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 for National Oceanic and Atmospheric Administration Office of Marine and Aviation Operations Ketchikan Port Facility Recapitalization Project

NMFS Consultation Number: AKRO-2021-02754

Action Agencies: National Oceanic and Atmospheric Administration (NOAA), Office of Marine and Aviation Operations (OMAO)

National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division (PR1)

U.S. Army Corps of Engineers (USACE), POA-2003-00442

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

Issued By:

Robert D. Mecum
Acting Administrator, Alaska Region

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Terms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
AKR	Alaska Region NMFS
BA	Biological Assessment
CFR	Code of Federal Regulations
COK	City of Ketchikan
CV	Coefficient of variation
dB	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
hr	hour(s)
Hz	Hertz
IHA	Incidental Harassment Authorization
IPCC	Intergovernmental Panel on Climate Change
ITS	Incidental Take Statement
kHz	kilohertz
km	kilometer(s)
lb	pound(s)
L_E	cumulative sound exposure level
LOA	Length overall
m	meter(s)
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
OMAO	Office of Marine and Aviation Operations
PR1	NMFS Office of Protected Resources, Permits and Conservation Division
PRD	Protected Resources Division, Alaska NMFS
PSO	Protected Species Observer
PTS	Permanent Threshold Shift
rms	root mean square
RPM	Reasonable and Prudent Measures
SAR	marine mammal stock assessment reports

SEL	Sound Exposure Level
SEL_{cum}	Cumulative Sound Exposure Level
SPL	Sound Pressure Level
SPL_{PK}	Peak Sound Pressure Level
SSV	Sound Source Verification
TL	Transmission Loss
TTS	Temporary Threshold Shift
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 or critical habitat, 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 may 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 NOAA Office of Marine and Aviation Operations (NOAA OMAO) is both the applicant and an action agency. Additional action agencies include the U.S. Army Corps of Engineers (USACE), which proposes to authorize construction activities at the OMAO's Ketchikan Port Facility, and the NMFS Office of Protected Resources Permits and Conservation Division (OPR). OPR proposes to permit Marine Mammal Protection Act (MMPA) Level A take (i.e., take by injury or mortality) of harbor seals (*Phoca vitulina*), harbor porpoise (*Phocoena phocoena*), and Dall's porpoise (*Phocoenoides dalli*), and Level B take (i.e., take by harassment) of nine marine mammal species: harbor seal, harbor porpoise, Dall's porpoise, Steller sea lion (*Eumetopias jubatus*) (only the non-listed eastern DPS is expected to be present in the action area), killer whale (*Orcinus orca*), humpback whale (*Megaptera novaeangliae)*, minke whale (*Balaenoptera acutorostrata*), gray whale (*Eschrichtius robustus*), and Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), in conjunction with the action. AECOM Technical Services, Inc. prepared the biological assessment (BA) and incidental harassment authorization (IHA) request (AECOM 2021) for Ahtna Engineering Services, LLC, the design and consulting firm under contract with NOAA OMAO. The BA was included as Appendix C to the IHA request. The consulting agency for this proposed action is NMFS's Alaska Region (AKR). This document represents AKR's biological opinion on the effects of the proposed construction activities on endangered and threatened species and their designated critical habitat.

The biological opinion and incidental take statement (ITS) were prepared by NMFS AKR in accordance with section 7(b) of the ESA of 1973, as amended (16 U.S.C. § 1536), and implementing regulations at 50 CFR §402.

The biological opinion and ITS are in compliance with the Data Quality Act (44 U.S.C. §3504(d)(1)) and underwent pre-dissemination review.

1.1 Background

This opinion considers the effects of a proposed action by the NOAA OMAO to recapitalize their Ketchikan port facility to provide critical management and operational and logistical support to the NOAA research vessel (R/V) *Fairweather* and intermittently to other NOAA and non-NOAA vessels. Additionally, the project would meet the congressional mandate of the Frank LoBiondo Coast Guard Authorization Act of 2018 to develop NOAA marine infrastructure in select U.S. communities.

The action may affect the threatened Mexico Distinct Population Segment (DPS) of humpback whale. Critical habitat was designated for the Mexico DPS of humpback whale (86 FR 21082, April 21, 2021), but there is no critical habitat in Southeast Alaska.

This biological opinion is based on information provided in the October 2021 IHA application and BA (AECOM 2021); updated project proposals; email and telephone conversations among NMFS AKR, the NOAA OMAO consultant team, the USACE, and NMFS OPR; 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 the NOAA OMAO consultation team, OPR, and USACE regarding this consultation is summarized as follows:

- **October 26, 2021**: AECOM submitted an initial IHA application on behalf of the Ahtna Engineering and NOAA OMAO for the non-lethal taking of marine mammals incidental to pile driving and dock construction activities at a port facility (described below in Action Area), owned by NOAA OMAO, during February 2022 through January 2023.
- **November 16, 2021:** OPR deemed the IHA application adequate and complete.
- **November 26, 2021:** OPR requested initiation of formal consultation with AKR.
- **November 26, 2021**: AKR deemed the initiation package complete and initiated formal consultation with OPR and USACE.
- **December 1, 2021:** OPR published the notice of a proposed IHA in the *Federal Register* (86 FR 68223) with a comment period extending through January 3, 2022.
- **January 13, 2022:** All parties agreed to the proposed mitigation measures.
- **January 14, 2022:** OPR sent AKR the final draft IHA (RTID 0648-XA569) and notification of changes to the proposed IHA in response to public comments and new information since the proposed rule was published. Changes from the draft to final IHA include establishing shutdown zones based on functional hearing-groups instead of a single shutdown zone for all marine mammals, adding a measure to allow harassment and shutdown zones to be revised based on *in situ* hydroacoustic monitoring for sound source verification, and the addition of harassment and shutdown zones for steel pile removal methods.

2 Description of the Proposed Action and Action Area

“Action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

This opinion considers the effects on listed species in the action area incidental to vibratory and impact pile driving and removal, and use of a down-the-hole (DTH) drilling system.

Construction is expected to occur between February 2022 and January 2023, with approximately 47 days of in-water work. The action has the potential to affect waters in Tongass Narrows and nearby Revillagigedo Channel, approximately 3 miles to the south (Figure 1).

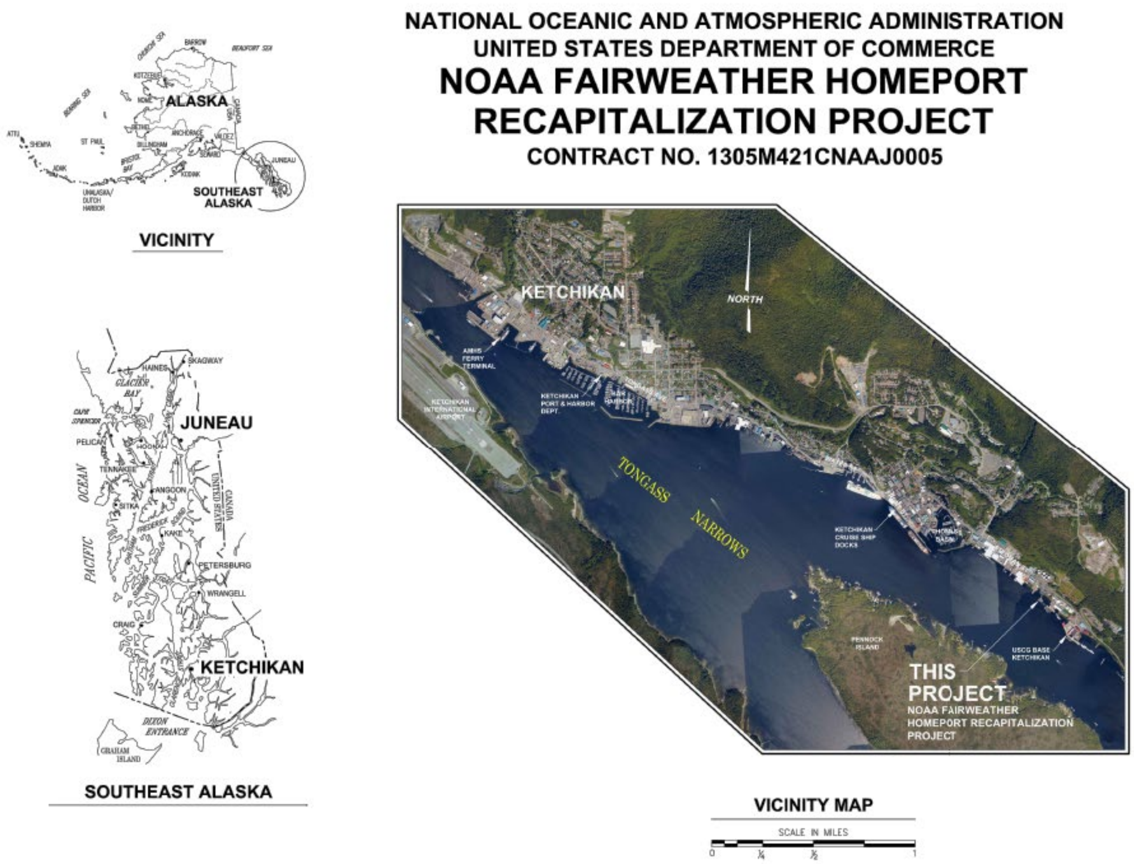

Figure 1. Project vicinity in Tongass Narrows, Ketchikan, Southeast Alaska (excerpted from Drawing G1.01 of Appendix A in AECOM (2021)).

2.1 Proposed action and activities

The project consists of an almost complete recapitalization of the existing facility (see Drawing G1.04 of existing conditions in Appendix A of AECOM (2021)). This includes the removal and appropriate disposal of unused or obsolete structures and infrastructure, in both a 77,000 square foot (ft^2) upland area and within 102,000 ft^2 of the in-water area. Descriptions of additional upland activities may be found in the application (AECOM 2021), but such actions will not affect marine mammals and are not described in detail here.

All existing in-water structures, including pier, access trestle, and mooring dolphins present above and below the water surface, would be removed except for a concrete/steel mooring platform and breasting dolphin with fender (see Drawing G1.05 of the demolition plan in Appendix A of AECOM (2021)). The in-water structures would be replaced by adequately sized and structurally sound elements necessary for berthing, preparing, and maintaining vessel operations (Figure 2).

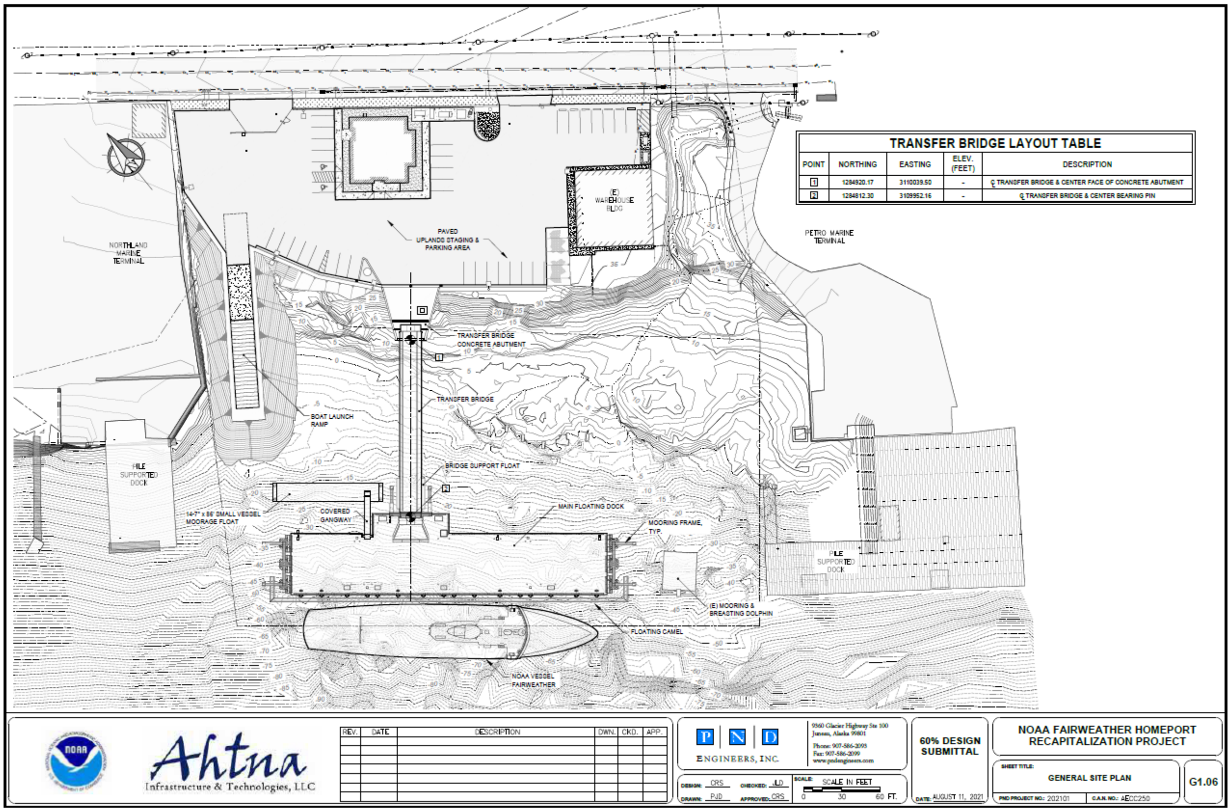

Figure 2. General site plan for new in-water facilities at the NOAA OMAO R/V *Fairweather* homeport (Drawing G1.06 of Appendix A from AECOM 2021).

An estimated 134 remnant 14-inch diameter timber piles would be removed by direct pull (crane with a choker) or by vibratory methods. If a pile breaks or splinters during the removal process, the pile would be cut at or about 2 ft (0.67 m) from the bottom. In addition, approximately 70 remnant steel piles (~28 pile 14-in diameter, ~42 piles 20-24-in diameter) must be removed. These piles will be removed by direct pull crane with a choker, if possible, or extracted with a vibratory hammer. It is likely that some of the existing steel piles are anchored in place, making direct pull and vibratory methods ineffective for removal. Anchored steel piles will be removed by use of a pile clipper or hydraulic saw.

An approximately 240-ft long and 50-ft wide (73 m by 15 m) floating pier would replace the existing pier and its supporting piles. The floating pier would be secured and stabilized by 10 24-inch diameter steel pipe piles, and accessed via a single, 144-ft long and 17-ft wide (44 m by 5 m) steel, truss-framed transfer bridge. The transfer bridge would be supported by a bridge support float adjacent to the pier and hinged to the shoreline cast in place concrete abutment. The

24-ft by 22-ft (7.3 m by 6.7 m) bridge support float would be secured by four additional 24-inch diameter steel piles. A small boat dock, approximately 90 ft long by 14 ft wide (27 m by 4 m), would be installed and connected to the floating pier by an aluminum gangway and would require an additional four 24-inch steel piles. Thus the new structures would require a total of 18 24-inch steel piles. Installation of the new steel piles is anticipated to be undertaken using a barge mounted DTH system to create holes in the rock (sockets) in which the piles would be placed. Piles would be embedded into socket holes created by the DTH in bedrock to a minimum depth of 20 ft. The last foot of each pile would be "proofed" using an impact pile driver that is anticipated will require approximately 5 to 10 blows per pile.

Replacement mooring dolphins and fenders for mooring would be installed. Ship utilities would be extended dockside attached to the transfer bridge. A small boat launch ramp would be built on the northern portion of the site and would be supported on a raised, rip-rap protected mound with a footprint of approximately 200 ft by 70 ft wide (61 m by 21 m).

Vessels associated with the project include three barges (Deck Barge *Swinomish* 156' x 49', Deck Barge *Stan Boice* 145' x 48', and Deck Barge *Steve Middleton* 135' x 40'); a 750 HP tug (*Waldo*), and several small work skiffs (less than 25 ft length overall). There may also be a skiff to support hydroacoustic and marine mammal monitoring. One barge will be used as a work platform and to support a crane. The other barges will be used for storing, stockpiling, and transporting materials. The barges will remain anchored on-site during construction, making only minor adjustments in position as required to perform the work. Skiffs may transport workers very short distances at low speeds from shore to the work platform. A tug and barge will also transport materials, including pre-assembled dock and access trestle components, along established shipping routes from Seattle, WA, to Ketchikan, AK. Table 1 summarizes the proposed pile driving activities and number of piles to be installed and removed[1].

In-water work would be performed using equipment based on a floating barge or from the shore, as needed. Pile work would normally only occur during civil daylight hours unless work needs to continue on a pile until it is safe to leave overnight. OMAO anticipates 47 days (over the course of 10 weeks) of pile driving activities: 20 days to remove the 200 existing timber and steel piles, and 27 days to install 18 new steel piles.

The R/V *Fairweather* is currently berthed at the NOAA Marine Operations Center-Pacific in Newport, Oregon. Recapitalization of OMAO's Ketchikan Port Facility will allow the R/V *Fairweather* to be homeported in Ketchikan in closer proximity to its primary mission support area in Alaska. The R/V *Fairweather* is a 231-ft (70 m) hydrographic survey vessel that travels at a cruising speed of 12.5 knots in open water and a maximum speed of 13.4 knots[2].

[1] Hereafter, "pile driving activities" will be used as a general term to include pile installation or removal using vibratory, impact, or down-the-hole (DTH) hammers, or pile clippers/hydraulic saws.
[2] R/V *Fairweather* vessel statistics are available at https://www.omao.noaa.gov/learn/marine-operations/ships/fairweather/about/specifications, accessed January 4, 2022.

Table 1. Summary of pile driving activities for the NOAA OMAO Ketchikan Port Recapitalization Project

Method	Pile Type	Number of Piles
Impact installation with DTH, if necessary	24-inch steel	18
Direct pull, cutting near substrate, or vibratory removal	14-inch timber	Approx. 134
Direct pull, vibratory removal, or cutting near substrate with hydraulic saw or pile clippers	14-inch to 24-inch steel	Approx. 70

2.2 Mitigation Measures

OMAO has agreed to implement the following measures to avoid and minimize impacts to the Mexico DPS humpback whale. For all reporting that results from implementation of these mitigation measures, OMAO or its contractors will contact NMFS using the contact information specified in Table 3. In all cases, notification will reference the NMFS consultation tracking number: AKRO-2021-02754.

Unless otherwise specified, the term "pile driving activities" is defined to include vibratory pile removal, vibratory pile driving, impact pile driving, pile clipping or cutting, and/or down-the-hole socketing and anchoring.

2.2.1 General Conditions

1. *Pre-construction notification*-- At least one week prior to commencing construction, OMAO will notify the NMFS Alaska Regional Office (see Table 3) that construction is planned to begin.
2. If construction activities will occur outside of the time window specified, the applicant will notify NMFS at least 60 days prior to the end of the specified time window to allow for reinitiation of consultation.
3. Project-associated staff will cut all materials that form closed loops (e.g., plastic packing bands, rubber bands, and all other loops) prior to proper disposal in a closed and secured trash bin. Trash bins will be properly secured with locked or secured lids that cannot blow open, preventing trash from entering into the environment, thus reducing the risk of entanglement in the event that waste enters marine waters.
4. Project-associated staff will properly secure all ropes, nets, and other materials that could blow or wash overboard.
5. All trash will be immediately placed in trash bins and bins will be properly secured with locked or secured lids that cannot blow open and disperse trash into the environment.

2.2.2 Visual Monitoring by Protected Species Observers

2.2.2.1 Shutdown and monitoring zones

PSOs will monitor the shutdown and monitoring zones listed in Table 2 and depicted in Figures 3-6 during pile driving activities. Shutdown zones will be centered on the pile being driven and will therefore shift depending on the pile's location from what is shown in Figures 3-6. All sightings of humpback whales will be documented.

Table 2. Shutdown and monitoring zones for humpback whales (low frequency cetaceans) during in-water project activities

Method	Pile Type	Shutdown Zone (m)	Monitoring Zone (m)
DTH installation	24-inch steel	130	11,600
Impact installation	24-inch steel	160	2,530
Vibratory removal	14-inch timber	10	2,930
Vibratory removal	14- to 16-inch steel	10	2,930
Vibratory removal	18- to 24-inch steel	10	5,420
Small Pile Clipper	14- to 16-inch steel	10	1,850
Large Pile Clipper	18- to 24-inch Steel	10	5,420
All other in-water heavy machinery	-	10	n/a

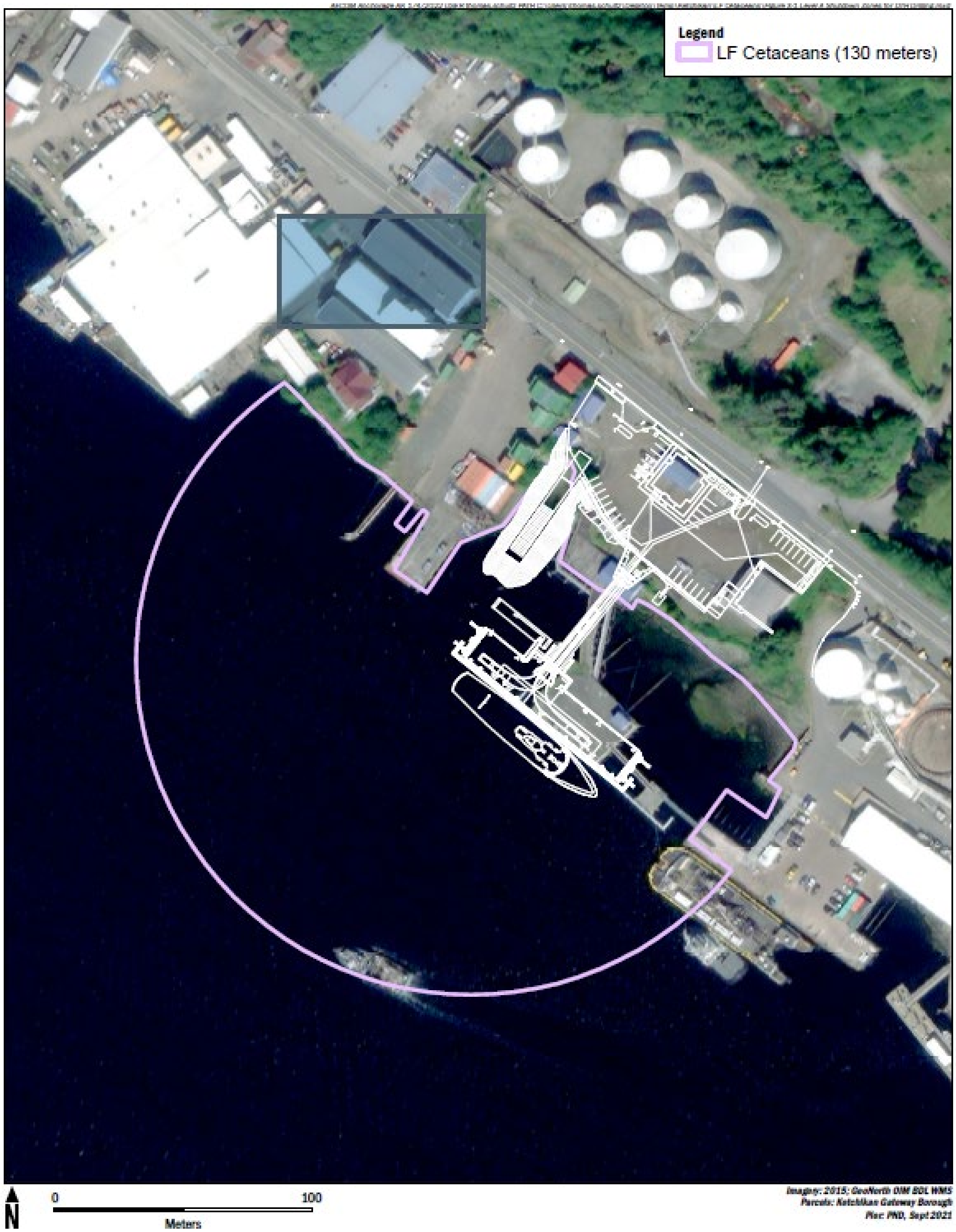

Figure 3. Example of the 130-m shutdown zone for DTH (figure prepared by AECOM). Shutdown zones will be centered on the pile being installed and may differ from what is depicted in this figure depending on the location of the pile.

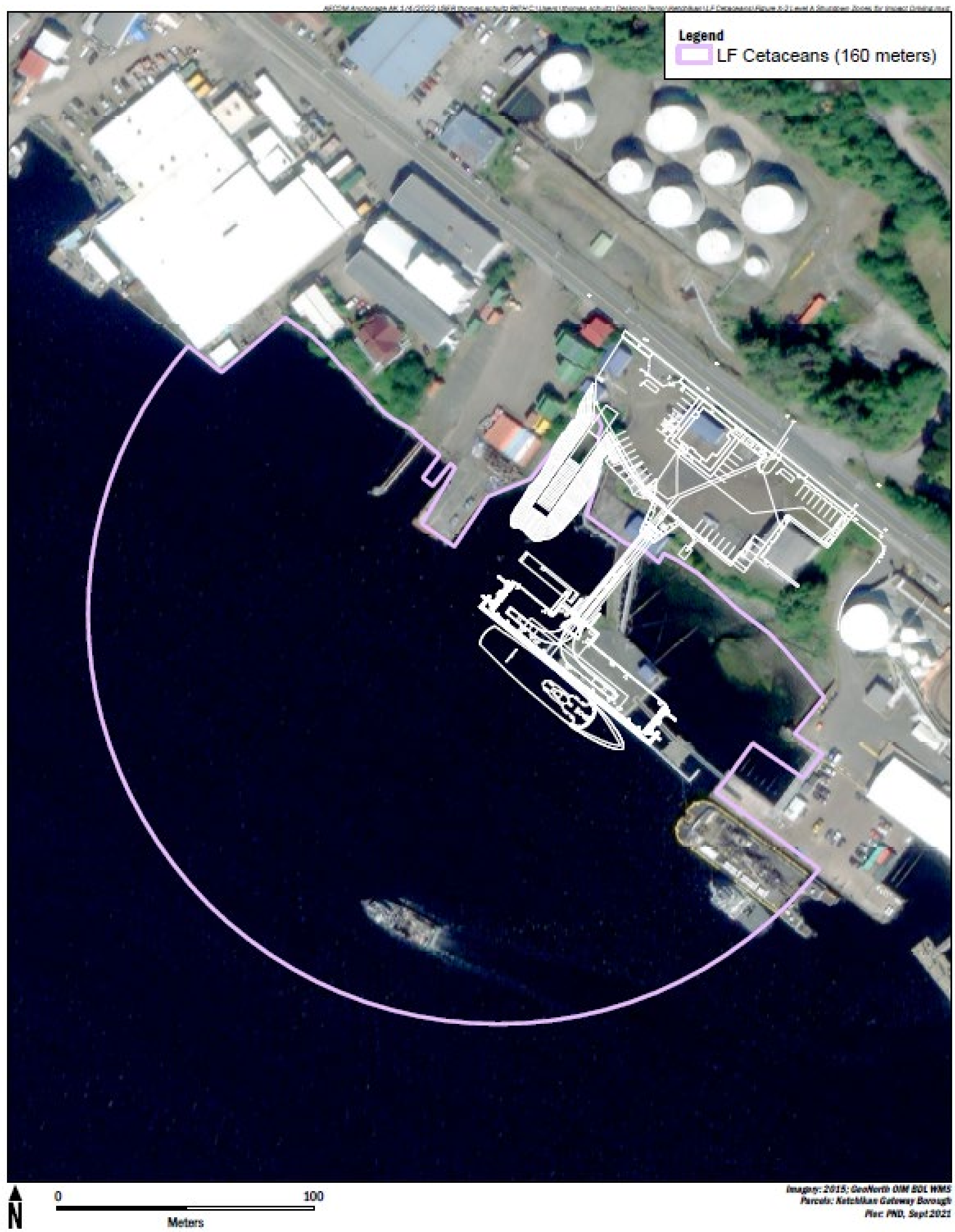

Figure 4. Example of a 160-m shutdown zone for impact pile driving (figure prepared by AECOM). Shutdown zones will be centered on the pile being installed and may differ from what is depicted in this figure, depending on the location of the pile.

Figure 5. Example of a 10-m shutdown zone for pile removal (direct pull, vibratory extraction, pile clipping) and other in-water construction activities (figure prepared by AECOM). Shutdown zones will be centered on the pile being installed and may differ from what is depicted in this figure, depending on the location of the pile.

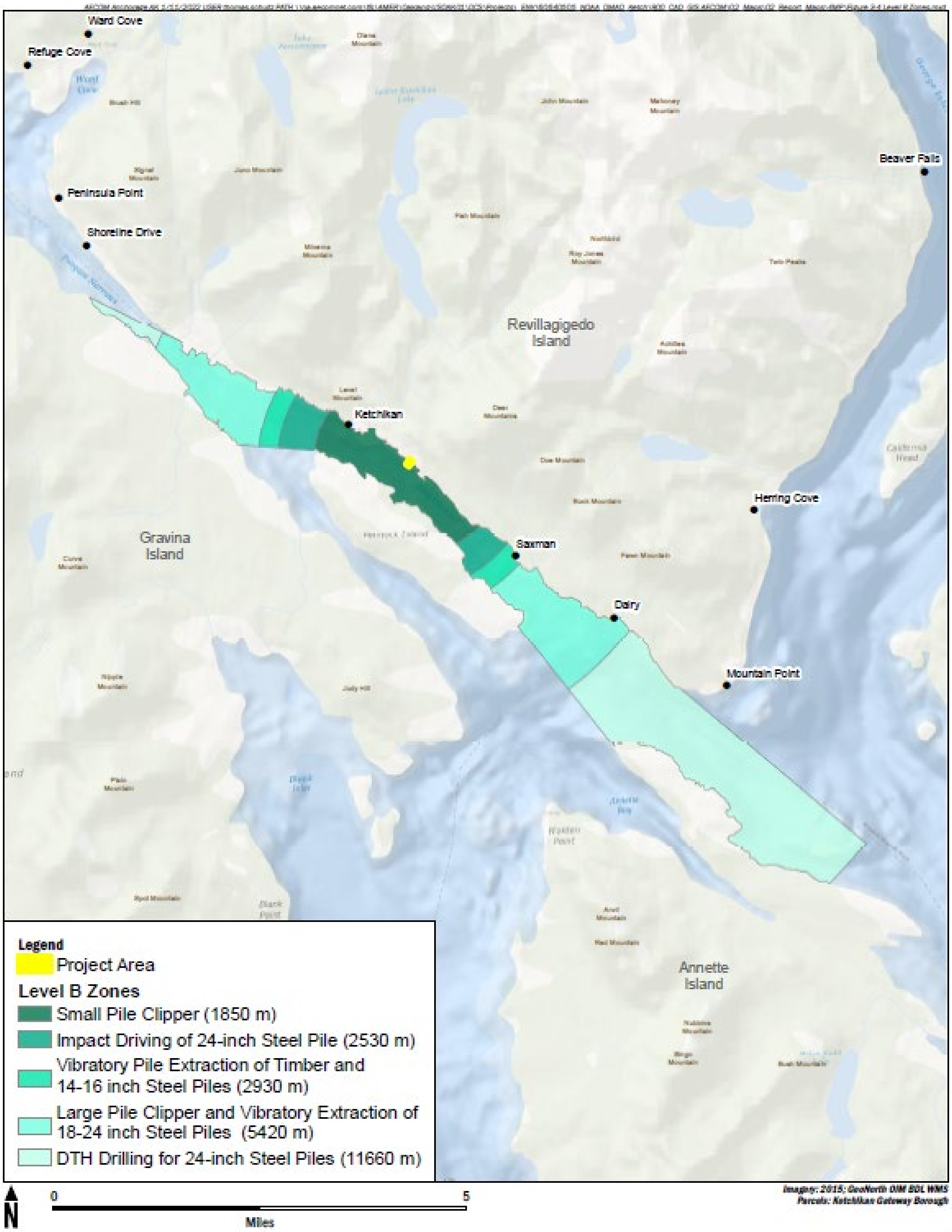

Figure 6. Monitoring zones to be implemented for all pile driving activities (figure provided by AECOM).

2.2.2.2 General requirements for visual monitoring

6. Three or more PSOs will perform PSO duties onsite throughout all pile driving activities.
7. *Establishing Point of Contact with Construction Crew:* Prior to commencing in-water work or at changes in watch, PSOs will establish a point of contact with the construction crew. The PSO will brief the point of contact as to the shutdown procedures if listed species are observed likely to enter or within the shutdown zone, and will request that the point of contact instruct the crew to notify the PSO when a marine mammal is observed. If the point of contact goes "off shift" and delegates his duties, the PSO must be informed and brief the new point of contact.
8. PSOs will have no duties other than to watch for and report on events related to marine mammals during monitoring periods. PSOs will have no construction-related tasks or responsibilities while monitoring for marine mammals
9. PSOs will have the ability and authority to order appropriate mitigation response, including shutdowns, to avoid takes of all listed species.
10. *Shifts*-- PSOs will work in shifts lasting no longer than 4 hours with at least a 1-hour break from monitoring duties between shifts. PSOs will not perform PSO duties for more than 12 hours in a 24-hour period.

2.2.2.3 Monitoring the Shutdown Zone

11. For each in-water pile driving activity, at least one PSO will monitor all marine waters within the indicated shutdown zone radius for that activity (Table 2 and Figures 3-5).
12. For other in-water heavy machinery activities, on days when pile driving activities are not scheduled to occur, monitoring of the shutdown zone may be performed by construction personnel.
13. At least one PSO will continuously monitor the shutdown zone and adjacent waters during in-water construction activities for the presence of listed species.
14. *Clearing Shutdown Zone:* Prior to commencing pile driving activities, or whenever a break in pile driving activities of 30 minutes or longer occurs, PSOs will scan waters within the shutdown zone and confirm no listed species are within the relevant shutdown zone for at least 30 minutes immediately prior to initiation of the in-water activity. If one or more listed species are observed within the relevant shutdown zone, the in-water activity will not begin until the whale exits the shutdown zone of its own accord, or the shutdown zone has remained clear of listed species for 30 minutes immediately prior to pile driving activities.
15. If visibility degrades to where the PSO cannot ensure that the relevant shutdown zone remains devoid of listed species during pile driving activities, the crew will cease in-water work until the entire shutdown zone is visible and the PSO has indicated that the zone has remained devoid of listed species for 30 minutes.
16. If pile driving is delayed or halted due to the presence of a humpback whale in the relevant shutdown zone, the activity may not commence or resume until either the whale has voluntarily exited and been visually confirmed beyond the shutdown zone, or 30 minutes have elapsed without re-detection of the whale.

17. The PSO will order the pile driving activities to immediately cease if one or more listed species approaches, has entered, or appears likely to enter, the associated shutdown zone.
18. If a listed species is observed within a shutdown zone during production of in-water sound or is otherwise harassed, harmed, injured, or disturbed, PSOs will immediately report that occurrence to NMFS using the contact information specified in Table 3.

2.2.2.4 Monitoring the Level B Zones for all pile driving activities

19. *Pre-activity survey of the monitoring zone:* At the start of the 30-minute pre-activity monitoring period, one PSO will remain at the construction site to monitor the Level A shutdown zone, while two or more PSOs will start at the project site and travel along Tongass Narrows, counting all humpback whales present, until they have reached the edge of the Level B monitoring zone. At this point, the PSOs will identify suitable observation points from which to observe the Level B monitoring zone for the duration of pile driving activities (except during DTH, see 2.2.2.5 below).
20. During pile driving and removal operations, PSOs will be responsible for observing only the width of Tongass Narrows at the Level B zone entry point/boundary rather than the entirety of the Level B zone because any humpback whale entering the Level B zone would need to pass by one of these PSOs. All PSOs will be in constant radio contact with one another and the lead PSO will be in contact with the construction team to request a work stoppage, if necessary.
21. When a humpback whale is present in the Level B monitoring zone, activities may continue if authorized take levels have not been met, and Level B take will be recorded and reported.
22. If the boundaries of the Level B monitoring zone have not been monitored continuously during a work stoppage, the entire Level B zone will be surveyed again for the presence of humpback whales.
23. If a listed species for which authorization has not been granted is observed approaching or within the Level B monitoring zone (Table 2 and Figure 6), 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 15 minutes for pinnipeds or 30 minutes for cetaceans have passed without subsequent detections of marine mammals in the Level B monitoring zone.

2.2.2.5 Additional measures for monitoring Level B zones during DTH

24. One additional PSO is required to monitor the portion of the Level B zone that extends beyond Tongass Narrows during DTH.
25. *Extrapolation of take in Revillagigedo Channel south of Tongass Narrows:* For the portion of the monitoring zone that extends southward beyond the confines of Tongass Narrows and may not be entirely visible by PSOs, extrapolation methods may be used to estimate take. Estimated numbers of individuals will be extrapolated by dividing the number of individuals observed that day by the area that is reliably monitored and multiplying that density by the area of the monitoring zone that was not visible. For this project, NMFS estimated that two groups of two whales may be present in the action area weekly throughout the duration of the project. Therefore, unless direct counts exceed 4

individuals, 4 would be the daily maximum number of individuals assumed to be within the Level B monitoring zone when extrapolation methods are used. For example:

On a given day, if two humpback whales were recorded in the effectively monitored area of 10 square kilometers, and 2 square kilometers of the monitoring zone could not be reliably observed, the extrapolated take would be calculated as follows:

> 2 humpback / 10 km^2 = 0.2 humpback/km^2 x 2 km^2 not visible = 0.4 humpback whale extrapolated take for that day, for a total of 2.4 takes

When extrapolation occurs, fractional takes may be recorded on a daily basis and would be tallied and rounded up to the nearest whole number at project completion.

2.2.2.6 Post-activity Monitoring

26. PSOs will conduct post-activity monitoring of the shutdown and monitoring zones for 30 minutes after the daily cessation of in-water construction and pile driving activities.
27. The length of the post-activity monitoring period may be reduced if pile driving activities continue for more than 30 minutes after sunset and darkness precludes visibility of the shutdown and monitoring zones.

2.2.2.7 Soft Start Procedures for Impact Pile Installation

28. If no listed species are observed within the impact pile driving shutdown zone for 30 minutes immediately prior to pile driving, soft-start procedures will be implemented immediately prior to activities. Soft start requires contractors to provide an initial set of three strikes at no more than half the operational power, followed by a 30 second waiting period, then two subsequent reduced power strike sets. A soft start must be implemented at the start of each day’s impact pile driving, any time pile driving has been shutdown or delayed due the presence of a listed species, and following cessation of pile driving for a period of 30 minutes or longer.
29. Following this soft-start procedure, operational impact pile driving may commence and continue provided listed species remain absent from the shutdown zone and Level B harassment take authorizations have not been met.

2.2.2.8 Scheduling

30. In-water activities will take place only:
    a. between civil dawn and civil dusk when PSOs can effectively monitor for the presence of marine mammals;
    b. during conditions with a Beaufort Sea State of 4 or less;
    c. when the entire shutdown zone and adjacent waters are visible (e.g., monitoring effectiveness is not reduced due to rain, fog, snow, etc.).
31. Exception: Some pile driving activities may continue for up to 30 minutes after sunset during evening civil twilight, as necessary to secure a pile for safety prior to demobilization for the evening. PSO(s) will continue to observe shutdown and monitoring zones during this time.

2.2.2.9 Qualifications of PSOs

32. PSOs must be independent (i.e., not construction personnel) and have no other assigned tasks during monitoring periods.

33. The action agency or its designated non-federal representative will provide resumes of PSO candidates to the NMFS Office of Protected Resources (see *Contact Information* in Table 3) for approval at least one week prior to in-water work. NMFS will provide a brief explanation of lack of approval in instances where an individual is not approved.

34. At least one PSO will have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization. Other PSOs may substitute other relevant experience, education (degree in biological science or related field), or training.

35. PSOs must complete PSO training prior to deployment. The training will include instruction on:
    a. field identification of marine mammals and marine mammal behavior;
    b. ecological information on Alaska's marine mammals and specifics on the ecology and management concerns of those marine mammals;
    c. ESA and MMPA regulations;
    d. mitigation measures outlined in this letter;
    e. proper equipment use;
    f. methodologies in marine mammal observation and data recording and proper reporting protocols; and,
    g. PSO roles and responsibilities.

36. When a team of three or more PSOs is required, a lead observer or monitoring coordinator must be designated.

37. All PSOs will have the following abilities:
    a. have adequate vision to perform their duties;
    b. have the ability to effectively communicate orally, by radio and in person, with project personnel;
    c. have prior experience collecting field observations and recording field data accurately and in accordance with project protocols;
    d. be able to identify to species all marine mammals that are endemic to the action area;
    e. be able to record marine mammal behavior; and
    f. have technical writing skills sufficient to create understandable reports of observations

38. *Required PSO Equipment:* PSOs will have the following equipment to perform their duties:

a. tools which enable them to accurately determine the position of a marine mammal in relationship to the shutdown zone;
b. two-way radio communication, or equivalent, with onsite project manager;
c. tide tables for the project area;
d. watch or chronometer;
e. binoculars (7x50 or higher magnification) with built-in rangefinder or reticles (rangefinder may be provided separately);
f. global positioning system;
g. a legible copy of this biological opinion and all appendices
h. legible and fillable observation record form allowing for required PSO data entry.

2.2.3 Vessel Strike Avoidance

39. To minimize the risk of vessel strikes, vessel operators will:

a. maintain a watch for marine mammals at all times while underway;
b. stay at least 91 m (100 yd) away from listed marine mammals;
c. travel at less than 5 knots (9 km/hr) when within 274 m (300 yd) of a whale;
d. avoid changes in direction and speed when within 274 m (300 yd) of whales, unless doing so is necessary for maritime safety;
e. not position vessel(s) in the path of whales, and will not cut in front of whales in a way or at a distance that causes the whales to change their direction of travel or behavior (including breathing/surfacing pattern);
f. check the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged;
g. reduce vessel speed to 10 knots or less when weather conditions reduce visibility to 1.6 km (1 mi) or less;
h. 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));
i. not allow lines to remain in the water, and no trash or other debris will be thrown overboard, thereby reducing the potential for marine mammal entanglement.
j. follow established transit routes and will travel <10 knots while in the action area. The speed limit within Tongass Narrows is 7 knots for vessels over 23 feet in length.
k. If a whale's course and speed are such that it will likely cross in front of a vessel that is underway, or approach within 91 m (100 yd) of the vessel, and if maritime conditions safely allow, the engine will be put in neutral and the whale will be allowed to pass beyond the vessel.

2.2.4 Hazardous Material Spill Avoidance

40. Structures will be designed to limit contaminant releases and will be maintained in a

manner that manages pollutants and debris streams to avoid incidental introduction of deleterious materials into Tongass Narrows.

41. Fuels, lubricants, chemicals and other hazardous substances will be stored above the high tide line to prevent spills.
42. Oil booms will be readily available for containment should any releases occur.
43. To prevent spills or leakage of hazardous material during construction, standard spill-prevention measures will be implemented during construction. The contractor will provide and maintain a spill clean-up kit on-site at all times.
44. The contractor will monitor equipment and gear storage areas for drips or leaks regularly, including inspection of fuel hoses, oil drums, oil or fuel transfer valves and fittings, and fuel storage that occurs at the project site. Equipment will be maintained and stored properly to prevent spills.
45. If contaminated or hazardous materials are encountered during construction, all work in the vicinity of the contaminated site will be stopped until a corrective action plan is devised and implemented to minimize impacts on surface waters and organisms in the project area.

2.2.5 General Data Collection and Reporting

2.2.5.1 Data Collection

46. PSOs will record observations on data forms or into electronic data sheets.
47. The action agency will ensure that PSO data will be submitted to NMFS electronically in a format that can be queried such as a spreadsheet or database (i.e., digital images of data sheets are not sufficient).
48. PSOs will record the following, at minimum:
    a. Dates and times (beginning and ending) of all marine mammal monitoring effort;
    b. PSO name and monitoring location;
    c. Environmental conditions during monitoring periods (at beginning and end of PSO shift and whenever conditions change significantly) including Beaufort sea state, and any other relevant weather conditions including cloud cover, fog, glare, overall visibility to the horizon, and estimated observable distance;
    d. Construction activities occurring during each daily observation period, including:
        i. the number and type of piles that were installed or removed and the method,
        ii. the total duration of pile driving time (vibratory) and number of strikes (impact) for each pile, along with start and stop times for pile driving, and
        iii. for DTH, duration of operation for both impulsive and non-impulsive components
    e. Upon observation of a whale, the PSO will record the following information:
        i. Name or other identifier of PSO who observed the whale(s) and PSO

location and activity at time of sighting;

ii. Time of sighting;

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

iv. Distance and location of each observed whale relative to the pile being driven for each sighting;

v. Geographic coordinates for the observed whales, with the position recorded by using the most precise coordinates practicable (coordinates will be recorded in decimal degrees, or similar standard and defined coordinate system).

vi. Estimated number of whales (min/max/best estimate);

vii. Estimated number of whales by cohort (adults, juveniles, group composition, etc.);

viii. Number of marine mammals detected within the monitoring or shutdown zones,

ix. Whale's closest point of approach and estimated time spent within the monitoring or shutdown zones;

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

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

2.2.5.2 Unauthorized Take

49. If a listed marine mammal is determined by the PSO to have been disturbed, harassed, harmed, injured, or killed (e.g., a listed marine mammal(s) is observed entering a shutdown zone before operations can be shut down, or is injured or killed as a direct or indirect result of this action), the PSO will report the incident to NMFS within one business day, with information submitted to akr.section7@noaa.gov. These PSO records will include:

   a. all information to be provided in the final report (see *Final Report* section below):

   b. number of whales of each threatened and endangered species affected;

   c. the date, time, and location of each event (provide geographic coordinates);

   d. description of the event;

   e. the time the whale(s) was first observed or entered the shutdown zone, and, if known, the time the whale was last seen or exited the zone, and the fate of the whale;

f. mitigation measures implemented prior to and after the whale was taken; and

g. if a vessel struck a marine mammal, the contact information for the PSO on duty, or the contact information for the individual piloting the vessel if there was no PSO on duty;

h. Photographs or video footage of the whale(s) (if available).

2.2.5.3 Stranded, Injured, Sick or Dead Marine Mammal (not associated with the project)

50. If PSOs observe an injured, sick, or dead marine mammal (i.e., stranded marine mammal), they will notify the Alaska Marine Mammal Stranding Hotline at 877-925-7773. The PSOs will submit photos and available data to aid NMFS in determining how to respond to the stranded animal. If possible, data submitted to NMFS in response to stranded marine mammals will include date/time, location of stranded marine mammal, species and number of stranded marine mammals, description of the stranded marine mammal's condition, event type (e.g., entanglement, dead, floating), and behavior of live-stranded marine mammals.

2.2.5.4 Illegal Activities

51. If PSOs observe marine mammals being disturbed, harassed, harmed, injured, or killed (e.g., feeding or unauthorized harassment), these activities will be reported to NMFS Alaska Region Office of Law Enforcement at (Table 2; 1-800-853-1964).

52. Data submitted to NMFS will include date/time, location, description of the event, and any photos or videos taken.

2.2.5.5 Monthly Report

53. Submit interim monthly PSO monitoring reports, including digital data sheets. These reports will include a summary of marine mammal species and behavioral observations, shutdowns or delays, and work completed.

54. Monthly reports will be submitted to AKR.section7@noaa.gov by the 15th day of the month following the reporting period. For example the report for activities conducted in June 2023 will be submitted by July 15, 2023.

2.2.5.6 Final Report

55. A final report will be submitted to NMFS within 90 calendar days of the completion of the project summarizing the data recorded and submitted to the email addresses shown in Table 3. The report will summarize all in-water activities associated with the proposed action, and results of PSO monitoring conducted during the in-water project activities.

56. The final report will include:

    a. summaries of monitoring efforts, including dates and times of construction, dates and times of monitoring, and dates, times, and duration of shutdowns due to marine mammal presence;

    b. analyses on the effects from various factors that may have influenced detectability of marine mammals (e.g., sea state, number of observers, fog, glare, and other factors as determined by the PSOs);

c. date and time of marine mammal observations, geographic coordinates of marine mammals at their closest approach to the project site, marine mammal species, numbers, age/size/sex categories (if determinable), and group sizes;

d. number of marine mammals observed (by species) during periods with and without project activities (and other variables that could affect detectability);

e. initial, closest, and last marine mammal observation distances versus project activity at time of observation;

f. observed marine mammal behaviors and movement types versus project activity at time of observation;

g. numbers of marine mammal observations/individuals seen versus project activity at time of observation;

h. distribution of marine mammals around the action area versus project activity at time of observation;

i. digital, queryable documents containing PSO observations and records, and digital, queryable reports.

2.2.6 Summary of Agency Contact Information

Table 3. Summary of agency contact information.

Topic	**Contact Information**
NMFS ESA Section 7 Consultation	NMFS Alaska Regional Office, Protected Resources Division *Alaska Region Section 7 Coordinator:* Greg Balogh, Greg.Balogh@noaa.gov, 907-271-3023 *Consultation Biologist:* Julie Scheurer, Julie.Scheurer@noaa.gov, 907-586-7111
NMFS MMPA IHA Authorization and PSO resumes	NMFS Office of Protected Resources Permits Division Benjamin Laws, Benjamin.Laws@noaa.gov 301-427-8425
PSO Monitoring Reports & Data Submittal	AKR.section7@noaa.gov PR.ITP.MonitoringReports@noaa.gov Benjamin.Laws@noaa.gov
Reporting of Stranded, Injured, or Dead Marine Mammals	NMFS Alaska Region 24-hr Stranding Hotline 877-925-7773 NMFS Office of Protected Resources Permits Division Benjamin Laws, Benjamin.Laws@noaa.gov

Topic	Contact Information
	301-427-8425
Oil Spill & Hazardous Materials Response	U.S. Coast Guard National Response Center: 1-800-424-8802 AKRNMFSSpillResponse@noaa.gov
Illegal Activities *(not related to project activities; e.g., feeding, unauthorized harassment, or disturbance to marine mammals)*	NMFS Office of Law Enforcement (AK Hotline): 1-800-853-1964
Unauthorized Take by Project Activities	NMFS Alaska Regional Office 907-586-7236 *Alaska Region Section 7 Coordinator:* Greg Balogh, Greg.Balogh@noaa.gov, 907-271-3023 *Section 7 Consultation Biologist:* Julie Scheurer, Julie.Scheurer@noaa.gov, 907-586-7111 NMFS Office of Protected Resources Permits Division Benjamin Laws, Benjamin.Laws@noaa.gov 301-427-8425

2.3 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 includes the area in which pile driving and other in-water work activities will take place, the ensonified area around pile driving activities, and other in-water work activities associated with the project (Figure 7).

Ketchikan is located in Southeast Alaska on the western coast of Revillagigedo Island, near the southernmost boundary of Alaska and the U.S.-Canada border (Figure 1). Ketchikan encompasses an area of approximately 3 square miles (7.8 km^2) of land and 1 square mile (2.6 km^2) of water. The site is located on the east side of Tongass Narrows, an 11-mile-long (17.7 km), narrow marine channel between Revillagigedo and Gravina islands. OMAO operates and maintains its MOC-P Ketchikan Port Facility at 1010 Stedman Street in Ketchikan. The facility was acquired to serve as the dedicated homeport for the NOAA Ship Fairweather in support of its primary mission to conduct surveys to provide updates to nautical charts and other hydrographic products.

At the project site where piles will be driven, water depths range between approximately 40 ft (12.2 m) and 72 ft (21.9 m). Tidal currents generally range from 0.3 to 1.6 miles per hour (0.5-2.6 km/hr) during flood and ebb tides (PND Engineers 2006). The tide range in Ketchikan is more than 20 ft (6.1 m). Water depths in the area of Tongass Narrows that will be ensonified by this project are generally 160 ft (48.8 m) or shallower, but get deeper past the southern end of Pennock Island reaching depths up to 745 ft (227 m) near Spire Island.

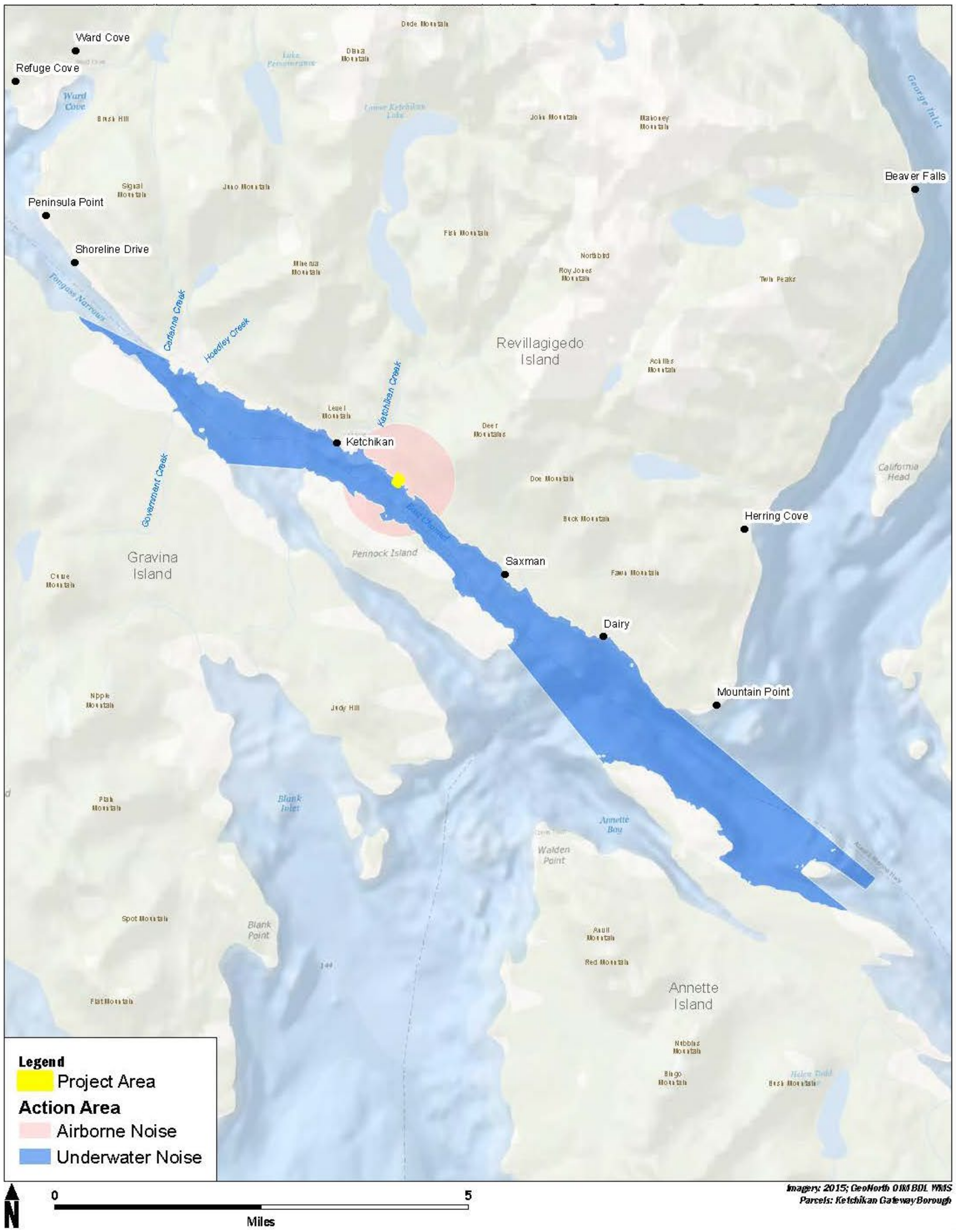

Figure 7. Action area for the NOAA OMAO port facility project based on the largest ensonified zone to be monitored (approximately 12 km) (Figure from AECOM (2021)).

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. Because there is no critical habitat in or near the action area, we do not consider adverse modification further in this biological opinion.

To "jeopardize the continued existence of a listed species" means to engage in an action that reasonably 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 will result in a jeopardy biological opinion (51 FR 19926, 19934 (June 2, 1986)).

We use the following approach to determine whether the proposed action described in Section 2 is likely to jeopardize listed species:

- Identify those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on listed species. 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 likely to be adversely affected by the proposed action. This section describes the current status of each listed species relative to the conditions needed for recovery. *Status of the Species* is discussed in Section 4 of this biological 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 biological 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 sex 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 and the *Exposure Analysis* is described in Section 6.4 of this biological 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 6.5 of this biological 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 biological 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) appreciably diminish the value of critical habitat for the conservation of the species. These assessments are made in full consideration of the *Rangewide Status of the Species and Critical Habitat* (Section 4). *Integration and Synthesis* with risk analyses are described in Section 8 of this biological 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.
- If necessary, define a reasonable and prudent alternative to the proposed action. If, in completing the last step in the analysis, NMFS determines that the action under consultation is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, NMFS must identify a reasonable and prudent alternative (RPA) to the action.

4 Rangewide Status of the Species and Critical Habitat

One ESA-listed marine mammal species under NMFS's jurisdiction may occur in the action area: the threatened Mexico DPS humpback whale. No critical habitat for any ESA-listed species occurs within the action area (Table 4).

Table 4. 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	April 21, 2021 86 FR 21082

4.1 Climate Change

Factors which affect the ocean, like temperature and pH can have direct and indirect impacts on marine mammals and the resources they depend upon. First, we provide background on the physical effects climate change has caused on a broad scale; then we focus on changes that have occurred in Alaska. Next, we provide an overview of how these physical changes translate to biological effects.

4.1.1 Physical Effects

4.1.1.1 Air Temperature

There is consensus throughout the scientific community that atmospheric temperatures are increasing, and will continue to increase, for at least the next several decades (Watson and Albritton 2001; Oreskes 2004). The Intergovernmental Panel on Climate Change (IPCC) estimated that since the mid-1800s, average global land and sea surface temperature has increased by 0.85°C (±0.2°C), with most of the change occurring since 1976 (IPCC 2019). 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).

Continued emission of greenhouse gases is expected to cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems (IPCC 2019). Data show that 2020 was the second warmest year in the 141-year record, and global land and ocean surface temperatures increased +0.98°C (+1.76°F) over the 20th-century average[3]. The seven warmest years in the 1880–2020 record have all occurred since 2014, and the 10 warmest years have occurred since 2005[3].

The impacts of climate change are especially pronounced at high latitudes. Across Alaska, average air temperatures have been increasing, and the average annual temperature is now 1.65-2.2°C (3-4°F) warmer than during the early and mid-century (Thoman and Walsh 2019). Winter temperatures have increased by 3.3°C (6˚F) (Chapin et al. 2014) and the snow season is shortening (Thoman and Walsh 2019). Although 2020 experienced its coldest year since 2012 in 2020[4], Alaska had its warmest year on record in 2019, with a statewide average temperature of 32.2°F, 6.2°F above the long-term average. This surpassed the previous record of 31.9°F in 2016. The four warmest years on record for Alaska have occurred in the past 7 years[5].

4.1.1.2 Ocean Heat

Higher air temperatures have led to higher ocean temperatures. More than 90% of the excess heat created by global climate change is stored in the world's oceans, causing increases in ocean temperature (IPCC 2019; Cheng et al. 2020). The upper ocean heat content, which measures the amount of heat stored in the upper 2000 m (6,561 ft) of the ocean, was the highest on record in 2019 by a wide margin, and is the warmest in recorded human history (Cheng et al. 2020). The seas surrounding Alaska have been unusually warm in recent years, with unprecedented warmth in some cases (Thoman and Walsh 2019).

A marine heat wave is a coherent area of extreme warm temperature at the sea surface that persists (Frölicher et al. 2018). The largest recorded marine heat wave occurred in the northeast Pacific Ocean from 2013-2015 (Frölicher et al. 2018). It was called "the blob". The blob first

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[3] NOAA National Centers for Environmental Information webpage. Assessing the global climate in 2020. Available from https://www.ncei.noaa.gov/news/global-climate-202012, accessed January 3, 2022.
[4] NOAA National Centers for Environmental Information webpage. Assessing the U.S. Climate in 2020. Available at https://www.ncei.noaa.gov/news/national-climate-202012, accessed January 3, 2022.
[5] NOAA National Centers for Environmental Information webpage. Assessing the U.S. Climate in 2019. Available at https://www.ncei.noaa.gov/news/national-climate-201912, accessed January 3, 2022.

appeared off the coast of Alaska in the winter of 2013-2014 and by the end of 2015 it stretched from Alaska to Baja California. Consequences of this event included an unprecedented harmful algal bloom that extended from the Aleutian Islands to southern California, mass strandings of marine mammals, shifts in the distribution of invertebrates and fish, and shifts in abundance of several fish species (Cavole et al. 2016). The 2018 Pacific cod stock assessment[6] estimated that the female spawning biomass of Pacific cod is at its lowest point in the 41-year time series, following three years of poor recruitment and increased natural mortality as a result of the blob. It is thought that marine mammals in the Gulf of Alaska were also likely impacted by the low prey availability associated with warm ocean temperatures that occurred (Bond et al. 2015; Peterson et al. 2016; Sweeney et al. 2018).

4.1.1.3 Ocean Acidification

For 650,000 years or more, the average global atmospheric carbon dioxide (CO_2) concentration varied between 180 and 300 parts per million (ppm), but since the beginning of the industrial revolution in the late 1700s, atmospheric CO_2 concentrations have been increasing rapidly, primarily due to anthropogenic inputs (Fabry et al. 2008; Lüthi et al. 2008). The world's oceans have absorbed approximately one-third of the anthropogenic CO_2 released, which has buffered the increase in atmospheric CO_2 concentrations (Feely et al. 2004; Feely et al. 2009). Despite the oceans' role as large carbon sinks, the CO_2 level continues to rise and is currently over 415 ppm[7].

As the oceans absorb CO_2, the pH of seawater is reduced. This process is referred to as ocean acidification. Ocean acidification reduces the saturation states of certain biologically important calcium carbonate minerals like aragonite and calcite that many organisms use to form and maintain shells (Bates et al. 2009; Reisdorph and Mathis 2014). When seawater is supersaturated with these minerals, calcification (growth) of shells is favored. Likewise, when the sea water becomes undersaturated, dissolution is favored (Feely et al. 2009).

High latitude (colder) oceans have naturally lower saturation states of calcium carbonate minerals than more temperate or tropical waters, making Alaska's oceans more susceptible to the effects of ocean acidification (Fabry et al. 2009; Jiang et al. 2015). Undersaturated waters are potentially highly corrosive to any calcifying organism, such as corals, bivalves, crustaceans, echinoderms and many forms of zooplankton such as copepods and pteropods (Fabry et al. 2008; Bates et al. 2009). Pteropods, which are often considered indicator species for ecosystem health, are prey for many species of carnivorous zooplankton, fishes including salmon, mackerel, herring, and cod, and baleen whales (Orr et al. 2005). Because of their thin shells and dependence on aragonite, under increasingly acidic conditions, pteropods may not be able to grow and maintain shells (Lischka and Riebesell 2012). It is uncertain if these species, which play a large role in supporting many levels of the Alaskan marine food web, may be able to adapt to changing ocean conditions (Fabry et al. 2008; Lischka and Riebesell 2012)

[6] NOAA Fisheries, Alaska Fisheries Science Center website. Available at https://apps-afsc.fisheries.noaa.gov/REFM/stocks/Historic_Assess.htm, accessed December 2, 2020.
[7] NOAA Global Monitoring Laboratory website. Trends in Atmospheric Carbon Dioxide. Available at https://www.esrl.noaa.gov/gmd/ccgg/trends/, accessed January 3, 2022.

4.1.2 Biological Effects

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 (Hinzman et al. 2005; Burek et al. 2008; Doney et al. 2012; Huntington et al. 2020). The physical effects on the environment described above have impacted, are impacting, and will continue to impact marine species in a variety of ways (IPCC 2014), such as:

- Shifting abundances
- Changes in distribution
- Changes in timing of migration
- Changes in periodic life cycles of species.

Some of the biological consequences of the changing ocean conditions are shown in Table 5.

Table 5. A summary of possible direct and indirect health effects for humpback whales related to climate change, adapted from Burek et al. (2008).

Effect	Result
Direct	
Increase in ocean temperature	Changes in distribution and range (fish, whales) Increase in harmful algal blooms Loss of suitable habitat Change in prey base
Ocean acidification	Changes in prey base
Indirect	
Changes in infectious disease transmission (changes in host–pathogen associations due to altered pathogen transmission or host resistance)	Increased host density due to reduced habitat, increasing density-dependent diseases. Epidemic disease due to host or vector range expansion. Increased survival of pathogens in the environment. Interactions between diseases, loss of body condition, and increased immunosuppressive contaminants, resulting in increased susceptibility to endemic or epidemic disease.
Alterations in the predator–prey relationship	Affect body condition and, potentially, immune function.
Changes in toxicant pathways (harmful algal blooms, variation in long-range transport, biotransport, runoff, increased use of the Arctic)	Mortality events from biotoxins Toxic effects of contaminants on immune function, reproduction, skin, endocrine systems, etc.

Changes in ocean surface temperature may impact species migrations, range, prey abundance, and overall habitat quality. For ESA-listed species that undertake long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperature regimes, the timing of migration can change. For example, cetaceans with restricted distributions linked to cooler water temperatures may be particularly exposed to range restriction (Learmonth et al. 2006; Isaac 2009). Macleod (2009) estimated that, based on expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, 47 percent will be negatively affected, and 21 percent will be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters, and preferences for shelf habitats (Macleod 2009). Other typically subarctic species, such as humpback, minke, and fin whales, appear to be expanding their ranges to include higher latitudes in response to climate change (Brower et al. 2018).

4.2 Status of Listed Species- Humpback whale (*Megaptera novaeangliae*)

This biological opinion examines the status of the listed species that is likely to be adversely affected by the proposed action. For this action, the threatened Mexico DPS humpback whale is the only listed species that we expect to 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. This section also helps to inform the description of the species' current reproduction, numbers, and distribution.

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 biological 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 biological 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. 2021), the humpback whale status review (Bettridge et al. 2015), and an updated report on estimated abundance and migratory destinations for North Pacific humpback whales (Wade 2021). In addition, PSO monitoring reports from the ADOT&PF Tongass Narrows project informed our estimates of the distribution and abundance of humpback whales in the action area (NMFS 2019a).

4.2.1 Population Structure and Conservation Status

The humpback 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 nine are not listed under the ESA (81 FR 62260; September 8, 2016). Three humpback whale DPSs occur in Alaska waters. The Hawaii DPS is not listed, the Mexico DPS is listed as threatened, and the Western North Pacific DPS is listed as endangered. The Mexico DPS humpback whale is the only ESA-listed species that we expect to occur within the action area. Critical habitat was designated on April 21, 2021 (86 FR 21082), but does not include waters of Southeast Alaska or the action area.

4.2.2 Humpback Whales in Southeast Alaska

Wade (2021) estimated abundance of humpback whales within all sampled winter and summer areas in the North Pacific, and estimated migration rates between these areas. The probability of encountering whales from each of the four North Pacific DPSs in various feeding areas is summarized in Table 6 below (NMFS 2021). As shown in Table 6 for Southeast Alaska and Northern British Columbia, only whales from the Mexico and Hawaii DPSs are likely to be present in the action area.

Table 6. Probability of encountering humpback whales from each DPS in the North Pacific Ocean in various feeding areas. Adapted from Wade (2021).

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	91%	9%	0%	0%
Aleutian Is/ Bering/Chukchi	2%	91%	7%	0%
Gulf of Alaska	1%	89%	11%	0%
Southeast Alaska/ Northern BC	0%	98%	2%	0%
Southern BC/WA	0%	69%	25%	6%
OR/CA	0%	0%	58%	42%

[1] Note that in the past iteration of this guidance (Wade et al. 2016), upper confidence intervals were used for endangered DPSs. However, the revised estimates do not have associated coefficients of variation to cite. Therefore, the point estimate is being used for each probability of occurrence.

Relatively high densities of humpback whales occur throughout much of Southeast Alaska and northern British Columbia, particularly during the summer months. The abundance estimate for humpback whales in Southeast Alaska is estimated to be 6,137 (CV= 0.07) whales, which includes whales from the Hawaii DPS (98%) and Mexico DPS (2%) (Wade 2021). Whales from these two DPSs overlap on feeding grounds off Alaska, and are visually indistinguishable unless individuals have been photo-identified on breeding grounds and again on feeding grounds.

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). Given their widespread range and opportunistic foraging strategies, and planned year-round construction activities, Mexico DPS humpback whales are likely to overlap with proposed project activities.

4.2.3 Humpback Whales in the Action Area

No systematic studies have documented humpback whale abundance near Ketchikan, but anecdotal information suggests that this species is present in low numbers year-round in Tongass Narrows, with the highest abundance during summer and fall.

The best information available for humpback whale occurrence in Tongass Narrows is from marine mammal monitoring reports from other construction projects in the area. The City of Ketchikan's Berth II rock pinnacle removal project, which was located approximately 4 kilometers (km) southeast of the proposed project site, reported one humpback whale sighting of one individual during the project (December 2019 through January 2020) (NMFS 2019b). Protected species observers for the Ward Cove cruise ship dock construction project, approximately 5 km northwest of the proposed project site, recorded 28 sightings of humpbacks on eighteen days of in-water work between February and September 2020, with at least one humpback whale recorded every month. A total of 42 individuals were recorded and group sizes ranged from 1 to 6, although most sightings were of individual whales (PSSA 2020). The largest group size of 6 was observed once occasion in May. Humpback whales were sighted on 17 days out of 88 days of monitoring in Tongass Narrows in 2020 and 2021 (ADOT&PF 2020, and 2021 monthly monitoring reports). There were no sightings in January or February, but humpback whales were observed each month from October to December 2020 and May to June 2021. During November 2020, a single known individual (by fluke pattern) was observed repeatedly, accounting for 14 of the 26 sighting events that month (ADOT&PF 2020). The majority of observations by ADOT&PF were of individuals or pairs of whales. During monitoring, humpback whales were observed on average once a week.

The presence of larger group sizes appears to be a rare occurrence; therefore, NMFS determined an average group size of 2 whales (which accounts for a whale cow with a calf) is appropriate. The frequency of observations of humpback whales varies seasonally, with more frequent observations in the spring and summer and fewer in the winter. For this project, NMFS estimated that two groups of two whales, or four whales, may be present in the action area weekly throughout the duration of the project.

4.2.4 Natural History

4.2.4.1 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 (Clapham 1992; Barlow and Clapham 1997). Gestation is about 12 months, and calves probably are weaned by the end of their first year (Perry et al. 1999).

4.2.4.2 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).

4.2.4.3 Diving and social behavior

In Hawaiian waters, humpback whales remain almost exclusively within the 1,800 m isobath and usually within water depths less than 182 m. Maximum diving depths are approximately 170 m but usually less than 60 m (Hamilton et al. 1997). Humpback whales observed feeding on Stellwagen Bank dove less than 40 m (Hain et al. 1995). Because most humpback prey is likely found above 300 m depths most humpback dives are probably relatively shallow. Hamilton et al. (1997) tracked one whale near Bermuda possibly diving and feeding to 240 m depth. The deepest dives in Southeast Alaska were recorded to 148 m (Dolphin 1987a).

Humpback whales may remain submerged during a dive for up to 21 min (Dolphin 1987a). 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 (Dolphin 1987a).

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).

4.2.4.4 Vocalization and hearing

Humpback whales are considered low frequency cetaceans with an applied frequency range anticipated to be between 7 Hz to 35 kHz (NMFS 2018). 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 a variety of vocalizations ranging from 20 Hz to 10 kHz (Winn et al. 1970; Tyack and Whitehead 1983; Payne and Payne 1985; Silber 1986; Thompson et al. 1986; Richardson et al. 1995; Au 2000; Frazer and Mercado 2000; Erbe 2002; Au et al. 2006; Vu et al. 2012).

During the breeding season males sing long, complex songs, with frequencies in the 20-5000 Hz range and intensities as high as 181 dB (Payne 1970; Winn et al. 1970; Thompson et al. 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson et al. 1979). The songs appear to have an effective range of approximately 10 to 20 km. Whales in mating groups produce a variety of sounds (Tyack 1981).

Social sounds in breeding areas associated with aggressive behavior in male humpback whales are very different than songs and extend from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz (Tyack and Whitehead 1983; Silber 1986). These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983).

Humpback whales produce sounds less frequently in their summer feeding areas. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 seconds and source levels of 175-192 dB (Thompson et al. 1986). These sounds are attractive and appear to rally whales to the feeding activity (D'Vincent et al. 1985; Sharpe and Dill 1997).

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

4.2.5 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 (SARs) do not correspond 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 (Muto et al. 2021).

4.2.5.1 Commercial whaling

Historically, commercial whaling represented the greatest threat to every population of humpback whale and was ultimately responsible for listing the humpback whale as an endangered species. From 1900 to 1965, nearly 30,000 whales were killed in whaling operations in the Pacific Ocean. Prior to that, an unknown number of humpback whales were hunted and killed (Perry et al. 1999). Humpback whales in the North Pacific were protected in 1965 by a ban on commercial whaling put into place by the International Whaling Commission (IWC). However, illegal catches by the USSR continued into the 1970s (Muto et al. 2021). This, among other factors, prompted the IWC to impose a global moratorium on all commercial whaling beginning in 1986.

4.2.5.2 Predation

Humpback whales are killed by orcas (Whitehead and Glass 1985; Dolphin 1987b; Florezgonzalez et al. 1994; Naessig and Lanyon 2004), 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).

4.2.5.3 Toxins and parasites

Toxic algae blooms are a potential stressor for humpback whales. 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%) (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).

4.2.5.4 Subsistence harvest

Subsistence harvest of humpback whales is prohibited under the Whaling Convention Act and there were no reported takes of humpback whales from the Central North Pacific stock by subsistence hunters in Alaska for the 2014–2018 period (Muto et al. 2021).

4.2.5.5 Unusual Mortality Event (UME)

NMFS declared a UME for large whales in the western Gulf of Alaska; it occurred between May 22 and December 31, 2015, and included 22 humpback and 12 fin whale mortalities[8]. 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.

4.2.5.6 Fishery interactions and entanglements

Humpback whales are occasionally entangled during interactions with commercial, recreational, and subsistence fishing gear, marine debris, vessel ground tackle, and other anchored lines (Muto et al. 2021). Mortalities and serious injuries attributed to specific fisheries and gear types are summarized in Tables 1 and 2 of the assessment for the Central North Pacific stock of humpback whales in Muto et al. (2021). A photographic study of humpback whales in Southeast Alaska in 2003 and 2004 found at least 53% of individuals showed some kind of scarring from entanglement (Neilson et al. 2005).

Aquaculture operations may pose an entanglement risk to humpback whales (Price et al. 2017). Humpback whales in Southeast Alaska have been observed feeding around and near salmon aquaculture 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.

Fisheries research, including stock assessment surveys, use gear types similar to those used in commercial fisheries. In 2021, a take of a humpback whale occurred during an International Pacific Halibut Commission longline survey.

4.2.5.7 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 will continue into the future. The potential for ship strikes may increase as vessel traffic in northern latitudes increases with changes in sea-ice coverage (Muto et al. 2021).

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

4.2.5.8 Other stressors

Elevated levels of sound from anthropogenic sources (e.g., shipping, military sonar) are a

[8] 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.

potential concern for humpback whales in the North Pacific (Muto et al. 2021). A humpback was reported entangled in a research wave rider buoy off the U.S. West Coast in 2014 (Carretta et al. 2020). 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. 2021).

5 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR § 402.02).

Focusing on the impacts of activities specifically within the action area allows us to assess the prior experience and condition of the animals that will be exposed to effects from the actions under consultation. This focus is important because individuals of ESA-listed species may commonly exhibit, or be more susceptible to, adverse responses to stressors in some life history states, stages, or areas within their distributions than in others. These localized stress responses or baseline stress conditions may increase the severity of the adverse effects expected from proposed actions.

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 Recent Biological Opinions for Projects in the Action Area

NMFS has issued a number of biological opinions and letters of concurrence for construction projects in Tongass Narrows in recent years including:

- Ketchikan Berth IV Dock Upgrades (PCTS #AKR-2018-9764), Ketchikan Dock Company, July 2018.
- Tongass Narrows (Gravina Access) Project (ECO # AKRO-2019-03432), Alaska Department of Transportation and Public Facilities, December 2019.
- Berth II Rock Pinnacle Removal Project, (ECO # AKRO-2019-00553), City of Ketchikan, July 2019.
- Ward Cove Cruise Ship Dock Letter of Concurrence, (ECO # AKRO-2019-03664), Power Systems and Supplies of Alaska (PSSA), January 2020.
- City of Ketchikan Berth III Mooring Dolphins, (ECO #AKRO-2020-02183), City of Ketchikan, February 2021.

These biological opinions are available on the NMFS Alaska Region website at: https://www.fisheries.noaa.gov/alaska/consultations/section-7-biological-opinions-issued-alaska-region.

5.2 Marine Vessel Activity

The action area normally experiences high levels of marine vessel traffic with highest volumes occurring May through September. Marine vessels that use the action area include cruise ships, passenger ferries, commercial freight vessels/barges, commercial tank barges, U.S. Coast Guard vessels, commercial fishing boats, charter vessels, recreational vessels, kayaks, and floatplanes[9].

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. Forty-six ships were expected to visit Ketchikan in 2019 with a total of 576 stops and more than 1.14 million passengers. This was an increase from 40 ships with 504 stops and 1.07 million passengers in 2018[10]. Owing to the COVID-19 pandemic, tourism and cruise ship traffic were practically non-existent in 2020 and greatly reduced in 2021 and it is uncertain how long it may take for tourism cruise ship traffic to return to pre-COVID levels in Alaska. Despite this temporary setback in the tourism and cruise industries, the length of the cruise ship season, size of ships, numbers of ships, numbers of stops, and numbers of passengers are all expected to increase in the future.

Two 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, making up to 60 crossings of the channel each day. These vessels, the M/V *Ken Eichner 2* and the M/V *Oral Freeman,* are each 116 ft (35.4 m) long and are powered by twin diesel 850 hp motors. The airport ferries can carry up to 20 vehicles and 50–100 passengers at a time. Each crossing takes approximately 3.5 minutes at speeds averaging 5 kt and not exceeding 9 kt.[11]

The Alaska Marine Highway also operates ferries year-round in Ketchikan. Ketchikan receives ferry service seven days per week in the summer, and typically five to six days per week in the winter.[12]

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

[9] U.S. Coast Guard (USCG). Tongass Narrows Voluntary Waterway Guide. Available at http://seapa.com/waterway/TNVWG.pdf, accessed December 2021.
[10] Ketchikan Visitors Bureau Visitor Statistics. Available https://www.visit-ketchikan.com/en/Membership/Visitor-Statistics, accessed December 2021 and not updated with 2021 statistics.
[11] Ketchikan Gateway Borough website (available at https://www.borough.ketchikan.ak.us/147/Airport-Ferry, accessed December 2021), and personal communication with Mike Carney, General Manager of Ketchikan International Airport (Dec. 2018).
[12] Alaska Marine Highway website. Available at https://www.dot.state.ak.us/amhs/, accessed December 2021.

ships, tugs, and ferries dominated the north-south traffic (Nuka Research and Planning Group 2012).

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].

All of these sources of vessel traffic increase underwater noise and contribute to the risk of vessel-whale collisions.

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 (15 m) long
- Most fatal vessel 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

The NMFS Alaska Marine Mammal Stranding Network database has records of 96 confirmed vessel strikes involving large whales between 2005 and 2019, 60% occurred within Southeast Alaska and 58 involved humpback whales, but none were reported within or near the action area.

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)). See Section 2.2.8 *Strike Avoidance* for additional information. In addition to the approach regulations discussed above, some whale watching companies in the Ketchikan area 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. More information is available at https://www.fisheries.noaa.gov/resource/tool-app/whale-alert.

5.3 Fishery Interactions Including Entanglements

Entanglement of marine mammals 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

[13] City of Ketchikan, Port and Harbors. Available at https://www.ktn-ak.us/port-harbors, accessed December 2021.

foraging, reduced fitness, and increased energy expenditure (van der Hoop et al. 2016).

The NMFS Alaska Marine Mammal Stranding Network database has records of 224 large whale entanglements between 2000 and 2020.[14] Of these, 64 percent were humpback whales from Southeast Alaska. Most of these whales were entangled with gear between the beginning of June and the beginning of September, when they were on their nearshore foraging grounds in Alaska waters. Between 2000 and 2020, 20 percent of humpback entanglements in Southeast Alaska were with pot gear, 30 percent with gillnet gear, and less than 1 percent were associated with longline gear. Humpback whales have been reported as entangled in the action area or near the action area in recent years, including two near Ketchikan in 2011 and one near Gravina Island in 2019.

The minimum mean annual mortality and serious injury rate due to interactions with all fisheries in 2014-2018 is 19 Central North Pacific humpback whales (9.8 in commercial fisheries + 0.6 in recreational fisheries + 0.4 in subsistence fisheries + 7.9 in unknown fisheries).

Commercial fisheries may indirectly affect whales by reducing the amount of available prey or affecting prey species composition.

5.4 Pollution

A number of contaminant discharges into marine waters have been reported within the action area including domestic, municipal, and industrial wastewater discharges such as graywater from cruise ships. A number of historically contaminated sites are associated with underground storage tanks (UST). Many of these UST cleanup sites are listed as complete on the Alaska Department of Environmental Conservation's (ADEC) Contaminated Sites Database[15]. Five active contaminated sites within the project vicinity are in proximity to the shoreline of Revillagigedo and Gravina Island. The ADEC Spills Database records of 1,214 spills since 1995 that have occurred in Tongass Narrows, 56 of which occurred between 2018 and March 2020. Spills generally consisted of hydraulic oil, diesel, aviation fuel, gasoline, and engine lube/gear oil. Spills over the last 3 years were generally less than 1 gallon, but up to 250 gallons (PND Engineers 2020).

5.5 Climate Change

As discussed in Section 4.1, there is widespread consensus within the scientific community that atmospheric temperatures on earth are increasing. Recent studies and observations have shown changes in distribution (Brower et al. 2018), body condition (Neilson and Gabriele 2020), and migratory patterns[16] of humpback whales, likely in response to climate change. 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.

[14] NMFS Alaska Marine Mammal Stranding Network database, accessed November 5, 2020.
[15] ADEC website, accessed December 2021, available at https://dec.alaska.gov/spar/csp/
[16] Dr. Suzie Teerlink, National Marine Fisheries Service, Alaska Region, personal communication, February 9, 2021.

5.6 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. There is moderate shoreline development on nearby Pennock and Gravina islands. The majority of the City of Ketchikan is located on Revillagigedo Island. Marine facilities include fish processing plants, small boat harbors, cruise ship and ferry terminals, float plane docks, a dry dock, shipyard, and other infrastructure. Ketchikan International Airport is located on Gravina Island.

5.7 In-Water Noise

Ambient underwater noise levels in Tongass Narrows range from 120-130 dB and fluctuate temporally, with levels at the highest during summer months (HDR 2018). Main sources of underwater background sounds originate from man-made sources such as coastal construction, seafood processing facilities, aircraft, upland vehicle traffic and vessels including recreational vessels, passenger ferries, commercial freight vessels/barges, cruise ships, charter vessels and commercial fishing vessels. Natural sounds consist of marine mammal and fish sounds and surface-generated wind and waves.

Because responses to anthropogenic noise vary among species and individuals within species, it is difficult to determine long-term effects to humpback whales in the action area. Habitat abandonment due to anthropogenic noise exposure has been found in terrestrial species (Francis and Barber 2013). Clark et al. (2009) identified increasing levels of anthropogenic noise as a habitat concern for whales because of its potential effect on their ability to communicate (i.e., masking). Some research (Parks 2003; McDonald et al. 2006; Parks 2009) suggests marine mammals compensate for masking by changing the frequency, source level, redundancy, and timing of their calls. However, the long-term implications of these adjustments, if any, are currently unknown.

6 Effects of the Action

"Effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR §402.02).

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.

NMFS identified and addressed all potential stressors; and considered all consequences of the proposed action, individually and cumulatively, in developing the analysis and conclusions in this opinion regarding the effects of the proposed action on ESA-listed species and designated critical habitat.

6.1 Project Stressors

Stressors are any physical, chemical, or biological phenomena that can induce an adverse response. This section identifies the stressors that may be produced by the proposed action. Based on our review of the IHA application and BA (AECOM 2021), personal communications, and available literature as referenced in this biological opinion, our analysis recognizes that the proposed action may cause these primary stressors:

- Underwater noise produced by impulsive and non-impulsive noise sources related to pile driving activities including vibratory pile removal, impact pile driving, pile cutting/clipping, and down-the-hole drilling;
- Injury or disturbance due to vessel traffic or vessel noise;
- Disturbance to seafloor, marine mammal habitat, and marine mammal prey; and
- Pollution from unauthorized spills.

6.2 Stressors Not Likely to Adversely Affect ESA-listed Humpback Whales

Based on a review of available information, we determined the following stressors are either unlikely to occur or likely to have minimal impacts on Mexico DPS humpback whales.

6.2.1 Vessel strike

The types of vessels to be employed during the construction phase of this project are described in Section 2.1 and include tugs, barges, and work skiffs. Upon completion of construction, the R/V *Fairweather* will be homeported at the Ketchikan facility. Other vessels may occasionally also use the newly recapitalized facility. Vessel strike associated with the proposed action is extremely unlikely.

Tug towing operations for construction occur at relatively low speeds (5 knots), and the maximum transit speed for tugs and barges is expected to be 7 knots. Tugs transporting supplies from Seattle to the project area will travel at slow speeds and follow established shipping routes. Once barges are towed to the construction site, they will be anchored, limiting risk of strike. Skiffs may transport workers very short distances and at low speeds from shore to the work platform.

Between 2014 and 2018 the minimum mean annual mortality and serious injury rate due to ship strikes reported in Alaska for humpback whales was 2.6 whales (Muto et al. 2021). These incidents account for a very small fraction of the total humpback whale population (Laist et al. 2001). Of the reported vessel strikes of humpback whales in the Ketchikan vicinity between 2007 and 2017, 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.

Most ship strikes of large whales occur when vessels are traveling at speeds of 10 knots or more (Laist et al. 2001; Jensen and Silber 2004). Vessels are required to travel at speeds averaging less than 7 knots when entering Tongass Narrows, and slower when approaching docks and harbors. Therefore, it is unlikely that NOAA research vessels will collide with a humpback whale in waters near the port facility as they approach or depart. Thus, we do not expect an increased risk of vessel strike from NOAA research vessels as a result of the action.

Vessel disturbance or strikes of Mexico DPS humpback whales are not expected as a result of the proposed action because 1) vessel traffic associated with the project is minimal; 2) relatively few humpback whales use Tongass Narrows; 3) only 2 percent of humpback whales that occur in the area are from the listed Mexico DPS; 4) all vessels, including vessels used in construction of the NOAA OMAO port facility and the R/V *Fairweather* that will be homeported there, are limited to a speed of 7 knots or less in Tongass Narrows; and 5) vessels must 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)) that prohibit approaching within 100 yards of humpback whales. All of these factors limit the risk of strike; therefore, we conclude that vessel strike is extremely unlikely to occur.

6.2.2 Vessel noise

Tongass Narrows near Ketchikan is a busy industrial port with median background noise levels measured at 117.1 dB re 1 µPa (Warner and Austin 2016), and much of that noise is from vessels. Vessel noise transmitted through water is a continuous (non-impulsive) noise source. Broadband source levels for tugs and barges have been measured at 145 to 170 dB re 1 µPa, and 151 to 152 dB re 1µPa for small vessels with outboard motors (Richardson et al. 1995). Sound from vessels within this size range would reach the 120 dB threshold at distances between 86 and 233 m (282 and 764 feet) from the source (Richardson et al. 1995).

Vessel noise associated with this action will be minimal because most work will be conducted from anchored barges and work platforms. Workers will be transported to and from these platforms by skiffs traveling only short distances from shore and at slow speeds. Up to three barges will be moved into place by tugs traveling short distances from shore at slow speeds.

Homeporting the R/V *Fairweather* in Alaska may incrementally increase vessel noise in the already-noisy Tongass Narrows, but would reduce ocean noise overall because the vessel will have to travel much shorter distances to reach its mission support area in Alaska.

NMFS anticipates minimal low-level exposure of short-term duration to listed humpback whales from vessel noise related to this action. If whales are exposed and do respond, they may exhibit slight deflection from the noise source and 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 whales. 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 them. The few vessels involved in the construction portion of the action will travel only short distances at slow speeds. Additionally, the infrequent occurrence of humpback whales in the action area, adherence to the mitigation measures, and vessels following the Alaska Humpback Whale Approach Regulations and Marine Mammal Code of Conduct should minimize close approaches and exposure to noise from vessels related to this action. The impact of vessel noise on Mexico DPS humpback whales is therefore determined to be minimal.

6.2.3 Disturbance to seafloor, habitat, and prey resources

The proposed action will have temporary impacts on water quality (increases in turbidity levels) and on prey species distribution. Pile driving may cause temporary and localized turbidity through sediment disturbance. Turbidity plumes during pile installation and removal will be localized around the pile. Due to temporary, localized, and low levels of turbidity increases, it is not anticipated that turbidity would result in immediate or long-term effects to the Mexico DPS humpback whale or their prey.

Construction activities would produce non-impulsive (i.e., vibratory pile removal and DTH) and impulsive (i.e., impact driving and DTH) 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 related to large, multiyear bridge construction projects (e.g., Scholik and Yan 2001; Scholik and Yan 2002; Popper and Hastings 2009). 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 ceases 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 given the small area of pile driving within the action area relative to known feeding areas for humpback whales. In general, we expect fish will be capable of moving away from project activities to avoid exposure to noise. We expect the area in which stress, injury, TTS, or changes in balance of prey species may occur will be limited to a few meters directly around the pile driving and drilling operations. We consider potential adverse impacts to prey resources from pile-driving and drilling in the action area to be immeasurably small.

Studies on euphausiids and copepods, two of the more abundant and biologically important groups of zooplankton, have documented some sensitivity of zooplankton to sound (Chu et al. 1996; Wiese 1996); 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. While previous studies concluded that crustaceans (such as zooplankton) are not particularly sensitive to sound produced by even louder impulsive sounds such as seismic operations (Wiese 1996), a recent study provides evidence that seismic surveys may cause significant mortality (McCauley et al. 2017). However, seismic surveys are significantly louder and lower frequency than the sound sources associated with this project and are not directly comparable.

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.

Construction activities will temporarily increase in-water noise and may adversely affect prey in the action area. The timing of in-water construction, with a no-work window between March 15–June 15, 2022, has been planned to avoid major spawning and migration times (NMFS 2022). Adverse effects on prey species populations during project construction will be short-term, based on the short duration of the project. After pile driving activities are completed, habitat use and function are expected to return to similar pre-construction levels and fish are expected to repopulate the area.

NOAA OMAO has adopted a number of conservation measures to improve essential fish habitat in the project area including avoiding pile driving during the no-work window, reducing shading by over-water structures, surveying for submerged aquatic vegetation, and removing old timber piles treated with creosote that degrade water quality (NMFS 2022).

Given the numbers of fish and other prey species in the vicinity, the short-term nature of effects on fish species, and the mitigation measures to protect fish and marine mammals during construction, the proposed action is not expected to have measurable effects on the distribution or abundance of potential marine mammal prey species. Any behavioral avoidance by fish of the disturbed area would still leave sufficiently large areas of fish and marine mammal foraging habitat outside Tongass Narrows.

The surrounding area is heavily trafficked by large and small ships and is not a significant foraging ground for humpback whales. There are no known aggregations of forage fish important to humpback whales in the project vicinity that will be impacted by the action. Implementation of the mitigation measures described in Section 2.2 of this opinion and the EFH conservation recommendations from NMFS Habitat Conservation Division (NMFS 2022) will avoid or minimize effects to prey resources. In summary, the effects of disturbance to the seafloor, habitat, and prey resources resulting from the NOAA OMAO port recapitalization project activities are expected to have a negligible impact on Mexico DPS humpback whales.

6.2.4 Introduction of pollutants into waters

Measures to prevent spills of oil and other pollutants as described in Section 2.2 of this opinion will be implemented during construction. Plans will be in place and materials available for spill prevention and cleanup activities at the marine terminal to limit potential contamination. Construction will be conducted in accordance with Clean Water Act Section 404 and 401 regulations to minimize potential construction-related impacts on water quality, and any effects to Mexico DPS humpback whales would be immeasurably small. Therefore, we conclude that the effects from this stressor are negligible.

6.2.5 Summary of Stressors Not Likely to Adversely Affect ESA-listed Species

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

We determined vessel noise associated with the action is not likely to have measurable impact; therefore, we consider the effects to Mexico DPS humpback whales to be negligible.

We determined disturbance to seafloor, habitat, and prey resources, and introduction of pollutants are not likely to have measurable impact; therefore, we consider the effects to Mexico DPS humpback whales to be negligible.

Although these stressors are not likely to adversely affect listed species, the effects of these stressors are considered and addressed in the *Integration and Synthesis* portion of the opinion.

6.3 Stressors Likely to Adversely Affect ESA-listed Humpback Whales

Underwater noise from pile driving activities is likely to adversely affect Mexico DPS humpback whales. This stressor will be analyzed further in the *Exposure Analysis* and *Response Analysis.*

6.3.1 Description of sound sources

The marine soundscape is comprised of both ambient (naturally-produced) and anthropogenic sounds. The sound level of an area is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (e.g., waves, wind, precipitation, earthquakes, ice, atmospheric sound), biological (e.g., sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (e.g., vessels, dredging, aircraft, construction).

Natural sound sources at any given location and time comprise “ambient” sound, while the sum of ambient sounds and typical anthropogenic sound comprises the “background” sound. Received levels of ambient and background sound depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Ambient sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson et al. 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could adversely affect marine mammals.

In-water construction activities associated with the project include vibratory pile removal, pile clipping or cutting, impact pile driving, and DTH pile installation. The sounds produced by these activities fall into one of two general sound types: impulsive and non-impulsive. Impulsive sounds (e.g., explosions, gunshots, sonic booms, impact pile driving) are typically transient, brief (less than one second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI (American National Standards Institute) 1986; NIOSH (National Institute for Occupational Safety and Health) 1998; ANSI (American National Standards Institute) 2005; NMFS 2018). Non-impulsive sounds (e.g., aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems) can be broadband, narrowband or tonal, brief or prolonged (non-impulsive or intermittent), and typically do not have the high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI 1995; NIOSH (National Institute for Occupational Safety and Health) 1998; NMFS 2018). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (e.g., Ward 1997 in Southall et al. 2007).

Impact hammers operate by repeatedly dropping a heavy piston onto a pile to drive the pile into the substrate. Sound generated by impact hammers is characterized by rapid rise times and high peak levels, a potentially injurious combination (Hastings and Popper 2005). Vibratory hammers install piles by vibrating them and allowing the weight of the hammer to push them into the sediment. Vibratory hammers produce significantly less sound than impact hammers. Peak sound pressure levels (SPLs) may be 180 dB or greater, but are generally 10 to 20 dB lower than SPLs generated during impact pile driving of the same-sized pile (Oestman et al. 2009). Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (Nedwell and Edwards 2002; Carlson et al. 2005).

A DTH hammer drill is used to place hollow steel piles or casings by drilling. A DTH hammer drill is a drill bit that drills through the bedrock using a pulse mechanism that functions at the bottom of the hole. This pulsing bit breaks up rock to allow removal of debris and insertion of the pile. The head extends so that the drilling takes place below the pile. The pulsing sounds produced by DTH hammer drills were previously thought to be non-impulsive. However, recent sound source verification (SSV) monitoring has shown that DTH hammer drill can create sound that can be considered impulsive (Denes et al. 2019). Therefore, NMFS characterizes sound from DTH pile installation as being impulsive when evaluating potential Level A harassment (i.e., injury) impacts and as being non-impulsive when assessing potential Level B harassment (i.e., behavior) effects.

The likely or possible impacts of OMAO's proposed activity on marine mammals could involve both non-acoustic and acoustic stressors. As discussed above in Section 6.2, *Stressors Not Likely to Adversely Affect ESA-listed Species*, potential non-acoustic stressors could result from the physical presence of the equipment and personnel; however, any impacts to marine mammals are expected to primarily be acoustic in nature. Acoustic stressors include effects of heavy equipment operation during pile installation and removal.

6.3.2 Acoustic thresholds

OMAO intends to conduct construction activities that would introduce underwater noise into the marine environment that may result in disturbance to listed species.

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, 1872). NMFS recently developed comprehensive guidance on sound levels likely to cause injury to marine mammals through onset of permanent threshold shifts (PTS: Level A harassment) and temporary threshold shifts (TTS; Level B 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[17], expressed in root mean square[18] (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}
- non-impulsive sound: 120 dB re 1μPa_{rms}

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 2018). 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 7):

Table 7. Summary of PTS onset acoustic thresholds for Level A harassment (NMFS 2018).

Hearing Group	PTS Onset Thresholds* (Received Level)	
	Impulsive	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*Lp,*0-pk,flat: 219 dB *L*E,*p,* LF,24h: 183 dB	*L*E,*p*, LF,24h: 199 dB
Mid-Frequency (MF) Cetaceans	*Lp,*0-pk,flat: 230 dB *L*E,*p,* MF,24h: 185 dB	*L*E,*p*, MF,24h: 198 dB
High-Frequency (HF) Cetaceans	*Lp,*0-pk,flat: 202 dB *L*E,*p*,HF,24h: 155 dB	*L*E,*p,* HF,24h: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Lp,*0-pk.flat: 218 dB *L*E,*p*,PW,24h: 185 dB	*L*E,*p,*PW,24h: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Lp,*0-pk,flat: 232 dB *L*E,*p*,OW,24h: 203 dB	*L*E,*p,*OW,24h: 219 dB

* Dual metric 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 are recommended for consideration.

Note: Peak sound pressure level (*Lp,*0-pk) has a reference value of 1 μPa, and weighted cumulative sound exposure level (*L*E,*p*) has a reference value of 1$\mu Pa^2 s$. In this Table, thresholds are abbreviated to be more reflective of International Organization for Standardization standards (ISO 2017). The subscript "flat" is being included to indicate peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kHz). 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 weighted 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 thresholds will be exceeded.

[17] 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.

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

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 issued guidance interpreting the term "harass" under the ESA as 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 (see Section 10).

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) and potential injury. With the addition of mitigation measures (including shutdown zones), no mortalities or permanent impairment to hearing are anticipated.

6.4 Exposure Analysis

As discussed in the *Approach to the Assessment* section of this biological opinion, exposure analyses are designed to identify the listed species 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 estimate the number of individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent.

As discussed in Section 2.2 above, OMAO proposed mitigation measures that should avoid or minimize exposure of Mexico DPS humpback whales to stressors from the proposed action.

NMFS expects that humpback whales will be exposed to underwater noise from pile driving activities (including vibratory pile removal, pile clipping, impact pile driving, and DTH). Possible responses by Mexico DPS humpback whales to the sound produced by pile driving activities include:

- Physical Responses
  - Temporary or permanent hearing impairment (threshold shifts)
  - Non-auditory physiological effects
- Behavioral responses

6.4.1 Ensonified area

This section describes the operational and environmental parameters of each construction activity that allow NMFS to estimate the area ensonified above the acoustic thresholds, based on only a single construction activity occurring at a time, as proposed by OMAO.

The sound field in the action area is the existing background noise plus additional construction noise from the proposed project. Marine mammals may be affected via sound generated by the primary components of the project (i.e., vibratory pile removal, pile clipping, impact pile driving, and DTH pile installation). NMFS used acoustic monitoring data from other locations to develop the source levels used to calculate distances to the Level A and Level B thresholds for different sizes of piles and installation/removal methods. The values used and the source from which they were derived are summarized in Table 8 and described in detail below.

NMFS developed a spreadsheet tool[19] to help implement the 2018 Technical Guidance (NMFS 2018) that incorporates the duration of an activity into the estimation of a distance to the Level A isopleth. This estimation can then be used in conjunction with marine mammal density or occurrence to help predict takes. NMFS notes that because of some of the assumptions included in the methods used for these tools, the isopleths estimated may be overestimates, and the resulting estimate of Level A take almost certainly overestimates the number of whales that actually experience PTS if they should cross the Level A isopleth for fairly brief amounts of time. However, these tools offer the best available way to conservatively predict appropriate isopleths until more sophisticated modeling methods are widely available. NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For stationary sources such as impact driving, vibratory driving, and DTH pile installation, the NMFS User Spreadsheet predicts the distance at which a marine mammal would incur PTS if it remained at that distance for the duration of the activity.

Inputs used in the User Spreadsheet are shown in Table 8, and the resulting Level A isopleths are shown in Table 9. Level A harassment thresholds for impulsive sound sources (impact pile driving, DTH pile installation) are defined for both cumulative sound exposure levels (SELcum) and peak sound pressure level (SPL_{PK}), with the threshold that results in the largest modeled isopleth for each marine mammal hearing group used to establish the Level A harassment isopleth.

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 (Southall et al. 2007; Ellison et al. 2012). Based on the available science and the practical need to use a threshold 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 non-impulsive sources (e.g., vibratory pile-driving) and above 160 dB re 1 μPa rms for non-explosive impulsive (e.g., impact pile-driving) or intermittent sources.

OMAO's proposed construction activity for the Ketchikan Port Facility includes the use of non-

[19] NMFS User Spreadsheet Tool, version 2.2 (updated December 2020), available at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance, accessed January 21, 2021.

impulsive and impulsive sources, and therefore the 120 and 160 dB re 1 μPa rms thresholds for Level B behavioral harassment are applicable.

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 (R1/R2), where

TL = transmission loss in dB

B = transmission loss coefficient; for practical spreading equals 15

R1 = the distance of the modeled SPL from the driven pile, and

R2 = the distance from the driven pile of the initial measurement

When site-specific transmission loss measurements are not available, the recommended TL coefficient for most nearshore environments is the default practical spreading value of 15. This value results in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions, which is the most appropriate assumption for OMAO's proposed activity.

Using the practical spreading model, OMAO determined underwater noise would fall below the Level B threshold of 120 dB rms for marine mammals at a maximum radial distance of 11,659 m for DTH of 24-inch piles. This distance determines the maximum Level B harassment zone for the project. Other activities, including pile removal and impact pile driving, have smaller Level B harassment zones. All Level B harassment isopleths are reported in Table 9 below. It should be noted that based on the geography of Tongass Narrows and the surrounding islands, sound will not reach the full distance of the Level B harassment isopleth, but will be constrained by land masses including Revillagigedo, Gravina, Pennock, and Spire islands.

Table 8. User Spreadsheet (version 2.2)[20] input parameters for pile driving activities for calculating Level A and Level B isopleths. All calculations use a transmission loss value of 15.

Method	Pile Type	Spreadsheet Tab	Weighting Factor Adjustment	Number of Piles	Duration	Piles per Day	Estimated Sound Source Level at 10 m (dB)	Reference
DTH	24-inch Steel	E.2	2	18	25,000 strikes @ 25 strikes/sec. for 1,000 sec.	1.5	154 SELss (impulsive, Level A) 166 dB RMS (non-impulsive, Level B)	Reyff & Heyvaert (2019) Denes et al. (2016)
Impact installation[2]	24-inch Steel	E.1	2	18	48 strikes	1.5	209.8 Pk, 182.1 SEL, 196.2 RMS	Table 72 in Denes et al. (2016) 90th percentile
Vibratory removal	14-inch Timber	A.1	2.5	130	2 min	10	153 RMS	WSDOT (2011)
Vibratory removal	14-24 inch steel	A.1	2.5	28	5 min	5	155.5 RMS	Denes et al. (2016)
Small Pile Clipper	14-16 inch Steel	A.1	2.5	28	10 min	10	154 RMS	NAVFAC SW (2020)
Large Pile Clipper	18-24 inch Steel	A.1	2.5	42	10 min	10	161 RMS	NAVFAC SW (2020)

[20] User spreadsheet tool (version 2.2) and instruction manual available at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance, accessed January 26, 2021.

DTH pile installation includes drilling (non-impulsive sound) and hammering (impulsive sound) to penetrate rocky substrates (Denes et al. 2016; Denes et al. 2019; Reyff and Heyvaert 2019). DTH pile installation was initially thought be a non-impulsive noise source. However, Denes et al. (2019) concluded from their study at Thimble Shoal, VA, that DTH should be characterized as impulsive based on a >3 dB difference in sound pressure level in a 0.035-second window (Southall et al. 2007) compared to a 1-second window. Therefore, DTH pile installation is treated as both an impulsive and non-impulsive noise source. In order to evaluate Level A harassment, DTH pile installation activities are evaluated according to the impulsive criteria using the "User Spreadsheet" calculator. For this project, sound level estimates for impact installation of 42-inch piles in Skagway, Alaska, were used to calculate the impulsive component (Level A isopleth) (Reyff and Heyvaert 2019). Level B harassment isopleths are determined by applying non-impulsive criteria and using the 120 dB threshold which is also used for vibratory driving. Non-impulsive sound level measurements of DTH of 30-inch piles in Kodiak, Alaska, were used to estimate the non-impulsive component (Level B isopleth) (Denes et al. 2016)

The 90th percentile values for impact pile driving of 30-inch steel piles in Ketchikan, Alaska, from Denes et al. (2016) were used as a conservative estimate of sound levels for impact installation of 24-inch steel piles.

WSDOT (2011) measured vibratory extraction of 12-inch diameter timber piles in Port Townsend, Washington at 153 dB RMS @ 10 m (Table 8) yielding distances of 1,585 m to the Level B isopleth and 1 m to the Level A isopleth (Table 9). WSDOT (2011) was used as a proxy for vibratory extraction of 14-inch diameter timber piles for this project. OMAO has agreed to implement a conservative monitoring zone of 2,930 m and shutdown zone of 10 m (Table 2) for this activity to account for the larger 14-inch timber piles to be used in this project.

Denes et al. (2016) recorded a mean value of 155.5 dB RMS @ 10 m for vibratory installation of 24-inch diameter steel piles into pre-drilled holes in Kodiak, AK (Table 8), yielding distances of 2,326 m to the Level B isopleth and 1.6 m to the Level A isopleth (Table 9). Estimates of sound levels produced by vibratory pile installation are often used as proxies for vibratory pile removal. Because all steel piles to be removed by OMAO are 24-inches or smaller in diameter, Denes et al. (2016) was determined to be a reasonable proxy for this activity for this project. For vibratory removal of steel piles 14-16 inches in diameter, OMAO has agreed to implement monitoring and shutdown zones of 2,930 m and 10 m, respectively (Table 2). For larger pile sizes, OMAO has agreed implement even more conservative monitoring and shutdown zones of 5,420 m and 10 m, respectively (Table 2).

If remnant piles cannot be directly pulled or extracted using a vibratory hammer, they will be cut off near the substrate using either pile clippers or a hydraulic saw. Because pile clippers are louder than a hydraulic saw, and it is uncertain which method will be employed to cut the piles, we used estimated sound levels for pile clippers to estimate the most precautionary source level for this activity. The U.S. Navy measured the noise produced by small and large pile clippers for polycarbonate and concrete piles and found that the size of pile clipper affected the source level more than the material being clipped. The largest reported mean of maximum sound level for clipping piles of different sizes and materials with small or large pile clippers were rounded up to estimate noise produced by this activity (NAVFAC SW 2020). We expect that small pile clippers may be used to cut 14- and 16- inch steel piles, and large pile clippers may be used for larger pile sizes; however, it is possible that small pile clippers may be used for larger pile sizes.

OMAO intends to conduct acoustic monitoring and sound source verification for all pile driving activities. Monitoring zones will be adjusted as necessary to reflect the actual sound source levels measured at the project site.

Table 9. Calculated distances to Level A and Level B isopleths for low-frequency cetaceans by type of pile driving activity.

Method	Pile Type	Level A	Level B
DTH	24-inch steel	130	11,659
Impact Driving	24-inch steel	151	2,530
Vibratory Removal	14-inch timber	1	1,585
Vibratory Removal	14- to 24-inch steel	1.6	2,326
Small Pile Clipper	14- to 16-inch steel	3.3	1,848
Large Pile Clipper	18- to 24-inch steel	9.6	5,412

6.4.2 Estimating humpback whale occurrence and exposure

In this section we provide the information about the presence, density, or group dynamics of humpback whales that informed the take calculations.

Humpback whales occur frequently in Tongass Narrows during summer and fall months to feed, but are less common during winter and spring. As described in Section 4.2.3 *Humpback Whales in the Action Area,* for the proposed project, NMFS estimates two groups of two whales may be present weekly.

Based on the expected local occurrence of two groups of two humpback whales per week, we infer that the average daily occurrence rate would be 4 whales per week / 7 days per week = 0.57 whales per day. With 47 expected days of project-related construction noise, we expect 0.57 x 47 = 26.79 exposures of humpback whales to noise that would cause Level B harassment, which we round to 27 instances of Level B harassment.

As described in Section 4.2.1, an estimated 2 percent of humpback whales in Southeast Alaska are from the Mexico DPS (Wade 2021). Therefore, of the 27 instances of Level B harassment due to NOAA OMAO in-water construction activities, we expect that 2% of these 27 exposures (0.54, which we round to 1) would be ESA-listed Mexico DPS humpback whales, and the remaining exposures would be from the non-listed Hawaii DPS.

OMAO requested no authorization for serious injury or mortality or take by Level A harassment because these large whales can be effectively monitored and work can be halted before whales enter the Level A shutdown zone when they are present. The largest Level A zone to be monitored is 160 m, and multiple PSOs will monitor Tongass Narrows to ensure that no humpback whales approach or enter the Level A shutdown zone undetected. Humpbacks are usually readily visible; therefore, shutdown measures can be implemented prior to any humpback whales entering Level A shutdown zones.

Table 10. Amount of proposed incidental harassment (takes) of Mexico DPS humpback whales from NOAA OMAO pile driving activities. Take estimates are rounded to the nearest whole number.

Species	Proposed Authorized Level A Takes	Proposed Authorized Level B Takes
Mexico DPS humpback whale (*Megaptera novaeangliae*)	0	1

Temporarily elevated underwater noise during pile driving activities 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 and the mitigation measures proposed in Section 2.2 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 marine mammals will be behaviorally harassed or incur TTS; 2) the area or volume of water that will be ensonified above these levels in a day; 3) the density or occurrence of marine mammals within these ensonified areas; and, 4) the number of days of activities.

Exposure Assumptions

- A whale occurring within the Level A ensonified zone during pile driving activities would only be counted as Level A take, not both Level A and Level B take, even though the Level A zone is within the Level B zone.
- Exposures are based on total number of days that pile driving activities could occur and that whales might occur in the ensonified zone.
- All humpback whales occurring in the portion of the action area that is ensonified to levels that are expected to cause harassment during pile driving activities are assumed to be incidentally taken (i.e., exposures to sound levels at or above the relevant thresholds equate to take).
- An individual whale can only be taken once during a 24-hour period.
- For whales that may occur in groups, each individual in the group exposed to levels of sound capable of causing harassment would be considered taken.
- Level B exposure estimates are unmitigated and do not take into account monitoring and mitigation efforts to reduce take as described in Section 2.2.
- The percentage of humpback whale exposures that is estimated to be from the threatened Mexico DPS (2 %) is based on the percentages reported in Wade (2021).

6.5 Response Analysis

As discussed in the *Approach to the Assessment* section of this biological 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 non-impulsive sound produced by pile installation and removal and vessel noise include:

- Physical Response
  - Temporary or permanent hearing impairment (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
  - Startle or fleeing/flight

6.5.1 Responses to major noise sources (pile driving/removal 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 installation and removal activities. We assume that some individuals are likely to be exposed and respond to these impulsive and non-impulsive noise sources.

Between February 2022 and January 2023, with proper implementation of the mitigation measures and shutdown procedures described in Section 2.2, we do not anticipate that any Mexico DPS humpback whales will be exposed to noise levels loud enough, long enough, or at distances close enough for the proposed action to cause Level A harassment. We expect no more than 1 exposure of Mexico DPS humpback whales to noise levels sufficient to cause Level B harassment, as described in Section 6.4.2. All level B instances of take are anticipated to occur at received levels greater than 120 dB or 160 dB for non-impulsive and impulsive noise sources, respectively.

The introduction of anthropogenic noise into the aquatic environment from pile driving activities is the primary means by which marine mammals may be harassed from OMAO's specified activity. In general, animals exposed to natural or anthropogenic sound may experience physical and physiological effects, ranging in magnitude from none to severe (Southall et al. 2007). In general, exposure to pile driving and removal noise has the potential to result in auditory threshold shifts and behavioral reactions (e.g., avoidance, temporary cessation of foraging and vocalizing, changes in dive behavior). Exposure to anthropogenic noise can also lead to non-observable physiological responses such an increase in stress hormones. Additional noise in a marine mammal's habitat can mask acoustic cues used by marine mammals to carry out daily functions such as communication and predator and prey detection. The effects of pile driving and removal noise on marine mammals are dependent on several factors, including, but not limited to, sound type (e.g., impulsive vs. non-impulsive), the species, age and sex class (e.g., adult male vs. mom with calf), duration of exposure, the distance between the pile and the animal, received levels, behavior at time of exposure, and previous history with exposure (Wartzok et al. 2003; Southall et al. 2007). Here we discuss physical auditory effects (threshold shifts) followed by behavioral effects.

6.5.1.1 Threshold Shifts

NMFS defines a noise-induced threshold shift (TS) as a change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018). In other words, a threshold shift is a hearing impairment and may be temporary (such as ringing in your ears after a loud rock concert), or permanent (such as the loss of the ability to hear certain frequencies or partial or complete deafness). The amount of threshold shift is customarily expressed in dB. As described in NMFS (2018), there are numerous factors to consider when examining the consequence of TS, including, but not limited to: 1) the signal temporal pattern (e.g., impulsive or non-impulsive), 2) likelihood an individual would be exposed for a long enough duration or to a high enough level to induce a TS, 3) the magnitude of the TS, 4) time to recovery (seconds to minutes or hours to days), 5) the frequency range of the exposure (i.e., spectral content), 6) the hearing and vocalization frequency range of the exposed species relative to the signal's frequency spectrum (i.e., how and animal uses sound within the frequency band of the signal; e.g., Kastelein et al. 2014), and 7) the overlap between the animal and the sound source (e.g., spatial, temporal, and spectral).

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 exist on the sound levels and durations necessary to elicit mild TTS in marine mammals, and none of the published data describe 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 2018).

Although some Level B exposures may occur during the course of the proposed action, not all instances of Level B take will result in TTS because the estimated noise thresholds for the onset of TTS are conservative. If TTS does occur, it is expected to mild and temporary and not likely to affect the long term fitness of the affected individuals.

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 the onset of TTS 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 which induces 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 2018).

For the proposed project activities, the calculated distances to the Level A isopleths range from 1 m to150 m. The shutdown zones to be implemented are larger than the calculated isopleths to ensure that no humpback whales are exposed to noise levels that could cause PTS or other Level A disturbance. No exposures are anticipated at levels resulting in PTS due to conservative estimates of Level A isopleths and mitigation measures to shut down pile driving activities if a humpback whale approaches a Level A zone.

6.5.1.2 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, internal 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 activities 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.

An animal’s perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (Moberg 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and "distress" is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (Jessop et al. 2003; Lankford et al. 2005; Crespi et al. 2013). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker 2000; Romano et al. 2002) and, more rarely, studied in wild populations (Romano et al. 2002). For example, Rolland et al. (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. During the time following September 11, 2001, shipping traffic and associated ocean noise decreased along the northeastern U.S. This decrease in ocean noise was associated with a significant decline in fecal stress hormones in North Atlantic right whales, suggesting that chronic exposure to increased noise levels, although not acutely injurious, can produce stress (Rolland et al. 2012). These stress hormones returned to their previous level within 24 hours after the resumption of shipping traffic. Exposure to loud noise can also adversely affect reproductive and metabolic physiology (Kight and Swaddle 2011). In a variety of factors, including behavioral and physiological responses, females appear to be more sensitive or respond more strongly than males (Kight and Swaddle 2011).

These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC 2003)

We expect a small number of humpback whales (no more than 40 individuals) may experience TTS and may experience non-auditory physiological effects from project activities. Of the affected whales, we expect that no more than one humpback whale from the ESA-listed Mexico DPS may experience mild stress responses in reaction to project activities within the Level B zone. However, we expect most humpback whales would leave the ensonified areas to avoid excessive noise and avoid stress. If humpbacks are not displaced and remain in a stressful environment (i.e., within the harassment zone of pile driving activities), we expect the stress response will dissipate shortly after the cessation of pile driving activities. However, in any of the above scenarios, we do not expect significant or long-term harm to individuals from a stress response because of this action.

6.5.1.3 Behavioral Disturbance Reactions

Behavioral responses are influenced by an animal's assessment of whether a potential stressor poses a threat or risk. Behavioral responses 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.

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 (Richardson et al. 1995; NRC 2003; Wartzok et al. 2003).

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al. 1997; Finneran et al. 2003). 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; Wartzok et al. 2003; Thorson and Reyff 2006; Nowacek et al. 2007). Responses to non-impulsive sound, such as vibratory pile installation, have not been documented as fully as responses to pulsed sounds.

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 biologically significant if the change affects growth, survival, or fitness. Significant behavioral modifications that could potentially lead to effects on growth, survival, or fitness 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);
- Longer-term habitat abandonment due to loss of desirable acoustic environment; and
- Longer-term cessation of feeding or social interaction;
- Cow/calf separation.

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).

6.5.1.4 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 or 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. Anthropogenic sounds may also affect communication signals when both occur in the same 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 a three-fold increase 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 activities is relatively short-term. It is possible that pile driving noise or vessel noise resulting from this proposed action may mask acoustic signals important to Mexico DPS humpback whales, but the limited affected area and infrequent occurrence of humpback whales in the action 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*.

6.5.2 Response analysis summary

Humpback whales' probable responses to pile installation and removal include TTS, increased stress, and/or short-term behavioral disturbance reactions such as changes in activity and vocalizations, masking, avoidance or displacement, or habituation. These reactions and behavioral changes are expected to be temporary and subside quickly when the exposures cease. The primary mechanism by which these behavioral changes may 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 the 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. Tongass Narrows has not been identified as important foraging habitat for humpback whales, and the proposed activities are not expected to displace foraging whales. Because humpbacks are not expected to be feeding in the action area, there is little incentive for them to remain in the action area while the disturbance is occurring and we expect most whales would leave the area during pile driving activities if they were disturbed. 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.

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 versus cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the *Environmental Baseline* (Section 5).

All of the activities described in the *Environmental Baseline* are expected to continue into the future. The NOAA OMAO Ketchikan Port Facility Recapitalization Project is intended to enable OMAO to provide critical management and operational and logistical support to the R/V *Fairweather* and intermittently to other NOAA and non-NOAA vessels. Recapitalization of the facility is mandated by Congress under the Frank LoBiondo Coast Guard Authorization Act of 2018. The action will remove condemned and deteriorating structures and replace them with state-of-the-art docking facilities. The action may slightly increase the amount of vessel traffic in Tongass Narrows, but will reduce vessel traffic overall because the R/V *Fairweather* will no longer need to travel from Newport, OR, to reach its mission area in Alaska. Tongass Narrows will continue to function as the main transportation corridor for the City of Ketchikan and surrounding communities.

8 Integration and Synthesis

This section is the final step of NMFS's assessment of the risk posed to listed species 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 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. 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 biological opinion, we begin our risk analyses 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.

As part of our risk analyses, we identified and addressed all potential stressors and considered all consequences of exposing listed species to all the stressors associated with the proposed action, individually and cumulatively, given that the individuals in the action area for this consultation are also exposed to other stressors in the action area and elsewhere in their geographic range.

Based on the results of the exposure and response analyses, we expect a maximum of 40 instances of Level B harassment of humpback whales by noise from pile driving activities (impact, vibratory, and DTH), and 2 percent (1 individual) of those instances of harassment of humpback whales are anticipated to affect whales from the threatened 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 negligible 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 extremely unlikely because of the few additional vessels introduced by the action, slow speeds within Tongass Narrows, and the unlikelihood of these type of interactions. Disturbance to seafloor, habitat, and prey resources are not expected to adversely affect humpback whales because these disturbances are temporary, and the action area is not important habitat to humpback whales for foraging, migrating, breeding, or other essential life functions. Mitigation measures and adherence to Clean Water Act regulations are expected to minimize the risk of exposure of humpback whales to the potential introduction of pollutants into the action area.

As discussed in the *Proposed Action* and *Status of the Species* sections, this action does not overlap in space or time with humpback whale breeding. Some Mexico DPS humpback whales feed in Southeast Alaska in the summer and fall months and 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.

We do not expect the effects of the proposed project activities combined with the existing activities described in the *Environmental Baseline* (Section 5) and the cumulative effects (Section 7) to hinder population growth of Mexico DPS humpback whales. 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

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.

10 Incidental Take Statement

Section 9 of the ESA prohibits the take of endangered species unless there is a special exemption. NMFS extended all the prohibitions of section 9 to threatened Mexico DPS humpback whales through a rule issued pursuant to ESA section 4(d) (81 FR 62260, 62314; September 8, 2016). "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. 16 USC § 1532(19). "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 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 (1) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (2) 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, NMFS anticipates that any take will be by Level B harassment only. No serious injury, mortality, or Level A takes are contemplated or authorized. This ITS is valid only for the activities described in this biological opinion that have a federal nexus, and which have been authorized under section 101(a)(5) of the MMPA.

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 ITS is inoperative.

The terms and conditions described below are nondiscretionary. The USACE, OMAO, and

NMFS OPR (OPR) have a continuing duty to regulate the activities covered by this ITS. In order to monitor the impact of incidental take, the USACE, OMAO, and OPR must monitor and report the progress of the action and its impact on the species as specified in the ITS (50 CFR §402.14(i)(3)). If the USACE, OMAO, or OPR (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 or 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 whales 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)).

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. Table 11 lists the amount and timing of authorized take (incidental take by harassment) for this action. The method for estimating the number of whales exposed to sound levels expected to result in Level B harassment is described in Section 6.4. NMFS anticipates that 27 instances of Level B harassment of humpback whales may occur. Of these 27 whales, 2% (0.54 rounded to 1 whale) is predicted to be from the Mexico DPS. Therefore, NMFS is authorizing 1 Level B harassment takes under the ESA. NMFS will consider that OMAO has reached their take limit when 50 humpback whales have been observed in the Level B zone during in-water construction activities, because we expect 2% of all humpback whales encountered to be from the Mexico DPS (50 x 0.02 = 1).

Pile driving activities will be halted as soon as possible when it appears a humpback whale is approaching the Level A shutdown zone and before it reaches the Level A isopleth. No Level A take of marine mammals is authorized in this biological opinion.

Table 11. Summary of anticipated instances of exposure to sound from pile driving activities resulting in the incidental take of Mexico DPS humpback whales by Level B 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.

Species	**Total Amount of Take Associated with Proposed Action**		**Anticipated Temporal Extent of Take**
	Level A	**Level B**	
Mexico DPS humpback whale	0	1	February 2022, through January 2023

10.2 Effect of the Take

The only takes authorized during the proposed action are Level B takes by acoustic harassment from pile driving activities. No serious injury or mortality or Level A harassment is anticipated or authorized as part of this proposed action. This consultation has assumed that exposure to pile driving activities might disrupt one or more behavioral patterns that are essential to an individual animal's life history. However, any behavioral responses of these whales and any associated disruptions are not expected to affect their fitness, reproduction, survival, or recovery.

In Section 9 of this biological 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 measures that are "necessary or appropriate to minimize the impact of the amount or extent of incidental take" (50 CFR § 402.02). Failure to comply with RPMs (and the terms and conditions that implement them) may invalidate the take exemption and result in unauthorized take.

RPMs are distinct from the mitigation measures that are included in the proposed action (described in Section 2.2). We presume that the mitigation measures will be implemented as described in this opinion. The failure to do so will constitute a change to the action that may require reinitiation of consultation pursuant to 50 CFR § 402.16.

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. The USACE, OMAO, and OPR will ensure the creation and implementation of a monitoring and reporting program consistent with section 2.2 of this Biological Opinion that allows NMFS AKR to evaluate the exposure estimates contained in this biological opinion and that underlie this ITS.
2. The USACE, OMAO, and OPR will ensure the implementation of any additional mitigation measures applicable to humpback whales that are required by the IHA issued by NMFS Permits Division.

10.4 Terms and Conditions

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

In order to be exempt from the prohibitions of section 9 of the ESA, the USACE, OMAO, and OPR must comply (or must ensure that any applicant complies) with the following terms and conditions. These terms and conditions are in addition to the mitigation measures included in the proposed action, as set forth in Section 2.1.2 of this opinion. The USACE, OMAO, and OPR, 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(i)(3)).

Any taking that is in compliance with these terms and conditions is not prohibited under the ESA

(50 CFR § 402.14(i)(5)). As such, partial compliance with these terms and conditions may invalidate this take exemption and result in unauthorized, prohibited take under the ESA. If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the action may lapse.

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 RPMs #1 and 2 the USACE, OMAO, OPR, or its authorization holder must undertake the following:

1. Submit a draft marine mammal monitoring and mitigation plan consistent with section 2.2 of this Biological Opinion to NMFS AKR for review and approval prior to commencing in-water construction activities.
2. Immediately report to NMFS AKR (see Table 3 for *Contact Information*) the taking of any ESA-listed marine mammal in a manner other than that described in this ITS.

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). For this proposed action, NMFS suggests the following conservation recommendation:

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://www.fisheries.noaa.gov/resource/tool-app/whale-alert.
2. Sound Source Verification (SSV) may be conducted according to established and approved methods to obtain in situ measurements of sound levels from project activities. A report of SSV monitoring results must be submitted to and approved by NMFS AKR and OPR prior to adjusting the monitoring and shutdown zones.

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

12 Reinitiation of Consultation

As provided in 50 CFR 402.16, reinitiation of 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 biological 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 biological 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 biological opinion addresses these DQA components, documents compliance with the DQA, and certifies that this biological 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, NOAA OMAO, the USACE, 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 https://www.fisheries.noaa.gov/alaska/consultations/section-7-biological-opinions-issued-alaska-region. 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 biological opinion contain 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.

14 Literature Cited

ADOT&PF. 2020. Protected species preliminary monitoring report for ADOT&PF Ferry Berth Improvements, Phase 1, Tongass Narrows, Ketchikan, Alaska. Marine mammal monitoring report for AKRO-2019-03432 prepared by the Alaska Department of Transportation and Public Facilities, Juneau, AK, December 28, 2020.

AECOM. 2021. Request for Incidental Harassment Authorization of marine mammals resulting from the proposed Ketchikan port facility recapitalization project. Prepared by AECOM Technical Services, Inc., for Ahtna Infrastructure & Technologies, LLC, for the National Oceanic and Atmospheric Administration Office of Marine and Aviation Operations, Marine Operations Center-Pacific, October 2021.

ANSI. 1995. Bioacoustical Terminology (ANSI S3.20-1995). American National Standards Institute, Acoustical Society of America, Woodbury, NY.

ANSI (American National Standards Institute). 1986. Methods of measurement for impulse noise 3 (ANSI S12.7-1986). Acoustical Society of America, Woodbury, NY.

ANSI (American National Standards Institute). 2005. Measurement of sound pressure levels in air (ANSI S1.13-2005). Acoustical Society of America, Woodbury, NY.

Au, W. W. L. 2000. Hearing in whales and dolphins: An overview. Pages 1-42 *in* W. W. L. Au, A. N. Popper, and R. R. Fay, editors. Hearing by Whales and Dolphins. Springer-Verlag, New York.

Au, W. W. L., A. A. Pack, M. O. Lammers, L. M. Herman, M. H. Deakos, and K. Andrews. 2006. Acoustic properties of humpback whale songs. Journal of the Acoustical Society of America 120(2):1103-1110.

Baker, C. S., L. M. Herman, A. Perry, W. S. Lawton, J. M. Straley, and J. H. Straley. 1985. Population characteristics and migration of summer and late-season humpback whales (*Megaptera novaeangliae*) in southeastern Alaska. Marine Mammal Science 1(4):304-323.

Barlow, J., and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology 78(2):535-546.

Bates, N. R., J. T. Mathis, and L. W. Cooper. 2009. Ocean acidification and biologically induced seasonality of carbonate mineral saturation states in the western Arctic Ocean. Journal of Geophysical Research 114(C11007).

Bettridge, S., C. S. Baker, J. Barlow, P. Clapham, M. Ford, D. Gouveia, D. Mattila, R. Pace, P. E. Rosel, G. K. Silber, and P. Wade. 2015. Status review of the humpback whale (*Megaptera novaeangliae*) under the Endangered Species Act. U.S. Dept. Commer., NOAA, NMFS, SWFSC, March 2015. NOAA Technical Memorandum NMFS-SWFSC-540, 263 p.

Bond, N. A., M. F. Cronin, H. Freeland, and N. Mantua. 2015. Causes and impacts of the 2014 warm anomaly in the NE Pacific. Geophysical Research Letters 42(9):3414-3420.

Brower, A. A., J. T. Clarke, and M. C. Ferguson. 2018. Increased sightings of subArctic cetaceans in the eastern Chukchi Sea, 2008–2016: population recovery, response to climate change, or increased survey effort? Polar Biology 41(5):1033-1039.

Burek, K. A., F. Gulland, and T. M. O'Hara. 2008. Effects of climate change on Arctic marine mammal health. Ecological Applications 18(sp2).

Carlson, T. J., D. L. Woodruff, G. E. Johnson, N. P. Kohn, G. R. Ploskey, M. A. Wieland, and e. al. 2005. Hydroacoustic measurements during pile driving at the Hood Canal Bridge, September through November 2004. Prepared by Battelle Marine Sciences Laboratory for the Washington State Department of Transportation, 165 p.

Carretta, J. V., K. A. Forney, E. M. Oleson, D. W. Weller, A. R. Lang, J. Baker, M. M. Muto, B. Hanson, A. J. Orr, H. Huber, M. S. Lowry, J. Barlow, J. E. Moore, D. Lynch, L. Carswell, and R. L. B. Jr. 2020. U.S. Pacific marine mammal stock assessments: 2019. U.S. Dep. Commer., NOAA, NMFS, Southwest Fisheries Science Center, August 2020. NOAA Technical Memorandum NMFS-SWFSC-629.

Cavole, L. M., A. M. Demko, R. E. Diner, A. Giddings, I. Koester, C. M. Pagniello, M.-L. Paulsen, A. Ramirez-Valdez, S. M. Schwenck, and N. K. Yen. 2016. Biological impacts of the 2013–2015 warm-water anomaly in the Northeast Pacific: winners, losers, and the future. Oceanography 29(2):273-285.

Chapin, F. S., III, S. F. Trainor, P. Cochran, H. Huntington, C. Markon, M. McCammon, A. D. McGuire, and M. Serreze. 2014. Ch. 22: Alaska. Pages 514-536 *in* J. M. Melillo, T. C. Richmond, and G. W. Yohe, editors. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program.

Cheng, L., J. Abraham, J. Zhu, K. E. Trenberth, J. Fasullo, T. Boyer, R. Locarnini, B. Zhang, F. Yu, L. Wan, X. Chen, X. Song, Y. Liu, and M. E. Mann. 2020. Record-Setting Ocean Warmth Continued in 2019. Advances in Atmospheric Sciences 37(2):137-142.

Chenoweth, E. M., J. M. Straley, M. V. McPhee, S. Atkinson, and S. Reifenstuhl. 2017. Humpback whales feed on hatchery-released juvenile salmon. Royal Society Open Science 4:170180.

Chu, K., C. Sze, and C. Wong. 1996. Swimming behaviour during the larval development of the shrimp *Metapenaeus ensis* (De Haan, 1844)(Decapoda, Penaeidae). Crustaceana 69(3):368-378.

Clapham, P. J. 1992. Age at attainment of sexual maturity in humpback whales, Megaptera novaeangliae. Canadian Journal of Zoology 70(7):1470-1472.

Clapham, P. J. 1994. Maturational changes in patterns of association in male and female humpback whales, *Megaptera novaeangliae*. Journal of Zoology 234:265-274.

Clapham, P. J. 1996. The social and reproductive biology of Humpback Whales: An ecological perspective. Mammal Review 26(1):27-49.

Clark, C. W., W. T. Ellison, B. L. Southall, L. Hatch, S. M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Marine Ecology Progress Series 395:201-222.

Cox, T. M., T. Ragen, A. Read, E. Vos, R. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, and L. Crum. 2006. Understanding the impacts of anthropogenic sound on beaked whales. Space and Naval Warfare Systems Center, San Diego, CA.

Crespi, E. J., T. D. Williams, T. S. Jessop, and B. Delehanty. 2013. Life history and the ecology of stress: how do glucocorticoid hormones influence life-history variation in animals? Functional Ecology 27(1):93-106.

Crowley, T. J. 2000. Causes of climate change over the past 1000 years. Science 289(5477):270-277.

D'Vincent, C. G., R. M. Nilson, and R. E. Hanna. 1985. Vocalization and coordinated feeding behavior of the humpback whale in southeastern Alaska. Scientific Reports of the Whales Research Institute 36:41–47.

Denes, S. L., J. Vallarta, and D. G. Zeddies. 2019. Sound source characterization of down-the-hole hammering, Thimble Shoal, Virginia. Technical report by JASCO Applied Sciences for Chesapeake Tunnel Joint Venture, Document 00188, Version 1.0, 10 September 2019.

Denes, S. L., G. A. Warner, M. E. Austin, and A. O. MacGillivray. 2016. Hydroacoustic pile driving noise study - comprehensive report. Technical report by JASCO Applied Sciences for Alaska Department of Transportation & Public Facilities, December 2016.

Dolphin, W. F. 1987a. Dive behavior and estimated energy expenditure of foraging humpback whales in southeast Alaska. Canadian Journal of Zoology 65(2):354-362.

Dolphin, W. F. 1987b. Observations of humpback whale, *Megaptera novaeangliae* - killer whale, *Orcinus orca*, interactions in Alaska: comparison with terrestrial predator-prey relationships. Canadian Field-Naturalist 101(1):70-75.

Doney, S. C., M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate change impacts on marine ecosystems. Annual Reviews in Marine Science 4:11-37.

Ellison, W. T., B. L. Southall, C. W. Clark, and A. S. Frankel. 2012. A new context-based approach to assess marine mammal behavioral responses to anthropogenic sounds. Conservation Biology 26(1):21-28.

Erbe, C. 2002. Hearing abilities of baleen whales. Defense Research and Development Canada, Ottawa, Ontario, October 2002. DRDC Atlantic CR 2002-065.

Fabry, V. J., J. B. McClintock, J. T. Mathis, and J. M. Grebmeier. 2009. Ocean acidification at high latitudes: the Bellweather. Oceanography 22(4):160-171.

Fabry, V. J., B. A. Seibel, R. A. Feely, and J. C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. ICES Journal of Marine Science 65:414-432.

Fair, P. A., and P. R. Becker. 2000. Review of stress in marine mammals. Journal of Aquatic Ecosystem Stress and Recovery 7(4):335-354.

Feely, R. A., S. C. Doney, and S. R. Cooley. 2009. Ocean acidification: present conditions and future changes in a high-CO_2 world. Oceanography 22(4):37-47.

Feely, R. A., C. L. Sabine, K. Lee, W. Berelson, J. Kleypas, V. J. Fabry, and F. J. Millero. 2004. Impact of anthropogenic CO2 on the CaCO3 system in the oceans. Science 305(5682):362-366.

Finneran, J. J., R. Dear, D. A. Carder, and S. H. Ridgway. 2003. Auditory and behavioral responses of California sea lions (*Zalophus californianus*) to single underwater impulses from an arc-gap transducer. Journal of the Acoustical Society of America 114(3):1667-1677.

Florezgonzalez, L., J. J. Capella, and H. C. Rosenbaum. 1994. Attack of killer whales (*Orcinus orca*) on humpback whales (*Megaptera novaeangliae*) on a South American Pacific breeding ground. Marine Mammal Science 10(2):218-222.

Foote, A. D., R. W. Osborne, and A. R. Hoelzel. 2004. Whale-call response to masking boat noise. Nature 428:910.

Ford, J. K. B., and R. R. Reeves. 2008. Fight or flight: antipredator strategies of baleen whales. Mammal Review 38(1):50-86.

Francis, C. D., and J. R. Barber. 2013. A framework for understanding noise impacts on wildlife: An urgent conservation priority. Frontiers in Ecology and the Environment 11(6):305-313.

Frazer, L. N., and E. Mercado. 2000. A sonar model for humpback whale song. IEEE Journal of Oceanic Engineering 25(1):160-182.

Frölicher, T. L., E. M. Fischer, and N. Gruber. 2018. Marine heatwaves under global warming. Nature 560(7718):360-364.

Hain, J. H. W., S. L. Ellis, R. D. Kenney, P. J. Clapham, B. K. Gray, M. T. Weinrich, and I. G. Babb. 1995. Apparent bottom feeding by humpback whales on Stellwagen Bank. Marine Mammal Science 11(4):464-479.

Hamilton, P. K., G. S. Stone, and S. M. Martin. 1997. Note on a deep humpback whale *Megaptera novaeangliae* dive near Bermuda. Bulletin of Marine Science 61(2):491-494.

Hastings, M. C., and A. N. Popper. 2005. Effects of sound on fish. Report prepared by Jones and Stokes under contract with California Department of Transportation, No. 43A0139, Sacramento, CA, January 28, 2005.

HDR. 2018. Application for Marine Mammal Protection Act Incidental Harassment Authorizations for the Tongass Narrows Project (Ketchikan-Gravina Island Access, Revilla New Ferry Berth, & New Gravina Island Shuttle Ferry Berth Projects). Prepared by HDR, Inc., for the Alaska Dept. of Transportation and Public Facilities, Anchorage, AK, September 2018.

Hildebrand, J. A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395(5):5-20.

Hinzman, L. D., N. D. Bettez, W. R. Bolton, F. S. Chapin, M. B. Dyurgerov, C. L. Fastie, B. Griffith, R. D. Hollister, A. Hope, H. P. Huntington, A. M. Jensen, G. J. Jia, T. Jorgenson, D. L. Kane, D. R. Klein, G. Kofinas, A. H. Lynch, A. H. Lloyd, A. D. McGuire, F. E. Nelson, W. C. Oechel, T. E. Osterkamp, C. H. Racine, V. E. Romanovsky, R. S. Stone, D. A. Stow, M. Sturm, C. E. Tweedie, G. L. Vourlitis, M. D. Walker, D. A. Walker, P. J. Webber, J. M. Welker, K. S. Winker, and K. Yoshikawa. 2005. Evidence and Implications of Recent Climate Change in Northern Alaska and Other Arctic Regions. Climatic Change 72(3):251-298.

Holt, M. M., D. P. Noren, V. Veirs, C. K. Emmons, and S. Veirs. 2009. Speaking up: Killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. Journal of the Acoustical Society of America 125(1):EL27-EL32.

Huntington, H. P., S. L. Danielson, F. K. Wiese, M. Baker, P. Boveng, J. J. Citta, A. De Robertis, D. M. Dickson, E. Farley, and J. C. George. 2020. Evidence suggests potential transformation of the Pacific Arctic ecosystem is underway. Nature Climate Change 10(4):342-348.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 p.

IPCC. 2019. Summary for Policymakers. Pages 1-36 *in* D. C. R. H.- O. Pörtner, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer, editor. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Intergovernmental Panel on Climate Change.

Isaac, J. L. 2009. Effects of climate change on life history: implications for extinction risk in mammals. Endangered Species Research 7(2):115-123.

Jensen, A., M. Williams, L. Jemison, and K. Raum-Suryan. 2009. Somebody untangle me! Taking a closer look at marine mammal entanglement in marine debris. Pages pp. 63-69 *in* M. Williams, and E. Ammann, editors. Marine Debris in Alaska: coordinating our efforts, volume 09-01. Alaska Sea Grant College Program, University of Alaska Fairbanks.

Jensen, A. S., and G. K. Silber. 2004. Large whale ship strike database. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD, January 2004. NOAA Technical Memorandum NMFS-OPR-25, 37 p.

Jessop, T. S., A. D. Tucker, C. J. Limpus, and J. M. Whittier. 2003. Interactions between ecology, demography, capture stress, and profiles of corticosterone and glucose in a free-living population of Australian freshwater crocodiles. Gen Comp Endocrinol 132(1):161-170.

Jiang, L., R. A. Feely, B. R. Carter, D. J. Greeley, D. K. Gledhill, and K. M. Arzayus. 2015. Climatological distribution of aragonite saturation state in the global oceans. Global Biogeochemical Cycles 29:1656-1673.

Johnson, J. H., and A. A. Wolman. 1984. The Humpback Whale, *Megaptera novaeangliae*. Marine Fisheries Review 46(4):300-337.

Kastelein, R. A., L. Hoek, R. Gransier, M. Rambags, and N. Claeys. 2014. Effect of level, duration, and inter-pulse interval of 1-2 kHz sonar signal exposures on harbor porpoise hearing. Journal of the Acoustical Society of America 136(1):412-22.

Ketten, D. R. 1997. Structure and function in whale ears. Bioacoustics 8:103-135.

Kight, C. R., and J. P. Swaddle. 2011. How and why environmental noise impacts animals: an integrative, mechanistic review. Ecology Letters 14(10):1052-61.

Kryter, K. D. 1970. The effects of noise on man. Academic Press, Inc., New York.

Kryter, K. D. 1985. The handbook of hearing and the effects of noise, 2nd edition. Academic Press, Orlando, FL.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Lambertsen, R. H. 1992. Crassicaudosis: a parasitic disease threatening the health and population recovery of large baleen whales. Rev. Sci. Technol., Off. Int. Epizoot. 11(4):1131-1141.

Lankford, S., T. Adams, R. Miller, and J. Cech Jr. 2005. The cost of chronic stress: impacts of a nonhabituating stress response on metabolic variables and swimming performance in sturgeon. Physiological and Biochemical Zoology 78(4):599-609.

Learmonth, J. A., C. D. Macleod, M. B. Santos, G. J. Pierce, H. Q. P. Crick, and R. A. Robinson. 2006. Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44:431-464.

Lefebvre, K. A., L. Quakenbush, E. Frame, K. B. Huntington, G. Sheffield, R. Stimmelmayr, A. Bryan, P. Kendrick, H. Ziel, T. Goldstein, J. A. Snyder, T. Gelatt, F. Gulland, B. Dickerson, and V. Gill. 2016. Prevalence of algal toxins in Alaskan marine mammals foraging in a changing arctic and subarctic environment. Harmful Algae 55:13-24.

Lischka, S., and U. Riebesell. 2012. Synergistic effects of ocean acidification and warming on overwintering pteropods in the Arctic. Global Change Biology 18(12):3517-3528.

Lüthi, D., M. Le Floch, B. Bereiter, T. Blunier, J.-M. Barnola, U. Siegenthaler, D. Raynaud, J. Jouzel, H. Fischer, K. Kawamura, and T. F. Stocker. 2008. High-resolution carbon dioxide concentration record 650,000–800,000 years before present. Nature 453(7193):379-382.

Macleod, C. D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endangered Species Research 7(2):125-136.

McCauley, R. D., R. D. Day, K. M. Swadling, Q. P. Fitzgibbon, R. A. Watson, and J. M. Semmens. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1(7):0195.

McDonald, M. A., J. A. Hildebrand, and S. M. Wiggins. 2006. Increases in deep ocean anibient noise in the Northeast Pacific west of San Nicolas Island, California. Journal of the Acoustical Society of America 120(2):711-718.

Moberg, G. P. 2000. Biological response to stress: Implications for animal welfare. Pages 1-21 *in* G. P. Moberg, and J. A. Mench, editors. The biology of animal stress: basic principles and implications for animal welfare. CABI Publishing, Oxon, United Kingdom.

Morton, A., and H. K. Symonds. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada. ICES Journal of Marine Science 59(1):71-80.

Muto, M. M., V. T. Helker, B. J. Delean, N. C. Young, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2021. Alaska marine mammal stock assessments, 2020. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, July 2021. NOAA Technical Memorandum NMFS-AFSC-421, 398 p.

Naessig, P. J., and J. M. Lanyon. 2004. Levels and probable origin of predatory scarring on humpback whales (*Megaptera novaeangliae*) in east Australian waters. Wildlife Research 31(2):163-170.

NAVFAC SW. 2020. Compendium of underwater and airborne sound data during pile installation and in-water demolition activities in San Diego, Bay, California. Prepared by Tierra Data Inc. for Naval Facilities Engineering Command Southwest (NAVFAC SW), Coastal Integrated Products Team, San Diego, CA, October 2020.

Nedwell, J., and B. Edwards. 2002. Measurements of underwater noise in the Arun River during piling at County Wharf, Littlehampton. Report No. 513R0108, Prepared by Subacoustech, Ltd. for David Wilson Homes, Ltd., Soberton Heath, UK, 28 p.

Neilson, J., C. Gabriele, J. Straley, S. Hills, and J. Robbins. 2005. Humpback whale entanglement rates in southeast Alaska. Pages 203-204 *in* Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, California.

Neilson, J. L., and C. Gabriele. 2020. Glacier Bay and Icy Strait humpback whale population monitoring: 2019 update. National Park Service Resource Brief, Gustavus, AK.

Neilson, J. L., C. M. Gabriele, A. S. Jensen, K. Jackson, and J. M. Straley. 2012. Summary of reported whale-vessel collisions in Alaskan waters. Journal of Marine Biology:106282.

NIOSH (National Institute for Occupational Safety and Health). 1998. Criteria for a recommended standard: Occupational noise exposure. United States Department of Health and Human Services, Cincinnati, OH.

NMFS. 2018. Revision to Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce, NOAA, NMFS, Office of Protected Resources, Silver Spring, MD. NOAA Tech. Memo. NMFS-OPR-55, 178 p.

NMFS. 2019a. Endangered Species Act Section 7 biological opinion for listed species under the jurisdiction of the National Marine Fisheries Service for the Alaska Department of Transportation and Public Facilities for construction of the Tongass Narrows Project (Gravina Access), Ketchikan, Alaska. U.S. Dept. Commer., NOAA, NMFS, Alaska Regional Office, Juneau, AK, February 6, 2019. Consultation number AKRO-2019-03432.

NMFS. 2019b. Endangered Species Act Section 7 biological opinion for listed species under the jurisdiction of the National Marine Fisheries Service for the City of Ketchikan Berth II Rock Pinnacle Removal Project in Tongass Narrows, Ketchikan, Alaska. U.S. Dept. of Commerce, NOAA, NMFS, Alaska Region, Protected Resources Division, Juneau, AK, July 16, 2019.

NMFS. 2021. Occurrence of Endangered Species Act (ESA) listed humpback whales off Alaska. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Region Protected Resources Division, Juneau, AK, Revised August 6, 2021. Internal guidance document.

NMFS. 2022. Essential Fish Habitat conservation recommendations for NOAA OMAO Ketchikan Port Facility Recapitalization Project. U.S. Dept. of Commerce, NOAA, NMFS, Alaska Region, Habitat Conservation Division, Juneau, AK, January 7, 2022. EFH consultation AKRO-2021-03392 for ESA Section 7 consultation AKRO-2021-02754.

Nowacek, D. P., L. H. Thorne, D. W. Johnston, and P. L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2):81-115.

NRC. 2003. Ocean Noise and Marine Mammals. National Research Council, Ocean Study Board, National Academy Press, Washington, D.C.

Nuka Research and Planning Group, L. 2012. Southeast Alaska Vessel Traffic Study, Revision 1, July 23, 2012.

Oestman, R., D. Buehler, J. Reyff, and R. Rodkin. 2009. Technical guidance for assessment and mitigation of the hydroacoustic effects of pile driving on fish. Report prepared by ICF Jones and Stokes and Illingworth and Rodkin for California Department of Transportation (Caltrans), February 2009, 298 p.

Oreskes, N. 2004. The scientifc consensus on climate change. Science 306:1686.

Orr, J. C., V. J. Fabry, O. Aumont, L. Bopp, S. C. Doney, R. A. Feely, A. Gnanadesikan, N. Gruber, A. Ishida, F. Joos, R. M. Key, K. Lindsay, E. Maier-Reimer, R. Matear, P. Monfray, A. Mouchet, R. G. Najjar, G.-K. Plattner, K. B. Rodgers, C. L. Sabine, J. L. Sarmiento, R. Schlitzer, R. D. Slater, I. J. Totterdell, M.-F. Weirig, Y. Yamanaka, and A. Yool. 2005. Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature 437:681-686.

Parks, S. E. 2003. Response of North Atlantic right whales (*Eubalaena glacialis*) to playback of calls recorded from surface active groups in both the North and South Atlantic. Marine Mammal Science 19(3):563-580.

Parks, S. E. 2009. Assessment of acoustic adaptations for noise compensation in marine mammals. Report prepared by the Pennsylvania State University Applied Research Laboratory for the Office of Naval Research under award number N00014-08-1-0967, State College, PA.

Payne, K., and R. Payne. 1985. Large scale changes over 19 years in songs of humpback whales in Bermuda. Zeitschrift für Tierpsychologie 68(2):89-114.

Payne, R. S. 1970. Songs of the humpback whale. Capitol Records, Hollywood, CA.

Pearson, W. H., J. R. Skalski, and C. I. Malme. 1992. Effects of sounds from a geophysical survey device on behavior of captive rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences 49(7):1343-1356.

Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. Marine Fisheries Review 61(1):1-74.

Peterson, W., N. Bond, and M. Robert. 2016. The blob (part three): Going, going, gone? PICES Press 24(1):46.

PND Engineers. 2006. Geotechnical Investigation. City of Ketchikan Port Berth reconfiguration/expansion. Prepared for the City of Ketchikan, Seattle, WA, March 2006.

PND Engineers. 2020. Draft Biologial Assessment for the Berth III New Mooring Dolphins Project, City of Ketchikan, Alaska, Ports and Harbors, Revision 01 June, 2020.

Popper, A. N., and M. C. Hastings. 2009. The effects of anthropogenic sources of sound on fishes. Journal of Fish Biology 75(3):455-489.

Price, C. S., E. Keane, D. Morin, C. Vaccaro, D. Bean, and J. A. Morris. 2017. Protected species and marine aquaculture interactions. U.S. Dept. Commer., NOAA, National Ocean Service, National Centers for Coastal Ocean Science, Beaufort, NC, January 2017. NOAA Technical Memorandum NOS-NCCOS-211, 85 p.

PSSA. 2020. Protected species final report for the Ward Cove Cruise Ship Dock Project, Ketchikan, Alaska. Monitoring report for Ward Cove Cruise Ship Dock Project (AKRO-2019-03664) prepared by Power Systems & Supplies of Alaska, Ward Cove, AK, Submitted December 12, 2020, and modified December 23, 2020.

Reisdorph, S. C., and J. T. Mathis. 2014. The dynamic controls on carbonate mineral saturation states and ocean acidification in a glacially dominated estuary. Estuarine, Coastal and Shelf Science 144:8-18.

Reyff, J., and C. Heyvaert. 2019. White Pass and Yukon Railroad mooring dolphin installation: pile driving and drilling sound source verification, Skagway, AK, Prepared by Illingworth and Rodkin, Inc. for PND Engineers, Inc., Job No 18-221.

Richardson, W. J., C. R. Greene Jr, C. I. Malme, and D. H. Thomson. 1995. Marine mammals and noise. Academic Press, Inc., San Diego, CA.

Ridgway, S. H., D. A. Carder, R. R. Smith, T. Kamolnick, C. E. Schlunt, and W. R. Elsberry. 1997. Behavioural responses and temporary shift in masked hearing threshold of bottlenose dolphins, *Tursiops truncatus*, to 1-second tones of 141 to 201 dB re 1 μPa. Naval Command, Control and Surveillance Center, RDT&E Division, San Diego, California, July 1997.

Rolland, R. M., S. E. Parks, K. E. Hunt, M. Castellote, P. J. Corkeron, D. P. Nowacek, S. K. Wasser, and S. D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proceedings of the Royal Society B: Biological Sciences 279(1737):2363-2368.

Romano, T. A., D. L. Felten, S. Y. Stevens, J. A. Olschowka, V. Quaranta, and S. H. Ridgway. 2002. Immune response, stress, and environment: Implications for cetaceans. Pages 253-279 *in* C. J. Pfeiffer, editor. Molecular and Cell Biology of Marine Mammals. Krieger Publishing Co., Malabar, FL.

Scholik, A. R., and H. Y. Yan. 2001. Effects of underwater noise on auditory sensitivity of a cyprinid fish. Hearing research 152(1-2):17-24.

Scholik, A. R., and H. Y. Yan. 2002. Effects of boat engine noise on the auditory sensitivity of the fathead minnow, Pimephales promelas. Environmental Biology of Fishes 63(2):203-209.

Sharpe, F. A., and L. M. Dill. 1997. The behavior of Pacific herring schools in response to artificial humpback whale bubbles. Canadian Journal of Zoology-Revue Canadienne De Zoologie 75(5):725-730.

Silber, G. K. 1986. The relationship of social vocalizations to surface behavior and aggression in the Hawaiian humpback whale (*Megaptera novaeangliae*). Canadian Journal of Zoology 64(10):2075-2080.

Skalski, J. R., W. H. Pearson, and C. I. Malme. 1992. Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences 49(7):1357-1365.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4):411-521.

Stimpert, A. K., D. N. Wiley, W. W. L. Au, M. P. Johnson, and R. Arsenault. 2007. ‘Megapclicks’: Acoustic click trains and buzzes produced during night-time foraging of humpback whales (*Megaptera novaeangliae*). Biology Letters 3(5):467-470.

Straley, J. M. 1990. Fall and winter occurrence of humpback whales (*Megaptera novaeangliae*) in southeastern Alaska. Report of the International Whaling Commission Special Issue 12:319-323.

Straley, J. M., J. R. Moran, K. M. Boswell, J. J. Vollenweider, R. A. Heintz, T. J. Quinn Ii, B. H. Witteveen, and S. D. Rice. 2018. Seasonal presence and potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 147:173-186.

Sweeney, K., R. Towell, and T. Gelatt. 2018. Results of Steller Sea Lion Surveys in Alaska, June-July 2018: Memorandum to The Record. U.S. Dept. of Commerce, NOAA, NMFS, Alaska Fisheries Science Center, Marine Mammal Laboratory, Seattle, WA. December 4, 2018.

Thoman, R., and J. Walsh. 2019. Alaska's Changing Environment: documenting Alaska's physical and biological changes through observations. International Arctic Research Center, University of Alaska Fairbanks.

Thompson, P. O., W. C. Cummings, and S. J. Ha. 1986. Sounds, source levels, and associated behavior of humpback whales, Southeast Alaska. Journal of the Acoustical Society of America 80(3):735-740.

Thompson, T. J., H. E. Winn, and P. J. Perkins. 1979. Mysticete sounds. Pages 403-431 *in* H. E. Winn, and B. L. Olla, editors. Behavior of Marine Animals: Current Perspectives in Research Vol. 3: Cetaceans. Plenum Press, New York, NY.

Thorson, P., and J. Reyff. 2006. San Francisco-Oakland Bay bridge east span seismic safety project marine mammals and acoustic monitoring for the marine foundations at piers E2 and T1, January-September 2006. Prepared by SRS Technologies and Illingworth & Rodkin, Inc. for the California Department of Transportation: 51 p.

Tyack, P., and H. Whitehead. 1983. Male competition in large groups of wintering humpback whales. Behaviour 83(1/2):132-154.

Tyack, P. L. 1981. Interactions between singing Hawaiian humpback whales and conspecifics nearby. Behavioral Ecology and Sociobiology 8:105-116.

van der Hoop, J. M., P. Corkeron, J. Kenney, S. Landry, D. Morin, J. Smith, and M. J. Moore. 2016. Drag from fishing gear entangling North Atlantic right whales. Marine Mammal Science 32(2):619-642.

Vu, E. T., D. Risch, C. W. Clark, S. Gaylord, L. T. Hatch, M. A. Thompson, D. N. Wiley, and S. M. Van Parijs. 2012. Humpback whale song occurs extensively on feeding grounds in the western North Atlantic Ocean. Aquatic Biology 14(2):175-183.

Wade, P. R. 2021. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas, NMFS Alaska Fisheries Science Center, Seattle, WA. Paper submitted to the International Whaling Commission SC/68C/IA/03.

Wade, P. R., T. J. Quinn II, J. Barlow, C. S. Baker, A. M. Burdin, J. Calambokidis, P. J. Clapham, E. Falcone, J. K. B. Ford, C. M. Gabriele, R. Leduc, D. K. Mattila, L. Rojas-Bracho, J. Straley, B. L. Taylor, J. Urbán R., D. Weller, B. H. Witteveen, and M. Yamaguchi. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas, Bled, Slovenia, June 2016. Paper SC/66b/IA21 submitted to the Scientific Committee of the International Whaling Commission, 42 p.

Ward, W. D. 1997. Effects of high-intensity sound. Pages 1497-1507 *in* M. J. Crocker, editor. Encyclopedia of Acoustics, Vol. III. Wiley & Sons, New York.

Warner, G., and M. E. Austin. 2016. Alaska DOT Hydroacoustic Pile Driving Noise Study: Ketchikan Monitoring Results. Technical report by JASCO Applied Sciences for Alaska Department of Transportation and Public Facilities, August 2016.

Wartzok, D., A. N. Popper, J. Gordon, and J. Merrill. 2003. Factors Affecting the Responses of Marine Mammals to Acoustic Disturbance. Marine Technology Society Journal 37(4):6-15.

Watson, R. T., and D. L. Albritton. 2001. Climate change 2001: Synthesis report: Third assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Whitehead, H., and C. Glass. 1985. Orcas (killer whales) attack humpback whales. Journal of Mammalogy 66(1):183-185.

Wiese, K. 1996. Sensory capacities of euphausiids in the context of schooling. Marine and Freshwater Behaviour and Physiology 28(3):183-194.

Winn, H. E., P. J. Perkins, and T. C. Poulter. 1970. Sounds of the humpback whale. Pages 39-52 *in* 7th Annual Conference on Biological Sonar and Diving Mammals, Stanford Research Institute, Menlo Park.

WSDOT. 2011. Port Townsend Dolphin Timber Pile Removal – Vibratory Pile Monitoring Technical Memorandum. Prepared by Jim Laughlin for the Washington State Dept. of Transportation, January 3, 2011.