2010 ANNUAL MARINE MAMMAL MONITORING REPORT

CONSTRUCTION AND SCIENTIFIC MARINE MAMMAL MONITORING ASSOCIATED WITH THE PORT OF ANCHORAGE MARINE TERMINAL REDEVELOPMENT PROJECT

In Accordance with the USACE 404/10 Permit and the NMFS 2010- 2011 Letter of Authorization

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Cover: Construction Marine Mammal Monitoring at barge berth, Port of Anchorage, Alaska, Marine Terminal Redevelopment Project. Above right: Scientific Marine Mammal Monitoring at Cairn Point Station on Joint Base Elmendorf-Richardson. August 2010.

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1.0 INTRODUCTION AND PURPOSE

Located within the Municipality of Anchorage on the Knik Arm of Cook Inlet (Figure 1), the Port of Anchorage (Port) handles 90 percent of all consumer goods and cargo for 85 percent of the population of the state of Alaska. The Port is currently operating at or above sustainable practical capacity for the majority of the cargo types handled. Existing facilities and structures are substantially beyond reasonable design life and degraded to levels of marginal operation safety; many are functionally obsolete. The U.S. Department of Transportation, Maritime Administration (Maritime Administration) under a Memorandum of Understanding with the Municipality of Anchorage, owner and operator of the Port, is overseeing the expansion effort, the Port of Anchorage Marine Terminal Redevelopment Project (MTR Project). Integrated Concepts & Research Corporation (ICRC), prime contractor for the Maritime Administration, is managing the MTR Project construction and permitting process. Port construction activities (Figure 2) were authorized under the U.S. Army Corps of Engineers (USACE) 404/10 Permit *POA-2003-502 issued* in August 2007.

The pile-driving equipment used for construction of the wharf generates sound waves within the water, which have the potential to present a disturbance hazard to marine mammals. The Marine Mammal Protection Act (MMPA) defines this type of hazard as *Level B Harassment*, "an act that has the potential to disturb a marine mammal stock in the wild by causing disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

In July 2009, the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) published a *Biological Opinion*, a Section 7 Consultation under the Endangered Species Act. The Biological Opinion was based, in part, on the *Biological Assessment of the Beluga Whale Delphinapterus leucas in Cook Inlet for USACE Dredging and Marine Terminal Redevelopment Project at the Port of Anchorage, Alaska,* submitted to NOAA/NMFS March 2009 by the Maritime Administration, the Port of Anchorage administration (POA), and the USACE. In-water construction activities for the MTR Project must be conducted according to the conditions of the Biological Opinion.

Prior to the 2010 MTR Construction Season, in compliance with the MMPA, the POA and the Maritime Administration applied for and received a Letter of Authorization (LOA), from NOAA/NMFS for the period 15 July 2010 through 14 July 2011 The 2010-2011 LOA allows Level B "takes" of marine mammals during in-water construction activities associated with the MTR Project. The regulations governing the issuance of an LOA allow the incidental, but not intentional, take of marine mammals under certain circumstances; these regulations are codified in 50 Code of Federal Regulations (CFR) Part 217, Subpart U. Where applicable, the stipulations of the 2010-2011 LOA supersede those of Special Condition (SC) IV of the 2007 USACE 404/10 Permit.

1.1 Annual Reporting for USACE and NMFS Permits

The POA and the Maritime Administration have implemented NMFS-approved marine mammal monitoring programs that collect information on marine mammal behavior in the vicinity of the Port. The monitoring programs were designed to comply with the conditions of the 404/10 Permit, the Biological Opinion, and the LOA. Details of these programs are described in the Marine Mammal Monthly Reports for July through November 2010. The 2010 Annual Marine Mammal Monitoring Report meets the reporting requirements of the NMFS LOA and the USACE 404/10 Permit, SC-IV; there are no reporting requirements associated with the Biological Opinion. All these documents and more can be found on the Port of Anchorage website: through the library portal http://portofanchorage.org/library.html.

2.0 MTR CONSTRUCTION: NORTH EXTENSION BULKHEAD

Construction activities during 2010 were conducted at the North Extension Bulkhead (Figure 3) from July through approximately 10 December; in-water construction began 22 July and ended 20 November. The following activities took place at the construction site:

- Placement of fill material
- Placement, driving, and removal of steel sheet pile
- Dredging of marine sediment (Figure 4);
- Conducting quality assurance inspection activities

3.0 SAFETY AND HARASSMENT ZONES

As required by the 404/10 Permit, the LOA, and the Biological Opinion, the POA and the Maritime Administration utilized established safety and harassment zones at the MTR Project

construction site. The presence of marine mammals was monitored before and during in-water work activities. If the applicable safety and harassment zones were not visible because of fog, poor light, darkness, sea state, or any other reason, in-water construction activities were safely shut down until the area was once again visible.

3.1 Safety Zones

The LOA established conservative *safety zones* to prevent in-water construction activities from physically harming marine mammals. When marine mammals are sighted either approaching the safety zones or surfacing within the safety zones, all in-water construction activities must be suspended until the marine mammal has moved to a safe distance or had not been sighted within the safety zones for at least 15 minutes. The enforced safety zones are:

- 50 meters (m) from in-water construction activities that do not involve vibratory or impact pile driving, such as dredging (Figure 4) and fill placement
- 200 m from either vibratory or impact pile driving

3.2 Harassment Zones

The LOA also established conservative *harassment zones* for in-water construction. The following harassment zones and protocols were in effect during the 2010 construction season:

- 350 m from impact pile driving
- 1300 m from vibratory pile driving

Suspension of in-water pile driving when marine mammals approach or are sighted within these zones is encouraged, but not mandatory, *with the following exceptions*:

- Level A Harassment (injury/mortality) takes are prohibited.
- No Level B takes of beluga whale calves are allowed when a beluga calf or calves are sighted approaching the harassment zones or are sighted within the harassment zones.
- To limit the number of takes and avoid exceeding the authorized take limit, when a group of five or more beluga whales is sighted approaching the harassment zones, in-water pile driving is suspended.

Under the preceding conditions, which were in effect during the 2010 construction season and will be in effect for the upcoming 2011 construction season, in-water pile driving activities are suspended until the marine mammal(s) are sighted 1) outside of, and moving away from, the harassment zones or 2) have not been sighted within a harassment zone for at least 15 minutes. In addition, for compliance with the conditions of the 404/10 Permit, the Biological

Opinion, and the LOA, no in-water impact pile driving is conducted within two hours of published low tide occurrence.

3.3 Take Count

A take occurs when a marine mammal(s) is sighted within the safety and harassment zones while in-water construction activities are being conducted. The LOA permits the POA and the Maritime Administration to *take by Level B harassment*: 34 beluga whales *(Delphinapterus leucas)*, 20 harbor porpoises (*Phocoena phocoena)*, 20 harbor seals *(Phoca vitulina)*, and 5 killer whales *(Orcinus orca)* annually during MTR Project construction activities. Construction marine mammal observers are contractually required to keep an accurate take count of marine mammals sighted within the safety and harassment zones and report the take(s) on an NMFS-approved sighting form. Once the allowable number of takes for a marine mammal species has been reached, the harassment zones are treated as mandatory shutdown zones.

4.0 MARINE MAMMAL MONITORING PROGRAMS

The Maritime Administration is responsible for implementing both the Scientific Marine Mammal Monitoring Program and the Construction Marine Mammal Monitoring Program. The marine mammal monitoring area includes all waters within the Knik Arm of Upper Cook Inlet visible from the site of the in-water construction activities located near and offshore of the Port, as shown on pages 3 and 4 of the Construction Marine Mammal Sighting Form (Figure 5). During marine mammal monitoring and data collection activities in 2010, emphasis was placed on documenting marine mammal abundance, frequency, and response to construction activities within and near the construction area.

4.1 Construction Marine Mammal Monitoring Program

The Construction Marine Mammal Monitoring Program requires that Construction Marine Mammal Observers (MMOs) be present at all times during in-water construction activities and also 30 minutes prior to commencement of in-water pile driving. In 2010, 61 North, under contract to West, ICRC's construction contractor, provided qualified Construction MMOs who were stationed at the best vantage points practicable to monitor the waters of Knik Arm. Each Construction MMO worked up to four hours at a station, then rotated to one of the other stations to avoid fatigue. The Construction MMOs at the South Backlands and the North Extension Bulkhead stations worked in 50-foot-high scissor lifts for improved viewing of marine mammals approaching the Port area from the south (Figure 6).

A third Construction MMO worked from the roof of a connex located on the shore north and around the bend from the Cairn Point bluff (Figures 7 and 8). This remote location, one kilometer north of the Project area, provides optimal viewing of marine mammals approaching from the north, before they enter the 1300-m Harassment Zone. However, additional safety precautions are necessary at this location because bears frequently pass through the area on their way to the tidal flats. When the station is not accessible on foot due to high tide, the MMO must use a skiff to reach the monitoring station.

4.1.1 Sighting Form – Construction Marine Mammal Monitoring Program

The Construction MMOs documented marine mammal sightings (Figure 9) on the NMFS-approved marine mammal sighting form (Figure 5). Marine mammal location was recorded on the page 3 and page 4 grid maps of the sighting form, according to the distance of the animal(s) from the noise source at the construction site. The number of animals per sighting; the number of adults, juveniles, and calves; and the behavior of the marine mammals was also recorded. The individual sighting forms completed by the Construction MMOs were provided in the monthly reports submitted to USACE and NMFS from August through November 2010. Before the beginning of the 2010 construction season, ICRC made minor revisions (approved by NMFS) to the 2009 marine mammal sighting form to improve readability and capture additional information.

In addition to documenting marine mammal sighting information on the form, the Construction MMOs recorded the type of construction work ongoing at the time of the sighting (e.g., vibratory pile driving/pile pulling). When a marine mammal was sighted, the Construction MMO immediately notified the construction contractor's project manager marine mammal's direction of travel and if an equipment shutdown was necessary. For quality control purposes, the Construction MMO Supervisor was required to submit a *No Sightings* form for the days when Construction MMOs were on duty but no marine mammals were observed.

Each Construction MMO was equipped with high-powered binoculars and trained in distance estimation, as well as the detection and identification of marine mammals. The Construction MMOs had no other construction-related task and were required to be fully engaged in monitoring. Prior to the start of the 2010 construction season, ICRC reviewed the comprehensive marine mammal monitoring plan submitted by the Construction MMO subcontractor to verify that it met the contractual requirements of the POA, the Maritime

Administration, and ICRC and that it met the conditions of the 404/10 Permit, the Biological Opinion, and the LOA.

4.2 Scientific Marine Mammal Monitoring Program

The Alaska Pacific University (APU) Environmental Science Program, Marine Biology Department, implemented the 2010 Scientific Marine Mammal Monitoring Program. Scientific MMOs documented the 1) abundance and frequency at which beluga whales and/or other marine mammals were inside or outside of the MTR Project footprint; 2) habitat use, behavior, direction of travel, and group composition; and 3) observed reactions or changes in behavior of marine mammals in response to in-water construction activities or other in-water Port activities taking place at the time of the observation.

In June 2010, the Scientific MMOs began scheduled marine mammal observation from the Cairn Point Station on Joint Base Elmendorf-Richardson (formerly Elmendorf Air Force Base). Trained graduate and undergraduate marine biology students utilized high-powered binoculars and a surveyor's theodolite (Figure 10) connected to a laptop computer to track marine mammal movement. The two Scientific MMOs who worked the morning shift were relieved by two Scientific MMOs who worked the afternoon shift. The monitoring teams worked four days per week during two tide cycles per observation day. The Scientific MMOs worked in collaboration with the Construction MMOs to immediately communicate information about beluga whales or other marine mammals that were approaching the Port area. During their monitoring shifts, the Scientific MMOs were notified by the Construction MMOs of anticipated construction schedule changes.

APU submitted a Scientific Marine Mammal Monitoring Plan in 2010, which ICRC approved prior to implementation of the Scientific Monitoring Program. APU also submitted monthly marine mammal monitoring reports to ICRC; these reports were provided to the POA, the Maritime Administration, USACE and NMFS as an appendix to the ICRC Monthly Marine Mammal Monitoring reports. The 2010 Annual Report for Scientific Marine Mammal Monitoring Program is presented as the appendix to this document.

4.2.1 Marine Mammal Observation Log – Scientific Marine Mammal Monitoring Program

In addition to documenting the location, behaviors, and estimated age of beluga whales, the Scientific MMOs also recorded visibility, weather, and sea-state information. The data form used

to record this information is provided at the end of the 2010 Annual Report for Scientific Marine Mammal Monitoring Program.

5.0 IN-WATER CONSTRUCTION ACTIVITIES

ICRC managed the Scientific Marine Mammal Monitoring Program and ICRC's 2010 construction subcontractor for the North Extension Bulkhead provided Construction MMOs, as stipulated by the conditions of the 404/10 Permit, the Biological Opinion, and the LOA. In-water construction and construction marine mammal monitoring ended on 20 November, when ice formation and poor visibility impeded further in-water fill placement and pile removal/pile driving activities.

5.1 Hours of Hammer Operation

ICRC recorded the number of hours per day of use for each type of hammer and method used to drive or pull sheet pile during in-water construction: impact hammer (Figure 11), vibratory hammer (Figure 12), and vibratory stabbing. During the 2010 field season, 861.20 hours of in-water pile-driving/pile pulling were recorded over a period of 90 days between 21 July and 20 November (Table 1).

5.1.1 Pile Driving/Pile Pulling Hours

As required by the 404/10 Permit, the Biological Opinion, and the LOA, the vibratory hammer was used as often as possible for driving and pulling sheet pile, rather than the impact hammer, in order to mitigate marine mammal exposure to in-water sound waves. Of the total number of in-water pile-driving/pile pulling hours (861.20) recorded during 90 days of marine mammal observation in 2010, the vibratory hammer was used *intermittently* for 548.20 hours, or approximately 64 percent of the time. Stabbing with the vibratory hammer accounted for 203 hours, approximately 24 percent of the time. The impact hammer was used for 110 hours, approximately 12 percent of the time.

It is important to note that in-water pile driving is not conducted continuously for extended periods of time. Pile driving hammers are operated for short periods of time (from less than 1 minute to approximately 3.5 minutes within a 1-hour period for vibratory hammers, and from approximately 3 to 20 minutes within a 1-hour period for impact hammers), followed by a period of down time to move and reset the hammer (from 1 or 2 minutes up to 15 minutes).

5.1.2 Construction Shutdowns for Marine Mammals

There were 27 delays and 41 shutdowns of in-water pile driving when marine mammals were sighted approaching the harassment zones, in compliance with the conditions of the 404/10 Permit, the Biological Opinion, and the LOA. The peak month for delays and shutdowns was September, when 10 delays and 20 shutdowns were recorded.

6.0 *MARINE MAMMAL MONITORING DATA*

The following sections summarize the data collected in 2010 by the Construction and Scientific MMOs. The data collected for each marine mammal monitoring program differ, based on the days when observation was conducted, duration of the observation period, and the observation locations of the MMOs.

6.1 Construction Marine Mammal Monitoring Program Data

From 21 July through 20 November, during 106 days of observation, the Construction MMOs recorded 118 marine mammal sightings and a total of 746 animals observed (Table 1). Of this number, 731 animals, approximately 98 percent of the total number of animals observed, were beluga whales (422 white, 244 gray, and 85 dark gray). Thirteen harbor seals and two harbor porpoise were also observed. The highest number of marine mammal sightings, 44, and the highest number of marine mammals observed, 265, occurred in September.

6.1.1 Marine Mammal Takes

Thirteen Level B, beluga whale takes occurred during the 2010 construction season: 9 in October and 4 in November; 1 harbor seal take occurred in September. The Construction Marine Mammal Monitoring Program for 2011 will include measures to maintain and not exceed the remaining allowable takes through 14 July 2011. The current status of marine mammal takes under the 2010-2011 LOA is as follows:

2010 Construction Season Takes: 21 July – 20 November

- 13 beluga whale
- 1 harbor seal
- 0 harbor porpoise
- 0 killer whale

Remaining Allowable Takes through 14 July 2011

- 21 beluga whale
- 19 harbor seal
- 20 harbor porpoise
- 5 killer whale

6.2 Scientific Marine Mammal Monitoring Program Data

Beginning 28 June and continuing through 19 November, the Scientific MMOs conducted approximately 600 hours of marine mammal observation over an 87-day period. They observed a total of 42 beluga whale groups and a total of 115 beluga whales (80 white; 32 gray; 3 dark gray). The monthly report for the Scientific Marine Mammal Monitoring Program was included as an appendix in each of the monthly reports for the Construction Marine Mammal Monitoring Program submitted to USACE and NMFS.

6.3 Comparison of Beluga Whale Data Recorded for the Construction and Scientific Programs

Information on beluga whale behavior and abundance in the Knik Arm of Upper Cook Inlet has been collected for the PIEP since 2005, two years before construction began on the MTR Project. Placement of fill material began in 2007; in-water pile driving began in 2008.

The following information is provided to show existing trends in the number of beluga whales reported each year by the Scientific and Construction marine mammal monitoring programs (Figure 13), how each program utilizes the same grid map differently to describe sighting location (Figure 14), and the percent of beluga whale use of the MTR Project area (Figure 15). A comparison of the Scientific and Construction monitoring programs is provided in Table 2.

A close-up version of the grid map used by both monitoring programs to determine whale location is presented as Figure 14. A number of areas beyond those represented by this map (i.e., areas over 7,000 m from the MTR Project noise source) are shown on the page 4 grid map of the Marine Mammal Sighting Form (Figure 5), although some marine mammal sightings are beyond even these areas. The expanded map is used by both the Construction and the Scientific MMOs.

The primary observation area is represented by a total of 243 grid cells, each cell representing a distance 500 m by 500 m. The areas represented by 47 of the 243 cells are landlocked, however, and therefore do not represent possible areas in which beluga whales could be observed. Of the remaining area, represented by 196 grid cells, the location of the MTR Project footprint is represented by six cells (red diagonal lines). Nine other cells (blue pattern) represent the area adjacent to the MTR Project footprint. The area designated as the harassment zone (purple diagonal lines) extends 1300 m beyond the MTR Project footprint. The total MTR Project area is the sum of the MTR Project footprint, the area adjacent to the

footprint, and the additional area that extends to the 1300-m boundary of the harassment zone. This 27-cell area is 10.2 percent of the total observation area. As construction progresses on the MTR Project, the observation area currently available to the whales, 89.8 percent of the total, will diminish to some degree.

As shown in Figure 15, there appears to be a trend in beluga whales utilizing areas outside the MTR Project area, but not a significant change in the distribution of whale observations from 2005 through 2010. The animals seem to be shifting their range further out into Knik Arm. Almost 50 percent of the beluga whale population continues to travel along the eastern shoreline of Knik Arm during MTR Project construction, indicating that although construction may have caused beluga whales to adapt to the changing shoreline, it has not caused an abandonment of habitat.

TABLES

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Table 1. Cumulative Summary of Construction Marine Mammal Sightings and In-Water Pile Driving Hours: MTR Project 2010

Day/Month	Total: Marine Mammal Sightings	Total: Marine Mammals Observed	Marine Mammal Species, Number, and Group Composition[1]	Animals in Safety Zones[2]	Animals in Harassment Zones[3]	Shutdowns and Delays[4]	Takes	Total Days: Pile Driving In-water	Total Hours: Pile Driving In-water	Total Hours: Vibratory Hammer In-water Pile Driving	Total Hours: Impact Hammer In-water Pile Driving	Total Hours: Stabbing In-water *(Vibratory)*
21 July – 31 July	2	2	beluga whale: 0 harbor seal: 1 harbor porpoise: 1	1	1	0 delays 0 shutdowns	0	4	9.00	8.75	0.00	0.25
1 Aug. – 31 Aug.	22	146	beluga whale: 140 *(79 white; 50 gray; 11 dark gray)* harbor seal: 5 harbor porpoise: 1	32	46	3 delays 7 shutdowns	0	19	112.50	90.75	2.00	19.75
1 Sept. – 30 Sept.	44	265	beluga whale: 261 (172 white; 59 gray; 30 dark gray) harbor seal: 4 harbor porpoise: 0	16	136	10 delays 20 shutdowns	1 harbor seal	26	217.40	163.60	8.80	45.00
1 Oct. – 31 Oct.	28	205	beluga whale: 203 *(99 white; 76 gray; 28 dark gray)* harbor seal: 2 harbor porpoise: 0	43	112	7 delays 9 shutdowns	9 beluga whale	27	383.20	195.20	67.30	120.70
1 Nov. – 20 Nov.	22	128	beluga whale: 127 *(72 white; 39 gray; 16 dark gray)* harbor seal: 1 harbor porpoise: 0	26	69	7 delays 5 shutdowns	4 beluga whale	14	139.10	89.90	32.10	17.10
CUMULATIVE TOTALS: 2010 IN-WATER CONSTRUCTION 21 JULY – 20 NOV.	118	746	beluga whale: 731 *(422 white; 244 gray; 85 dark gray)* harbor seal: 13 harbor porpoise: 2	118	364	27 delays 41 shutdowns	14	90	861.20	548.20	110.20	202.8

Notes

1. Distribution of white, gray, and dark gray beluga whales.
2. Safety zones under the National Marine Fisheries Service Letter of Authorization (LOA): 200 meters (m) from either vibratory or impact pile driving; 50 m from other in-water project activities. Animals that entered the Safety zones also entered the Harassment zones.
3. Harassment zones under the LOA: 350 m from impact pile driving; 1,300 m from vibratory pile driving. Some of the animals that entered the Harassment zones also entered the Safety zones.
4. In-water construction activities were shut down or delayed until marine mammal(s) left the harassment zones.
5. The LOA for 15 July 2010 through 14 July 2011 allows 34 beluga whale takes, 20 harbor seal takes, 20 harbor porpoise takes, and 5 killer whale takes.

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Table 2. Comparison of MTR Project Marine Mammal Monitoring Programs

Variable	Construction Marine Mammal Monitoring Program	Scientific Marine Mammal Monitoring Program
Mission	**Monitor whale movements to assist the construction contractor in complying with the conditions of the 404/10 Permit, the LOA, and the Biological Opinion**	**Collect scientific data on beluga whales in compliance with the conditions of the 404/10 Permit, the LOA, and the Biological Opinion**
Location of Monitoring Stations	**Three locations: South Backlands, North Extension Bulkhead, and on the shore north of Cairn Point**	**One location: Cairn Point Bluff**
Number of Marine Mammal Observers (MMOs)	**Three MMOs: one at each of the three monitoring stations**	**Two MMOs: one monitoring station**
Hours per day/Days per week worked on site by MMOs	**Between 8 and 16 hours per day (depending on hours of daylight), typically 7 days per week**	**Typically between 6 and 6.5 hours per day, 4 days per week**

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FIGURES

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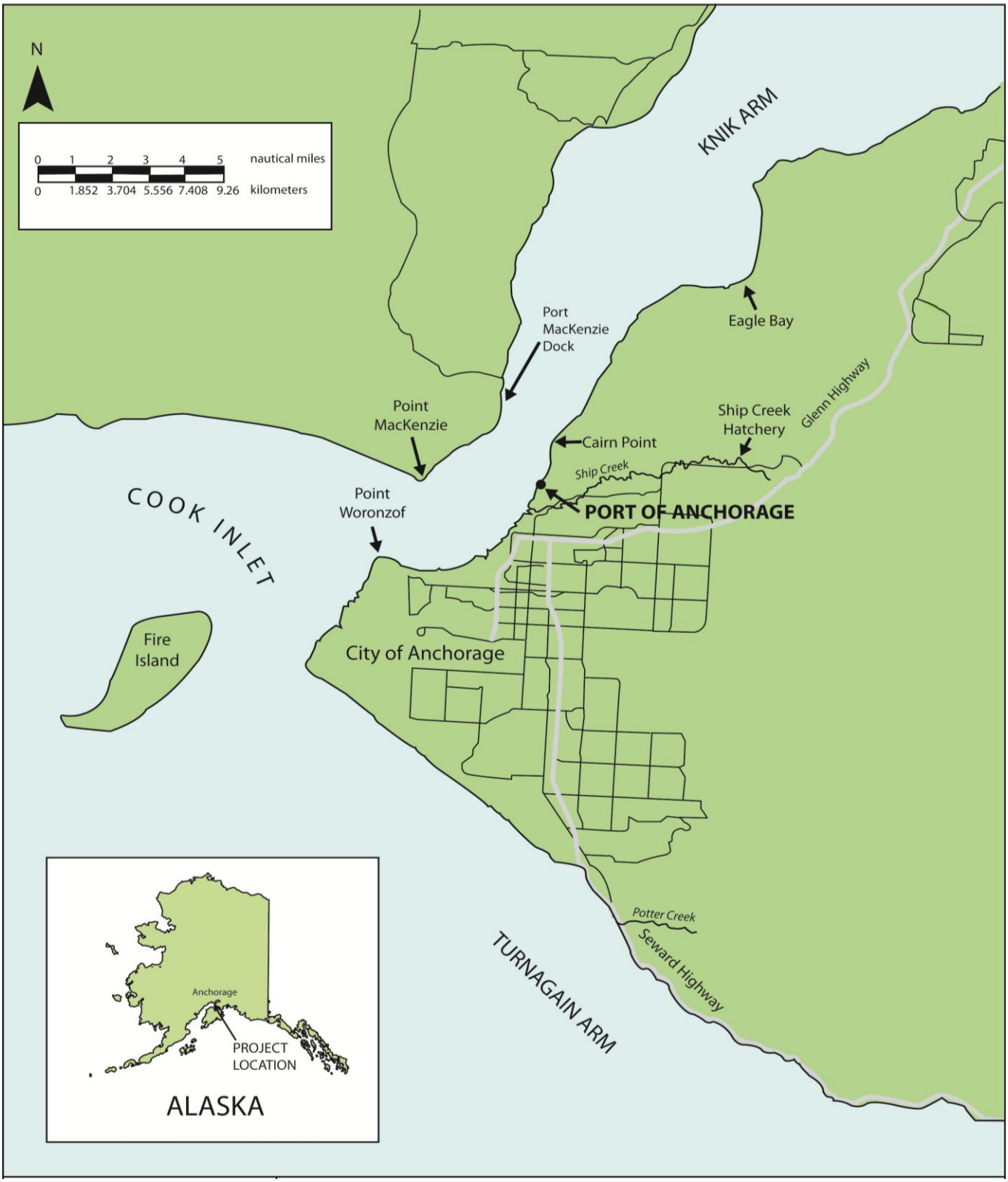

Figure 1. Port of Anchorage Vicinity Map

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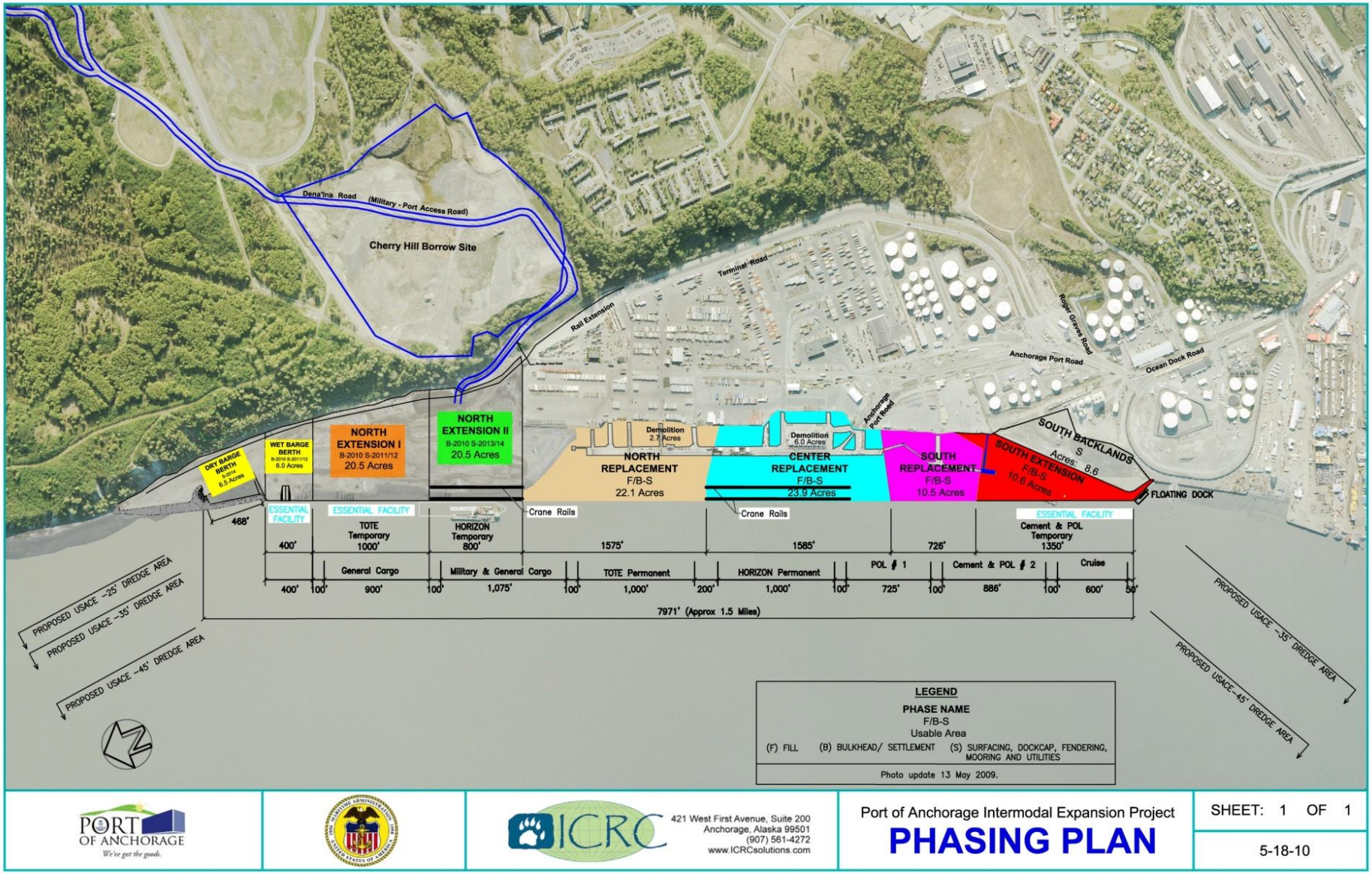

Figure 2. Port of Anchorage Intermodal Expansion Project Phasing Plan

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Figure 3. Construction Marine Mammal Observer at North Extension Bulkhead construction site

Figure 4. Manson dredge barge. White anchor buoy on far side of dredge.

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Figure 5. Marine Mammal Sighting Form 2010

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Marine Mammal Sighting Form – Project Construction Subcontractor
Port of Anchorage Marine Terminal Redevelopment Project

Date of Observation: _____ **Observer Name & Affiliation:** _____

Observer's Location: _____ **Total marine mammals sighted:** _____ ***Take Count this Sighting:*** _____

Sighting #: _____ *(1st sighting of the day is Sighting # 1)* ***If Take occurs, report immediately.***

Time of First Sighting ↓	Time of Last Sighting ↓	Weather Conditions (circle) ↓	Species (circle) ↓	Number of Marine Mammals Sighted ↓	↓	Number of Marine Mammals in Each Classification ↓	Initial Heading (circle) ↓	Final Heading (circle) ↓
		sunny sun/clouds overcast light rain rain light snow snow Other:	beluga whale harbor seal harbor porpoise killer whale Other:	**Inside Harassment Zones:**	**Outside Harassment Zones:**	*Use these color classifications for beluga whales:* **White** _____ **Gray** _____ **Dark Gray/Calf:** ___ ********** *Other marine mammals:* **Adults** ____ **Juveniles** _____ **Calves /Pups** _____ **Unknown age class**__ **Unidentified sex** ____ **Male**____ **Female**____	**N** **NE** **E** **SE** **S** **SW** **W** **NW**	**N** **NE** **E** **SE** **S** **SW** **W** **NW**

Distances / map coordinates of marine mammal(s) from in-water noise source: *(meters)* ***(even if no in-water work in progress)***

1. **Initial Distance** = _____ **Grid Map coordinates** _____
2. **Closest Distance =** _____ **Grid Map coordinates** _____
3. **Final Distance** = _____ **Grid Map coordinates** _____

Tidal Stage at time of sighting: *(circle):* ***low slack*** ***low ebb*** ***low flood*** ***high slack*** ***high ebb*** ***high flood***

Beaufort Sea State: *(circle)* ***0*** ***1*** ***2*** ***3*** ***4*** ***5***

In-Water Project Activities at time of sighting: (*check box that applies*) ☐ ***Soft start*** ☐ ***Stabbing w/ vibratory hammer***

☐ ***Vibratory hammer*** ☐ ***Impact hammer*** ☐ ***Other (non-pile driving)*** ** ☐ ***Stabbing (no hammer)***

☐ ***NO in-water activity*** ***Describe other in-water, non-pile-driving activity on Page 2.***

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Sighting # _____ / Date _____

☐ ***Project activities were (circle one) Shut Down or Delayed from _____ to _____ (time).***

☐ ***Project activities Were Not shut down. Explanation Required:***

Behavior of Marine Mammal: *(mark **X** to indicate behaviors)*

( ) traveling	**( ) diving**	**( ) resting**	**( ) milling**
( ) swimming	**( ) swimming toward construction**	**( ) swimming away from construction**	**( ) fleeing**
( ) feeding observed	**( ) feeding suspected**	**( ) mating**	**( ) other**

Describe initial group cohesion: *(orientation; how far apart)* _____

Describe final group cohesion: _____

Change in behavior? *(in response to Project construction? or other Port activities?)* ☐ ***NO*** ☐ ***YES*** → ***Time:*** _____

Describe behavioral change:

Construction activity *(if activity different than the activity recorded on page 1)* _____

Additional Information: *(describe additional behaviors and/or patterns observed)*

Maps *To the best of your ability, mark your location, location of the noise source, and the approximate initial, closest, and final locations of the marine mammal(s) on one or both grid maps* (pages 3 & 4), *as applicable. Use the page 4 map when the marine mammal's location is beyond the borders of the page 3 map.*

↓

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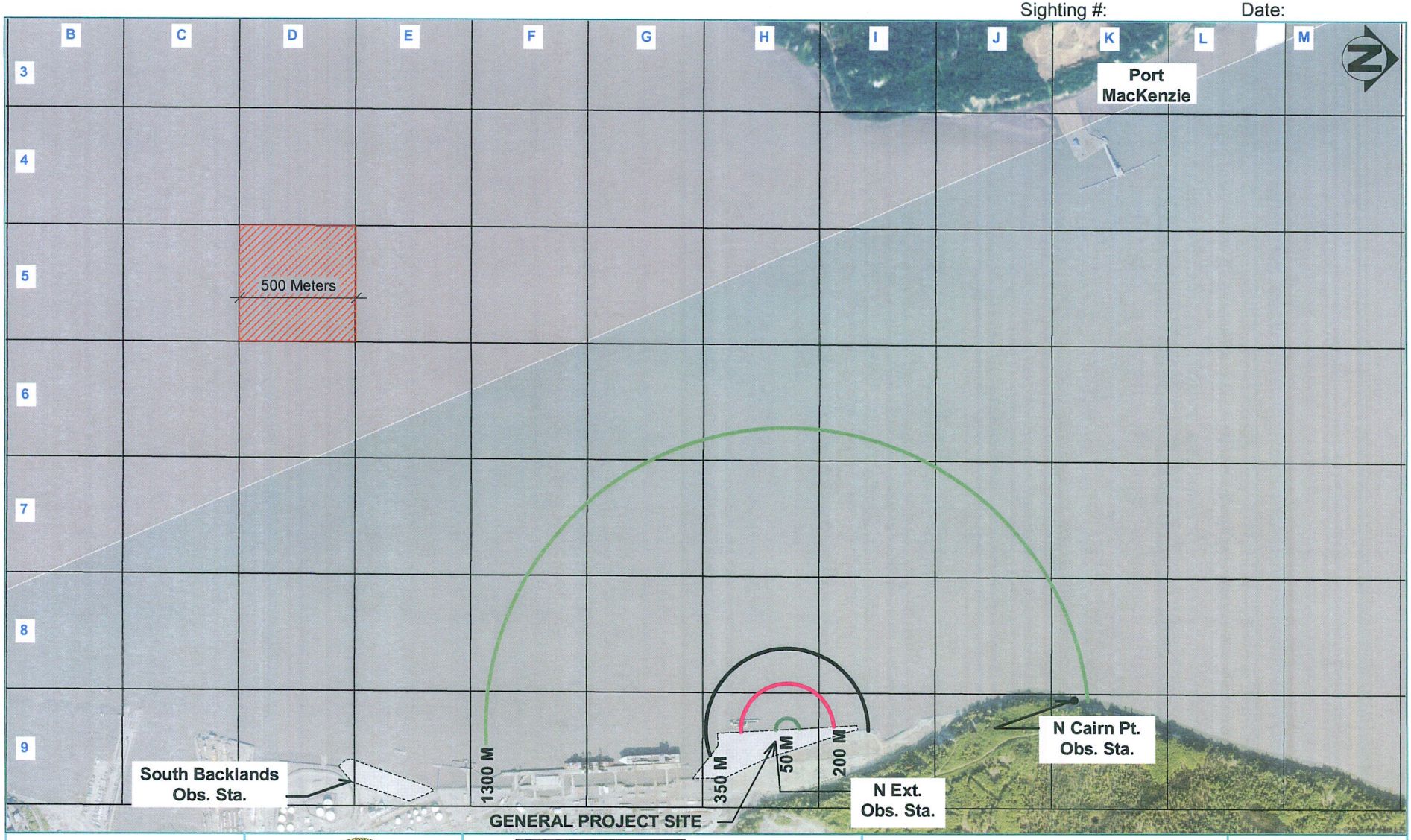
Sighting #: Date:



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Port of Anchorage Marine Terminal Redevelopment Project

Construction Marine Mammal Monitoring 2010 Grid Map

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Figure 6. Construction Marine Mammal Observer at South Backlands Monitoring Station overlooking Knik Arm. View facing west.

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Figure 7. Construction Marine Mammal Monitoring Station on the shore north of Cairn Point. View at low tide facing north.

Figure 8. Construction Marine Mammal Monitoring Station on the shore north of Cairn Point. View at low tide facing northeast.

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Figure 9. Two beluga whales swimming inside MTR Project Area within Knik Arm.

Figure 10. Scientific Marine Mammal Observers with theodolite, Cairn Point Monitoring Station on Joint Base Elmendorf-Richardson.

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Figure 11. Positioning impact hammer on sheet pile.

Figure 12. Adjusting vibratory hammer.

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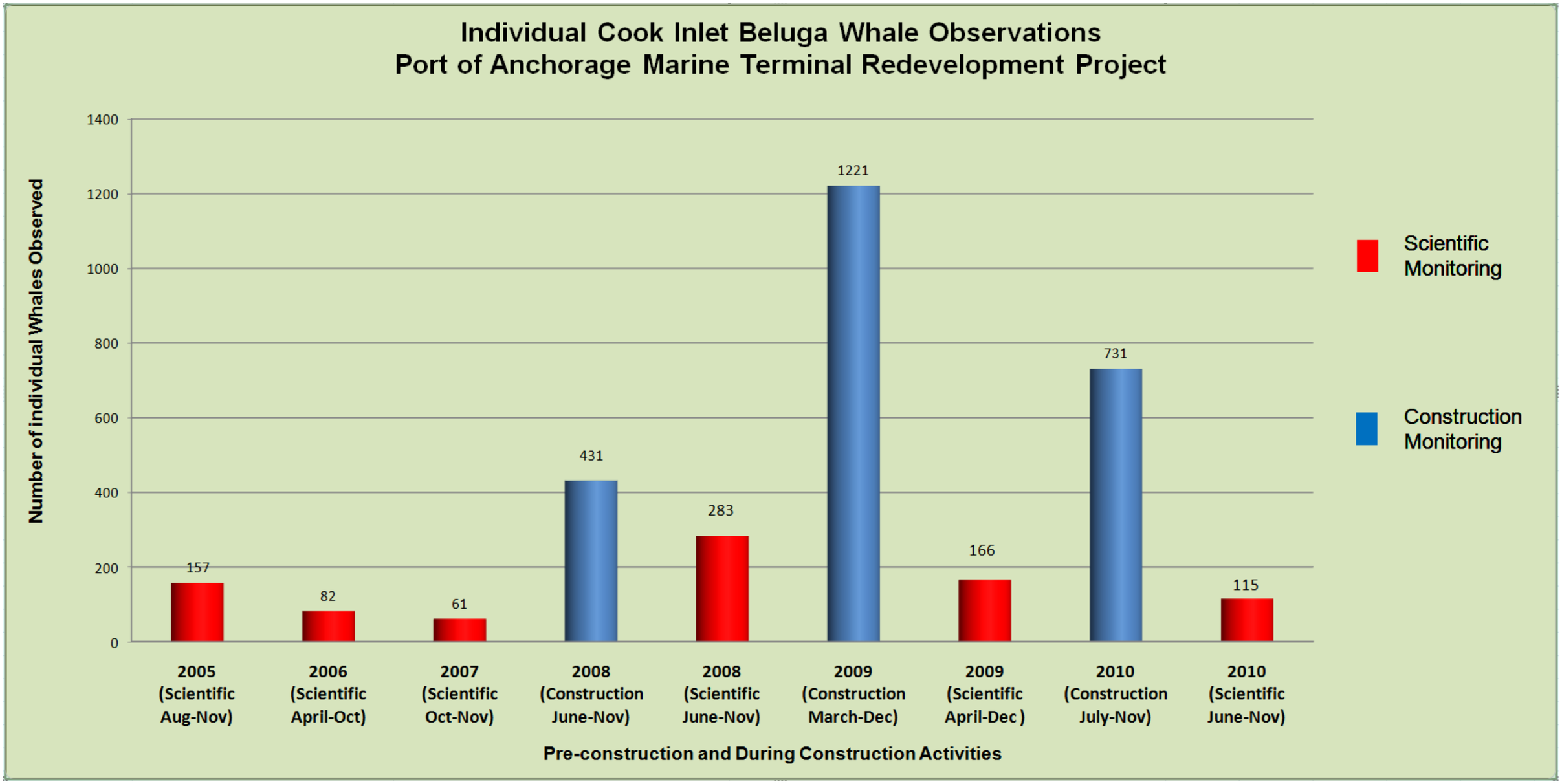

Figure 13. Individual Cook Inlet Beluga Whale Observation Port of Anchorage Marine Terminal Redevelopment Project

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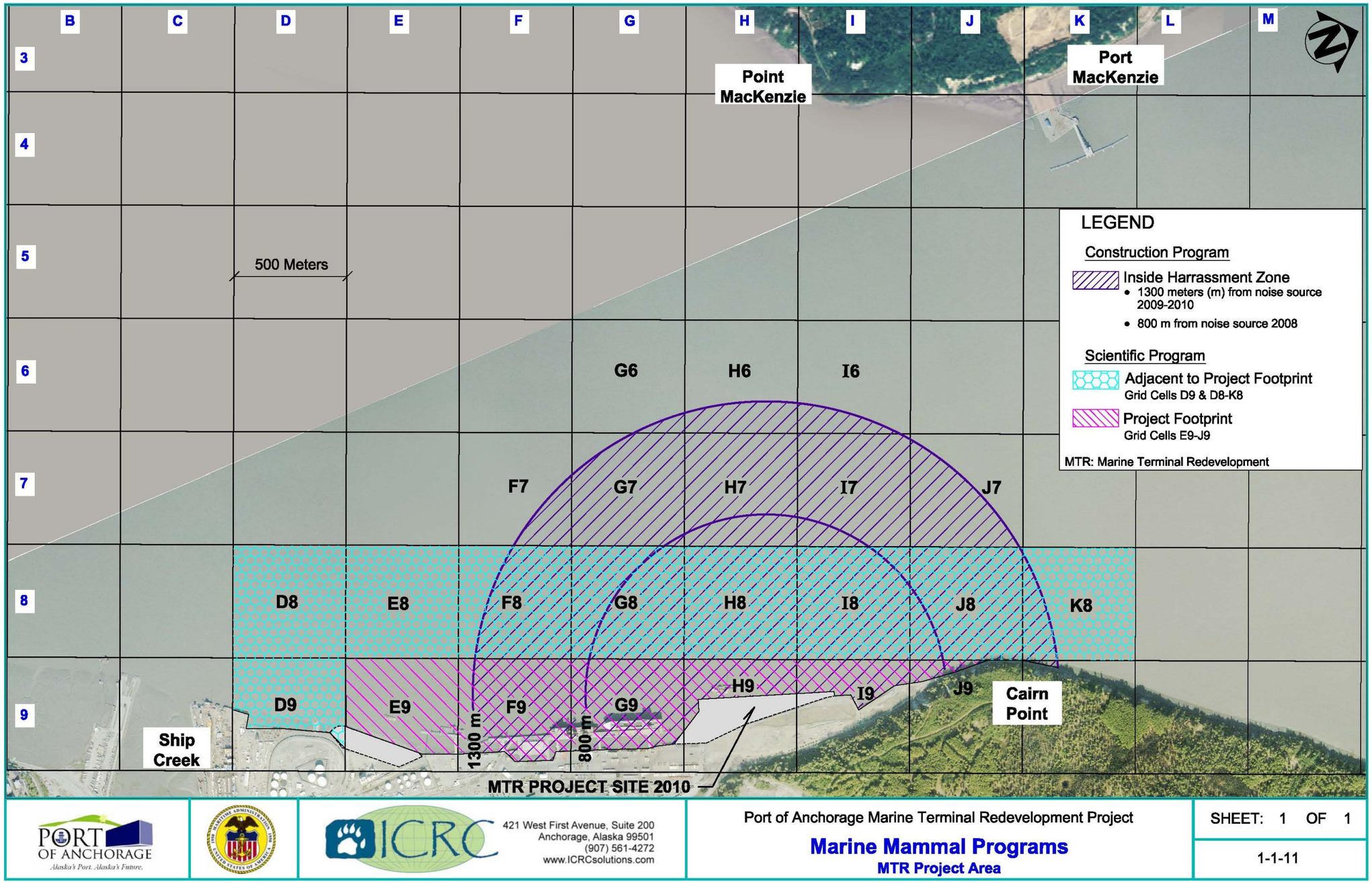

Figure 14. Marine Mammal Programs: MTR Project Area

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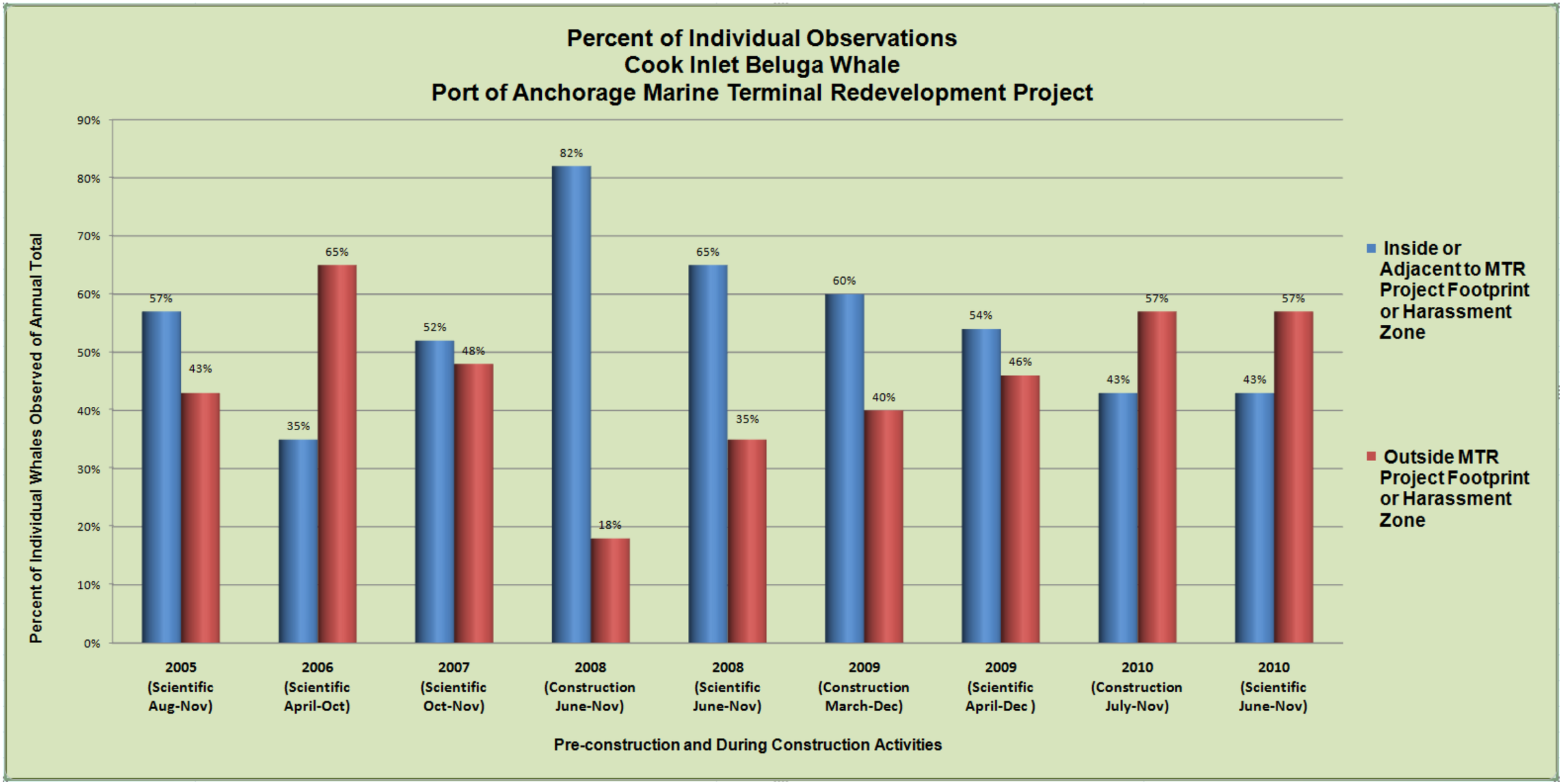

Figure 15. Percent of Individual Observations Cook Inlet Beluga Whale Port of Anchorage Marine Terminal Redevelopment Project

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APPENDIX
Scientific Marine Mammal Monitoring Program: 2010 Annual Report

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Distribution, Habitat Use and Behavior of Cook Inlet Beluga Whales and Other Marine Mammals at the Port of Anchorage Marine Terminal Redevelopment Project
June – November 2010

Scientific Marine Mammal Monitoring Program
2010 Annual Report

Prepared for

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February 2011

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1.0 Executive Summary

This report summarizes the 2010 activities of the Scientific Marine Mammal Monitoring Program (Scientific Program). The Scientific Program was conducted in support of the Port of Anchorage Marine Terminal Redevelopment (MTR) Project, as required by the 2010 Letter of Authorization (LOA) issued to the Port of Anchorage Administration (POA) and the US Department of Transportation, Maritime Administration (Maritime Administration) in June 2010 by the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS).

The Scientific Program was designed to meet the scientific monitoring objectives set forth by NMFS, within the project scope agreed upon by the POA, ICRC, NMFS, and the Maritime Administration, the lead federal agency for the MTR Project. The Scientific Program was conducted by trained graduate and undergraduate Marine Mammal Observers (MMOs) from the Alaska Pacific University (APU) Marine Biology program. *The Scientific Marine Mammal Monitoring Program 2010 Annual Report* presents information required by the LOA on Cook Inlet beluga whale (*Delphinapterus leucas*) and other marine mammal presence, habitat use and behavior within and near the Port of Anchorage (Port) in the Knik Arm of Cook Inlet, Alaska.

In addition to marine mammal monitoring and data collection efforts, Scientific MMOs provided real-time information (e.g., marine mammal sightings, proximity of animals to the construction site) to Construction MMOs working with the MTR construction crew at the Port. During APU's monitoring and data collection activities, particular emphasis was placed on documenting the presence of beluga whales within and near the MTR Project footprint and evaluating, as practicable, the potential responses of beluga whales to construction activities. This information was communicated between the Scientific and Construction MMOs.

A total of ~600 hours of observational effort was completed across 87 days from 29 June 2010 through 19 November 2010. Overall sighting conditions during the entire study period were moderate to excellent. A total of 115 beluga whales (80 white, 32 gray, 3 dark gray calves) in 42 groups was observed during the monitoring period, resulting in an overall sighting rate of 0.13 groups sighted per hour of effort. Mean group size was

2.7 ± .35 individuals. Only three groups contained identified calves, one of which was sighted within the MTR Project footprint. The overall sighting rate, total number of whales, total number of calves, and mean group size with calves were lower in 2010 compared to previous years with comparable sampling efforts, but these differences were not statistically significant.

No immediate negative behaviors (e.g., abrupt behavioral changes, rapid descents) were observed in response to pile driving or other MTR in-water construction activities. However, there is preliminary evidence that beluga whales have altered habitat use patterns in Knik Arm by avoiding the area in and around the MTR Project footprint and increasing use of the mid-channel and western shoreline.

2.0 Program Objectives

The Scientific Program addresses the following objectives:

1. Estimate the frequency at which beluga whales and other marine mammals are present within and adjacent to the MTR Project footprint;
2. Characterize habitat use and behavior of beluga whales near the MTR Project footprint during ice-free months in the Knik Arm of Upper Cook Inlet; and
3. Observe, analyze and document potential changes in beluga whale and other marine mammal habitat use and behavior in response to in-water construction.

APU provided Scientific MMOs, under the supervision of Associate Professor Dr. Leslie Cornick, Environmental Science Department, to staff the Cairn Point Marine Mammal Monitoring Station (Cairn Point Station) located on Joint Base Elmendorf Richardson (JBER). Scientific MMOs worked up to four days per week, eight hours per day. During in-water construction activities, Scientific MMOs informed Construction MMOs of the presence, direction of travel, and proximity to the MTR Project footprint of beluga whales so that the appropriate course of action could be determined for pile driving or other in-water work. Scientific MMOs were not responsible for construction shutdown decisions.

3.0 Methods

Under the supervision of Dr. Leslie Cornick, the Scientific MMOs received training in marine mammal identification and behavior, shore-based observational methodologies, and ICRC, POA, and JBER safety and security protocols. Schedules and training were

coordinated by two student supervisors. All observations were conducted by teams of two observers.

3.1 Study Area and Observation Station

The study area included all waters of the Knik Arm of Upper Cook Inlet visible from the Cairn Point Station (Figure 3.1), which directly overlooks the MTR Project footprint (Figure 3.2). An observation platform at Cairn Point Station provided height above sea level near the shoreline (62.0 meters (m) /203 feet (ft) above mean low low water; MLLW).

The added height of the platform maximized the probability of detecting beluga whales in and around the Port. The POA holds a Right-Of-Entry Permit from JBER to access Cairn Point.

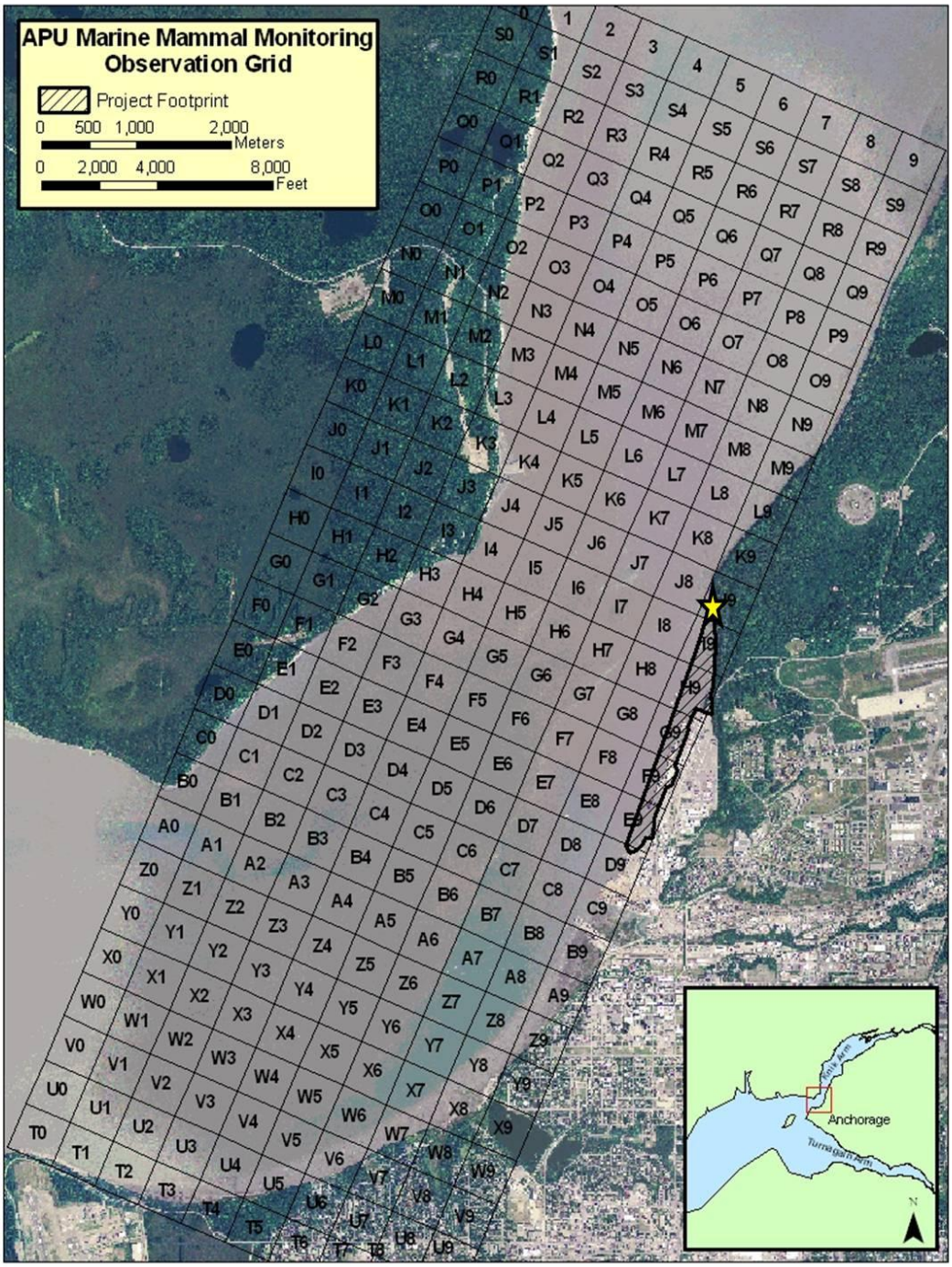

Figure 3.1. Map of the study area with 500 x 500 m grid overlay. MTR Project footprint is outlined and cross hatched (Grid Cells D9 – J9). Cairn Point Station is indicated by the yellow star (Grid Cell J9).

Figure 3.2. Cairn Point Station at Joint Base Elmendorf Richardson, Anchorage, Alaska (theodolite facing west).

3.2 Sampling Effort

Marine mammal monitoring was conducted up to 4 days per week in 4 to 6 hour shifts up to 32 hours per week, covering the full range of tidal cycles as practicable during hours of access to Cairn Point Station (Monday through Friday 0700 – 1900, Saturday 1000 – 1800). Observation start and end times were adjusted according to changes in daylight. Monitoring days were scheduled to provide a sample of beluga whale habitat use and behavior under varying conditions (e.g., noise, vessel traffic, environmental conditions), while accommodating the logistical, safety and security concerns of POA, JBER, ICRC and APU.

3.3 Sampling Protocols

The following sections describe APU's data collection, analysis and reporting protocols for conducting the Scientific Program. Data sheets were reviewed for accuracy prior to data entry, and electronic data bases were spot checked with data sheets randomly by Dr. Cornick or a supervisor for quality assurance and control.

3.3.1 Environmental Conditions

Environmental data pertaining to sighting conditions were logged hourly during observation sessions. These conditions included air temperature (^{o}C), wind speed (kilometers per hour; km/hr), sea state (Beaufort scale[1]), swell height (m), glare (presence/absence), percent cloud cover, percent ice cover and precipitation.

3.3.2 Port of Anchorage Activities

The number and type of vessels at the Port were documented during monitoring sessions throughout the observation period. MTR Project activities, including pile driving, dredging and in-water fill placement, were noted at regular intervals during all observation periods in order to facilitate examination of beluga whale occurrence and behavior with respect to these activities. When pile driving was recorded, this activity was further categorized as soft start, impact pile driving or vibratory pile driving based on visual and auditory signatures of each activity and communication with the Construction MMOs. The duration of pile driving and sheet pile pulling activity and other in-water construction activities (e.g., in-water fill placement) was also recorded.

3.3.3 Beluga Whale Observations

Each observer of the two-person team, equipped with binoculars (Bushnell 7x50 with internal compass and range-finding reticle; Nikon Monarch ATB 10x42), conducted beluga whale observations using 10-minute scan samples. Detailed observation protocols can be found in the *Scientific Marine Mammal Monitoring Plan*.

Beluga whales were classified by color (white, gray, dark gray). White beluga whales are typically adults and gray beluga whales are typically juveniles; however there is considerable variation in the age at which beluga whales acquire their full white color. Therefore, color cannot be used reliably to determine maturity. Dark gray beluga whales were classified as calves.

Scans were recorded on standardized marine mammal monitoring forms (Appendix). When beluga whales were observed, the following information was recorded: date, time, number of whales sighted, color classification (white, gray, dark gray), heading and

[1] The Beaufort sea state scale is defined as: 0 = mirror-like; 1 = ripples without foam crest; 2 = small wavelets, crests do not break; 3 = large wavelets, scattered white caps; 4 = small waves, fairly frequent white caps.

[2] Data referenced in Saxon-Kendall (2010) were collected by LGL Alaska Research Associates, Inc. under contract to ICRC for the POA during the period 2005 – 2006, and by the Scientific

direction of travel, behavior, location and group swimming formation. Detailed data were also collected as feasible and practicable regarding the locations, movements and behavior of beluga whales near the Port. Locations were initially classified according to a grid-cell mapping system using bearings obtained from sighting binoculars and distances estimated by eye (Figure 3.1). Focal group sampling was used to document the behavior of whales (Mann 2000). Whales were tracked and behaviors were recorded until the whales were no longer in view, and the standard 10-minute scanning protocols were resumed.

If other marine mammal species were observed, the same protocols were followed as described above.

3.3.4 Theodolite Tracking

A tripod-mounted surveyor's theodolite (Topcon D-200) connected to a laptop computer was used to track beluga whale movement patterns (Prevel Ramos *et al*. 2006). Horizontal (azimuth) and vertical (declination) readings from the theodolite were used to calculate the position of whales. Accurate assessment of whale group locations was facilitated by precise measurement of height and location of Cairn Point Station and input of tide tables to account for tidal variation during the sample. Beluga whale group location data were estimated for tidal variation during the sampling period using J-Tides tide prediction website (http://www.arachnoid.com/JTides/) and corrected using final recorded tide height data from NOAA Tides and Currents (www.tidesandcurrents.noaa.gov).

Theodolite tracking data were used to measure the distance of whales from MTR construction activities and to detail whale movement patterns and habitat use with the highest level of precision for shore-based observations. Successive location fixes of moving objects were used to calculate parameter estimates related to movement patterns (e.g., speed, linearity, re-orientation rate, bearing). Fixes of multiple objects were used to calculate distance between objects (e.g., whales) and orientation (toward, away, neutral). Time stamping of horizontal and vertical angle-fix information, input of other observations (e.g., group size, behavior, and environmental parameters) and rapid, real-time longitude-latitude position and movement pattern calculations were recorded using *Pythagorus* (http://www.tamug.edu/mmrp/Software/pythagoras/Index.html). GIS-

compatible whale tracks were calculated to estimate distances between whales and shore and record movements of beluga whale groups.

3.3.5 500m x 500m Grid

In order to maintain sighting consistency and allow for simplified display of spatial data with respect to the MTR Project footprint, APU also continued to employ a grid system (500m x 500m grids) to monitor the locations and movements of beluga whales in Knik Arm (Funk *et al*. 2005). MMOs used a combination of compass bearings taken from binoculars and landmarks to place the locations of whale groups in grid cells during each sampling interval. Grid cell locations were updated as the whales moved through the study area. The MTR Project footprint is located within cells D9 to J9 of the grid (Figure 3.1). The grid cell system was also used to communicate whale position information to the Construction MMOs.

3.3.6 Group Size, Composition and Behavioral Sampling

When whales were sighted during scan samples, detailed focal group behavior was recorded continuously until whales were out of view (Martin and Bateson 1986, Mann 2000). Behavioral state (Table 3.1), swimming formation, inter-individual distance/group spread and noteworthy behavioral events (e.g., spy hopping, vocalizations, rapid chases) were documented for each group.

Table 3.1 Beluga Whale Behaviors.

Beluga Whale Behavior Classifications[1]	
Traveling/Moving	Startled effect
Diving	Approaches then leaves
Motionless on surface	Change in swimming speed
Spyhopping	Abrupt change in direction
Breaching	Abrupt dives
Feeding Observed	Disperse
Feeding Suspected	Other
Milling	

1. Behaviors may be classified as either primary or secondary.

3.4 Data Entry and Analysis

All observations including marine mammal activity, environmental conditions and vessel activity were documented on standardized datasheets (Appendix). Data were then checked for accuracy and entered into SPSS v. 18 for Windows for storage and

analysis. Sampling intervals were classified into their observational hour by the start time of the interval. Observational hours are defined as each hour on the hour from 0800 – 1900 in order to encompass the entire range of effort. Alpha levels were set at $p < .05$. All values are reported as mean ± 1 standard error unless otherwise noted.

3.4.1 Environmental Conditions

Environmental conditions were summarized for each season (spring, summer, fall) in order to characterize the predominant viewing conditions.

3.4.2 Sighting Rates and Temporal Distribution

Beluga whale sightings were summarized for monthly reporting purposes by overall sighting rate (beluga whale groups per hour of effort), time of day and tidal stage. Data for the complete 2010 reporting period are summarized by overall sighting rate and sightings across time of day, tidal stage, and season. Seasons are defined in the database as spring (May – June), summer (July – September) and fall (October – November), and are based broadly on the solstice (summer) and equinox (spring, fall). One-way analysis of variance (ANOVA) was used to examine differences in sighting duration across time of day for 2010 and interannual differences in mean sighting rates.

Daily tidal heights were classified into six stages, each two hours long and defined as hours before (-) or after (+) low tide (Figure 3.3). Tidal stages initially derived from J-Tides were corrected prior to data analysis based on the NOAA Tides and Currents, Anchorage (Knik Arm) reporting station located at the Port (station ID 9455920).

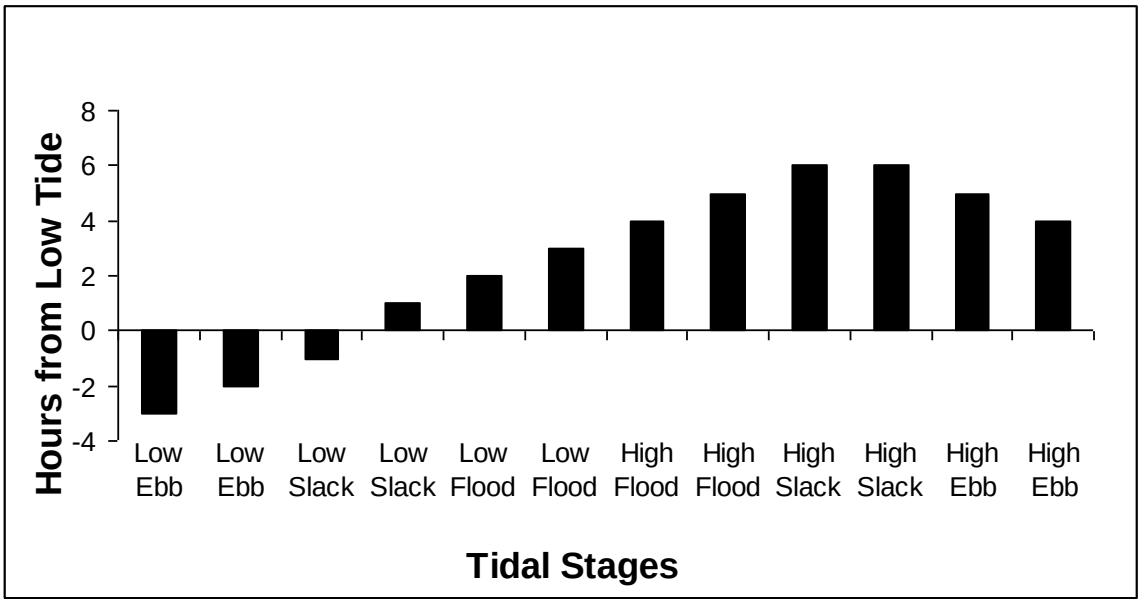

Figure 3.3 Classification of daily tidal cycles into six stages of two hours each. The stages are defined as hours before (-) or after (+) low tide. Repeats for each stage illustrate gradual transition from one stage to the next.

3.4.3 Spatial Distribution

Sightings were summed for all grid cell locations where beluga whales were sighted during the observation period and classified according to whether the whales were observed outside, adjacent to or within the MTR Project footprint. Habitat use of whales in each location was calculated as total number of beluga whale groups sighted, total number of whales sighted and total observation time.

Habitat use and movement were mapped using ArcGIS ArcInfo 9.3 to display whale track lines obtained from theodolite fixes and translated in *Pythagoras*. Habitat use was determined by overlapping track lines with grid cells and summing the total number of beluga whale groups sighted within each grid cell. Beluga sightings during tidal stages were determined by overlapping track lines with grid cells and matching the time of day whales were observed with the correct tidal stage.

3.4.4 Group Size, Structure and Behavior

Mean group size and structure were analyzed for all sightings and according to whether the whales were observed outside, adjacent to or within the MTR Project footprint. Behavioral states were summarized for all whale groups observed and unusual behaviors noted, if observed. One-way analysis of variance (ANOVA) was used to examine interannual differences in mean group size and composition.

3.4.5 Other Marine Mammals

No other marine mammals were sighted during the 2010 reporting period.

4.0 Results

A total of 599.7 hours of observation was completed from 29 June – 19 November 2010, with the majority of effort taking place during the summer (July – September; Table 4.1). Monitoring shifts ranged from 0800 to1900, with shifts scheduled as either morning (~0800 to 1200) or afternoon (1200 – 1600 or 1400 – 1900). Effort hours were largely evenly distributed across this time range, with some tapering of the earliest morning and latest afternoon hours in October and November as light levels decreased.

Table 4.1. Observational effort by season.

Season	Days	Hours
Spring (Jun)	3	11
Summer (Jul - Sep)	52	402.4
Fall (Oct - Nov)	32	186.3
Total	87	599.7

4.1 Environmental Conditions

Environmental data are summarized in Table 4.2. Overall sighting conditions during the entire study period were moderate to excellent. Glare sufficient to obstruct sightings was present during 139 days of observations during the summer and fall.

Table 4.2. Environmental conditions by season.

Season	Overall Conditions	Primary Sea State	Wind Speed (km/hr)	Temperature (°C)	Visibility (km)	Cloud Cover (%)
Spring (Jun)	Moderate	2	5.1	15.0	10.0	71
Summer (Jul - Sep)	Excellent	2	3.3	14.7	9.3	75
Fall (Oct - Nov)	Excellent	2	4.0	3.6	9.7	64

Overall conditions and primary sea state are reported as most frequently observed.

Wind speed, temperature, visibility and % cloud cover are reported as means.

4.2 Beluga Whales

A total of 115 beluga whales (80 white, 32 gray, 3 dark gray calves) in 42 groups was observed during the period 29 June – 19 November 2010 (Table 4.3). This resulted in

an overall sighting rate of 0.13 groups sighted per hour of effort. The following sections describe temporal and spatial distribution, group size and structure, and behavior of beluga whales across time of day, tidal stage and season during 2010.

Table 4.3. Beluga whale sighting summary.

						Group Composition			
Date	Grid Cell	Time	Duration of Observation (min)	Time within Footprint[1] (min)	Group #	White	Grey	Calf/ Dk. Grey	Total
12.08.10	G2, H3, I4, J4, G4, H4, H5, I5, J5	1830-1903	33	0	1	9	1	0	10
16.08.10	J9, I9, I8, I7, H7, G7, G8, F8, E8, D8, F9, G9, H9	1621-1648	27	3	1	1	0	0	1
18.08.10	I9, H9, G9, F9, F8, E8, E9, D9, D8, D7, C8	1519-1557	38	6	1	0	3	0	3
18.08.10	D8, D7, E7, H9, G9	1529-1548	19	0	2	0	1	0	1
18.08.10	G9	1530-1540	1	0	3	0	1	0	1
18.08.10	D8, E8, E9, G7, G8, H7, I7, I8, J8, F9, G9, H9, I9, J9	1559-1635	36	2	4	0	4	0	4
23.08.10	T2	0814-0820	6	0	1	1	0	0	1
23.08.10	T0	0826-0827	1	0	2	3	0	0	3
24.08.10	C9, D9, F9, G9, H9	1550-1600	10	5	1	0	3	0	3
01.09.10	M4	0931	1	0	1	3	0	0	3
01.09.10	K7, K8	1410-1417	7	0	1	2	0	0	2
07.09.10	L3, L4	1332	1	0	1	1	0	0	1
08.09.10	L3, J4, I4, L4, K4	1340-1352	12	0	1	2	0	0	2
08.09.10	K5	1359-1400	1	0	2	1	0	0	1
08.09.10	K4, J4, J5	1440-1509	29	0	3	2	0	0	2
13.09.10	G9, G7, K8	0840-0850	10	3	1	3	0	0	3
13.09.10	F9, G9, H9, E7, E6	1307-1320	13	13	1	5	0	0	5
14.09.10	K8, J8	1745-1755	10	0	1	0	4	0	4
14.09.10	K8, J8	1754	1	0	2	0	8	0	8
05.10.10	P2	1032	1	0	1	2	0	0	2
05.10.10	M3, I4	1039-1048	9	0	2	1	0	0	1
05.10.10	M3, L3, K3, K4, J4, I4, H3, F2, E1, D2, D1, C1, C0, B0	1040-1200	80	0	3	8	0	0	8
06.10.10	B1, B0	1419-1524	65	0	1	1	1	0	2
06.10.10	D1, E1	1656-1710	14	0	2	6	0	0	6
06.10.10	D1, C0, B0	1715-1737	22	0	3	2	0	0	2
09.10.10	D9, E9	1145-1154	10	10	1	4	1	1	6
09.10.10	E7, F6, J6	1329-1353	14	0	2	0	1	1	2
19.10.10	I8, J8	1325-1330	5	0	1	3	1	1	5
20.10.10	H3,G2, F2, E1, D1, C0	1018-1110	52	0	1	1	0	0	1
23.10.10	A2	0921-0923	2	0	1	2	0	0	2
23.10.10	B0, D0, D1, E1, F1, F2, G2, H3, I4, J4, K4	1352-1449	57	0	2	5	0	0	5
24.10.10	I5	1300	1	0	1	1	0	0	1
24.10.10	H5	1310	1	0	2	1	0	0	1
24.10.10	G5	1337	1	0	3	1	0	0	1
24.10.10	H5	1350	1	0	4	1	0	0	1
03.11.10	L6	1252	1	0	1	1	0	0	1
06.11.10	J8	1345	1	0	1	3	1	0	4
07.11.10	D9	1625	1	1	1	2	0	0	2
09.11.10	A8	1210	1	0	1	0	1	0	1
09.11.10	Z9	1224	1	0	2	0	1	0	1
11.11.10	K4	1220	1	0	1	1	0	0	1
17.11.10	E9	1452	1	1	1	1	0	0	1
Total			**598**	**44**		**80**	**32**	**3**	**115**

[1]Footprint Grid Cells D9-J9

4.2.1 Sightings by time of day

Beluga whale sightings occurred during all hours of the day (Figure 4.1). The majority of sightings occurred between 1200 and 1500, with two smaller peaks from 0800 – 0900 and from 1700 – 1800. The mean duration of sightings was 14.2 ± 3.0 min. There were no significant differences in the mean duration of sightings across time of day.

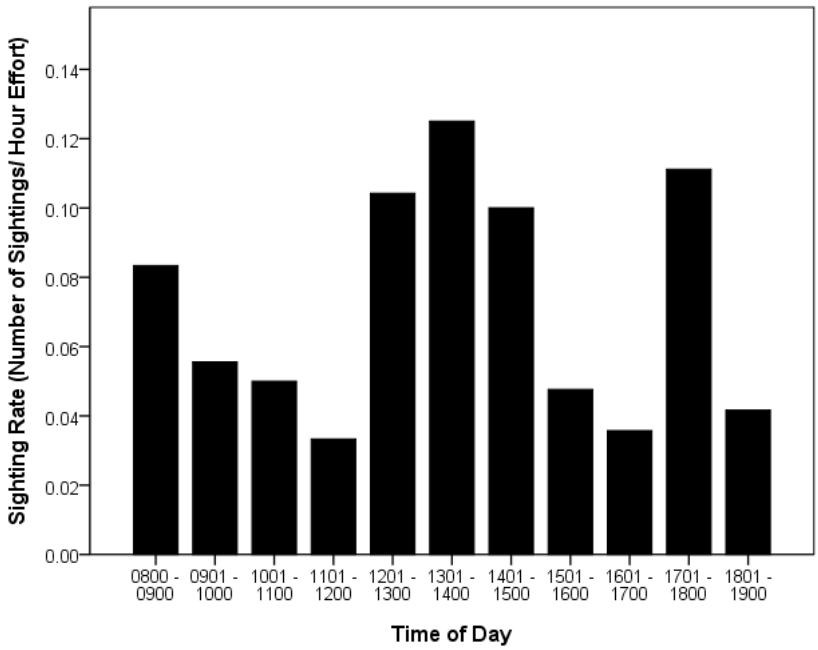

Figure 4.1. Beluga whale sighting rate (number of beluga whale groups sighted per hour of effort) by time of day. Sightings are classified into the hour in which they began.

4.2.2 Sightings by tidal stage

Beluga whales were sighted during all six tidal stages (Figure 4.2). The majority of sightings occurred during the low ebb tide, followed by low and high slack tides. The fewest number of sightings occurred during the high flood tide.

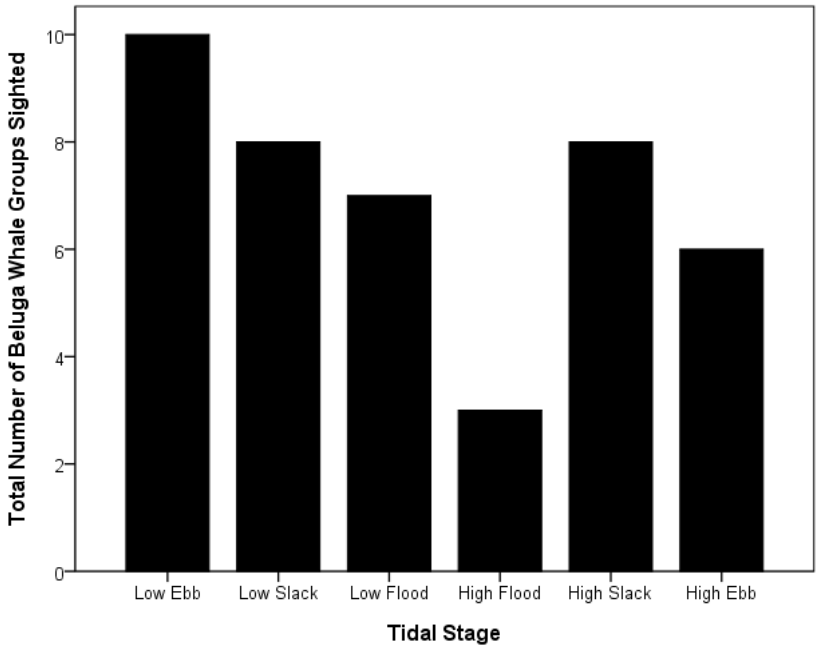

Figure 4.2. Beluga whale sightings by tidal stage. The stages are defined as hours before (-) or after (+) low tide; each stage is two hours in duration.

4.2.3 Sightings by season

Sighting rates were nearly three times higher in the fall (Oct – Nov) than in the summer (Jul – Sep), and no beluga whales were sighted during the spring (May – Jun) or during the month of July (Figure 4.3). However, during 2010 observations did not begin until 29 June, which is later than in two of the three previous years (2008 – 2009).

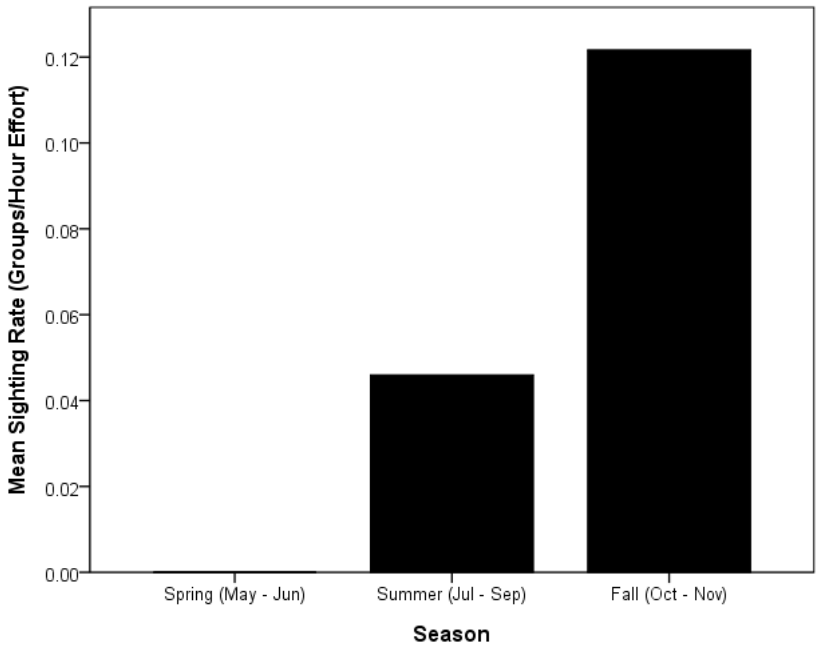

Figure 4.3. Beluga whale sighting rate (number of beluga whale groups sighted per hour of effort) by season.

4.2.4 Spatial distribution relative to the MTR Project footprint

Beluga whales were sighted throughout the study area (Figure 4.4). Nine of the sightings, approximately 21% of the total sightings (n = 42), occurred within the MTR Project footprint, including 1 of the 3 calves sighted. Five additional sightings occurred adjacent to the MTR Project footprint, including 1 calf. Beluga whales spent a total of 80 minutes (min) within or adjacent to the MTR Project footprint, ~13 % of the total observation time (598 min). The greatest concentration of whale observations (65 out of 115 whales sighted, ~57%) occurred outside the MTR Project footprint.

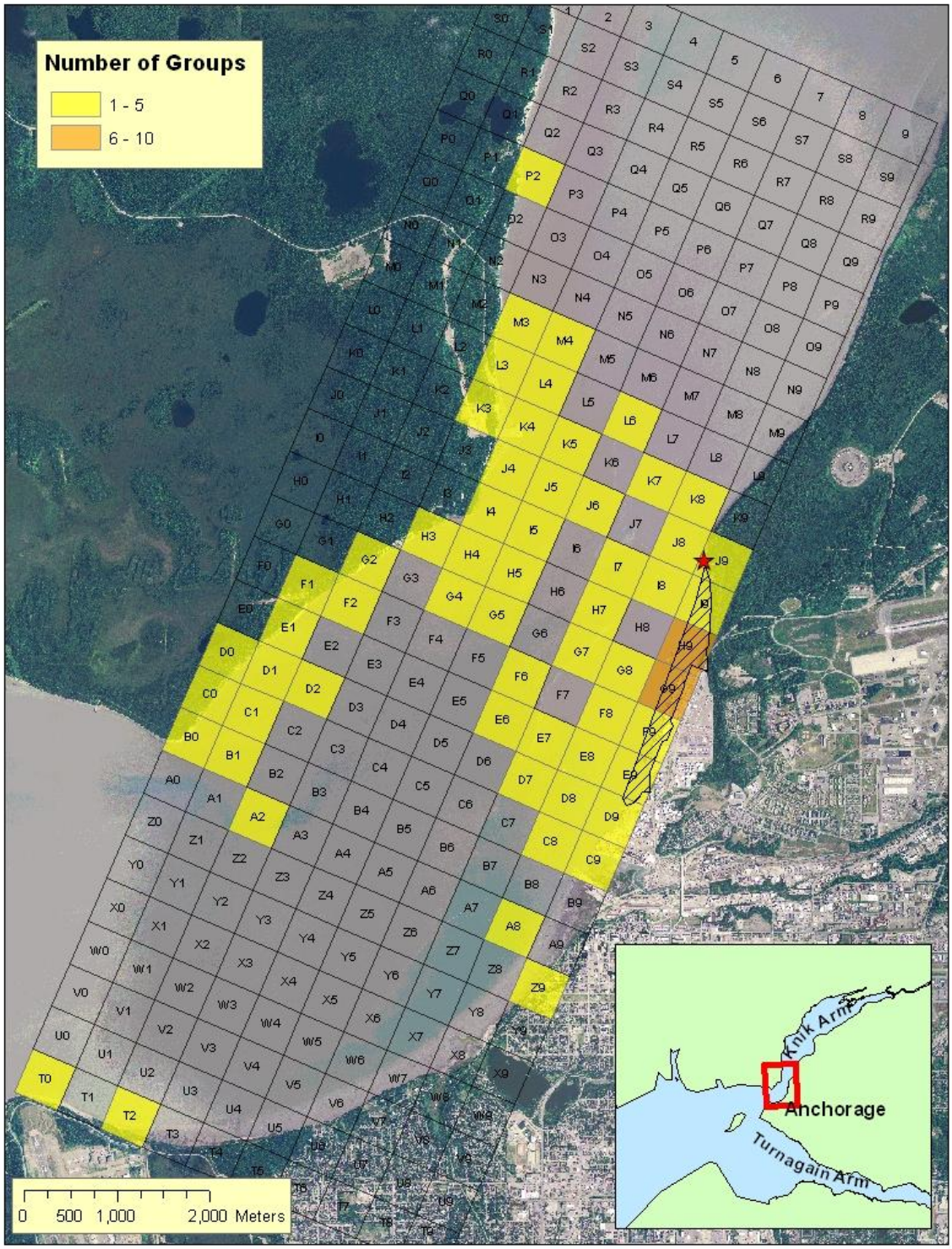

Figure 4.4. Spatial distribution of beluga whales. MTR Project footprint is outlined in black and crosshatched (Grid Cells E9 – J9). Cells are color coded by the total number of beluga whale groups sighted during the entire reporting period 29 June – 19 November 2010.

4.2.5 Spatial distribution by tidal stage

Spatial distribution by tidal cycle was primarily along the shoreline (Figures 4.5 – 4.6). Beluga whales were fairly evenly distributed across Knik Arm during low tides, with increased presence on the eastern shoreline (closest to the MTR Project footprint) during low flood (Figure 4.5c) and high slack (Figure 4.6b) and high ebb (Figure 4.6c) tides. During low slack tides, whales were concentrated on the western shoreline between Port MacKenzie and Point MacKenzie (Figure 4.5b). Six of the 42 beluga whale groups (~14%) were sighted during high flood tide (Figure 4.6a).

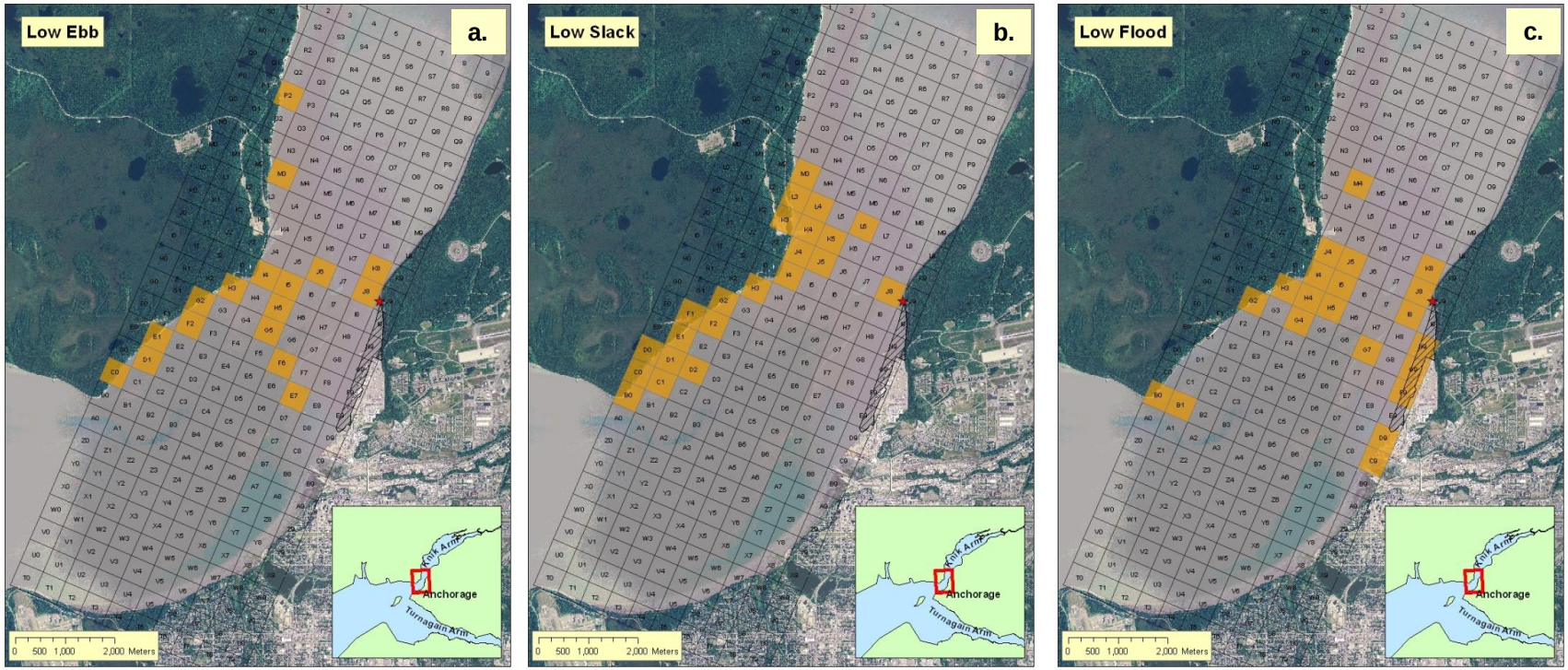

Figure 4.5. Spatial distribution of beluga whale sightings during a) low ebb, b) low slack and c) low flood tides. MTR Project footprint is outlined in black and crosshatched. Cairn Point Station is indicated by the red star. Panels are ordered according to daily tidal cycles (see Figure 3.3).

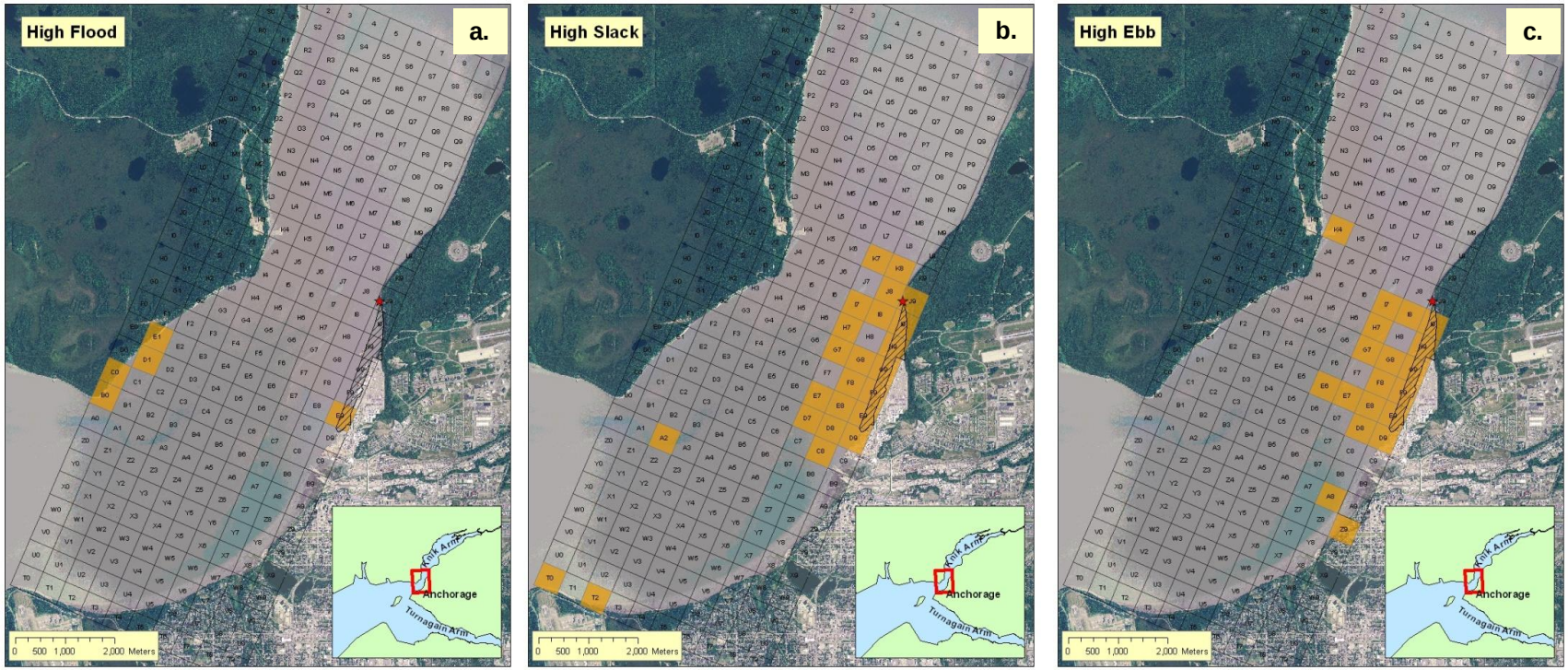

Figure 4.6. Spatial distribution of beluga whale sightings during a) high flood, b) high slack and c) high ebb tides. MTR Project footprint is outlined in black and crosshatched. Cairn Point Station is indicated by the red star. Panels are ordered according to daily tidal cycles (see Figure 3.3).

4.2.6 Group Size and Structure

Mean overall group size was 2.7 ± 0.35 individuals. Only 3 groups contained identified calves, and groups with calves were larger on average (4.3 ± 1.2 individuals) than those without (2.6 ± 0.36). Two of the 3 groups containing calves were sighted within or adjacent to the MTR Project footprint.

Twenty-one of the 25 groups with more than one individual were densely packed and moving in a unified pattern (either aligned or abreast). The remaining three groups were traveling or milling in dispersed groups. Two of the 3 groups with calves were traveling in densely packed groups. The remaining group with calves was milling in a dispersed group.

4.2.7 Movements and Behavior

Whales were primarily observed moving south through the study area during the mid-summer (Aug), and traveling north during the late summer and early fall (Sep – Oct). Traveling and milling were the only behaviors recorded during the study period. Diving was not observed, and there were no suspected or confirmed feeding events. No unusual behavioral events (e.g., abrupt directional changes, rapid descents) were observed during the study period.

4.2.8 Responses to Pile Driving

There were no observed behavioral changes (e.g., abrupt change of direction, rapid descents) or other indicators of acute response to pile driving or other in-water construction.

4.2.9 Other Marine Mammals

No other marine mammals were sighted by the Scientific MMOs during the reporting period.

4.3 Interannual Comparisons

The following sections examine differences in beluga whale sighting rates, spatial distribution and behavior from 2007 – 2010. During 2007, observations were conducted only during October and November, so comparisons including 2007 are limited to overall sighting rates, mean group size, and broad patterns of habitat use and behavior. During

2010 only 2 days of observations were conducted during the spring, so seasonal comparisons are focused on summer and fall from 2008 – 2010.

4.3.1 Interannual differences in beluga whale sightings

Overall sighting rates of beluga whales have declined steadily since 2007 (Figure 4.7). This decline is not statistically significant; however this may be a function of seasonal variability in sighting rates. Sampling effort did not differ significantly between the four years. Mean group size declined during 2009 and 2010 from previous years; however these differences were not statistically significant (Figure 4.8). Mean group size for groups with calves continued to decline in 2010 (4.3 ± 1.2) relative to previous years (Figure 4.9). The large group size for groups with calves in 2008 (12.9 ± 3.4) was larger than all other years, but these differences were not statistically significant.

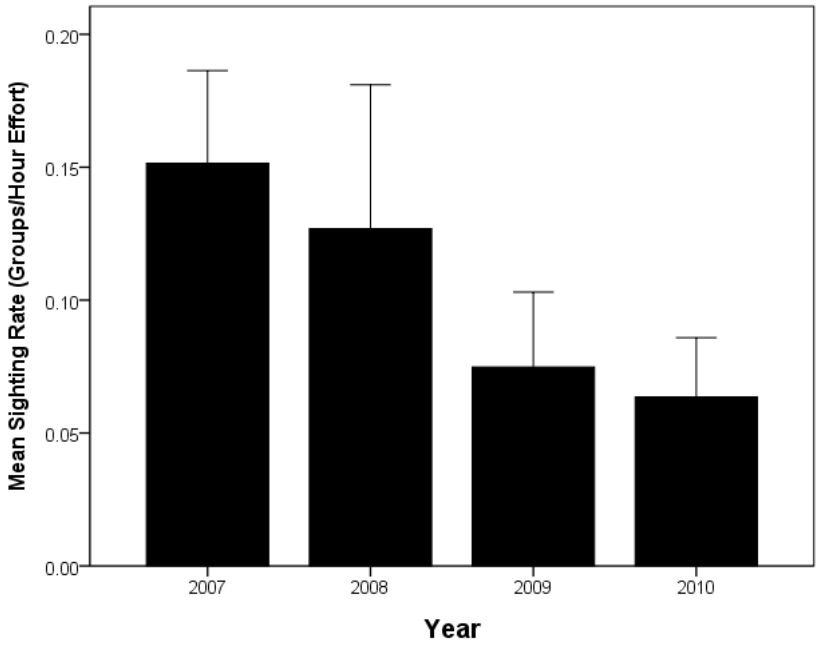

Figure 4.7. Mean sighting rates of beluga whales each year from 2007 – 2010. Error bars represent one stand error of the mean. Differences in sighting rates across years were not statistically significant.

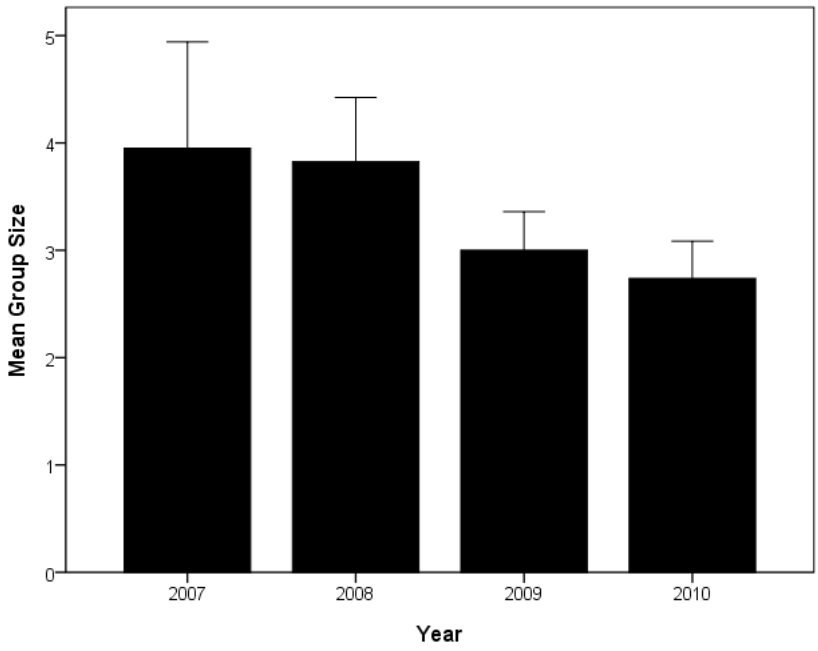

Figure 4.8. Mean group size for all groups each year from 2007 – 2010. Error bars represent one stand error of the mean. Differences in group size across years were not statistically significant.

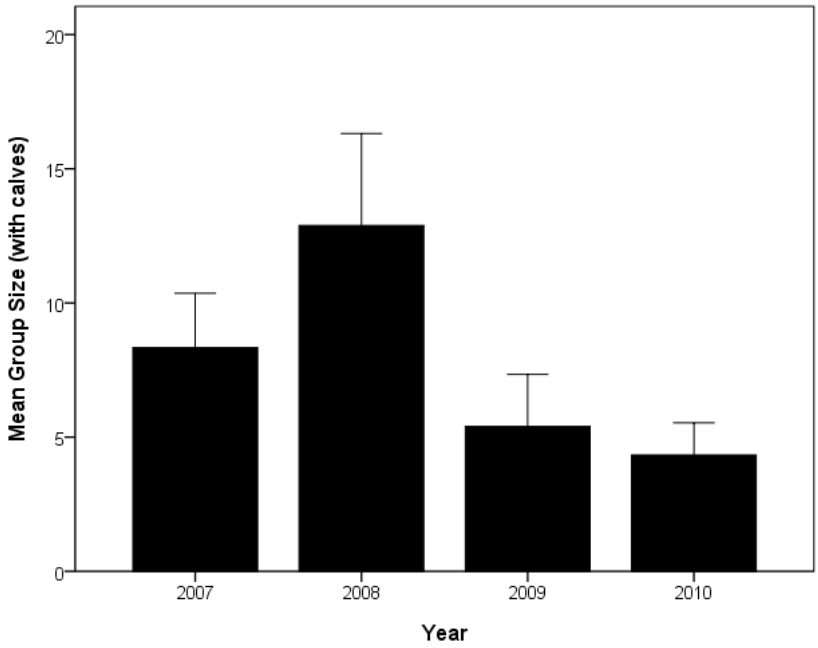

Figure 4.9. Mean group size for groups with calves each year from 2007 – 2010. Error bars represent one stand error of the mean. Differences in group size across years were not statistically significant.

4.3.2 Interannual Differences in Spatial Distribution

Whales were distributed throughout the survey area in all years (Figure 4.10) except 2007, when observations were limited to the fall (Oct – Nov). There was a reduced concentration of groups within the MTR Project footprint in 2010 relative to 2008 and 2009, which is consistent with the reduced proportion of sightings in those areas from 2008 – 2010.

During the summer, beluga whales were distributed more evenly along both shorelines across the three years with summer observations (2008 – 2010; Figure 4.11a). During the fall, beluga whales were distributed primarily along the eastern shoreline and within the immediate vicinity of the MTR Project footprint in 2008 and 2009. However, they were distributed very heavily along the western shoreline during 2010 (Figure 4.11b). This is also consistent with the reduced proportion of sightings within and adjacent to the MTR Project footprint in 2010.

Beluga whales were observed during all 6 tidal stages (Figures 4.12 – 4.13) but were most often sighted during ebb tides (low and high) across all four years (Figures 4.12a, 4.13c). In the 3 years except 2009 beluga whales were more often sighted during low tides. In 2009 a greater proportion of sightings occurred during the high flood tide than in any of the other 3 years (Figure 4.13a).

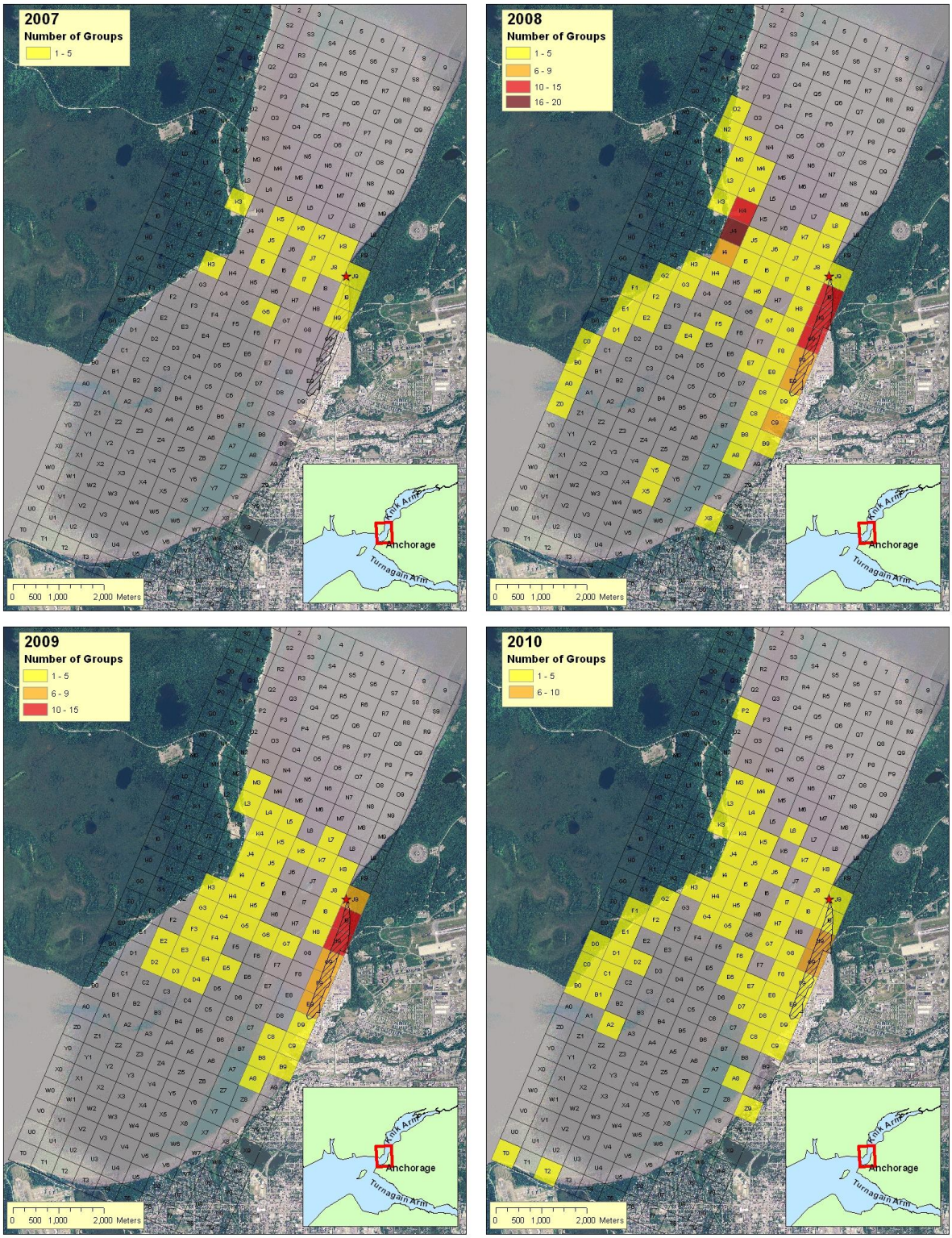

Figure 4.10. Spatial distribution of beluga whale sightings for all years (2007 – 2010). MTR Project footprint is outlined in black and crosshatched. Cairn Point Station is indicated by the red star. Observations during 2007 were only conducted in the fall (Oct – Nov).

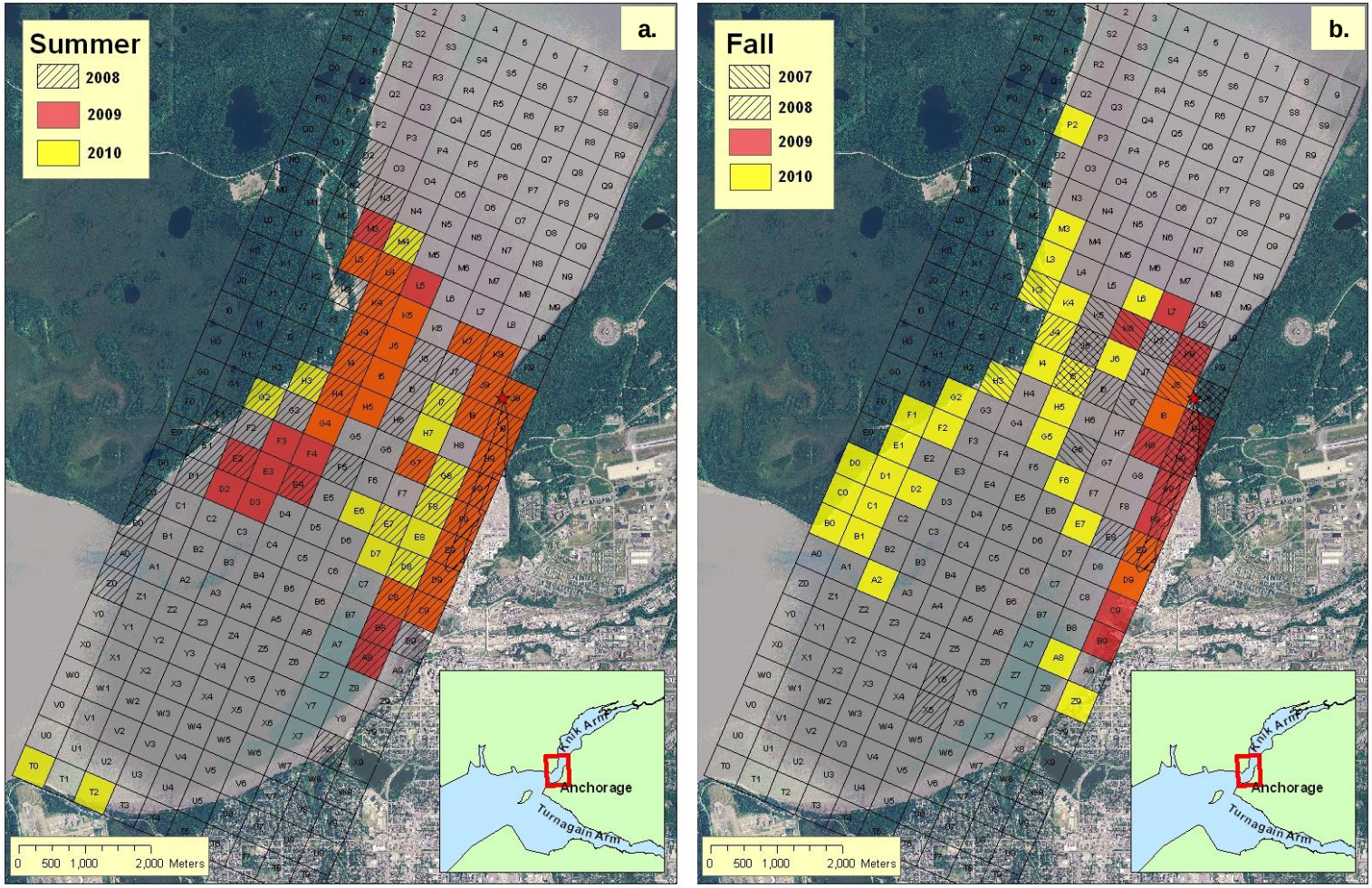

Figure 4.11. Spatial distribution of beluga whale sightings during the a) summer (Jul – Sep) and b) fall (Oct – Nov) for all years (2007 – 2010). MTR Project footprint is outlined in black and crosshatched. Cairn Point Station is indicated by the red star. Areas of multi-year sightings are indicated by overlapping hash marks and/or blended color (orange). Only 2009 had sightings during the spring (May only) so that season is excluded.

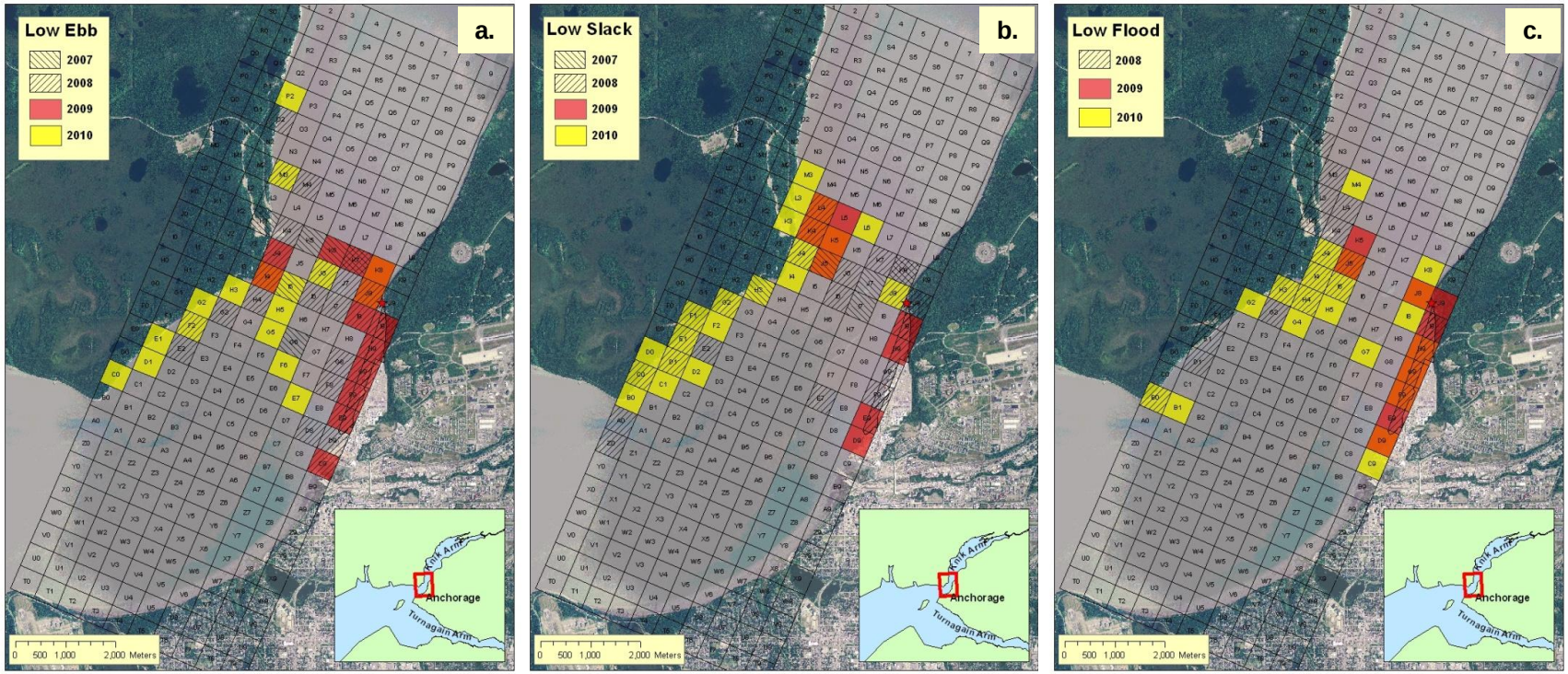

Figure 4.12. Spatial distribution of beluga whale sightings during a) low ebb, b) low slack and c) low flood tides for all years (2007 – 2010). MTR Project footprint is outlined in black and crosshatched. Cairn Point Station is indicated by the red star. Areas of multi-year sightings are indicated by overlapping hash marks and/or blended color (orange). No beluga whales were sighted during low flood tide during 2007.

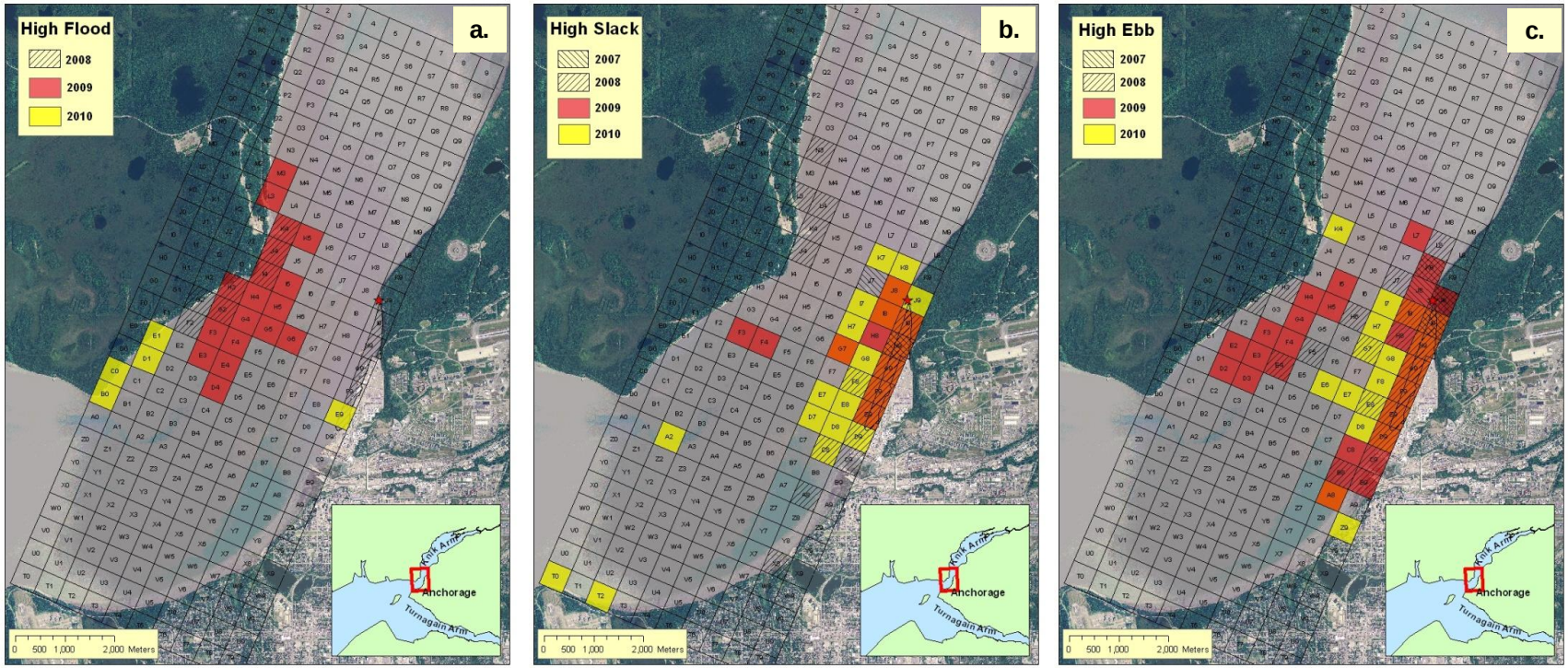

Figure 4.13. Spatial distribution of beluga whale sightings during a) high flood, b) high slack and c) high ebb tides for all years (2007 – 2010). MTR Project footprint is outlined in black and crosshatched. Cairn Point Station is indicated by the red star. Areas of multi-year sightings are indicated by overlapping hash marks and/or blended color (orange). No beluga whales were sighted during high flood tide during 2007.

5.0 Discussion

This section synthesizes the results of marine mammal monitoring performed by the Scientific Program during 2010, as well as the interannual comparisons from 2007 – 2010 presented in Section 4.3. All interpretations and conclusions are derived from data collected solely for the MTR Project during 2007 – 2010. References to current trends in the overall population status of Cook Inlet beluga whales are based on published survey data collected by the NMFS.

5.1 Sighting Rates

Sighting rates have declined each of the past four years (2007 – 2010), although these declines are not statistically significant (Figure 4.7). The decline in sighting rates is likely reflective of a continued ~1.1% annual decline in the Cook Inlet beluga whale population (NMFS 2010). However; there has also been a decline in the proportion of sightings within and adjacent to the MTR Project footprint since 2008 (21% in 2010, 46% in 2009, 64% in 2008). This suggests that beluga whales are avoiding the area within the immediate vicinity of the MTR Project footprint. Saxon-Kendall (2010)[2] found no significant correlation between sighting rates and pile driving rates from 2008 – 2009. However, during 2010 pile driving was conducted from a barge offshore, whereas in the two previous years pile driving was conducted from onshore. This change in the location of pile driving equipment may have caused the reduction in sightings within and adjacent to the MTR Project footprint, if beluga whales moving further into Knik Arm from the lower inlet or feeding areas at Ship Creek changed their movement patterns to outside the area where the barge was stationed, rather than continuing alongshore. This is also supported by the increased use of the mid-channel and western shoreline in 2010 (Section 4.3.2). The position of this construction activity offshore may also have changed the underwater noise profile associated with pile driving.

5.2 Temporal Distribution

Beluga whale sightings continue to peak in the late summer and early fall as beluga whales move into Knik Arm in response to movements of their primary prey. Sightings have continued into November for the fourth consecutive year. Continued later use of

[2] Data referenced in Saxon-Kendall (2010) were collected by LGL Alaska Research Associates, Inc. under contract to ICRC for the POA during the period 2005 – 2006, and by the Scientific Program during the period 2007 – 2009.

Knik Arm by beluga whales is consistent with recent survey data that indicate a significant range contraction of Cook Inlet beluga whales into the furthest reaches of the upper inlet (Hobbs *et al*. 2008). This pattern is expected to persist as long as ice-free conditions are adequate for movement of whales.

5.3 Spatial Distribution

Since 2008 there has been increased use of the western shoreline and mid-channel areas (Figure 4.10), which is consistent with the reduction in the proportion of sightings within and adjacent to the MTR Project footprint. Distribution across tidal stages has been consistent, with the exception of 2009, when the typical pattern of more low tide observations was reversed, and there was a high concentration of sightings during the high flood tide. The reason for this reversal is unknown.

5.4 Group Size, Structure and Behavior

Mean group size has declined from a mean of ~4 animals to a mean of ~3 animals since 2008 (Figure 4.8), but this decline is not statistically significant. The mean size of groups with calves was notably smaller in 2009 (~5 whales) than in all three previous years (12 in 2006 reported by LGL, 8 in 2007 reported by APU, and 13 in 2008 reported by APU). This decline continued in 2010 to a mean group size with calves of ~4 animals. The lack of statistical significance in this decline is likely a function of the small number of groups with calves across years (fewer than 5) resulting in a lack of statistical power[3]. Declines in group size are likely a function of the continued decline in the population (NMFS 2010). Group structure during 2010 was comparable to previous years, with the majority of groups of greater than one individual being densely packed.

Observed beluga whale behavior in 2010 was also consistent with previous years, with whales primarily traveling through the study area on the incoming and outgoing tides to and from foraging areas further up Knik Arm (e.g., Fish Creek, Eagle River, Eklutna). Beluga whales have been observed during all tidal stages, with the exception of flood tides during 2007. However, this is likely an artifact of reduced sampling effort, as observations during that year were only conducted for six weeks (October – November).

[3] Each statistical test has a certain level of power to detect an effect of a given magnitude with a given sample size. The larger the sample size, the greater the power of a test to detect an effect of smaller magnitude. Because there are so few groups with calves every year, the statistics are not powerful enough to distinguish the changes in group size across the four years.

5.5 Responses to pile driving

No immediate negative behavioral responses or abrupt changes of direction or pattern of movements were observed during 2010 or in any of the previous 3 years, during pile driving or any other in-water construction activities. However, the changes in habitat use patterns discussed in Section 5.1 are likely in response to the movement of pile driving activity offshore. Saxon-Kendall (2010) found a significant reduction in sighting duration and a significant increase in traveling behavior between periods without (2005 – 2007) and with (2008 – 2009) pile driving, which also supports the hypothesis that whales may be changing their habitat use patterns in order to avoid construction activity. However, because 2010 is the first year that such changes in habitat use have been documented, additional data are needed in subsequent years in order to confirm this effect.

Within the limits of their maximum physiological capacity, marine mammals have the ability to alter their behavior in response to moderate changes in their environment. Therefore, although beluga whales may be altering their movement patterns in Knik Arm in response to construction at the Port, these changes are not likely detrimental to the health or survival of individual whales, or to the Cook Inlet population as a whole. It is unlikely that beluga whales are experiencing reduced access to prey, as none of the known feeding areas are within the immediate vicinity of the MTR Project. Ship Creek is the closest proximity feeding area, and beluga whales have been observed feeding there since in-water construction activities commenced (Cornick and Saxon-Kendall 2009, Cornick et al. 2010). It is also unlikely that increased risk of predation is a significant impact of increased use of the mid-channel areas of Knik Arm, as no killer whales have been observed by the Scientific MMOs since 2007. If tidal and current profiles in the mid-channel areas relative to the shorelines increase the energy expenditure required for travelling through the area, it is possible that this could have a detrimental effect on foraging efficiency. However, no data are available to test this hypothesis, and the increased energy expenditure would have to be substantial. Beluga whales are known to use the tides to minimize the cost of swimming as they move into and out of Knik Arm, and this strategy is likely effective both along the shoreline and in the mid-channel.

6.0 Conclusions

Despite the lack of statistical significance in interannual comparisons, which are likely a function of small sample sizes and high levels of variability in beluga whale habitat use and behavior, clear trends (e.g., reduced sighting rates and mean group size, reduced use of the area in close proximity to the MTR Project footprint) are emerging as a result of the Scientific Program monitoring. While changes in sighting rates and group size are likely related to the continued decline in the Cook Inlet beluga whale population (Section 5.1), there is preliminary evidence that beluga whales are changing their movement patterns in response to changes in construction activities of the MTR Project. Additional data are needed to confirm this effect, and these changes are not likely detrimental to beluga whales. However, shore-based observations are not able to capture negative behavioral or acoustic responses that may occur beneath the surface, so we cannot definitively state that there have been no negative impacts.

7.0 Acknowledgements

We would like to acknowledge the contributions of several people to the successful completion of the Scientific Marine Mammal Monitoring Program. The environmental program staff at ICRC provided APU with excellent logistical support. The safety program staff ensured the continued safety and security of our team. Seven APU students worked as supervisor and observers during 2010 and also assisted with data entry. The opportunity provided by ICRC and the Maritime Administration is a significant enhancement to their training in the APU Marine Biology Program.

8.0 References

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APPENDIX

Scientific Marine Mammal Monitoring Program
Marine Mammal and Environmental Data Sheets

POA Land-Based Surveys of Marine Mammals: Beluga whales (*Delphinapterus leucas*) **Alaska Pacific University**

Station:	Date (dd/mm/yy):	Observer (s):	Pg __ of __	Verified_____ Entered by_____ Sheet#_____
Shift Start Time (hh:mm):		Shift End Time (hh:mm):	Optic:	

Sampling Round	Best Sample ?	Time (hh:mm)	Beluga Count			Harbor Seal	Harbor Porpoise	Steller Sea Lion	Killer Whale	Other	Magnetic Compass Bearing 001-360°	Grid Cell	Group #	Group Code	Activity		Direction	In-water Construction Activity		Start/End/Arrive/Leave (S/E/A/L)		Comments - Write additional comments on the reverse side of this sheet. Be sure to identify which record additional comments are associated with.	Comments on the Reverse ?
			White	Gray	Dk. Gray (Calf)										1	2		1	2	CON 1	CON 2		
	?																						
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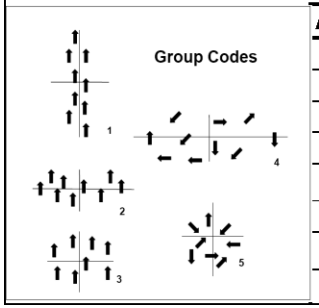
Note the time at the first and last sighting of each whale/group. Identify EACH grid cell the whales move through and note the time they enter each cell!!

Continue to count whales throughout the time the whales are in the area, until you get an accurate count (Best Sample)



Activity Code		Activity Code		In-water Construction Activities			
1	Traveling/Moving	9	Startled effect	0	No construction	6	Dredging
2	Diving	10	Approaches then leaves	1	Soft-start	7	In-water fill
3	Motionless on surface	11	Change in swimming speed	2	Impact sheet PD	8	Impact + Vibratory PD
4	Spyhopping	12	Abrupt change in direction	3	Vibratory sheet PD	9	Dredge + Impact PD
5	Breaching	13	Abrupt dives	4	Impact pipe PD	10	Dredge + Vibratory PD
6	Feeding Observed	14	Disperse	5	Vibratory pipe PD	11	Dredge + Impact + Vibratory
7	Feeding Suspected	99	Other			99	Other
8	Milling						

POA Land-Based Surveys of Marine Mammals: Environmental Conditions **Alaska Pacific University**

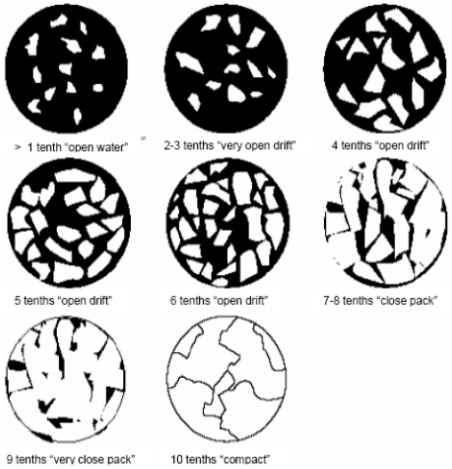
Station:	Date (dd/mm/yy):	Observer(s):	Pg___of___

Verified_____
Entered by_____
Sheet #_____

Time (hh:mm)	Air Temp. (°C)	Precip Code 00-none 01-fog 02-rain 03-snow	Wind Dir. (99 if null)	Wind Speed (km/hr, nearest whole number)	Cloud Cover (%)	Vis. Dis. (km)	See Far Shore	Glare	Central Glare Bearing 001-360°	Swell (ht in m)	Sea State (Beaufort)	White Caps	Sea Ice Concentration (tenths 00-10)	Overall Conditions	# of vessels (hourly)	Comments	Comments on Reverse

Sea State	Description
0	Sea like mirror
1	Ripples but without foam crests
2	Small wavelets
3	Large wavelets, perhaps scattered white horses
4	Small wavelets, fairly frequent white horses

Sea Ice Concentration (tenths 00-10)



Types of Vessels	
Ship	Skiff
Tug boat	Dredge
Barge	Coast Guard
Tug & barge	Other

Overall Conditions	
1	Poor
2	Moderate
3	Excellent

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