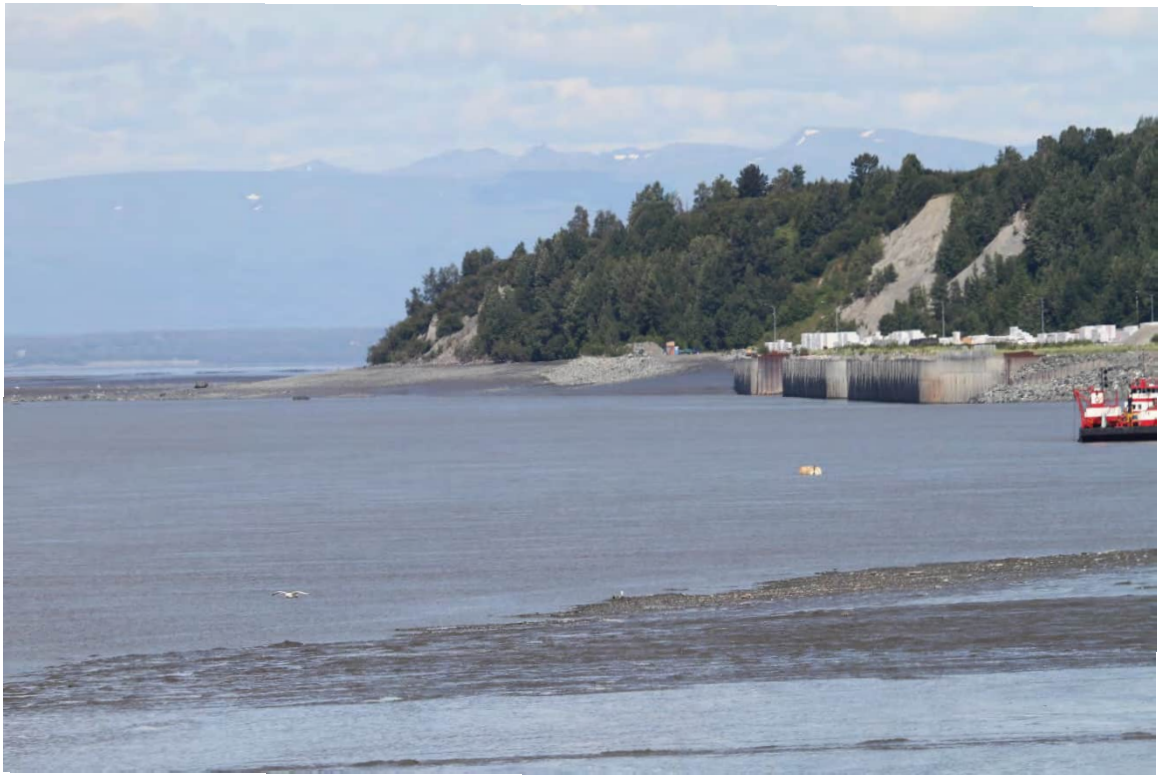

Photo 14. View towards NEX PSO station from Ship Creek PSO station

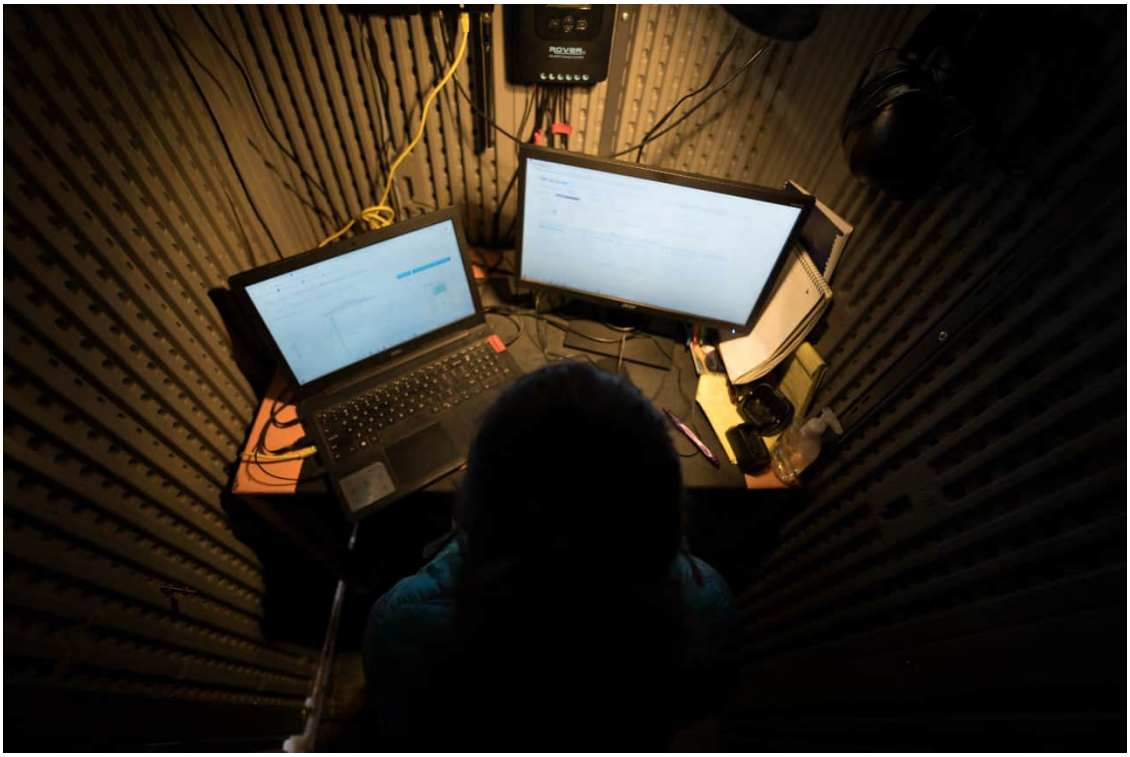

Photo 15. PSO entering data in the “data shack” at the NEX PSO station (Photo Credit: Kristina Smolenski – The Photo Gecko)

Photo 16. PSO using Topcon DT-205 digital theodolite (Photo Credit: Kristina Smolenski – The Photo Gecko)

Photo 17. View towards PCT from Ship Creek PSO station

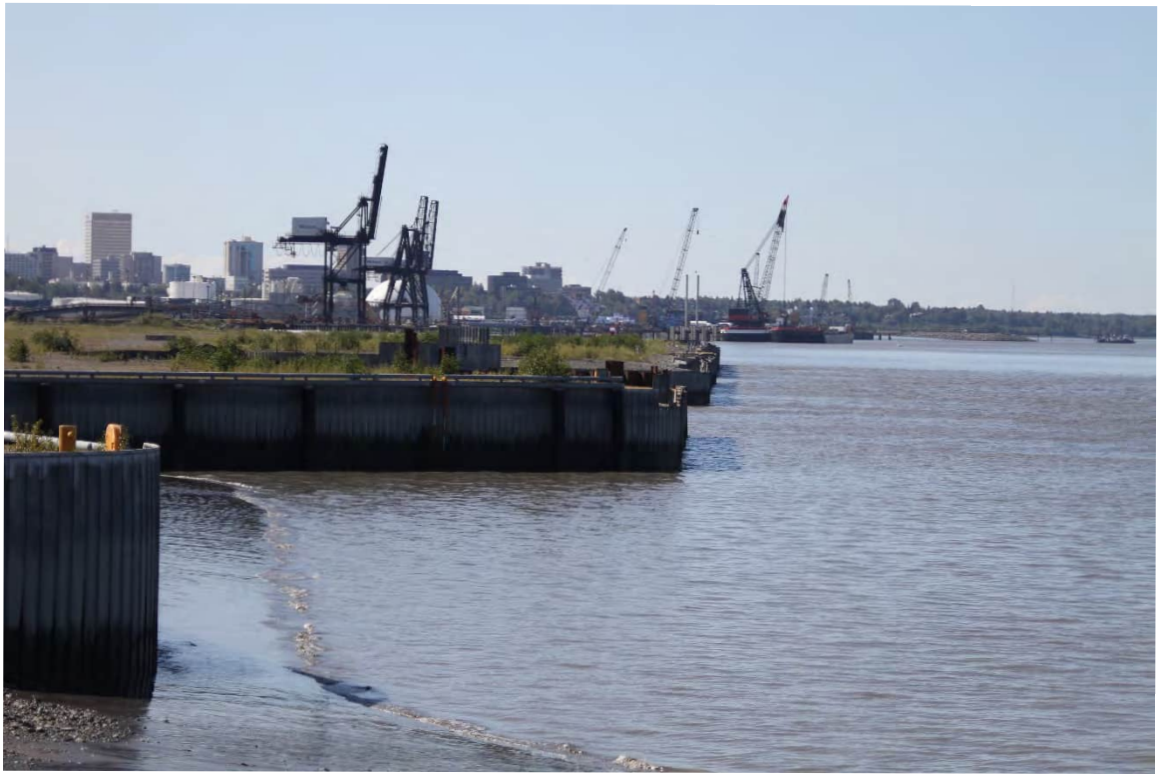

Photo 18. View towards PCT from NEX PSO station

Photo 19. NEX PSO Station

Photo 20. View north towards Cairn Point from NEX PSO station

Photo 21. PSO at the CP remote station, Cairn Point Beach (Photo Credit: Kristina Smolenski – The Photo Gecko)

Photo 22. Beluga group off of the POA (Photo Credit: Kristina Smolenski – The Photo Gecko)

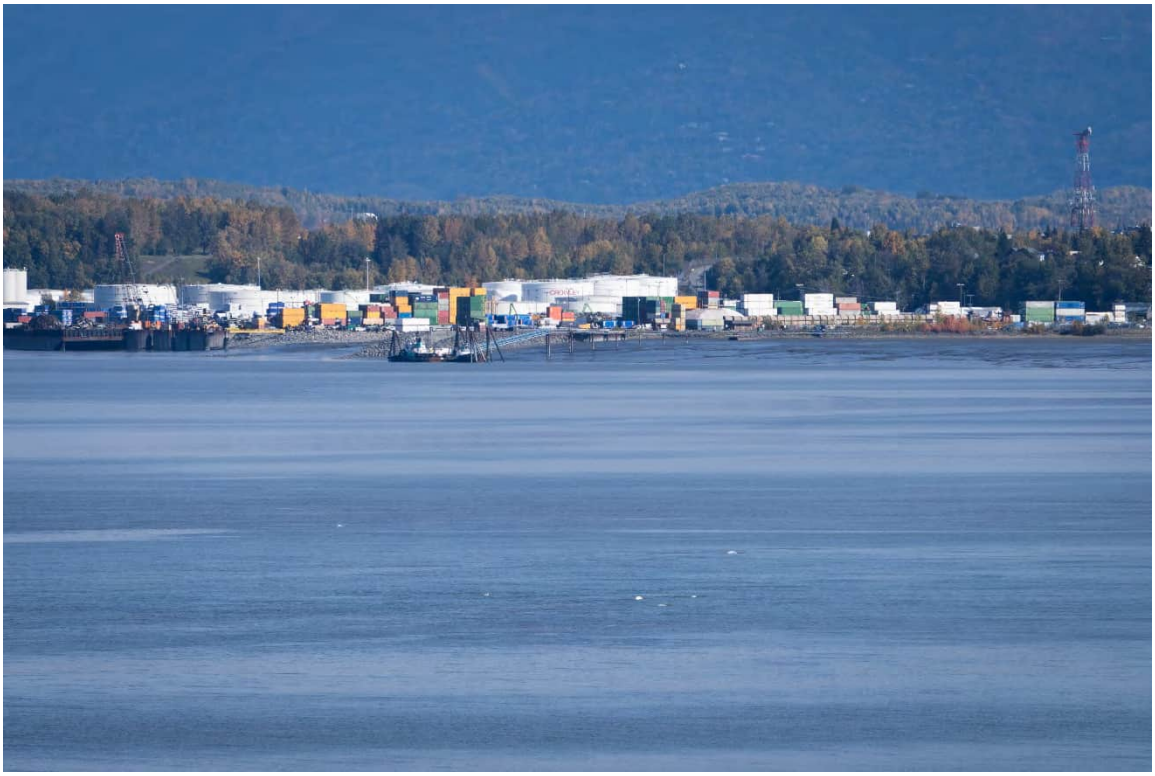

Photo 23. Beluga group offshore of Bootleggers Cove (Photo Credit: Kristina Smolenski – The Photo Gecko)

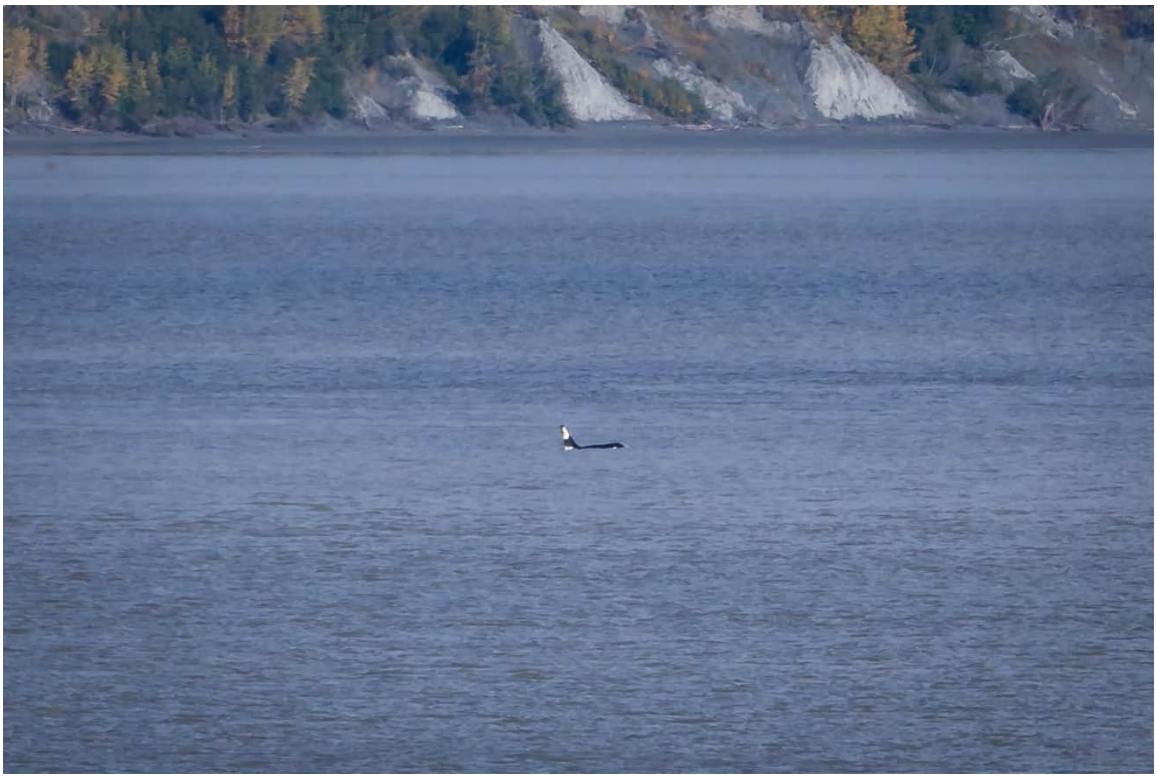

Photo 24. Male killer whale in Knik Arm (Photo Credit: Kristina Smolenski – The Photo Gecko)

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APPENDIX C-1

Figures - Beluga Groups Sighted During IPIR

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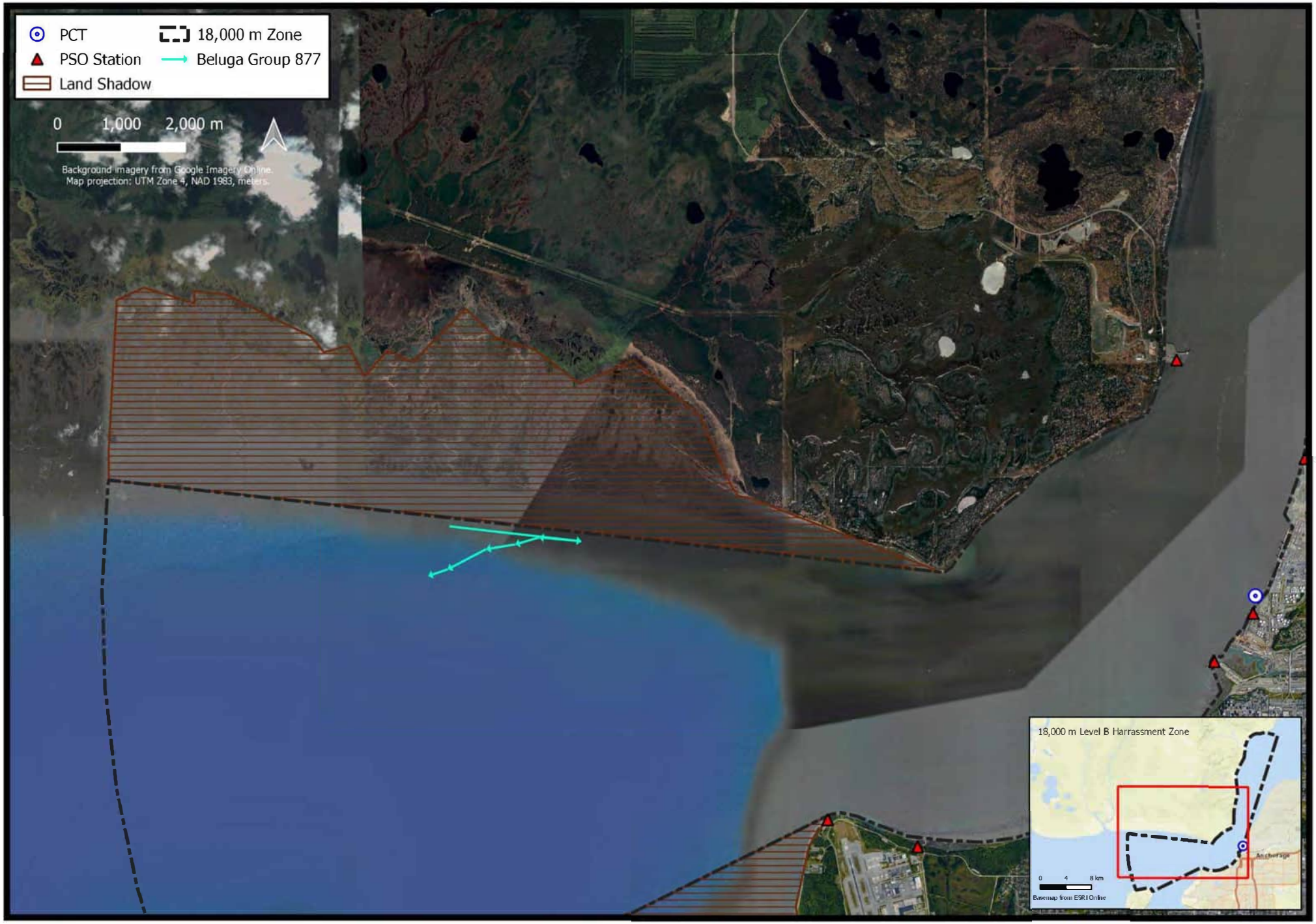

Figure C-1-1. Beluga Group 877; 26 May 2021 IPIR Event

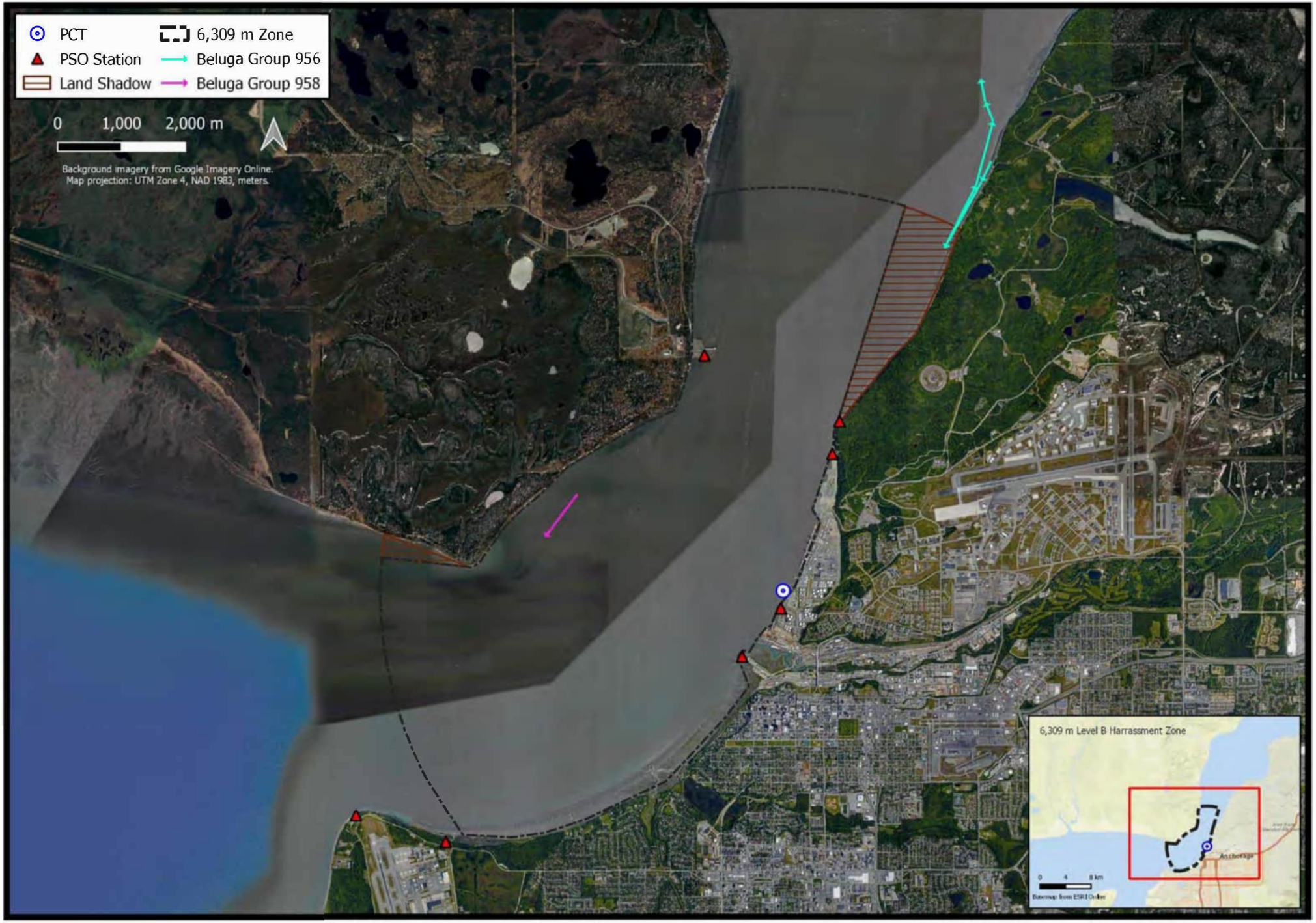

Figure C-1-2. Beluga Groups 956 and 958; 18 June 2021 IPIR Event

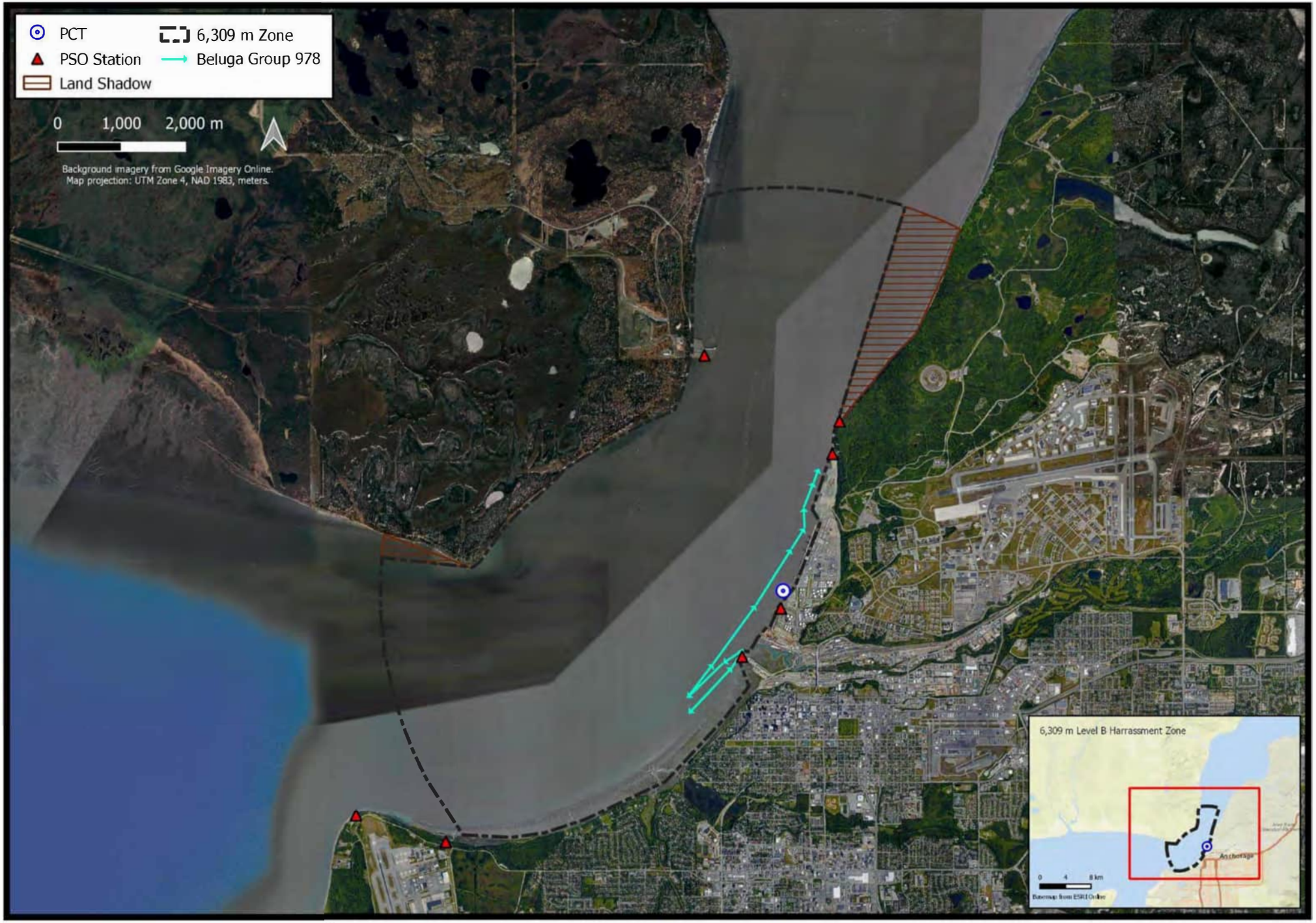

Figure C-1-3. Beluga Group 978; 21 June 2021 IPIR Event

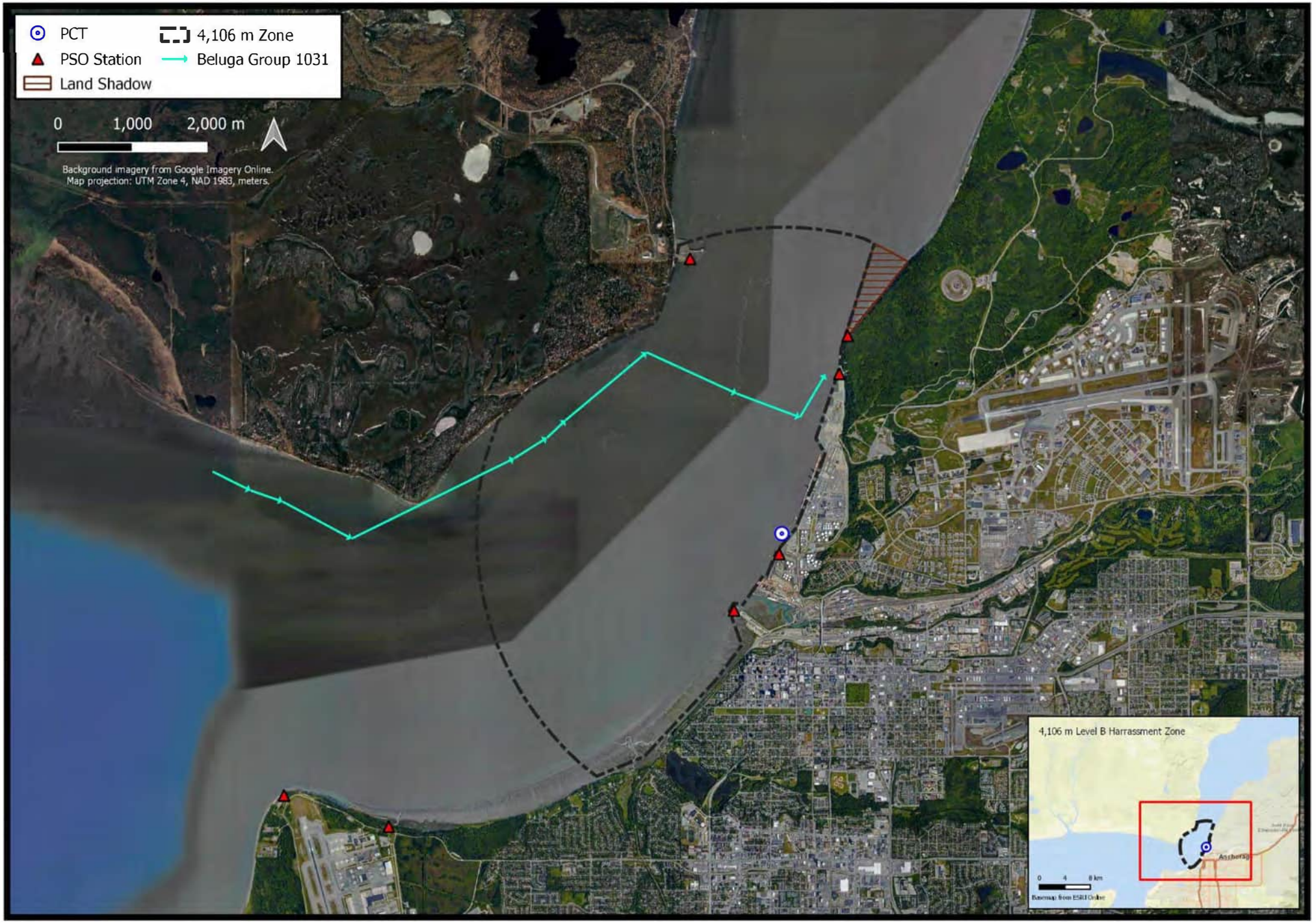

Figure C-1-4. Beluga Group 1031; 7 September 2021 IPIR Event

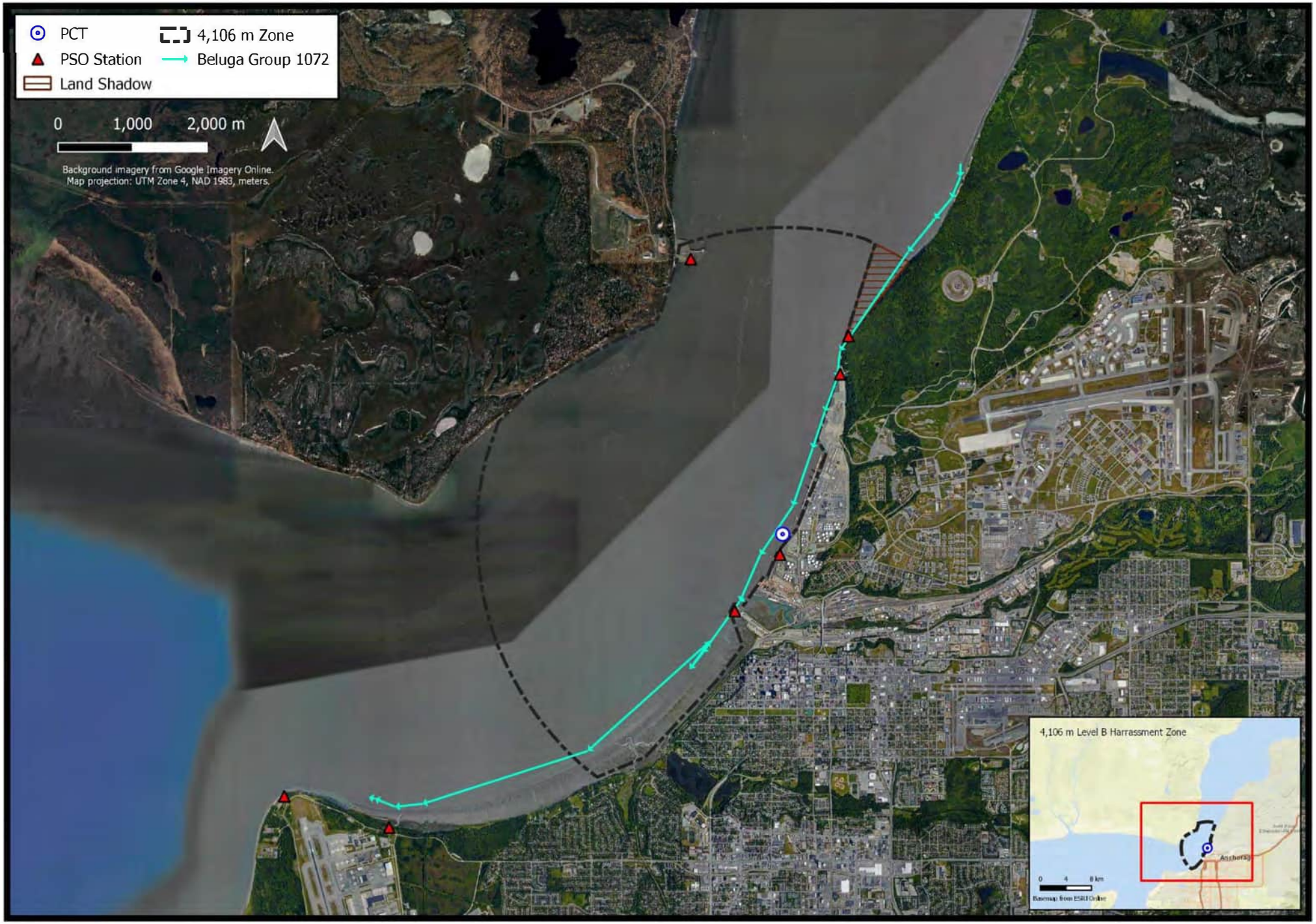

Figure C-1-5. Beluga Group 1072; 10 September 2021 IPIR Event

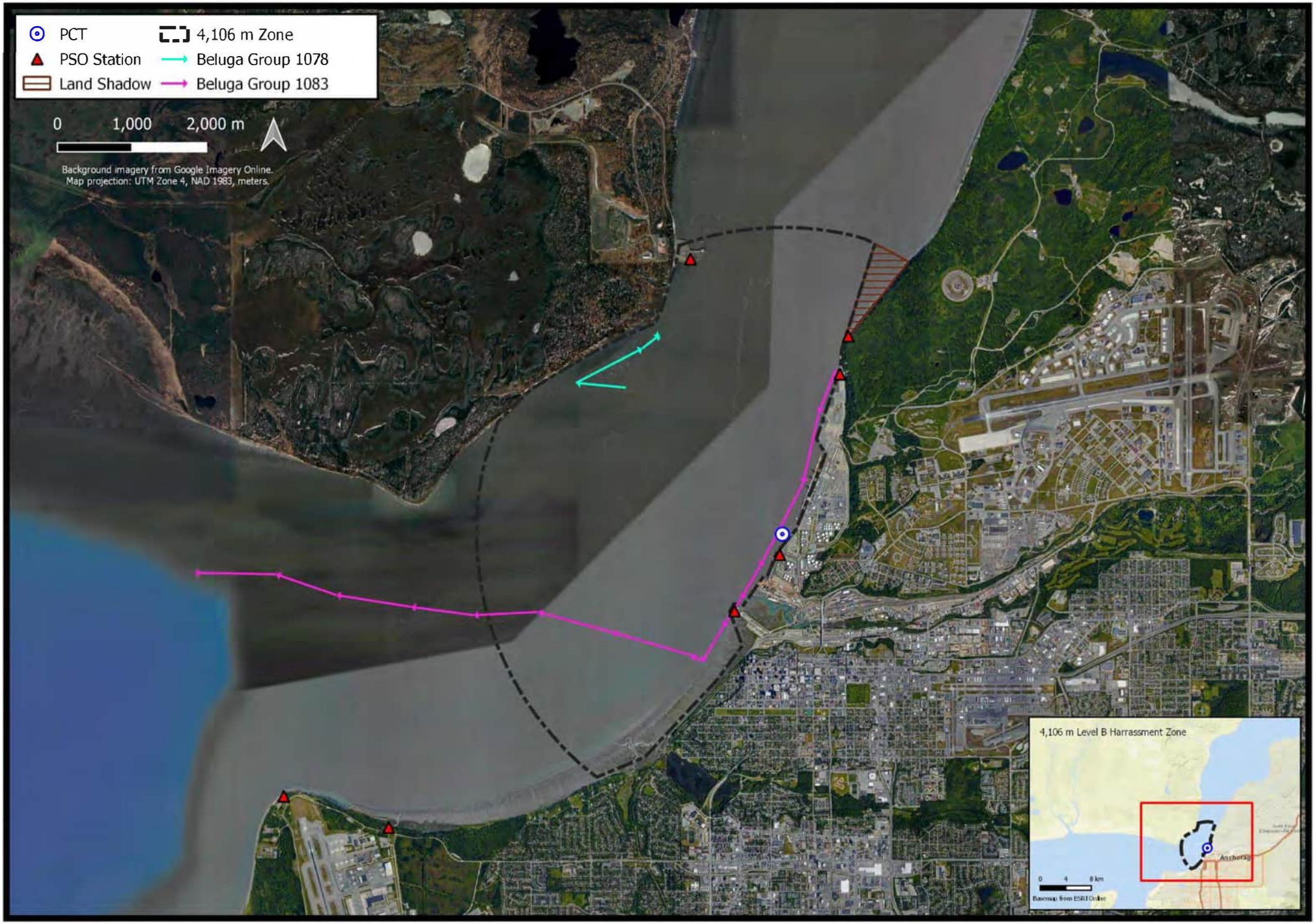

Figure C-1-6. Beluga Groups 1078 and 1083; 11 September 2021 IPIR Event

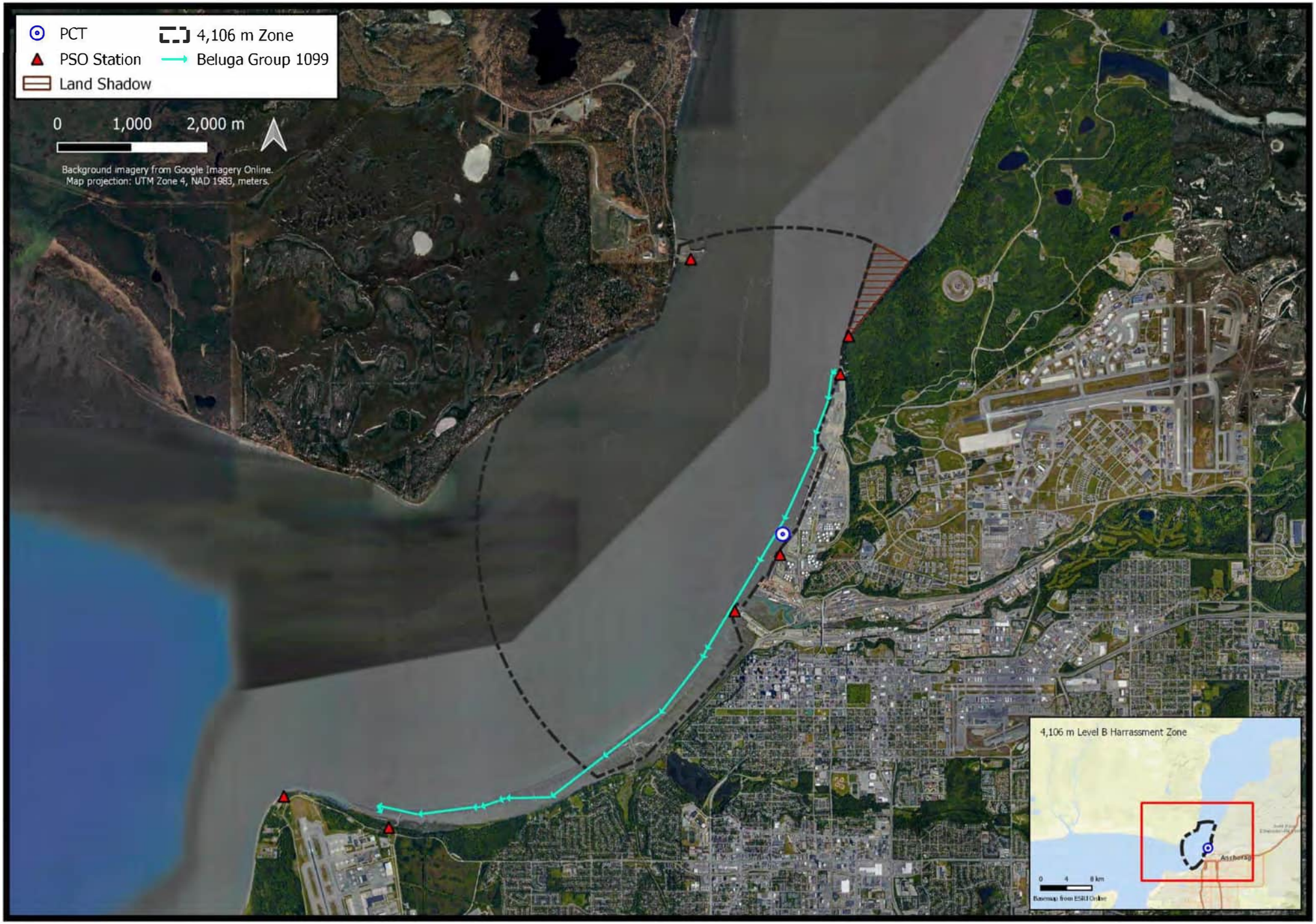

Figure C-1-7. Beluga Group 1099; 12 September 2021 IPIR Event

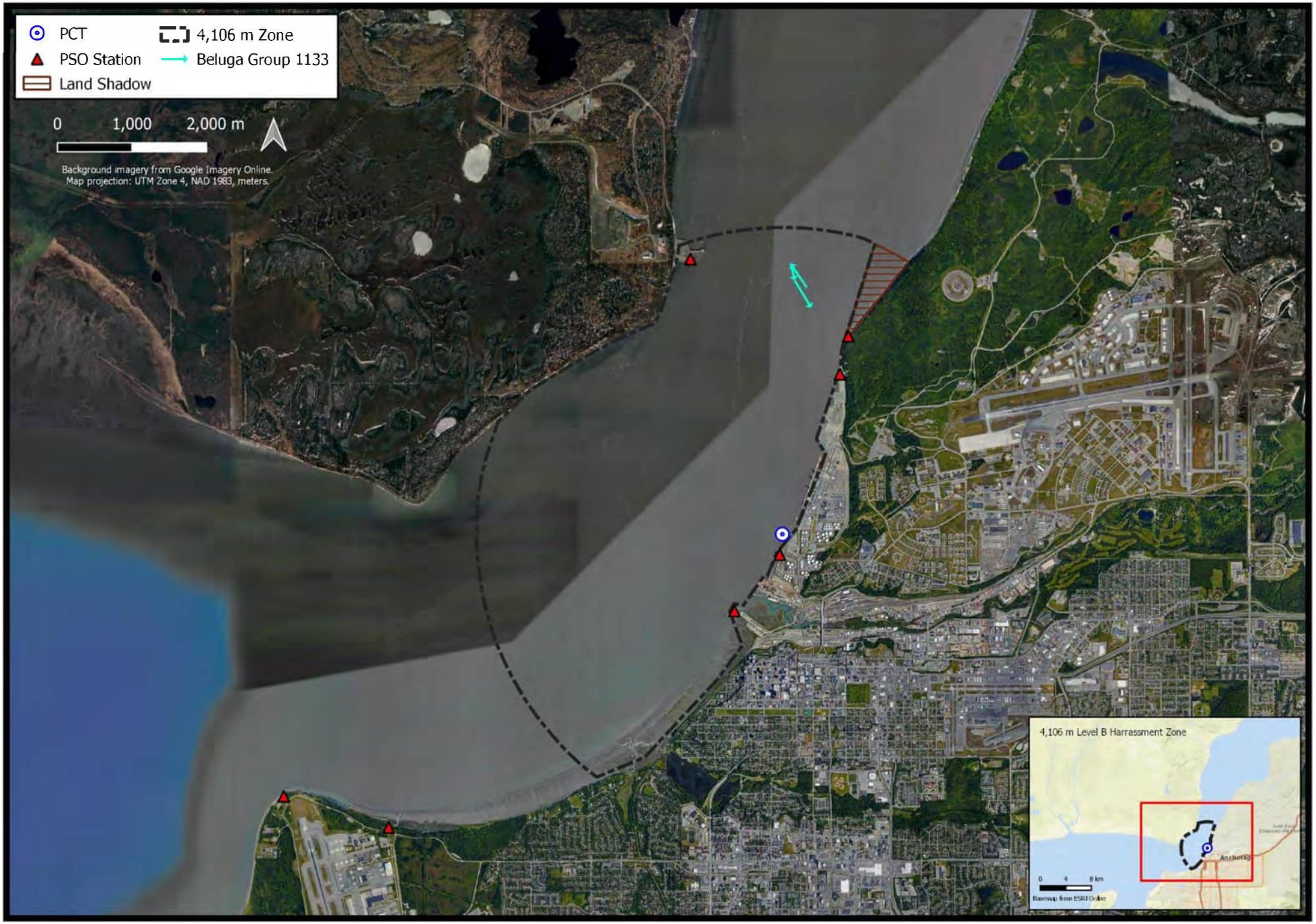

Figure C-1-8. Beluga Group 1133; 15 September 2021 IPIR Event

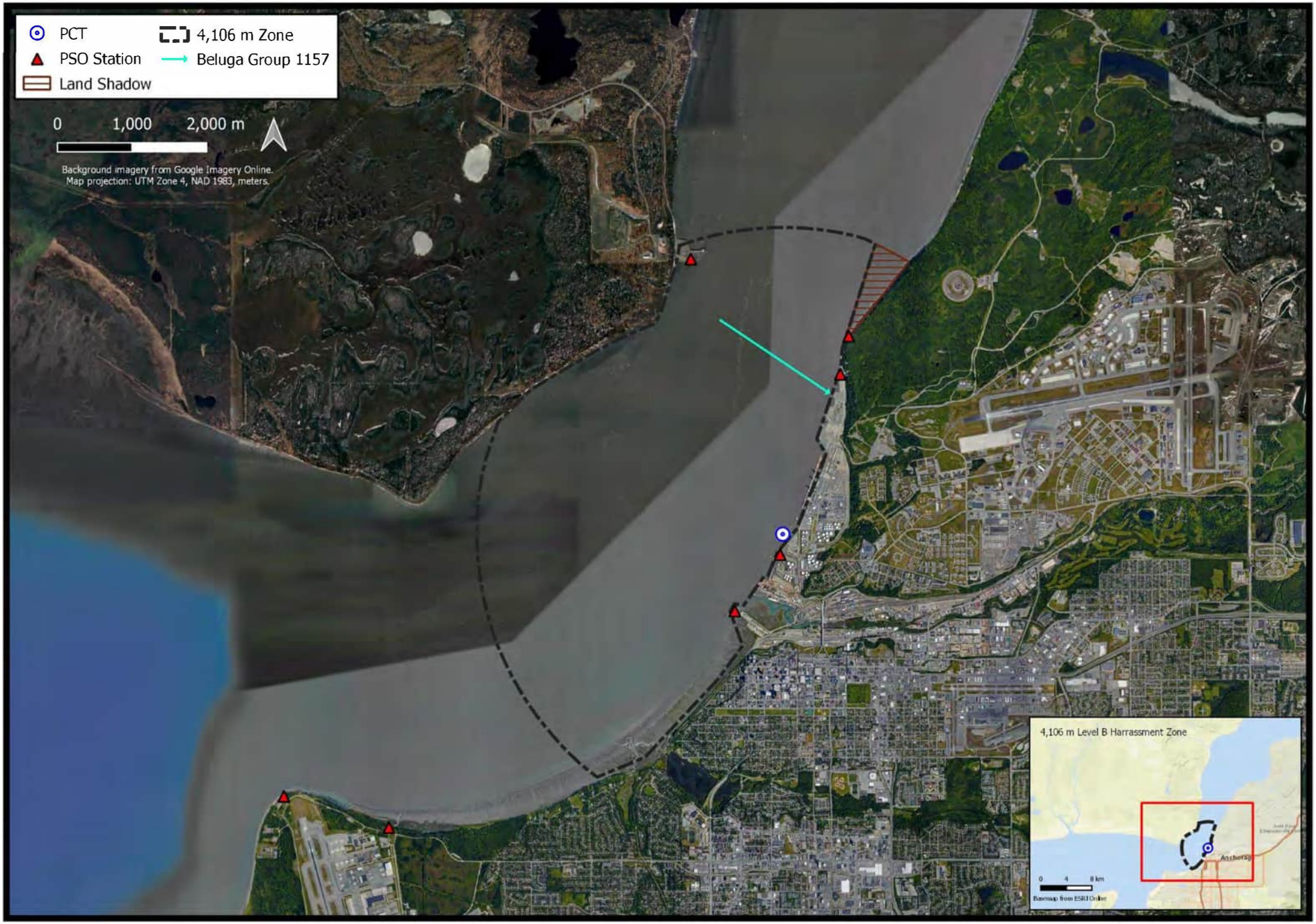

Figure C-1-9. Beluga Group 1157; 17 September 2021 IPIR Event

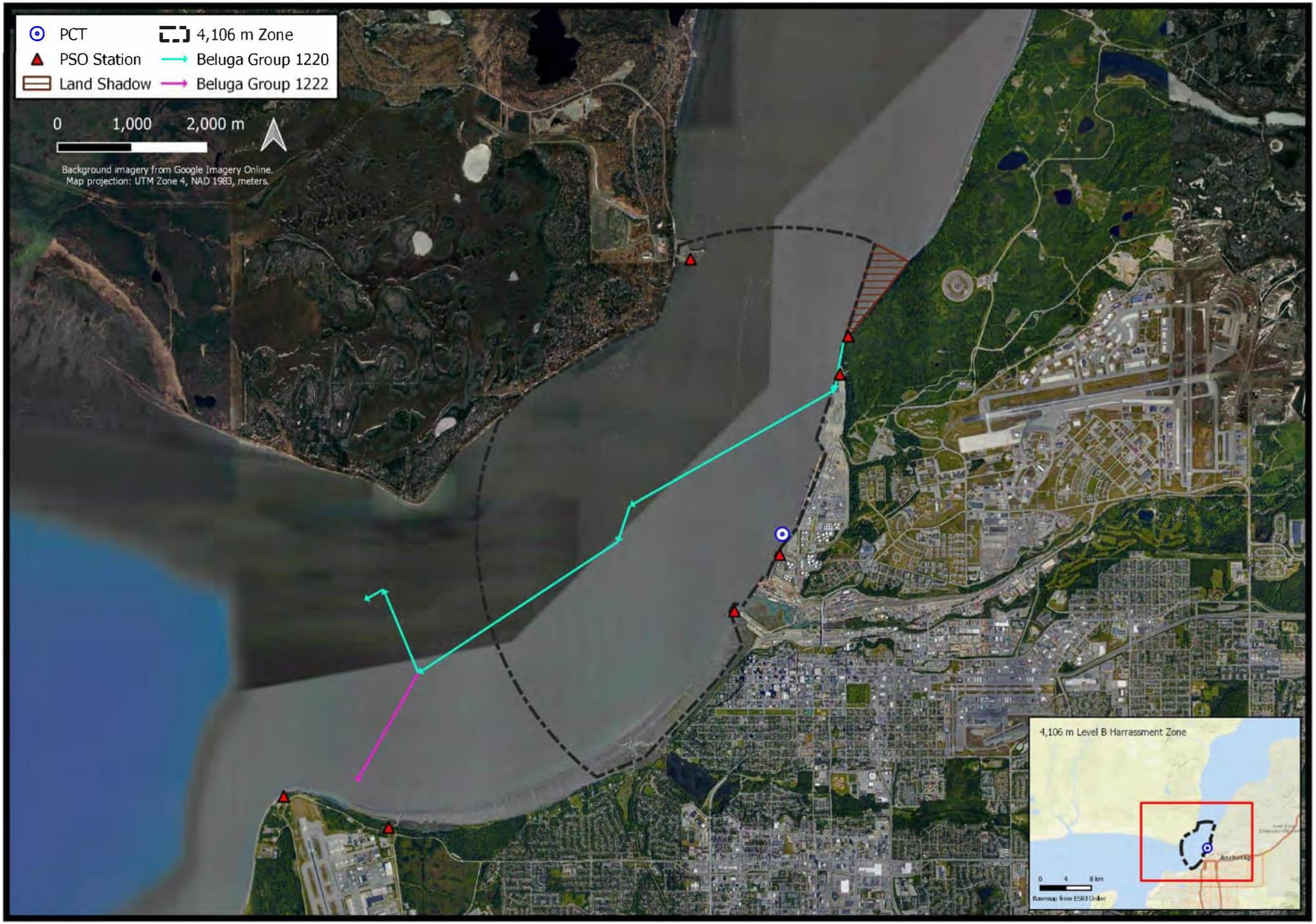

Figure C-1-10. Beluga Groups 1220 and 1222; 24 September 2021 IPIR Event

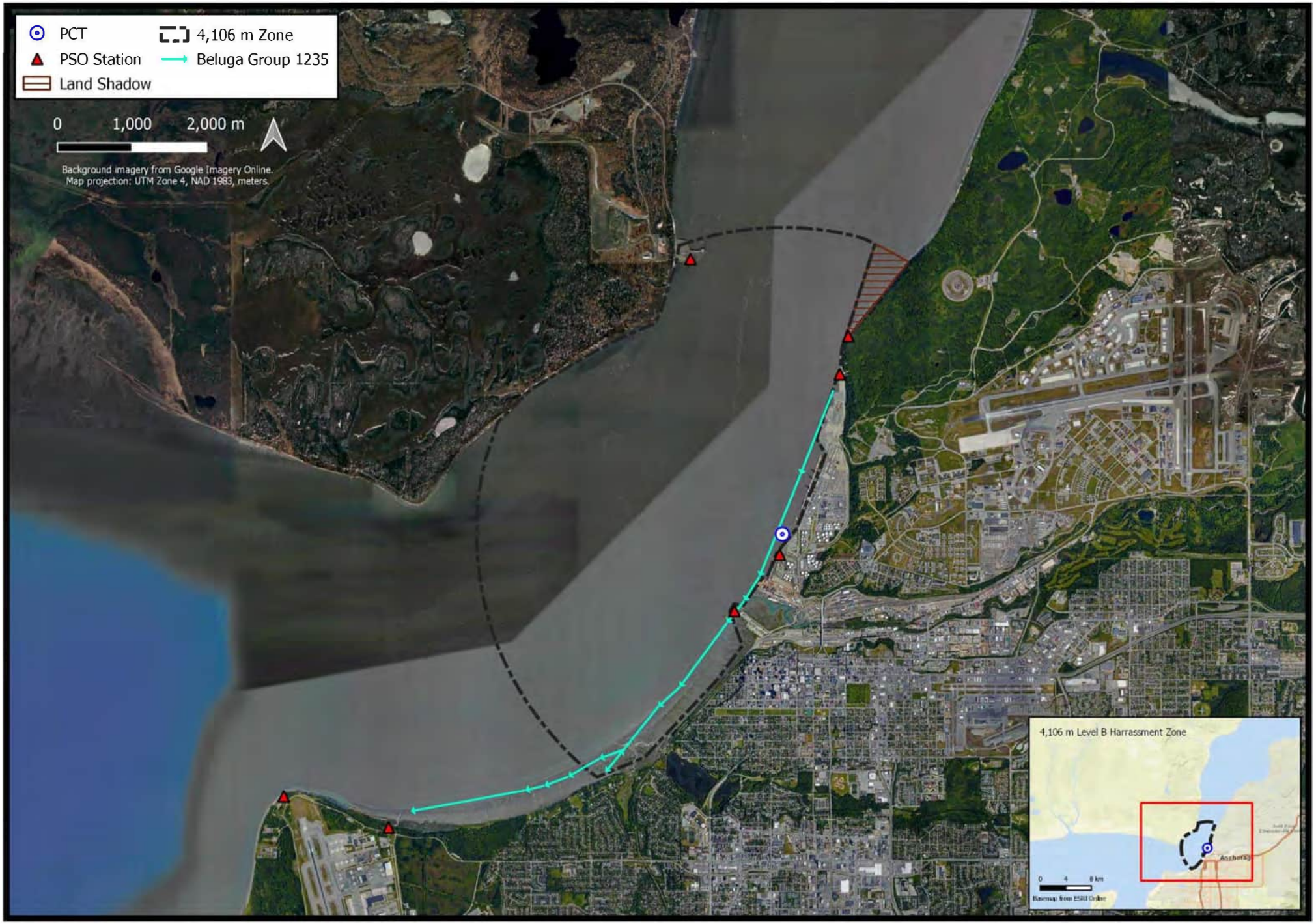

Figure C-1-11. Beluga Group 1235; 25 September 2021 IPIR Event

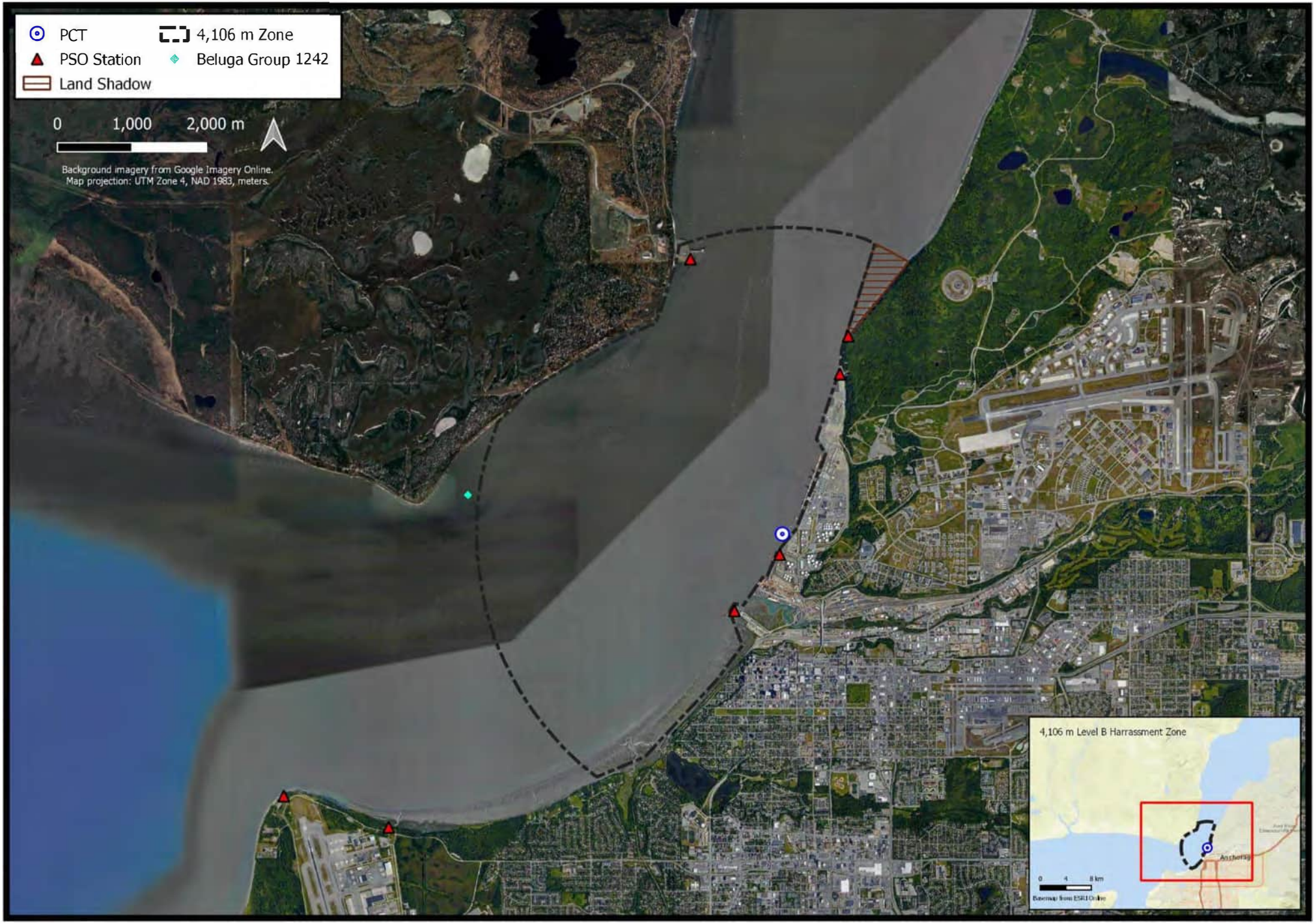

Figure C-1-12. Beluga Group 1242; 26 September 2021 IPIR Event

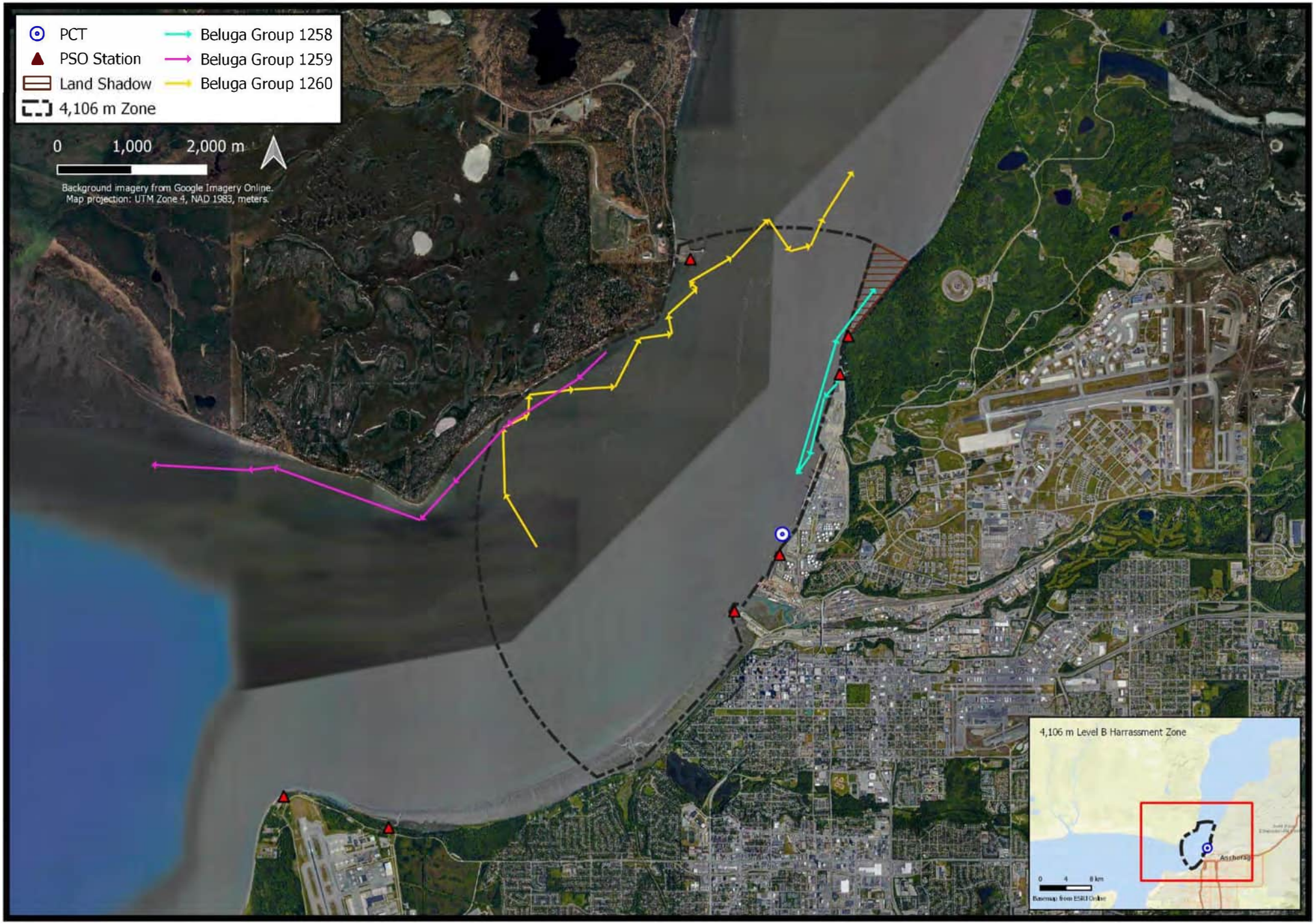

Figure C-1-13. Beluga Groups 1258, 1259, and 1260; 28 September 2021 IPIR Event

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APPENDIX C-2

Figures – Marine Mammal Sightings by Month

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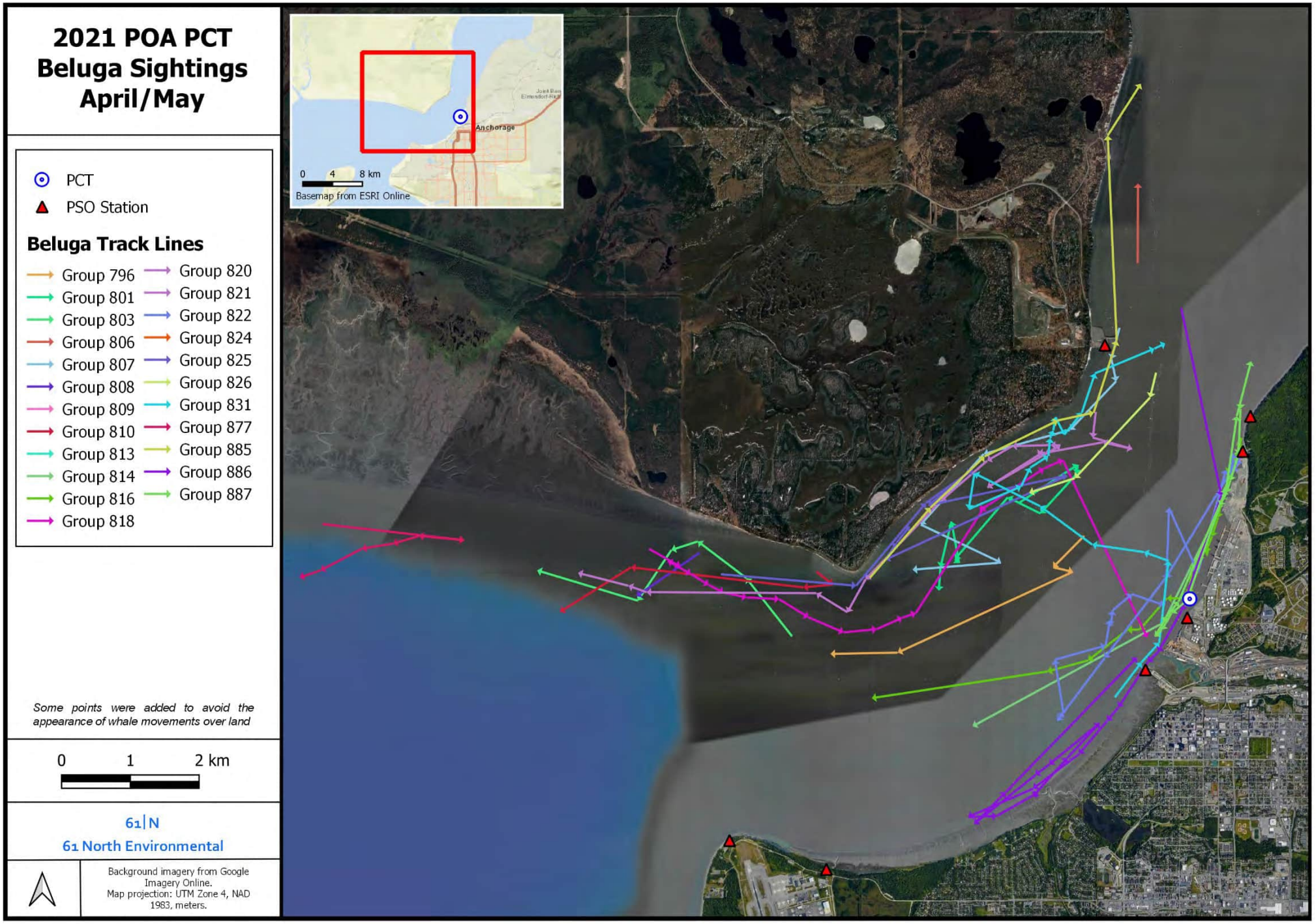

Figure C-2-1. Beluga Sightings and Track Lines April/May 2021

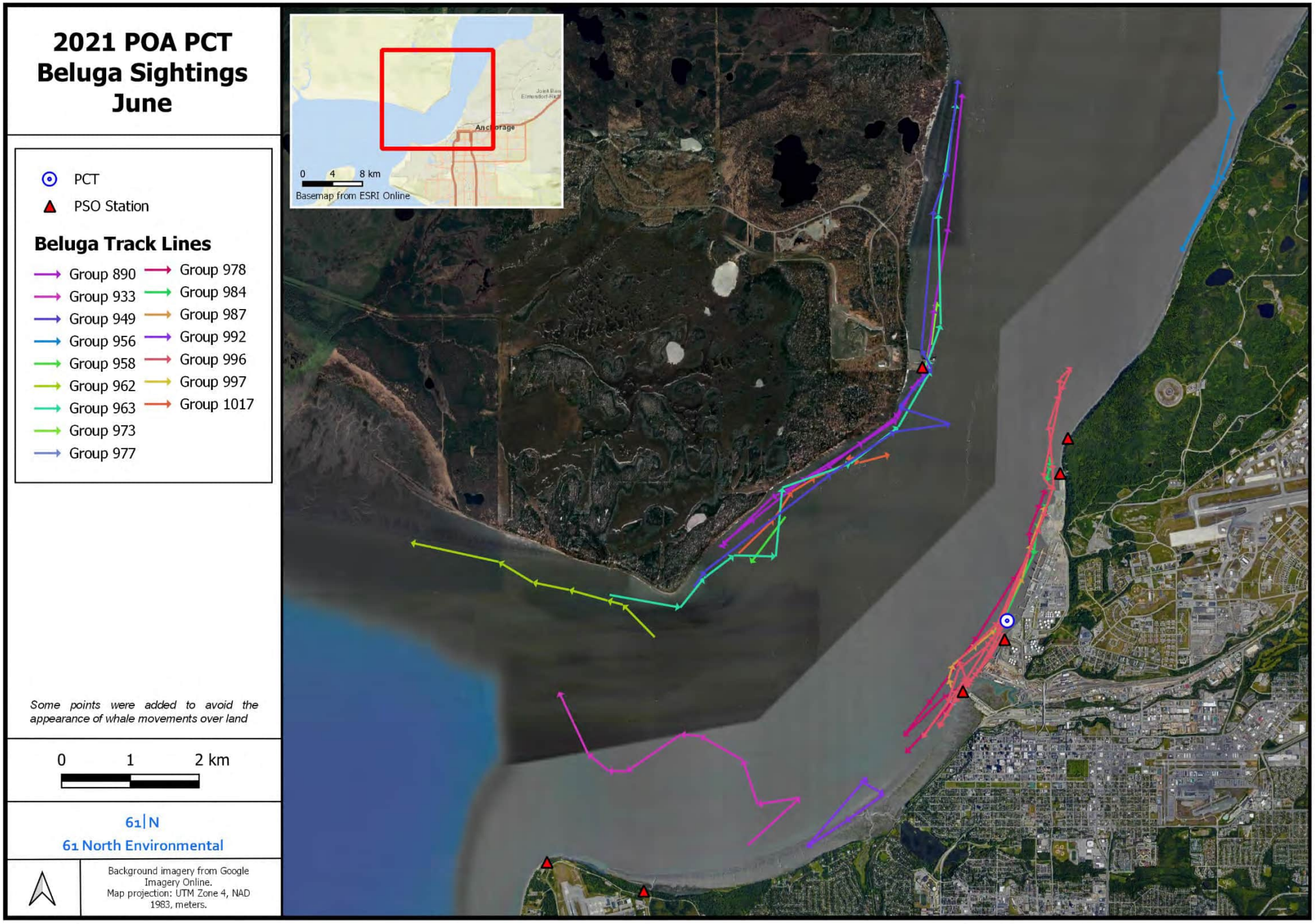

Figure C-2-2. Beluga Sightings and Track Lines June 2021

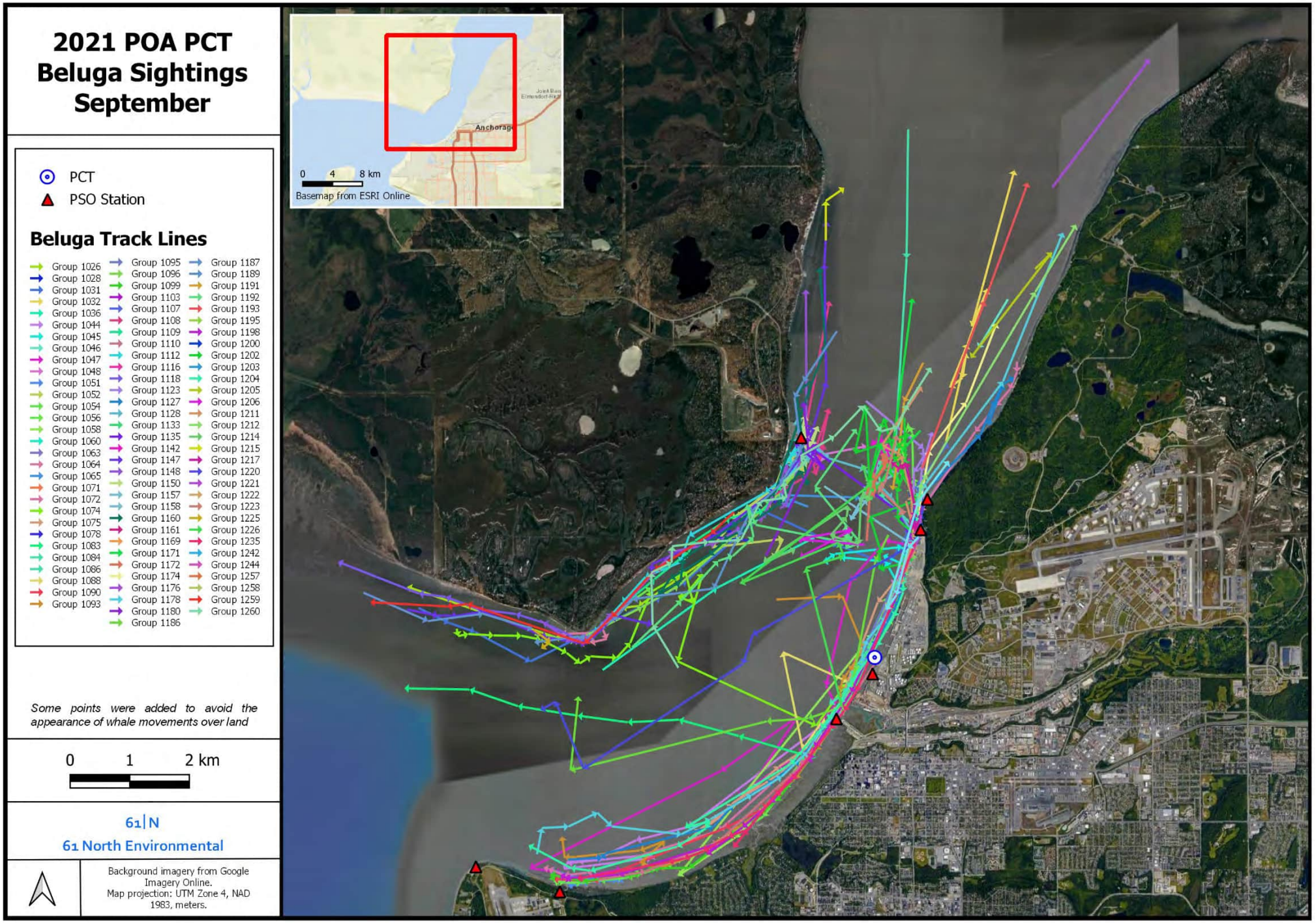

Figure C-2-3. Beluga Sightings and Track Lines September 2021

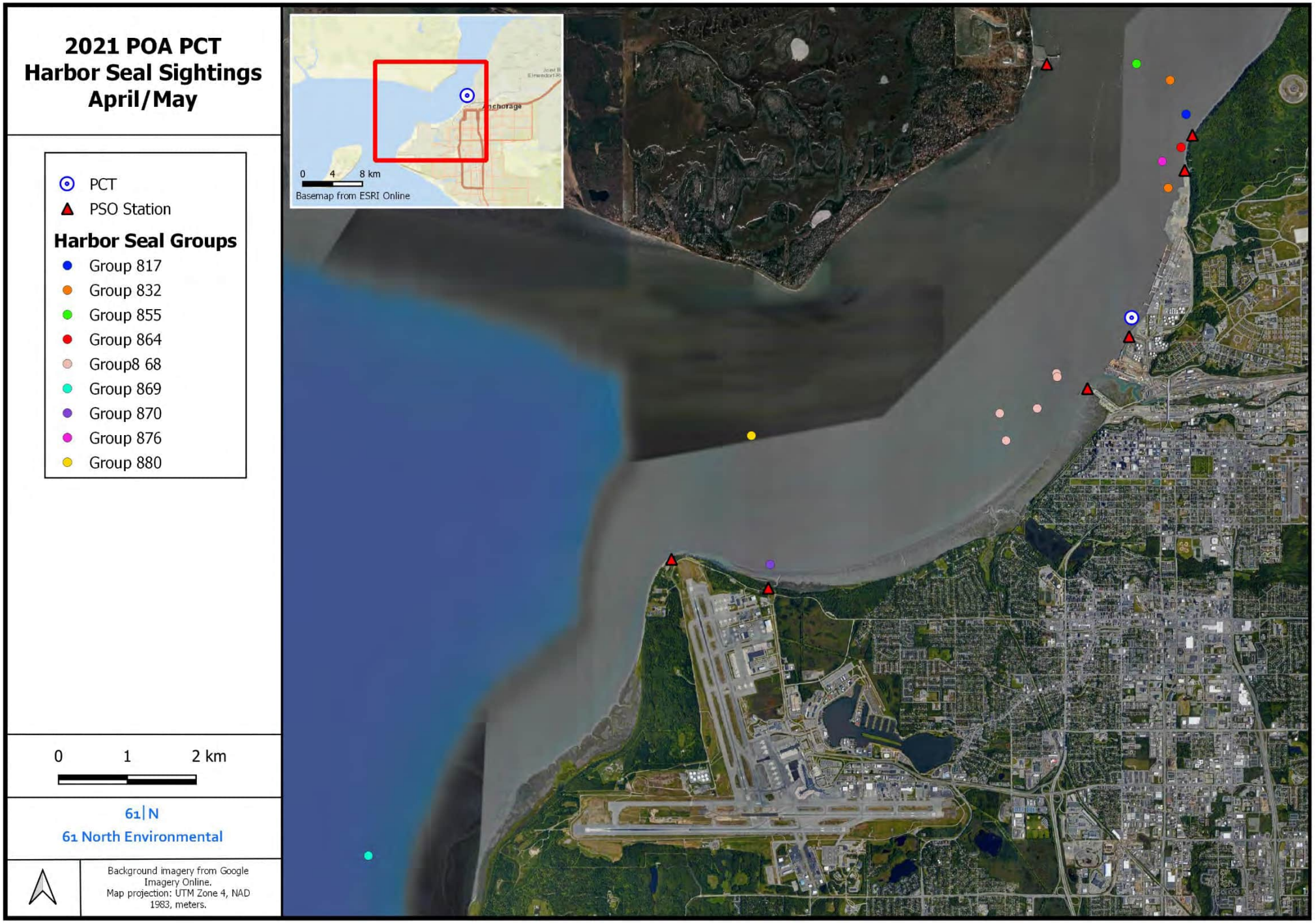

Figure C-2-4. Harbor Seal Locations April/May 2021

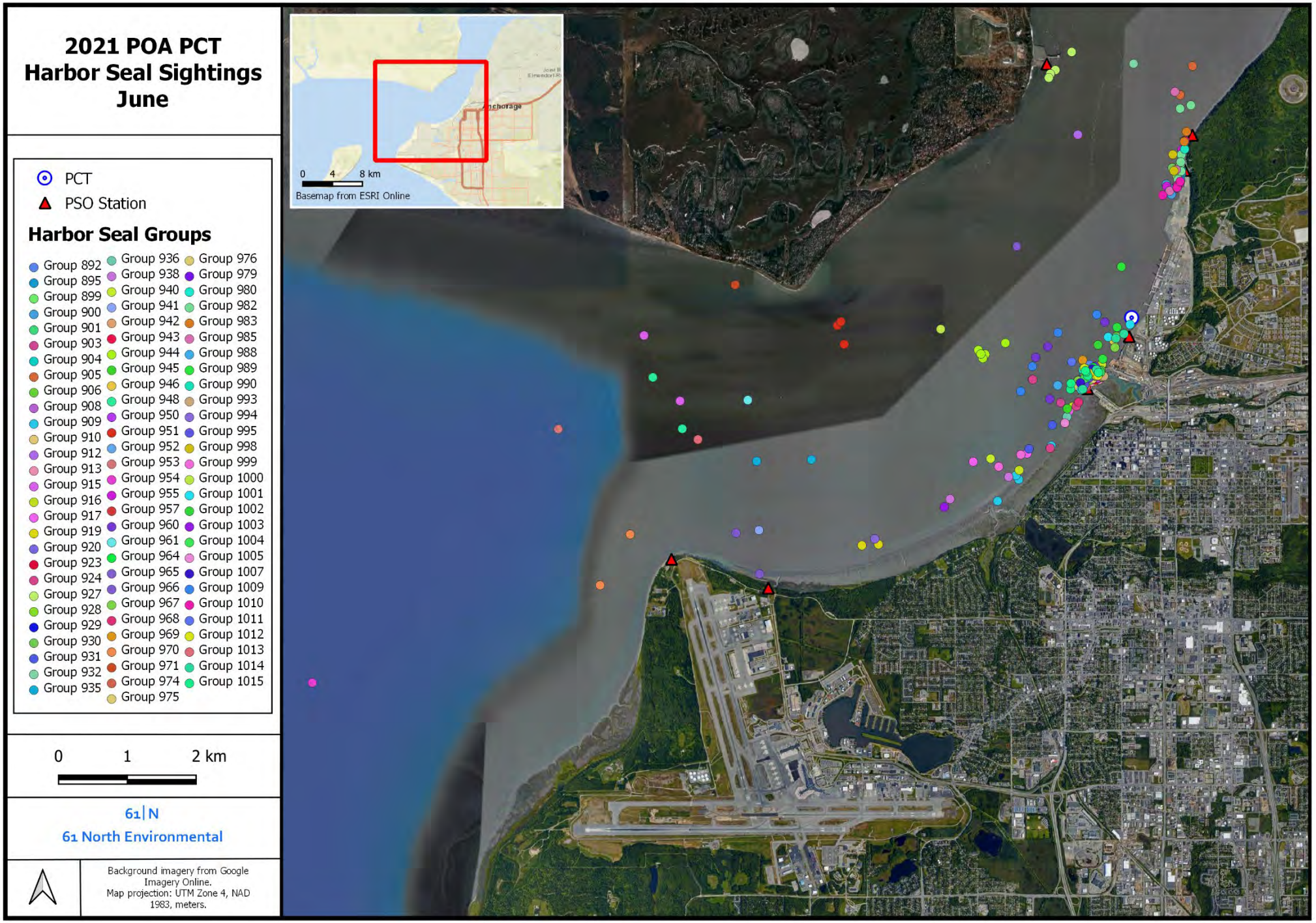

Figure C-2-5. Harbor Seal Locations June 2021

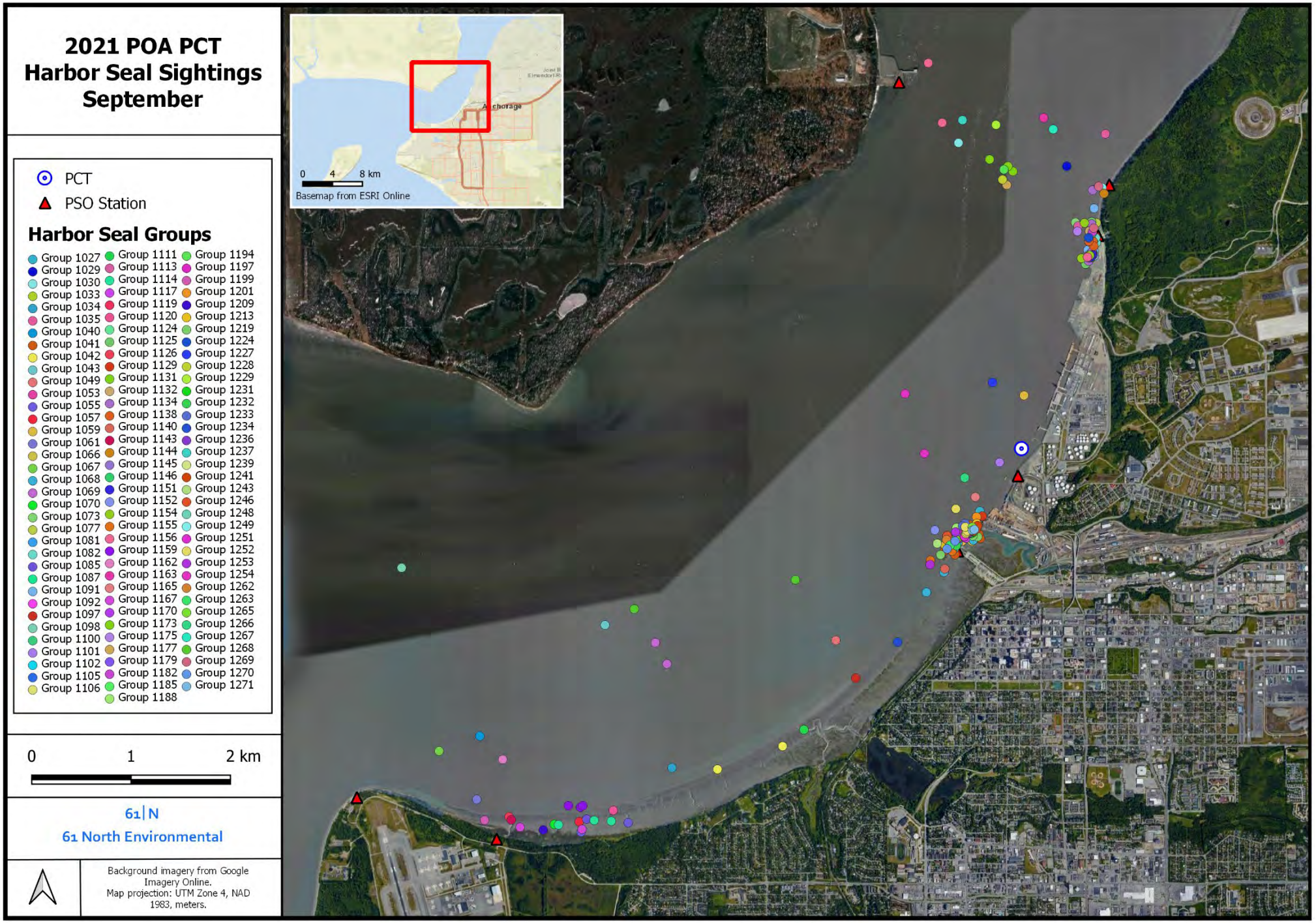

Figure C-2-6. Harbor Seal Locations September 2021

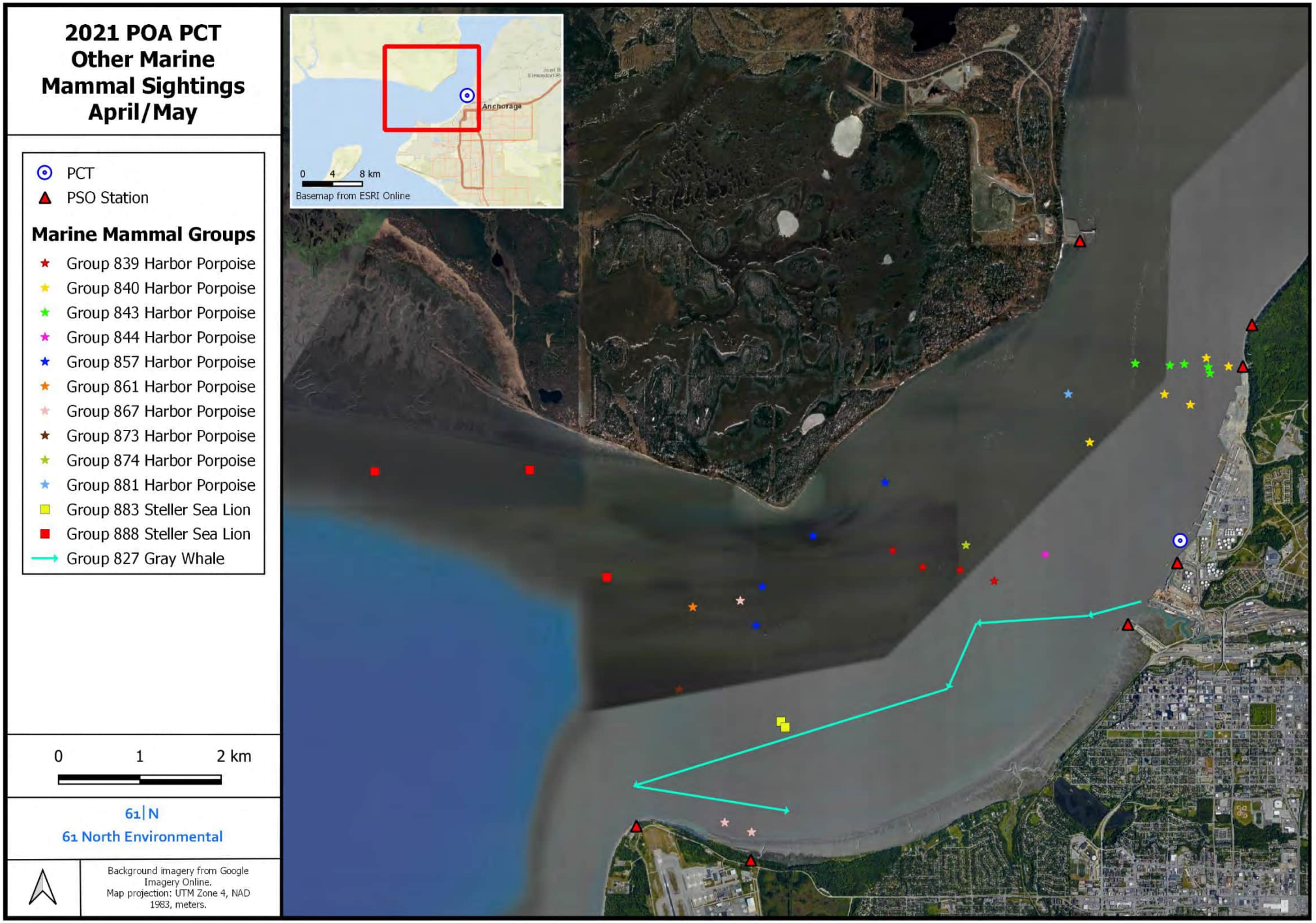

Figure C-2-7. Other Marine Mammal Locations, and Gray Whale Track April/May 2021

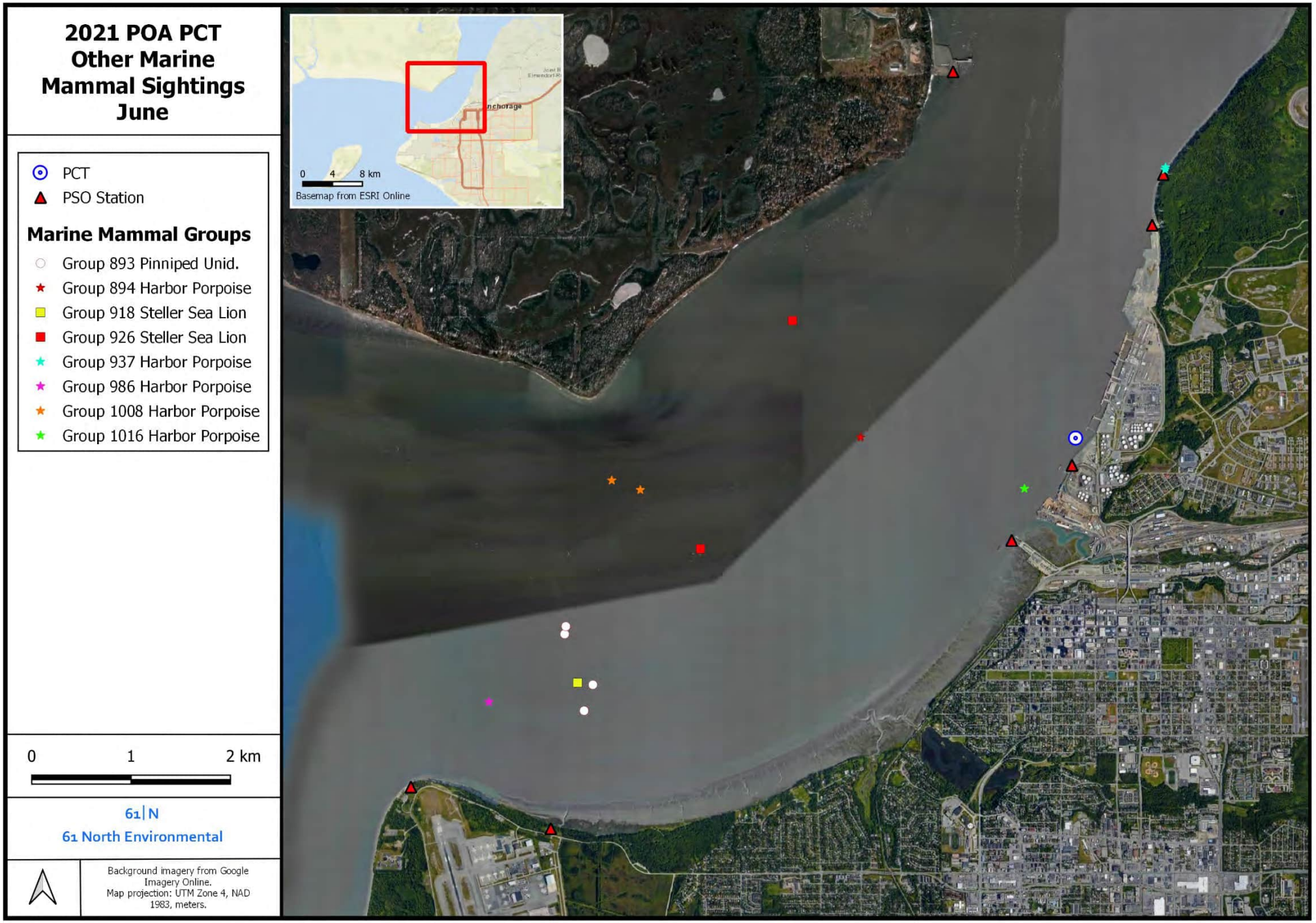

Figure C-2-8. Other Marine Mammal Group Locations June 2021

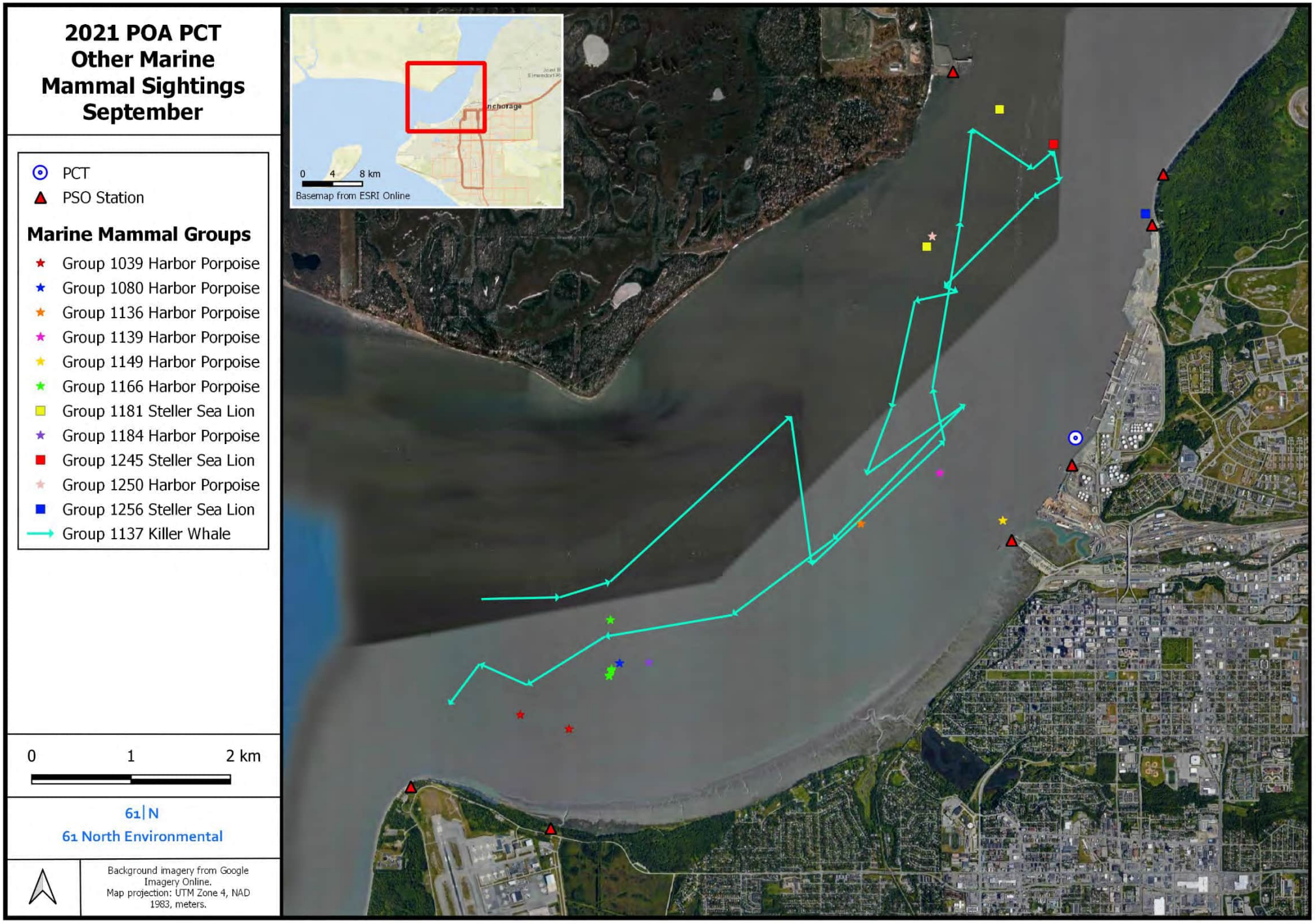

Figure C-2-9. Other Marine Mammal Group Locations and Killer Whale Track Line September 2021

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APPENDIX C-3

Figures – Extrapolated Beluga Exposures

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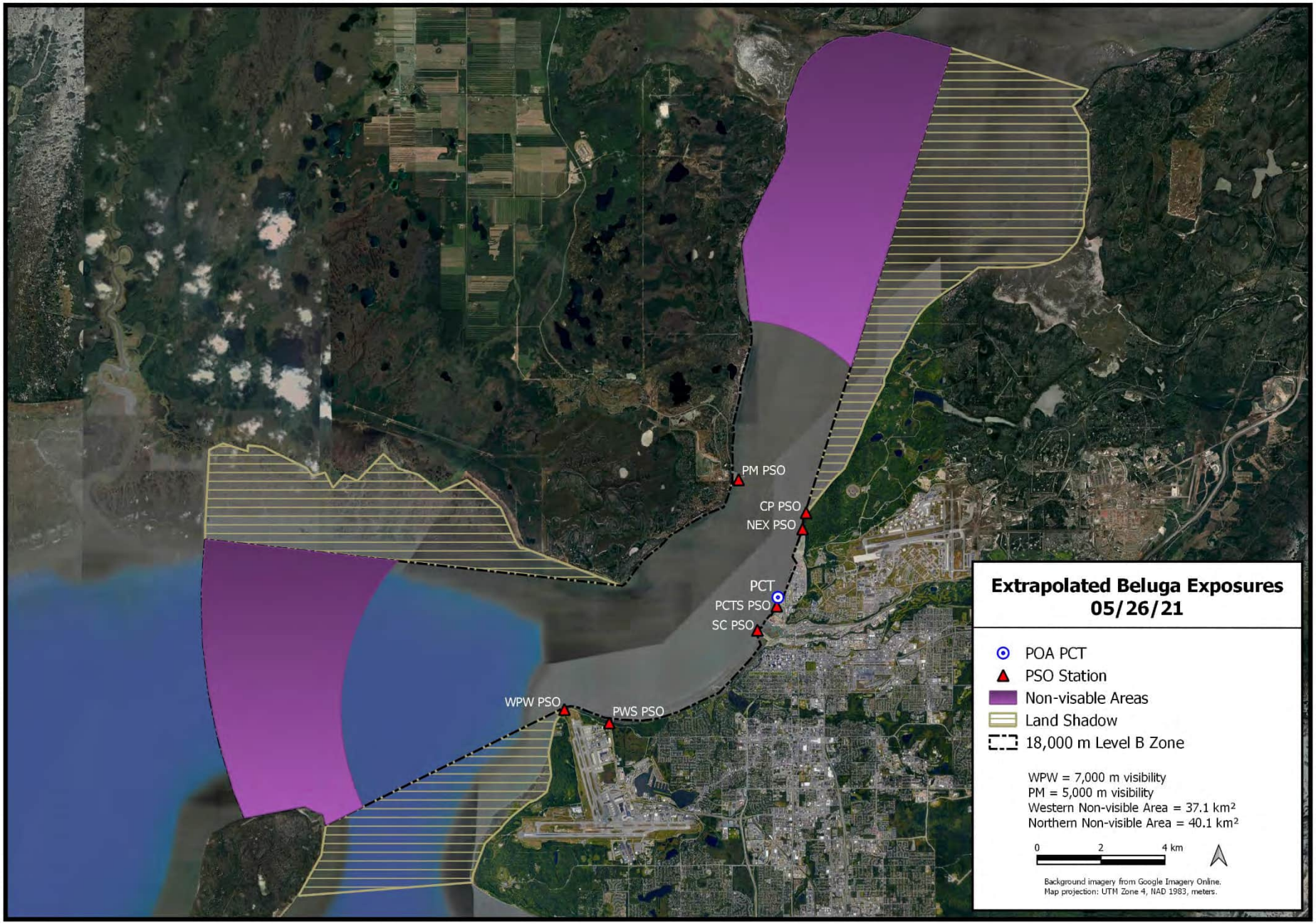

Figure C-3- 1. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 26 May 2021

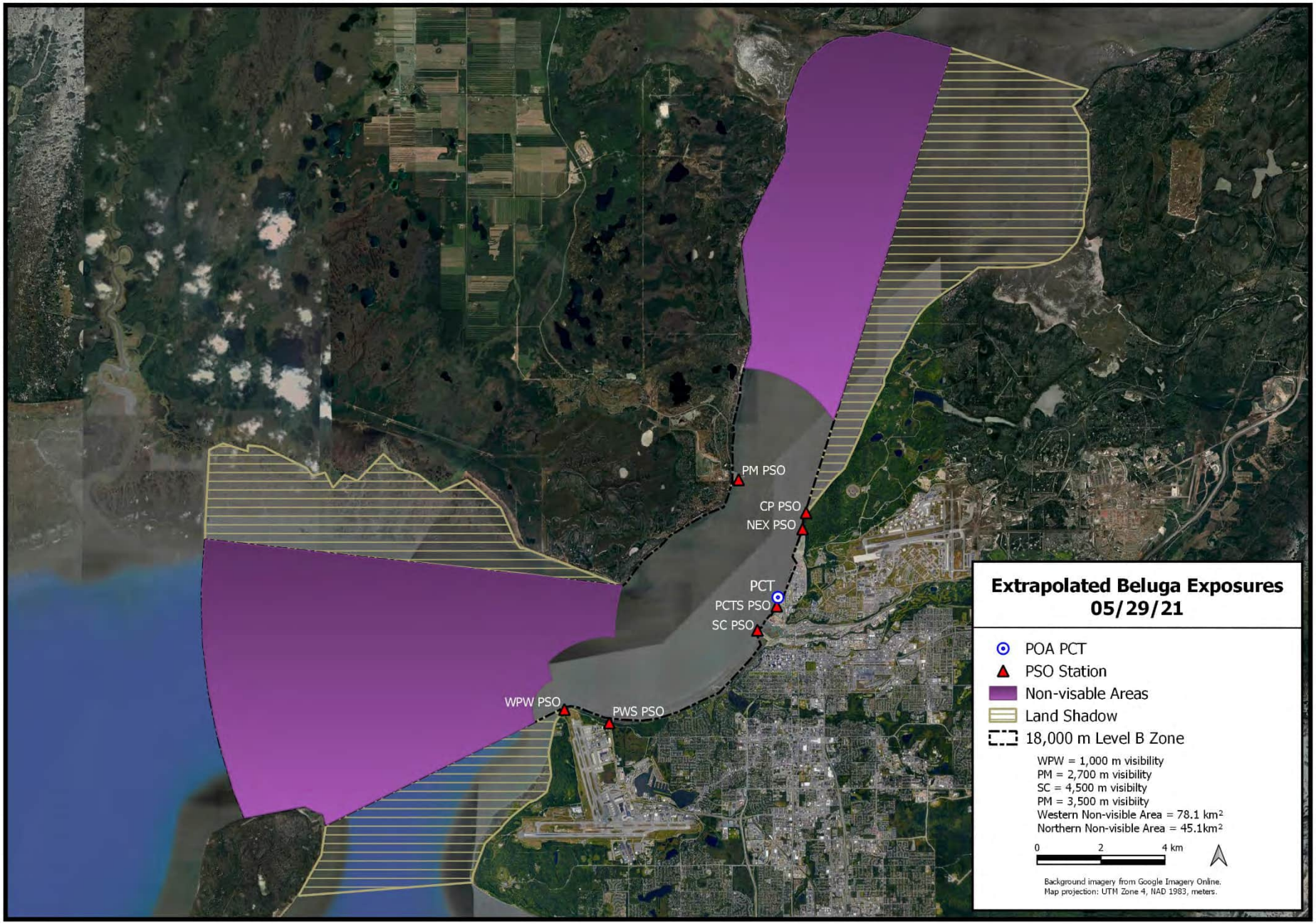

Figure C-3- 2. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 29 May 2021

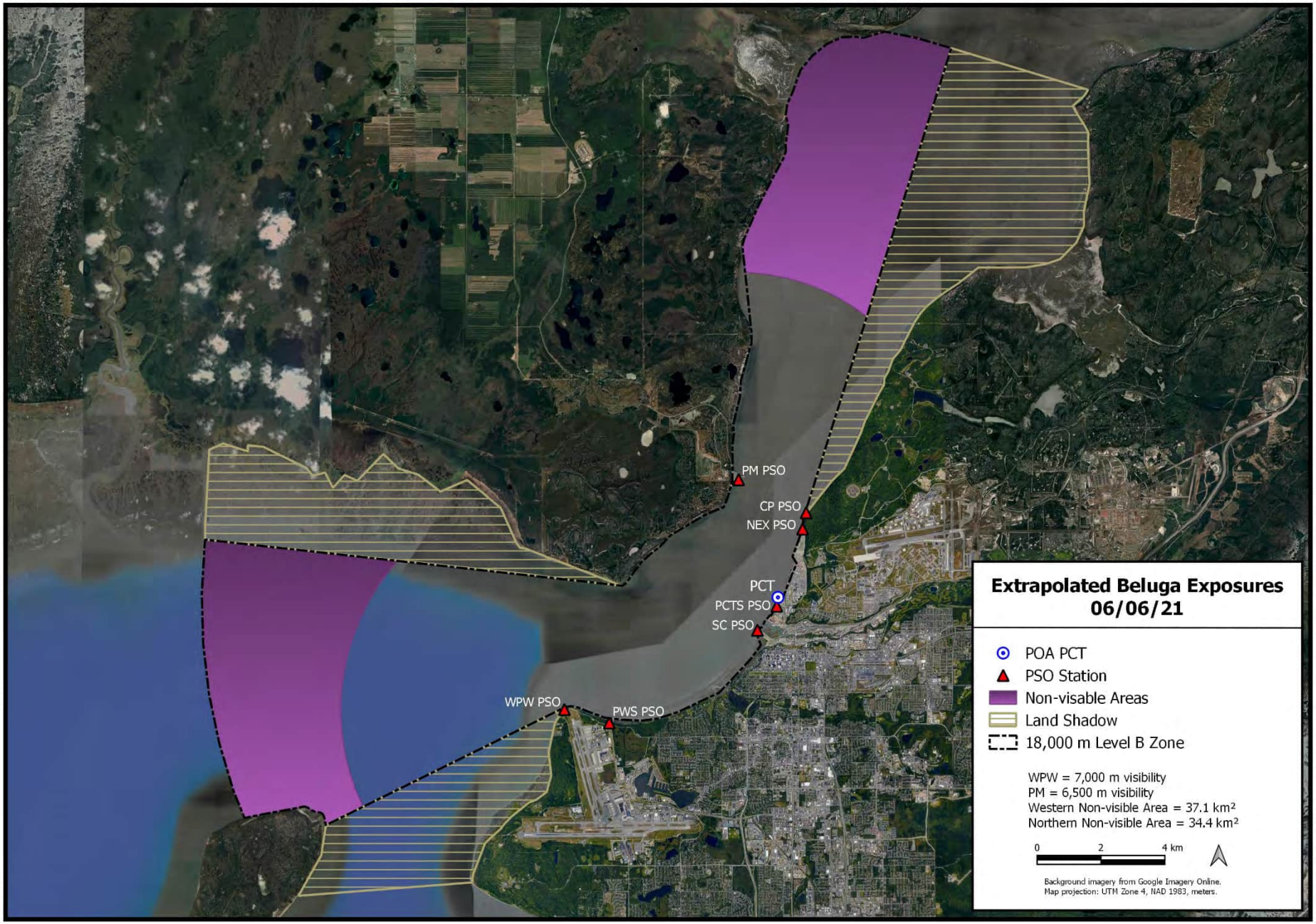

Figure C-3- 3. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 6 June 2021

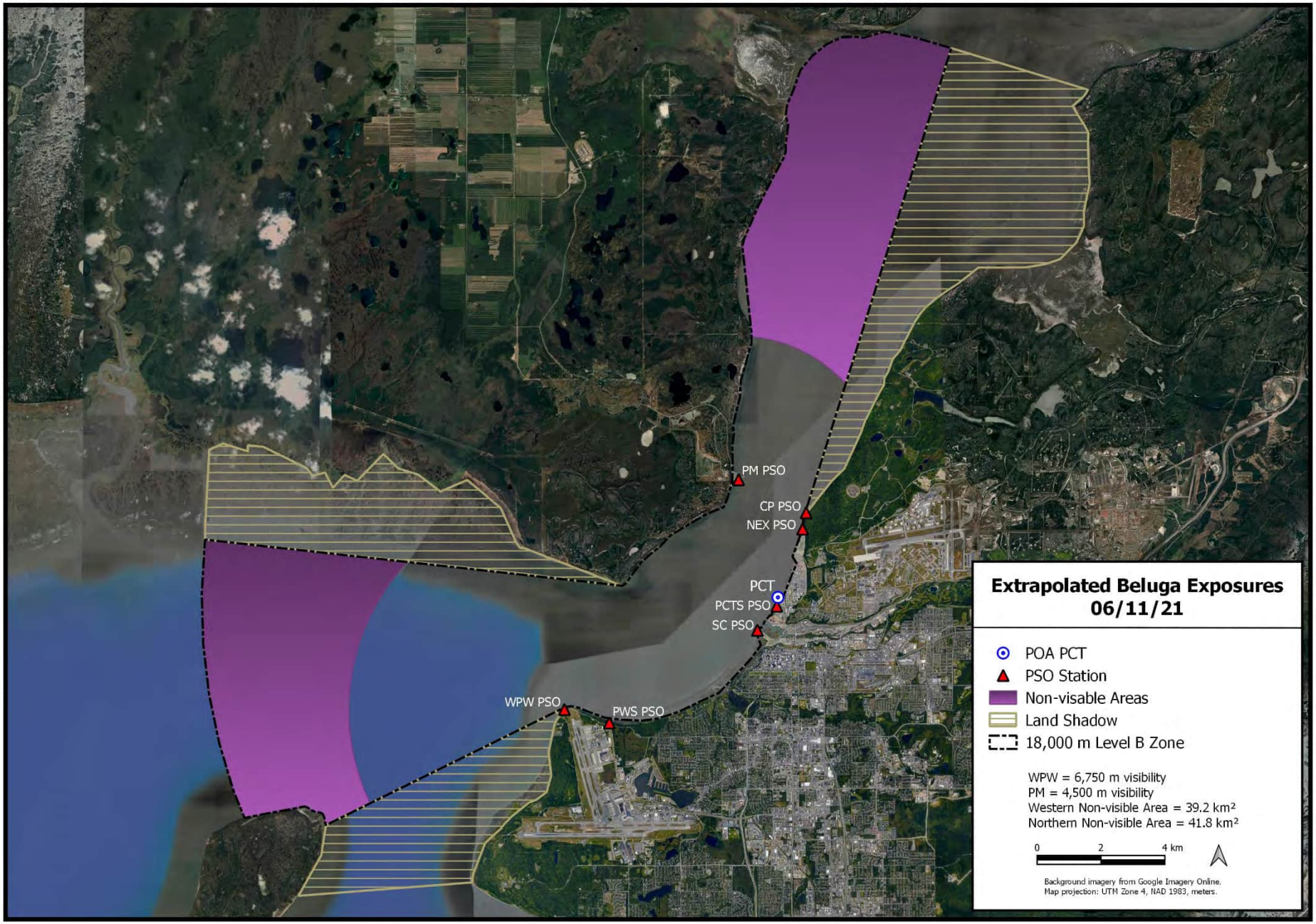

Figure C-3- 4. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 11 June 2021

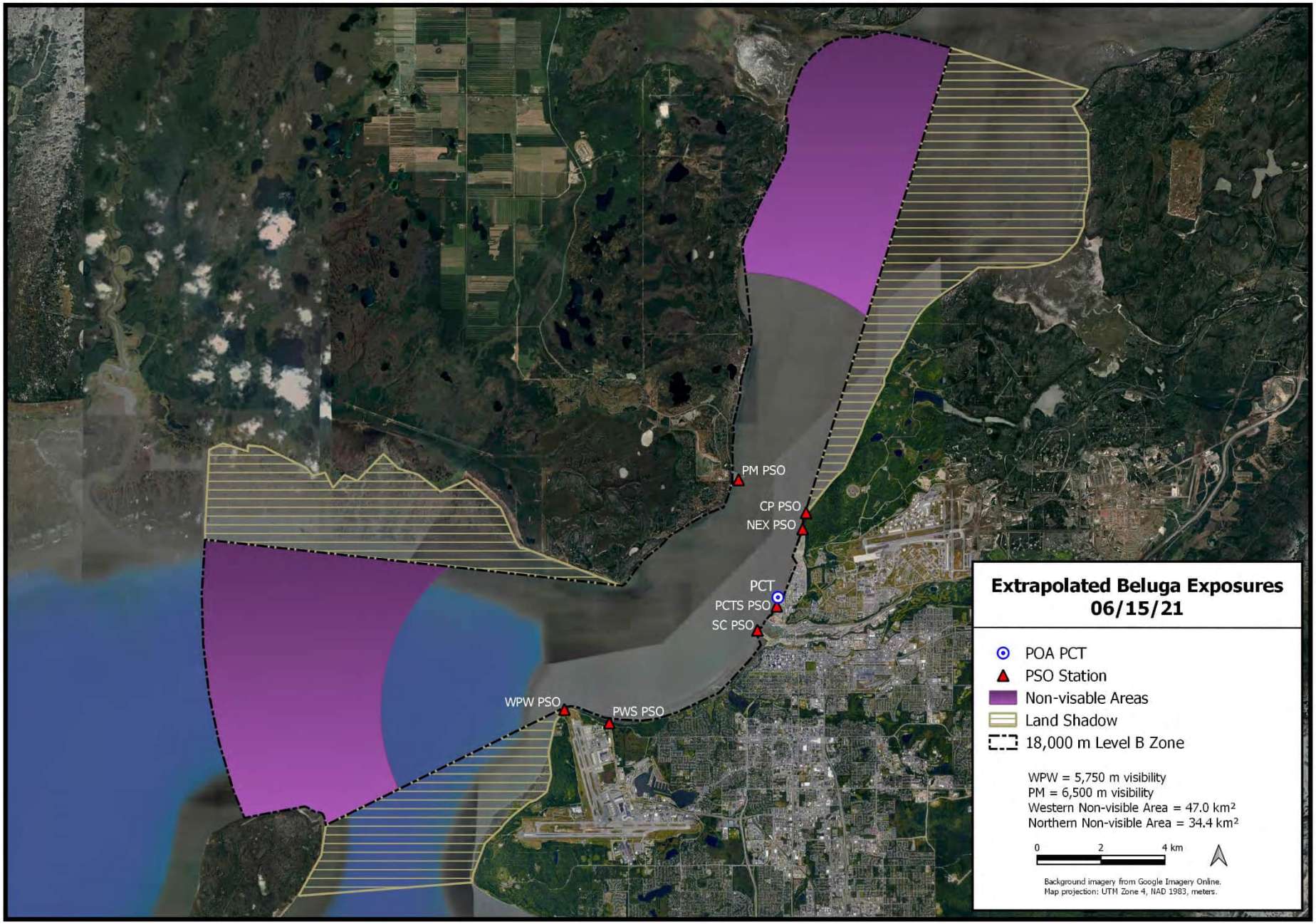

Figure C-3- 5. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 15 June 2021

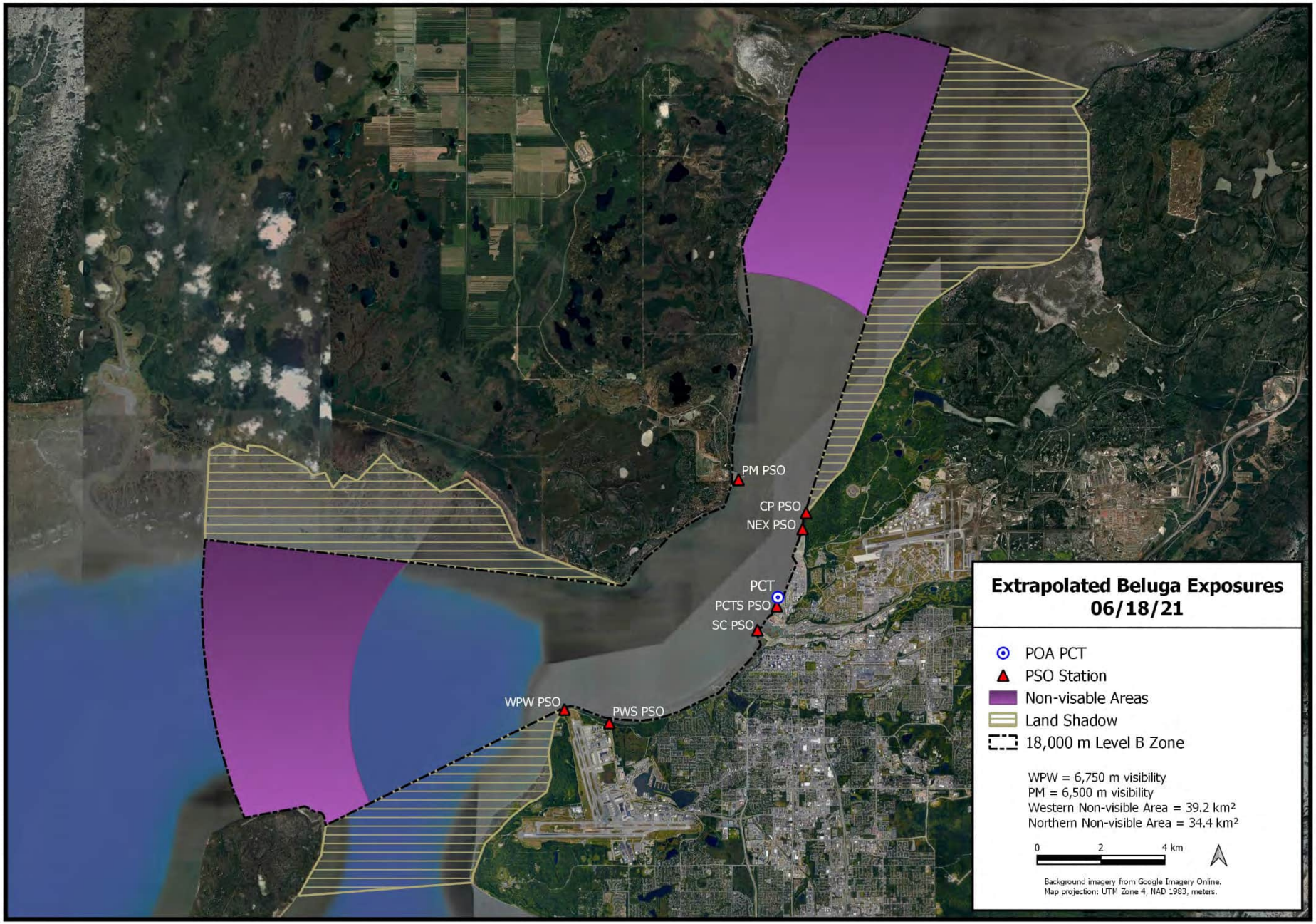

Figure C-3- 6. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 18 June 2021

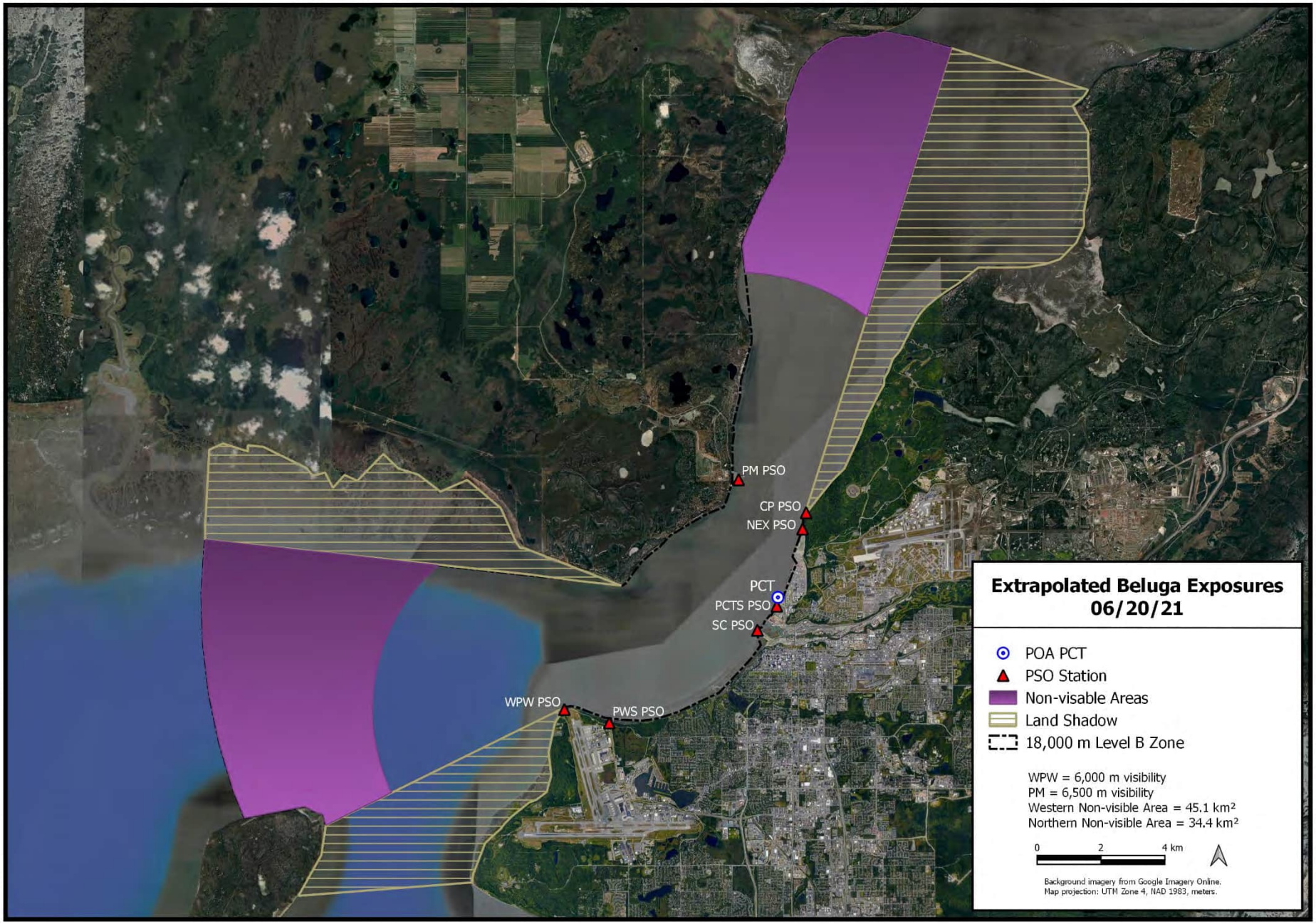

Figure C-3- 7. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 20 June 2021

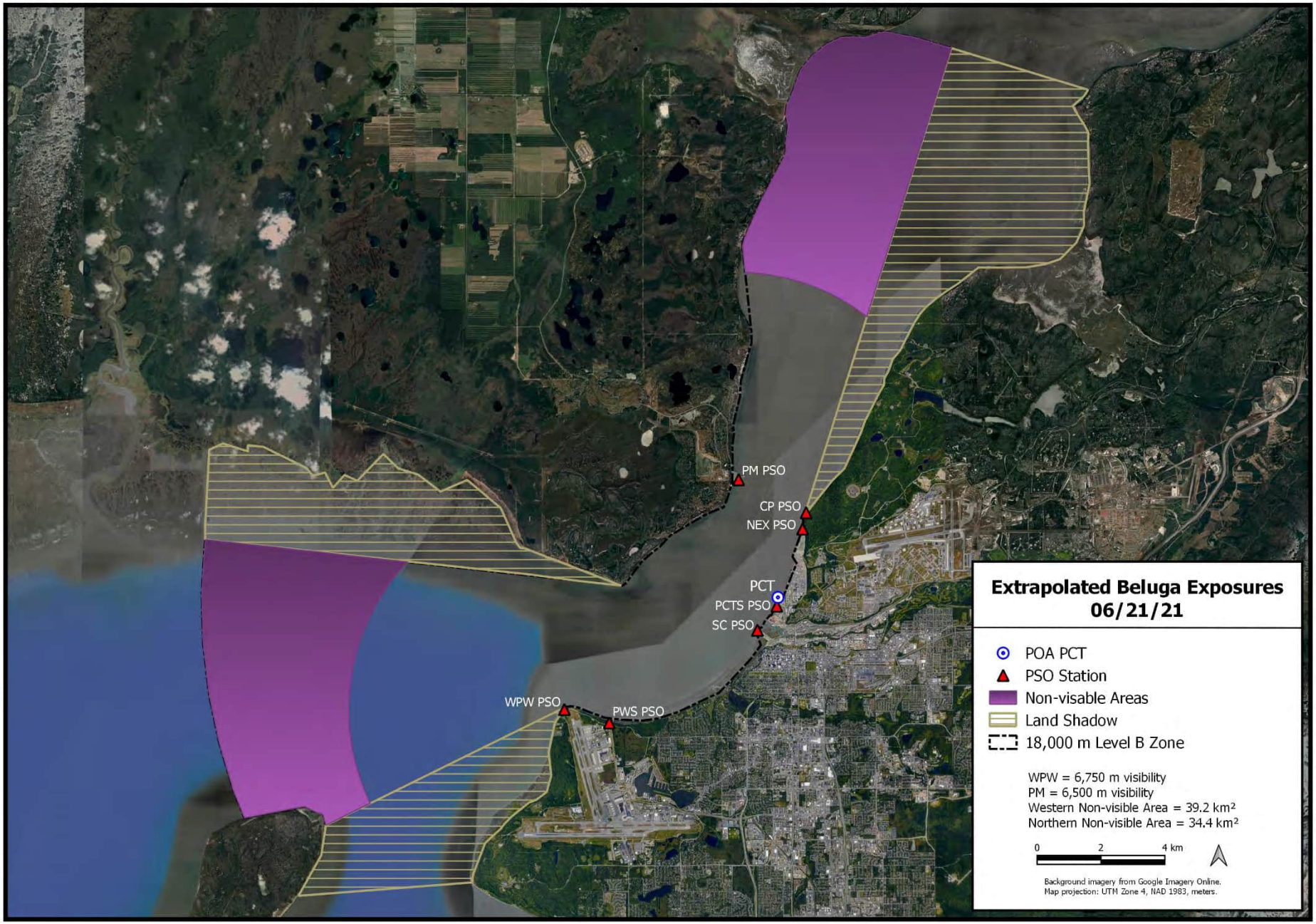

Figure C-3- 8. Extrapolation for Non-Visible Portion of 18,000-meter Level B Zone, 21 June 2021

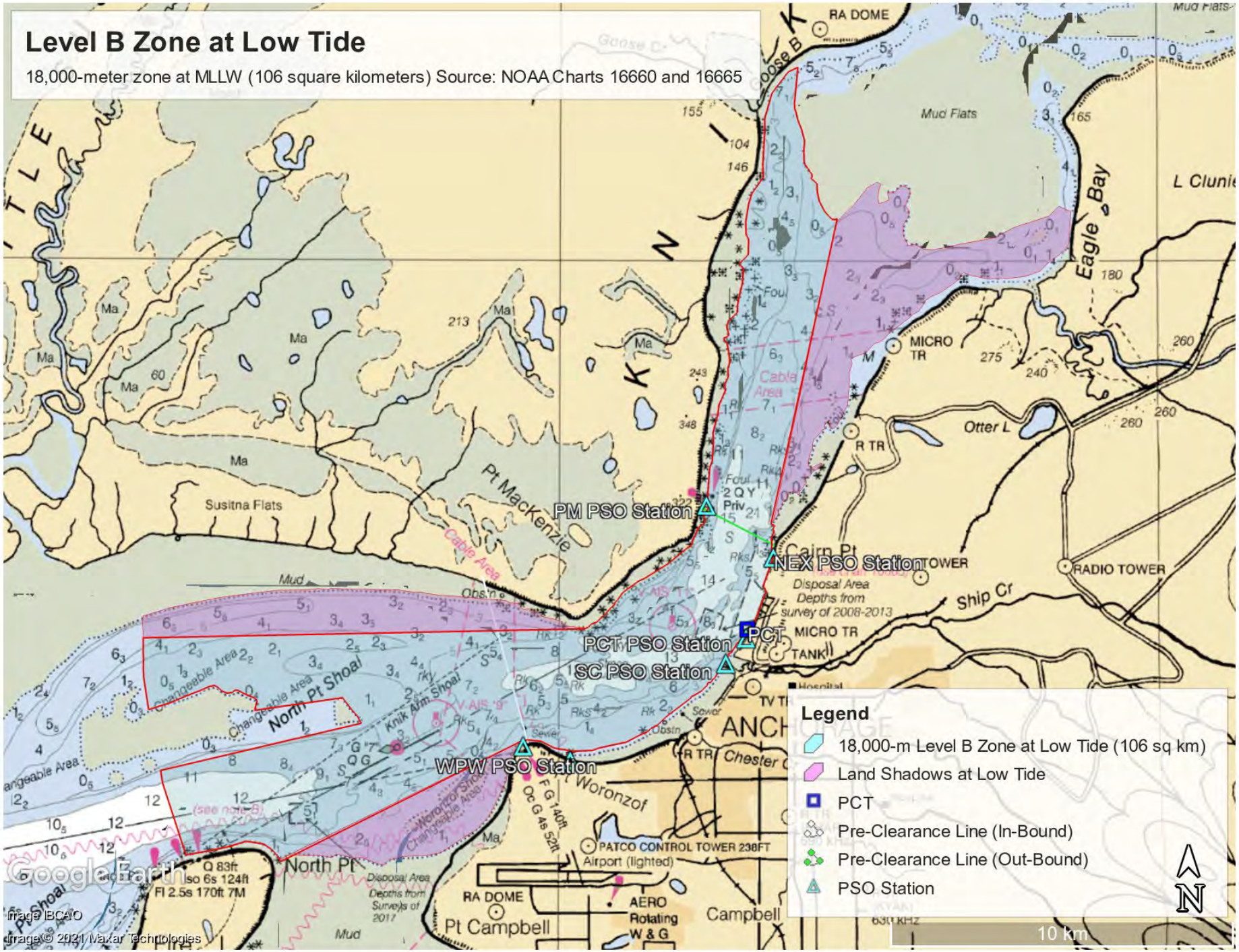

Figure C-3-9. 18,000-meter Level B Zone at Low Tide

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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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Beluga	796	3	4/26/21 7:15	4/26/21 8:30	1:15	1,736	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	801	2	4/27/21 7:06	4/27/21 9:11	2:05	2,441	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	803	3	4/27/21 8:00	4/27/21 8:40	0:40	5,783	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	806	1	4/28/21 7:22	4/28/21 7:55	0:33	4,924	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	807	2	4/28/21 7:22	4/28/21 9:28	2:06	2,783	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	808	3	4/28/21 9:08	4/28/21 9:20	0:12	7,125	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	809	2	4/28/21 9:23	4/28/21 9:36	0:13	1,802	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	810	2	4/28/21 9:37	4/28/21 10:10	0:33	5,174	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	813	2	4/29/21 9:55	4/29/21 9:58	0:03	6,485	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	814	2	4/29/21 10:10	4/29/21 11:41	1:31	513	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	816	4	4/30/21 11:10	4/30/21 12:20	1:10	53	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	817	1	4/30/21 12:17	4/30/21 12:18	0:01	3,052	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	818	3	4/30/21 15:00	4/30/21 17:20	2:20	832	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	820	1	5/1/21 7:17	5/1/21 7:22	0:05	2,390	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	821	3	5/1/21 8:25	5/1/21 12:30	4:05	2,327	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	822	6	5/1/21 11:24	5/1/21 17:29	6:05	380	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	824	2	5/3/21 7:55	5/3/21 7:58	0:03	4,702	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	825	4	5/3/21 10:11	5/3/21 12:10	1:59	2,518	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	826	4	5/3/21 11:47	5/3/21 12:43	0:56	2,413	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Gray Whale	827	1	5/3/21 12:33	5/3/21 14:10	1:37	886	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	831	6	5/5/21 8:30	5/5/21 12:54	4:24	630	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	832	1	5/5/21 9:26	5/5/21 9:44	0:18	1,955	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	839	1	5/8/21 8:17	5/8/21 9:03	0:46	2,331	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	840	1	5/8/21 13:09	5/8/21 14:22	1:13	1,637	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	843	1	5/10/21 9:27	5/10/21 9:54	0:27	2,084	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	844	1	5/10/21 14:56	5/10/21 14:57	0:01	1,664	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	**855**	**1**	**5/17/21 8:49**	**5/17/21 8:50**	**0:01**	**3,681**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Porpoise	857	1	5/18/21 11:11	5/18/21 11:59	0:48	3,685	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	861	1	5/20/21 14:22	5/20/21 14:23	0:01	6,026	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	864	1	5/22/21 7:21	5/22/21 7:22	0:01	2,571	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	867	1	5/24/21 6:59	5/24/21 7:20	0:21	5,439	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	868	1	5/24/21 9:48	5/24/21 10:45	0:57	1,354	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	869	1	5/24/21 10:14	5/24/21 10:15	0:01	13,526	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	870	1	5/24/21 16:19	5/24/21 16:29	0:10	6,339	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	**873**	**3**	**5/26/21 8:50**	**5/26/21 8:51**	**0:01**	**6,382**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Porpoise	**874**	**1**	**5/26/21 9:44**	**5/26/21 9:45**	**0:01**	**2,625**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	876	1	5/26/21 10:35	5/26/21 10:36	0:01	2,310	Between IPIR	n/a	n/a	n/a	n/a	No	
Beluga	**877**	**7**	**5/26/21 15:25**	**5/26/21 16:56**	**1:31**	**10,609**	**During IPIR**	**18,000**	**Vibratory**	**Bubble Curtain**	**144**	**B**	
Harbor Seal	880	1	5/28/21 9:13	5/28/21 9:24	0:11	5,765	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	881	1	5/28/21 14:35	5/28/21 14:36	0:01	2,260	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	883	1	5/29/21 7:50	5/29/21 8:03	0:13	5,351	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	885	7	5/30/21 6:56	5/30/21 8:33	1:37	3,036	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	886	1	5/30/21 11:45	5/30/21 16:07	4:22	207	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	887	8	5/30/21 14:28	5/30/21 16:23	1:55	45	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	888	1	5/30/21 16:27	5/30/21 16:48	0:21	7,038	Non-IPIR Day	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Beluga	890	6	6/1/21 7:02	6/1/21 9:49	2:47	3,323	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	892	1	6/2/21 7:43	6/2/21 8:30	0:47	916	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Pinniped Unid.	893	1	6/2/21 12:04	6/2/21 12:36	0:32	5,435	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	894	1	6/2/21 12:48	6/2/21 12:53	0:05	2,155	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	895	1	6/2/21 14:25	6/2/21 17:30	3:05	2,009	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	**899**	**1**	**6/6/21 8:16**	**6/6/21 13:45**	**5:29**	**943**	**During IPIR**	**18,000**	**Vibratory**	**Bubble Curtain**	**144**	**B**	
Harbor Seal	**900**	**1**	**6/6/21 13:21**	**6/6/21 13:58**	**0:37**	**1,876**	**During IPIR**	**18,000**	**Vibratory**	**Bubble Curtain**	**144**	**B**	
Harbor Seal	**901**	**1**	**6/6/21 14:59**	**6/6/21 15:54**	**0:55**	**974**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	903	1	6/7/21 7:17	6/7/21 7:19	0:02	1,605	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**904**	**1**	**6/7/21 9:14**	**6/7/21 12:13**	**2:59**	**943**	**During IPIR**	**6,309**	**Impact**	**Bubble Curtain**	**144**	**A**	
Harbor Seal	905	1	6/7/21 14:10	6/7/21 14:17	0:07	3,302	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**906**	**1**	**6/7/21 17:19**	**6/7/21 17:20**	**0:01**	**946**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	908	1	6/8/21 7:07	6/8/21 8:32	1:25	1,152	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	909	1	6/8/21 8:16	6/8/21 9:55	1:39	2,190	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	910	1	6/8/21 15:32	6/8/21 15:34	0:02	1,042	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	912	1	6/11/21 10:43	6/11/21 10:44	0:01	2,765	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	913	1	6/12/21 9:00	6/12/21 13:03	4:03	1,022	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	915	1	6/12/21 9:34	6/12/21 9:59	0:25	6,649	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	916	1	6/12/21 9:43	6/12/21 13:03	3:20	806	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	917	1	6/12/21 11:21	6/12/21 13:57	2:36	1,628	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	918	1	6/12/21 12:10	6/12/21 12:11	0:01	5,563	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	919	2	6/12/21 14:46	6/12/21 15:46	1:00	4,922	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	920	1	6/12/21 16:47	6/12/21 17:23	0:36	994	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	923	1	6/13/21 10:10	6/13/21 10:15	0:05	1,044	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	924	1	6/13/21 11:06	6/13/21 12:28	1:22	1,512	Before IPIR	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	926	1	6/15/21 9:58	6/15/21 10:11	0:13	3,072	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	927	1	6/15/21 10:05	6/15/21 10:50	0:45	3,646	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	928	1	6/15/21 10:41	6/15/21 11:15	0:34	1,148	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**929**	**1**	**6/15/21 13:06**	**6/15/21 13:07**	**0:01**	**1,011**	**During IPIR**	**18,000**	**Vibratory**	**Bubble Curtain**	**144**	**B**	
Harbor Seal	**930**	**1**	**6/15/21 14:23**	**6/15/21 15:19**	**0:56**	**2,156**	**During IPIR**	**6,309**	**Impact**	**Bubble Curtain**	**144**	**A**	
Harbor Seal	**931**	**1**	**6/15/21 14:41**	**6/15/21 15:32**	**0:51**	**925**	**During IPIR**	**6,309**	**Impact**	**Bubble Curtain**	**144**	**A**	
Harbor Seal	**932**	**1**	**6/15/21 16:05**	**6/15/21 16:06**	**0:01**	**3,682**	**During IPIR**	**6,309**	**Impact**	**Bubble Curtain**	**144**	**B**	
Beluga	933	2	6/16/21 9:14	6/16/21 11:00	1:46	3,943	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	935	1	6/16/21 10:07	6/16/21 10:28	0:21	5,071	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	936	1	6/16/21 12:20	6/16/21 12:55	0:35	1,251	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	**937**	**1**	**6/16/21 14:47**	**6/16/21 15:41**	**0:54**	**2,931**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	938	1	6/16/21 16:56	6/16/21 17:07	0:11	2,916	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	940	1	6/17/21 7:14	6/17/21 7:15	0:01	2,888	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	941	1	6/17/21 7:54	6/17/21 7:55	0:01	6,213	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	942	1	6/17/21 8:11	6/17/21 8:12	0:01	2,677	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	943	1	6/17/21 10:36	6/17/21 10:37	0:01	963	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	944	1	6/17/21 12:41	6/17/21 13:40	0:59	1,865	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	945	1	6/17/21 14:07	6/17/21 14:12	0:05	1,615	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	946	1	6/17/21 14:54	6/17/21 14:55	0:01	422	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	948	1	6/18/21 10:29	6/18/21 10:38	0:09	6,703	Before IPIR	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Beluga	949	2	6/18/21 10:56	6/18/21 12:41	1:45	2,966	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	950	1	6/18/21 11:44	6/18/21 13:06	1:22	961	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	951	1	6/18/21 14:36	6/18/21 14:56	0:20	4,180	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	952	1	6/18/21 14:51	6/18/21 14:52	0:01	1,298	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	953	1	6/18/21 15:25	6/18/21 15:26	0:01	8,499	During IPIR	18,000	Vibratory	Bubble Curtain	144	B	
Harbor Seal	954	1	6/18/21 16:09	6/18/21 16:10	0:01	13,040	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	955	1	6/18/21 18:07	6/18/21 18:27	0:20	1,914	During IPIR	6,309	Impact	Bubble Curtain	144	A	
Beluga	**956**	**4**	**6/18/21 18:10**	**6/18/21 18:49**	**0:39**	**5,851**	**During IPIR**	**6,309**	**Impact**	**Bubble Curtain**	**144**	**No**	
Harbor Seal	957	1	6/18/21 18:36	6/18/21 19:22	0:46	1,003	During IPIR	6,309	Impact	Bubble Curtain	144	A	
Beluga	958	2	6/18/21 19:25	6/18/21 19:36	0:11	3,556	During IPIR	6,309	Impact	Bubble Curtain	144	B	
Harbor Seal	960	1	6/20/21 9:04	6/20/21 12:13	3:09	394	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	961	1	6/20/21 10:08	6/20/21 10:09	0:01	5,685	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	962	2	6/20/21 10:47	6/20/21 11:22	0:35	5,108	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	963	6	6/20/21 12:18	6/20/21 13:48	1:30	3,216	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	964	1	6/20/21 12:29	6/20/21 13:58	1:29	907	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	965	1	6/20/21 12:52	6/20/21 12:53	0:01	1,960	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	966	1	6/20/21 13:07	6/20/21 13:57	0:50	6,524	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	967	1	6/20/21 13:11	6/20/21 13:58	0:47	351	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	968	1	6/20/21 14:48	6/20/21 14:56	0:08	961	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	969	1	6/20/21 15:12	6/20/21 16:11	0:59	930	During IPIR	18,000	Vibratory	Bubble Curtain	144	B	
Harbor Seal	970	1	6/20/21 15:34	6/20/21 15:45	0:11	7,865	Before IPIR	n/a	n/a	n/a	n/a	No	Group was flagged as a potential take but after review was determined to have enough time to leave Level B zone prior to pile driving.
Harbor Seal	971	1	6/20/21 19:28	6/20/21 19:29	0:01	5,737	During IPIR	6,309	Impact	Bubble Curtain	144	B	
Beluga	973	1	6/21/21 12:51	6/21/21 13:08	0:17	3,822	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	974	1	6/21/21 13:01	6/21/21 13:11	0:10	1,193	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	975	1	6/21/21 17:19	6/21/21 17:20	0:01	1,239	During IPIR	18,000	Vibratory	Bubble Curtain	144	B	
Harbor Seal	976	1	6/21/21 18:33	6/21/21 18:46	0:13	955	During IPIR	18,000	Vibratory	Bubble Curtain	144	B	
Beluga	977	1	6/21/21 19:01	6/21/21 19:04	0:03	1,245	Between IPIR	n/a	n/a	n/a	n/a	No	
Beluga	978	1	6/21/21 20:24	6/21/21 22:17	1:53	404	During IPIR	6,309	Impact	Bubble Curtain	144	B	
Harbor Seal	979	1	6/21/21 21:18	6/21/21 21:19	0:01	2,330	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	980	1	6/21/21 21:52	6/21/21 22:14	0:22	877	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	982	1	6/22/21 8:41	6/22/21 10:47	2:06	2,113	During IPIR	6,309	Impact	Bubble Curtain	144	B	
Harbor Seal	983	1	6/22/21 9:10	6/22/21 9:13	0:03	2,758	After IPIR	n/a	n/a	n/a	n/a	No	Initially reported as a potential exposure, but was first sighted on edge of the "land shadow" near Cairn Point, 15 minutes after pile driving.
Beluga	984	1	6/22/21 9:57	6/22/21 10:47	0:50	269	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	985	1	6/22/21 11:49	6/22/21 12:27	0:38	1,918	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	986	1	6/22/21 12:26	6/22/21 12:29	0:03	6,449	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	987	1	6/22/21 12:35	6/22/21 13:22	0:47	225	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	988	1	6/22/21 14:37	6/22/21 14:38	0:01	1,452	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	989	1	6/22/21 15:49	6/22/21 17:00	1:11	253	After IPIR	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Harbor Seal	990	1	6/22/21 17:23	6/22/21 17:24	0:01	2,560	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	992	1	6/23/21 8:40	6/23/21 9:45	1:05	3,039	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	993	2	6/23/21 9:25	6/23/21 9:37	0:12	940	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	994	1	6/23/21 10:44	6/23/21 10:45	0:01	4,909	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	995	1	6/23/21 11:00	6/23/21 12:11	1:11	973	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	996	1	6/23/21 11:10	6/23/21 18:45	7:35	26	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	997	1	6/23/21 11:25	6/23/21 11:27	0:02	1,429	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	998	1	6/23/21 12:06	6/23/21 12:10	0:04	2,216	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	999	1	6/23/21 12:13	6/23/21 13:08	0:55	2,553	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1000	1	6/23/21 12:15	6/23/21 12:16	0:01	2,770	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1001	1	6/23/21 12:35	6/23/21 13:43	1:08	102	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1002	1	6/23/21 13:25	6/23/21 13:34	0:09	626	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1003	1	6/23/21 14:10	6/23/21 14:11	0:01	3,859	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1004	1	6/23/21 14:33	6/23/21 16:19	1:46	914	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1005	1	6/23/21 16:45	6/23/21 16:46	0:01	1,807	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1007	1	6/24/21 8:24	6/24/21 8:40	0:16	939	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1008	1	6/24/21 8:52	6/24/21 9:02	0:10	4,394	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1009	1	6/24/21 9:19	6/24/21 9:54	0:35	508	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1010	1	6/24/21 9:23	6/24/21 11:21	1:58	1,830	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1011	1	6/24/21 10:33	6/24/21 10:34	0:01	1,078	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1012	1	6/24/21 10:33	6/24/21 11:54	1:21	973	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1013	1	6/24/21 11:06	6/24/21 11:07	0:01	6,523	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1014	1	6/24/21 12:05	6/24/21 13:15	1:10	259	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1015	1	6/24/21 14:05	6/24/21 16:07	2:02	929	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1016	1	6/24/21 14:33	6/24/21 14:34	0:01	722	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1017	6	6/24/21 16:44	6/24/21 17:45	1:01	2,948	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1026	2	9/7/21 8:19	9/7/21 9:20	1:01	3,028	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1027	1	9/7/21 8:36	9/7/21 8:37	0:01	594	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1028	2	9/7/21 8:59	9/7/21 9:21	0:22	3,189	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1029	1	9/7/21 10:10	9/7/21 10:11	0:01	2,869	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1030	1	9/7/21 11:34	9/7/21 11:35	0:01	3,132	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	**1031**	**4**	**9/7/21 12:48**	**9/7/21 14:48**	**2:00**	**1,572**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Beluga	1032	5	9/7/21 13:14	9/7/21 15:46	2:32	3,808	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1033**	**1**	**9/7/21 13:56**	**9/7/21 16:51**	**2:55**	**792**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	1034	1	9/7/21 15:28	9/7/21 15:29	0:01	4,601	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1035**	**1**	**9/7/21 16:25**	**9/7/21 16:26**	**0:01**	**3,211**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	1036	3	9/7/21 17:11	9/7/21 17:53	0:42	2,245	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1039	2	9/8/21 8:08	9/8/21 8:24	0:16	5,734	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1040**	**1**	**9/8/21 8:33**	**9/8/21 8:34**	**0:01**	**6,027**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	1041	2	9/8/21 9:56	9/8/21 16:40	6:44	767	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1042	1	9/8/21 10:37	9/8/21 11:09	0:32	3,672	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1043	1	9/8/21 10:53	9/8/21 10:54	0:01	4,424	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1044	28	9/8/21 10:57	9/8/21 13:05	2:08	172	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1045	2	9/8/21 10:57	9/8/21 17:43	6:46	1,322	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1046	3	9/8/21 13:08	9/8/21 13:25	0:17	5,456	After IPIR	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Beluga	1047	2	9/8/21 13:44	9/8/21 17:43	3:59	282	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1048	2	9/8/21 16:11	9/8/21 17:36	1:25	3,416	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1049	1	9/8/21 16:16	9/8/21 16:17	0:01	2,527	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1051	9	9/9/21 7:02	9/9/21 9:20	2:18	5,456	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1052	3	9/9/21 7:11	9/9/21 11:16	4:05	2,368	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1053	1	9/9/21 7:23	9/9/21 7:41	0:18	1,048	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1054	2	9/9/21 7:35	9/9/21 7:37	0:02	3,916	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1055	1	9/9/21 9:25	9/9/21 9:42	0:17	5,297	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1056	4	9/9/21 9:59	9/9/21 17:45	7:46	301	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1057	1	9/9/21 11:19	9/9/21 12:24	1:05	5,660	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1058	3	9/9/21 11:41	9/9/21 17:45	6:04	381	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1059	1	9/9/21 13:11	9/9/21 16:56	3:45	534	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1060	1	9/9/21 13:54	9/9/21 14:08	0:14	5,742	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1061	1	9/9/21 15:18	9/9/21 15:19	0:01	6,367	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1063	1	9/10/21 7:46	9/10/21 7:47	0:01	2,408	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1064	4	9/10/21 8:05	9/10/21 9:26	1:21	4,485	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1065	2	9/10/21 8:27	9/10/21 10:46	2:19	2,684	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1066	1	9/10/21 8:34	9/10/21 8:35	0:01	1,053	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1067	1	9/10/21 9:56	9/10/21 9:57	0:01	6,580	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1068**	**2**	**9/10/21 9:59**	**9/10/21 17:42**	**7:43**	**999**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	***Note: only one of the two harbor seals was present during pile driving and is reported as a potential exposure.**
Harbor Seal	1069	1	9/10/21 11:15	9/10/21 11:24	0:09	4,155	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1070	1	9/10/21 11:28	9/10/21 11:46	0:18	6,013	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1071	2	9/10/21 11:31	9/10/21 11:38	0:07	961	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	**1072**	**4**	**9/10/21 12:54**	**9/10/21 15:53**	**2:59**	**406**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	**1073**	**1**	**9/10/21 13:00**	**9/10/21 13:52**	**0:52**	**1,994**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	1074	2	9/10/21 13:49	9/10/21 17:45	3:56	651	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1075	2	9/10/21 14:12	9/10/21 17:43	3:31	923	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1077**	**1**	**9/11/21 7:29**	**9/11/21 7:53**	**0:24**	**2,105**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	**1078**	**2**	**9/11/21 7:57**	**9/11/21 8:28**	**0:31**	**2,862**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Porpoise	1080	2	9/11/21 9:18	9/11/21 9:19	0:01	5,100	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1081	1	9/11/21 9:49	9/11/21 9:50	0:01	1,104	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1082**	**1**	**9/11/21 9:53**	**9/11/21 15:45**	**5:52**	**2,036**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	**1083**	**2**	**9/11/21 11:40**	**9/11/21 13:34**	**1:54**	**86**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Beluga	1084	8	9/11/21 14:02	9/11/21 17:43	3:41	153	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1085	1	9/11/21 14:12	9/11/21 14:13	0:01	5,728	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1086	6	9/11/21 15:10	9/11/21 17:43	2:33	1,948	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1087	1	9/11/21 15:43	9/11/21 17:16	1:33	1,005	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1088	2	9/11/21 16:58	9/11/21 17:41	0:43	608	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1090	10	9/12/21 7:05	9/12/21 9:24	2:19	570	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1091**	**1**	**9/12/21 7:22**	**9/12/21 17:35**	**10:13**	**1,934**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	1092	1	9/12/21 7:24	9/12/21 10:36	3:12	891	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1093	2	9/12/21 8:04	9/12/21 10:48	2:44	237	Before IPIR	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Beluga	1095	3	9/12/21 8:05	9/12/21 10:19	2:14	216	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1096	1	9/12/21 9:15	9/12/21 10:21	1:06	3,128	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1097	1	9/12/21 9:38	9/12/21 9:39	0:01	2,839	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1098	1	9/12/21 11:34	9/12/21 11:35	0:01	6,328	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	**1099**	**4**	**9/12/21 12:37**	**9/12/21 14:12**	**1:35**	**116**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	1100	1	9/12/21 12:59	9/12/21 13:00	0:01	1,092	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1101**	**1**	**9/12/21 13:55**	**9/12/21 13:56**	**0:01**	**260**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	1102	2	9/12/21 17:07	9/12/21 17:27	0:20	972	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1103	2	9/12/21 17:14	9/12/21 17:22	0:08	2,256	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1105	2	9/13/21 7:10	9/13/21 9:21	2:11	999	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1106	1	9/13/21 7:21	9/13/21 10:23	3:02	1,902	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1107	2	9/13/21 8:00	9/13/21 8:19	0:19	2,846	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1108	2	9/13/21 8:39	9/13/21 10:51	2:12	2,992	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1109	11	9/13/21 9:00	9/13/21 10:51	1:51	3,058	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1110	2	9/13/21 9:58	9/13/21 11:39	1:41	117	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1111	1	9/13/21 10:34	9/13/21 10:51	0:17	3,710	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1112	5	9/13/21 10:51	9/13/21 16:37	5:46	3,279	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1113	1	9/13/21 11:29	9/13/21 13:06	1:37	1,962	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1114	1	9/13/21 12:37	9/13/21 14:35	1:58	5,703	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1116	9	9/13/21 14:08	9/13/21 17:25	3:17	1,112	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1117	1	9/13/21 14:50	9/13/21 14:51	0:01	1,202	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1118	2	9/13/21 15:36	9/13/21 16:37	1:01	4,920	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1119	1	9/13/21 16:23	9/13/21 17:18	0:55	984	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1120	1	9/13/21 17:12	9/13/21 17:13	0:01	5,471	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1123	9	9/14/21 7:04	9/14/21 10:01	2:57	1,580	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1124	2	9/14/21 7:10	9/14/21 9:16	2:06	981	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1125	1	9/14/21 7:44	9/14/21 13:38	5:54	1,960	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1126	1	9/14/21 8:59	9/14/21 9:00	0:01	6,327	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1127	6	9/14/21 9:00	9/14/21 11:12	2:12	201	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1128	2	9/14/21 10:34	9/14/21 17:43	7:09	1,811	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1129	1	9/14/21 13:03	9/14/21 13:04	0:01	783	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1131**	**1**	**9/15/21 7:27**	**9/15/21 11:07**	**3:40**	**981**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	**1132**	**1**	**9/15/21 7:49**	**9/15/21 8:29**	**0:40**	**2,065**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	**1133**	**2**	**9/15/21 7:59**	**9/15/21 8:55**	**0:56**	**3,046**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	1134	1	9/15/21 9:20	9/15/21 13:21	4:01	1,915	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1135	2	9/15/21 9:47	9/15/21 17:31	7:44	1,974	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1136	1	9/15/21 12:48	9/15/21 12:50	0:02	2,319	After IPIR	n/a	n/a	n/a	n/a	No	
Killer Whale	1137	2	9/15/21 13:08	9/15/21 15:23	2:15	1,157	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1138	1	9/15/21 14:54	9/15/21 17:37	2:43	2,071	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1139	1	9/15/21 17:22	9/15/21 17:24	0:02	1,407	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1140	1	9/15/21 17:32	9/15/21 17:38	0:06	1,431	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1142	2	9/16/21 7:43	9/16/21 11:26	3:43	2,757	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1143	1	9/16/21 7:50	9/16/21 7:51	0:01	6,327	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1144	1	9/16/21 8:32	9/16/21 9:07	0:35	2,782	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1145	3	9/16/21 8:44	9/16/21 11:34	2:50	969	Non-IPIR Day	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Harbor Seal	1146	1	9/16/21 9:17	9/16/21 9:30	0:13	2,274	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1147	7	9/16/21 10:34	9/16/21 12:23	1:49	3,370	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1148	4	9/16/21 11:55	9/16/21 14:55	3:00	2,925	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1149	1	9/16/21 12:19	9/16/21 12:20	0:01	1,105	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1150	2	9/16/21 12:27	9/16/21 15:57	3:30	3,694	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1151	1	9/16/21 12:59	9/16/21 16:20	3:21	2,047	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1152	1	9/16/21 14:19	9/16/21 14:20	0:01	1,193	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1154	1	9/17/21 7:33	9/17/21 9:35	2:02	1,921	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1155	1	9/17/21 7:50	9/17/21 12:51	5:01	954	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1156	1	9/17/21 8:26	9/17/21 9:44	1:18	2,032	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Beluga	1157	2	9/17/21 8:37	9/17/21 9:30	0:53	1,980	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Beluga	1158	2	9/17/21 10:02	9/17/21 13:26	3:24	2,286	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1159	1	9/17/21 10:32	9/17/21 12:17	1:45	5,674	Between IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1160	8	9/17/21 10:39	9/17/21 14:00	3:21	3,016	Between IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1161	1	9/17/21 12:01	9/17/21 13:30	1:29	3,053	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1162	1	9/17/21 12:19	9/17/21 12:55	0:36	6,064	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1163	1	9/17/21 12:47	9/17/21 14:11	1:24	3,260	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1165	1	9/17/21 13:17	9/17/21 13:18	0:01	671	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	**1166**	**2**	**9/17/21 15:42**	**9/17/21 17:12**	**1:30**	**5,008**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	**1167**	**1**	**9/17/21 16:43**	**9/17/21 17:18**	**0:35**	**5,831**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Beluga	1169	2	9/18/21 7:20	9/18/21 7:41	0:21	772	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1170	2	9/18/21 7:52	9/18/21 11:29	3:37	900	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1171	1	9/18/21 8:57	9/18/21 15:26	6:29	2,579	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1172	2	9/18/21 8:57	9/18/21 15:23	6:26	1,897	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1173	1	9/18/21 10:46	9/18/21 12:11	1:25	2,725	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1174	8	9/18/21 10:51	9/18/21 11:28	0:37	2,335	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1175	1	9/18/21 12:03	9/18/21 12:05	0:02	2,173	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1176	3	9/18/21 12:20	9/18/21 12:30	0:10	8,320	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1177	1	9/18/21 13:20	9/18/21 13:21	0:01	2,593	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1178	30	9/18/21 13:38	9/18/21 15:31	1:53	195	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1179	1	9/18/21 14:32	9/18/21 14:33	0:01	999	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1180	3	9/18/21 16:16	9/18/21 17:21	1:05	2,490	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	1181	1	9/18/21 16:22	9/18/21 16:28	0:06	2,430	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1182	1	9/18/21 16:38	9/18/21 16:39	0:01	2,206	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Porpoise	1184	1	9/19/21 7:35	9/19/21 7:36	0:01	4,836	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1185	1	9/19/21 8:20	9/19/21 8:26	0:06	1,225	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1186	3	9/19/21 8:57	9/19/21 10:28	1:31	643	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1187	26	9/19/21 9:46	9/19/21 11:57	2:11	2,926	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1188	1	9/19/21 9:48	9/19/21 14:48	5:00	1,889	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1189	6	9/19/21 10:16	9/19/21 11:57	1:41	894	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1191	2	9/19/21 11:49	9/19/21 15:21	3:32	5,735	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1192	4	9/19/21 9:46	9/19/21 15:21	5:35	2,811	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1193	8	9/19/21 12:27	9/19/21 13:04	0:37	3,253	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1194	1	9/19/21 13:23	9/19/21 13:24	0:01	2,806	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1195	8	9/19/21 14:20	9/19/21 14:25	0:05	10,707	Non-IPIR Day	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Harbor Seal	1197	1	9/20/21 7:38	9/20/21 7:39	0:01	1,017	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1198	6	9/20/21 8:58	9/20/21 10:52	1:54	705	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1199	1	9/20/21 9:44	9/20/21 9:45	0:01	6,548	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1200	2	9/20/21 9:54	9/20/21 10:19	0:25	2,121	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1201	2	9/20/21 10:20	9/20/21 15:26	5:06	821	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1202	3	9/20/21 10:38	9/20/21 15:18	4:40	1,480	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1203	1	9/20/21 11:21	9/20/21 11:22	0:01	3,667	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1204	14	9/20/21 12:21	9/20/21 14:25	2:04	204	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1205	3	9/20/21 12:29	9/20/21 12:56	0:27	5,258	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1206	2	9/20/21 12:52	9/20/21 14:30	1:38	1,892	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1209	1	9/22/21 8:45	9/22/21 8:46	0:01	6,134	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1211	7	9/22/21 11:17	9/22/21 15:35	4:18	1,305	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1212	2	9/22/21 11:17	9/22/21 13:07	1:50	2,530	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Harbor Seal	1213	2	9/22/21 12:14	9/22/21 16:50	4:36	781	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1214	2	9/22/21 12:50	9/22/21 16:21	3:31	1,918	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1215	4	9/22/21 13:18	9/22/21 13:40	0:22	7,023	Non-IPIR Day	n/a	n/a	n/a	n/a	No	
Beluga	1217	2	9/23/21 10:43	9/23/21 14:50	4:07	2,176	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1219**	**2**	**9/24/21 8:55**	**9/24/21 16:54**	**7:59**	**871**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	**1220**	**5**	**9/24/21 10:56**	**9/24/21 12:22**	**1:26**	**2,043**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	1221	2	9/24/21 12:01	9/24/21 12:20	0:19	6,499	After IPIR	4,106	Vibratory	Bubble Curtain	36	No	
Beluga	**1222**	**2**	**9/24/21 10:56**	**9/24/21 12:22**	**1:26**	**1,399**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	**Group 1222 split from 1220, but was part of 1220 when potential exposure first occurred.**
Beluga	1223	4	9/24/21 12:32	9/24/21 15:04	2:32	2,441	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1224	1	9/24/21 13:15	9/24/21 13:16	0:01	2,220	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1225	1	9/24/21 13:32	9/24/21 14:20	0:48	5,382	After IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1226	2	9/24/21 14:42	9/24/21 17:28	2:46	898	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1227	1	9/24/21 14:57	9/24/21 14:58	0:01	724	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1228	1	9/24/21 15:03	9/24/21 15:22	0:19	2,707	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1229	1	9/24/21 16:58	9/24/21 16:59	0:01	3,259	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1231**	**1**	**9/25/21 8:16**	**9/25/21 11:06**	**2:50**	**968**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Harbor Seal	1232	1	9/25/21 9:18	9/25/21 9:19	0:01	1,172	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1233	1	9/25/21 9:22	9/25/21 10:39	1:17	941	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1234	1	9/25/21 9:45	9/25/21 9:46	0:01	2,305	Between IPIR	n/a	n/a	n/a	n/a	No	
Beluga	**1235**	**4**	**9/25/21 11:30**	**9/25/21 13:26**	**1:56**	**640**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	1236	2	9/25/21 15:23	9/25/21 17:46	2:23	983	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1237	1	9/25/21 15:40	9/25/21 15:41	0:01	3,349	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1239	1	9/25/21 16:58	9/25/21 16:59	0:01	1,199	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	**1241**	**1**	**9/26/21 8:59**	**9/26/21 10:40**	**1:41**	**727**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**B**	
Beluga	**1242**	**1**	**9/26/21 9:29**	**9/26/21 9:30**	**0:01**	**4,200**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	1243	1	9/26/21 10:58	9/26/21 11:33	0:35	1,121	Between IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1244	1	9/26/21 11:04	9/26/21 11:05	0:01	5,243	Between IPIR	n/a	n/a	n/a	n/a	No	
Steller Sea Lion	1245	1	9/26/21 14:40	9/26/21 14:41	0:01	2,958	After IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1246	3	9/26/21 15:05	9/26/21 17:52	2:47	810	After IPIR	n/a	n/a	n/a	n/a	No	

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 IPIR	Level B Zone	Hammer Type	Attenuation	Pile Diameter (inches)	Level B (or A) Exposure?	Notes
Harbor Seal	1248	2	9/27/21 7:47	9/27/21 10:44	2:57	831	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	*Note: only one of the two harbor seals was present during pile driving and is reported as a potential exposure.
Harbor Seal	1249	1	9/27/21 11:14	9/27/21 11:15	0:01	2,740	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Porpoise	1250	1	9/27/21 11:49	9/27/21 11:50	0:01	2,481	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1251	1	9/27/21 13:25	9/27/21 13:44	0:19	891	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	**1252**	**1**	**9/27/21 15:24**	**9/27/21 18:08**	**2:44**	**751**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	1253	1	9/27/21 18:32	9/27/21 18:42	0:10	911	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1254	1	9/27/21 19:16	9/27/21 19:29	0:13	924	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	Group was not initially flagged, but was determined to be a potential exposure after review.
Steller Sea Lion	1256	1	9/28/21 8:41	9/28/21 8:42	0:01	2,357	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	1257	1	9/28/21 9:47	9/28/21 9:49	0:02	6,216	Before IPIR	n/a	n/a	n/a	n/a	No	
Beluga	**1258**	**3**	**9/28/21 10:14**	**9/28/21 10:54**	**0:40**	**821**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Beluga	**1259**	**3**	**9/28/21 11:48**	**9/28/21 12:57**	**1:09**	**3,384**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Beluga	**1260**	**2**	**9/28/21 13:54**	**9/28/21 17:05**	**3:11**	**2,976**	**During IPIR**	**4,106**	**Vibratory**	**Bubble Curtain**	**36**	**No**	
Harbor Seal	1262	1	9/28/21 15:57	9/28/21 15:58	0:01	1,029	Between IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1263	1	9/28/21 17:46	9/28/21 17:47	0:01	1,048	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	Group was not initially flagged, but was determined to be a potential exposure after review.
Harbor Seal	1265	1	9/29/21 8:36	9/29/21 8:37	0:01	930	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1266	1	9/29/21 10:31	9/29/21 10:32	0:01	641	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1267	1	9/29/21 14:13	9/29/21 14:14	0:01	3,221	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1268	1	9/29/21 15:57	9/29/21 15:58	0:01	2,621	Before IPIR	n/a	n/a	n/a	n/a	No	
Harbor Seal	1269	1	9/29/21 16:32	9/29/21 16:38	0:06	2,328	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	
Harbor Seal	1270	1	9/29/21 17:10	9/29/21 17:29	0:19	1,143	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	Group was not initially flagged, but was determined to be a potential exposure after review.
Harbor Seal	1271	1	9/29/21 19:23	9/29/21 19:29	0:06	940	During IPIR	4,106	Vibratory	Bubble Curtain	36	B	

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APPENDIX E

Data Collection Attribute Definitions

excerpted from POA 2019, Appendix A

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
Marine Mammal Sighting Data	
Group identification code	Each group of marine mammals will be given a unique group identification code. This group identification code is **not species specific**. This identifier can also be used to identify a group whose location, behaviors, and other variables have changed, requiring the use of multiple datasheets.
Time of initial and last sighting	Time the group is initially sighted and last sighted
Time animals entered and exited harassment zones	Time the group entered and exited harassment zones, if applicable
Species observed	Identify species observed: beluga whale, harbor seal, harbor porpoise, Steller sea lion, killer whale, humpback whale, or other species
Sighting cue	First observation behavior or body part: head, fluke, dorsal fin, body, splash, blow, birds feeding, porpoise, or other
Group size	Minimum and maximum number of animals counted; record the count the MMO believes to be the most accurate
Color classification	Beluga whale color classifications: ***White*** - Large, bright white to dull white ***Gray*** - Large (larger than calves), light to medium gray ***Dark gray*** - Calf - Dark gray, relatively small (<2/3 the total length of white belugas), almost always swimming within 1 body length of larger whale Neonate - Newborns (estimated to be hours to days old, based on extremely small size (~1.5 m [5 ft]), a wrinkled appearance due to the presence of fetal folds, and uncoordinated swimming and surfacing patterns ***Unknown color*** - Any beluga not confidently identified in above categories
Sex and age, if possible	Generally, it will be difficult to make this determination; however, sometimes numbers of females with pups or calves can be determined.
Initial and final heading	Cardinal direction animals are headed during initial and last sightings
General pace	Sedate, moderate, or vigorous
Tracking movement and theodolite readings	The movements and changes in locations should be documented for each sighting, including the horizontal and vertical angles used to determine location and distance from in-water project activities
Distances from marine mammal to in-water project activities and observation station	Approximate distance in meters or kilometers from a marine mammal to in-water project activities when initially sighted, at closest approach to activities, and at final sighting
In-water project activities at time of sighting	Type of project activities occurring at time of sighting; indicate shutdown times for pile installation or removal, if shutdown occurs
Other activities at time of sighting	Description of nearby activities occurring at time of sighting, such as presence, number, and activity of vessels nearby
Behavior	Indicate primary and secondary behaviors (see Table 3-6). 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)

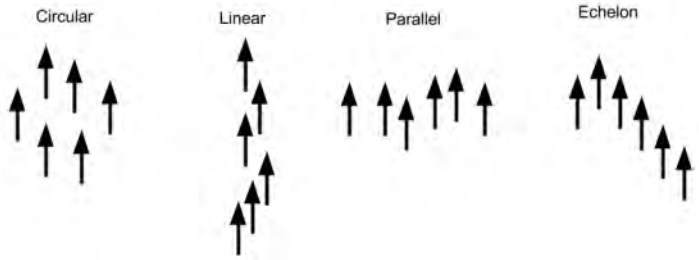
Data Attribute	Attribute Definition and Units Collected
Formation (for beluga whales only)	The formation of the group references how the individual beluga whales are distributed within the group. Enter the formation code that best reflects the distribution pattern of the group: **Circular** (C) – arranged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

Table 3-6. 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

APPENDIX F

Beluga Reactions to Pile Installation and Removal

Appendix F. Beluga Reactions to Pile Installation and Removal

Group	Date	Reaction	Hammer	Mitigation	Narrative of Event
877	26 May 2021	None	Vibratory	None	A PSO was stationed at the WPW location, and equipped with a 20X to 40X spotting scope and pair of 7X50 binoculars. The group of seven belugas were first sighted at 1525 on the opposite shore about halfway between the Little Susitna River and Point Mackenzie. The belugas were estimated to be approximately 6,800 to 7,500 meters away from observation location, and approximately 12,700 meters from the PCT. The initial trajectory of the belugas from 1525 to 1530 was east, toward the PCT. By 1545, prior to IPIR, the group reversed direction and began traveling west along the shoreline. At 1529 the PSO field lead contacted the PPM construction crew to inform them belugas were within or near the Level B zone for vibratory installation of a 144-inch pile with a bubble curtain (18,000-meters). At 1531 the PPM superintendent contacted the PSO field lead and stated that they intended to proceed. The PSO field lead interpreted the decision to proceed installing the free-standing 12-foot diameter pile as a necessary action to prevent a safety incident. Attenuated vibratory installation of a 144-inch pile was intermittent between 1547 and 1615, but the hammer was only active for approximately 1.4 minutes during the 28 minute period. Between 1545 and the end of the sighting at 1656, the group maintained their westward trajectory. Since the group reversed course prior to the start of IPIR, and then mainatined the trajectory, no reaction can be attributed to the 1.4 minutes of IPIR work. This was reported as a potential exposure.
956	18 Jun 2021	Potential	Impact	None	Impact installation of a 144-inch pile (BD3) with a bubble curtain (6,309-meter Level B zone) began with a soft start at 1642. At 1645 uniterrupted impact hammering began and continued until 1843. It then resumed from 1848 until 1905. At 1810, the PSOs at the Port Mackenzie station sighted four belugas traveling south near Sixmile Creek, on the eastern shore of Knik Arm, approximately 4,800 meters north of Carin Point. The group was first sighted near shore, in the "land shadow" behind Cairn Point, and outside of the 6,309-meter Level B zone. From 1810 to 1816, the group continued south toward the PCT. At 1816 reached to within approximately 5,800 meters of the active pile (as the crow flies), but remained close to shore, in the "land shadow" and so was approximately 800 meters from the zone. The group turned back to the north and continued on a northward trajectory until the last sighting at 1844. Since pile driving had been active for nearly an hour and a half prior to the sighting, and the initial trajectory of the group was toward the activity, the interaction could could be classified as "moving toward." However, because the group turned near the Level B zone, at which point they could have been receiving sound levels close to the 160-decible threshold, the interaction was classified as a "possible" reaction.
958	18 Jun 2021	Potential	Impact	None	From 1642 to 1905 the construction crew was using a impact hammer with a bubble curtain on a 144-inch pile. The Level B zone was 6,309 meters. At 1925, twenty minutes after the impact hammer was turned off, two belugas were sighted traveling southwest, approximately half-way between Port Mackenzie and Point Mackenzie. At the time, they were a swimming distance of at least 3,500 meters inside of the Level B zone, and also approximately 3,500 meters from the PCT. Because impact hammering had been ongoing for more than 2 hours prior to the sighting, the group must have moved toward the PCT during IPIR. The because of the distance inside of the zone, the group was reported as a potential exposure, even though they were not sighted during active pile driving.
978	21 Jun 2021	Potential	Impact	Shutdown	From 1901 to 1904, a single beluga was sighted near the Ship Creek station. After not resighting it, the construction crew was using an impact hammer on a 144-inch pile with a bubble curtain from 1946 to 2024. The Level B zone was 6,309 meters and the Level A zone for mid-frequency cetaceans was 117 to 194 meters (depending on the duration of 0.3 or 0.7 pile installed per day). A single beluga in group 978 was first sighted at 2024 in the vicinity of the last sighting of Group 977. The beluga was 1,773 meters from the PCT, and 4,536 meters inside of the Level B zone. The PCT PSO radioed the pile driving foreman of the Pacific Lifter, and the hammer was turned off at 2024. The initial trajectory of the beluga was south, away from the PCT(from 2024 to 2035). After moving south breifly, the beluga moved back north and milled in the area in front of Ship Creek, then began traveling north again. It is very likely that the animal in Group 978 was the same as the animal in Group 977. If so, it is unclear where the beluga was from 1904 to 2024, but it is possible that it was in Ship Creek and could not be seen by the PSOs. Because the initial trajectory was away from the PCT it is classified as a "potential" reaction. However, if it remained in the vicinity for 38 minutes of impact pile driving, it may not be considered an actual reaction to the pile driving. The pile driving remained shut down until 2214 when a lack of daylight ended observations. The event was reported as a potential exposure.
1031	07 Sep 2021	Toward	Vibratory	None	Vibratory removal of a 36-inch pile with a bubble curtain began at 1220 and continued until 1251. At 1248, Group 1031 was sighted on the far shore, west of Point Mackenzie, near the inbound line, approximately 7,600 meters from the PCT. The initial trajectory was toward the PCT and the group maintained its trajectory toward the PCT after the pile was complete. The group did not move within the Level B zone while pile driving was occuring.
1072	10 Sep 2021	Toward	Vibratory	Shutdown	Vibratory removal of a 36-inch pile with a bubble curtain began at 1243 and continued until 1310. The Level B zone was 4,106 meters. At 1254, Group 1072 was first sighted by PSOs stationed on the beach north of Cairn Point, and the initial trajectory was south toward the PCT. The Point Woronozof station was also able to see the group and was able to track its progress south toward the PCT. At 1310, the group was still in the "land shadow" behind Cairn Point, but was approaching the Level B zone. A shutdown was initiated and the group continued south toward the PCT.
1078	11 Sep 2021	Potential	Vibratory	None	From 0752 to 0758 the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. At 0757 one beluga was observed 1,243 meters inside the Level B zone and 2,862 meters from PCT. The PSO informed PCT of the sighting at 0757 and the PCT PSO Lead radioed for a shutdown at 0757. The construction crew continued to remove the pile with the vibratory hammer due to safety issues and the vibratory hammer was shut off at 0758. At 0808 a second beluga was observed in this group. The final count was two belugas. The initial trajectory of the belugas was to the east, away from the PCT. However, it is unknown what direction the belugas were traveling prior to and during the IPIR event, and no definitive reaction was observed.
1083	11 Sep 2021	None	Vibratory	Delay	Group 1083 was first sighted at 1140 near NEX, traveling south toward the PCT. No IPIR was being conducted at the time of the initial sighting. The group traveled south along the shoreline near the POA. The construction crew was ready to begin IPIR at 1210, and a delay was initiated because the group was within the 4,106-meter Level B zone for vibratory removal of a 36-inch pile with a bubble curtain. The group continued south, to approximately 1,000 meters south of Ship Creek, where they turned west and headed offshore across lower Knik Arm. At 1305 they cleared out of the 4,106-meter zone. By 1319, it was clear that they were maintaining their trajectory away from the PCT and the delay was ended. Pile removal was conducted from 1320 to 1330. The group maintained their westward trajectory out of Lower Knik Arm.

Appendix F. Beluga Reactions to Pile Installation and Removal

Group	Date	Reaction	Hammer	Mitigation	Narrative of Event
1099	12 Sep 2021	Toward	Vibratory	Shutdown	From 1234 to 1237 the construction crew was using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B Zone was 4,106 meters. At 1237 one beluga was initially sighted in front of NEX heading south toward the PCT, approximately 1,923 meters in the Level B Zone and 2,183 meters away from PCT. At 1237 the vibratory hammer was stopped and a shutdown was initiated. The NEX station added three more belugas to Group 1099 at 1240. The group likely orginated north of Cairn Point and was traveling toward the PCT during pile removal. The tide was high at the time of the sighting, preventing access to the beach north of Cairn Point.
1133	15 Sep 2021	Potential	Vibratory	None	From 0753 to 0758 the construction crew was using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. Immediately after pile removal ceased, one white beluga was first sighted at 0759 northwest of Cairn Point, 3,309 meters from the PCT, and 797 meters inside of the Level B zone. At 0818, the beluga count was updated to two. The initial trajectory was away from the PCT, but it was not established until after the vibratory hammer was turned off. Two PSOs were stationed on the beach at Cairn Point, but did not sight the group approaching the PCT. The group likely originated from the north of Cairn Point during pile removal, and would have been moving toward the PCT during pile driving, but the trajectory was not established during that time. Since the first trajectory established after cessation of the pile removal was away, it is possible the small group was missed by stations further south and was actually moving away from the PCT during pile removal. The event was reported as a potential exposure.
1157	17 Sep 2021	Toward	Vibratory	Delay and Shutdown	At 0837, Group 1157 was first sighted offshore between Port Mackenzie and Cairn Point, within the 4,106-meter Level B zone for vibratory removal of a 36-inch pile with a bubble curtain. The construction crew was prepared to begin removal at 0853, and a delay was initiated. The group was not resighted for 40 minutes and the all clear to begin pile removal was given at 0923. From 0925 to 0931 the construction crew removed the 36-inch pile. At 0930 one of the two whales in the group was resighted just south of the NEX station and they radioed for a shutdown. At the time of the second sighting, the whale was 1,900 meters from the active pile heading directly towards it while the vibratory hammer was in use. The event was reported as a potential exposure.
1220/1222	24 Sep 2021	Toward	Vibratory	Shutdown	From 1053 to 1056 the construction crew was actively using a vibratory hammer on a 36-inch pile with a bubble curtain. The Level B zone was 4,106 meters. At 1056, three white, three gray, and one calf beluga were first sighted near shore at Cairn Point, traveling south toward the PCT. The group was 2745 meters from pile being driven and 1250 meters within the Level B zone. The PCT lead PSO called for a shutdown and the hammer was deactivated at 1056. The group moved offshore, southwest toward the mouth of Lower Knik Arm. Two belugas (one white, one gray) later split from Group 1220 and were tracked under Group 1222. The total counts of groups 1220 and 1222 reflect the original (initial) count of Group 1220.
1235	25 Sep 2021	None	Vibratory	Delay	At 1006, construction was placed on a delay due to a high tide preventing PSOs from traveling out on the beach to observe the edge of the zone at Cairn Point were recent beluga exposures had been occuring. Group 1235 was first sighted at 1130 traveling south near the NEX station, which continued the construction delay. The group stayed near shore, traveling south along the POA dock, then southwest into Bootleggers Cove. At 1256, the group passed beyond the 4,106-meter Level B zone for vibratory removal of a 36-inch pile with a bubble curtain. At 1315, the group was approximately 4,800 meters from the active pile and on a trajectory away. Pile removal began at 1316, and the group maintained its trajectory away from the PCT.
1242	26 Sep 2021	Toward	Vibratory	Shutdown	From 0927-0929, the construction crew was removing a 36-inch pile with a vibratory hammer with a bubble curtain. The Level B zone was 4,106 meters. One beluga whale was sighted at 0929 near the Level B zone and on a trajectory toward the PCT. A shutdown was called and the hammer was deactivated at 0929. The theodolite fix showed the beluga was approximately 100 meters outside of the Level B zone and was therefore not marked as a potential take. The whale was not sighted again and pile removal recommenced after 43 minutes.
1258	28 Sep 2021	None	Vibratory	Delay	From 0953 to 1004, the construction crew removed a 36-inch pile with a vibratory hammer with a bubble curtain. The Level B zone was 4,106 meters. Ten minutes later at 1014, PSOs at Port Mackenzie sighted two white belugas and a calf near the shore north of Cairn Point (in the land shadow) on a trajectory toward the PCT. With pile removal having ceased 10 minutes before the group was first sighted, no reaction can be dicerned. However, they were approximately 3,600 meters away from the PCT and were moving towards it. It likely that the group had been getting closer to the PCT from 0953 to 1004 when the pile removal was occuring. The group continued south along the POA dock. The group was last sighted near the POA dock, between the PCT and NEX stations. The construction crew was ready to begin removal of another pile at 1044, but were delayed until 1124 when 30 minutes had passed since the last sighting of the group at 1054.
1259	28 Sep 2021	Potential	Vibratory	None	From 1126 to 1139, the construction crew removed a 36-inch pile with a vibratory hammer with a bubble curtain. The Level B zone was 4,106 meters. At 1148, a group of belugas with the same compostion as Group 1259 (two white, one calf) was sighted along the shore southeast of Port Mackenzie. The group was on the opposite shore of the last sighting of Group 1258. Group 1259 may or may not have been the same group as 1258. If it was the same group, then the movement across the inlet between 1054 and 1148 may have partially been in response to the pile removal conducted between 1126 and 1139. If the group was a new group, then it is possible that the group moved toward the PCT during the pile removal, since they were first seen approximately 2,000 meters (swimming distance) inside of the Level B zone. The group continued to travel southwest along the shore, and rounded Point Mackenzie before heading west toward the Little Susitna river.
1260	28 Sep 2021	Toward	Vibratory	None	From 1329 to 1350, the construction crew removed a 36-inch pile with a vibratory hammer with a bubble curtain. The Level B zone was 4,106 meters. At 1354, the beluga group was sighted approximately 3,300 meters from the pile location, indictating that they had likely traveled toward the PCT during the 20 minutes of pile removal.

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APPENDIX G

Electronic Deliverables

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