UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion
Ketchikan Berth IV Dock Upgrades

Public Consultation Tracking System (PCTS) Number: AKR-2018-9764

Action Agencies: National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division (PR1)
U.S. Army Corps of Engineers (USACE)

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Humpback whale (*Megaptera novaeangliae*) Mexico DPS	Threatened	Yes	No	N/A

Consultation Conducted By: National Marine Fisheries Service, Alaska Region

Issued By:

for James W. Balsiger, Ph.D.
Regional Administrator

Date: July 26, 2018

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TERMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ADOT&PF	Alaska Department of Transportation and Public Facilities
AKR	Alaska Region NMFS
BSAI	Bering Sea Aleutian Islands
CFR	Code of Federal Regulations
CV	Coefficient of variation
dB	Decibels
dBA	A-weighted decibels
DPS	Distinct Population Segment
DQA	Data Quality Act
DTH	down-the-hole
ECSA	Endangered Species Conservation Act
EFH	Essential Fish Habitat
ESA	Endangered Species Act of 1973
ft	feet
FR	*Federal Register*
GPS	Global Positioning System
HF	high-frequency
hr	hour(s)
Hz	Hertz
IHA	Incidental Harassment Authorization
IPCC	Intergovernmental Panel on Climate Change
ITS	Incidental Take Statement
KDC	Ketchikan Dock Company
kHz	kilohertz
km	kilometer(s)
lb	pound(s)
L_E	cumulative sound exposure level
LF	low frequency
LOA	length overall
m	meter(s)
MF	mid-frequency
min	minute(s)
MMPA	Marine Mammal Protection Act
µPa	microPascals
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
Opinion	Biological Opinion under Section 7 of the ESA
OPR	Office of Protected Resources, NMFS
OW	Otariid pinnipeds

PCTS	Public Consultation Tracking System
pk	peak sound level
PR1	NMFS Office of Protected Resources, Permits and Conservation Division
PRD	Protected Resources Division, Alaska NMFS
PSO	Protected Species Observers
PTS	Permanent Threshold Shifts
PW	Phocid pinnipeds
rms	root mean square
RPM	Reasonable and Prudent Measures
SAR	marine mammal stock assessment reports
SEL	Sound Exposure Level
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SSV	Sound Source Verification
TL	Transmission Loss
TTS	Temporary Threshold Shifts
UME	Unusual Mortality Event
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

1. INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each Federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a protected species, that agency is required to consult with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR §402.14(a)). Federal agencies fulfill this general requirement informally if they conclude that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat, and NMFS or the USFWS concurs with that conclusion (50 CFR §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the Federal agency's action is likely to affect ESA-listed species and their critical habitat. If incidental take is reasonably certain to occur, section 7(b)(4) requires the consulting agency to provide an incidental take statement (ITS) that specifies the impact of any incidental taking, specifies those reasonable and prudent measures necessary to minimize such impact, and sets forth terms and conditions to implement those measures.

For the actions described in this document, the action agencies are the U.S. Army Corps of Engineers (USACE) which proposes to authorize construction activities at the Port of Ketchikan, Berth IV, and the NMFS Office of Protected Resources Permits and Conservation Division (PR1). PR1 proposes to permit Marine Mammal Protection Act (MMPA) Level B take (*i.e.*, take by harassment) of humpback (*Megaptera novaeangliae)*, minke (*Balaenoptera acutorostrata*), and killer whales (*Orcinus orca*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), harbor seal (*Phoca vitulina*), and Steller sea lions (*Eumetopias jubatus*); and Level A take (*i.e.*, take by injury or mortality) of harbor porpoise and harbor seals in conjunction with the project. Solstice Alaska Consulting, Inc. (Solstice) is acting as the USACE's designated non-federal representative for this consultation. The consulting agency for this proposal is NMFS's Alaska Region (AKR). This document represents NMFS's biological opinion (hereafter, "Opinion") on the effects of the proposed construction activities on endangered and threatened species and designated critical habitat.

The Opinion and incidental take statement were prepared by NMFS AKR in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, *et seq*.), and implementing regulations at 50 CFR 402.

The Opinion and ITS are in compliance with the Data Quality Act (44 U.S.C. 3504(d)(1) *et seq*.) and underwent pre-dissemination review.

1.1 Background

This Opinion considers the effects of enlarging a cruise ship dock (Berth IV) at a dock owned by the Ketchikan Dock Company located in East Tongass Narrows, a waterway adjacent to downtown Ketchikan, Alaska. Construction activities for this action have the potential to affect the threatened Mexico Distinct Population Segment (DPS) of humpback whale. Critical habitat has not been designated for this DPS or species. No designated critical habitat for any species under NMFS's jurisdiction exists in the action area.

This Opinion is based on information provided by Solstice in the March 29, 2018, Biological Assessment and the March 28, 2018, Incidental Harassment Authorization application; proposed Incidental Harassment Authorization *Federal Register* notice (83 FR 22009); updated project proposals, email and telephone conversations between NMFS Alaska Region, Solstice, and NMFS PR1 staff; and other sources of information. A complete record of this consultation is on file at NMFS's Juneau, Alaska office.

1.2 Consultation History

Our communication with PR1, USACE, and Solstice Alaska Consulting, Inc., regarding this consultation is summarized as follows:

- **February 13, 2018**: Solstice submitted an initial Incidental Harassment Authorization (IHA) application on behalf of the Ketchikan Dock Company, LLC (hereinafter KDC), to NMFS PR1 for the lethal and non-lethal taking of marine mammals incidental to pile driving and dock construction activities at Berth IV (described below in Action Area), owned by KDC, during fall 2018.
- **March 13, 2018**: NMFS Alaska Region received a letter from the USACE delegating the role of lead action agency to PR1 for this consultation.
- **March 28, 2018**: Solstice submitted a revised IHA application to NMFS.
- **March 29, 2018**: Solstice submitted a biological assessment to the NMFS Alaska Region.
- **April 13, 2018**: PR1 submitted a request to initiate section 7 consultation to the NMFS Alaska Region.
- **April 13, 2018**: The NMFS Alaska Region deemed the initiation package complete and initiated consultation with PR1.
- **April 30, 2018**: NMFS Alaska Region sent a notice of Section 7 consultation request for information to the Alaska Department of Fish and Game (ADF&G).
- **May 7, 2018:** ADF&G responded with no comments or additional information.
- **May 11, 2018:** PR1 published the proposed IHA with a comment period extending through June 11, 2018.
- **June 8, 2018:** PR1 sent AKR the final draft IHA (RIN 0648-XG106) and notification of changes to the proposed IHA in response to comments from the Marine Mammal Commission. Changes included the anticipated numbers of strikes per pile, adding anchoring of piles as a project component with associated monitoring and shutdown zones, and changing the number of Level B takes for the Mexico DPS humpback whale from one to two.

2. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

“Action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies. “Interrelated actions” are those that are part of a larger action and depend on the larger action for their justification. “Interdependent actions” are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

This Opinion considers the effects of the USACE authorization of construction activities at KDC’s Berth IV to accommodate larger cruise ships, and of the issuance of an IHA to take marine mammals by harassment under the MMPA incidental to KDC’s construction activities within a four-month window between September 2018 and March 2019.

Ketchikan is one of the main ports-of-call for cruise ships in Alaska, receiving up to six ships daily from May through September, with more than 950,000 annual cruise passenger visits (Moffatt and Nichol/LandDesign 2016).

The average size of oceangoing cruise vessels operating within the Alaskan region has increased steadily over the past decade and this trend is expected to continue. Cruise ships in the 1970s typically held 500 passengers and were approximately 550 ft (168 m) length overall (LOA). Now ships greater than 900 ft (274 m) LOA are the operational norm. The *Norwegian Bliss,* measuring 1,093 ft LOA (333 m), began making trips through Alaska with stops in Ketchikan in the summer of 2018. With the average length of new cruise ships being constructed each year continuing to increase, combined with the retirement of older, smaller vessels, over the course of this decade cruise ships with lengths greater than 984 ft (300 m) LOA will become the operational norm in Alaska (Moffatt and Nichol/LandDesign 2016). In its present configuration, Berth IV is not capable of supporting these larger cruise ships.

2.1.1 Proposed activities

The KDC proposes to expand Berth IV by replacing the existing floating barge and float with a larger pontoon dock, a larger small craft float, and by expanding the existing mooring structures (Figure 1 and Figure 2).

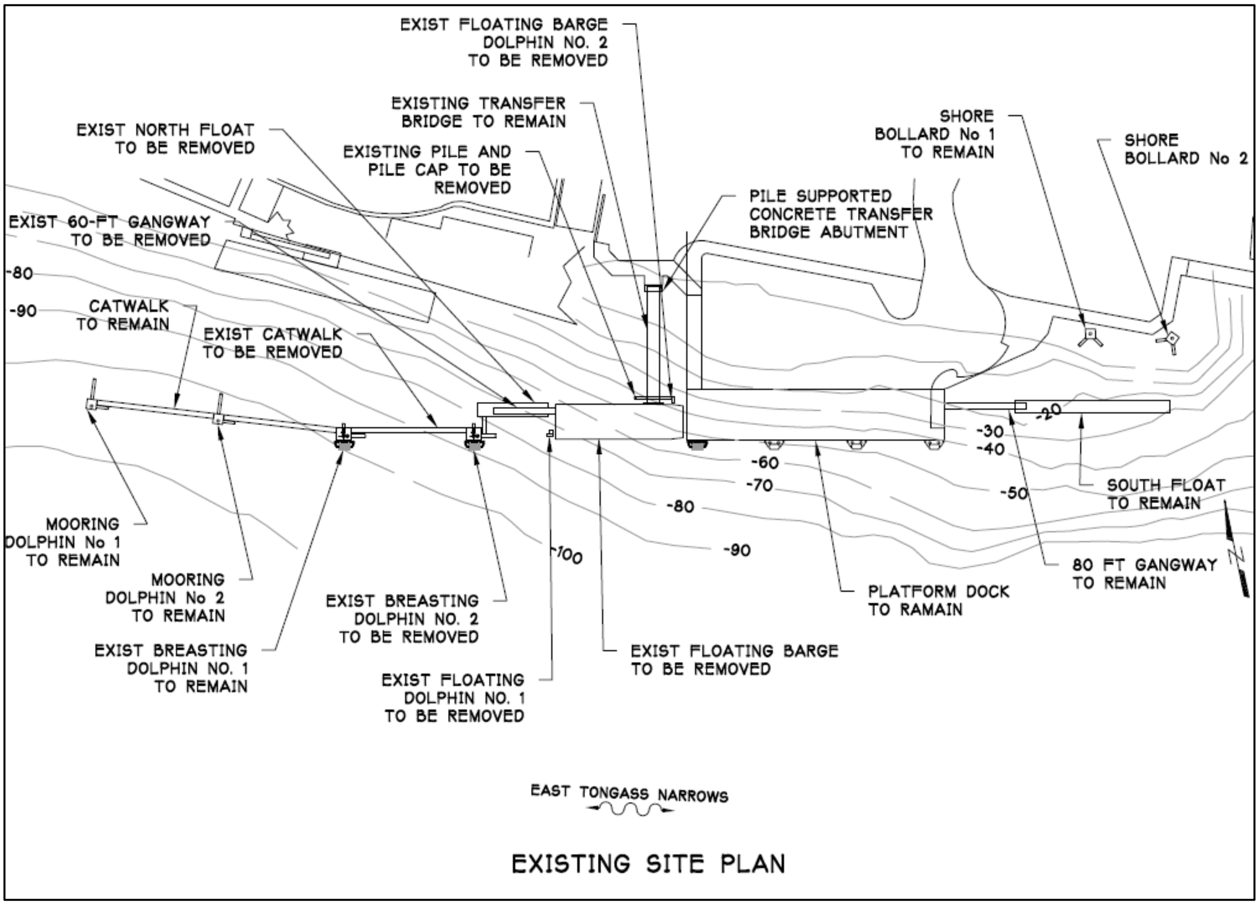

Figure 1. Existing site plan at Ketchikan Dock Company’s Berth IV showing existing structures to be removed and those to remain.

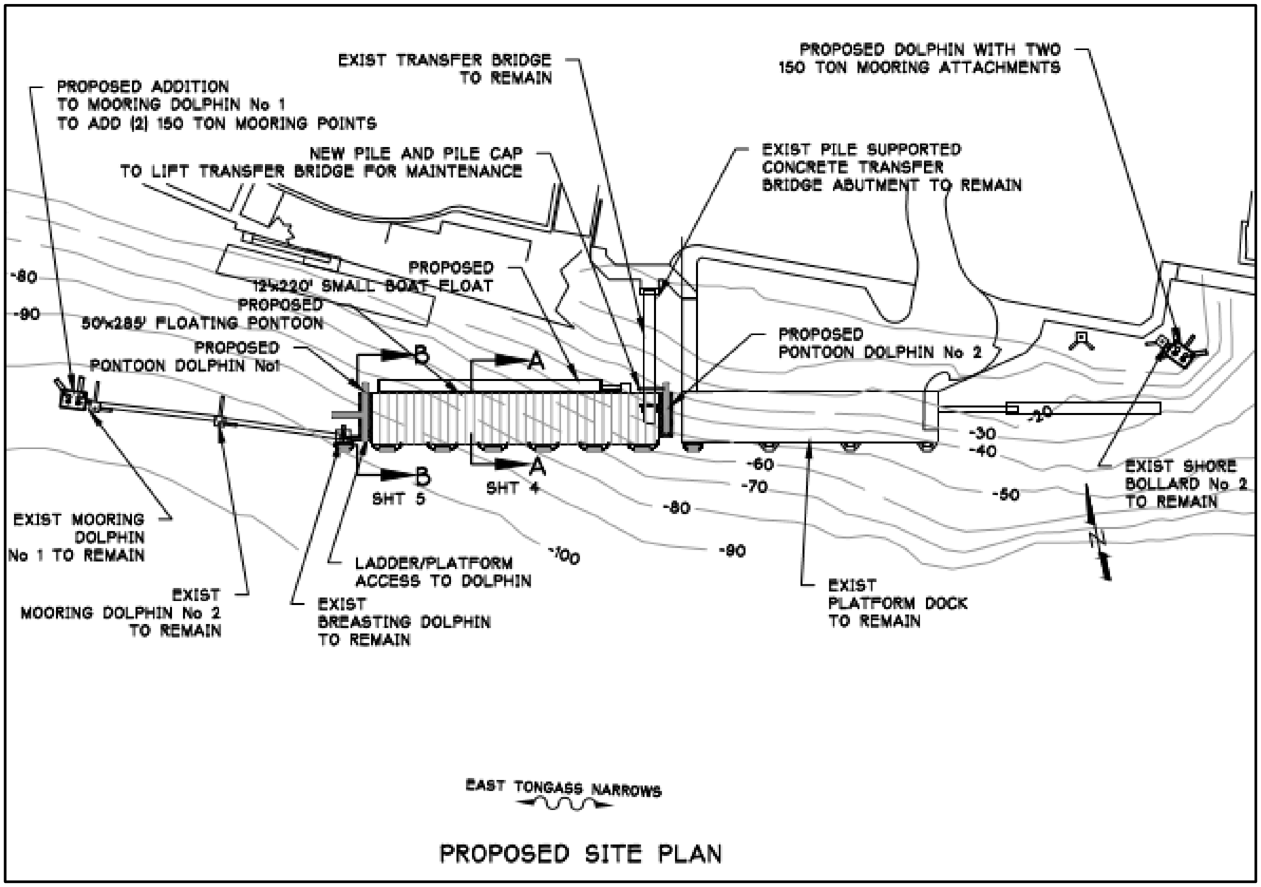

Figure 2. Proposed site plan for Ketchikan Dock Company's Berth IV showing new structures to be installed and existing structures to remain.

The proposed Berth IV modification would include the following construction activities:

- Permanently remove the existing 125 foot (ft) by 35 ft floating barge dock, 14 ft by 20 ft small boat dock float, and their associated three dolphins comprised of two 24-inch, six 30-inch, and four 36-inch diameter steel piles;
- Temporarily remove the existing transfer bridge, and then reinstall it on the new facility;
- Install sixteen temporary 30-inch diameter steel piles as templates to guide proper installation of permanent piles (these piles would be removed prior to project completion);
- Install seventeen permanent 48-inch diameter piles and one permanent 30-inch diameter pile to support a new 285 ft by 50 ft floating pontoon dock, its attached 220 ft by 12 ft small craft float, and mooring structures;
- Anchor seventeen 48-inch diameter piles with 30-inch diameter rock anchors; and
- Install bull rail, floating fenders, mooring cleats, and three mast lights. (Note: these components would be installed out of the water.)

During the pile driving, pile removal, and drilling activities, the following equipment will be used:

- A vibratory hammer: ICE 44B/12,450 pounds static weight;
- A diesel impact hammer: Delmag D46/Max Energy 107,280 ft-pounds (lb);
- A drilled shaft drill: Holte 100,000 ft-lb. top drive with down-the-hole (DTH) hammer and bit; and
- A socket drill: Holte 100,000 ft-lb. top drive with DTH hammer and under-reamer bit.

Materials and equipment, including the dock, would be transported to the project site by barge. While work is conducted in the water, anchored barges would be used to stage construction materials and equipment. Skiffs (25-ft) with 125 or 250 horsepower motors would be used to transport workers and materials during dock construction.

In-water construction would begin with the removal of existing piles followed by pile installation and anchoring. Table 1 below provides each activity type and a conservative estimate of the amount of time required for each activity.

Table 1. Pile driving construction summary for Ketchikan's Berth IV

Description	Project Component					
	Existing Pile Removal	**Temporary Pile Installation**	**Temporary Pile Removal**	**Permanent Pile Installation**	**Permanent Pile Installation**	**Max Installation/ Removal per Day**
Pile Diameter and Type	24, 30, and 36-inch steel	30-inch steel	30-inch steel	30-inch steel	48-inch steel	--
# of Piles	2, 6, and 4 respectively; 12 total	16	16	1	17	--
Vibratory Pile Driving						
Max # of Piles Vibrated Per Day	4	4	4	1	2	4 temporary or 2 permanent
Vibratory Time Per Pile	15 min	30 min	10 min	1 hr	1 hr	--
Vibratory Time per day	1 hr	2 hr	40 min	1 hr	2 hr	2 hr
Vibratory Time Total	3 hr	8 hr	2 hr 40 min	1 hr	17 hr	--
Impact Pile Driving						
Max # of Piles Impacted Per Day	0	0	0	0	3	3
# of Strikes Per Pile	0	0	0	0	50 strikes	150 strikes
Impact Time Per Pile	0	0	0	0	5 min	--
Impact Time per Day	0	0	0	0	15 min	15 min
Impact Time Total	0	0	0	0	1 hr 25 min	--
Socketing Pile Installation (Drilling)						
Max # of Piles Socketed per Day	0	0	0	1	0	1
Socket Time Per Pile	0	0	0	3 hr	0	--
Socket Time per Day	0	0	0	3 hr	0	3 hr
Socket Time Total	0	0	0	3 hr	0	--
Anchor Drilling						
Max # of Piles drilled per Day	0	0	0	3	0	3
Drilling Time Per Pile	0	0	0	2.5 hr	0	--
Drilling Time per Day	0	0	0	7.5 hr	0	7.5 hr
Anchor Time Total	0	0	0	42.5 hr	0	--

Moving Barge Platform into Place

Materials and equipment, including the new dock, would be transported from Washington to the project site by barge. Initially, the barge would be secured in place by mooring to the existing dock, where some equipment and supplies would be offloaded and staged. Once pile driving begins, the barge would be secured in place by four mooring anchors. The anchors would be kept below the surface and would not be a hazard to navigation. Local moves to the next pile installation area (approximately 100 ft away) would occur at a speed of less than 2 miles per hour.

Removal of Existing Floats

The existing north float, existing floating barge, and 12 piles would be removed. Crane lines will be tied to the floats and then pulled from place using a crane on the barge. The crane would place the floats on either the existing platform dock (which will remain) or the barge deck. The floats would be transported off-site via barge for disposal at a permitted landfill or sold. The floating barge would be untied from its existing location and floated to a new location yet to be determined. The existing dolphins would be removed by vibratory hammer and placed on the existing dock or barge deck and transported offsite by barge for proper disposal.

Removal of Existing Piles

The contractor would attempt to direct pull existing piles; if those efforts prove to be ineffective, existing piles would be removed with a vibratory hammer.

Installation and Removal of Temporary Piles

Temporary 30-inch diameter piles would be installed and removed with a vibratory hammer. The temporary piles will serve as templates to guide proper installation of the permanent piles and will be removed prior to project completion.

Installation of Permanent Piles

The single permanent 30-inch diameter pile would be installed through approximately 15 ft of sand and gravel with a vibratory hammer. Then the pile will be secured into underlying bedrock with conventional socketing. Conventional socketing means using a down-the-hole (DTH) hammer and under-reamer bit to drill a hole into the bedrock and then socket the pile into the bedrock. Socket depths are expected to be approximately 20 ft (as determined by the geotechnical engineer) and take approximately 3 hours. (Note, this socketing method can also be referred to as down the hole drilling. We refer to it as socketing throughout this document to distinguish this method from anchoring, which also uses a drill.)

Permanent 48-inch diameter piles would be driven through approximately 15 ft of sand and gravel with a vibratory hammer and impact driven into bedrock. The number of impact hammer strikes per pile would not exceed 50.

After being driven with an impact hammer, the piles will be secured with rock anchors. To install the rock anchors, a drill will be placed inside the hollow 48-inch diameter pile and will drill down into the bedrock. During this anchor drilling, the 48-inch pile will not be touched by the drill; therefore, anchoring will not generate steel-on-steel hammering noise (noise that is generated during socketing). In rock anchoring, the DTH drill only hits the bedrock and, for this effort, the 48-inch pile will act as a casing to isolate the drill noise. The process of anchoring has been used on many projects in Alaska with 8-inch diameter anchors (including the recently permitted Haines Ferry Terminal). Due to the significant loads generated from cruise ship berthing, the Ketchikan Berth IV project will use 30-inch diameter rock anchors. Each anchor will take approximately 2.5 hours to complete.

Transport of Workers to and from Work Platform

Generally, workers will be able to access the work platform by walking down the ramp and across the existing floats. When not accessible from the existing floats, workers will be transported from shore to the barge work platform by a 25-ft skiff with a 125–250 horse power motor. The travel distance will be less than 200 feet. There could be multiple shore to barge trips during the day; however, the area of travel will be relatively small, within a very busy area, and close to shore. Vessels will be refueled at existing fuel docks along Tongass Narrows. (Petro Marine Services, for example, has a pier fuel dock approximately 2 miles away.)

Other In-water Construction and Heavy Machinery Activities

In addition to the activities described above, the proposed action will involve other in-water construction and heavy machinery activities. Examples of other types of activities include using standard barges, tug boats, barge-mounted excavators, or clamshell equipment used to place or remove material; positioning piles on the substrate via a crane (*i.e.*, "stabbing the pile"); and removing piles from the water column/substrate via a crane (*i.e.*, "deadpulling").

2.1.2 Mitigation measures

KDC has agreed to implement the following mitigation measures to minimize impacts to marine mammals, including ESA-listed species, during pile driving activities[1].

2.1.2.1 General Conditions for Pile Driving

- *Pile cushion*-- KDC will use a softening material (*e.g.*, high-density polyethylene or ultra-high-molecular weight polyethylene) on all templates to eliminate steel on steel noise generation during impact pile driving.
- *Soft start for impact pile driving*-- Soft-start procedures are believed to provide additional protection to marine mammals by warning or giving marine mammals a chance to leave the area prior to the impact hammer operating at full capacity. For impact pile driving, KDC will provide an initial set of 3 strikes from the impact hammer at 40 percent energy, followed by a one-minute waiting period, then two subsequent 3-strike sets. This soft-start will be applied prior to beginning pile driving activities each day or when impact pile driving hammers have been idle for more than 30 minutes.

[1]Pile driving activities, for purposes of these mitigation measures, include vibratory and impact pile driving, pile removal, drilling, socketing, anchoring, and other in-water heavy construction. These activities will be referred to generically as "pile driving activities" for the remainder of this mitigation measures section.

- KDC will drive all piles with a vibratory hammer until a desired depth is achieved or refusal prior to using an impact hammer.

2.1.2.2 Monitoring and Shutdown Zones

2.1.2.2.1 Level A shutdown zones

For all pile driving activities, KDC will establish a shutdown zone for a marine mammal species that is greater than its modeled radial distance Level A zone. The shutdown zone is intended to encompass the area within which sound pressure levels[2] (SPLs) equal or exceed the auditory injury criteria for cetaceans and pinnipeds. The purpose of a shutdown zone is to define an area within which activity would be halted upon sighting of a marine mammal (or in anticipation of an animal entering the defined area), thus preventing injury (Level A harassment) of marine mammals. The shutdown zones for humpback whales for each of the pile driving and drilling activities are listed in Table 2.

[2] Sound pressure is the sound force per unit micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in acoustics is 1 μPa, and the units for underwater sound pressure levels are decibels (dB) re 1 μPa.

Table 2. Level A shutdown zones and Level B monitoring zones for humpback whales for different construction activities related to the Ketchikan Berth IV upgrades.

Source	Level A shutdown zone (m)	Level B monitoring zone (m)	Level B monitoring zone (km^2)
In-Water Construction Activities			
In-Water Construction and Heavy Machinery	10	n/a	n/a
Vibratory Pile Driving			
24-inch steel removal (2 piles) (~1 hour on 1 day)	25	6,215	5.9
30-inch steel removal (6 piles) (~1 hour per day on 2 days)	25	6,215	5.9
36-inch steel removal (4 piles) (~1 hour on 1 day)	25	13,755	10.3
30-inch steel temporary installation (16 piles) (~2 hours per day on 4 days)	25	6,215	5.9
30-inch steel permanent installation (1 pile) (~2 hours on 1 day)	25	6,215	5.9
48-inch steel permanent installation (17 piles) (~2 hours per day on 9 days)	50	13,755	10.3
Impact Pile Driving			
48-inch steel permanent installation (17 piles) (~15 minutes per day on 6 days)	500	3,745	4.9
Socketing Pile Installation (Drilling)			
30-inch steel permanent installation (1 pile) (3 hours per day on 1 day)	50	13,755	10.3
Anchor Drilling			
30-inch steel anchor within each 48-inch steel pile (17 anchors) (7.5 hours per day for up to 9 days)	80	13,755	10.3

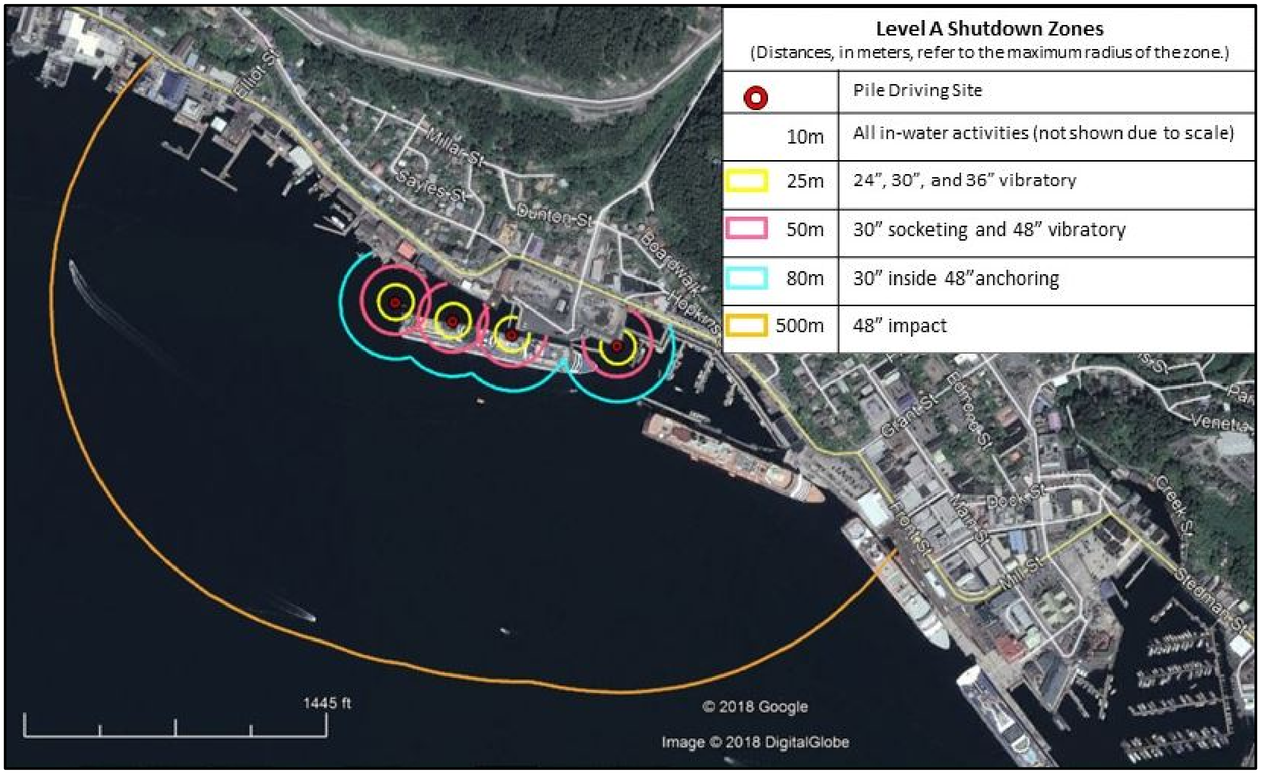

Figure 3. Level A shutdown zones by type of activity

2.1.2.2.2 Level B monitoring zones

KDC will establish and observe different Level B monitoring zones for this project depending on the type of pile driving activity that is happening that day. Level B monitoring zones are areas where SPLs are equal to or exceed 120 dB root mean square[3] (rms) for vibratory pile driving and drilling and 160 dB rms for impact driving. These areas are equal to Level B harassment zones and are presented in Table 2. These zones are useful for the monitoring conducted for mitigation purposes (*i.e.*, shutdown zone monitoring) by establishing monitoring protocols for areas adjacent to the shutdown zones. Monitoring zones enable protected species observers (PSOs) to be aware of and communicate the presence of marine mammals in the project area, but outside the shutdown zone, and thus prepare for potential shutdowns of activity. However, the primary purpose of monitoring zones is for documenting instances of Level B harassment.

Given the size of the monitoring zone for vibratory pile driving and drilling (*e.g.*, 6.2–13.7 km), it is impossible to guarantee that all animals would be observed or to make comprehensive observations of fine-scale behavioral reactions to sound, and only a portion of the zone (*e.g.*, what may be reasonably observed by PSOs from their stations) would be observed. In order to document observed instances of harassment, PSOs record all marine mammal observations, regardless of location. The PSO's location, as well as the location of the pile being driven, is known from a GPS. The location of the animal is estimated as a distance from the PSO, which is then compared to the location from the pile. It may then be estimated whether the animal was exposed to sound levels constituting incidental harassment based on predicted distances to

[3] Root mean square (rms) is the square root of the arithmetic average of the squared instantaneous pressure values.

relevant thresholds in post-processing of observational and acoustic data, and a precise accounting of observed incidences of harassment created. This information may then be used to extrapolate observed takes to reach an approximate understanding of actual total takes.

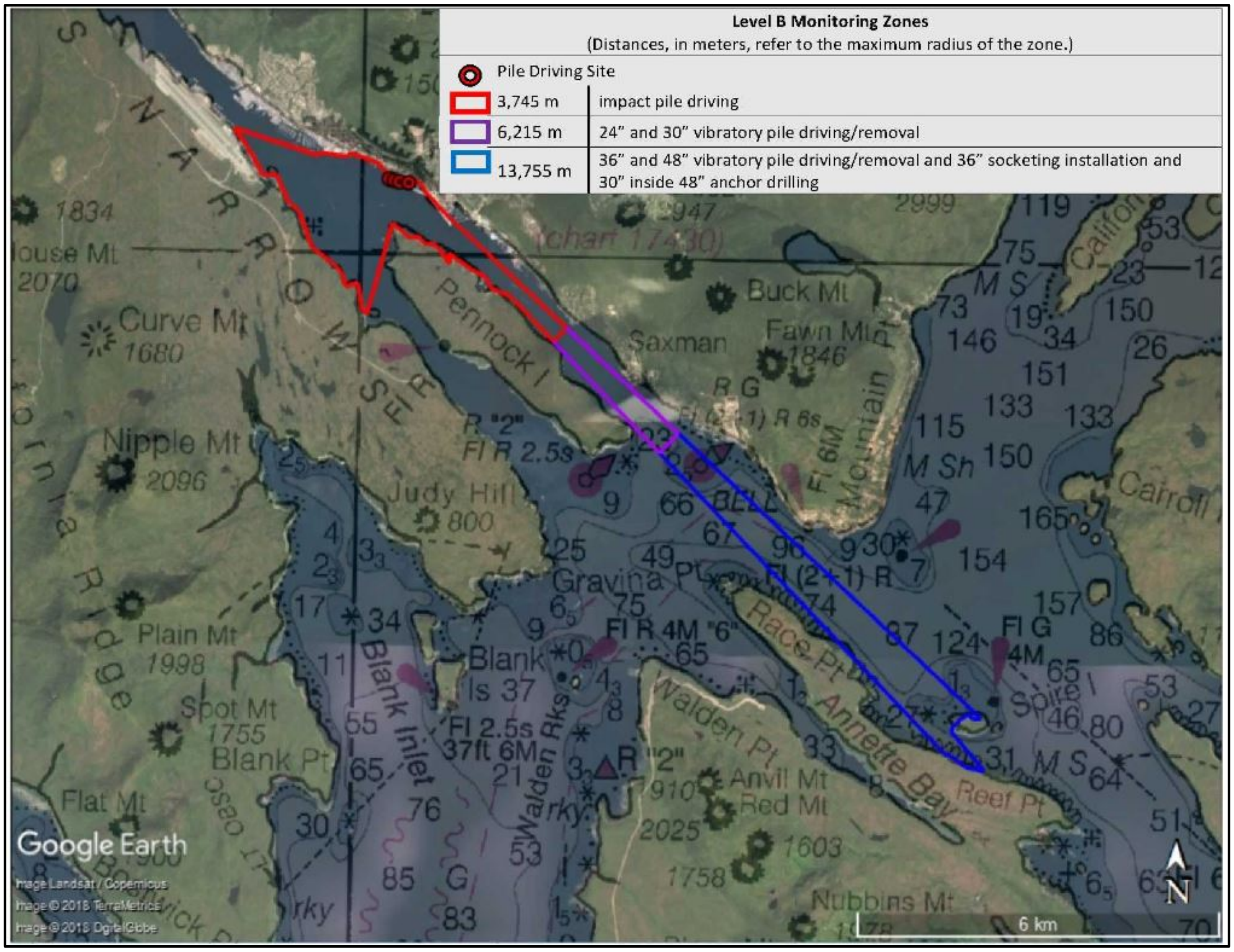

Figure 4. Level B monitoring zones.

2.1.2.3 Visual Monitoring by Protected Species Observers

2.1.2.3.1 General requirements for visual monitoring

- NMFS-approved PSOs, able to accurately identify and distinguish species of Alaska marine mammals, will be present before and during all pile driving activities.
- All work will be conducted during daylight hours to allow for visual monitoring.
- Pile-driving activities will not be conducted when weather conditions or darkness restrict clear, visible observation of all waters within and surrounding the Level A shutdown zone.

- The PSO will have the following to aid in determining the location of observed listed species, to take action if listed species enter the shutdown zone, and to record these events:
    - Binoculars
    - Range finder
    - GPS
    - Compass
    - Two-way radio communication with construction foreman/superintendent
    - A log book of all activities which will be made available to USACE and NMFS upon request

- *Pre-Construction Briefing*—KDC will conduct briefings between construction supervisors and crews, and the marine mammal monitoring team prior to the start of all pile driving activities and when new personnel join the work in order to explain responsibilities, communication procedures, marine mammal monitoring protocols, and operational procedures. The crew will be requested to alert the PSO when a marine mammal is spotted in the project area.

- *Daily Briefing*-- Each day prior to commencing pile driving activities, the lead PSO will conduct a radio check with the construction foreman or superintendent to confirm the activities and zones to be monitored that day. The construction foreman and lead PSO will maintain radio communications throughout the day so that the PSOs may be alerted to any changes in the planned construction activities and zones to be monitored.

- The PSOs will have no other primary duty than to watch for and report on events related to marine mammals during monitoring periods.

- *Shifts*-- The PSOs will work in shifts lasting no longer than 4 hr with at least a 1-hr break between shifts, and will not perform duties as a PSO for more than 12 hr in a 24-hr period (to reduce PSO fatigue).

- KDC will monitor the Level A shutdown zone and Level B monitoring zones in Table 2 during all pile driving activities.

- *Pre-activity monitoring*-- Prior to the start of daily pile driving activity, or whenever a break in pile driving activities of 30 minutes or longer occurs, the PSO(s) will observe the shutdown and monitoring zones for a period of 30 minutes before pile driving activities can begin.

    - If the shutdown zone has be observed to be clear of marine mammals for 30 minutes, pile driving activities can commence and work can continue even if visibility becomes impaired within the Level B monitoring zone. (Visibility may become impaired if weather conditions or Beaufort sea state change such that the entire monitoring zone is no longer visible.)

    - If any listed species are present within the Level A shutdown zone, pile driving activities will not begin until the animal(s) has left the shutdown zone or no listed species have been observed in the shutdown zone for 15 minutes.

  - If the monitoring zone has been observed for 30 minutes and no species for which take has not been authorized are present within the zone, soft start procedures can commence and work can continue even if visibility becomes impaired within the monitoring zone.
  - When a marine mammal for which for Level B take has been permitted is present in the monitoring zone, pile driving activities may begin and the PSO will record Level B take for that species.

- For all pile driving activities and in-water heavy machinery work, KDC will implement the appropriate shutdown zone (Table 2) around the pile or work zone. If a marine mammal comes within or approaches the shutdown zone, such operations will cease.
- For in-water heavy machinery and construction work (*e.g.*, barge movements, pile positioning, dead-pulling, and sound attenuation), a minimum 10 meter shutdown zone will be implemented. If a marine mammal comes within 10 meters of such operations, operations will cease and vessels will reduce speed to the minimum level required to maintain steerage and safe working conditions.
- After a shutdown occurs, pile driving activities can only begin after the animal is observed leaving the shutdown zone or has not been observed for 15 minutes after the commencement of the shutdown.
- If waters exceed a sea-state that restricts the observers' ability to make observations within the marine mammal shutdown zone, pile driving activities will cease. Pile driving activities will not be initiated or continue until the entire largest shutdown zone for the activity is visible.
- Post-construction monitoring will be conducted for 30 minutes beyond the cessation of pile driving activities at the end of the day.
- Throughout all pile driving activity, the PSO(s) will continuously scan the shutdown zone to monitor for the presence or approach of listed species.
  - If any listed species enter, or appear likely to enter, the shutdown zone during pile driving activities, all pile driving activities will cease immediately. Pile driving activities may resume when the animal(s) has been observed leaving the area on its own accord. If the animal(s) is not observed leaving the area, pile-driving activity may begin 15 minutes after the animal is last observed in the area.
- If the entire Level B monitoring zone is not visible, pile driving activities may continue, and the number of individual humpback whales within the Level B zone will be estimated and recorded. Estimated numbers of individuals will be extrapolated by dividing the number of observed individuals by the percentage of the monitoring zone that was visible.
  - For example, if wind and sea state increased causing visibility to diminish to a point that only 40 percent of the monitoring zone were visible, and 2 humpback

whales were observed entering the Level B zone, the PSO would estimate that 5 humpback whales were present in the Level B zone (2 whales observed in Level B zone ÷ 40% of zone visible = 5 whales estimated to be within Level B zone). (Note that the estimated number of individuals does not equal the estimated number of takes for humpback whales. See next bullet for further explanation.)

- Estimated takes will be calculated based on the total number of humpback whales observed (or estimated) in the Level B monitoring zone in a month multiplied by 6.1% (the percentage of humpback whales in the action area estimated to be from the listed Mexico DPS (Wade et al. 2016)).
    - For example, if 25 humpback whales were observed within the Level B zone within the monthly reporting period, 2 of those would be considered Level B takes of Mexico DPS humpback whales (25 observed humpback whales x 6.1% from Mexico DPS = 1.525 takes of Mexico DPS humpback whales (rounded up to 2 takes)).
- If a listed species enters or approaches the Level B zone and that listed species is either not authorized for take or its number of authorized takes has been met, pile driving activities must shut down immediately using delay and shut-down procedures. Activities must not resume until the animal has been confirmed to have left the area or an observation time period of 15 minutes since the animal was last seen has elapsed.

2.1.2.3.2 Number of PSOs Required

The number of PSOs will vary from two to four, depending on the type of activity, method of pile driving, and size of pile, which determines the size of the harassment zones.

- Two land-based PSOs will monitor during all impact pile driving
- Three land-based PSOs will monitor during vibratory pile driving/removal of 24-inch and 30-inch diameter piles
- Four land-based PSOs will monitor during vibratory pile driving/removal of 36-inch and 48-inch diameter piles and all socket/anchor drilling activities.

2.1.2.3.3 Location of PSOs

The PSOs will be positioned such that the entire shutdown zone is visible.

- One PSO will be stationed at Berth IV and will be able to view across Tongass Narrows south and west to Gravina Island.
- The second and third PSOs will be located in increments along the road systems at locations that provide the best vantage points for viewing Tongass Narrows west and east of Berth IV. These locations will vary depending on type of pile driving.
- The fourth PSO will be located on the road system near Mountain Point and will be able to view Tongass Narrows to the northwest and Revillagigedo Channel to the southeast.

- Monitoring locations will be selected to provide an unobstructed view of all water within the shutdown zone and as much of the Level B harassment zone as possible for pile driving activities.

2.1.2.3.4 Qualifications of PSO

KDC will adhere to the following conditions when selecting PSOs:

- Independent PSOs will be used (*i.e.*, not construction personnel).
- At least one PSO must have prior experience working as a marine mammal observer during construction activities.
- Other PSOs may substitute education (degree in biological science or related field) or training for experience.
- When a team of three or more PSOs is required, a lead PSO or monitoring coordinator will be designated. The lead PSO must have prior experience working as a marine mammal observer during construction.
- KDC will submit PSO résumés or curriculum vitae to NMFS PR1 for approval (Gray.Redding@noaa.gov).
- KDC will ensure that, and observers must have, the following additional qualifications:
    - 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; use of binoculars may be necessary to correctly identify the target;
    - Ability to conduct field observations and collect data according to assigned protocols;
    - Experience or training in the field identification of marine mammals, including the identification of behaviors;
    - Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
    - Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when pile driving activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior;
    - Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary; and

- Sufficient training, orientation, or experience with the construction operations to provide for personal safety during observations.

2.1.2.4 Reporting

2.1.2.4.1 Notification of intent to commence construction

KDC will inform NMFS Office of Protected Resources (OPR) and the NMFS Alaska Region Protected Resources Division one week prior to commencing construction activities (Julie Scheurer, 907-586-7111, Julie.Scheurer@noaa.gov).

2.1.2.4.2 Daily activity logs

For each day of construction activity that requires a PSO, the following information will be recorded in a log provided by KDC:

1. Date and time that each monitoring period[4] begins and ends;

2. Prevailing environmental conditions in each monitoring period (*e.g.*, wind speed, percent cloud cover, visibility, sea state, tide state);

3. Construction activities occurring during each monitoring period, including how many and what size of piles were driven; and

4. Indication of whether marine mammals were sighted. For each marine mammal sighting, the PSO will complete a “Marine Mammal Sighting Form” as described below.

2.1.2.4.3 Marine mammal sighting form

For each marine mammal sighting, the PSO will complete a “Marine Mammal Sighting Form”. The PSO will record the following information:

- Species, numbers, and, if possible, sex and age class of marine mammals;
- Description of any observable marine mammal behavior patterns, including bearing and direction of travel and distance from pile driving activity;
- Location and distance from pile driving activities to marine mammals and distance from the marine mammals to the observation point;
- Estimated amount of time that the animals remained in the Level B zone;
- Time and description of most recent project activity prior to marine mammal observation;
- Environmental conditions as they existed during each sighting event, including, but not limited to: Beaufort sea state, weather conditions, visibility (km), lighting conditions;
- Description of implementation of mitigation measures within each monitoring period (*e.g.*, shutdown or delay);
- Other human activity in the area within each monitoring period; and
- A summary of the following:
  - Total number of individuals of each species observed (or estimated, if appropriate) within the Level B Zone.

[4] There may be several monitoring periods within a day. If environmental conditions change throughout the day, the PSO should record a new monitoring period to reflect those changes. A new monitoring period would also begin after each break in construction activity.

- Total number of individuals of each species detected within the Level A Zone and the average amount of time that they remained in that zone.

2.1.2.4.4 Interim monthly reports

During construction, KDC will submit brief, monthly reports to the NMFS Alaska Region Protected Resources Division that summarize PSO observations and recorded takes. Monthly reporting will allow NMFS to track the amount of take (including extrapolated takes), to allow reinitiation of consultation in a timely manner, if necessary. The monthly reports will be submitted by email to Julie.Scheurer@noaa.gov.

The reporting period for each monthly PSO report will be the entire calendar month, and reports will be submitted by close of business on the fifth day of the month following the end of the reporting period (*e.g.*, the monthly report covering September 1–30, 2018, would be submitted to the NMFS by close of business on October 5, 2018).

2.1.2.4.5 Final report

KDC will submit a draft final report by email to NMFS OPR (Gray.Redding@noaa.gov) and NMFS Alaska Region Protected Resources Division (Julie.Scheurer@noaa.gov) not later than 90 days following the end of construction activities. KDC will provide a final report within 30 days following resolution of NMFS's comments on the draft report. If no comments are received from NMFS within 30 days, the draft final report will be considered the final report.

The final reports will contain, at minimum, the following information:

- Summary of construction activities, including beginning and completion dates;
- Description of any deviation from initial proposal in pile numbers, pile types, average driving times, etc.;
- Table summarizing all marine mammal sightings during the construction period including:
    a. dates, times, species, number, location, and behavior of any observed ESA-listed marine mammals, including all observed humpback whales;
    b. daily average number of individuals of each species (differentiated by month as appropriate) detected within the Level B Zone, and estimated as taken, if appropriate;
- Number of shut-downs throughout all monitoring activities;
- Table summarizing any incidents resulting in take of ESA-listed species;
- Brief description of any impediments to obtaining reliable observations during construction period;
- Description of any impediments to complying with these mitigation measures; and
- Appendices containing all PSO daily logs and marine mammal sighting forms.

2.1.2.5 Reporting Injured or Dead Marine Mammals

2.1.2.5.1 Contact information for reporting injured or dead marine mammals

Office of Protected Resources (NMFS OPR)
Telephone: 301-427-8401
Email: Gray.Redding@noaa.gov

NMFS Alaska Region Protected Resources Division
Telephone: 907-586-7111
Email: Julie.Scheurer@noaa.gov

NMFS Alaska Regional Stranding Coordinator
Telephone: 907-271-1332
Email: Mandy.Migura@noaa.gov

NMFS Alaska Regional Stranding Hotline
Telephone: 1-877-925-7773

2.1.2.5.2 For injuries or mortalities to animals from activities related to the project:

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner not authorized by the IHA, such as unauthorized Level A harassment, serious injury, or mortality, KDC will immediately cease the specified activities and report the incident to the NMFS Office of Protected Resources, the NMFS Alaska Region Protected Resources Division, and the NMFS Alaska Regional Stranding Coordinator or Hotline.

The report must include the following information:

- Time and date of the incident;
- Description of the incident;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if available).

Activities will not resume until NMFS is able to review the circumstances of the unauthorized take. NMFS would work with KDC to determine what measures are necessary to minimize the likelihood of further unauthorized take and ensure ESA and MMPA compliance. KDC may not resume their activities until notified by NMFS.

2.1.2.5.3 For injured or recently dead animals from unknown causes:

In the event that KDC discovers an injured or dead marine mammal within the action area, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), KDC will immediately report the incident to the NMFS Office of Protected Resources, and the NMFS Alaska Regional Stranding Coordinator or Hotline.

The report must include the same information identified in the paragraph above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with KDC to determine whether additional mitigation measures or modifications to the activities are appropriate.

2.1.2.5.4 For injured or dead animals from causes NOT related to the project:

In the event that KDC discovers an injured or dead marine mammal and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), KDC must report the incident to the NMFS Office of Protected Resources, and the NMFS Alaska Regional Stranding Coordinator or Hotline, within 24 hours of the discovery. KDC will provide photographs, video footage (if available), or other documentation of the stranded animal sighting to NMFS.

2.1.2.6 Strike Avoidance

Vessels will adhere to the Alaska Humpback Whale Approach Regulations when transiting to and from the project site (see 50 CFR §§ 216.18, 223.214, and 224.103(b)). These regulations require that all vessels:

- Not approach within 100 yards of a humpback whale, or cause a vessel or other object to approach within 100 yards of a humpback whale,
- Not place vessel in the path of oncoming humpback whales causing them to surface within 100 yards of vessel,
- Not disrupt the normal behavior or prior activity of a whale, and
- Operate at a slow, safe speed when near a humpback whale (safe speed is defined in regulation (see 33 CFR § 83.06)).

Vessels will also follow the NMFS Marine Mammal Code of Conduct for other species of marine mammals, which recommend maintaining a minimum distance of 100 yards; not encircling, or trapping marine mammals between boats, or boats and shore; and putting engines in neutral if approached by a whale or other marine mammal to allow the animals(s) to pass.

2.1.2.7 Oil and Spill Prevention

- The contractor will provide and maintain a spill cleanup kit on-site at all times, to be implemented as part of the DB Brightwater Shipboard Oil Pollution Emergency Plan for oil spill prevention and response (Turnagain Marine Construction 2018)
- Fuel hoses, oil drums, oil or fuel transfer valves and fittings, and similar equipment will be checked regularly for drips or leaks, and would be maintained and stored properly to prevent spills.

- Oil booms will be readily available for oil or other fuel spill containment should any release occur.
- All chemicals and petroleum products will be properly stored to prevent spills.
- No petroleum products, cement, chemicals, or other deleterious materials will be allowed to enter surface waters.

2.2 Action Area

Action area "means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). For this reason, the action area is typically larger than the project area and extends out to a point where no measurable effects from the proposed action occur.

The action area for the proposed dock project includes the maximum area within which project-related noise levels are expected to reach or exceed 120 dB re 1 μPa rms (henceforth 120 dB), *i.e.*, ambient noise levels (where no measurable effect from the project would occur). Based on modeled sound propagation estimates, received levels from installation of 48-inch piles (the loudest noise source associated with the proposed action) are expected to decline to 120 dB at 16,343 m from the source. However, the action area would be truncated where land masses obstruct underwater sound transmission (in this case, Annette Island to the southeast of the project); thus, the action area is largely confined to marine waters within Tongass Narrows, extending approximately 13.75 km into Revillagigedo Channel and encompassing approximately 10.3 km^2 (Figure 5). A description of the methods used to calculate the distance to the 120 dB isopleth to define the action area is given in Section 6.5.1.2.1 of this Opinion.

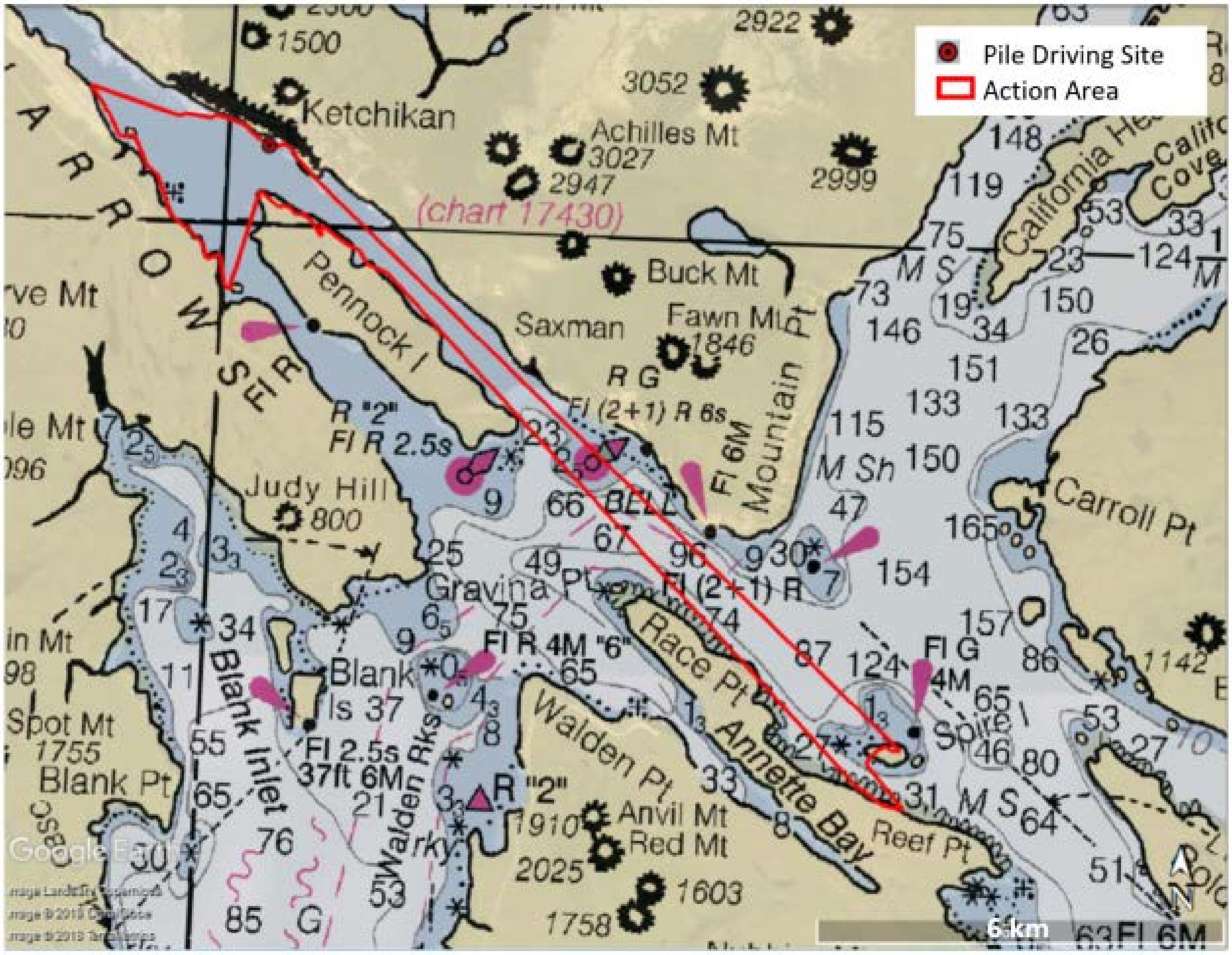

Figure 5. Action area for Ketchikan Berth IV dock upgrades.

3. Approach to the Assessment

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). As NMFS explained when it promulgated this definition, NMFS considers the likely impacts to a species' survival as well as likely impacts to its recovery. Further, it is possible that in certain, exceptional circumstances, injury to recovery alone may result in a jeopardy Biological Opinion (51 FR 19926, 19934 (June 2, 1986)).

Under NMFS's regulations, the destruction or adverse modification of critical habitat "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (50 CFR 402.02).

We use the following approach to determine whether the proposed action described in Section 2.1 is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on listed species or critical habitat. As part of this step, we identify the action area – the spatial and temporal extent of these direct and indirect effects.

- Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action. This section describes the current status of each listed species and its critical habitat relative to the conditions needed for recovery. We determine the rangewide status of critical habitat by examining the condition of its PBFs which were identified when the critical habitat was designated. Species and critical habitat status are discussed in Section 4 of this Opinion.

- Describe the environmental baseline including: past and present impacts of Federal, state, or private actions and other human activities *in the action area*; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, and the impacts of state or private actions that are contemporaneous with the consultation in process. The environmental baseline is discussed in Section 5 of this opinion.

- Analyze the effects of the proposed actions. Identify the listed species that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to stressors and the populations or subpopulations those individuals represent. The effects of the action are described in Section 6 of this opinion with the exposure analysis described in Section 6.5 of this Opinion.

- Once we identify which listed species are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed species are likely to respond given their exposure (these represent our *response analyses*). Response analysis is considered in Section 6.6 of this Opinion.

- Describe any cumulative effects. Cumulative effects, as defined in NMFS's implementing regulations (50 CFR 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation. Cumulative effects are considered in Section 7 of this Opinion.

- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat. In this step, NMFS adds the effects of the action (Section

6) to the environmental baseline (Section 5) and the cumulative effects (Section 7) to assess whether the action could reasonably be expected to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 4). Integration and synthesis with risk analyses occur in Section 8 of this Opinion.

- Reach jeopardy and adverse modification conclusions. Conclusions regarding jeopardy and the destruction or adverse modification of critical habitat are presented in Section 9. These conclusions flow from the logic and rationale presented in the *Integration and Synthesis* Section 8.

4. Rangewide Status of the Species and Critical Habitat

One ESA-listed marine mammal listed species under NMFS's jurisdiction may occur in the action area: the threatened Mexico DPS humpback whale. No critical habitat for this species or any others occurs within the action area (Table 3).

Table 3. Listing status and critical habitat designation for marine mammals considered in this Biological Opinion.

Species	Status	Listing	Critical Habitat
Humpback whale, Mexico DPS *(Megaptera novaeangliae)*	Threatened	September 8, 2016, 81 FR 62260	Not designated

4.1 Climate Change

In accordance with NMFS guidance on analyzing the effects of climate change (Sobeck 2016), NMFS assumes that climate conditions will be similar to the status quo throughout the length of the direct and indirect effects of this project. We present an overview of the potential climate change effects on Mexico DPS humpback whales and their habitat below.

There is widespread consensus within the scientific community that atmospheric temperatures on earth are increasing and that this will continue for at least the next several decades (Oreskes 2004; Watson and Albritton 2001). There is also consensus within the scientific community that this warming trend will alter current weather patterns and patterns associated with climatic phenomena, including the timing and intensity of extreme events such as heat waves, floods, storms, and wet-dry cycles. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Pachauri and Reisinger 2007).

The Intergovernmental Panel on Climate Change (IPCC) estimated that average global land and sea surface temperature has increased by 0.6°C (±0.2) since the mid-1800s, with most of the change occurring since 1976. This temperature increase is greater than what would be expected given the range of natural climatic variability recorded over the past 1,000 years (Crowley 2000). The IPCC reviewed computer simulations of the effect of greenhouse gas emissions on observed climate variations that have been recorded in the past and evaluated the influence of natural phenomena such as solar and volcanic activity. Based on their review, the IPCC concluded that natural phenomena are insufficient to explain the increasing trend in land and sea surface temperature, and that most of the warming observed over the last 50 years is likely to be attributable to human activities (IPCC 2013).

Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century (Watson and Albritton 2001). Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Houghton 2001; McCarthy 2001; Parry 2007). Climate change would result in increases in atmospheric temperatures, changes in sea surface temperatures, increased ocean acidity, changes in patterns of precipitation, and changes in sea level (IPCC 2013).

The indirect effects of climate change on Mexico DPS humpback whales would likely include changes in the distribution of temperatures suitable for many stages of their life history, the distribution and abundance of prey, and the distribution and abundance of competitors or predators.

4.2 Status of Listed Species

This Opinion examines the status of each listed species that would be adversely affected by the proposed action. For this action, the threatened Mexico DPS humpback whale is the only listed species that may be present in the action area. The status is determined by the level of extinction risk that the Mexico DPS humpback whale faces, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02.

The sections below summarize information on the population structure and distribution of humpback whales in the action area to provide a foundation for the exposure analyses that appear later in this Opinion. Then we summarize information on the threats to the species and the species' status given those threats to provide points of reference for the jeopardy determinations we make later in this Opinion. That is, we rely on the species' status and trend to determine whether or not the action's direct or indirect effects are likely to increase the species' probability of becoming extinct or failing to recover.

More detailed background information on the status of the Mexico DPS humpback whale can be found in a number of published documents including stock assessment reports on Alaska marine mammals (Muto et al. 2017) and the humpback whale status review (Bettridge et al. 2015). In addition, a Sea Grant Marine Advisory Program Officer provided information on the distribution of marine mammals for the action area considered in this Opinion[5].

4.2.1 Humpback whale (*Megaptera novaeangliae*)

4.2.1.1 Population Structure and Conservation Status

The humpback whale (a mysticete or "baleen" whale) was listed as endangered under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (35 FR 18319). Congress replaced the ESCA with the ESA in 1973, and humpback whales continued to be listed as endangered. NMFS recently conducted a global status review and changed the status of humpback whales under the ESA. The globally listed species was divided into 14 DPSs, four of which are endangered, one is threatened, and the remaining 9 are not listed under the ESA (81 FR 62260; September 8, 2016). Three humpback whale DPSs occur in Alaska waters. The Hawaii DPS is no longer listed as endangered or threatened, the Mexico DPS is listed as threatened, and the Western North Pacific DPS is listed as endangered. Critical habitat has not been designated for the listed Western North Pacific or Mexico DPSs (NMFS 2016a).

4.2.1.2 Humpback Whales in Southeast Alaska

Wade et al. (2016) estimated abundance of humpback whales within all sampled winter and summer areas in the North Pacific, and estimated migration rates between these areas. The

[5] Personal communication with Kate Arduser, Solstice Alaska Consulting, Inc. and Gary Freitag, Sea Grant Marine Advisory Program Officer and longtime Ketchikan resident, regarding marine mammal occurrence, behavior, and typical group size in Ketchikan vicinity, 2017.

probability of encountering whales from each of the four North Pacific DPSs in various feeding areas is summarized in Table 4 below (NMFS 2016a). As shown in Table 4 for Southeast Alaska and Northern British Columbia, only the Mexico and Hawaii DPSs are likely to be present in the action area, and an estimated 6.1% of the observed humpback whales might be from the threatened Mexico DPS.

Table 4. Probability of encountering humpback whales from each DPS in the North Pacific Ocean in various feeding areas. Adapted from Wade et al. (2016).

Summer Feeding Areas	**North Pacific Distinct Population Segments**			
	Western North Pacific DPS (endangered)[1]	**Hawaii DPS (not listed)**	**Mexico DPS (threatened)**	**Central America DPS (endangered)[1]**
Kamchatka	100%	0%	0%	0%
Aleutian Is/ Bering/Chukchi	4.4%	86.5%	11.3%	0%
Gulf of Alaska	0.5%	89%	10.5%	0%
Southeast Alaska/ Northern BC	0%	93.9%	6.1%	0%
Southern BC/WA	0%	52.9%	41.9%	14.7%
OR/CA	0%	0%	89.6%	19.7%

[1] For the endangered DPSs, these percentages reflect the 95% confidence interval of the probability of occurrence in order to give the benefit of the doubt to the species and to reduce the chance of underestimating potential takes.

Whales from the Mexico and Hawaii DPSs overlap in Southeast Alaska. The Mexico DPS is comprised of approximately 3,264 (CV=0.06) animals (Wade et al. 2016) with an unknown population trend, though likely to be in decline (81 FR 62260). The Hawaii DPS is estimated to be comprised of 10,103 (CV=0.3) animals (Muto et al. 2017). The population trend for the Hawaii DPS is estimated to be increasing at an annual rate of between 5.5 and 6.0 percent (Calambokidis et al. 2008).

Humpback whales are present in Southeast Alaska in all months of the year. Most Southeast Alaska humpback whales winter in low latitudes, but some individuals have been documented over-wintering near Sitka and Juneau (National Park Service Fact Sheet available at http://www.nps.gov/glba). Late fall and winter whale habitat in Southeast Alaska appears to correlate with areas that have over-wintering herring, such as Sitka Sound (Baker et al. 1985; Moran et al. 2018; Straley 1990)

Relatively high densities of humpback whales occur throughout much of Southeast Alaska and northern British Columbia, particularly during the summer months (Muto et al. 2017). The abundance estimate for humpback whales in the Southeast Alaska is estimated to be 6,137 (CV=0.07) animals which includes whales from the Hawaii DPS (~94%) and Mexico DPS (~6%) (Wade et al. 2016). Although migration timing varies among individuals, most whales depart for Hawaii or Mexico in fall or winter and begin returning to Southeast Alaska in spring, with continued returns through the summer and a peak occurrence in Southeast Alaska during late summer to early fall. However, there are significant overlaps in departures and returns (Baker et al. 1985; Straley 1990).

4.2.1.3 Humpback Whales in the Action Area

Given their widespread range and their opportunistic foraging strategies, humpback whales may be in the project vicinity during the proposed project activities.

4.2.1.4 Natural History

4.2.1.4.1 Reproduction and growth

Humpbacks give birth and presumably mate on low-latitude wintering grounds in January to March in the Northern Hemisphere. Females attain sexual maturity at 5 years in some populations and exhibit a mean calving interval of approximately two years (Barlow and Clapham 1997; Clapham 1992). Gestation is about 12 months, and calves probably are weaned by the end of their first year (Perry et al. 1999).

Although long-term relationships do not appear to exist between males and females, mature females do pair with other females; those individuals with the longest standing relationships also have the highest reproductive output, possibly as a result of improved feeding cooperation (Ramp et al. 2010).

4.2.1.4.2 Feeding and prey selection

Humpback whales tend to feed on summer grounds and not on winter grounds. However, some opportunistic winter feeding has been observed at low latitudes (Perry et al. 1999). Humpback whales engulf large volumes of water and then filter small crustaceans and fish through their fringed baleen plates.

Humpback whales are relatively generalized in their feeding compared to some other baleen whales. In the Northern Hemisphere, known prey includes: euphausiids (krill); copepods; herring; juvenile salmonids; Arctic cod; walleye pollock; pteropods; and cephalopods (Johnson and Wolman 1984; Perry et al. 1999; Straley et al. 2018). Foraging is confined primarily to higher latitudes (Stimpert et al. 2007).

4.2.1.4.3 Diving and social behavior

In Hawaiian waters, humpback whales remain almost exclusively within the 1800 m isobath and usually within water depths less than 182 meters. Maximum diving depths are approximately 170 m (558 ft) (but usually <60 m [197 ft]), with a very deep dive (240 m [787 ft]) recorded off Bermuda (Hamilton et al. 1997). They may remain submerged for up to 21 min (Dolphin 1987a). Dives on feeding grounds ranged from 2.1-5.1 min in the north Atlantic (Goodyear unpublished manuscript); whales observed feeding on Stellwagen Bank dove <40 m (Hain et al. 1995). In southeast Alaska average dive times were 2.8 min for feeding whales, 3.0 min for non-feeding whales, and 4.3 min for resting whales, with the deepest dives to 148 m (Dolphin 1987a). Because most humpback prey is likely found above 300 m depths most humpback dives are probably relatively shallow. Hamilton et al. (1997) tracked one possibly feeding whale near Bermuda to 240 m depth.

In a review of the social behavior of humpback whales, Clapham (1996) reported that they form small, unstable social groups during the breeding season. During the feeding season they form small groups that occasionally aggregate on concentrations of food. Feeding groups are sometimes stable for long periods of time. There is good evidence of some territoriality on feeding grounds (Clapham 1994; Clapham 1996) and calving areas (Tyack 1981). In calving areas, males sing long complex songs directed towards females, other males or both. The breeding season can best be described as a floating lek or male dominance polygyny (Clapham 1996). Inter-male competition for proximity to females can be intense as expected by the sex ratio on the breeding grounds which may be as high as 2.4:1.

4.2.1.4.4 Vocalization and hearing

While there is no direct data on hearing in low-frequency cetaceans, the functional hearing range is anticipated to be between 7 Hz to 35 kHz (Au et al. 2006; Ciminello et al. 2012; NMFS 2016b; Southall et al. 2007; Watkins 1986). Baleen whales have inner ears that appear to be specialized for low-frequency hearing. In a study of the morphology of the mysticete auditory apparatus, Ketten (1997) hypothesized that large mysticetes have acute infrasonic hearing.

Humpback whales produce at least three kinds of sounds:

1. Complex songs with components ranging from at least 20 Hz–24 kHz with estimated source levels from 144–174 dB; these are mostly sung by males on the breeding grounds (Au et al. 2006; Au et al. 2000; Frazer and Mercado 2000; Richardson et al. 1995; Winn et al. 1970);
2. Social sounds in the breeding areas that extend from 50Hz – more than 10 kHz with most energy below 3kHz (Richardson et al. 1995; Tyack and Whitehead 1983); and
3. Feeding area vocalizations that are less frequent, but tend to be 20 Hz–2 kHz with estimated sources levels in excess of 175 dB re 1 Pa at 1m (Richardson et al. 1995; Thompson et al. 1986).

Humpback whales are in the low frequency (LF) cetacean function hearing group (Southall et al. 2007).

4.2.1.5 Stressors and Threats

The MMPA stock delineations have not yet been revised to correspond with the 14 DPSs established for humpback whales in 2016. Therefore, estimates of rates of mortality and serious injury in the stock assessment reports (SAR) do not correspond exactly with individual DPSs. A general description of threats and stressors to all humpback whales occurring in Alaska is provided below. Please refer to the SARs for more information about rates of mortality and serious injury by MMPA stock (Carretta et al. 2017; Muto et al. 2017).

4.2.1.5.1 Commercial whaling

Historically, commercial whaling represented the greatest threat to every population of humpback whales and was ultimately responsible for listing humpback whales as an endangered species. From 1900 to 1965, nearly 30,000 whales were taken in modern whaling operations of the Pacific Ocean. Prior to that, an unknown number of humpback whales were taken (Perry et al. 1999). In 1965, the International Whaling Commission banned commercial hunting of humpback whales in the Pacific Ocean.

4.2.1.5.2 Predation

Humpback whales are killed by orcas (Dolphin 1987b; Florezgonzalez et al. 1994; Naessig and Lanyon 2004; Whitehead and Glass 1985), and are probably killed by false killer whales and sharks. Calves remain protected near mothers or within a group and lone calves have been known to be protected by presumably unrelated adults when confronted with attack (Ford and Reeves 2008).

4.2.1.5.3 Disease

Out of 13 marine mammal species examined in Alaska, domoic acid was detected in all species examined with humpback whale showing 38% prevalence. Saxitoxin was detected in 10 of the 13 species, with the highest prevalence in humpback whales (50%) and bowhead whales (32%) (Lefebvre et al. 2016). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992).

4.2.1.5.4 Subsistence harvest

Subsistence harvest of humpback whales is not authorized under the Whaling Convention Act. There are no reported takes of humpback whales from the Mexico DPS by subsistence hunters in Alaska for the 2010-2014 period (Muto et al. 2017). One humpback whale was taken illegally by Alaska Native subsistence hunters near Toksook Bay in western Alaska in 2016, and while it could have been a member of the Mexico DPS or Western North Pacific DPS, it was more likely from the non-listed Hawaii DPS (NMFS unpublished data; Wade et al. 2016).

4.2.1.5.5 Unusual Mortality Event (UME)

NMFS declared a UME for large whales in the western Gulf of Alaska that occurred between May 22 and December 31, 2015, and included 22 humpback and 12 fin whale mortalities[6]. No specific cause for the increased mortality was identified, although it was most likely related to unusual oceanographic and climatic conditions that may have led to shifts in prey distribution or harmful algal blooms. This UME has been closed.

4.2.1.5.6 Fishery interactions and entanglements

Humpback whales are occasionally entangled during interactions with commercial fishing gear. In Alaska, interactions resulting in entanglements, mortality, or serious injury of humpback whales occurred in the following fisheries between 2010-2014: Bering Sea Aleutian Islands (BSAI) flatfish trawl, BSAI pollock trawl, Southeast Alaska salmon drift gillnet, Pacific cod jig, Bering Sea pot gear, Prince William Sound shrimp pot gear, and Gulf of Alaska Dungeness crab pot gear (Muto et al. 2017). Pot and trap gear are the most commonly documented source of mortality and serious injury to humpback whales off the U.S. West Coast outside of Alaska (Carretta et al. 2017).

Aquaculture operations may pose an entanglement risk to humpback whales. Although NMFS is unaware of any entanglements that have occurred between humpback whales and aquaculture operations, entanglements have been reported in other countries (Price et al. 2017). Humpback whales in Southeast Alaska have been observed feeding around and near salmon aquaculture

[6] NMFS Office of Protected Resources website: https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2016-large-whale-unusual-mortality-event-western-gulf-alaska. Accessed June 4, 2018.

facilities (Chenoweth et al. 2017). In June 2018, NMFS received a report of a humpback whale damaging a floating salmon net pen near Ketchikan. The encounter did not result in an entanglement, but illustrates the potential for interactions. The aquaculture industry is growing in Alaska, increasing the potential for marine mammal entanglements.

A photographic study of humpback whales in southeastern Alaska in 2003 and 2004 found at least 53% of individuals showed some kind of scarring from entanglement (Neilson et al. 2005).

4.2.1.5.7 Vessel collisions

Vessel collisions with humpback whales remain a significant management concern, given the increasing abundance of humpback whales foraging in Alaska, as well as the growing presence of marine traffic in Alaska's coastal waters. Based on these factors, injury and mortality of humpback whales as a result of vessel strike may likely continue into the future (NMFS 2006). The potential for ship strikes may increase as vessel traffic in northern latitudes increases with changes in sea-ice coverage (Muto et al. 2017).

Neilson et al. (2012) reviewed 108 whale-vessel collisions in Alaska from 1978–2011 and found that 86% involved humpback whales. Collision hotspots occurred in southeast Alaska in popular whale watching locations. Of the 10 stranded humpback whales from the Ketchikan area reported to the NMFS Alaska Region Marine Mammal Stranding Program between 2007 and 2017, 3 whales for which cause of death could be determined were killed by vessel strikes.

4.2.1.5.8 Other stressors

Elevated levels of sound from anthropogenic sources (*e.g.*, shipping, military sonar) are a potential concern for humpback whales in the North Pacific (Muto et al. 2017). A humpback was reported entangled in a research wave rider buoy off the U.S. West Coast (Carretta et al. 2017). Other potential impacts include possible changes in prey distribution with climate change, entanglement in or ingestion of marine debris, impacts from oil and gas activities, and disturbance from whale watching activities (Muto et al. 2017).

5. ENVIRONMENTAL BASELINE

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The project vicinity is an area of high human use and habitat alteration. Ongoing human activity in the action area that impacts marine mammals includes marine vessel activity, pollution, climate change, noise (*e.g.*, aircraft, vessel, pile-driving, etc.), and coastal zone development.

5.1 Physical Environment

The action area radiates from Berth IV in Tongass Narrows into Revillagigedo Channel. Revillagigedo Channel is a large channel that is part of the Inside Passage. To the south it opens into Dixon Entrance at the Canada-United States border, and it extends north to Tongass Narrows. The channel varies between 5 and 15 km (3.1–9.3 miles) wide and, in places, is 365 m (1,200 ft) deep[7].

Tongass Narrows is glacier-carved fjord that stretches from Nichols Passage on the southeast end to Guard Island on the north. The Narrows is bounded on the eastern side by Revillagigedo Island and by Gravina Island on the west. The cities of Ketchikan and Saxman lie along the eastern side and the airport lies on the western side of Tongass Narrows.

Tongass Narrows is approximately 14 km long and at its narrowest point is only about 500 m (1,640 ft) wide (Nuka Research and Planning Group 2012); it varies from 15 to 33 m (50–108 feet) deep (ADEC 2017). Water temperatures in the Narrows range from 12.7 to 16.6° C (54.9–62° F) with an average of 15° C (59° F) (ADEC 2017). Tongass Narrows is known for strong tidal currents and unusually large tidal ranges of 7.6 m (25 ft) or more (Pentec Environmental 2001). The Narrows is characterized by steep bedrock or coarse gravel-cobble-boulder shoreline. Lower intertidal and shallow subtidal areas are often sandy or mixed gravel, sand, and shell with varying amounts of silt (HDR 2003).

The majority of the project footprint is previously disturbed by the existing Berth IV. The facility currently supports cruise ship berthing and passenger loading and unloading (Moffatt and Nichol/LandDesign 2016). Island Wings Air Service is located approximately 300 meters to the west, and the Casey Moran Harbor, owned and operated by the City of Ketchikan, is located immediately to the east (Marine Exchanges of Alaska 2017).

According to NMFS's ShoreZone Mapper[8], the Berth IV site has an anthropomorphic permeable habitat class and solid man-made structures with sheltered rocky beaches environmental sensitivity index.

5.2 Fish and Essential Fish Habitat

Tongass Narrows and Revillagigedo Channel are designated as Essential Fish Habitat (EFH) under the Magnuson Stevens Fisheries and Conservation Management Act for Dover sole (*Solea solea*) and all 5 species of Pacific salmon[9]. Pacific salmon species include: chum salmon (*Oncorhynchus keta*), Chinook salmon (*O. tshawytscha*), pink salmon (*O. gorbuscha*), coho salmon (*O. kisutch*), and sockeye salmon (*O. nerka*). Alaska Department of Fish and Game and NMFS have also identified Pacific herring and Pacific halibut as important in the project area (HDR 2017).

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[7] From NOAA Raster Navigational Charts Chart 17420_1. As viewed on Google Earth. Digital chart updated January 10, 2018.

[8] NMFS Alaska Shorezone Coastal Mapping. Available at https://alaskafisheries.noaa.gov/habitat/shorezone, accessed November 10, 2017.

[9] NOAA Habitat Conservation Division, Habitat Protection EFH Mapper. Available at https://www.habitat.noaa.gov/protection/efh/efhmapper/, accessed July 2018.

There are no anadromous streams that flow directly into the Berth IV site; however, the Alaska Department of Fish and Game Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes lists numerous anadromous streams that flow into the action area. The closest, Ketchikan Creek, is located about 1 kilometer (0.62 miles) southeast of Berth IV. Ketchikan Creek provides habitat for all five species of Pacific salmon, cutthroat trout (*O. clarkia*), and steelhead (*O. mykiss*)[10]. Other anadromous streams that are located in or flow into the action area include Carlanna Creek, Airport Creek, and Government Creek, Fiedler Creek, Gravina Creek, Rain Creek, Stensland Creek, Clam Creek, Adams Creek, and two unnamed creeks[10].

5.3 Marine Vessel Activity

The action area experiences high levels of marine vessel traffic with highest volumes occurring May through September. Marine vessels that use the action area include passenger ferries, commercial freight vessels/barges, commercial tank barges, cruise ships, U.S. Coast Guard vessels, commercial fishing boats, charter vessels, recreational vessels, kayaks, and floatplanes[11].

Passenger ferries transport passengers across Tongass Narrows from the City of Ketchikan to the airport on Gravina Island year-round, 7 days a week, 16 hours a day. The Alaska Marine Highway operates year-round in Ketchikan.

The waters of the Inside Passage support marine cargo transportation. According to automatic identification system passage-line data plots obtained from the Marine Exchange of Alaska, in 2011, 1,489 vessels moved north or south between Alaska and British Columbia. The data show that 288 vessels moved east or west between the Dixon Entrance and the Pacific Ocean during the year. Cargo ships calling at Prince Rupert dominated the east-west large vessel traffic. Cruise ships, tugs, and ferries dominated the north-south traffic (Nuka Research and Planning Group 2012).

Cruise ships are the largest vessels that routinely use the action area. At any given time during the summer (May–September), as many as five large cruise ships may be moored or at anchor in the Port of Ketchikan. Cruise ship stops in Ketchikan generally increased through the 1990s and peaked in 2005 (see Table 5). Forty ships are expected to visit Ketchikan in 2018 with a total of 504 stops[12].

[10]ADFG. Fish Resource Monitor. Available at http://extra.sf.adfg.state.ak.us/FishResourceMonitor/?mode=awc, accessed February 2018.

[11] U.S. Coast Guard (USCG). Tongass Narrows Voluntary Waterway Guide. Available at http://seapa.com/waterway/TNVWG.pdf, accessed February 2018.

[12] Ketchikan Visitors Bureau Visitor Statistics. Available at http://www.visit-ketchikan.com/Getting-Here/Getting-Here-by-Sea, accessed February 2018; and personal communication with Kerri Hassett, Visitor Services Manager, Ketchikan Visitors Bureau.

Table 5. Cruise ship data for Ketchikan

Year	# of Passengers	#of Ships	# of Stops
2017	958,901	43	507
2016	948,089	38	489
2015	944,500	38	496
2014	884,503	39	492
2013	954,685	40	505
2012	894,320	36	470
2011	844,412	30	449
2010	828,929	26	429
2009	937,419	36	496
2008	941,910	37	502
2007	899,638	36	499
2006	838,880	36	503
2005	921,429	37	562
2004	848,969	37	535
2003	770,663	37	538
2002	700,993	34	503
2001	665,221	39	514
2000	549,114	34	461
1999	565,005	32	452
1998	531,108	35	488
1997	480,688	35	472
1996	426,232	36	437
1995	355,784	32	329
1994	379,645	30	453
1993	321,780	38	421
1992	263,046	23	364
1991	242,755	27	362
1990	236,325	23	314
Sources: Ketchikan Visitors Bureau 2018, HDR 2017.			

Numerous commercial and charter fishing vessels and recreational craft, such as powerboats and sailboats, operate in the project vicinity. The Ketchikan Port & Harbors Department operates and maintains five boat harbors: Bar Harbor, Thomas Basin, Casey Moran, Knudson Cove, and Hole-In-The-Wall; the Port of Ketchikan; and three launch ramps that are heavily used[13].

Vessel-based recreational activities, commercial fishing, shipping, whale-watching, and general transportation occur within the action area regularly. All of these sources of vessel traffic increase underwater noise and contribute to the risk of vessel-whale collisions.

[13] City of Ketchikan, Port and Harbors. Available at https://www.ktn-ak.us/port-harbors, accessed March 2018.

Vessel strikes are a leading cause of mortality in large whales. Neilson et al. (2012) reported the following summary statements about humpback whale and vessel collisions in Southeast Alaska.

- Most vessels that strike whales are less than 49 ft long
- Most collisions occur at speeds over 13 knots
- Most collisions occur between May and September
- Calves and juveniles appear to be at higher risk of collisions than adult whales

NMFS implemented regulations to minimize harmful interactions between ships and humpback whales in Alaska (see 50 CFR §§ 216.18, 223.214, and 224.103(b)). These regulations require that all vessels:

a. Not approach within 100 yards of a humpback whale, or cause a vessel or other object to approach within 100 yards of a humpback whale,
b. Not place vessel in the path of oncoming humpback whales causing them to surface within 100 yards of vessel,
c. Not disrupt the normal behavior or prior activity of a whale, and
d. Operate vessel at a slow, safe speed when near a humpback whale. Safe speed is defined in regulation (see 33 CFR § 83.06).

In addition to the approach regulations discussed above, whale watching companies in several areas of Alaska participate in NMFS's Whale SENSE program, agreeing to practice additional precautions around whales. NMFS implemented Whale Sense Alaska in 2015, a voluntary program developed in collaboration with the whale-watching industry that recognizes companies who commit to responsible practices. More information is available at https://whalesense.org/.

Since 2011, cruise lines, pilots, NMFS, and National Park Service (NPS) biologists have worked together to produce weekly whale sightings maps to improve situational awareness for cruise ships and state ferries in Southeast Alaska. In 2016, NMFS and NPS launched Whale Alert, another voluntary program that receives and shares real-time whale sightings with controlled access to reduce the risk of ship strike and contribute to whale avoidance.

5.4 Fishery Interactions Including Entanglements

Entanglement of pinnipeds and cetaceans in fishing gear and other human-made material is a major threat to their survival worldwide. Other materials also pose entanglement risks including marine debris, mooring lines, anchor lines, and underwater cables. While in many instances, marine mammals may be able to disentangle themselves (see Jensen et al. 2009), other entanglements result in lethal and sublethal trauma to marine mammals including drowning, injury, reduced foraging, reduced fitness, and increased energy expenditure (van der Hoop et al. 2016).

Entangled marine mammals may drown or starve due to being restricted by gear, suffer physical trauma and systemic infections, or be hit by vessels due to an inability to avoid them.

Entanglement can include many different gear interaction scenarios, but the following have occurred with humpback whales:

- Gear loosely wrapped around the marine mammal's body that moves or shifts freely with the marine mammal's movement and does not indent the skin can result in disfigurement.
- Gear that encircles any body part and has sufficient tension to either indent the skin or to not shift with marine mammal's movement can cause lacerations, partial or complete fin amputation, organ damage, or muscle damage and interfere with mobility, feeding, and breathing. Chronic tissue damage from line under pressure can compromise a whale's physiology. Fecal samples from entangled whales had extremely high levels of cortisols (Rolland et al. 2005), an immune system hormone. Extended periods of pituitary release of cortisols can exhaust the immune system, making a whale susceptible to disease and infection.

The NMFS Alaska Marine Mammal Stranding Network database has records of 199 large whale entanglements between 1990 and 2016. Of these, 67% were humpback whales. Most humpbacks get entangled with gear between the beginning of June and the beginning of September, when they are on their nearshore foraging grounds in Alaska waters. Between 1990 and 2016, 29% of humpback entanglements were with pot gear and 37% with gillnet gear. Longline gear comprised only 1–2% of all humpback fishing gear interactions.

5.5 Pollution

A number of intentional and accidental discharges of contaminants pollute the marine waters of Alaska annually. Intentional sources of pollution, including domestic, municipal, and industrial wastewater discharges, are managed and permitted by the Alaska Department of Environmental Conservation (ADEC). Pollution may also occur from unintentional discharges and spills.

According to the ADEC's most recent list of impaired waterbodies, there are no impaired waterbodies in the action area[14]. However, marine water quality in the action area can be affected by discharges from seafood processing plants, timber industry activities, shipyard and other industrial activity, treated sewer system outflows, cruise ships and other vessels operating in marine waters, and sediment runoff from paved surfaces and disturbed areas (HDR 2017).

Seafood processing facilities in Ketchikan discharge fish waste via outfalls into deep waters in Tongass Narrows under an Alaska Pollutant Discharge Elimination System general permit for Alaskan shore-based seafood processors. As required by the permit, the discharge outfalls are situated in underwater areas that are continually flushed by strong tides (HDR 2017).

[14] ADEC. Division of Spill Prevention and Response. Contaminated Sites Map. Availabe at http://www.arcgis.com/home/webmap/viewer.html?webmap=315240bfbaf84aa0b8272ad1cef3cad3&center=-131.656975,55.344914&level=15&marker=-131.656975,55.344914,,Click%20on%20arrow%20to%20get%20information%20about%20this%20site, accessed March 2018.

Cruise ships discharge treated sewage and laundry/shower/galley sink wastes ("greywater") into marine waters. The Commercial Passenger Vessel Environmental Compliance Program under ADEC regulates cruise ship and ferry waste discharged to Alaska waters (HDR 2017).

A search of the ADEC Contaminated sites database showed that there are four land-based active contaminated sites in the vicinity of Ketchikan and Saxman. These include the Former Ketchikan Hospital site (Hazard ID 25353, approximately 0.7 kilometers from Berth IV) where soil samples verify lead presence in the soil; the USCG Ketchikan Base (Hazard ID1184, approximately 2.35 kilometers from Berth IV) where petroleum hydrocarbon contaminated soils have been identified, the USCG Ketchikan Officer's Quarters (Hazard ID 2990, 2.5 kilometers from Berth IV) where diesel contamination from a heating oil tank has been identified; and the Ketchikan Airport Maintenance Building USTs (Hazard ID 24498, approximately 3 kilometers from Berth IV) where spills during fuel transfer resulted in contaminated soil[14]. Clean-up is in progress at the four sites.

5.6 Climate and Ocean Regime Change

As discussed in Section 4.1, there is widespread consensus within the scientific community that atmospheric temperatures on earth are increasing and that this will continue for at least the next several decades (Oreskes 2004; Watson and Albritton 2001). The Intergovernmental Panel on Climate Change estimated that average global land and sea surface temperature has increased by 0.6°C (±0.2) since the mid-1800s, with most of the change occurring since 1976. This temperature increase is greater than what would be expected given the range of natural climatic variability recorded over the past 1,000 years (Crowley 2000). The time period between 1983 and 2012 was likely the warmest 30-year period in the Northern Hemisphere in the last 1,400 years. This warming is thought to lead to increased decadal and inter-annual variability and increases in extreme weather events (IPCC 2013). The likelihood of further global-scale changes in weather and climate events is virtually certain (IPCC 2013; Overland and Wang 2007; Salinger et al. 2013).

Effects to marine ecosystems from climate change include ocean acidification, expanded oligotrophic gyres, shift in temperature, circulation, stratification, and nutrient input (Doney et al. 2012). Altered oceanic circulation and warming cause reduced subsurface oxygen concentrations (Keeling et al. 2010). These large-scale shifts have the potential to disrupt existing trophic pathways as change cascades from primary producers to top level predators (Doney et al. 2012; Salinger et al. 2013).

The strongest warming is expected in the north, exceeding the estimate for mean global warming by a factor of 3, due in part to the "ice-albedo feedback," whereby as the reflective areas of Arctic ice and snow retreat, the earth absorbs more heat, accentuating the warming (NRC 2012). Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (NRC 2012).

The indirect effects of climate change on Mexico DPS humpback whales over time would likely include changes in the distribution of ocean temperatures suitable for many stages of their life history, the distribution and abundance of prey, and the distribution and abundance of competitors or predators.

5.7 Coastal Zone Development

Coastal zone development results in the loss and alteration of nearshore marine mammal habitat and changes in habitat quality. Increased development may prevent marine mammals from reaching or using important feeding, breeding, and resting areas. The shoreline at the project site is highly developed, with man-made structures and impervious surfaces at the shoreline. Within and near the project area, there is little coastline area that has not been impacted by human development.

5.8 In-Water Noise

The project area is subject to noise from many anthropogenic sources, including marine vessels, seafood processing, shoreline and dock construction, aircraft, and land vehicles. Beyond Tongass Narrows, the project action area extends to the south into Revillagigedo Channel; a relatively undeveloped area.

5.9 Competition for Prey

Competition for prey between humpback whales, other marine life, and humans may exist. Humpback whales feed on schooling fish, including species that are harvested by humans commercially or for personal use. Given the recent abundance trends discussed above and the remoteness and small scale of the action area compared to commercial and personal use fishing grounds, NMFS expects any competition for prey in the action area to be insignificant.

6. Effects of the Action

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

This Biological Opinion relies on the best scientific and commercial information available. We try to note areas of uncertainty, or situations where data is not available. In analyzing the effects of the action, NMFS gives the benefit of the doubt to the listed species by minimizing the likelihood of false negative conclusions (concluding that adverse effects are not likely when such effects are, in fact, likely to occur).

We organize our effects analysis using a stressor identification – exposure – response – risk assessment framework for the proposed activities.

We conclude this section with an *Integration and Synthesis of Effects* that integrates information presented in the *Status of the Species* and *Environmental Baseline* sections of this Opinion with the results of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species.

6.1 Project Stressors

Based on our review of the Biological Assessment (Solstice 2018a), the IHA application (Solstice 2018b), personal communications, and available literature as referenced in this

Opinion, our analysis recognizes that the proposed construction activities at the Ketchikan Berth IV may cause these primary stressors:

- Underwater noise from:
  - Pile driving and pile removal
  - Drilling (socketing and anchoring)
  - Vessels (tugboats, barges, and skiffs)
- Vessel strike
- Disturbance to seafloor
- Pollution from unauthorized spills
- Overwater shading and effects to prey
- Indirect effects

Most of the analysis and discussion of effects to Mexico DPS humpback whales from this action will focus on exposure to impulsive and continuous noise sources because these stressors will likely have the most direct impacts.

6.2 Stressors Not Likely to Adversely Affect ESA-listed Species

Based on a review of available information, we determined which of the possible stressors may occur, but for which the likely effects are discountable or insignificant. A discountable effect is one that is extremely unlikely to occur. Insignificant effects are responses that are incapable of being detected, measured, or evaluated. If the impact will likely be negative, but the consequences are so minute that a person could not measure or detect such responses, then it is appropriate to conclude insignificant effects.

6.2.1 Vessel strike

The possibility of vessel strike associated with the proposed action is extremely unlikely. Tug towing operations for construction occur at relatively low speed limits (5 knots), and the maximum transit speed for tug and barge is anticipated to be 8–10 knots. Once vessels get to the construction site, they will be anchored. Skiffs may transport workers very short distances and low speeds from shore to the work platform. Due to the common presence of commercial and recreational vessels in the action area and habituation of marine mammals to regular vessel traffic, the use of slow-moving tugboats and barges associated with construction of the project is not anticipated to adversely affect ESA-listed species.

In 2017, there were seven reported vessel strikes to humpback whales in Alaska (https://alaskafisheries.noaa.gov/sites/default/files/17strandings.pdf). Between 2010 and 2014 the minimum mean annual mortality and serious injury rate due to ship strikes reported in Alaska for humpback whales was 2.7 whales (Muto et al. 2017). These incidents account for a very small fraction of the total humpback whale population (Laist et al. 2001).

Although Tongass Narrows has high volumes of vessel traffic, the likelihood of a vessel strike as a result of the proposed action is low. Humpback whales are seldom observed within the action area and surrounding waters of Tongass Narrows. Once the work platform has been barged to the location and is anchored in place, the work platform will be accessible to workers by foot by a ramp. When vessels are required to transport workers to the work platform, they will be transported by skiff at low speeds across very short distances from the shore. In addition, all vessels will be required to observe the Alaska humpback whale approach regulations (100 yards), which will further reduce the likelihood of interactions.

Of the reported vessel strikes of humpback whales in the Ketchikan vicinity between 2007 and 2017, only one was reported within Tongass Narrows. That whale arrived in the Ketchikan Harbor on the bulbous bow of a cruise ship when it came into port, but it is uncertain if it was struck in Tongass Narrows or elsewhere.

In general, the association in space and time of project-related vessels and humpback whales is highly unlikely because 1) humpbacks are uncommon visitors to Tongass Narrows, 2) the action area is small and of poor habitat value compared to the other available habitat for humpbacks in the surrounding area, 3) vessel traffic associated with the proposed action will be minimal, and 4) the duration of operations is limited to fall and winter months when the majority of humpbacks migrate from the area. In addition, NMFS's regulations for approaching humpback whales require that vessels not approach within 100 yards. All of these factors limit the risk of strike. We conclude the probability of strike occurring is extremely unlikely and therefore effects are discountable.

6.2.2 Disturbance to seafloor

During drilling, pile removal, pile installation, and anchoring activities, a temporary and localized increase in turbidity and sedimentation near the seafloor is possible in the immediate area surrounding each pile. Mud and other substrates that accumulate inside the pile will be augered out and allowed to settle close to the base of the pile. In general, turbidity associated with pile installation is expected to be localized to about a 25-ft radius around the pile (Everitt et al. 1980).

Considering local currents, tidal action, and implementation of best management practices, any potential water quality exceedances would likely be temporary and highly localized. The local tides and currents would disperse suspended sediments from pile driving operations at a moderate to rapid rate depending on tidal stage.

Cetaceans are not expected to come close enough to the Berth IV site to encounter increased turbidity from construction activities. Therefore, the impact from increased turbidity levels would be negligible to humpback whales and would not cause a disruption of behavioral patterns that would rise to the level of harassment. Therefore, we conclude that the effects from this stressor are so small that they are not measurable, *i.e.*, they are insignificant.

6.2.3 Introduction of pollutants into waters

The contractor has a Shipboard Oil Pollution Emergency Plan (SOPEP) (Turnagain Marine Construction 2018) registered and approved by the U.S. Coast Guard (USCG) for spill prevention. As part of the SOPEP and normal operating procedures, the contractor will have boom, sorbent materials, and containment available. The contractor will also have the contact information for spill response contractors in Ketchikan. Construction would be conducted in accordance with Clean Water Act Section 404 and 401 regulations, to minimize potential construction-related impacts on water quality. Therefore, we conclude that the effects from this stressor are insignificant.

6.2.4 Overwater shading and effects to prey

Expansion of the Ketchikan Berth IV would result in a net increase of approximately 9,100 square feet (845 square meters) of overwater shading in water that is 60–90 ft deep. This may result in a small, localized reduction in habitat and productivity for benthic invertebrate resources in the project footprint due an increase in shading beneath the expanded docks. However, the quality and quantity of existing prey habitat in the vicinity of Berth IV is minimal, owing to prior development and disturbance; therefore, the effects of a slight increase in overwater shading are also expected to have minimal impacts on prey resources. Indirect effects to prey would be too small to detect or measure due to the small area affected, and effects to humpback whales would be insignificant.

6.2.5 Indirect effects of increasing numbers of tourists

Although the project does not propose to increase the number of cruise vessels visiting Alaska, larger ships will bring more passengers to Alaska each year. Additionally, cruise ships have been extending their seasons in recent years to accommodate more trips and port calls per vessel. For example in 2017, the first ship arrived in Ketchikan on May 4 and the last ship arrived on September 30. The proposed schedule for 2019 has the first ship arriving April 27 and the last October 5.[15] Larger vessels and longer seasons have the potential to bring tens of thousands more passengers to the region each year, which could have indirect effects on listed species.

To meet the demands of increasing numbers of visitors to Ketchikan, NMFS expects that other types of marine vessel traffic (*e.g.*, float planes, charter fishing vessels, whale watching vessels, ferries, etc.) will increase. An overall increase in vessel traffic could affect listed humpback whales through increased noise, harassment, displacement, pollution, etc.; however, these incremental effects would be too small to detect or measure and therefore are insignificant.

6.3 Stressors Likely to Adversely Affect ESA-listed Species

The following stressors are likely to adversely affect Mexico DPS humpback whales: underwater noise from pile removal, installation, and rock drilling, and vessel noise. These stressors will be analyzed below in the *Exposure Analysis.*

6.3.1 Description of sound propagation

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds. Amplitude is the height of the sound pressure wave or the ‘loudness’ of a sound and is typically measured using the dB scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards). It is a logarithmic unit that accounts for large variations in amplitude; therefore,

[15] Cruise Line Agencies of Alaska website, available at www.claalaska.com, accessed June 28, 2018.

relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs; the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level (SL) represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position. Note that all underwater sound levels in this document are referenced to a pressure of 1 μPa and all airborne sound levels in this document are referenced to a pressure of 20 μPa.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Rms is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick 1983). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in all directions away from the source (similar to ripples on the surface of a pond), except in cases where the source is directional. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

6.3.2 Acoustic thresholds

As discussed in Section 2, *Description of the Proposed Action*, KDC intends to conduct construction activities that would introduce acoustic disturbance into the marine environment.

Since 1997 NMFS has used generic sound exposure thresholds to determine whether an activity produces underwater sounds that might result in impacts to marine mammals (70 FR 1871). NMFS recently developed comprehensive guidance on sound levels likely to cause injury to marine mammals through onset of permanent and temporary threshold shifts (PTS and TTS; Level A harassment) (81 FR 51693). NMFS is in the process of developing guidance for behavioral disruption (Level B harassment). However, until such guidance is available, NMFS uses the following conservative thresholds of underwater sound pressure levels[16], expressed in root mean square[17] (rms), from broadband sounds that cause behavioral disturbance, and referred to as Level B harassment under section 3(18)(A)(ii) of the MMPA::

- impulsive sound: 160 dB re 1 μPa_{rms}
- continuous sound: 120 dB re 1μPa_{rms}

[16] Sound pressure is the sound force per unit micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in acoustics is 1 μPa, and the units for underwater sound pressure levels are decibels (dB) re 1 μPa.

[17] Root mean square (rms) is the square root of the arithmetic average of the squared instantaneous pressure values.

Under the PTS/TTS Technical Guidance, NMFS uses the following thresholds for underwater sounds that cause injury, referred to as Level A harassment under section 3(18)(A)(i) of the MMPA (NMFS 2016b). These acoustic thresholds are presented using dual metrics of cumulative sound exposure level (L_E) and peak sound level (pk) for impulsive sounds and L_E for non-impulsive sounds:

Table 6. PTS onset acoustic thresholds for Level A harassment (NMFS 2016b)

Hearing Group	PTS Onset Acoustic Thresholds* (Received Level)	
	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	$L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	$L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	$L_{E,OW,24h}$: 219 dB

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa^{2}s. The subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

The MMPA, as well as applicable regulations at 50 CFR § 216.3, define "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering, but which does not have the potential to injure a marine mammal or marine mammal stock in the wild [Level B harassment].

While the ESA does not define "harass," NMFS recently issued guidance interpreting the term "harass" under the ESA as a means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). For the purposes of this consultation, any incidental harassment of listed species under the MMPA—whether Level A or Level B— constitutes an incidental take under the ESA and must be authorized by the Incidental Take Statement.

As described below, we anticipate that exposures to listed marine mammals from noise associated with the proposed action may result in disturbance (Level B harassment). With the addition of mitigation measures including shutdown zones, no mortalities or permanent impairment to hearing are anticipated.

6.4 Summary of Effects

6.4.1 Stressors not likely to adversely affect ESA-listed species

In conclusion, based on review of available information, we determined effects from vessel strike are extremely unlikely to occur. We consider the effects to Mexico DPS humpback whales to be discountable.

We determined the effects from disturbance of seafloor, introduction of pollutants, overwater shading and effects to prey, and indirect effects are not likely to have measurable impact; therefore, we consider effects to ESA-listed whales to be insignificant.

6.4.2 Stressors likely to adversely affect ESA-listed species

The following stressors are likely to adversely affect ESA-listed species: underwater noise from pile driving, pile removal, drilling (socketing and anchoring), and vessel noise. These stressors will be analyzed below in the *Exposure Analysis.*

6.5 Exposure Analysis

As discussed in the *Approach to the Assessment* section of this Opinion, exposure analyses are designed to identify the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence. In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action’s effects and the populations or subpopulations those individuals represent.

6.5.1 Exposure to noise from pile driving activities

Mexico DPS humpback whales may be present within the waters of the action area during the time that the in-water work is being conducted and could be exposed to temporarily elevated underwater noise levels resulting in harassment.

Temporarily elevated underwater noise during pile driving activities (including vibratory pile driving and removal, impact pile driving, socketing and anchoring) has the potential to result in Level B (behavioral) harassment of marine mammals. Level A harassment (resulting in injury) is not expected to occur as a result of the proposed action because shutdown zones will be implemented (Table 2 and Figure 3) and the marine mammal monitoring plan in the *Mitigation Measures* will reduce the potential for exposure to levels of underwater noise above the injury threshold established by NMFS.

For this analysis we estimated take by considering: 1) acoustic thresholds above which the best available science indicates listed marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; 2) the area that will be ensonified above these levels in a day; 3) the expected density or occurrence of listed marine mammals within these ensonified areas; and 4) and the number of days of activities.

6.5.1.1 Distances to Level A and Level B Sound Thresholds

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed or experience TTS (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment for non-explosive sources – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Ellison et al. 2012; Southall et al. 2007). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa rms for continuous (*e.g.*, vibratory pile-driving, drilling) and above 160 dB re 1 μPa rms for non-explosive impulsive (*e.g.*, seismic airguns) or intermittent (*e.g.*, scientific sonar) sources.

KDC's proposed construction activity includes the use of continuous (vibratory pile driving and drilling) and impulsive (impact pile driving) sources, and therefore the 120 and 160 dB re 1 μPa rms thresholds for Level B behavioral harassment are applicable.

Level A harassment for non-explosive sources - NMFS's Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2016b) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups based on hearing sensitivity as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). KDC's proposed activity includes the use of impulsive (impact pile driving) and non-impulsive (vibratory pile driving and drilling) sources. The Level A thresholds for the onset of PTS are provided in Table 6.

6.5.1.2 Calculating the ensonified area

This section describes the operational and environmental parameters of the activity that allow NMFS to estimate the area ensonified above the acoustic thresholds.

Reference sound levels used by KDC for all vibratory and impact piling activities were derived from source level data from construction projects at the Port of Anchorage (Austin et al. 2016) and Ketchikan Ferry Terminal (Denes et al. 2016). To determine the ensonified areas for both the Level A and Level B zones for vibratory driving of 48-inch/36-inch steel piles and 30-inch/24-inch steel piles, KDC used Sound Pressure Levels (SPLs) of 168.2 dB re 1 μPa rms and 161.9 dB dB re 1 μPa rms respectively. These were derived from vibratory pile driving data (of the same pile sizes) during the Port of Anchorage test pile project (Austin et al. 2016, Tables 9 and 16) and the Ketchikan Ferry Terminal (Denes et al. 2016, Table 72).

For impact pile driving, KDC used both SPLs and Sound Exposure Levels (SEL) derived from sound source verification (SSV) studies conducted on 48-inch steel piles during the Port of Anchorage test pile project. To determine Level A ensonified zones from impact piling, KDC utilized an SEL of 186.7 dB. When determining Level A zones, SELs are more accurate than SPLs, as they incorporate the pulse duration explicitly rather than assuming a proxy pulse duration and they provide a more refined estimation of impacts. However, to determine the Level B zone for impact piling, an SPL of 198.6 dB re 1 μPa rms was used. In addition, for drilling (socket and anchor pile installation), KDC used a reference sound level of 167.7 dB re 1 μPa rms from SSV studies conducted during drilling activities at the Kodiak Ferry Terminal to calculate both the Level A and Level B ensonified zones for the Berth IV Expansion project. More information on the source levels used are presented in Table 7 below.

Table 7. Project Source Levels.

Activity	Source Level at 10 meters (dB)
Vibratory Pile Driving/Removal	
24-inch steel removal (2 piles) (~1 hour on 1 day)[1]	161.9 SPL[2]
30-inch steel removal (6 piles) (~1 hour per day on 2 days)	161.9 SPL[2]
36-inch steel removal (4 piles) (~1 hour on 1 day)	168.2 SPL[2]
30-inch steel temporary installation (16 piles) (~2 hours per day on 4 days)	161.9 SPL[2]
30-inch steel permanent installation (1 pile) (~2 hours on 1 day)	161.9 SPL[2]
48-inch steel permanent installation (17 piles) (~2 hours per day on 9 days)	168.2 SPL[2]
Impact Pile Driving	
48-inch steel permanent installation (17 piles) (~15 minutes per day on 6 days)	186.7 SEL/ 198.6 SPL[3]
Socketing Installation (Drilling)	
30-inch steel permanent installation (1 pile) (~3 hours on 1 day)	167.7 SPL[4]
Anchoring Installation (Drilling)	
30-inch steel anchors within 48-inch steel piles (17 anchors) (7.5 hours per day on 9 days)	167.7 SPL[4]

[1] This project will only remove two 24-inch diameter steel piles total for a maximum of 30 minutes of removal in one day. However, because a maximum of 4 pile could be removed each day, we used 1 hour (the time it would take to remove four piles) of removal time instead of 30 minutes to calculate the distance threshold.

[2] The 36-inch and 48-inch diameter pile source levels are proxy from median measured source levels from pile driving of 48-inch piles for the Port of Anchorage test pile project (Austin et al. 2016, Tables 9 and 16). The 24-inch and 30-inch diameter source levels are proxy from median measured sources levels from pile driving of 30-inch diameter piles to construct the Ketchikan Ferry Terminal (Denes et al. 2016, Table 72).

[3] Sound pressure level root-mean-square (SPL rms) values were used to calculate distance to Level B harassment isopleths for impact pile driving. The source level of 186.7 SEL is the median measured from the Port of Anchorage test pile project for 48-inch piles (Austin et al. 2016, Table 9). We calculated the distances to Level A thresholds assuming 50 strikes per pile at 3 piles per day.

[4] The 30-inch diameter socketing and anchor source levels are derived from rom mean measured source levels from drilling of 24-inch diameter piles to construct the Kodiak Ferry Terminal (Denes et al. 2016, Table 72). The mean was chosen as a proxy due to it being more conservative than the median source level.

6.5.1.2.1 Calculating Level B zones

The practical spreading model was used by KDC to generate the Level B harassment zones for all piling and drilling activities. Practical spreading, a form of transmission loss, is described in detail below.

Pile driving and drilling generate underwater noise that can potentially result in disturbance to marine mammals in the project area. Transmission loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

$$TL = B * \log10(R_1/R_2), \text{ where}$$

R_1 = the distance of the modeled SPL from the driven pile, and

R_2 = the distance from the driven pile of the initial measurement.

This formula neglects loss due to scattering and absorption, which is assumed to be zero here. The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, most notably the water bathymetry and presence or absence of reflective or absorptive conditions including in-water structures and sediments. Spherical spreading occurs in a perfectly unobstructed (free-field) environment not limited by depth or water surface, resulting in a 6 dB reduction in sound level for each doubling of distance from the source (20*log[range]). Cylindrical spreading occurs in an environment in which sound propagation is bounded by the water surface and sea bottom, resulting in a reduction of 3 dB in sound level for each doubling of distance from the source (10*log[range]). A practical spreading value of 15 is often used under conditions where water increases with depth as the receiver moves away from the shoreline, resulting in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions.

Utilizing the practical spreading loss model, KDC determined underwater noise will fall below the behavioral effects threshold of 120 dB rms for marine mammals at a maximum radial distance of 16,343 meters and 15,136 meters for vibratory piling and drilling, respectively[18]. With these radial distances, and due to the occurrence of landforms (See Figure 5 of IHA Application), the largest Level B zone calculated for vibratory piling and drilling equaled 10.3 km^2. For calculating the Level B zone for impact driving, the practical spreading loss model was used with a behavioral threshold of 160 dB rms. The maximum radial distance of the Level B ensonified zone for impact piling equaled 3,744 meters. At this radial distance, the entire Level B zone for impact pile driving equaled 4.9 km^2. Table 5 below provides all Level B radial distances and their corresponding areas for each activity during KDC's Berth IV Expansion project.

[18] These distances represent calculated distances based on the practical spreading model; however, landforms will block sound transmission at closer distances. The farthest distance that sound will transmit from the source is 13,755 m before transmission is stopped by Annette Island.

Table 8. Level B zones calculated using the practical spreading model.

Source	Level B Zones (meters)	Level B Zone (square kilometers)
Vibratory Pile Driving		
24-inch steel removal (2 piles) (~1 hour on 1 day 3)	6,215	5.9
30-inch steel removal (6 piles) (~1 hour per day on 2 days)	6,215	5.9
36-inch steel removal (4 piles) (~1 hour on 1 day)	16,343*	10.3
30-inch steel temporary installation (16 piles) (~2 hours per day on 4 days)	6,215	5.9
30-inch steel permanent installation (1 pile) (~2 hours on 1 day)	6,215	5.9
48-inch steel permanent installation (17 piles) (~2 hours per day on 9 days)	16,343*	10.3
Impact Pile Driving		
48-inch steel (17 piles) (~15 minutes per day on 6 days)	3,745	4.9
Socketing Pile Installation (Drilling)		
30-inch diameter steel pile (1 pile) (~3 hours on 1 day)	15,136*	10.3
Anchor Pile Installation (Drilling)		
30-inch steel anchors within 48-inch steel piles (17 anchors) (7.5 hours per day on 9 days)	15,136*	10.3
*These distances represent calculated distances based on the practical spreading model; however, landforms will block sound transmission at closer distances. The farthest distance that sound will transmit from the source is 13,755 m before transmission is stopped by Annette Island.		

6.5.1.2.2 Calculating Level A zones

When NMFS's Underwater Acoustic Thresholds Guidance (NMFS 2016b) was published, in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component in the new thresholds, a User Spreadsheet was developed to include tools to help predict a simple isopleth to use in conjunction with marine mammal density or occurrence to help predict takes. Some of the assumptions included in the methods used for these tools produce isopleths which result in overestimates of Level A take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and qualitatively address the output where appropriate. For stationary sources (*i.e.*, pile driving and drilling), NMFS's User Spreadsheet predicts the closest distance at which, if a marine mammal remained at that distance the whole duration of the activity, it would not incur PTS. Inputs used in the User Spreadsheet, and the resulting Level A isopleths are reported below in Table 9.

Table 9. NMFS's optional user spreadsheet inputs and outputs.

USER SPREADSHEET INPUT							
Equipment Type	**Socket Drill**	**Anchor Drill**	**Vibratory Pile Driver (Removal of 30-inch and 24-inch steel piles)**	**Vibratory Pile Driver (Installation of 30-inch steel piles)**	**Vibratory Pile Driver (Installation of 36-inch steel piles)**	**Vibratory Pile Driver (Installation of 48-inch steel piles)**	**Impact Pile Driver**
Spreadsheet Tab Used	Non-impulsive, continuous	Non-impulsive, continuous	Non-impulsive, continuous	Non-impulsive, continuous	Non-impulsive, continuous	Non-impulsive, continuous	Impulsive, Non-continuous
Source Level	167.7 SPL	167.7 SPL	161.9 SPL	161.9 SPL	168.2 SPL	168.2 SPL	186.7 SEL
Weighting Factor Adjustment (kHz)	2	2	2.5	2.5	2.5	2.5	2
(a)Activity duration within 24 hours (b) Number of strikes per pile (c) Number of piles per day	(a)3	(a)7.5	(a)1	(a)2	(a)1	(a) 2	(b) 150 (c) 3
Propagation (xLogR)	15	15	15	15	15	15	15
Distance of source level measurement (meters)+	10	10	10	10	10	10	10
USER SPREADSHEET OUTPUT FOR LOW-FREQUENCY CETACEANS							
Distance to PTS (Level A) isopleth (m)	40	73.6	7.8	12.4	20.6	32.7	497.5
Daily ensonified area (km2)	0.003	0.02	0.0001	0.0002	0.001	0.003	0.8

6.5.1.3 Estimating marine mammal occurrence

Local information about the presence, density, or group dynamics of marine mammals inform take calculations. Potential exposures to impact pile driving, vibratory pile driving/removal and drilling noises for each acoustic threshold were estimated using group size estimates and local observational data. Level B take for humpback whales were calculated based on monthly sightings data and average group sizes within the action area.

Humpback whales frequent the action area and could be encountered during any given day of dock construction. In the project vicinity, humpback whales typically occur in groups of 1–2 animals, with an estimated maximum group size of four animals. Humpback whales can pass through the action area 0-3 times a month (Gary Freitag, pers. comm.).

Based on observational and group data it is estimated that a group of 2 humpback whales may occur within the Level B harassment zone three times each month over the four-month construction window during active pile driving (2 animals in a group x 3 groups each month × 4 months = 24 animals). Therefore, we would expect 24 Level B takes of humpback whales. As described previously, an estimated 6.1 percent of humpback whales in Southeast Alaska are from the Mexico DPS (Wade et al. 2016). Therefore, of the 24 animals potentially exposed to Level B harassment due to construction activities, approximately 2 of these would be ESA-listed Mexico DPS humpback whales.

The maximum distance at which a humpback whale may be exposed to noise levels that exceed Level A thresholds is 498 m during impact driving of 48-inch piles (see Table 9). PSOs will be stationed to ensure effective monitoring and shutdown of this zone before humpback whales enter the Level A zone to avoid Level A take. No Level A takes for Mexico DPS humpback whales are anticipated.

6.5.2 Exposure to vessel noise

6.5.2.1 Mitigation Measures to Minimize the Likelihood of Exposure to Vessel Noise

As discussed in *Mitigation Measures*, the Humpback Whale Approach Regulations will be followed during the proposed activity and when transiting to and from the project site (see 50 CFR §§ 216.18, 223.214, and 224.103(b)). These regulations are primarily intended to reduce the chance of vessel strike, but also help to minimize the exposure of humpback whales to vessel noise. .

Results of Vessel Noise Exposure

There are two phases of vessel noise and associated disturbance related to the proposed action. The first is vessel noise associated with construction, and the second is vessel noise associated with operation of Berth IV.

These acoustic impacts will result from moving sources, and for individual marine mammals that are exposed to noise from transiting vessels, the effects from each exposure will be temporary in duration, on the order of minutes. For species such as humpback whales that prey upon food items that are not tied to a particular location in the way that salmon are seasonally tied to stream channels and stream mouths, effects of transient and temporary noise are expected to result in low levels of exposure that the animals can likely avoid without foregoing highly valuable foraging opportunities.

Vessel noise associated with this action will be transmitted through water and constitutes a continuous noise source. NMFS anticipates that whenever noise is produced from vessel operations, it may overlap with Mexico DPS humpback whales and that some individuals are likely to be exposed to these continuous noise sources.

For vessels used during the construction phase of the proposed action, broadband source levels for tugs and barges have been measured at 145 to 170 dB re: 1 µPa, and 170 to 180 dB re: 1µPa for small ships and supply vessels (Richardson et al. 1995). Sound from vessels within this size range would reach the 120 dB threshold distances between 86 m and 233 m (282 and 764 feet) from the source (Richardson et al. 1995). Listed cetaceans have the potential to overlap with vessel noise associated with the proposed construction activities.

Cruise ships were the loudest of 24 ships in four categories recorded by Allen et al. (2012) with the highest broadband source level calculated to be 219 ± 3.8 dB re: 1 µPa. Other studies estimated average source levels for cruise ships at 181 ± 3 dB re: 1 µPa (Hatch et al. 2008) and 182 dB re: 1 µPa (Kipple and Gabriele 2007). Allen et al. (2012) also found that source levels typically increased with vessel size and speed. Listed cetaceans have the potential to overlap with vessel noise associated with the operation of Berth IV.

We anticipate low level exposure of short-term duration to listed humpback whales from vessel noise, and do not expect significant behavioral reactions. We will discuss potential responses of listed species to vessel noise in the following *Response Analysis*.

6.6 Response Analysis

As discussed in the *Approach to the Assessment* section of this Opinion, response analyses determine how listed species are likely to respond after being exposed to an action's effects on the environment or directly on listed species themselves. Our assessments try to detect the probability of lethal responses, physical damage, physiological responses (particular stress responses), behavioral responses, and social responses that might result in reducing the fitness of listed individuals. Ideally, our response analyses consider and weigh evidence of adverse consequences, beneficial consequences, or the absence of such consequences.

Loud underwater noise can result in physical effects on the marine environment that can affect marine organisms. Possible responses by Mexico DPS humpback whales to the impulsive and continuous sound produced by pile installation and removal, drilling, and vessel noise include:

- Physical Response
    - Threshold shifts
    - Non-auditory physiological effects
- Behavioral responses
    - Auditory interference (masking)
    - Tolerance or Habituation
    - Change in dive, respiration, or feeding behavior
    - Change in vocalizations
    - Avoidance or Displacement
    - Vigilance

This analysis also considers information on the potential effects on prey of ESA-listed species in the action area.

6.6.1 Responses to major noise sources (pile driving activities)

As described in the *Exposure Analysis*, Mexico DPS humpback whales are anticipated to occur in the action area and are anticipated to overlap with noise associated with pile driving, pile removal, and drilling activities. We assume that some individuals are likely to be exposed and respond to these impulsive and continuous noise sources. Between September 2018 and March 2019, we do not anticipate that Mexico DPS humpback whales will be exposed to noise levels loud enough, long enough, or at distances close enough to cause Level A harassment. We do expect 2 instances of exposure by Mexico DPS humpback whales to noise levels sufficient to cause Level B harassment. All level B instances of take are anticipated to occur at received levels ≥ 120 dB or 160 dB for continuous and impulsive noise sources, respectively.

In general, the effects of sounds from pile driving, pile removal, and drilling activities could result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Gordon 2007; Nowacek et al. 2007; Richardson et al. 1995; Southall et al. 2007). The effects of pile driving on marine mammals are dependent on several factors, including the size, type, and depth of the animal; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the standoff distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment. Shallow environments are typically more structurally complex, which leads to rapid sound attenuation. In addition, substrates that are soft (*e.g.,* sand) absorb or attenuate the sound more readily than hard substrates (*e.g.*, rock), which may reflect the acoustic wave. Soft porous substrates would also likely require less time to drive the pile, and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

In the absence of mitigation, impacts to marine species would be expected to result from physiological and behavioral responses to both the type and strength of the acoustic signature (Viada et al. 2008). The type and severity of behavioral impacts are more difficult to define due to limited studies addressing the behavioral effects of impulsive sounds on marine mammals. Potential effects from impulsive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton et al. 1973).

Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift, which is the loss of hearing sensitivity at certain frequency ranges (Finneran et al. 2005; Finneran et al. 2002; Kastak et al. 1999; Schlundt et al. 2000). Threshold shift can be permanent (PTS), in which case the loss of hearing sensitivity is not recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall et al. 2007). Marine mammals depend on acoustic cues for vital biological functions, (*e.g.,* orientation, communication, finding prey, avoiding predators); thus, TTS may result in reduced fitness, survival, and reproduction. However, this depends on the frequency and duration of TTS, as well as the biological context in which it occurs. TTS of limited duration, occurring in a frequency range that does not coincide with that used for recognition of important acoustic cues, would have little to no effect on an animal's fitness. Repeated sound exposure that leads to TTS could cause PTS. PTS constitutes injury, but TTS does not (Southall et al. 2007). The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects. We anticipate that few (if any) exposures would occur at received levels >160 dB due to avoidance of high received levels, and shut-down mitigation measures.

6.6.1.1 Temporary Threshold Shift (TTS)

TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1970). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes or hours to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in (Southall et al. 2007).

For low-frequency cetaceans, no behavioral or auditory evoked potential threshold data exist. Therefore, hearing thresholds were estimated by synthesizing information from anatomical measurements, mathematical models of hearing, and animal vocalization frequencies (NMFS 2016c).

Few (if any) exposures would occur at received levels >160 dB resulting in TTS due to avoidance of high received levels, and shut-down mitigation measures.

6.6.1.2 Permanent Threshold Shift (PTS)

When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, while in other cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter 1985). There is no specific evidence that exposure to pulses of sound can cause PTS in any marine mammal. However, given the possibility that mammals close to a sound source can incur TTS, it is possible that some individuals will incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals, based on anatomical similarities. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time. For non-impulsive exposures (*i.e.*, vibratory pile driving), a variety of terrestrial and marine mammal data sources indicate that threshold shift up to 40 to 50 dB may be induced without PTS, and that 40 dB is a conservative upper limit for threshold shift to prevent PTS. An exposure causing 40 dB of TTS is therefore considered equivalent to PTS onset (NMFS 2016b).

No exposures are anticipated at levels resulting in PTS due to avoidance of high received levels, and shut-down mitigation measures.

6.6.1.3 Non-Auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox et al. 2006; Southall et al. 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall et al. 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of pile driving, including some odontocetes and some pinnipeds, are especially unlikely to incur auditory impairment or non-auditory physical effects.

6.6.1.4 Behavioral Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Behavioral responses to sound are highly variable and context-specific, and reactions, if any, depend on species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day, and many other factors (Southall et al. 2007).

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al. 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (NRC 2003; Richardson et al. 1995; Wartzok et al. 2003).

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Finneran et al. 2003; Ridgway et al. 1997). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices, but also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; Nowacek et al. 2007; Thorson and Reyff 2006; Wartzok et al. 2003). Responses to continuous sound, such as vibratory pile installation, have not been documented as well as responses to pulsed sounds.

With both types of pile driving, it is likely that the onset of pile driving could result in temporary, short-term changes in an animal’s typical behavior and/or avoidance of the affected area. These behavioral changes may include: changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (*e.g.*, pinnipeds flushing into water from haulouts or rookeries).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

- Drastic changes in diving/surfacing patterns (such as those thought to cause beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall et al. 2007).

6.6.1.5 Auditory Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with, a marine mammal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher levels. Chronic exposure to excessive, though not high-intensity, sound could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustical sensors or environment are being severely masked could also be impaired from maximizing their performance fitness in survival and reproduction. If the coincident (masking) sound were anthropogenic, it could be potentially harassing if it disrupted hearing-related behavior. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs only during the sound exposure. Because masking (without resulting in threshold shift) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

Masking occurs at the frequency band the animals utilize, so the frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Lower frequency man-made sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey sound. It may also affect communication signals when they occur near the sound band and thus reduce the communication space of animals (Clark et al. 2009) and cause increased stress levels (Foote et al. 2004; Holt et al. 2009).

Masking has the potential to affect species at the population or community levels as well as at individual levels. Masking affects both senders and receivers of the signals and can potentially have long-term chronic effects on marine mammal species and populations. Recent research suggests that low frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, and that most of these increases are from distant shipping (Hildebrand 2009). All anthropogenic sound sources, such as those from vessel traffic, pile driving, and dredging activities, contribute to the elevated ambient sound levels, thus intensifying masking.

Noise from pile driving and drilling activities is relatively short-term. It is possible that pile driving/removal noise resulting from this proposed action may mask acoustic signals important to Mexico DPS humpback whales, but the short-term duration (up to 29 days over four winter months) and limited affected area would result in insignificant impacts from masking. Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory pile driving, and which have already been taken into account in the *Exposure Analysis*.

6.6.1.6 Anticipated Effects on Habitat

The proposed activities at the project area would not result in permanent negative impacts to habitats used directly by humpback whales, but may have potential short-term impacts to food sources such as forage fish and may affect acoustic habitat (see masking discussion above). There are no known foraging hotspots or other ocean bottom structure of significant biological importance to humpback whales present in the project area. The project area is located in an industrial and commercial shipping marina. Therefore, the main impact issue associated with the proposed activity would be temporarily elevated sound levels and the associated direct effects on marine mammals, as discussed previously in this document. The primary potential acoustic impacts to marine mammal habitat are associated with elevated sound levels produced by vibratory and impact pile driving and removal and drilling in the area. However, other potential impacts to the surrounding habitat from physical disturbance are also possible, although this will be minimal since construction is occurring in an already industrial and commercial shipping area.

6.6.1.7 Effects on Potential Prey

As described in the *Status of Listed Species*, in Southeast Alaska, marine mammal distributions and seasonal increases in their abundance are strongly influenced by seasonal pre-spawning and spawning aggregations of forage fish, particularly Pacific herring (*Clupea pallasii*), eulachon (*Thaleichthys pacificus*) and Pacific salmon (*Oncorhynchus* spp.) (Marston et al. 2002; Sigler et al. 2004; Womble et al. 2005).

Herring are a keystone species in Southeast Alaska, serving as a vital link between lower trophic levels, including crustaceans and small fish, and higher trophic levels. In Southeast Alaska, Pacific herring typically spawn from March to May and attract large numbers of predators (Marston et al. 2002) The relationship between humpback whales and these ephemeral fish runs is so strong in Southeast Alaska that the seasonal abundance and distribution of marine mammals reflects the distribution of pre-spawning and spawning herring, and overwintering aggregations of adult herring.

Construction activities would produce continuous (*i.e.,* vibratory pile driving and DTH drilling) and impulsive (*i.e.*, impact driving) sounds. Fish react to sounds that are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pile driving on fish, although several are based on studies in support of large, multiyear bridge construction projects (*e.g.*, Scholik and Yan 2001, 2002; Popper and Hastings 2009). Sound impulsive sounds at received levels of 160 dB may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson et al., 1992; Skalski et al., 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality.

The most likely impact to fish from pile driving and drilling activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the short timeframe (29 days) for the project.

Studies on euphausiids and copepods, which are some of the more abundant and biologically important groups of zookplankton, have documented the use of hearing receptors to maintain schooling structures (Wiese 1996) and detection of predators (Chu et al. 1996) respectively, and therefore have some sensitivity to sound; however any effects of pile driving and drilling activities on zooplankton would be expected to be restricted to the area within a few feet or meters of the project and would likely be sub-lethal.

No appreciable adverse impact on zooplankton populations will occur due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortality or impacts on zooplankton as a result of construction operations is immaterial as compared to the naturally-occurring reproductive and mortality rates of these species. This is consistent with previous conclusions that crustaceans (such as zooplankton) are not particularly sensitive to sound produced by even louder impulsive sounds such as seismic operations (Wiese 1996).

6.6.1.8 Pile driving effects on potential foraging habitat

The area likely impacted by the project is relatively small compared to the available habitat in the Ketchikan area. Avoidance by potential prey (*i.e.*, fish) of the immediate area due to the temporary loss of this foraging habitat is also possible. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity of Ketchikan's Berth IV dock.

The duration of the construction activities is relatively short. The construction window is for a maximum of 29 days and construction activities would only occur for a few hours each day. Impacts to habitat and prey are expected to be minimal based on the short duration of activities.

In summary, given the short daily duration of sound associated with individual pile driving and drilling events and the relatively small areas being affected, pile driving and drilling activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Thus, any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual Mexico DPS humpback whales or the DPS as a whole.

6.6.2 Probable responses to major noise sources (pile driving activities)

Pile driving, pile removal, and drilling activities associated with the Ketchikan Berth IV expansion, as outlined previously, have the potential to disturb or displace marine mammals. The specified activities may result in take, in the form of Level B harassment (behavioral disturbance), from underwater sounds generated from pile driving activities. Potential takes could occur if individuals of these species are present in the ensonified zone during these activities.

NMFS does not anticipate any Level A take due to appropriate monitoring and shutdown zones. NMFS does not anticipate injury or mortality given the nature of the activity and measures designed to minimize the possibility of injury to Mexico DPS humpback whales. The potential for these outcomes is minimized through the construction method and the implementation of the planned mitigation measures.

Initial installation of steel piles through the sediment layer will first be attempted using vibratory methods for up to 60 minutes per pile. If the sediment layer is very thin, instead of vibratory methods, a few strikes from an impact hammer may be used to seat some steel piles into the weathered bedrock before drilling begins. It is possible that only an impact hammer and drilling will be used for some piles, and only a vibratory hammer and drilling will be used for other piles, depending on sediment conditions. Impact pile driving produces short, sharp pulses with higher peak levels and much sharper rise time to reach those peaks. When impact driving is necessary, required measures (implementation of shutdown zones) reduce the potential for injury. Given sufficient "notice" through use of soft start (for impact driving), marine mammals are expected to move away from a sound source that is annoying prior to the noise becoming potentially injurious. The high likelihood of marine mammal detection by trained protected species observers under the required observation protocols further enables the implementation of shutdowns to avoid injury, serious injury, or mortality.

The applicant's proposed activities are spatially and temporally localized. Pile removal, installation, and drilling are expected to occur over 29 non-consecutive days in a 4-month period. The project will require the removal of approximately 28 existing and temporary piles of varying sizes and materials. Not all existing piles will be removed. It is anticipated that, when possible, existing piles will be extracted by directly lifting them with a crane. A vibratory hammer will be used only if necessary to extract piles that cannot be directly lifted. Removal of each old pile is estimated to require not more than 15 minutes of vibratory hammer use. The project will require the installation of 16 temporary and 18 permanent piles of varying sizes and materials. Tension anchors will be installed in 17 of the 18 permanent piles. All steel piles will be inserted through the overlying sediment with a vibratory hammer for no more than 60 minutes per pile. Following initial pile installation, piles will be socketed or anchored. One 30-inch pile will be socketed and down-the-hole drilling will take approximately 3 hours. Seventeen 48-inch piles will be anchored, requiring approximately 2.5 hours per anchor. The total duration of activities producing major sources of noise is estimated at 29 days over a four-month period.

In summary, up to 2 individual Mexico DPS humpback whales may be exposed to Level B harassment sound levels during the proposed action. While mitigation measures include shut-down zones to prevent Level A exposure, if animals approach within the corresponding thresholds shown in Table 2, Level B harassment may occur. At these distances (3.7–13.7 km), a marine mammal that perceived pile driving/removal and drilling operations is likely to ignore such a signal and devote its attentional resources to stimuli in its local environment. If animals do respond, some listed species are likely to change their behavioral state – reduce the amount of time they spend at the ocean's surface, increase their swimming speed, change their swimming direction to avoid pile driving, change their respiration rates, increase dive times, reduce feeding behavior, and/or alter vocalizations and social interactions (Frid and Dill. 2002; Funk et al. 2010; Koski et al. 2009; Melcon et al. 2012).

6.6.3 Responses to vessel traffic and noise

As described in the *Exposure Analysis*, Mexico DPS humpback whales are anticipated to occur in the action area and are anticipated to overlap with noise associated with vessel transit. We assume that some individuals are likely to be exposed and respond to this continuous noise source.

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals engage in avoidance behavior when surface vessels move toward them. It is not clear whether these responses are caused by the physical presence of a surface vessel, the underwater noise generated by the vessel, or an interaction between the two (Goodwin and Cotton 2004; Lusseau 2006). However, several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). These studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators.

Based on a suite of studies of cetacean behavior to vessel approaches (Au and Perryman 1982; Au and Green 2000; Bain et al. 2006; Bauer and Herman 1986; Bejder et al. 1999; Bejder et al. 2006; Corkeron 1995; David 2002; Goodwin and Cotton 2004; Hewitt 1985; Lusseau 2006; Lusseau and Bejder 2007; Magalhaes et al. 2002; Ng and Leung 2003; Nowacek et al. 2001; Richter et al. 2006; Schaffar et al. 2013), the set of variables that help determine whether marine mammals are likely to be disturbed by surface vessels include:

1. *Number of vessels*. The behavioral repertoire marine mammals have used to avoid interactions with surface vessels appears to depend on the number of vessels in their perceptual field (the area within which animals detect acoustic, visual, or other cues) and the animal's assessment of the risks associated with those vessels (the primary index of risk is probably vessel proximity relative to the animal's flight initiation distance).
2. *Below a threshold number of vessels* (which probably varies from one species to another, although groups of marine mammals probably share sets of patterns): studies have shown that whales will attempt to avoid an interaction using horizontal avoidance behavior. Above that threshold, studies have shown that marine mammals will tend to avoid interactions using vertical avoidance behavior, although some marine mammals will combine horizontal avoidance behavior with vertical avoidance behavior (Christiansen et al. 2010; Lusseau 2003).

3. *Distance between vessel and marine mammals* when the animal perceives that an approach has started and during the course of the interaction (Au and Perryman 1982; David 2002; Kruse 1991).
4. *Vessel's speed and vector* (David 2002).
5. *Predictability of the vessel's path*. That is, cetaceans are more likely to respond to approaching vessels when vessels stay on a single or predictable path (Lusseau 2003; Williams et al. 2002) than when it engages in frequent course changes (Evans et al. 1994; Lusseau 2006; Williams et al. 2002).
6. *Noise associated with the vessel* (particularly engine noise) and the rate at which the engine noise increases, which the animal may treat as evidence of the vessel's speed (David 2002; Lusseau 2003; Lusseau 2006).
7. *Type of vessel* (displacement versus planning), which marine mammals may be interpret as evidence of a vessel's maneuverability (Goodwin and Cotton 2004).
8. *Behavioral state of the marine mammals* (David 2002; Lusseau 2003; Lusseau 2006). For example, Würsig et al. (1998) concluded that whales were more likely to engage in avoidance responses when the whales were 'milling' or 'resting' than during other behavioral states.

Most of the investigations cited earlier reported that animals tended to reduce their visibility at the water's surface and move horizontally away from the source of disturbance or adopt erratic swimming strategies (Lusseau 2003; Lusseau 2006; Williams et al. 2002). In the process, their dive times increased, vocalizations and jumping were reduced (with the exception of beaked whales), individuals in groups move closer together, swimming speeds increased, and their direction of travel took them away from the source of disturbance (Evans et al. 1994; Kruse 1991). Some individuals also dove and remained motionless, waiting until the vessel moved past their location. Most animals finding themselves in confined spaces, such as shallow bays, during vessel approaches tended to move towards more open, deeper waters (Kruse 1991). We assume that this movement would give them greater opportunities to avoid or evade vessels as conditions warranted.

Humpback whale reactions to approaching boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1983) reported that humpbacks in Hawaii responded to vessels at distances of 2 to 4 km. Bauer and Herman (1986) concluded that reactions to vessels are probably stressful to humpback whales, but that the biological significance of that stress is unknown. Humpback whales seem less likely to react to vessels when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984). Mothers with newborn calves seem most sensitive to vessel disturbance (Clapham and Mattila 1993). Marine mammals that have been disturbed by anthropogenic noise and vessel approaches are commonly reported to shift from resting behavioral states to active behavioral states, which would imply that they incur an energy cost. Morete et al. (2007) reported that undisturbed humpback whale cows that were accompanied by their calves were frequently observed resting while their calves circled them (milling) and rolling interspersed with dives. When vessels approached, the amount of time cows and calves spent resting and milling respectively declined significantly.

Animals that perceive an approaching potential predator, predatory stimulus, or disturbance stimulus have four behavioral options (see Blumstein 2003; Nonacs and Dill 1990):

a. ignore the disturbance stimulus entirely and continue behaving as if a risk of predation did not exist;

b. alter their behavior in ways that minimize their perceived risk of predation, which generally involves fleeing immediately;

c. change their behavior proportional to increases in their perceived risk of predation, which requires them to monitor the behavior of the predator or predatory stimulus while they continue their current activity; or

d. take proportionally greater risks of predation in situations in which they perceive a high gain and proportionally lower risks where gain is lower, which also requires them to monitor the behavior of the predator or disturbance stimulus while they continue their current activity.

The latter two options are energetically costly and reduce benefits associated with the animal’s current behavioral state. As a result, animals that detect a predator or predatory stimulus at a greater distance are more likely to flee at a greater distance (Lord et al. 2001). Some investigators have argued that short-term avoidance reactions can lead to longer term impacts, such as causing marine mammals to avoid an area (Salden 1988) or altering a population’s behavioral budget—time and energy spent foraging versus travelling (Lusseau 2004). These impacts can have biologically significant consequences on the energy budget and reproductive output of individuals and their populations. However, these levels of responses are not anticipated in association with the proposed action as described below.

6.6.4 Probable responses to vessel traffic and noise

Materials and equipment would be transported to the project site by barge. While work is conducted in the water, anchored barges will be used to stage construction materials equipment. Vessel speed, course changes, and sounds associated with their engines may be considered stressors to listed humpback whales.

We anticipate low level exposure of short-term duration to listed humpback whales from vessel noise. If animals do respond, they may exhibit slight deflection from the noise source, engage in low-level avoidance behavior, short-term vigilance behavior, or short-term masking behavior, but these behaviors are not likely to result in adverse consequences for the animals. The nature and duration of response is not anticipated to be a significant disruption of important behavioral patterns such as feeding or resting. The action area is not considered high quality habitat for humpback whales so slight avoidance of the area is not likely to adversely affect these species**.**

The small number of vessels involved in the action, the short duration of any potential exposure, and vessels following the Alaska Humpback Whale Approach Regulations and Marine Mammal Code of Conduct should prevent close approaches and additional harassment of humpback whales. The impact of vessel traffic on Mexico DPS humpback whales is not anticipated to cause significant disruption its behaviors.

6.7 Interrelated/Interdependent Effects

Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An interrelated activity is one that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is one that has no independent utility apart from the action under consultation. NMFS did not identify any interrelated or interdependent effects associated with this project.

7. CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, and that are reasonably certain to occur within the action area (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate change within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the *Environmental Baseli*ne (Section 5.0).

There are currently no other known state or private activities reasonably certain to occur in the action area that may affect listed species and are not subject to section 7 consultation.

8. INTEGRATION AND SYNTHESIS

This section is the final step of NMFS's assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the *Effects of the Action* (Section 6) to the *Environmental Baseline* (Section 5) and the *Cumulative Effects* (Section 7) to formulate the agency's Biological Opinion as to whether the proposed action is likely to (1) result in appreciable reductions in the likelihood of the survival or recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) result in the adverse modification or destruction of critical habitat as measured through potential reductions in the value of designated critical habitat for the conservation of the species. These assessments are made in full consideration of the *Status of the Species* (Section 4).

As discussed in the *Approach to the Assessment* (Section 3) section of this Opinion, we begin our risk analysis by asking whether the probable physical, physiological, behavioral, or social responses of endangered or threatened species are likely to reduce the fitness of endangered or threatened individuals or the growth, annual survival or reproductive success, or lifetime reproductive success of those individuals.

8.1 Mexico DPS Humpback Whale Risk Analysis

Based on the results of the exposure analysis, we expect a maximum of 24 humpback whales may be exposed to noise from pile driving, and 6% or 2 of those humpback whales are anticipated to be from the Mexico DPS. Exposure to vessel noise from transit and potential for vessel strike may occur, but adverse effects from vessel disturbance and noise are likely to be insignificant due to the small marginal increase in such activities relative to the environmental baseline and the transitory nature of vessels. Adverse effects from vessel strike are considered discountable because of the few additional vessels introduced by the action and the unlikelihood of these type of interactions.

Humpback whales' probable response to pile driving and pile removal includes brief startle reactions or short-term behavioral modification. These reactions and behavioral changes are expected to subside quickly when the exposures cease. The primary mechanism by which the behavioral changes we have discussed affect the fitness of individual animals is through the animals' energy budget, time budget, or both (the two are related because foraging requires time). Large whales such as humpbacks have an ability to store substantial amounts of energy, which allows them to survive for months on stored energy during migration and while in their wintering areas, and their feeding patterns allow them to acquire energy at high rates. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to reduce the energy budgets of humpback whales, and their probable exposure to noise sources are not likely to reduce their fitness. As discussed in the *Description of the Proposed Action* and *Status of the Species* sections, this action does not overlap in space or time with humpback whale breeding. Mexico DPS humpback whales feed in Southeast Alaska in the summer and fall months, but migrate to Mexican waters for breeding and calving in the late winter months. As a result, the probable responses to pile driving and removal noise are not likely to reduce the current or expected future reproductive success of Mexico DPS humpback whales or reduce the rates at which they grow, mature, or become reproductively active.

Therefore, these exposures are not likely to reduce the abundance, reproduction rates, or growth rates (or increase variance in one or more of these rates) of the populations those individuals represent. The short duration of sound generation and the implementation of mitigation measures to reduce exposure to high levels of sound reduce the likelihood that exposure would cause a behavioral response that may affect vital functions, or cause TTS or PTS. Additionally, when considered in conjunction with the effects of the proposed action, cumulative effects of future state or private activities in the action area are likely to affect humpback whales at a level comparable to present. The current and recent population trends for humpback whales in Southeast Alaska indicate that these levels of activity are not hindering population growth.

As a result, this project is not likely to appreciably reduce Mexico DPS humpback whales' likelihood of surviving or recovering in the wild.

9. CONCLUSION

This Biological Opinion has considered the direct, indirect, and cumulative effects of this action on Mexico DPS humpback whales. The proposed action is expected to result in direct and indirect impacts to this species. We estimate that Level B take of 2 Mexico DPS humpback whales may occur during the term of the MMPA authorization (*i.e.*, construction period) by harassment. This harassment is not likely to result in injury or death, although individuals may alter their behavior for a brief period of time.

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Mexico DPS of humpback whale. Critical habitat has not been designated or proposed for this species, therefore, none will be affected.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species unless there is a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR 402.02). Based on recent NMFS guidance, the term "harass" under the ESA means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (16 U.S.C. §1362(18)(A)(i) and (ii)). For this consultation, PR1 anticipates that any take will be by harassment only. No Level A takes are contemplated or authorized.

Under the terms of Section 7(b)(4) and Section 7(o)(2) of the ESA, taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement (ITS).

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized by Section 101(a)(5) of the MMPA. Accordingly, **the terms of this incidental take statement and the exemption from Section 9 of the ESA become effective only upon the issuance of MMPA authorization to take the marine mammals identified**. Absent such authorization, this incidental take statement is inoperative.

The terms and conditions described below are nondiscretionary. PR1 and the USACE have a continuing duty to regulate the activities covered by this ITS. In order to monitor the impact of incidental take, PR1 and the USACE must monitor the progress of the action and its impact on the species as specified in the ITS (50 CFR 402.14(i)(3)). If PR1 and the USACE (1) fail to require the authorization holder to adhere to the terms and conditions of the ITS through enforceable terms that are added to the authorization, or (2) fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

10.1 Amount of Extent of Take

Section 7 regulations require NMFS to estimate the number of individuals that may be taken by proposed actions or utilize a surrogate (*e.g.*, other species, habitat, or ecological conditions) if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (50 CFR § 402.14 (i)(1); see also 80 FR 26832 (May 11, 2015). Table 10 lists the amount and timing of authorized take (incidental take by harassment) for this action.

For Mexico DPS humpback whales, based on the best scientific and commercial information available, we would not anticipate responses to impulsive noise at received levels <160 dB re 1 μPa rms would rise to the level of "take" as defined under the ESA. For this reason, in assessing the total instances of harassment for humpback whales from impact pile driving, NMFS only considered exposures at received levels ≥160 dB re 1 μPa rms. For continuous noise sources such as vibratory pile driving, we only considered exposures at received levels ≥120 dB re 1 μPa rms.

Based on observational data and groups sizes of humpback whales observed, it is estimated that a group of 2 humpback whales may occur within the Level B harassment zone three times each month over the four-month construction window during active pile driving (2 animals in a group x 3 groups each month × 4 months = 24 animals). Therefore, under the MMPA, NMFS anticipates that 24 Level B takes of humpback whales may occur. Of these, 6% or 2 animals are predicted to be from the Mexico DPS. Therefore, NMFS is authorizing 2 Level B harassment takes under the ESA.

Table 10. Summary of anticipated instances of exposure to sound from pile driving and pile removal resulting in the incidental take of Mexico DPS humpback whales by behavioral harassment. These take numbers reflect only the individuals that are expected to be from the ESA-listed DPS that may be present in the action area.

DPS and Species	Total Amount of Take Associated with Proposed Action		Anticipated Temporal Extent of Take
	Level A	Level B	
Mexico DPS humpback whale	0	2	September 2018 through January 2019

10.2 Effect of the Take

Studies of marine mammals and responses to anthropogenic impacts have shown that humpback whales are likely to respond behaviorally to acoustic disturbance. The only takes authorized during the proposed action are takes by acoustic harassment. No serious injury or mortalities are anticipated or authorized as part of this proposed action. Although the biological significance of those behavioral responses remains unknown, this consultation has assumed that exposure to major noise sources might disrupt one or more behavioral patterns that are essential to an individual animal's life history. However, any behavioral responses of these whales to major noise sources and any associated disruptions are not expected to affect the fitness, reproduction, survival, or recovery of these species.

In Section 9 of this Opinion, NMFS determined that the level of incidental take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of Mexico DPS humpback whales.

10.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" (RPMs) are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02).

The RPMs included below, along with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. NMFS concludes that the following RPMs are necessary and appropriate to minimize or to monitor the incidental take of Mexico DPS humpback whales resulting from the proposed action.

1. This ITS is valid only for the activities described in this Opinion, and which have been authorized under section 101(a)(5) of the MMPA.

2. The taking of Mexico DPS humpback whales will be by incidental harassment only. The taking by serious injury or death is prohibited and will result in the modification, suspension, or revocation of the ITS.

3. USACE and PR1 will implement a monitoring program that includes all items described in the mitigation measures section of this Opinion (Section 2.1.2) and allows NMFS AKR to evaluate the exposure estimates contained in this Opinion and that underlie this ITS.

10.4 Terms and Conditions

"Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

In order to be exempt from the prohibitions of section 9 of the ESA, USACE and PR1 or any applicant must comply with the following terms and conditions, which implement the RPMs described above and the mitigation measures set forth in Section 2.1.2 of this Opinion. USACE and PR1 or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR 402.14).

Partial compliance with these terms and conditions may result in more take than anticipated, and may invalidate this take exemption. These terms and conditions constitute no more than a minor change to the proposed action because they are consistent with the basic design of the proposed action.

To carry out the RPMs, USACE, NMFS PR1, or their authorization holder must undertake the following:

1. Require the permitted operators to possess a current and valid Incidental Harassment Authorization issued by NMFS under section 101(a)(5) of the MMPA, and any take must occur in compliance with all terms, conditions, and requirements included in such authorizations.

2. Conduct the action as described in this Opinion including all mitigation measures and observation and shut-down zones.

3. The taking of any marine mammal in a manner other than that described in this ITS must be reported immediately to NMFS AKR, Protected Resources Division at 907-586-7636.

4. If operations conducted under the proposed action cause a take of a marine mammal that results in a serious injury or mortality, or other unauthorized take, all operations will immediately cease, and KDC will follow the reporting requirements described in the Mitigation Measures.

5. KDC will immediately notify NMFS AKR, Protected Resources Division at 907-586-7636, when 16 humpback whales have been detected in the Level B zone while construction activities that would expose them to noise levels exceeding the Level B threshold were underway. (This would equate to one take of Mexico DPS humpback whales, and one-half of the authorized take for this action.)

6. Comply with all monitoring and reporting requirements as detailed in the mitigation measures of this Opinion (Section 2.1.2) and the IHA issued by NMFS under section 101(a)(5) of the MMPA.

11. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. Project vessel crews should participate in the WhaleAlert program to report real-time sightings of whales while transiting in the waters of Southeast Alaska and to minimize the risk of vessel strikes. More information is available at https://alaskafisheries.noaa.gov/pr/whale-alert.

In order to keep NMFS's Protected Resources Division informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, USACE and PR1 should notify NMFS of any conservation recommendations they implement in their final action.

12. REINITIATION OF CONSULTATION

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this Opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of incidental take is exceeded, section 7 consultation must be reinitiated immediately.

13. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act (DQA)) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

13.1 Utility

This document records the results of an interagency consultation. The information presented in this document is useful to NMFS, the USACE, the City of Ketchikan, AKDOT, and the general public. These consultations help to fulfill multiple legal obligations of the named agencies. The information is also useful and of interest to the general public as it describes the manner in which public trust resources are being managed and conserved. The information presented in these documents and used in the underlying consultations represents the best available scientific and commercial information and has been improved through interaction with the consulting agency.

This consultation will be posted on the NMFS Alaska Region website http://alaskafisheries.noaa.gov/pr/biological-opinions/. The format and name adhere to conventional standards for style.

13.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

13.3 Objectivity

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this Opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA implementation, and reviewed in accordance with Alaska Region ESA quality control and assurance processes.

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