Marine Mammal Monitoring & Mitigation Plan

St. George Island Geotechnical Survey

St. George, Alaska

Submitted to:
National Marine Fisheries Service
Office of Protected Resources
1315 East-West Highway
Silver Spring, Maryland 20910-3226

Prepared by:
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ACRONYMS AND ABBREVIATIONS

4MP	*Marine Mammal Monitoring and Mitigation Plan*
dB	*Decibel*
DHT	*Down the Hole*
GPS	*Global Positioning System*
HFC	*Very High-Frequency Cetaceans*
IHA	*Incidental Harassment Authorization*
LFC	*Low-Frequency Cetaceans*
LPT	*Long Penetration Test*
m	*Meters*
MFC	*High-Frequency Cetaceans*
MMPA	*Marine Mammal Protection Act*
NMFS	*National Marine Fisheries*
NOAA	*National Oceanic Atmospheric Administration*
PED	*Preconstruction, Engineering, and Design*
SPL	*Sound Pressure Level*
USACE	*United States Army Corps of Engineers*

1.0 Introduction

The purpose of this Marine Mammal Monitoring and Mitigation Plan (4MP) is to provide a protocol for monitoring of affected species during the geophysical survey in the marine waters near St. George, Alaska (Figure 1-1). This plan was developed to support the Incidental Harassment Authorization (IHA) document for Marine Mammal Protection Act (MMPA), Section 101(a)(5)(D) permitting.

A Marine Mammal Monitoring Program will be implemented at the start of the survey and will follow the protocols outlined in this 4MP. The primary goals of the monitoring program are to:

- Monitor the proposed shutdown and monitoring zones;
- Log the number of marine mammals exposed to noise at established thresholds;
- Document marine mammal responses;
- Minimize impacts to the marine mammal species present in the project area by implementing mitigation measures including monitoring, clearing the zones, and shutdown procedures; and,
- Collect data on the occurrence and behavior of marine mammal species in the project area and any potential impacts from the project.

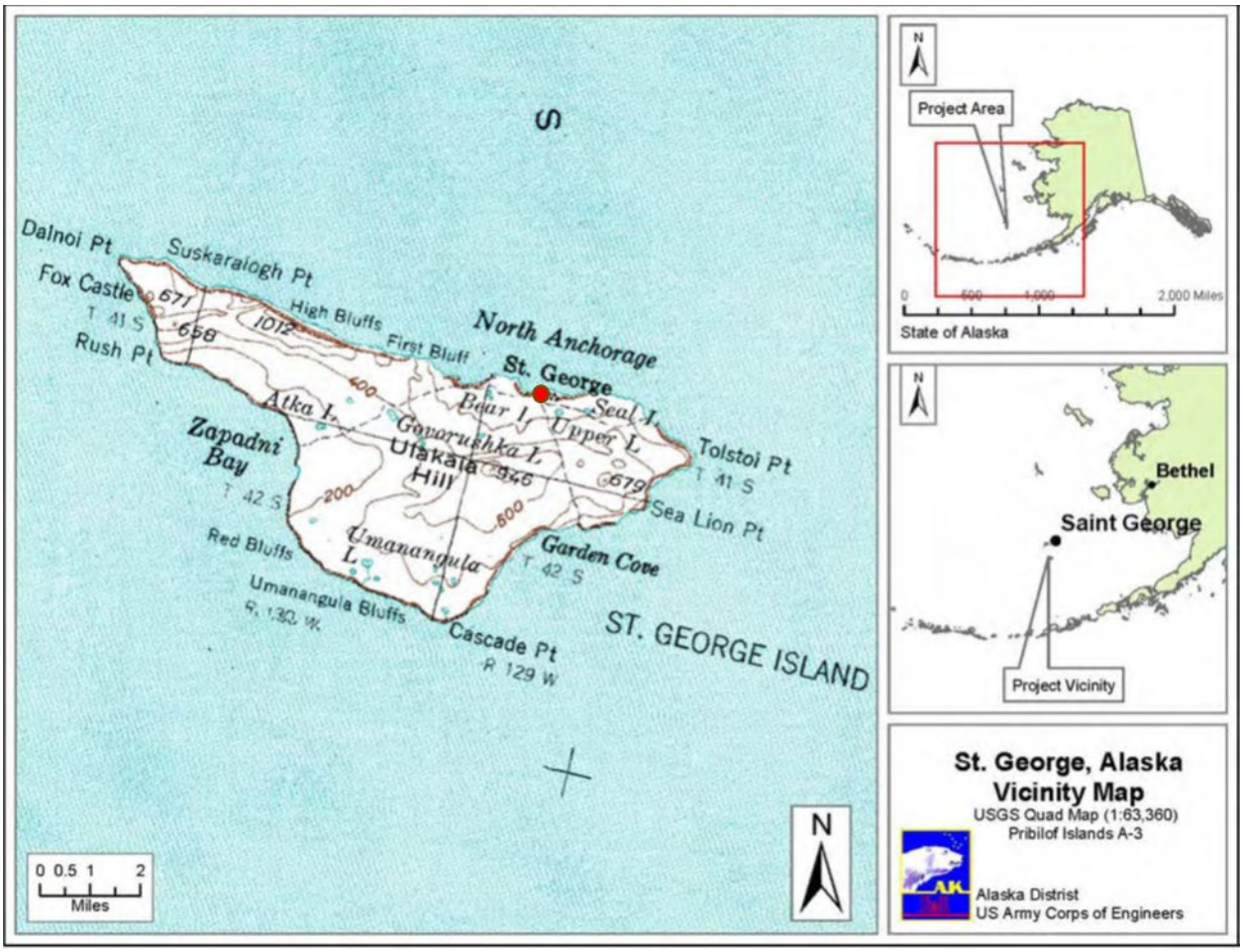

Figure 1-1. Project location on St. George Island, Alaska.

2.0 Project Description

The U.S. Army Corps of Engineers (USACE) is in the preconstruction, engineering, and design (PED) phase for constructing a small boat harbor on St. George Island, Alaska (Figure 1-1). PED activities, such as geotechnical surveys, have the potential to take marine mammals. Borehole drilling may result in take of marine mammals under Level B harassment (behavioral harassment). This IHA would authorize take for the geotechnical surveys, which are scheduled to begin on 15 April 2025. In-water work would occur during daylight hours plus periods of nautical twilight for up to approximately 16 hours per day during. The IHA would cover geotechnical surveys from 15 April 2025 to 15 June 2025. The intent is to complete the survey as early as possible in this time window to minimize potential impacts to northern fur seals as abundance increases as the summer progresses. Only 15 days of actual drilling is anticipated to occur during this 60-day work window.

3.0 Methods

Experienced land-based marine mammal observers will be located on-site before, during, and after geotechnical drilling and large penetration testing (LPT) at sites appropriate for monitoring marine mammals within and approaching the Level A and Level B harassment zones; as described in *Section 3.4 Level A and Level B Harassment Zones*. A vessel-based monitor will be used for the more seaward boreholes to ensure adequate visibility of the entire Level B zone. Names and resumes of observers will be submitted to the National Marine Fisheries Service (NMFS) for approval prior to the start of the survey.

During observation periods, observers will continuously scan the area for marine mammals using binoculars and the naked eye. Observers will work shifts of up to four consecutive hours maximum followed by an observer rotation or a one hour break and will work no more than 12 hours in any 24-hour period. Observers will collect data including, but not limited to, environmental conditions (e.g., sea state, precipitation, glare), marine mammal sightings (e.g., species, numbers, location, behavior, responses to construction activity, etc.), construction activity at the time of sighting, and number of marine mammal exposures. Observers will conduct observations, meet training requirements, fill out data forms, and report findings in accordance with this 4MP.

A minimum of one PSO must be assigned to conduct daily morning counts of hauled out pinnipeds at North Rookery, from the Northern Point of north Rookery and following the rocky shoreline to the south. USACE must adjust the counting area each day based on accessibility, visibility, and the need to avoid seals. USACE will provide coordinates identifying the PSO monitoring location and the start and end location of where counts are conducted each day

Observers will implement mitigation measures including monitoring of the proposed shutdown and monitoring zones, clearing of the zones, and shutdown procedures. They will be in continuous contact with the construction personnel via two-way radio. Cellular phones do not work on St. George Island, so back-up radios will be on hand.

An employee of the geotechnical contractor will be identified as the main point of contact for observers at the start of each construction day. Observers will report directly to the monitoring coordinator when a shutdown is deemed necessary due to marine mammals approaching the relevant shutdown zones during a potentially hazardous construction activity.

3.1 Observer Qualifications

Monitoring will be conducted by qualified, trained marine mammal observers (hereafter, "observers"). For an individual to be considered qualified to serve as an observer, the following requirements must be met:

1. Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance;
2. Physical capability of performing essential duties, including sitting or standing for periods of up to four hours, using binoculars or other field aids, and documenting observations;
3. Experience and ability to conduct field observations and collect data according to assigned protocols;
4. Experience or training in the field identification of marine mammals and marine mammal behavior, including the ability to accurately identify marine mammal species in Alaskan waters;
5. Sufficient training, orientation, or experience with the construction operation to provide for identification of concurrent activities and for personal safety during observations;
6. Writing skills sufficient to prepare reports of observations; and,
7. Ability to communicate orally, by radio and in person, with project personnel to provide real-time information on marine mammals observed in the area and the appropriate mitigation response for the circumstances.

3.2 Data Collection

Observers will use a NMFS-approved Marine Mammal Observation Record Form (see Appendix A) which will be completed by each observer for each survey day and location. Observation records will be used by observers to record the following:

- Date and time that permitted construction activity begins or ends;
- Weather parameters (e.g., percent cloud cover, percent glare, visibility) and sea state will be used to determine sea state (see Appendix B);
- Species, numbers, and, if possible, sex and age class of observed marine mammals;
- Construction activities occurring during each sighting;
- Marine mammal behavior patterns observed, including bearing and direction of travel;
- Specific focus should be paid to behavioral reactions just prior to, or during, soft-start and shutdown procedures;
- Location of marine mammal, distance from observer to the marine mammal, and distance from pile driving activities to marine mammals;
- Record of whether an observation required the implementation of mitigation measures, including shutdown procedures and the duration of each shutdown; and,
- Other human activity in the area.

3.3 Equipment

The following equipment will be required to conduct observations for this project:

- Portable radios for the observers to communicate with the monitoring coordinator and other observers;
- Contact information for the other observers, monitoring coordinator, and NMFS point of contact;
- Daily tide tables for the project area;
- Watch or chronometer;
- Binoculars (7x50 or stronger) with built-in rangefinder (rangefinder may be provided separately);
- Spotting scope (20-50X) on a tripod or window mount. Only one is required to be on site and it should be placed at the best vantage point for a given day;
- Hand-held Global Positioning System (GPS) unit, map and compass, or grid map to record locations of marine mammals;
- Copies of the 4MP, IHA, and/or other relevant permit requirement specifications in sealed clear plastic cover; and,
- Clipboard with pre-standardized monitoring Marine Mammal Observation Record Forms on waterproof paper.

3.4 Level A and Level B Harassment Zones

Zones have been established to delineate areas where marine mammals would experience Level A or Level B harassment due to exposure to underwater sound from construction activity. Shutdown of construction will occur where the underwater sound pressure levels (SPLs) are anticipated to equal or exceed the Level A harassment thresholds for permitted pinnipeds and otariids or where the Level B harassment threshold would be exceeded for a marine mammal not included in the IHA. Where underwater SPLs would exceed the Level B harassment thresholds for non-pulse (120 decibel [dB] isopleth) and impulsive (160 dB isopleth) sound sources, observers will monitor and record sightings and behavior of permitted species but will not shut down.

Species with permitted “take” under the IHA include the following species: harbor seal (*Phoca vitulina*) and northern fur seal (*Callorhinus ursinus*). Take of any other marine mammal by Level B harassment is not permitted under the IHA.

The final shutdown zone radii are summarized in Table 3-1.

Table 3-1. Shutdown and Harassment Zones.

Activity	Shutdown Zones (m)					
	LF	HF	VHF	Phocid	Otariid	
					NOFS	Other
Drilling/Coring (Vibratory)	300			10	10	300
LPT (impact)	400			200	50	400

The harassment zones will be monitored throughout the time that drilling and LPT occur. If an authorized marine mammal enters the monitoring zone, an exposure will be recorded, and marine mammal behaviors documented. However, drilling/LPT would continue without stopping, unless the marine mammal approaches or enters the shutdown zone. If an authorized marine mammal approaches or enters the shutdown zone, all drilling/LPT activities will be immediately halted.

3.5 Observer Monitoring Locations

To monitor the Level A and Level B harassment zones effectively, observers will be positioned at the best practicable vantage points, taking into consideration safety, access, and space limitations. Observers will be stationed at locations that provide adequate visual coverage for the harassment zones. Proposed observation locations are depicted in 3-1. Two of these locations would be monitored at all times during drilling depending on the ability to see the zone. Two shore-based observers can ideally be adequate for nearshore stations, but a barge-based observer will be employed for boreholes located at the farther offshore locations. The observer locations will be decided by the observers based on the work scheduled, visibility and sea state. Observers may select alternate locations that work better for the conditions at the time. While most monitoring can likely be done with two observers, a third observer will be on site as part of the rotation plan. Since observers are required to have no more than four-hour shifts without a break, a third observer has to be part of the overall observer plan. When necessary to effectively monitor the work, a third observer will be used to augment the other two observers to optimize observer coverage.

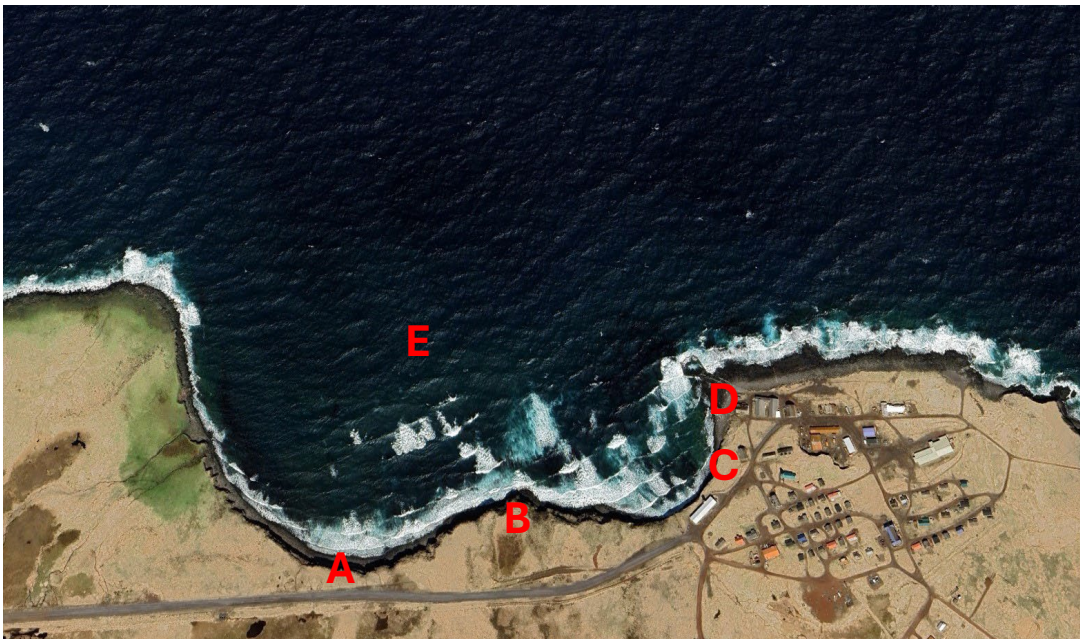

Figure 3-1. Proposed observer monitoring locations “A” through “E”. “E” would be barge-based and change based on the location of the barge.

“E” would be vessel-based and used on the more offshore borehole locations. This figure is an example of the radii around the most distant borehole site from the harbor.

3.6 Monitoring Techniques

Observers will collect sighting data and behaviors of marine mammal species that are observed in the shutdown and monitoring zones during periods of construction. NMFS requires that the observers have no other construction-related tasks while conducting monitoring. Observation necessitates that daylight is sufficient for observers to visualize the entirety of the monitoring zones, so observations will commence and be complete during daylight hours, including periods of civil twilight as needed. Monitoring of shutdown and observation zones will take place from 30 minutes prior to initiation through 30 minutes post-completion of all drilling/LPT.

3.6.1 Pre-Activity Monitoring

The following survey methodology will be implemented prior to commencing permitted activities:

- Prior to the start of permitted activities, observers will monitor the shutdown and monitoring zones for 30 minutes. They will ensure that no marine mammals are present within shutdown zone before permitted activities begin. Northern fur seals and harbor seals can be present in the Level B zone and would be recorded as takes.
- The shutdown zone will be cleared when marine mammals have not been observed within zone for that 30-minute period. If an unauthorized marine mammal is observed within the Level B zone, drilling/LPT cannot proceed until the marine mammal has left the zone or has not been observed for 15 minutes without redetection of the animal.
- When all applicable zones have been cleared, the observers will radio the monitoring coordinator. Permitted activities will not commence until the monitoring coordinator receives verbal confirmation the zones are clear.

- If permitted species are present within the Level B monitoring zone, work will not be delayed, but observers will monitor and document the behavior of individuals that remain in the monitoring zone.

3.6.2 During-Activity Monitoring

The following survey methodology will be implemented during permitted activities:

- If permitted species are observed within the monitoring zone during permitted activities, an exposure would be recorded, and behaviors documented. Work will not stop unless a marine mammal enters or appears likely to enter the shutdown zone.

3.6.3 Shutdown

If a marine mammal enters or appears likely to enter the shutdown zone:

- The observers shall immediately radio or call to alert the monitoring coordinator.
- All permitted activities will be immediately halted.
- In the event of a shutdown of drilling or LPT, permitted activities may resume only when:
    - The marine mammal(s) within or approaching the shutdown zone has been visually confirmed beyond the shutdown zone or has not been resighted in the size for 15 minutes
    - Observers will then radio the monitoring coordinator that activities can re-commence.

3.6.4 Breaks in Work

During an in-water construction delay, the shutdown and monitoring zones will continue to be monitored. No exposures will be recorded for permitted species in the monitoring zone if there are no concurrent permitted construction activities.

If permitted activities cease for more than 30 minutes and monitoring has not continued, pre-activity monitoring must recommence. This includes breaks due to scheduled or unforeseen construction practices or breaks due to permit-required shutdown. Following 30 minutes of monitoring, work can begin according to the pre-activity monitoring protocols. Work cannot begin if an unauthorized marine mammal is within the shutdown zone.

3.6.5 Post-Activity Monitoring

Monitoring of the shutdown and monitoring zones will continue for 30 minutes following completion of drilling/LPT. These surveys will record observations and will focus on observing and reporting unusual or abnormal behavior of marine mammals. Observation Record forms will be used to document observed behavior.

4.0 Reporting

(a) The Holder must submit its draft report(s) on all monitoring conducted under this IHA within 90 calendar days of the completion of monitoring or 60 calendar days prior to the requested issuance of any subsequent IHA for construction activity at the same location, whichever comes first. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of receipt of the draft report, the report shall be considered final.

(b) All draft and final monitoring reports must be submitted PR.ITP.MonitoringReports@noaa.gov and itp.fleming@noaa.gov.

(c) The marine mammal report must contain the informational elements described in the Monitoring Plan and, at minimum, must include:

(i) Dates and times (begin and end) of all marine mammal monitoring;

(ii) Construction activities occurring during each daily observation period, including (geotechnical surveys only):

A. The number and type of geotechnical surveys that were completed and the method (e.g., LPT, borehole drilling); and

B. Total duration of survey time for each location (borehole drilling) and number of strikes for each survey location (LPT).

(iii) PSO locations during marine mammal monitoring;

(iv) Environmental conditions during monitoring periods (at beginning and end of PSO shift and whenever conditions change significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon, and estimated observable distance;

(v) During all monitoring efforts, upon observation of a marine mammal, the following information:

A. Name of PSO who sighted the animal(s) and PSO location and activity at time of sighting;

B. Time of sighting;

C. Identification of the animal(s) (e.g., genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species;

D. Distance and location of each observed marine mammal relative to the survey location being completed for each sighting;

E. Estimated number of animals (min/max/best estimate);

F. Estimated number of animals by cohort (adults, juveniles, neonates, group composition, etc.);

(vi) During monitoring associated with geotechnical activities only, the following information:

A. Animal's closest point of approach and estimated time spent within the harassment zone;

B. Description of any marine mammal behavioral observations (e.g., observed behaviors such as feeding or traveling), including an assessment of behavioral responses thought to have resulted from the activity (e.g., no response or changes in behavioral state such as ceasing feeding, changing direction, flushing, or breaching);

(vii) Number of marine mammals detected within the harassment zones, by species; and

(viii) Detailed information about implementation of any mitigation (e.g., shutdowns and delays), a description of specific actions that ensued, and resulting changes in behavior of the animal(s), if any.

(d) The Holder must submit all PSO data electronically in a format that can be queried such as a spreadsheet or database (i.e., digital images of data sheets are not sufficient).

(e) Reporting injured or dead marine mammals:

In the event that personnel involved in the construction activities discover an injured or dead marine mammal, the Holder must report the incident to the Office of Protected Resources (OPR), NMFS (PR.ITP.MonitoringReports@noaa.gov and itp.fleming@noaa.gov) and to the Alaska regional stranding network (877- 925-7773) as soon as feasible. If the death or injury was clearly caused by the specified activity, the Holder must immediately cease the activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of this IHA. The Holder must not resume their activities until notified by NMFS.

The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
(ii) Species identification (if known) or description of the animal(s) involved;
(iii) Condition of the animal(s) (including carcass condition if the animal is dead);
(iv) Observed behaviors of the animal(s), if alive;
(v) If available, photographs or video footage of the animal(s); and
(vi) General circumstances under which the animal was discovered.

5.0 Appendix A: Marine Mammal Observation Record

MARINE MAMMAL OBSERVATION RECORD

Project Name: Eareckson Air Station Long-term Pier Repair

Monitoring Location:

Date:

Time Effort Initiated:

Time Effort Completed

Page of

Time	Visibility	Glare	Weather Condition	Wave Height	BSS	Wind Dir.	Swell Dir.
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W
:	B - P - M - G - E	%	S - PC - L - R - F - OC - SN - HR	Lt / Mod / Hvy		N S E W	N S E W

Event Code	Sight # (1 or 1.1 if resight)	Time/Dur. (Start/ End time if cont.)	WP/ Grid #/ Dir. of Travel	Zone/ Radius/ Impact Pile #?	Obs.	Sighting Cue	Species	Group Size	Behavior Code(s)	Construction Type	Mitigation Type	Exposure?	Behavior Change/ Response to Activity/ Comments/ Human Activity/ Vessel Hull # or Name/ Visibility Notice
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
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E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	
E ON - PRE - POST - CON - S - M - OR - E OFF		: :	GRID N or S W or E			BL - BO - BR - DF - SA - OTHER		MIN: MAX: BEST:		SSV - SSI - V - DR - I - DP - ST - OWC - NOWC - NONE	SS - BC - DE - SD - NONE	Y / N	

BEHAVIOR CODES

CODE	BEHAVIOR	DEFINITION
BR	Breaching	Leaps clear of water
CD	Change Direction	Suddenly changes direction of travel
CH	Chuff	Makes loud, forceful exhalation of air at surface
DI	Dive	Forward dives below surface
DE	Dead	Shows decomposition or is confirmed as dead by investigation
DS	Disorientation	An individual displaying multiple behaviors that have no clear direction or purpose
FI	Fight	Agonistic interactions between two or more individuals
FO	Foraging	Confirmed by food seen in mouth
MI	Milling	Moving slowly at surface, changing direction often, not moving in any particular direction
PL	Play	Behavior that does not seem to be directed towards a particular goal; may involve one, two, or more individuals
PO	Porpoising	Moving rapidly with body breaking surface of water
SL	Slap	Vigorously slaps surface of water with body, flippers, tail, etc
SP	Spyhopping	Rises vertically in the water to "look" above the water
SW	Swimming	General progression in a direction. Note general direction of travel when last seen (Ex, "SW (N)" for swimming north)
TR	Traveling	Traveling in an obvious direction. Note direction of travel when last seen (Ex, "TR (N)" for traveling north)
UN	Unknown	Behavior of animal undetermined, does not fit into another behavior
AWA	Approach Work	Approaching the area where work is being conducted
LWA	Leave Work Area	Leaving the area where work is being conducted
PINNIPED ONLY		
EW	Enter Water (from haulout)	Enters water from a haul-out for no obvious reason
FL	Flush (from haulout)	Enters water in response to disturbance
HO	Haulout (from water)	Hauls out on land
RE	Resting	Resting onshore or on surface of water
LO	Look	Is upright in water "looking" in several direction or at a single focus
SI	Sink	Sinks out of sight below surface without obvious effort (usually from an upright position)
VO	Vocalizing	Animal emits barks, squeals, etc
CETACEAN ONLY		
LG	Logging	Resting on surface of water with no obvious signs of movement

SPECIES

CODE	MARINE MAMMAL SPECIES
BBW	Baird's Beaked Whale
BW	Blue Whale
DP	Dall's Porpoise
FW	Fin Whale
GW	Gray Whale
HP	Harbor Porpoise
HS	Harbor Seal
HW	Humpback Whale
KW	Killer Whale
MW	Minke Whale
NFS	Northern Fur Seal
NPRW	North Pacific Right Whale
PWSD	Pacific White-Sided Dolphin
RS	Ribbon Seal
SW	Sperm Whale
SBW	Stejneger's Beaked Whale
SSL	Steller Sea Lion
NSO	Northern Sea Otter
UW	Unknown Whale
UP	Unknown Pinniped
UNK	Unknown

SIGHTING CUES

CODE	ACTIVITY TYPE
BL	Blow
BO	Body
BR	Breach
DF	Dorsal Fin
SA	Surface Activity
OTR	Other

EVENT CODES

CODE	ACTIVITY TYPE
E ON	Effort On
E OFF	Effort Off
PRE	Pre-Construction Watch
POST	Post-Construction Watch
CON	Construction (see types)
S	Sighting
M	Migration (see types)
OR	Observer Rotation

CONSTRUCTION TYPE

CODE	ACTIVITY TYPE
V	Vibratory Pile Driving
I	Impact Pile Driving
DP	Dead pull
ST	Stabbing
DR	Drilling
OWC	Over-Water Constrcution
NOWC	No Over-Water Construction
NONE	No Construction

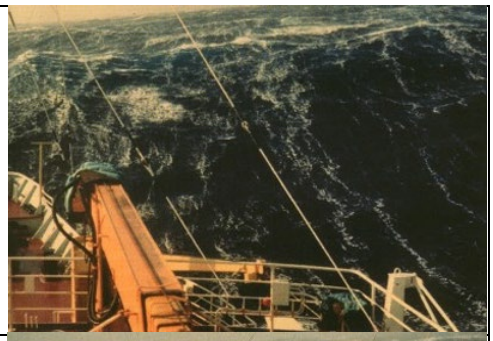
MITIGATION TYPE

CODE	ACTIVITY TYPE
SS	Soft Start
BC	Bubble Curatin
DE	Delay onset of in-water work
SD	Shut down in-water water

6.0 Appendix B: Beaufort Sea Scale

Beaufort Number (Wind Force)	Wind Velocity (Knots)	Wind Description	Sea Conditions	Heights of Waves (Feet)	Photographic Example
0	<1	Calm	Sea surface smooth and mirror-like	0	
1	1-3	Light Air	Scaly ripples, no foam crests	0-1	
2	4-6	Light Breeze	Small wavelets, crest glassy, no breaking	1-2	
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	2-3.5	

4	11-16	Moderate Breeze	Small waves, becoming longer, numerous whitecaps	1-4	
5	17-21	Fresh Breeze	Moderate waves, taking longer form, many whitecaps, some spray	4-8	
6	22-27	Strong Breeze	Larger waves, whitecaps common, more spray	8-13	
7	28-33	Near Gale	Sea heaps up, white foam streaks off breakers	13-19	
8	34-40	Gale	Moderately high, waves of greater length, edges of crests begin to break into spindrift, foam blown into streaks	18-25	

9	41-47	Strong Gale	High waves, sea begins to roll, dense streaks of foam, spray may reduce visibility	23-32	
10	48-55	Storm	Very high waves, with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	29-41	
11	56-63	Violent Storm	Exceptionally high waves, foam patches cover sea, visibility more reduced	37-52	
12	64+	Hurricane	Air filled with foam, sea completely white with driving spray, visibility greatly reduced	45+	

Images obtained from an online webpage titled, “The Seas of the Beaufort Scale,” at http://www.meiotic.co.uk/my/research/beaufort-seas/.