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 Construction of the Tongass Narrows Project (Gravina Access)

NMFS Consultation Number: AKRO-2019-03432

Action Agencies:
Alaska Department of Transportation and Public Facilities (ADOT&PF) on behalf of the Federal Highway Administration (FHA)
National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division (PR1)

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: James W. Balsiger, Ph.D.
Administrator, Alaska Region

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TERMS AND ABBREVIATIONS

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

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

1. INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each Federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a protected species, that agency is required to consult with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR §402.14(a)). Federal agencies 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 action agencies are the Federal Highway Administration (FHA) and the NMFS Office of Protected Resources Permits and Conservation Division (PR1). FHA proposes to fund construction to improve access to developable land on Gravina Island, improve access to the Ketchikan International Airport, and facilitate economic development in the Ketchikan Gateway Borough (specifically on Gravina Island). PR1 proposes to authorize Marine Mammal Protection Act (MMPA) Level A take (*i.e.*, take by injury) 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 eight marine mammal species: harbor seal, harbor porpoise, Dall's porpoise, Steller sea lion (*Eumetopias jubatus*), killer whale (*Orcinus orca*), humpback whale (*Megaptera novaeangliae)*, minke whale (*Balaenoptera acutorostrata*), and Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), in conjunction with the action.
This project consists of six components that will be constructed in two phases. The environmental review, consultation, and other actions required of the FHA by applicable federal environmental laws for this project are being carried out by the Alaska Department of Transportation and Public Facilities (ADOT&PF) pursuant to 23 U.S.C. § 326 and a Memorandum of Understanding executed by FHA and ADOT&PF.

The consulting agency for this proposal is NMFS's Alaska Region (AKR). This document represents NMFS's biological opinion (opinion) on the effects of the proposed construction activities on endangered and threatened species and designated critical habitat.

The biological opinion and incidental take statement were prepared by NMFS AKR in accordance with section 7(b) of the ESA of 1973, as amended (16 U.S.C. 1531, *et seq*.), 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) *et seq*.) and underwent pre-dissemination review.

As discussed below in section 1.2, NMFS previously completed a biological opinion on FHA's funding for this project. Reinitiation of formal consultation is required to add PR1 as an action agency and to analyze changes to the action that were not considered in the February 2019 opinion (PCTS# AKR-2018-9806 / ECO# AKRO-2018-01287). The original opinion considered the effects of only one project component being constructed at a time. Since then, ADOT&PF has determined that the project components may be awarded to up to three contractors and construction activities may occur at up to three locations simultaneously. Simultaneous in-water construction activity may cause effects to listed species that were not considered in the original opinion; therefore, reinitiation of formal consultation was required. Additionally, some minor changes in the estimated number of piles to be installed and rounding of monitoring and exclusion zones were made between when the February 2019 opinion was completed and PR1 published the proposed incidental harassment authorizations (IHAs) in July 2019. Those changes are incorporated into this revised opinion.

1.1 Background

This opinion considers the effects of the Tongass Narrows Project in the City of Ketchikan in Southeast Alaska. The Tongass Narrows Project includes six project components constructed in two phases intended to (1) improve access to developable land on Gravina Island; (2) improve access to the Ketchikan International Airport; (3) facilitate economic development in the Ketchikan Gateway Borough (specifically on Gravina Island); and (4) provide backup berthing facilities for the existing ferry berths.

The two phases and six components are as follows:

Phase 1

1. Revillagigedo Island new airport shuttle ferry berth and upland improvements
2. New Gravina Island airport shuttle ferry berth and related terminal improvements
3. Improvements to Gravina Island ferry layup dock facility
4. New Gravina Island heavy freight mooring facility

Phase 2

5. Refurbish existing Revillagigedo Island ferry berth facility
6. Refurbish existing Gravina Island ferry berth facility

The existing ferry berth at the terminal on Revillagigedo Island is nearing the end of its useful life and is periodically out of service for repairs and maintenance. The new facilities will allow for multiple shuttle ferries and a back-up berthing facility, will be constructed to current standards, and will improve reliability of that transportation system.

The opinion considers the effects of construction and operations. The action may affect the threatened Mexico Distinct Population Segment (DPS) of humpback whale. Critical habitat has been proposed (84 FR 54354, October 9, 2019), but has not yet been designated for this DPS or species. No designated critical habitat for any species under NMFS's jurisdiction exists in the action area.

This opinion is based on information provided by HDR in the September 4, 2018, Biological Assessment; October 2018 Incidental Harassment Authorization (IHA) request; proposed IHA (84 FR 34134); August 2019 memo from ADOT&PF to PR1; October 2019 memo from ADOT&PF to PR1 and AKR; updated project proposals; email and telephone conversations between NMFS Alaska Region, HDR, and PR1 staff; and other sources of information. A complete record of this consultation is on file at NMFS's Juneau, Alaska office.

1.2 Consultation History

Our communication with PR1, ADOT&PF and HDR regarding this consultation is summarized as follows:

- **July 18, 2018:** ADOT&PF submitted a request for informal consultation prepared by HDR, Inc., for the proposed action.
- **August 2, 2018:** NMFS AKR issued a non-concurrence letter in response to ADOT&PF's determination that the proposed action is not likely to adversely affect Mexico DPS humpback whales. NMFS recommended that ADOT&PF request an incidental take authorization for Level B take of Mexico DPS humpback whales under the Marine Mammal Protection Act and request formal consultation under the ESA.
- **August 20, 2018**: ADOT&PF submitted a biological assessment (BA) for formal consultation prepared by HDR, Inc., for the proposed action.
- **August 22, 2018**: NMFS AKR requested additional information.
- **September 4, 2018**: ADOT&PF submitted a revised BA for formal consultation prepared by HDR, Inc., for the proposed action.
- **September 5, 2018**: NMFS AKR deemed the initiation package complete and initiated consultation with ADOT&PF. The original Public Consultation Tracking System (PCTS) Number for this consultation is AKR-2018-9806 and ECO consultation number was AKRO-2018-01287.
- **December 22, 2018 – January 25, 2019**: Consultation was held in abeyance for 38 days due to a lapse in appropriations and resulting partial government shutdown. Consultation resumed on January 28, 2019.
- **February 6, 2019:** Completed consultation with ADOT&PF.
- **July 17, 2019**: PR1 published *Federal Register* notice of the two proposed IHAs to be issued for this project.

- **July 23, 2019:** NMFS AKR received a request for initiation of formal consultation from PR1. Minor differences in the number of piles and monitoring and shutdown zones were identified between the February 2019 opinion and the proposed IHAs, but these changes did not rise to the level of requiring a reinitiation of the original consultation.
- **August 26, 2019:** ADOT&PF issued a memo to PR1 with changes to the proposed action. These changes would result in effects not considered in the February 2019 opinion; therefore, reinitiation of consultation was required.
- **October 23, 2019**: ADOT&PF submitted a memorandum to AKR and PR1 that outlined changes to the proposed project, including revised monitoring and shutdowns zones and take estimates, and requested reinitiation of consultation with AKR.
- **October 23, 2019**: AKR reinitiated consultation with ADOT&PF and initiated consultation with PR1. The ECO number for this reinitiated consultation is AKRO-2019-03432.

2. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

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

This opinion considers the effects of the construction activities by ADOT&PF in Tongass Narrows on listed species in the action area. The purpose and need of the Tongass Narrows Project is to (1) improve access to developable land on Gravina Island; (2) improve access to the Ketchikan International Airport; (3) facilitate economic development in the Ketchikan Gateway Borough (specifically on Gravina Island); and (4) provide backup berthing facilities for the existing ferry berths. The existing ferry berth at the terminal on Revillagigedo Island is nearing the end of its useful life and is periodically out of service for repairs and maintenance. The new facilities will allow for multiple shuttle ferries and a back-up berthing facility, will be constructed to current standards, and will improve reliability of that transportation system.

The proposed construction activities that may affect listed species will take place in two phases over a three-year period between March 2020 and February 2022. Phase 1 will require approximately 101 days of pile installation, and Phase 2 will require approximately 23 days of pile installation (and removal). Construction of Phase 1 will occur over the course of 12 months, from approximately March 2020 through February 2021. Phase 2 will occur over the course of 5 months sometime between March 2021 and February 2022.

2.1.1 Proposed activities: project components

All six components are located within 0.5 mile of each other within the City of Ketchikan (Figure 1). Each component listed in Table 1, including installation method and pile information, is described in more detail in Section 2.1.2.

Figure 1. Planned locations of the six project component in Tongass Narrows, Ketchikan, Alaska (HDR 2018b).

Table 1. Summary of Tongass Narrows Project phases and components.

Phase	Component	Title	New Construction or Refurbish?	State Project ID
1	1	Revillagigedo Island Airport Shuttle Ferry Berth	New	SFHWY00085
1	2	Gravina Island Airport Shuttle Ferry Berth	New	SFHWY00109
1	3	Gravina Island Airport Ferry Layup Dock	Refurbish	SFHWY00152
1	4	Gravina Island Heavy Freight Barge Mooring Facility	New	SFHWY00154
2	5	Revillagigedo Island Ferry Berth	Refurbish	SFHWY00150
2	6	Gravina Island Ferry Berth	Refurbish	SFHWY00153

Phase 1, Component 1: Revillagigedo Island Airport Shuttle Ferry Berth

The new Revillagigedo Island Airport Shuttle Ferry Berth will be constructed immediately adjacent to the existing Revillagigedo Island Ferry Berth. The new ferry berth will consist of a 7,400-ft^2 pile-supported approach trestle at the shore side of the ferry terminal and a 1,500-ft^2 pile-supported approach trestle extension located landside and north of the new approach trestle. A 25-ft by 142-ft steel transfer bridge with vehicle traffic lane and separated pedestrian walkway will extend from the trestle to a new 2,200-ft^2 steel float and apron. The steel float will be supported by three guide pile dolphins. Two new stern berth dolphins with fixed hanging fenders and three new floating fender dolphins will be constructed to moor vessels. A new apron will be supported by three new guide pile dolphins. Water depths at the dolphins will reach approximately 60 ft. A bulkhead retaining wall will be constructed with sheet piles at the transition from uplands to the approach trestle, and installation will occur when the site is dewatered at low tide. Upland improvements will include reconstruction of terminal facilities, installation of utilities, and improvements to existing staging/parking areas. A plan drawing is provided in Figure 2.

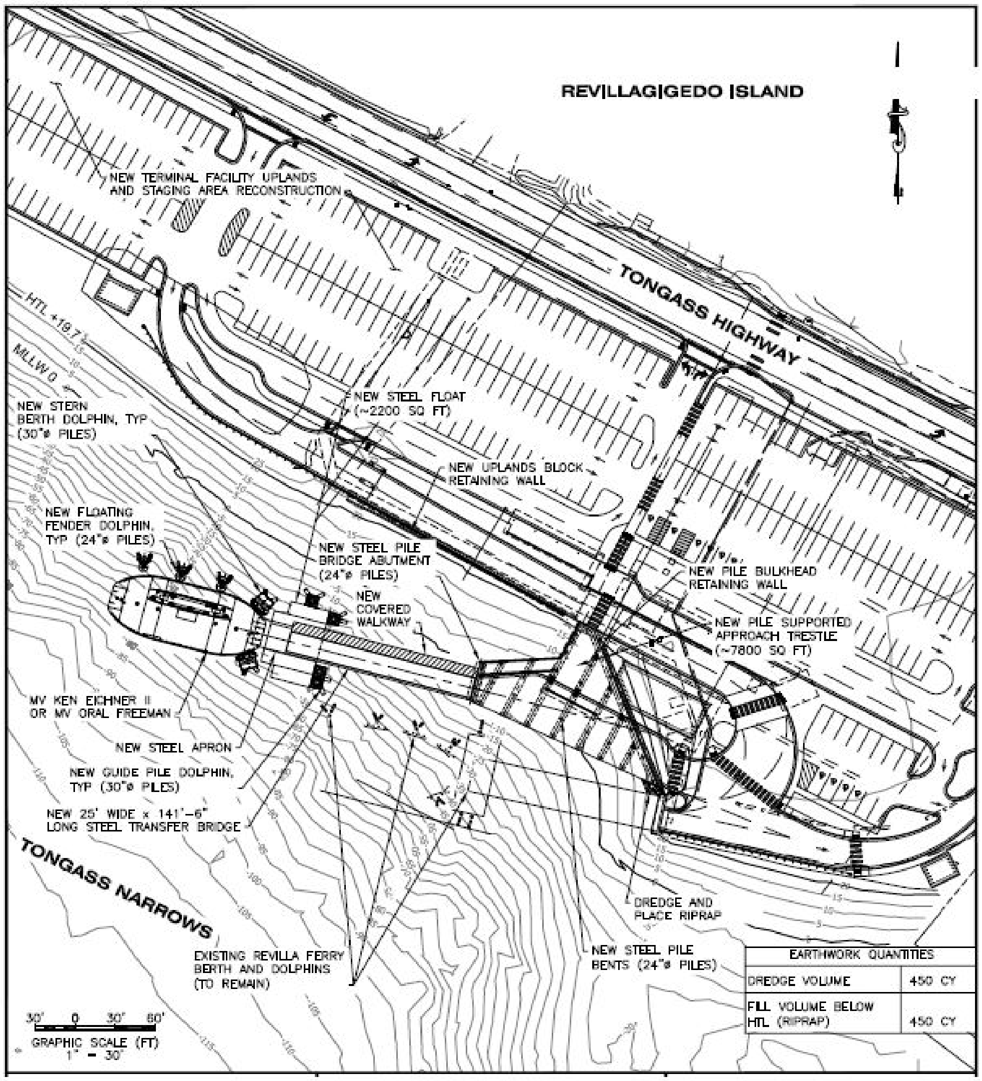

Figure 2. Site plan for the proposed new Revillagigedo Island Shuttle Ferry Berth (Phase 1, Component 1)(HDR 2018b).

Phase 1, Component 2: Gravina Island Airport Shuttle Ferry Berth

The new Gravina Island Airport Shuttle Ferry Berth will be constructed immediately adjacent to the existing Gravina Island Ferry Berth. The new facility will consist of an approximately 7,000-ft^2 pile-supported approach trestle at the shore side of the ferry terminal. A 25-ft by 142-ft steel transfer bridge with vehicle traffic lane and separated pedestrian walkway will lead to a new 2,200-ft^2 steel float and apron. The steel float will be supported by three new guide pile dolphins. Ferry berthing will be supported by two new stern berth dolphins and three new floating fender dolphins. To support the new facility, a new bulkhead retaining wall will be constructed with sheet pile between the existing ferry berth and the new approach trestle. About 66 percent of the bulkhead will be installed at low tide when the site is dewatered; the remainder will be installed in shallow marine waters. A new fill slope will be constructed west of the approach trestle. Upland improvements include widening of the ferry approach road, retrofits to the existing pedestrian walkway, installation of utilities, and a new employee access walkway. A plan drawing is provided in Figure 3.

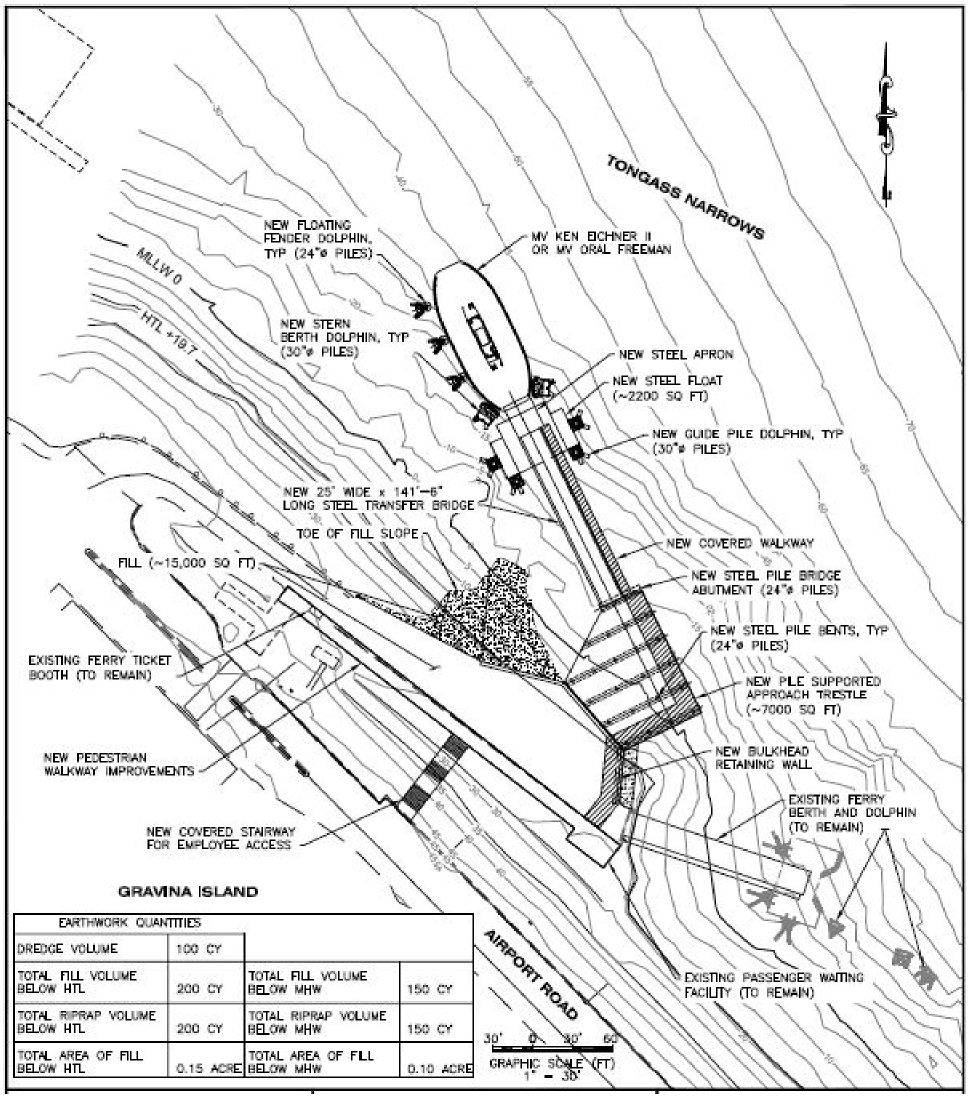

Figure 3. Site plan for the proposed new Gravina Island Airport Shuttle Ferry Berth (Phase 1, Component 2)(HDR 2018b).

Phase 1, Component 3: Gravina Island Airport Ferry Layup Dock

Improvements to the Gravina Island Airport Ferry Layup Dock will occur in the same location as the existing layup dock facility. The current layup dock is in disrepair and needs to be replaced. The new facility will accommodate layup and maintenance of the airport ferry system. The existing 265-ft-long floating dock, mooring structures, and transfer bridge will be removed. A new 250-ft by 85-ft concrete or steel floating dock will be constructed in its place. The floating dock will be restrained by two side-restraint float dolphins and three corner/mid-restraint float dolphins. A new 20-ft by 140-ft steel transfer bridge will provide access to the floating dock. It will be necessary to remove, relocate, and replenish the existing rock slope, demolish the existing concrete abutment, and construct a new pile-supported bridge abutment. A plan drawing is provided in Figure 4.

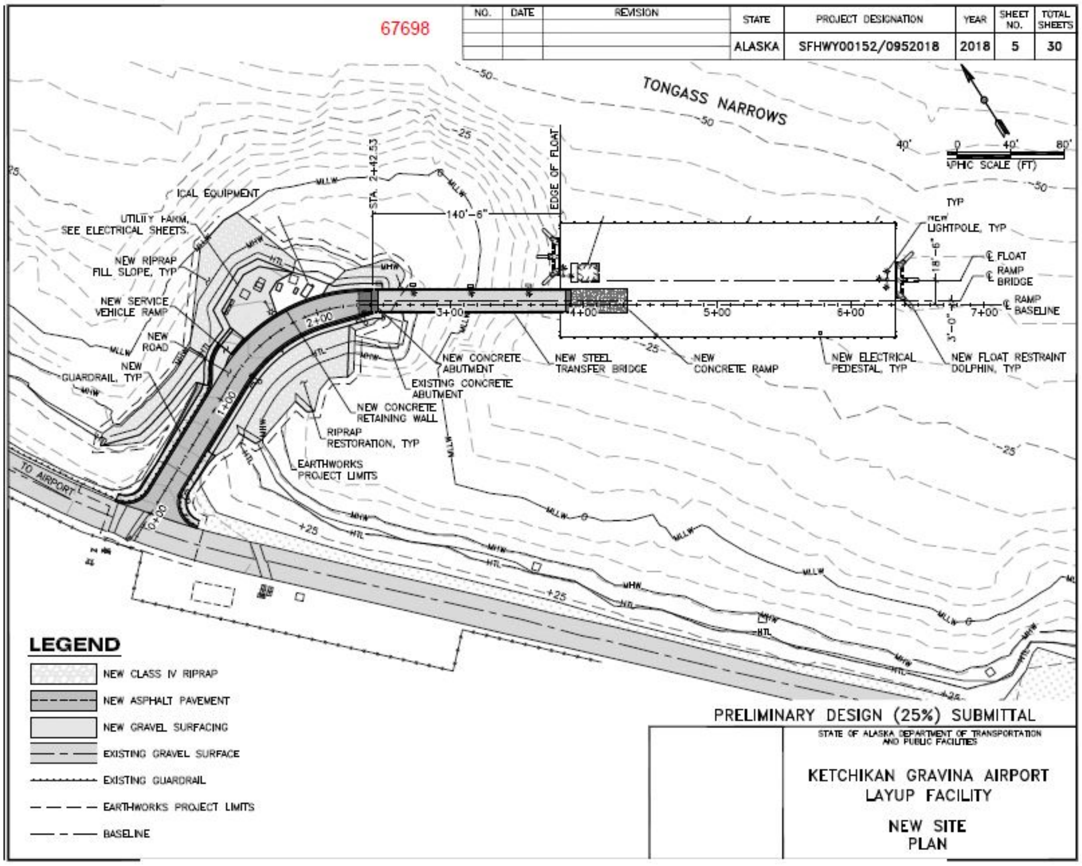

Figure 4. Plan drawing for improvements to the Gravina Island Airport Ferry Layup Dock (Phase 1, Component 3)(HDR 2018b).

Phase 1 Component 4: Gravina Island Heavy Freight Barge Mooring Facility

The new Gravina Island Heavy Freight Mooring Facility will be constructed in the same location as the existing barge offload facility. This facility will provide improved access to Gravina Island for highway loads that cannot be accommodated by the shuttle ferry. The existing ramp will be widened and re-graded both above and below the high tide line. A new concrete plank or asphalt pavement ramp will be constructed in its place. Five breasting dolphins and one mooring dolphin will be constructed to support barge docking and will include pedestrian walkways for access by personnel. In addition, two new pile-supported mooring line structures will be constructed above the high tide line. A plan drawing is provided in Figure 5.

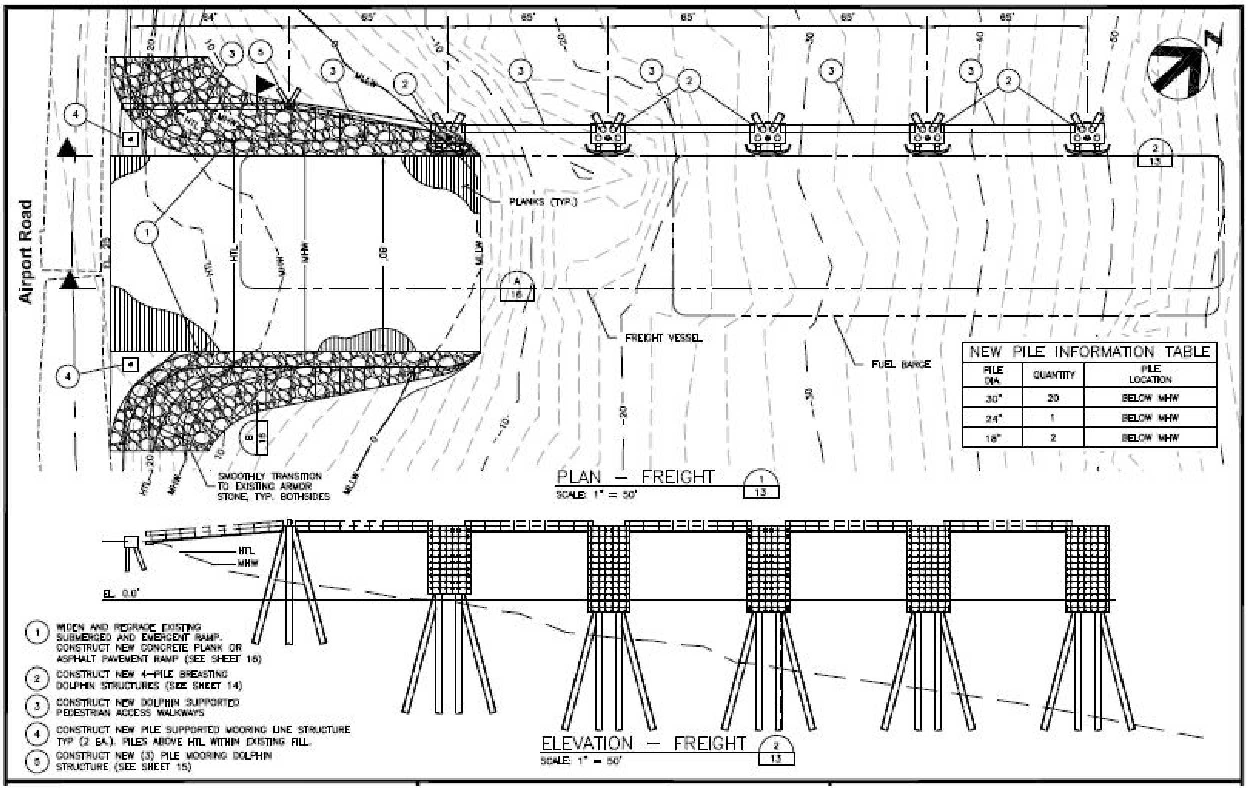

Figure 5. Plan drawing for new Gravina Island Heavy Freight Barge Mooring Facility (Phase 1, Component 4)(HDR 2018b).

Phase 2, Component 1: Revillagigedo Island Ferry Berth

After the new Revillagigedo Island Airport Ferry Shuttle Berth has been completed in Phase 1, the existing Revillagigedo Island Ferry Berth will be refurbished in Phase 2. Improvements to the existing Revillagigedo Island Ferry Berth will include the following: (1) replace the access bridge, (2) replace rubber fender elements and fender panels, (3) remove and replace one 24-inch pile on the floating fender dolphin, and (4) replace the bridge float with a concrete or steel float of the same dimensions. A plan drawing is provided in Figure 6.

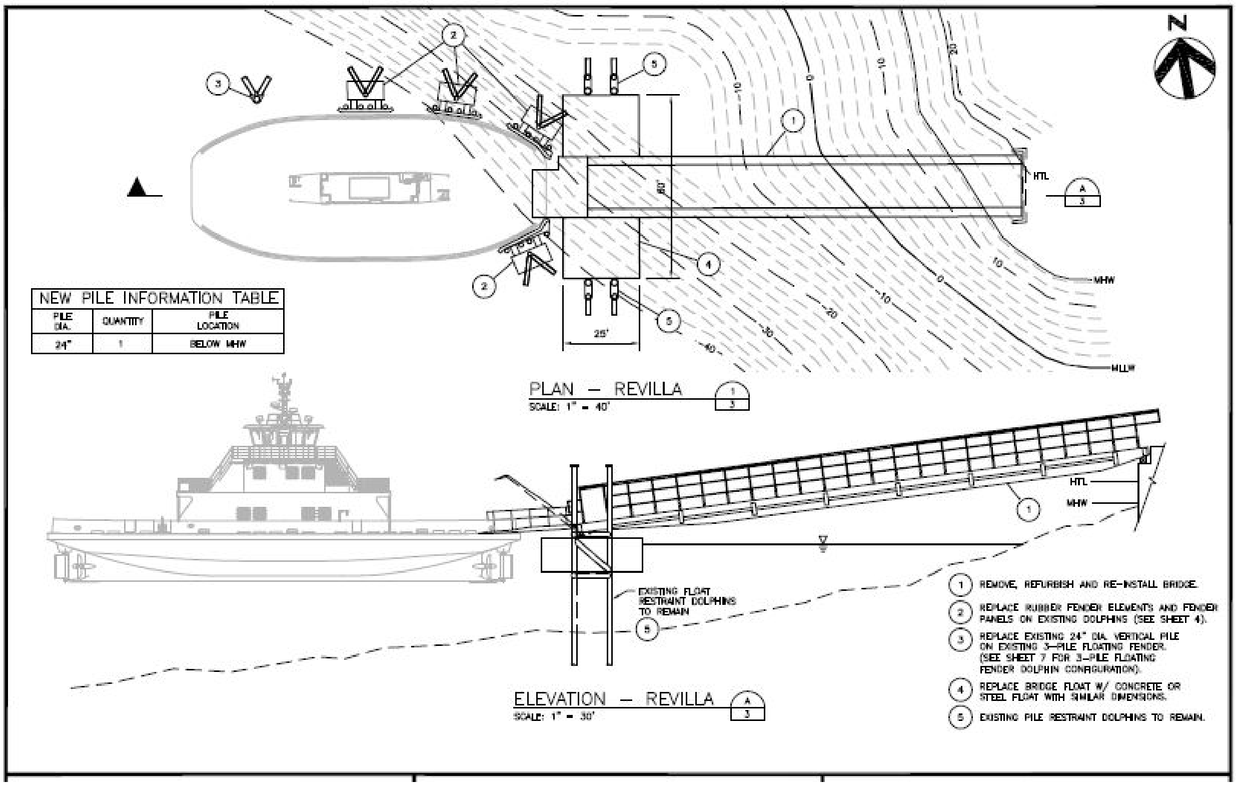

Figure 6. Plan drawing for refurbishment of existing Revillagigedo Island Ferry Berth (Phase 2, Component 1)(HDR 2018b).

Phase 2, Component 2: Gravina Island Ferry Berth

After the new Gravina Island Airport Ferry Shuttle Berth has been completed in Phase 1, the existing Gravina Island Ferry Berth will be refurbished in Phase 2. Improvements to the existing Gravina Island Ferry Berth will include the following: (1) replace the transfer bridge, (2) remove the catwalk and the nine 16-inch diameter piles that support the three existing dolphins, (3) replace the bridge float with concrete or steel float of the same dimensions, (4) construct a floating fender dolphin, and (5) construct four new breasting dolphins. Fifteen 24-inch diameter piles and eight 30-inch-diameter piles will be installed to construct the dolphins at the existing Gravina Island Ferry Berth. A plan drawing is provided in Figure 7.

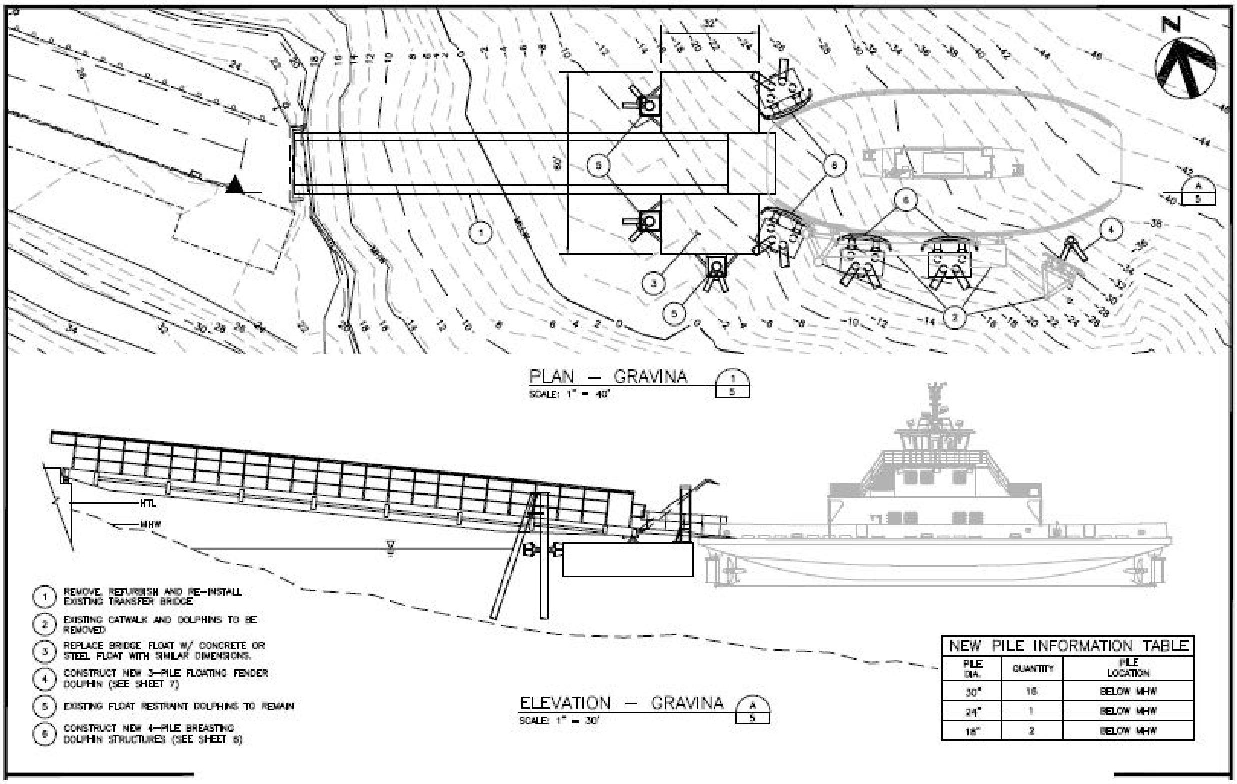

Figure 7. Plan drawing for refurbishment of the existing Gravina Island Ferry Berth, (Phase 2, Component 2)(HDR 2018b).

2.1.2 Proposed activities: construction methods

Table 2 summarizes the construction methods proposed to be employed for each project component in Phase 1. Table 3 summarizes the construction methods proposed to be employed for each project component in Phase 2. Descriptions of each proposed construction method follow.

Table 2. Summary of construction methods for each component in Phase 1 of the Tongass Narrows Project (HDR 2018a).

Project Component / Pile Type	Structural Feature	Number of Piles	Number of Rock Sockets	Number of Tension Anchors	Average Vibratory Duration Per Pile (minutes)	Average Drilling Duration for Rock Sockets Per Pile (minutes)	Impact Strikes Per Pile	Estimated Total Number of Hours	Production Rate (Range)	Days of Installation
New Revillagigedo Island Airport Shuttle Ferry Berth and upland improvements										
24” Pile Diameter	Approach Trestle	45	0	16	30	N/A	200	45	1.5 (1–3)	30
	Bridge Abutment	5	0	0	30	N/A	200	5	1.5 (1–3)	3
	Floating Fender Dolphin	15	0	9	30	N/A	200	15	1.5 (1–3)	10
30” Pile Diameter	Steel Float	10	0	10	30	N/A	200	10	1.5 (1–3)	7
	Stern Dolphin	8	0	4	30	N/A	200	8	1.5 (1–3)	5
AZ 14-770 Sheet Pile	Bulkhead Retaining Wall[a]	55	N/A	N/A	15	N/A	N/A	14	10 (10–12)	6
New Gravina Island Airport Shuttle Ferry Berth and related terminal improvements										
24” Pile Diameter	Steel Float	12	4	12	15	120	50	33	1.5 (1–3)	8
	Approach Trestle	34	34	4	15	120	50	94	1.5 (1–3)	23
	Bridge Abutment	5	5	0	15	120	50	14	1.5 (1–3)	3
	Floating Fender Dolphin	15	9	9	15	120	50	41	1.5 (1–3)	10
30” Pile Diameter	Stern Dolphin	8	4	4	15	180	50	30	1.5 (1–3)	5

Project Component / Pile Type	Structural Feature	Number of Piles	Number of Rock Sockets	Number of Tension Anchors	Average Vibratory Duration Per Pile (minutes)	Average Drilling Duration for Rock Sockets Per Pile (minutes)	Impact Strikes Per Pile	Estimated Total Number of Hours	Production Rate (Range)	Days of Installation
AZ 19-700 Sheet Pile	Bulkhead Retaining Wall[b]	80	N/A	N/A	15	N/A	N/A	20	10 (10–12)	8
Gravina Island Airport Ferry Layup Dock										
18” Pile Diameter	Bridge Abutment	3	0	0	15	N/A	50	2	1.5 (1–3)	2
30” Pile Diameter	Side-Restraint Dolphin (South)	6	6	4	15	180	50	23	1.5 (1–3)	4
	Side-Restraint Dolphin (North)	6	6	6	15	180	50	23	1.5 (1–3)	4
Gravina Island Heavy Freight Barge Mooring Facility										
20” Pile Diameter	Mooring Dolphin	6	0	6	15	N/A	50	2	1.5 (1–3)	1
24” Pile Diameter	Mooring Dolphin	3	3	3	15	120	50	3	1.5 (1–3)	1
30” Pile Diameter	Breasting Dolphins	4	2	4	15	180	50	75	1.5 (1–3)	13
TOTAL PILES		**320**	**73**	**91**						**144**[c]

[a] Total length of sheet pile bulkhead retaining wall is approximately 140 linear feet.
[b] Total length of sheet pile bulkhead retaining wall is approximately 185 linear feet.
[c.] This number reflects the number of days that would be required if pile driving only occurred at one location at a time. ADOT&PF expects that multiple project components may be constructed simultaneously, reducing the actual number of days of pile driving to 101.
Note: Production Rate is estimated average number of piles installed per day. Days of Installation do not sum to 144 due to rounding.

Table 3. Summary of construction methods for each component of Phase 2 of the Tongass Narrows Project (HDR 2018a).

Project Component / Pile Type	Structural Feature	Number of Piles	Average Vibratory Duration Per Pile (minutes)	Impact Strikes Per Pile	Estimated Total Number of Hours	Production Rate (Range)	Days of Installation and Removal
Refurbish existing Revillagigedo Island Ferry Berth							
24” Pile Diameter	Floating Fender Dolphin	1	30	50	1	1	1
24" Pile Diameter	Remove Floating Fender Dolphin Pile	1	30	N/A	1	1	1
Refurbish existing Gravina Island Ferry Berth							
24” Pile Diameter	Floating Fender Dolphin	15	15	50	11	1.5 (1-3)	10
30” Pile Diameter	Breasting Dolphins	8	15	50	6	1.5 (1-3)	5
16" Pile Diameter	Remove Existing Dolphins	12	15	N/A	2	1.5 (1-3)	6
TOTAL PILES INSTALLED AND REMOVED		**37**					**23**

2.1.2.1 Temporary piles

The installation and removal of temporary template piles during Phase 1 was not considered in the February 2019 opinion for this action. A vibratory hammer will be used to install 44 temporary template piles, no greater than 20 inches in diameter, to a depth of 25 feet or less. The total duration of vibratory installation and subsequent removal of temporary piles will be approximately 44 hours spread over multiple days as shown in Table 2 of the proposed IHA (84 FR 34134), and will take place within the same days as permanent pile installation. Installation and removal of temporary piles is therefore not anticipated to add to the overall estimated days of pile installation and removal for Phase 1 as shown in Table 2 of the proposed IHA.

2.1.2.2 Permanent Piles

Each of the six components will include installation of steel pipe piles that are 18, 24, or 30 inches in diameter, or sheet piles that are approximately 28 or 30 inches in width.

During Phase 1, four methods of pile installation are planned. These include vibratory and impact hammer pile driving, down-the-hole drilling of rock sockets, and installation of tension anchors at some locations. (These four methods will be collectively referred to as “pile installation and removal” throughout the remainder of this document, unless otherwise indicated.) Piles sizes are will range from 18 to 30 inches in diameter, with a total of 320 steel piles installed (see Table 2). Most piles will be installed vertically (plumb), but some will be installed at an angle (battered). Tension anchors will be used to secure some piles to the bedrock to withstand uplift forces. Rock sockets will be drilled at other locations where overlying sediments are too shallow to adequately secure the bottom portion of the pile. Some piles will be seated in rock sockets as well as anchored with tension anchors.

During Phase 2, vibratory and impact pile driving will be utilized to install 24 piles ranging from 24-30 inches in diameter. Thirteen piles will be removed using a vibratory hammer, if necessary. Installation of sheet piles, rock sockets, and tension anchors is not planned during Phase 2.

2.1.2.3 Sheet Piles

Components 1 and 2 of Phase 1 will require the installation of steel Z-shaped sheet piles that will comprise the bulkhead abutments. Each pile is approximately 28 to 30 inches wide, and they interlock together to form a continuous wall. These sheet piles will be installed into the existing ground at elevations varying from +8 inches to +26 inches mean lower low water. Most of this work is expected to be done at lower tides so that in-water pile driving work is minimized. However, some installation work below the tidal elevations (in water) is expected. The ground where the sheet piles will be installed is comprised of existing rubble mound slopes. Some excavation work will be needed to temporarily remove the large rocks prior to driving the sheet piles. Sheet piles will only be installed using vibratory hammering.

2.1.2.4 Vibratory and Impact Pile-Driving Methods

All installation scenarios will use vibratory hammering as the predominant installation method (see Table 1). The sheet pile abutment bulkheads for the new Revillagigedo Island and Gravina Island Airport Shuttle Ferry Berths will be installed using vibratory hammer methods only. Other piles may use a combination of vibratory, impact, and socketing methods. Depending on the location, the pile will be advanced to refusal at bedrock using impact methods. Where sediments are deep and rock socketing or anchoring is not required, the final approximately 10 feet of driving will be conducted using an impact hammer so that the structural capacity of the pile embedment can be verified. Where sediments are shallow, an impact hammer will be used to seat the piles into competent bedrock before rock socketing begins. The pile installation methods used will depend on sediment depth and conditions at each pile location.

2.1.2.5 Rock Socketing

Rock socketing involves inserting the pile in a drilled hole into the underlying bedrock after the pile has been driven through the overlying softer sediments to refusal by vibratory or impact methods. The pile is advanced farther into this drilled hole to properly secure the bottom portion of the pile into the rock. The depth of the rock socket varies, but 10–15 feet is commonly required. The diameter of the rock socket is slightly larger than the pile being driven. Rock sockets are constructed utilizing both rotary and percussion-type drill devices. These devices consist of a drill bit that drills through the bedrock using both rotary and pulse impact mechanisms. This breaks up the rock to allow removal of the fragments and insertion of the pile. The pile is usually advanced at the same time that drilling occurs. Drill cuttings are expelled from the top of the pile using compressed air. It is estimated that drilling rock sockets into the bedrock will take about 1–3 hours per pile. **Figure 8** depicts a schematic of rock socket drilling techniques.

2.1.2.6 Tension Anchors

Tension anchors are installed within piles that are drilled into the bedrock below the elevation of the pile tip, after the pile has been driven through the sediment layer to refusal. A 6- or 8-inch diameter steel pipe casing is inserted inside the larger diameter production pile. A rock drill is inserted into the casing, and a 6- to 8-inch-diameter hole is drilled into bedrock with rotary and percussion drilling methods. The drilling work is contained within the steel pile casing and the steel pipe pile. The typical depth of the drilled hole varies, but 20–30 feet is common. Rock fragments will be removed through the top of the casing with compressed air. A steel rod is then grouted into the drilled hole and affixed to the top of the pile. The purpose of a rock anchor is to secure the pile to the bedrock to withstand uplift forces. Table 2 indicates the expected number and locations where tension anchors are required. Figure 8 depicts a schematic of tension anchor drilling techniques.

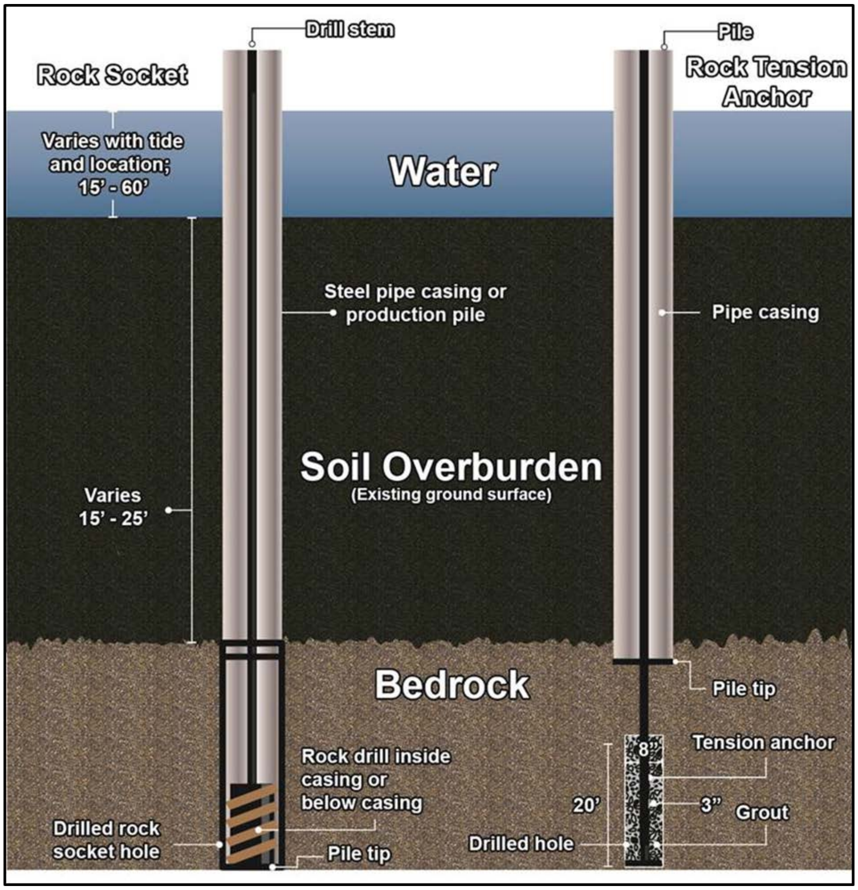

Figure 8. Schematic of methods for rock socketing and tension anchoring.

2.1.2.7 Removal of Existing Piles

One 24-inch pile will be removed from the floating fender dolphin at the existing Revillagigedo ferry berth. The twelve 16-inch-diameter piles that support the three existing dolphins at the Gravina Island Ferry Berth will also be removed. When possible, existing piles will be extracted by directly lifting them with a crane. A vibratory hammer will be used if necessary to extract piles that cannot be directly lifted.

2.1.2.8 Work Platforms

The contractor for the new ferry berths on Gravina and Revillagigedo islands would work with a crane from shore to build the earth-retaining bulkhead walls, and 1-2 rows of offshore piles. The rest of offshore pile work would be completed with a barge-mounted crane. Marine contractors typically stage from a floating work barge, in addition to the crane barge.

2.1.2.9 Moving Barge Platforms into Place

Platforms would be moved into place with a tug. The contractor's barges will be required to stay clear from the existing ferry traffic lane, Tongass Narrows traffic, and will not impact any other marine traffic. The contractor typically provides a barge mooring plan that shows the location of their mooring anchors and how they propose to stage equipment during the project.

Pre-manufactured floats and bridges will likely be barged to the project location from Washington State.

2.1.2.10 Removal of Existing Floats

The floats on the refurbishment projects in Phase 2 will become property of the contractor. The steel float at the existing Revillagigedo Island Ferry Berth would be hoisted out of the water by a crane and placed on a barge for removal. The concrete float at the existing Gravina Island ferry berth is very heavy and would most likely be floated off-site with a tug.

2.1.2.11 Transport of Workers to and from Work Platform

One or two skiffs will be used to transport workers short distances between the shore and work platforms. There could be multiple shore to barge trips during the day; however, the area of travel will be relatively small, within a very busy area, and close to shore. Vessels will be refueled at existing fuel docks along Tongass Narrows.

2.1.2.12. Excavation and Placement of Fill

Construction of the six project components includes the excavation of existing natural or man-made material as well as the placement of embankment fill (shot rock), rip-rap (armor rock), or concrete planks/asphalt below the high tide line. The estimated volumes of excavation and fill and the area affected vary and are listed below by project component (Table 4).

Table 4. Estimated amounts of excavation and fill below the high tide lines in cubic yards (CY) for each project component.

Project Component	Dredge Volume (CY)	Embankment Fill (CY)	Rip-Rap Fill (CY)	Concrete Planks/ Asphalt Fill (CY)	Fill Area (Square Feet)
Revillagigedo New Ferry Berth and Upland Improvements	2,400	400	0	0	500
New Gravina Island Shuttle Ferry Berth/Related Terminal Improvements	2,150	300	300	0	2,200
Gravina Airport Ferry Layup Facility	100	260	340	0	8,712
Gravina Freight Facility	36	995	767	296	30,492
Revillagigedo Refurbish Existing Ferry Berth Facility	1	0	0	0	0
Gravina Refurbish Existing Ferry Berth Facility	18	0	0	0	0
Totals	**4,705**	**1,955**	**1,407**	**296**	**41,904**

2.1.2.13 New Overwater Shaded Area

Construction of the six project components includes the placement of float, dock, transfer bridges, and walkway surfaces that will create shade in areas below the high tide line. In addition, Phase 2 of the project will extend the life of existing facilities and therefore result in continued overwater shading by those facilities. The estimated areas of the surfaces that will create overwater shading vary by project component (Table 5). Approximately 53,000 square feet of new overwater shading are proposed for this project.

Table 5. Amount of overwater shaded area associated with each project component (in square feet) (modified from Table 1.5 in HDR 2018b).

Project Component	New or Replaced Shaded Area				Existing Shading Area	Total Shaded Area
	Float	Dock	Transfer Bridge	Pedestrian Access Walkway		
Revillagigedo New Ferry Berth and Upland Improvements	2,624	9,823	0	0	0	12,447
New Gravina Island Shuttle Ferry Berth/Related Terminal Improvements	2,624	10,285	0	0	0	12,909
Gravina Airport Ferry Layup Facility	0	23,375	3,080	0	26,455	26,455
Gravina Freight Facility	0	0	0	1,001	1,001	1,001
Revillagigedo Refurbish Existing Ferry Berth Facility	0	0	0	0	5,480	5,480
Gravina Refurbish Existing Ferry Berth Facility	0	0	0	0	5,480	5,480
Totals	**5,247**	**43,483**	**3,080**	**1,001**	**38,416**	**63,772**

2.1.2.14 Other In-water Construction and Heavy Machinery Activities

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

2.1.3 Changes to proposed activities from February 2019 opinion

2.1.3.1 Use of multiple hammers

In August 2019, the ADOT&PF realized that its contracting strategy for this project would likely result in two or three construction sites that could be active at one time during Phase 1. ADOT&PF does not anticipated that more than one construction site will be active during Phase 2.

The contracting approach will not change the construction phasing or the amount or extent of activity completed in each phase; however, it may result in up to three construction sites that are active simultaneously during Phase 1. Pile installation or removal may occur at all three locations on the same day. It is likely that two or three hammers or a combination of hammers and down-hole drills will be used on the same day. When this occurs, equipment use may be staggered or intermittent throughout the day, and hammer or drill use could occur at times when no other hammer or drill is being used.

It is also possible that one, two, or three hammers, or a combination of up to two down-hole drills and an impact or vibratory hammer, could be in use simultaneously on the same or different project components. Such an occurrence is anticipated to be infrequent and would be for only short durations. In-water pile installation is an intermittent activity, and it is common for installation to start and stop multiple times as each pile is adjusted and its progress is measured and documented. However, the potential for more than one piece of equipment (vibratory hammer, impact hammer, and/or down-hole drill) to operate within a day or simultaneously was not considered in the February 2019 opinion or the proposed IHAs for the project.

2.1.3.2. Decreased duration of construction with simultaneous activities

The extent to which the use of more than one hammer or down-hole drill could occur within a day or simultaneously is unknown and difficult to quantify. Use of more than one hammer for pile installation on the same day (whether simultaneous or not) will result in a reduction in the total number of days of pile installation by increasing the number of piles that can be installed per day. The overall number of days of pile installation will decrease with use of two or three pieces of equipment. With two pieces of equipment used on 30 percent of construction days, the project duration will decrease from 144 days for Phase 1 to 101 days. Use of three hammers on some days will further reduce the total number of days of pile installation. ADOT&PF's best estimate is 101 days of pile installation and removal during Phase 1.

2.1.4 Description of sound propagation

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds. Amplitude is the height of the sound pressure wave or the 'loudness' of a sound and is typically measured using the decibel (dB) scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards). It is a logarithmic unit that accounts for large variations in amplitude; therefore, relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs; the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level (SL) represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position. Note that all underwater sound levels in this document are referenced to a pressure of 1 μPa and all airborne sound levels in this document are referenced to a pressure of 20 μPa.

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

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

2.1.5 Acoustic sources - single activity

This section describes the operational and environmental parameters of the activity that allow NMFS to estimate the area ensonified above the acoustic thresholds, and assumes only a single construction activity will occur at a time. Section 2.1.6 discusses a scenario with multiple construction activities occurring simultaneously.

Reference sound levels used by ADOT&PF for all vibratory pile installation and removal, rock socketing, and impact pile installation activities were derived from source level data from sound source verification (SSV) studies conducted during construction projects at the Ketchikan Ferry Terminal (Denes et al. 2016; Warner and Austin 2016a), elsewhere in Alaska (Denes et al. 2016; Warner and Austin 2016b), and outside of Alaska (CalTrans 2015; Navy 2015). The sound source levels used to determine the ensonified areas for both the Level A and Level B zones[1] and the data source from which those levels were derived are shown in Table 6.

2.1.5.1 Vibratory pile installation and removal

For vibratory pile installation of 30-inch piles, ADOT&PF used median reference sound level of 162 dB re 1 μPa rms from SSV studies conducted on 30-inch piles at the Ketchikan Ferry Terminal (Denes et al. 2016).

For vibratory installation of 16-, 18-, and 24-inch steel piles, ADOT&PF used median reference sound level of 161 dB re 1 μPa rms from SSV studies conducted on 16- and 24-inch steel piles during four projects at Naval installations in Puget Sound (Navy 2015).

For vibratory installation of 28- and 30-inch steel sheet piles, ADOT&PF used median reference sound level of 160 dB re 1 μPa rms from SSV studies conducted on “AZ-25” sheet piles at the Port of Oakland, CA, as summarized in CalTrans (2015).

[1] Level B harassment zones (monitoring zones) are the areas in which behavioral disruption are expected to occur. Level A harassment zones (shutdown zones) are the areas within which injury is likely to occur. More information about harassment zones and the methods for calculating them is provided in Sections 2.1.4.1 and 6.3.2.

Removal of piles using a vibratory hammer was assumed to produce the same levels of noise as vibratory installation of piles, even though this is likely an overestimate of the noise generated from pile removal.

2.1.5.2 Impact pile driving

For impact pile driving of 30-inch piles, ADOT&PF used Sound Exposure Levels (SEL) derived from SSV studies conducted on 30-inch steel piles during the Ketchikan Ferry Terminal project (Denes et al. 2016). To determine Level A ensonified zones from impact piling, ADOT&PF used an SEL of 181 dB. When determining Level A zones, SELs are more accurate than Sound Pressure Levels (SPLs), as they incorporate the pulse duration explicitly rather than assuming a proxy pulse duration and they provide a more refined estimation of impacts. However, to determine the Level B zone for impact piling, an SPL of 195 dB re 1 μPa rms was used. The RMS metric accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

For impact pile driving of 24- and 18-inch steel piles, ADOT&PF used SELs derived from sound SSV studies conducted on 24-inch steel piles at multiple locations in California (CalTrans 2015). To determine Level A ensonified zones from impact piling, ADOT&PF used an SEL of 177 dB for both pile sizes. To determine the Level B zone for impact piling, ADOT&PF used an SPL of 190 dB re 1 μPa rms.

2.1.5.3 Rock socketing

Source noise levels in the water column due to rock socket drilling are not well known. There are several variables that influence noise levels, including the depth and nature of the overlying sediments and the depth of the socket itself as it extends into the bedrock. The rock drilling occurs below the overlying sediments and bedrock and some sound attenuation likely occurs.

For rock socketing, ADOT&PF used a median reference sound level of 166.2 dB re 1 μPa rms from SSV studies conducted during drilling activities of 24-inch steel piles at the Kodiak Ferry Terminal to calculate both the Level A and Level B ensonified zones for the Tongass Narrows Project (Denes et al. 2016).

2.1.5.4 Tension anchoring

NMFS issued an IHA that considered tension anchoring at the Tenakee Springs Ferry Terminal (83 FR 29749) and determined that drilling of tension anchors does not result in noise levels in excess of ambient noise due to the depth below bedrock at which the drilling occurs, the installation method within a pile, and the small size of the anchoring drill. Additionally, sediments overlaying the bedrock will attenuate noise production from drilling and reduce noise propagation into the water column. Tension anchoring is therefore not expected to produce sounds levels that will cause Level B harassment.

Table 6. Project sound source levels for single activities.

Method and Pile Type	Sound Source Level at 10 meters			Literature Source
Vibratory Hammer	**dB rms**			
30-inch steel piles	162			Denes et al. 2016, Table 72
24-inch steel piles	161			Navy 2015
18-inch steel piles	161			Navy 2015
16-inch steel piles	161			Navy 2015
27.6-inch sheet pile	160			Caltrans 2015
30.3-inch sheet pile	160			Caltrans 2015
Drilling Rock Sockets	**dB rms**			
All pile diameters	166			Denes et al. 2016, Table 72
Impact Hammer	**dB rms**	**dB SEL**	**dB peak**	
30-inch steel piles	195	181	209	Denes et al. 2016, Table 72
24-inch steel piles	190	177	203	Caltrans 2015
18-inch steel piles	190	177	203	Caltrans 2015
Note: It is assumed that noise levels during pile installation and removal are similar. Use of an impact hammer will be limited to 5-10 minutes per pile, if necessary. It is assumed that drilling produces the same SSL regardless of down-hole diameter. SEL = sound exposure level; dB peak = peak sound level; rms = root mean square. ADOT&PF used a value of 166.2 dB rms to calculate ensonified zones for drilling rock sockets, and we have rounded that figure to 166 dB rms here.				

2.1.6 Acoustic sources - simultaneous activities

Simultaneous use of hammers could result in increased sound pressure levels and harassment zone sizes given the proximity of the component sites and the rules of decibel addition. NMFS PR1 provided guidance for handling overlapping sound fields created by use of more than one hammer for impact and vibratory hammers (Table 7)(Laws 2018). Down-hole drilling, which is currently regulated as a continuous noise source by NMFS, will be considered a similar noise to vibratory hammering and, for this analysis, the same rules of decibel addition will be applied.

Based on the PR1 guidance for use of two impact hammers simultaneously, it is unlikely that the two hammers would operate in synchrony, and therefore, the sound pressure levels will not be adjusted regardless of the distance between the hammers. In this case, each impact hammer will be considered to have its own independent harassment zones (Table 7).

During simultaneous use of an impact hammer and a vibratory hammer, the Level A zones for the impact hammer and the Level B zone for the vibratory hammer will be implemented (Table 7).

Simultaneous use of two continuous noise sources such as vibratory hammers can create overlapping sound fields that result in additive effects of sound from the different hammers under certain conditions (Table **7**) (Laws 2018; WSDOT 2019). Although the sound from two sources near the same location results in louder sound levels than from a single source, the sound levels cannot be added by standard addition because the decibel is measured on a logarithmic scale. For example, two sounds of equal level (plus or minus 1 decibel [dB]) combine to raise the sound level by 3 dB. However, if two sounds differ by more than 10 dB, there is no combined increase in the sound level; the higher output covers any other sound. This approach was used by the state of Washington Department of Transportation (WSDOT) in assessment of potential impacts from sound associated with construction of the Seattle Multimodal Construction Project (82 FR 15497) and by NMFS for the Parallel Thimble Shoal Tunnel Project (83 FR 18777); and it builds upon work by the U.S. Department of Transportation (USDOT 1995) and Kinsler et al. (2000). For marine mammal monitoring purposes, if the isopleth from one sound source encompasses a second sound source over a free sound field (i.e., no landmass separating the sound sources), then the sources are considered close enough to be a "combined sound source" and their sound levels are added (Laws 2018; WSDOT 2019) to determine the sound isopleth. The resulting isopleth is centered on the “combined source,” which is the geometric centroid of the polygon formed by the sound sources.

For simultaneous use of three or more hammers or down-hole drills, the three pieces with the highest noise levels must be identified. The same rules for decibel addition are then applied to the two lowest source levels of the three. The resulting combined source level is then added to the third, remaining source level using the same rules. For example, if two down-hole hammers (166 dB root mean square [rms] each) are used simultaneously with vibratory installation of a 24-inch pile (161 dB rms), first the two lowest levels are added together using the rules of decibel addition: 166–161 = 5, and therefore 1 dB is added to 166 dB (Table **7**), resulting in a combined noise level of 167 dB for the two pieces of equipment. Then 167 is added to the noise level of the third piece of equipment, 166. Since 167–166 is 1, 3 dB are added to 167, resulting in a combined noise level for all equipment of 170 dB (Laws 2018; WSDOT 2019).

Table 7. Rules for combining sound levels generated during pile installation and removal

Hammer Types	Difference in SSL	Level A Zones	Level B Zone
Vibratory, Impact	Any	Use impact zones	Use vibratory zone
Impact, Impact	Any	Use zones for each pile size and number of strikes	Use zone for each pile size
Vibratory, Vibratory	0 or 1 dB	Add 3 dB to the higher source level	Add 3 dB to the higher source level
	2 or 3 dB	Add 2 dB to the higher source level	Add 2 dB to the higher source level
	4 to 9 dB	Add 1 dB to the higher source level	Add 1 dB to the higher source level
	10 dB or more	Add 0 dB to the higher source level	Add 0 dB to the higher source level

Source: Modified from USDOT 1995, WSDOT 2019, and personal communication with Ben Laws (PR1) October 2018

Note: SSL = sound source level; dB = decibels

Sound source levels and resultant Level B zone sizes of Phase 1 were calculated for all possible combinations of pile installation and removal using two and three vibratory hammers and/or two down-hole drills. Simultaneous use of three down-hole drills was not analyzed because that combination of activities is not anticipated. The combined sound source levels for simultaneous vibratory hammer use, or use of a vibratory hammer and down-hole drill simultaneously, range from 163 to 170 dB rms, depending on the number of piles (two or more) being installed simultaneously, pile size and type, and method of installation (Table 8, Table 9, Table 10, Table 11). Simultaneous in-water pile installation and removal will not occur during Phase 2 of the Tongass Narrows Project, and therefore was not analyzed.

Table 8. Combined Sound Levels Generated during Pile Installation and Removal for Combinations of Two Pieces of Equipment: Impact Hammer, Vibratory Hammer, and Down-hole Drill

Phase 1	**Method**			Vibratory					Drilling		Impact		
		Pile Diameter		Sheet	18	20	24	30	24	30	18/20	24	30
			SSL	160	161	161	161	162	166	166	190	190	195
	Vibratory	Sheet	160	**163**	**164**	**164**	**164**	**164**	**167**	**167**	No Addition (Level B = Vibratory, Level A = Impact)		
		18	161	**164**	NA		**164**	**165**	**167**	**167**			
		20	161	**164**			**164**	**165**	**167**	**167**			
		24	161	**164**	**164**	**164**	**164**	**165**	**167**	**167**			
		30	162	**164**	**165**	**165**	**165**	**165**	**167**	**167**			
	Drilling	24	166	**167**	**167**	**167**	**167**	**167**	**169**	**169**			
		30	166	**167**	**167**	**167**	**167**	**167**	**169**	**169**			
	Impact	18/20	190	No Addition (Level B = Vibratory, Level A = Impact)							No Addition		
		24	190										
		30	195										

Note: Use this sheet if two piles are installed/removed simultaneously.

Table 9. Combined Sound Levels Generated during Pile Installation and Removal for Combinations of Three Pieces of Equipment: Impact Hammer, Vibratory Hammer, and Down-hole Drill, when the Pile Installed at Revilla is 24 inches in Diameter.

Phase 1 — **New Gravina Island Shuttle Ferry Berth** (rows: **Gravina Airport Layup and Freight**)

Method			Vibratory					Drilling		Impact		
	Pile Diameter		Sheet	18	20	24	30	24	30	18/20	24	30
		SSL	160	161	161	161	162	166	166	190	190	195
Vibratory	18	161	**166**	NA		**166**	**166**	**168**	**168**	No Addition (Level B = Vibratory, Level A = Impact)		
	20	161	**166**			**166**	**166**	**168**	**168**			
	24	161	**166**	**166**	**166**	**166**	**166**	**168**	**168**			
	30	162	**166**	**166**	**166**	**166**	**167**	**169**	**169**			
Drilling	24	166	**168**	**168**	**168**	**169**	**168**	**170**	**170**			
	30	166	**168**	**168**	**168**	**169**	**168**	**170**	**170**			
Impact	18/20	190	No Addition (Level B = Vibratory, Level A = Impact)							No Addition		
	24	190										
	30	195										

Notes: 24-inch SSL = 161

Use this table when three piles are installed simultaneously, and the pile installed at Revilla is 24-in diameter.

** NA = Combinations of equipment not possible given construction plans for each component.

Table 10. Combined Sound Levels Generated during Pile Installation and Removal for Combinations of Three Pieces of Equipment: Impact Hammer, Vibratory Hammer, and Down-hole Drill, when the Pile Installed at Revilla is 30 Inches in Diameter

	Method			Vibratory					Drilling		Impact		
		Pile Diameter		Sheet	18	20	24	30	24	30	18/20	24	30
			SSL	160	161	161	161	162	166	166	190	190	195
Gravina Airport Layup and Freight	Vibratory	18	161	**166**	NA		**166**	**167**	**169**	**169**	No Addition (Level B = Vibratory, Level A = Impact)		
		20	161	**166**			**166**	**167**	**169**	**169**			
		24	161	**166**	**166**	**166**	**166**	**167**	**169**	**169**			
		30	162	**166**	**167**	**167**	**167**	**167**	**169**	**169**			
	Drilling	24	166	**169**	**169**	**169**	**169**	**168**	**170**	**170**			
		30	166	**169**	**169**	**169**	**169**	**168**	**170**	**170**			
	Impact	18/20	190	No Addition (Level B = Vibratory, Level A = Impact)							No Addition		
		24	190										
		30	195										

Notes: 30-inch SSL = 162

Use this table when three piles are installed simultaneously, and the pile installed at Revilla is 30-in diameter.

** NA = Combinations of equipment not possible given construction plans for each component.

Table 11. Combined Sound Levels Generated during Pile Installation and Removal for Combinations of Three Pieces of Equipment: Impact Hammer, Vibratory Hammer, and Down-hole Drill, when the Pile Installed at Revilla is Sheet Pile

Phase 1	**New Gravina Island Shuttle Ferry Berth**												
	Method			Vibratory					Drilling		Impact		
		Pile Diameter		Sheet	18	20	24	30	24	30	18/20	24	30
			SSL	160	161	161	161	162	166	166	190	190	195
Gravina Airport Layup and Freight	Vibratory	18	161	**166**	NA	NA	**166**	**166**	**168**	**168**	No Addition (Level B = Vibratory, Level A = Impact)		
		20	161	**166**	NA	NA	**166**	**166**	**168**	**168**	No Addition (Level B = Vibratory, Level A = Impact)		
		24	161	**166**	**166**	**166**	**166**	**166**	**168**	**168**	No Addition (Level B = Vibratory, Level A = Impact)		
		30	162	**166**	**166**	**166**	**166**	**166**	**168**	**168**	No Addition (Level B = Vibratory, Level A = Impact)		
	Drilling	24	166	**168**	**168**	**168**	**168**	**168**	**170**	**170**	No Addition (Level B = Vibratory, Level A = Impact)		
		30	166	**168**	**168**	**168**	**168**	**168**	**170**	**170**	No Addition (Level B = Vibratory, Level A = Impact)		
	Impact	18/20	190	No Addition (Level B = Vibratory, Level A = Impact)							No Addition		
		24	190	No Addition (Level B = Vibratory, Level A = Impact)							No Addition		
		30	195	No Addition (Level B = Vibratory, Level A = Impact)							No Addition		

Notes: Sheet pile SSL = 160

Use this table when three piles are installed simultaneously, and sheet piles are installed at Revilla.

** NA = Combinations of equipment not possible given construction plans for each component.

2.1.7 Acoustic thresholds

ADOT&PF intends to conduct construction activities that would introduce acoustic disturbance into the marine environment.

Since 1997 NMFS has used generic sound exposure thresholds to determine whether an activity produces underwater sounds that might result in impacts to marine mammals (70 FR 1871). NMFS recently developed comprehensive guidance on sound levels likely to cause injury to marine mammals through onset of permanent and temporary threshold shifts (PTS and TTS; Level A harassment) (81 FR 51693). NMFS is in the process of developing guidance for behavioral disruption (Level B harassment). However, until such guidance is available, NMFS uses the following conservative thresholds of underwater sound pressure levels[2], expressed in root mean square[3] (rms), from broadband sounds that cause behavioral disturbance, and referred to as Level B harassment under section 3(18)(A)(ii) of the MMPA:

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

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 2018a). 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 12):

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

Table 12. Summary of PTS onset acoustic thresholds for Level A harassment (NMFS 2018a).

Hearing Group	PTS Onset Thresholds* (Received Level)	
	Impulsive	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{p,\text{0-pk,flat}}$: 219 dB $L_{E,p,\text{ LF,24h}}$: 183 dB	*Cell 2* $L_{E,p,\text{ LF,24h}}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{p,\text{0-pk,flat}}$: 230 dB $L_{E,p,\text{ MF,24h}}$: 185 dB	*Cell 4* $L_{E,p,\text{ MF,24h}}$: 198 dB
High-Frequency (HF) Cetaceans	*Cell 5* $L_{p,\text{0-pk,flat}}$: 202 dB $L_{E,p,\text{HF,24h}}$: 155 dB	*Cell 6* $L_{E,p,\text{ HF,24h}}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{p,\text{0-pk.flat}}$: 218 dB $L_{E,p,\text{PW,24h}}$: 185 dB	*Cell 8* $L_{E,p,\text{PW,24h}}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{p,\text{0-pk,flat}}$: 232 dB $L_{E,p,\text{OW,24h}}$: 203 dB	*Cell 10* $L_{E,p,\text{OW,24h}}$: 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 ($L_{p,\text{0-pk}}$) has a reference value of 1 µPa, and weighted cumulative sound exposure level ($L_{E,p}$) has a reference value of 1µPa^{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.

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

2.1.7.1 Calculating distances to Level A thresholds

Sound propagation and the distances to the sound isopleths defined by NMFS for Level A harassment of marine mammals under the current Technical Guidance were estimated using the User Spreadsheet developed by NMFS for this purpose (NMFS 2018a). The method uses estimates of SPL and duration of the activity to calculate the threshold distances at which a marine mammal exposed to those values would experience a PTS. Differences in hearing abilities among marine mammals are accounted for by use of weighting factor adjustments for the five functional hearing groups (NMFS 2016b). Pulse duration from the SSV studies used for source level estimates are unknown. All necessary parameters were available for the SEL_{cum} (cumulative Single Strike Equivalent) method for calculating isopleths, and therefore this method was selected. The SEL_{cum} method resulted in isopleths that were larger than those calculated using the peak source level method, and therefore the SEL_{cum} isopleths were selected for this project. To account for potential variations in daily productivity during impact installation, isopleths were calculated for different numbers of piles that could be installed each day (Table 6-5 of the IHA application). Therefore, should the contractor expect to install fewer piles in a day than the maximum anticipated, the Level A harassment zone would be smaller. The number of strikes per pile during impact installation is expected to not exceed 50 per pile at project components on Gravina Island. The number of strikes per pile during impact installation at project components on Revillagigedo Island is not expected to exceed 200 per pile. Level A distances are provided in Table 13 for both strike rates and three production rates for single activities.

When multiple simultaneous activities may occur, we analyzed the highest source levels for the longest durations of pile installation that could occur within a day to identify the isopleth for the largest cumulative exposure that could occur, based on the anticipated activities and durations. (Recall that SEL_{cum} is the 24-hr cumulative exposure to a particular sound level and is therefore a function of both the sound source level and the duration of exposure to that source level in a 24-hr period.) For example, if seventeen 30-inch piles were installed with a vibratory hammer on a single day, the cumulative exposure for all functional hearing groups would remain at levels requiring shutdown zones smaller than 50 meters. If an eighteenth 30-inch pile were to be installed in a 24-hr period, the duration of exposure to elevated noise levels would exceed the cumulative threshold for Level A exposure for high frequency cetaceans at 50 meters. Similarly, the combined source level for vibratory installation of three 30-inch piles is 167 dB rms (Table 10); the cumulative exposure for this source level would reach 50 meters only after the duration exceeds 165 minutes (2.75 hours) for all functional hearing groups. Only after 470 minutes (7.8 hours) of simultaneous installation of three 30-inch piles would the cumulative exposure reach the Level A threshold at 100 meters, a production rate that is unlikely to be met or exceeded.

If two down-hole drills operated within a day, five piles could be installed with 180 minutes of down-hole drilling for each (900 minutes or 15 total hours), and the Level A zone for all functional hearing groups would remain below 100 meters. Two down-hole drills operating simultaneously would have a combined source level of 169 dB rms (Table 8); the cumulative exposure threshold for this source level at 100 meters is reached when the duration of activity exceeds 520 minutes (8.7 hours) of simultaneous use of two down-hole drills, a production rate that is also unlikely to be met or exceeded.

The scenarios evaluated above represent levels of efficiency (production rates) that are unlikely to be achieved in the field, and Level A zones for all functional hearing groups remained below 100 meters in all cases presented above. To be precautionary, ADOT&PF will implement a shutdown zone of 100 meters for each vibratory hammer on days when it is anticipated that multiple vibratory hammers will be used. ADOT&PF will also implement a shutdown zone of 100 meters for each down-hole drill on days when it is anticipated that two down-hole drills will be used. Simultaneous impact hammering (*i.e.*, multiple impact hammers hammering at exactly the same time) is not expected and Level A zones are not expected to overlap when impact hammering is occurring at multiple locations in a day. The Level A zones for impact hammering will be implemented as calculated in Table 13.

Table 13. Calculated distances to Level A harassment isopleths during pile installation and removal.

Activity	Pile Diameter(s)	Minutes per Pile or Strikes per Pile	Piles Installed or Removed per day	Level A Harassment Isopleth Distance for low frequency cetaceans (meters)
Vibratory Installation	30-inch	30 Minutes	3	11
	24-inch, 18-inch	30 Minutes	3	9
	27.6-inch sheet pile, 30.3-inch sheet pile	15 Minutes	10	11
Vibratory Removal	24-inch, 16-inch	30 Minutes	5	13
Drilling Rock Sockets	30-inch	180 Minutes	3	66
	24-inch, 18-inch	120 Minutes	3	51
Impact Installation	30-inch	50 Strikes	3	208
		50 Strikes	2	159
		50 Strikes	1	100
		200 Strikes	3	523
		200 Strikes	2	399
		200 Strikes	1	252
Impact Installation	24-inch	50 Strikes	3	113
		50 Strikes	2	86
		50 Strikes	1	54
		200 Strikes	3	283
		200 Strikes	2	216
		200 Strikes	1	136
Impact Installation	18-inch	50 Strikes	3	113
		50 Strikes	2	86
		50 Strikes	1	54

2.1.7.2 Calculating distances to Level B thresholds

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

The practical spreading model was used by ADOT&PF to generate the Level B harassment zones for all pile installation and removal and drilling activities. Removal of piles using a vibratory hammer was assumed to produce the same levels of noise as vibratory installation of piles, even though this is likely an overestimate of the noise generated from pile removal. Practical spreading, a form of transmission loss, is described in detail below.

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

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

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

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

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

Transmission loss (TL) coefficients measured at other ports in coastal Alaska ranged from 14.6 to 21.9 (Denes et al. 2016). However, NMFS typically recommends a default practical spreading loss coefficient of 15 when site-specific empirical data are unavailable. ADOT&PF used a transmission loss coefficient of 15 to produce conservative estimates of harassment thresholds for the Tongass Narrows Project.

Using the practical spreading loss model, ADOT&PF determined underwater noise will fall below the behavioral effects threshold of 120 dB rms for marine mammals at a maximum radial distance of 6,310 meters for vibratory installation of 30-inch steel piles, and 12,023 meters for drilling of rock sockets. For calculating the Level B zone for impact pile driving, the practical spreading loss model was used with a behavioral threshold of 160 dB rms. The maximum radial distance of the Level B ensonified zone for impact pile driving equaled 2,154 meters for 30-inch steel piles. These are calculated distances based on the practical spreading model; however, landforms will block some sound transmission at closer distances so the Level B zone does not necessarily extend to this maximum distance in all directions. All Level B radial distances for each activity during ADOT&PF's Tongass Narrows Project are listed in Table 14. Figures 10-13 depict the Level B zones for each activity as truncated by land masses.

Larger monitoring zones are truncated to the southeast by islands, which prevent propagation of sound in that direction (Figure 14) beyond the confines of Tongass Narrows. To the northwest of Tongass Narrows, combined sound levels that equal or exceed 167 dB rms extend into Clarence Strait (Figure 14) before attenuating to sound levels that are presumably below 120 dB rms. The maximum size of the ensonified area in Clarence Strait is 21.3 square kilometers (km^2), which occurs only when two down-hole drills are used simultaneously with a vibratory hammer. This value for area is used in calculation of exposure estimates for Mexico DPS humpback whales, which are expected to pass through or near the ensonified area in Clarence Strait each day. This area estimate represents the maximum that could be ensonified when multiple pieces of equipment are used, and therefore results in a maximum estimate of exposure, because a smaller area is ensonified under most equipment combinations.

In some cases, Level B harassment zones for pile combinations are smaller than the Level B zone for down-hole drilling with a single drill, which is 12,050 meters (Table 14). The February 2019 opinion and proposed IHAs analyzed the Level B zones sound sources up to 166 dB rms and 12,050 meters. All combinations of two vibratory hammers result in Level B zones that are smaller than 12,050 meters in radius (Table 8). To reach the 167 dB rms threshold with only vibratory pile installation (no down-hole drilling), three vibratory hammers would have to simultaneously install 30-inch piles (Table 10). There could be potential for this to occur on rare occasions, given that the New Gravina Island Shuttle Ferry Berth/Related Terminal Improvements Project includes vibratory installation of only eight 30-inch piles for 15 minutes each, or a total of 2 hours of vibratory installation; the remaining 66 piles for this project are 24 inches in diameter.

ADOT&PF assumes that the 2 hours of simultaneous installation of 30-inch piles represents 2 days maximum when the Project's Level B zone could briefly exceed 12,050 meters. All other combinations of three vibratory hammers will have Level B zones that are smaller than 12,050 meters in radius and are confined within Tongass Narrows, and effects to this area were analyzed in the February opinion and proposed IHAs.

Combinations of one down-hole drill with a vibratory hammer, two down-hole drills, and two down-hole drills with a vibratory hammer also have source levels that equal or exceed 167 dB rms (see Table 8, Table 9, Table 10, and Table 11) and Level B zones that exceed 12,050 meters (Table 15). No down-hole drilling will occur during construction on Revilla Island. One or two down-hole drills could be used for construction of the New Gravina Island Shuttle Ferry Berth/Related Terminal Improvements Project and the Gravina Freight Facility and Gravina Airport Ferry Layup Facility on the same day and/or simultaneously.

Use of at least one down-hole drill simultaneously with a second down-hole drill or one or two vibratory hammers is the most likely combination of multiple pieces of equipment that will result in Level B zones that exceed 12,050 meters. It is estimated that construction of the New Gravina Island Shuttle Ferry Berth will require the most down-hole drilling, with an estimated 49 days at a production rate of 1.5 piles per day (approximately 180 minutes of down-hole drilling per day). On the days when down-hole drilling occurs, simultaneous use of one or more vibratory hammers or a second down-hole drill could also occur, resulting in a Level B zone that potentially could exceed 12,050 meters for a brief period each day.

In total, the Level B harassment zone could exceed the previously analyzed 12,050 meters on up to 51 days (2 days when three 30-inch piles could be installed simultaneously plus 49 days when a down-hole drill could be used in combination with a second down-hole drill or vibratory hammers, for 51 days total).

2.1.8 Mitigation measures

ADOT&PF has agreed to implement the following measures to avoid and minimize impacts to the humpback whale, including the ESA-listed Mexico DPS of humpback whale.

2.1.8.1 General Conditions for Pile Driving

- *Soft start for impact pile installation*--For impact pile installation, the Contractor will provide an initial set of 3 strikes from the impact hammer at reduced energy, followed by a one-minute waiting period, and then two subsequent 3-strike sets. This soft start will be applied prior to beginning pile installation each day or after an impact hammer has been idle for more than 30 minutes.

- In the event that more than one contractor is working at the same time, they will maintain radio or cellular coordination in order to coordinate adequate monitoring by protected species observers.

- Pile driving activities will occur only during daylight hours, when visual monitoring of humpback whales can be conducted.

Monitoring and Shutdown Zones

Monitoring zones are the areas in which SPLs are expected to equal or exceed 160 and 120 dB rms (Level B harassment for impulsive and continuous sound, respectively). Shutdown zones are the areas within which Level A harassment is likely to occur. Monitoring zones provide utility for monitoring conducted for mitigation purposes (*i.e.*, shutdown zone monitoring) by establishing monitoring protocols for areas adjacent to the shutdown zones. Monitoring zones enable observers to be aware of and communicate the presence of marine mammals in the project area but outside the shutdown zone and thus prepare for potential shutdowns of activity. However, the primary purpose of monitoring zones is for documenting instances of Level B harassment. Nominal radial distances for disturbance zones for single activities are shown in Table 14.

Trained protected species observers (PSOs) will monitor all or a portion of the action area (*i.e.,* a portion of the monitoring zones) for humpback whales. The extent of the monitoring zones will vary depending on the in-water work occurring at the time and the resultant isopleths.

Given the size of the monitoring zone for vibratory pile driving and rock socketing (*e.g.*, 4.7-21.5 km), it is impossible to guarantee that all humpback whales would be observed or to make comprehensive observations of fine-scale behavioral reactions to sound. In order to document observed instances of harassment, PSOs will record all marine mammal observations, regardless of location. The observer's location, as well as the location of the pile being driven, is known from a GPS. The location of the animal is estimated as a distance from the observer, which is then compared to the location from the pile. It may then be estimated whether the animal was exposed to sound levels constituting incidental harassment on the basis of predicted distances to relevant thresholds in post-processing of observational and acoustic data, and a precise accounting of observed incidences of harassment created. This information may then be used to extrapolate observed exposures to quantify total takes.

Table 14. Sound Source Levels, Level B isopleth distances and monitoring zones, and Level A isopleths and shutdown zones for each pile installation method and pile type for single activities. Gray shading indicates both monitoring and shutdown zones PSOs will observe (modified from Table 6-4 in HDR 2018a).

Method and Pile Type	Sound Source Level at 10 m (dB rms)	Distance to Level B Isopleth (m)	Monitoring Zone (m)	Distance to Level A Isopleth (m)	Shutdown Zone (m)
Vibratory Hammer	**dB rms**	**120 dB**			
30-inch steel piles	162	6,310	6,400	11	50
24-inch steel piles	161	5,412	5,500	9[b]	50
18-inch steel piles	161	5,412	5,500	9[b]	50
16-inch steel piles	161	5,412	5,500	13	50
27.6-inch sheet piles	160	4,642	4,700	11	50
30.3-inch sheet piles	160	4,642	4,700	11	50
Drilling of Rock Sockets	**dB rms**	**120 dB**			
All pile sizes	166.2	12,023	12,050	66	70
Impact Hammer[a]	**dB SEL**	**160 dB**			
30-inch steel piles	181	2,154	2,200	523	550
24-inch steel piles	177	1,000	1,000	283	300
18-inch steel piles	177	1,000	1,000	113	150

[a] Only the largest shutdown zones are shown. During impact installation different rates of pile installation would result in smaller isopleth distances.

For multiple simultaneous activities, the Level B harassment zone distance was determined by calculating the combination of simultaneously installed piles, and their resulting combined source level through decibel addition, as shown in Table 15. For each combined source level, the Level B harassment is consistent, regardless of the combination of equipment. Level B harassment zones range from 7,356 meters (vibratory installation of two sheet piles or two, 24-inch round piles simultaneously) to 21,544 meters (drilling for two piles and simultaneous vibratory installation of a 30-inch pile; Table 15).

When two or more pieces of equipment are used simultaneously, and the noise they produce is not continuous or is a combination of continuous and impulsive, Tables 8–11 will be used to determine the combined SSL and Table 15 will be followed to define the Level B zones. Level A zones for multiple activities are described in section 2.1.8.2.1.

Table 15. Level B zones for combinations of two and three piles of different sizes, types, and installation methods

Combined SSL (dB)	Distance to Level B Isopleth (meters)
163	7,356
164	8,577
165	10,000
166	11,659
167	13,594
168	15,849
169	18,478
170	21,544

2.1.8.1.1 Level A shutdown zones

The Level A shutdown zones for humpback whales are listed in Table 14 and shown in Figure 9. If a humpback whale is observed approaching the shutdown zone pertaining to the pile type and installation or removal method underway, pile installation/removal will cease immediately to avoid exposure of humpback whales to Level A harassment.

- *Single activity*: On days when a single piece of pile installation or removal equipment will be used, the Level A harassment zones for each pile will be monitored and implemented according to pile size, type, duration of installation, and installation method, as listed in Table 14 and shown in Figure 9.
- *Multiple activities*: On days when combinations of one down-hole drill with a vibratory hammer, two down-hole drills, or two down-hole drills with a vibratory hammer are used simultaneously, a 100-meter shutdown zone will be implemented for each vibratory hammer and each down-hole drill. These combinations of equipment have source levels that equal or exceed 167 dB rms when used simultaneously. If multiple activities are occurring simultaneously and they include impact hammering, Table 14 should be used to determine the appropriate Level A zone.

Figure 9. Level A shutdown zones for pile installation and removal activities at the Tongass Narrows Project (figure prepared by HDR for this opinion).

2.1.8.1.2 Level B monitoring zones

PSO(s) will monitor for humpback whales within portions of the monitoring zones during pile installation and removal. Level B monitoring zones are determined based on the method of pile installation or removal and the size and type of the pile. Monitoring zones are listed in Table 14 and Table 15 and shown in Figures 10-14.

- *Single activity*: On days and at times when a single piece of pile installation or removal equipment will be used, the Level B monitoring zone for each pile will be monitored and implemented according to pile size, type, and installation method as outlined in Table 14.
- *Multiple activities:* On days when multiple pieces of equipment that produce continuous noise are used simultaneously, Table 8, Table 9, Table 10, Table 11, and Table 15 will be used to define the Level B zones.

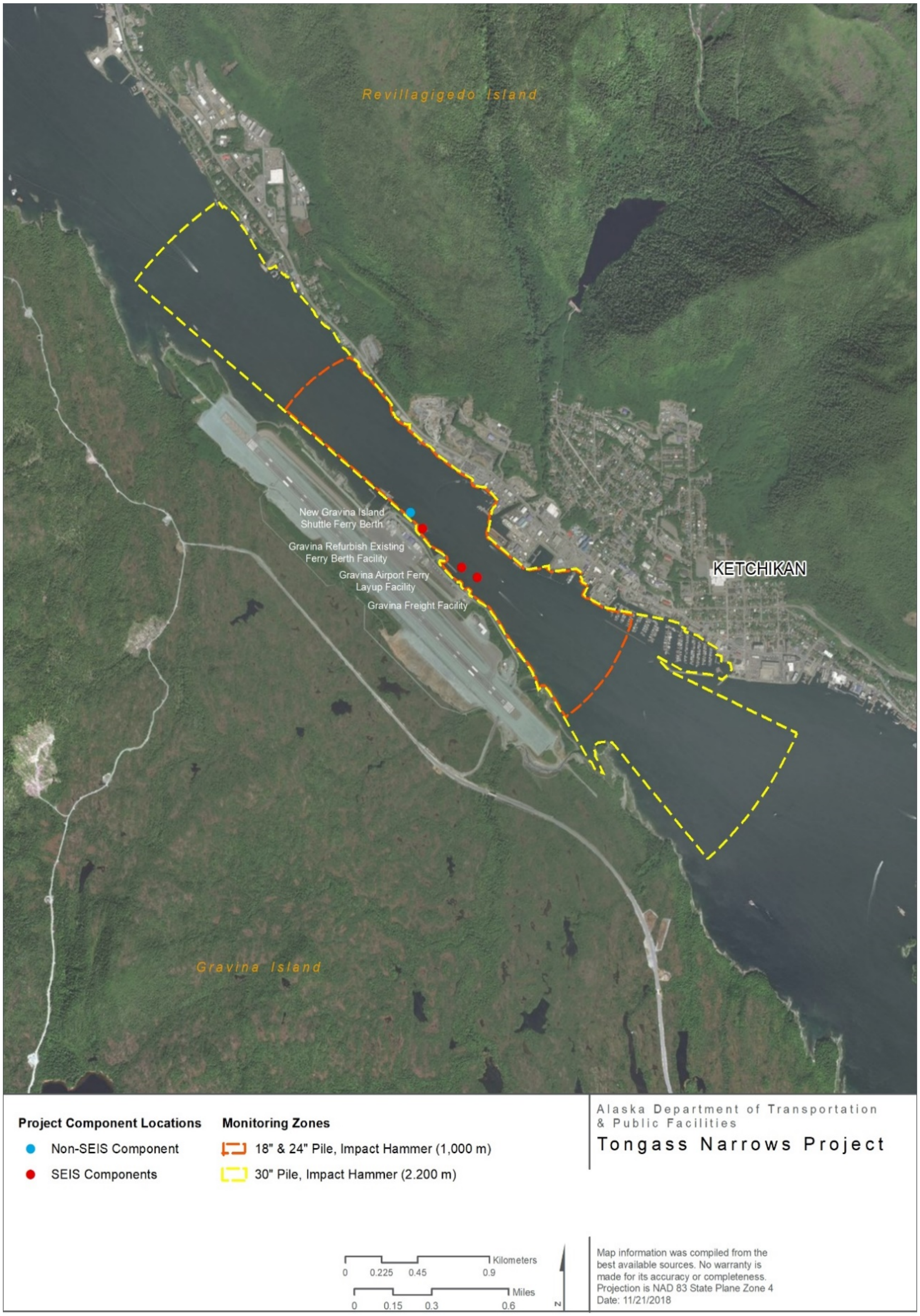

Figure 10. Level B monitoring zones for impact installation of 18-inch, 24-inch, and 30-inch diameter round steel piles at Tongass Narrows Project locations on Gravina Island (figure prepared by HDR for this opinion).

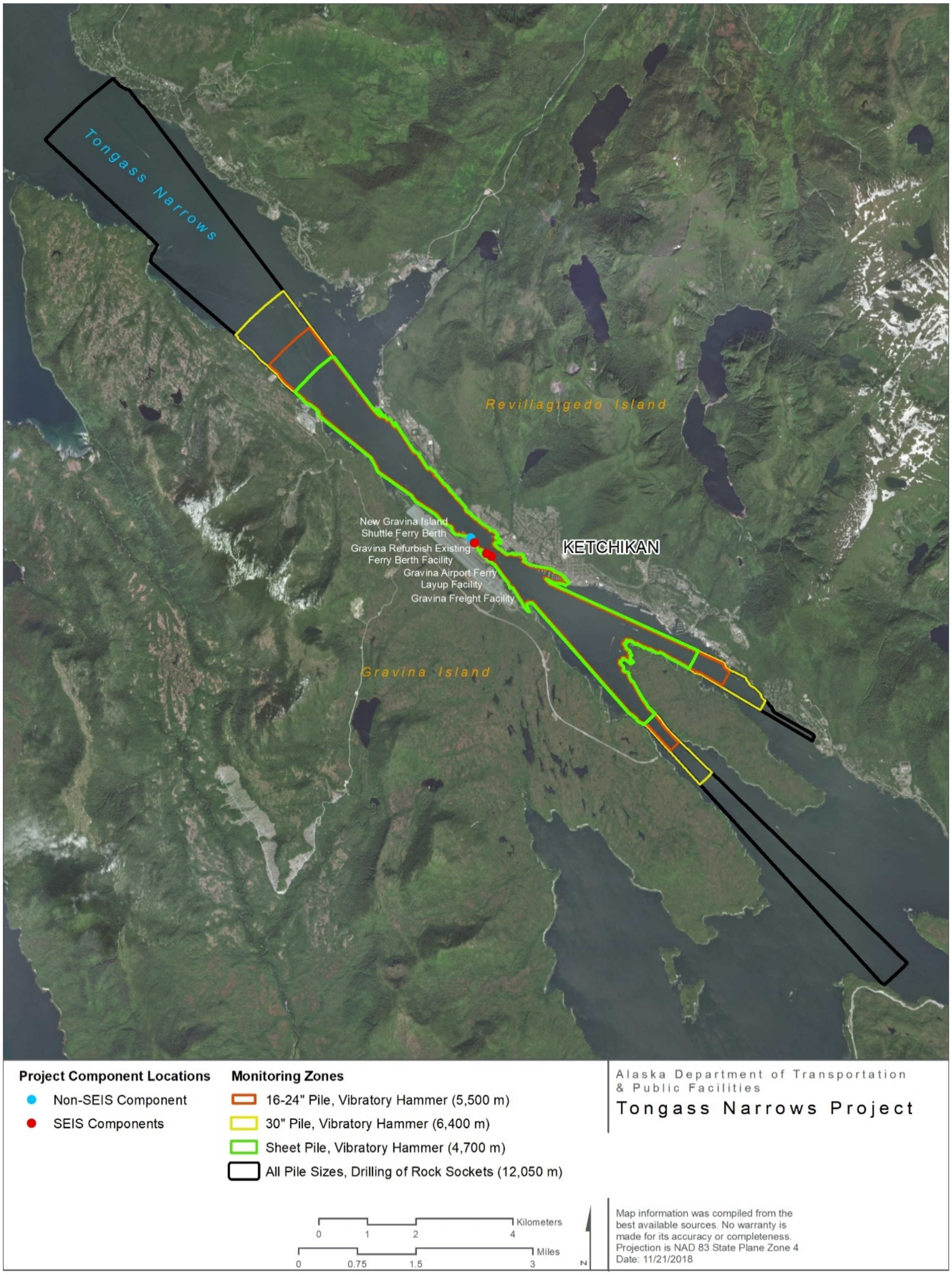

Figure 11. Level B monitoring zones for vibratory installation of 16-30-inch diameter round steel piles, sheet piles, and rock socketing at Tongass Narrows Project locations on Gravina Island (figure prepared by HDR for this opinion).

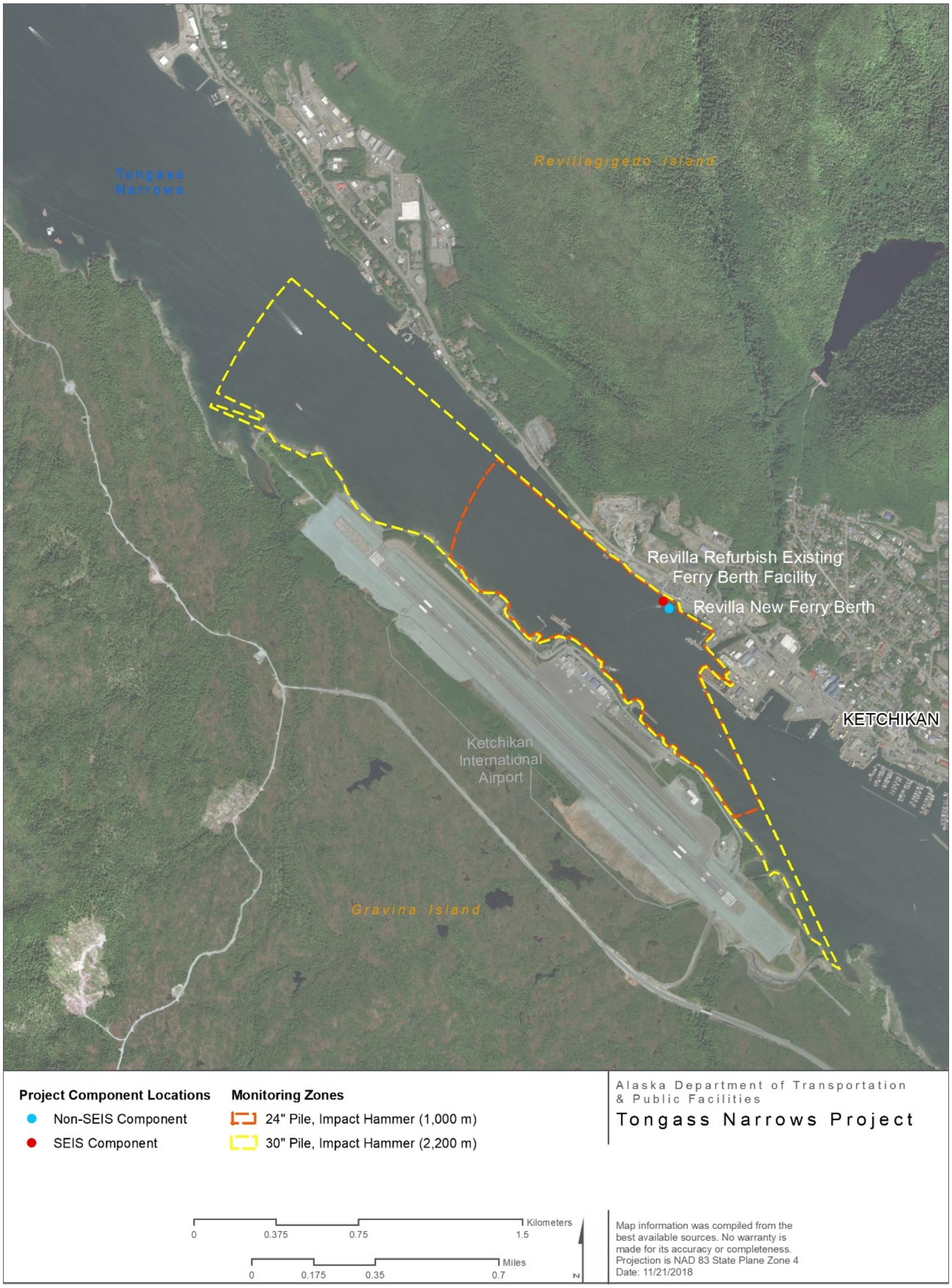

Figure 12. Level B monitoring zones for impact installation of 24- and 30-inch diameter round steel piles at Tongass Narrows Project locations on Revillagigedo Island (figure prepared by HDR for this opinion).

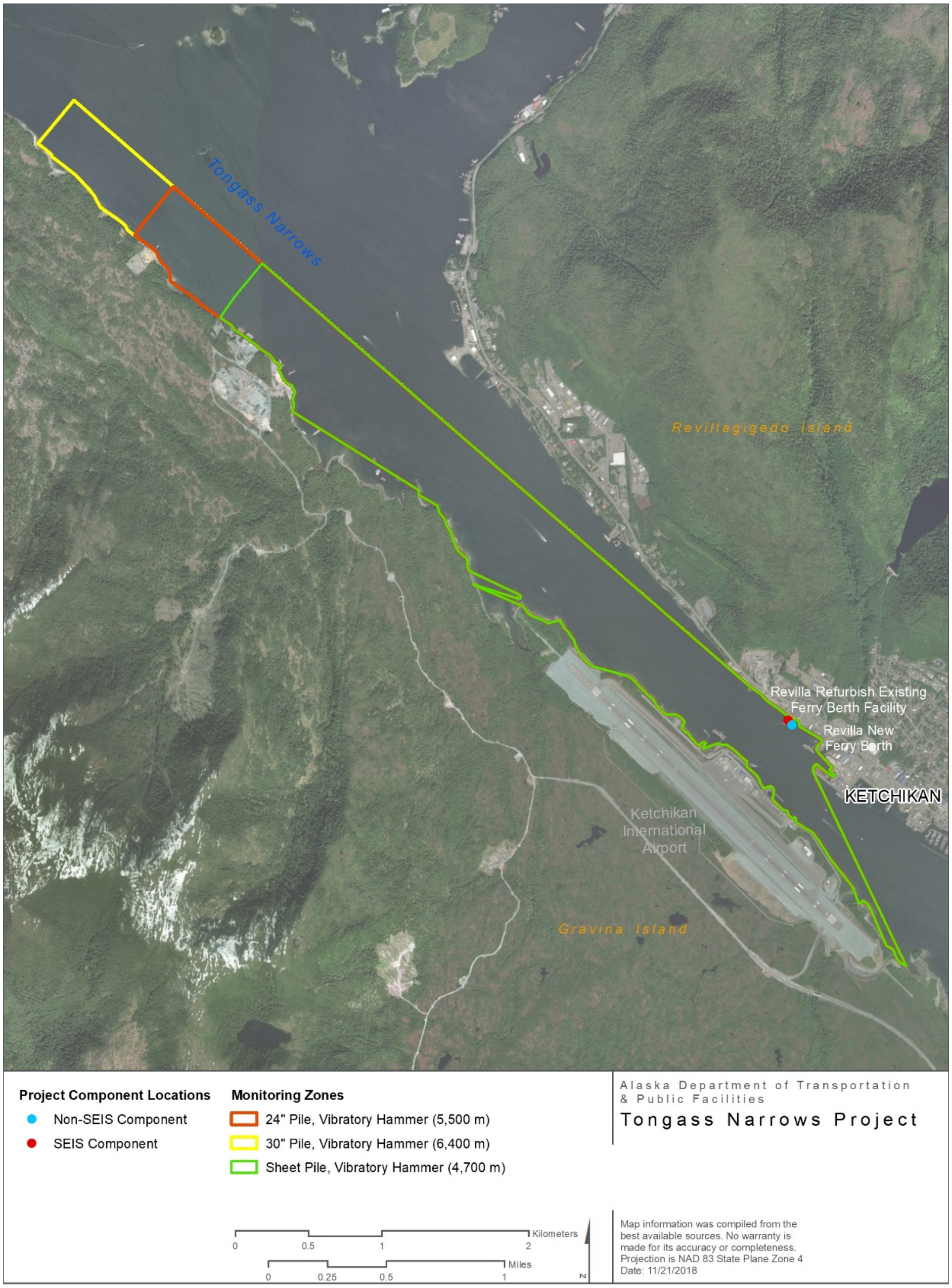

Figure 13. Level B monitoring zones for vibratory installation of 24- and 30-inch diameter round steel piles and sheet piles at Tongass Narrows Project locations on Revillagigedo Island (figure prepared by HDR for this opinion).

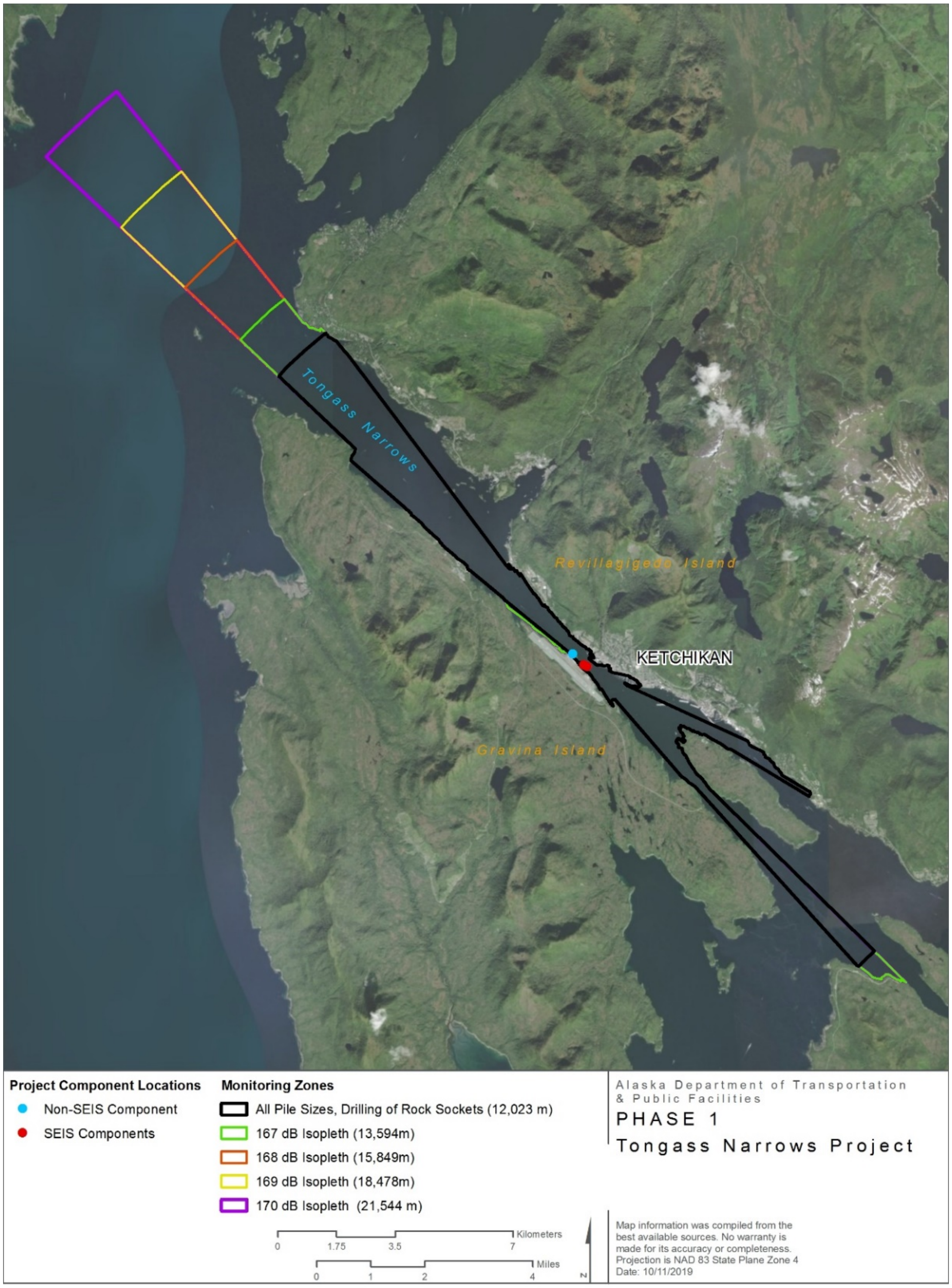

Figure 14. Level B monitoring zones for combinations of two and three piles of different sizes, types, and installation methods with sound source levels from 166-170 dB.

2.1.8.2 Visual Monitoring by Protected Species Observers

2.1.8.2.1 General requirements for visual monitoring

- PSOs able to accurately identify and distinguish species of Alaskan marine mammals will be present before and during in-water pile installation and removal.
- Each contractor managing an active construction site and on-going in-water pile installation or removal will provide qualified, independent PSOs for their specific contract.
- To ensure compliance, ADOT&PF's Construction Manager will coordinate among contractors and their PSOs during all project components to ensure adherence to environmental commitments and permit requirements. The ADOT&PF Construction Manager will ensure that the primary construction contractors and lead PSOs coordinate daily on the day's planned project activities and agree upon the PSO requirements and monitoring and shutdown zones to be implemented that day.
- The ADOT&PF Construction Manager will ensure that the contractors' personnel observe work timing restrictions and other environmental commitments or permit conditions during in-water construction. It will be a required component of the contracts that PSOs coordinate, collaborate, and otherwise work together on a daily basis to ensure compliance with project permits and authorizations.
- In-water pile installation and removal and drilling of rock sockets will not be conducted during periods when conditions such as low light, high sea state, fog, ice, rain, glare, or other conditions prevent effective marine mammal monitoring and visibility of all waters within the shutdown zone.
- PSOs will have the following to aid in determining the location of observed listed species, to take action if listed species enter the shutdown zone, and to record these events:
  - Binoculars
  - Range finder
  - GPS
  - Compass
  - Two-way radio communication with construction foreman/superintendent
  - A log book of all activities, which will be made available to NMFS upon request
- *Pre-Construction Briefing*—The ADOT&PF Construction Manager and contractor(s) will conduct briefings among construction supervisors, crews, and PSOs prior to the start of all in-water pile installation and removal in order to explain responsibilities, communication procedures, marine mammal monitoring protocols, and operational procedures. The crew will be requested to alert the PSO when a marine mammal is observed in the project area.

- *Daily Briefing*-- Each day prior to commencing in-water pile installation and removal, the lead PSO for each contractor will conduct a radio check with the ADOT&PF Construction Manager and the other lead PSO(s) to confirm the activities and zones to be monitored that day. The ADOT&PF Construction Manager and lead PSO(s) will maintain radio communications throughout the day so that the PSOs may be alerted to any changes in the planned construction activities and zones to be monitored.
- 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.
- PSOs must maintain verbal contact with construction personnel to immediately call for a halt of pile installation/removal or drilling operations to avoid exposures, if necessary. A clear authorization and communication system will be in place to ensure that PSOs and construction crew members understand their respective roles and responsibilities.
- *Shifts*-- PSOs will work in rotating shifts of 4–6 hours, as needed, each day to prevent fatigue. Pile installation and removal are intermittent by nature and it is anticipated that periods of rest will be interspersed throughout the day. PSOs will not perform duties as a PSO for more than 12 hours in a 24-hour period to reduce fatigue.
- PSOs will monitor the shutdown zones and portions of the monitoring zones during in-water pile installation and removal. All sightings of humpback whales will be documented.
- *Pre-installation/removal monitoring*-- Prior to the start of daily in-water pile installation or removal, or whenever a break in pile installation or removal of 30 minutes or longer occurs, the PSO(s) will observe the shutdown and monitoring zones for a period of 30 minutes before pile installation or removal can begin.
- While one PSO remains at the construction site to monitor the shutdown zone, two or more PSOs will start at the project site and travel in opposite directions along Tongass Narrows until they have reached the edge of the Level B zone. At this point, the PSOs will identify suitable observation points from which to observe the width of Tongass Narrows for the duration of pile installation/removal. Suitable observation points are plentiful along the shoreline of Tongass Narrows, including along the North and South Tongass Highway and along the Gravina Island Highway, both north and south of the airport. PSOs would only be responsible for observing the width of Tongass Narrows rather than the entirety of the Level B zone because any marine mammals entering the Level B zone would need to pass by one of these two PSOs. All PSOs would be in constant radio contact with one another and the lead PSO would be in contact with the construction team to request a work stoppage, if necessary.
    - When the monitoring zone extends into Clarence Strait, an additional PSO will be stationed at the northernmost monitoring location to monitor for humpback whales in Clarence Strait.

  - If the shutdown zone has been clear of humpback whales for 30 minutes, pile installation or removal can commence and work can continue even if visibility becomes impaired within the Level B monitoring zone. (Visibility may become impaired if weather conditions or Beaufort sea state change such that the width of the monitoring zone is no longer visible.)
  - If a humpback whale is present within the shutdown zone, pile installation or removal will not begin until the animal(s) has left the shutdown zone or no humpback whale has been observed in the shutdown zone for 30 minutes.
  - When a humpback whale for which take has been authorized is present in the monitoring zone, pile installation and removal may begin and the PSO will record take for that individual. Assuming that take has not exceeded the number authorized, pile installation and removal may continue while the humpback whale is within the monitoring zone. Each instance of Level B harassment would be considered authorized by the Incidental Harassment Authorization that NMFS will issue under the MMPA. One out of every 16 whales observed in the monitoring zone (6.1%) would be considered take of a Mexico DPS humpback whale allowed by the Incidental Take Statement issued with this opinion.
  - Soft-start or ramp-up procedures may be initiated while a humpback whale is within the monitoring zone.

- For in-water heavy machinery and construction work (*e.g.*, barge movements and pile positioning), a 10-meter shutdown zone will be implemented for humpback whales. If a humpback whale comes within 10 meters of these activities, the activity will cease as quickly as can safely be accomplished and vessels will reduce speed to the minimum level required to maintain steerage and safe working conditions. The activity may resume after the humpback whale is observed leaving the shutdown zone or has not been observed for 30 minutes.
- If waters exceed a sea state that restricts the PSOs' ability to make observations within the shutdown zone, in-water pile installation and removal will cease. Pile installation and removal will not be initiated or continue until the appropriate shutdown zone is visible in its entirety.
- *Extrapolation of take in Clarence Strait*: When multiple activities occur simultaneously that require monitoring zones that extend into Clarence Strait, extrapolation methods may be used to estimate take when the entire monitoring zone is not visible. If the entire Clarence Strait portion of the Level B monitoring zone is not visible, pile driving activities may continue, and the number of individual humpback whales within that portion of the Level B zone will be estimated and recorded. Estimated numbers of individuals will be extrapolated by dividing the number of observed individuals by the percentage of the monitoring zone in Clarence Strait that was visible.

- For example, if wind and sea state increased causing visibility to diminish to a point that only 50 percent of the Clarence Strait portion of the monitoring zone were visible, and 2 humpback whales were observed entering that portion of the Level B zone, the PSO would estimate that 4 humpback whales were present in the Level B zone in Clarence Strait (2 whales observed in Level B zone ÷ 50% of zone visible = 4 whales estimated to be within Level B zone). (Note that the estimated number of individuals does not equal the estimated number of takes for humpback whales. See Section 2.1.8.4.4 for a description of methods to calculate the number of takes of Mexico DPS humpback whales.)
- No more than four whales are expected to occur in Clarence Strait in a day. Therefore, unless direct counts exceed 4 individuals, 4 would be the maximum number of individuals assumed to be present in Clarence Strait when extrapolation methods are used.

- *During-construction monitoring*--Throughout in-water pile installation and removal, the PSO(s) will continuously monitor for the presence or approach of listed species.
  - If a humpback whale enters, or appears likely to enter, the shutdown zone during pile installation or removal, pile installation or removal will cease immediately. Pile installation or removal may resume when the animal(s) has been observed leaving the area on its own accord. If the animal(s) is not observed leaving the area, pile installation or removal may begin 30 minutes after the animal is last observed in the shutdown zone.
  - Assuming that take has not exceeded the number authorized, pile installation/removal may continue while the humpback whale is within the monitoring zone. Each instance of Level B harassment would be considered authorized by the Incidental Harassment Authorization that NMFS will issue under the MMPA. One out of every 16 whales observed in the monitoring zone (6.1%) would be considered take of a Mexico DPS humpback whale allowed by the Incidental Take Statement issued with this opinion.

2.1.8.2.2 Location of PSOs

- Monitoring locations will be selected to provide an unobstructed view of all water within the shutdown zone.
- One or more PSOs will be present at each construction site during in-water pile installation and removal so that all Level A zones and shutdown zones are monitored by a dedicated PSO at all times.

- When combinations of one down-hole drill with a vibratory hammer, two down-hole drills, or two down-hole drills with a vibratory hammer are used simultaneously, creating a Level B zone that is greater than 12,000 meters in radius, an additional PSO will be stationed at the northernmost monitoring location. One PSO will focus on Tongass Narrows, specifically watching for marine mammals that could approach or enter Tongass Narrows and the project area. The second PSO will look out into Clarence Strait, watching for marine mammals that could swim through the ensonified area. No additional PSO will be required at the southern-most monitoring location because the Level B zones are truncated to the southeast by islands, which prevent propagation of sound in that direction beyond the confines of Tongass Narrows.
- Observation points for viewing portions of the monitoring zones are available from the Tongass Highway and Gravina Airport Access Road. It is possible to observe the entire width of Tongass Narrows with unaided eyes.
- Individual PSOs will not be responsible for observing the entire monitoring zone at one time, but must be able to clearly see the entire width of Tongass Narrows to monitor for humpback whales that could potentially enter the monitoring zone from the north or south.

2.1.8.3 Reporting

2.1.8.3.1 Notification of intent to commence construction

ADOT&PF will inform the NMFS Office of Protected Resources (OPR) and the NMFS Alaska Region Protected Resources Division one week prior to commencing pile installation/removal (Julie Scheurer, 907-586-7111, Julie.Scheurer@noaa.gov).

2.1.8.3.2 Daily activity logs

For each day of pile installation/removal that requires a PSO, the following information will be recorded:

- Date and time that each monitoring period begins and ends;
- Prevailing environmental conditions in each monitoring period (*e.g.*, wind speed, percent cloud cover, visibility, sea state, tide state);
- In-water construction activities occurring during each monitoring period, including how many and what size of piles were installed/removed; and
- Indication of whether marine mammals were sighted. For each marine mammal sighting, the PSO will complete a “Marine Mammal Sighting Form.”

2.1.8.3.3 Marine mammal sighting form

The PSO will record the following information on the “Marine Mammal Sighting Form”:

- Species, number of individuals, and, if possible, sex and age class of marine mammals;

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

2.1.8.3.4 Estimation of Take

Estimated takes will be calculated based on the total number of humpback whales observed (or estimated) in the Level B monitoring zone multiplied by 6.1% (the percentage of humpback whales in the action area estimated to be from the listed Mexico DPS (Wade et al. 2016)). Therefore, for every 16 humpback whales observed in the monitoring zone, approximately one (6.1%) would be considered take of a Mexico DPS humpback whale allowed by the Incidental Take Statement issued with this opinion.

2.1.8.3.5 Interim monthly reports

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

The reporting period for each monthly PSO report will be the entire calendar month, and reports will be submitted by close of business on the tenth day of the month following the end of the reporting period (*e.g.*, the monthly report covering September 1–30, 2018, would be submitted to NMFS by close of business on October 10, 2018).

2.1.8.3.6 Final report

ADOT&PF will submit a draft final report by email to NMFS OPR (Robert.pauline@noaa.gov) and NMFS Alaska Region Protected Resources Division (Julie.Scheurer@noaa.gov) no later than 90 days following the end of construction. ADOT&PF will provide a final report within 30 days following resolution of NMFS's comments on the draft report. If no comments are received from NMFS within 30 days, the draft final report will be considered the final report.

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

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

2.1.8.3.7 Qualifications of PSOs

Monitoring will be conducted by PSOs who meet or exceed the qualifications identified by NMFS. These will include the following:

- Independent PSOs will be used (*i.e.*, not construction personnel).
- One PSO will be designated as the lead PSO or monitoring coordinator. The lead PSO must have prior experience working as a marine mammal observer during construction.
- One PSO must have prior experience working as a marine mammal observer.
- The other PSOs may substitute education (degree in biological science or related field) or training for experience.
- The contractor will ensure that PSOs have the following qualifications:
  - Ability to conduct field observations and collect data according to assigned protocols;

- Experience or training in the field identification of marine mammals, including the identification of behaviors;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when pile installation/removal was conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior; and
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

- Each PSO will be trained and provided with reference materials to ensure standardized and accurate observations and data collection.

2.1.8.4 Reporting Injured or Dead Marine Mammals

2.1.8.4.1 Contact information for reporting injured or dead marine mammals

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

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

In the unanticipated event that the specified activity clearly causes the take of a listed marine mammal in a manner not authorized by the Incidental Take Statement, such as serious injury, or mortality, ADOT&PF will immediately cease the specified activities and report the incident to the NMFS Office of Protected Resources, the NMFS Alaska Region Protected Resources Division, and the NMFS Alaska Regional Stranding Coordinator or Hotline.

The report must include the following information:

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

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

2.1.8.4.3 For injured or dead animals unrelated to the project:

In the event that ADOT&PF discovers an injured or dead marine mammal within the action area, and the lead PSO determines that the cause of the injury or death is unrelated to the project, ADOT&PF will immediately report the incident to the NMFS Alaska Regional Stranding Hotline.

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

2.1.8.5 Strike Avoidance

Vessels will adhere to the Alaska Humpback Whale Approach Regulations when transiting to and from the project site (see 50 CFR §§ 216.18, 223.214, and 224.103(b)). Under these regulations it is **prohibited** for a vessel to:

- approach, by any means, including by interception (*i.e.*, placing a vessel in the path of an oncoming humpback whale so that the whale surfaces within 100 yards (91.4 m) of the vessel), within 100 yards (91.4 m) of any humpback whale;
- cause a vessel or other object to approach within 100 yards (91.4 m) of a humpback whale; or
- disrupt the normal behavior or prior activity of a whale by any other act or omission. A disruption of normal behavior may be manifested by, among other actions on the part of the whale, a rapid change in direction or speed; escape tactics such as prolonged diving, underwater course changes, underwater exhalation, or evasive swimming patterns; interruptions of breeding, nursing, or resting activities, attempts by a whale to shield a calf from a vessel or human observer by tail swishing or by other protective movement; or the abandonment of a previously frequented area.
- Notwithstanding the prohibitions above, vessels must operate at a slow, safe speed when near a humpback whale (safe speed is defined in regulation (see 33 CFR § 83.06)).

Additionally,

- Vessels used in the construction of the project will follow established transit routes and will travel at slow speeds (< 10 knots) while in the action area.
- If a humpback whale comes within 10 m (32.8 ft) of a vessel during construction, the vessel will reduce speed to the minimum level required to maintain safe steerage and working conditions until the humpback whale is at least 10 m (32.8 ft) away from the vessel.

2.1.8.6 Oil and Spill Prevention

- If contaminated or hazardous materials are spilled or released during construction, all work in the vicinity of the contaminated site will be stopped until the Alaska Department of Environmental Conservation (ADEC) is contacted, and a corrective action plan is approved by ADEC and implemented.
- The contractor will provide and maintain a spill cleanup kit on-site at all times, to be implemented as part of the Spill Prevention, Control, and Countermeasure (SPCC) Plan, as well as the Hazardous Material Control Plan (HMCP) and Water Quality Control Plan (WQCP), in the event of a spill or if any oil products are observed in the water.
- Fuel hoses, oil drums, oil or fuel transfer valves and fittings, and similar equipment will be checked regularly for drips or leaks, and will be maintained and stored properly to prevent spills.
- Oil booms will be readily available for oil or other fuel spill containment should any release occur.
- All chemicals and petroleum products will be properly stored to prevent spills. No petroleum products, cement, chemicals, or other deleterious materials will be allowed to enter surface waters.

2.1.8.7 Other Measures

The ADOT&PF has incorporated a number of measures into the project design and construction plan in order to avoid and minimize potential impacts to ESA-listed species in the action area, including:

- All exposed project slopes that are susceptible to erosion will be stabilized in accordance with the project-specific WQCP.
- Work in waters of the U.S. will be conducted in accordance with the terms and conditions of the USACE permits to be obtained for the project.

As an additional measure to avoid and minimize potential impacts to ESA-listed species, the DOT&PF incorporates language into its construction contracts requiring the Contractor to remain compliant with project permits and authorizations, which include the following:

- Biological Opinion and Incidental Take Statement under the ESA;
- IHA under the Marine Mammal Protection Act (MMPA);
- ADEC Clean Water Act Section 401 Water Quality Certification;
- USACE Rivers and Harbors Act Section 10 permit and Clean Water Act Section 404 permit.

2.2 Action Area

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

The six components of the action occur within Tongass Narrows near Ketchikan, Alaska. The action area includes: (1) the six locations where construction activities will take place (see Figure 1); and (2) an ensonified area around pile removal and installation activities (see Table 6).

The action area for the six components of the proposed Tongass Narrows project includes the maximum area within which project-related noise levels are expected to reach or exceed 120 dB re 1 µPa rms (henceforth 120 dB). The loudest sound source with the greatest propagation distance is anticipated to be associated with rock socketing at more than one location simultaneously. Based on modeled sound propagation estimates received levels from drilling rock sockets in the bedrock with a source level of 170 dB re 10 µPa (Denes et al. 2016) may be expected to decline to 120 dB re 10 µPa (rms) within ~21.5 km from the source (HDR 2018b). However, the action area would be truncated where land masses obstruct underwater sound transmission (in this case, land masses on either side of Tongass Narrows and islands within Tongass Narrows); thus, the action area encompasses all of Tongass Narrows from the northern tip of Spire Island in Revillagigedo Channel to the south and northward into Clarence Strait (Figure **15**). A description of the methods used to calculate the distance to the 120 dB isopleth to define the action area is given in Section 6.5.1.2.1 of this opinion.

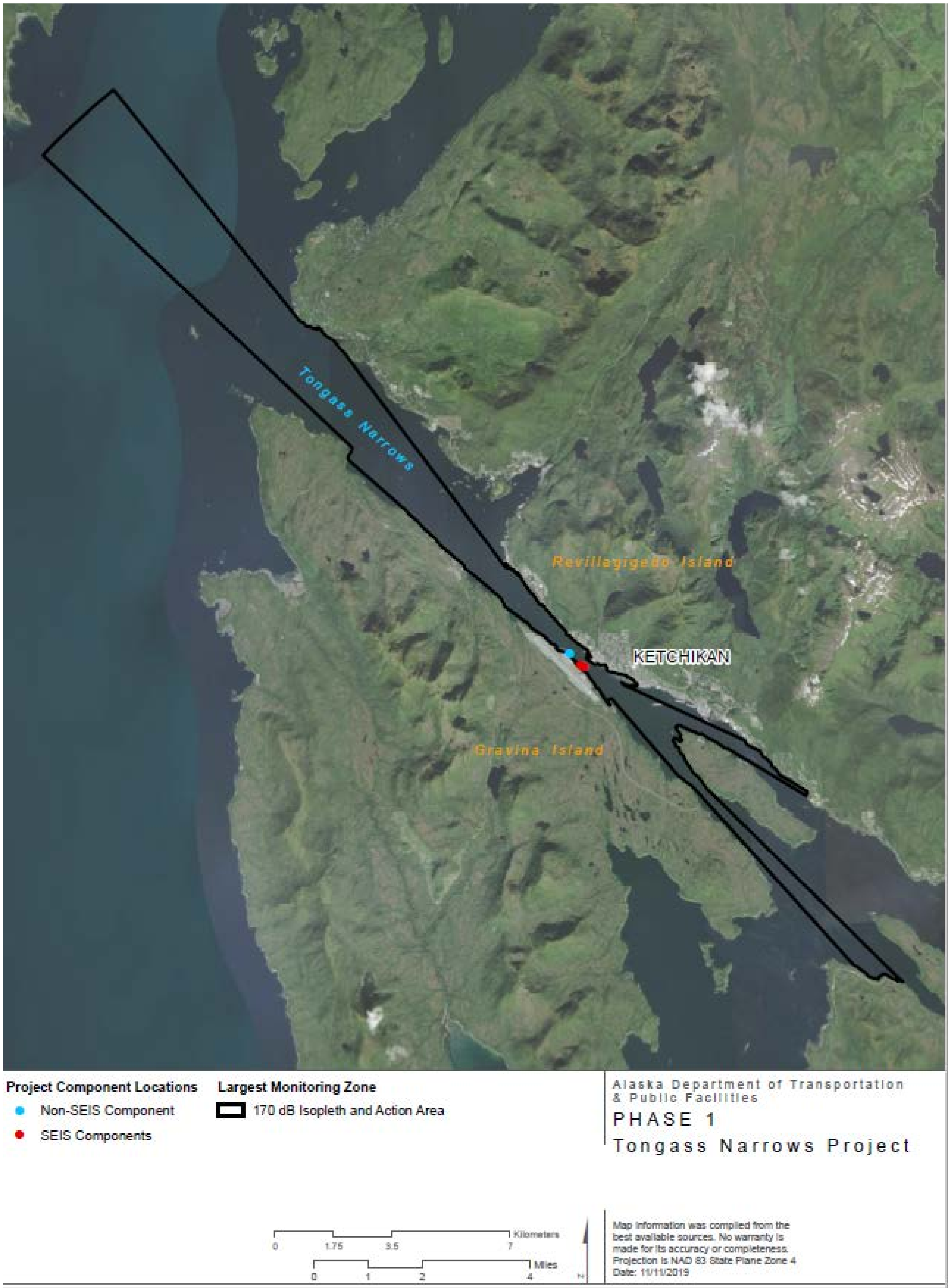

Figure 15. Action area for Tongass Narrows Project. The underwater action area extends approximately 12 km in each direction from the construction site (figure prepared by HDR for this opinion).

3. APPROACH TO THE ASSESSMENT

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

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

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

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

- Identify those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on listed species or critical habitat. As part of this step, we identify the action area – the spatial and temporal extent of these direct and indirect effects.
- Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action. This section describes the current status of each listed species and its critical habitat relative to the conditions needed for recovery. We determine the rangewide status of critical habitat by examining the condition of its PBFs which were identified when the critical habitat was designated. Species and critical habitat status are discussed in Section 4 of this 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 gender of the individuals that are likely to be exposed to stressors and the populations or subpopulations those individuals represent. The effects of the action are described in Section 6 of this biological opinion with the exposure analysis described in Section 6.5 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 6.6 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) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 4). Integration and synthesis with risk analyses occur in Section 8 of this 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.

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 this species or any other occurs within the action area (Table 16).

Table 16. Listing status and critical habitat designation for marine mammals considered in this biological opinion.

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

4.1 Climate Change

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

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

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

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

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

4.2 Status of Listed Species

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

The sections below summarize information on the population structure and distribution of humpback whales in the action area to provide a foundation for the exposure analyses that appear later in this 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. 2018) and the humpback whale status review (Bettridge et al. 2015). In addition, a Sea Grant Marine Advisory Program Officer provided information on the distribution of marine mammals for a similar action in Tongass Narrows (NMFS 2018b) that also apply to the action area considered in this biological opinion[4].

4.2.1 Humpback whale (*Megaptera novaeangliae*)

4.2.1.1 Population Structure and Conservation Status

The humpback whale (a mysticete or "baleen" whale) was listed as endangered under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (35 FR 18319). Congress replaced the ESCA with the ESA in 1973, and humpback whales continued to be listed as endangered. NMFS recently conducted a global status review and changed the status of humpback whales under the ESA. The globally listed species was divided into 14 DPSs, four of which are endangered, one is threatened, and the remaining 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. Critical habitat has not been designated for the listed Western North Pacific or Mexico DPSs (NMFS 2016a).

4.2.1.2 Humpback Whales in Southeast Alaska

Wade et al. (2016) estimated abundance of humpback whales within all sampled winter and summer areas in the North Pacific, and estimated migration rates between these areas. The probability of encountering whales from each of the four North Pacific DPSs in various feeding areas is summarized in Table 17 below (NMFS 2016a). As shown in Table 17 for Southeast Alaska and Northern British Columbia, only whales from the Mexico and Hawaii DPSs are likely to be present in the action area, and we expect an estimated 6.1% of the observed humpback whales to be from the threatened Mexico DPS.

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

Table 17. Probability of encountering humpback whales from each DPS in the North Pacific Ocean in various feeding areas. Adapted from Wade et al. (2016).

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

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

Whales from the Mexico and Hawaii DPSs overlap in Southeast Alaska. The Mexico DPS is comprised of approximately 3,264 (CV=0.06) animals (Wade et al. 2016) with an unknown population trend, though likely to be in decline (81 FR 62260). Under the MMPA, the stock structure is being revised to match the DPSs described in Wade et al. (2016). The Central North Pacific stock (which corresponds with the Hawaii DPS) is estimated to be comprised of 10,103 (CV=0.3) animals (Muto et al. 2018). The population trend for the Central North Pacific stock is estimated to be increasing at a maximum annual rate of 7 percent (Muto et al. 2018).

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

Relatively high densities of humpback whales occur throughout much of Southeast Alaska and northern British Columbia, particularly during the summer months (Muto et al. 2018). The abundance estimate for humpback whales in the Southeast Alaska is estimated to be 6,137 (CV=0.07) animals which includes whales from the Hawaii DPS (~94%) and Mexico DPS (~6%) (Wade et al. 2016). Although migration timing varies among individuals, most whales depart for Hawaii or Mexico in fall or winter and begin returning to Southeast Alaska in spring, with continued returns through the summer and a peak occurrence in Southeast Alaska during late summer to early fall. However, there are significant overlaps in departures and returns (Baker et al. 1985; Straley 1990).

4.2.1.3 Humpback Whales in the Action Area

Scientific surveys and resulting data such as population estimates, densities, or other quantitative information are lacking for humpback whales in and near Ketchikan, Alaska. Therefore, qualitative information was gathered from discussions with knowledgeable local people in the Ketchikan area, including biologists, the harbormaster, a tour operator, and other individuals familiar with marine mammals in Tongass Narrows and surrounding waters.

Qualitative information was obtained from discussions with the following individuals:

- Dan Berg, Senior Harbormaster, City of Ketchikan
- Gary Freitag, Alaska Sea Grant Marine Advisory Program Agent, Ketchikan
- Eric Lunde, Operations Manager and vessel captain, Allen Marine Tours, Ketchikan
- Andrew Mathews, National Oceanic and Atmospheric Administration Fisheries Law Enforcement officer, Ketchikan
- Boyd Porter, Wildlife Management Biologist, Alaska Department of Fish & Game (ADF&G), Ketchikan
- Bo Meredith, Assistant Management Biologist, Commercial Fisheries Division, ADF&G, Ketchikan
- Travis Robbins, Ketchikan Airport Ferry Operations Manager
- Mike Carney, Ketchikan Airport General Manager

No systematic studies have documented humpback whale abundance near Ketchikan. Anecdotal information suggests that this species is present in low numbers year-round in Tongass Narrows, with the highest abundance during summer and fall. Anecdotal reports suggest that humpback whales are seen only once or twice per month, while it has also been suggested that the occurrence is more regular, such as once per week on average, and more seasonal. In a recent biological opinion, and based on observations by Gary Freitag, Marine Advisory Agent for Alaska Sea Grant in Ketchikan, NMFS estimated that on average, humpback whales would occur in groups of 1-3 whales three times per month in Tongass Narrows (NMFS 2018b). Most humpback whales depart Alaska for their breeding grounds in October and November, and return in March and April. In August 2017, groups of six individuals were observed passing through Tongass Narrows several times per day, for several days in a row. During fall 2018, Ketchikan Airport staff and ferry captains reported an increase in the frequency of occurrence of humpback whales in the vicinity of the Tongass Narrows Project. On average, one whale was seen every 2–3 days, and a cow with calf were observed near the project location once every 2–3 weeks. Local specialists agreed that humpback whale presence and abundance are greater in Clarence Strait and estimated about four humpback whales could pass through or near the portion of the action area that extends into Clarence Strait each day.

4.2.1.4 Natural History

4.2.1.4.1 Reproduction and growth

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

4.2.1.4.2 Feeding and prey selection

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

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

4.2.1.4.3 Diving and social behavior

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

In a review of the social behavior of humpback whales, Clapham (1996) reported that they form small, unstable social groups during the breeding season. During the feeding season they form small groups that occasionally aggregate on concentrations of food. Feeding groups are sometimes stable for long periods of time. There is good evidence of some territoriality on feeding grounds (Clapham 1994; Clapham 1996) and calving areas (Tyack 1981).

4.2.1.4.4 Vocalization and hearing

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

Humpback whales produce at least three kinds of sounds:

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

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

4.2.1.5 Stressors and Threats

The MMPA stock delineations have not yet been revised to correspond with the 14 DPSs established for humpback whales in 2016. Therefore, estimates of rates of mortality and serious injury in the stock assessment reports (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. 2018).

4.2.1.5.1 Commercial whaling

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

4.2.1.5.2 Predation

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

4.2.1.5.3 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%) and bowhead whales (32%) (Lefebvre et al. 2016). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992).

4.2.1.5.4 Subsistence harvest

Subsistence harvest of humpback whales is prohibited under the Whaling Convention Act. There are no reported takes of humpback whales from the Mexico DPS by subsistence hunters in Alaska for the 2011-2015 period (Muto et al. 2018). One humpback whale was taken illegally by Alaska Native subsistence hunters near Toksook Bay in western Alaska in 2016, and while it could have been a member of the Mexico DPS or Western North Pacific DPS, it was more likely from the non-listed Hawaii DPS (NMFS unpublished data; Wade et al. 2016).

4.2.1.5.5 Unusual Mortality Event (UME)

NMFS declared a UME for large whales in the western Gulf of Alaska that occurred between May 22 and December 31, 2015, and included 22 humpback and 12 fin whale mortalities[5]. No specific cause for the increased mortality was identified, although it was most likely related to unusual oceanographic and climatic conditions that may have led to shifts in prey distribution or harmful algal blooms. This UME has been closed.

4.2.1.5.6 Fishery interactions and entanglements

Humpback whales are occasionally entangled during interactions with commercial, recreational, and subsistence fishing gear, marine debris, vessels' ground tackle, and other anchored lines (Muto et al. 2018). Summaries of mortalities and serious injuries attributed to specific fisheries and gear types are summarized in Tables 1 and 2 of Muto et al. (2018).

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.

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).

[5] 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.

4.2.1.5.7 Vessel collisions

Vessel collisions with humpback whales remain a significant management concern, given the increasing abundance of humpback whales foraging in Alaska, as well as the growing presence of marine traffic in Alaska's coastal waters. Based on these factors, injury and mortality of humpback whales as a result of vessel strike will continue into the future (NMFS 2006). The potential for ship strikes may increase as vessel traffic in northern latitudes increases with changes in sea-ice coverage (Muto et al. 2018).

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

4.2.1.5.8 Other stressors

Elevated levels of sound from anthropogenic sources (*e.g.*, shipping, military sonar) are a potential concern for humpback whales in the North Pacific (Muto et al. 2018). A humpback was reported entangled in a research wave rider buoy off the U.S. West Coast (Carretta et al. 2017). Other potential impacts include possible changes in prey distribution with climate change, entanglement in or ingestion of marine debris, impacts from oil and gas activities, and disturbance from whale watching activities (Muto et al. 2018).

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).

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

5.1 Physical Environment

Tongass Narrows is an approximately 13-mile-long, north-south-oriented marine channel situated between Revillagigedo Island to the east and Gravina Island to the west. In the vicinity of the project, Tongass Narrows is as little as 300 meters (984 feet) wide. 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. The airport averaged 43 aircraft operations per day in 2011 and offers multiple commercial flights per day.

Tongass Narrows is generally characterized by strong tidal currents and by steep bedrock or coarse gravel-cobble-boulder shoreline. Lower intertidal and shallow subtidal areas are often sandy or mixed gravel, sand, and shell, with varied amounts of silt. At other areas, however, such as at rocky points and along the northwestern shore of Pennock Island, bedrock slopes steeply to subtidal depths. Subtidal habitats are a mix of bedrock outcrops or ledges, boulder-cobble slopes, and, where lower slopes permit, sandy gravel bottoms, often mixed with significant amounts of shell debris, similar to intertidal habitats.

Several small natural coves and areas protected by constructed breakwaters provide wave and current protection for marine habitats with sand or gravel bottoms with some areas of eelgrass (*Zostera marina*) beds. Extensive areas of riprap bank protection and fill occur along the northeastern shoreline of the City of Ketchikan. Construction of numerous buildings and docks on pilings over the intertidal and shallow subtidal zone has significantly modified the shorelines in these areas. Shoreline protection activities have similarly modified about 1 mile of the shoreline of Gravina Island in the vicinity of the airport and airport ferry terminal.

Water depths reach approximately 49 meters (160 feet) in the middle of the Tongass Narrows between the airport and town, but generally do not exceed 18 meters (60 feet) where piles will be installed. The channel bottom slopes at about 2H:1V (horizontal:vertical) from opposite shores. Geologic conditions in the vicinity of the project were evaluated by CH2M in 2017 (CH2M 2018). The substrate consists of approximately 18 to 23 meters (60 to 75 feet) of very loose to very dense granular deltaic or alluvial sand and gravel. At approximately 18 to 23 meters (60 to 75 feet) below the mudline, the substrate transitions to phyllite bedrock (CH2M 2018).

5.2 Fish and Essential Fish Habitat

Tongass Narrows and Revillagigedo Channel are designated as Essential Fish Habitat (EFH) under the Magnuson Stevens Fisheries and Conservation Management Act for Dover sole (*Solea solea*) and all five species of Pacific salmon[6]. Pacific salmon species include: chum salmon (*Oncorhynchus keta*), Chinook salmon (*O. tshawytscha*), pink salmon (*O. gorbuscha*), coho salmon (*O. kisutch*), and sockeye salmon (*O. nerka*). Alaska Department of Fish and Game and NMFS have also identified Pacific herring and Pacific halibut as important in the project area (HDR 2017).

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

The Alaska Department of Fish and Game Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes lists numerous anadromous streams that flow into the action area. Anadromous streams in Tongass Narrows provide habitat for all five species of Pacific salmon, cutthroat trout (*O. clarkia*), and steelhead (*O. mykiss*)[7].

5.3 Marine Vessel Activity

The action area experiences high levels of marine vessel traffic with highest volumes occurring May through September. Marine vessels that use the action area include passenger ferries, commercial freight vessels/barges, commercial tank barges, cruise ships, U.S. Coast Guard vessels, commercial fishing boats, charter vessels, recreational vessels, kayaks, and floatplanes[8].

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 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.[9]

The Alaska Marine Highway also operates ferries year-round in Ketchikan. Ketchikan receives ferry service seven days per week in the summer, and five to six days per week in the winter. Additionally, ferries connect Ketchikan and Metlakatla five days per week year-round.[10]

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

Cruise ships are the largest vessels that routinely use the action area. At any given time during the summer (May–September), as many as five large cruise ships may be moored or at anchor in the Port of Ketchikan. Cruise ship stops in Ketchikan generally increased through the 1990s and peaked in 2005. Forty ships are expected to visit Ketchikan in 2018 with a total of 504 stops[11].

[7]ADFG. Fish Resource Monitor. Available at http://extra.sf.adfg.state.ak.us/FishResourceMonitor/?mode=awc, accessed February 2018.
[8] U.S. Coast Guard (USCG). Tongass Narrows Voluntary Waterway Guide. Available at http://seapa.com/waterway/TNVWG.pdf, accessed February 2018.
[9] Ketchikan Gateway Borough website (available at https://www.borough.ketchikan.ak.us/147/Airport-Ferry, accessed Jan. 2019), and personal communication with Mike Carney, General Manager of Ketchikan International Airport (Dec. 2018).
[10] Alaska Marine Highway website. Available at https://www.dot.state.ak.us/amhs/, accessed January 2019.
[11] Ketchikan Visitors Bureau Visitor Statistics. Available at http://www.visit-ketchikan.com/Getting-Here/Getting-Here-by-Sea, accessed February 2018; and personal communication with Kerri Hassett, Visitor Services Manager, Ketchikan Visitors Bureau.

Numerous commercial and charter fishing vessels and recreational craft, such as powerboats and sailboats, operate in the project vicinity. The Ketchikan Port & Harbors Department operates and maintains five boat harbors (Bar Harbor, Thomas Basin, Casey Moran, Knudson Cove, and Hole-In-The-Wall), the Port of Ketchikan, and three launch ramps that are heavily used[12].

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

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

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

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

a. Not approach within 100 yards of a humpback whale, or cause a vessel or other object to approach within 100 yards of a humpback whale,

b. Not place vessel in the path of oncoming humpback whales causing them to surface within 100 yards of vessel,

c. Not disrupt the normal behavior or prior activity of a whale, and

d. Operate vessel at a slow, safe speed when near a humpback whale. Safe speed is defined in regulation (see 33 CFR § 83.06).

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

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

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

5.4 Fishery Interactions Including Entanglements

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

Entangled marine mammals may drown or starve due to being restricted by gear, suffer physical trauma and systemic infections, or be hit by vessels due to an inability to avoid them. Entanglement can include many different gear interaction scenarios, but the following have occurred with humpback whales:

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

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

5.5 Pollution

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

According to the ADEC's most recent list of impaired waterbodies, there are no impaired waterbodies in the action area[13]. However, marine water quality in the action area can be affected by discharges from seafood processing plants, timber industry activities, shipyard and other industrial activity, treated sewer system outflows, cruise ships and other vessels operating in marine waters, and sediment runoff from paved surfaces and disturbed areas (HDR 2017).

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

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

A search of the ADEC Contaminated sites database showed that there are five land-based active contaminated sites in the vicinity of Ketchikan[13]. These include the Salvation Army site (Hazard ID 26907) where diesel fuel has contaminated the soil; the former Ketchikan Hospital (Hazard ID 25353) where soils are contaminated with lead; the USCG Ketchikan Base (Hazard ID 1184) where petroleum hydrocarbon contaminated soils have been identified; the USCG Ketchikan Officer's Quarters (Hazard ID 2990) where diesel contamination from a heating oil tank has been identified; and the Ketchikan Airport Maintenance Building USTs (Hazard ID 24498) where spills during fuel transfer resulted in contaminated soil. Clean-up is in progress at four of the five sites and near completion at the fifth site.

5.6 Climate and Ocean Regime Change

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

[13] ADEC. Division of Spill Prevention and Response. Contaminated Sites Map. Available at https://www.arcgis.com/home/webmap/viewer.html?webmap=315240bfbaf84aa0b8272ad1cef3cad3, accessed November 2018.

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

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

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

5.7 Coastal Zone Development

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

5.8 In-Water Noise

The project area is subject to noise from many anthropogenic sources, including marine vessels, seafood processing, shoreline and dock construction, aircraft, and land vehicles. Beyond Tongass Narrows, the project action area extends to the south into Revillagigedo Channel; a relatively undeveloped area. Ambient underwater noise levels in Tongass Narrows range from 120-130 dB, depending on season, with elevated levels during summer (HDR 2018b).

5.9 Competition for Prey

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

6. EFFECTS OF THE ACTION

Per 50 CFR 402.02, "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.

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 biological opinion with the results of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species.

6.1 Project Stressors

Based on our review of the Biological Assessment (HDR 2018b), the IHA application (HDR 2018a), personal communications, and available literature as referenced in this biological opinion, our analysis recognizes that the proposed construction activities at the Tongass Narrows Project may cause these primary stressors:

- Injury or disturbance due to construction vessel traffic
- Disturbance to seafloor
  - Excavation
  - Placement of fill
- Pollution from unauthorized spills
- Overwater shading and effects to prey
- Marine mammal habitat loss
- Indirect effects of increasing accessibility of Gravina Island
- Underwater noise from:
  - Pile installation and pile removal, including drilling (socketing and anchoring)
  - Vessel traffic

Most of the analysis and discussion of effects to Mexico DPS humpback whales from this action will focus on exposure to impulsive and continuous noise sources because these stressors will likely have the most direct impacts. The *Integration and Synthesis* (Section 8) considers the combined effects of all identified stressors in formulating the agency's biological opinion as to whether the proposed action is likely to jeopardize the continued existence of Mexico DPS humpback whales.

6.2 Stressors Unlikely to Occur or Likely to Have Negligible Impacts on ESA-listed Species

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

6.2.1 Injury or disturbance due to construction vessel traffic

The possibility of vessel strike or measurable disturbance associated with the proposed action is extremely unlikely. The contractor is expected to mobilize a crane and one or two floating barges on each side of Tongass Narrows that will be moved into location with a tugboat. Tug towing operations for construction occur at relatively low speeds (5 knots), and the maximum transit speed for tugs and barges is anticipated to be 8–10 knots. Once vessels get to the construction site, they will be anchored. Skiffs may transport workers very short distances and low speeds from shore to the work platform. All vessels associated with the project will follow well-established, frequently used navigation lanes within Tongass Narrows.

In 2017, there were seven reported vessel strikes to humpback whales in Alaska (https://alaskafisheries.noaa.gov/sites/default/files/17strandings.pdf). Between 2011 and 2015 the minimum mean annual mortality and serious injury rate due to ship strikes reported in Alaska for humpback whales was 1.8 whales (Muto et al. 2018). 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, only one was reported within Tongass Narrows. That whale arrived in the Ketchikan Harbor on the bulbous bow of a cruise ship when it came into port, but it is uncertain if it was struck in Tongass Narrows or elsewhere.

Following construction of the project, levels of vessel traffic between Revillagigedo and Gravina islands will remain about the same. There is potential for increased passenger load in the future, but the primary purpose for the new ferry berths is provide a backup berthing facility on either side of the channel in case a berth becomes damaged or inaccessible, not to increase the number of vessel crossings or passengers. The two existing passenger ferries will continue to provide multiple daily trips across the channel, where collision with or disturbance to humpback whales is possible, but unlikely.

Vessel activity is common throughout the action area. Most ship strikes of large whales occur when vessels are traveling at speeds of 10 knots or more (Jensen and Silber 2003; Laist et al. 2001). Because the ferries travel at speeds averaging 5-6 knots, it is unlikely that a ferry will collide with a humpback whale. Vessel activity in Tongass Narrows is a regular and almost constant occurrence. Humpback whales have become habituated to vessel traffic and continue to use marine waters in the action area, including in Tongass Narrows. A potential small increase in vessel activity in the future, particularly in an area with existing high levels of vessel activity, will not significantly increase the potential for disturbance or displacement of humpback whales.

Vessel disturbance or strikes on humpback whales are not expected because 1) commercial and recreational vessels are common in the action area; 2) humpbacks are infrequently present in the action area and those present are likely to habituated to regular vessel traffic; 3) vessels associated with the project are primarily slow-moving tugboats and barges and small skiffs for transporting workers; 4) vessel traffic is not expected to increase substantially once the project is completed; 5) airport ferries using the new and existing berths will transit at speeds averaging 5-6 knots and not exceeding 9 knots, slow down when whales are present, and announce over the radio to alert other mariners when whales are present [14]; and 6) vessels will follow NMFS's regulations that prohibit approaching within 100 yards of humpback whales. All of these factors limit the risk of strike. We conclude the anticipated effects of strike are unlikely to occur and any effects from disturbance are expected to be negligible.

6.2.2 Disturbance to seafloor

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

Excavation and fill placement activities will also disturb the seafloor and create turbidity. Much of the earth moving activity will be conducted at low tide stages and increased turbidity is expected to settle rapidly once the excavation or fill placement activity is complete. Approximately 1.8 acres of marine habitat below the high tide line will be permanently modified through the placement of fill. The area of fill is adjacent to a heavily modified, shallow shoreline and is not regularly used by humpback whales. No soil will be used for fill material; only clean shot rock will be used.

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

[14] Personal communication with Mike Carney, Ketchikan International Airport General Manager, December 21, 2018.

Humpback whales are not expected to come close enough to the Tongass Narrows Project sites to encounter increased turbidity from construction activities, and if they do, any impact from increased turbidity levels would be negligible and would not cause a disruption of behavioral patterns that would rise to the level of harassment. Therefore, we conclude that the effects from this stressor are so small that they are not measurable, *i.e.*, they are negligible.

6.2.3 Introduction of pollutants into waters

An SPCC Plan, HMCP, WQCP, Construction General Permit, and other Best Management Practices (as described in Section 2.1.8.7 *Oil and Spill Prevention* of this opinion) will be implemented during construction to prevent contaminants from entering the water column. 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 humpback whales would be immeasurably small. Therefore, we conclude that the effects from this stressor are negligible.

6.2.4 Overwater shading and effects to prey

Completion of the six in-water components of the Tongass Narrows Project would result in a net increase of approximately 52,000 square feet of overwater shading. This may result in a small, localized reduction in habitat and productivity for benthic invertebrate resources in the project footprint due an increase in shading beneath the new and expanded docks. However, prey habitat in the vicinity of the Tongass Narrows Project has been subjected to prior development and disturbance and the effects of a slight increase in overwater shading are expected to have minimal impacts on prey resources. Indirect effects to prey would be too small to detect or measure due to the small area affected, and effects to humpback whales would be negligible.

6.2.5 Loss of marine mammal habitat

The Tongass Narrows Project will occur within the same footprint of existing marine infrastructure. This area is already extensively developed and is not considered important habitat for feeding, resting, reproduction, or other important life functions of humpback whales. Approximately 1.8 acres of marine habitat below the high tide line will be permanently modified through the placement of fill. The area of fill is adjacent to a heavily modified, shallow shoreline and is not regularly used by humpback whales. The modification of this habitat is not expected to have an effect on humpback whale distribution or habitat use. Effects to humpback whales from the loss of habitat would be too small to detect or measure due to the small area affected.

6.2.6 Indirect effects of increasing accessibility of Gravina Island

Two of the goals of the Tongass Narrows Project are to improve access to developable land on Gravina Island and facilitate economic development in the Ketchikan Gateway Borough, specifically on Gravina Island. Development on Gravina Island may increase the demand for passenger ferries between Revillagigedo and Gravina islands.

The City of Ketchikan anticipates an increase in the number of cruise ship passengers that visit Ketchikan annually. This may also increase the demand for ferries between the islands, so that cruise ship passengers may access the airport.

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

6.3 Stressors Likely to Adversely Affect ESA-listed Species

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

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 try to identify the number, age (or life stage), and sex of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent.

6.4.1 Exposure to noise from pile driving activities

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

Temporarily elevated underwater noise during pile installation and removal has the potential to result in Level B (behavioral) harassment of marine mammals. Level A harassment (resulting in injury) is not expected to occur as a result of the proposed action because shutdown zones will be implemented (Table 14 , and Figure 9) and the *Mitigation Measures* proposed in Section 2.1.8 will reduce the potential for exposure to levels of underwater noise above the injury threshold established by NMFS.

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

Exposure Assumptions

- Animals occurring within the Level A and Level B ensonified zones are considered to be in each zone simultaneously, but would only be counted as one Level A take.

- Exposures are based on total number of days that pile driving could occur and that animals might occur in the ensonified Action Area.
- One day equates to any length of time that piles are driven whether it is a partial day or a 24-hour period.
- 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 and removal are assumed to be incidentally taken (i.e., exposures to sound levels at or above the relevant thresholds equate to take).
- An individual animal can only be taken once during a 24-hour period.
- For animals that may occur in groups, each individual in the group would be considered taken.
- Level B take estimates are unmitigated and do not take into account monitoring and mitigation efforts to reduce take as described in Section 2.1.4.
- The reported radii for 24-hr SEL (Level A) thresholds are based on the assumption that marine mammals remain stationary or at a constant exposure range during the entire 24-hr period, which is an extremely unlikely scenario. These estimated distances for Level A represent an unlikely worst-case scenario.

6.4.1.1Estimating marine mammal occurrence

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

Humpback whales are occasionally present in the action area and could be encountered during any given day of dock construction. In a recent biological opinion for a project occurring between September and March (NMFS 2018b), NMFS estimated the exposure of humpback whales to underwater noise based on the observation that humpback whales were likely to occur in Tongass Narrows in groups of 1–2 animals, 3 times per month. In the BA submitted for this project (HDR 2018b), observations were reported of humpback whales in groups of up to six individuals in Tongass Narrows for several days in a row in August 2017. In 2018, airport ferry personnel observed a lone humpback whale in the action area every few days for several months, and a group of two humpback whales every other week. To incorporate differences in abundance throughout the year, recent observations of larger groups of whales present during summer, and a higher than average frequency of occurrence in recent months, we assume that whales could be present twice per week in groups averaging two individuals year-round within Tongass Narrows. This may be an overestimate, but accounts for uncertainty in humpback whale density in the action area.

The following method was used to estimate the number of exposures to Level B harassment in the February 2019 opinion for this action. Based on observational and group data within Tongass Narrows it was estimated that one group of two humpback whales may occur within the Level B harassment zone twice each week. We assumed that whales will always occur in groups of 2, to account for larger group sizes (thus, higher densities) of whales observed during summer months. Using these assumptions, we can calculate a daily encounter rate of 0.286 groups/day (2 group per week/7 days= 0.286 groups/week). Pile driving is expected to occur on 167 days. With 167 days of pile installation and removal planned, the number of encounters is estimated to be 48 encounters (167 days x 0.286 encounters/day). If each group encountered during each of those 48 encounters contained 2 whales, we would expect 96 Level B takes of humpback whales (48 group encounters x 2 whales/group = 96 whales encountered). As described in Section 4.2.1, an estimated 6.1 percent of humpback whales in Southeast Alaska are from the Mexico DPS (Wade et al. 2016). Therefore, of the 96 animals potentially exposed to Level B harassment due to construction activities, approximately 6 of these would be ESA-listed Mexico DPS humpback whales, and the remaining 90 are likely from the Hawaii DPS.

6.4.1.1.1 Phase 1

Under this reinitiated analysis, the days of construction predicted for Phase 1 has been reduced from 144 to 101 days. Originally, NMFS determined that 82 humpback whales might be exposed to project noise in Tongass Narrows during Phase 1. Using the same methodology as above, NMFS predicts that 58 humpback whales could be exposed to project noise in Tongass Narrows over the anticipated 101 days of pile installation. (101 days x 0.286 encounters/day x 2 whales per encounter = 58 whales)

We also based our revised exposure estimate on the larger ensonified area that may extend into Clarence Strait. Local specialists agreed that about four humpback whales could pass through or near the ensonified area in Clarence Strait each day. This could result in up to 204 additional exposures of humpback whales (4 humpback whales x 51 days = 204 individuals). This results in an estimated total exposure of 262 humpback whales (204 + 58 = 262 humpback whales). Of the 262 humpback whales potentially exposed, an estimated 16 individuals (262 x 0.061 = 15.98, rounded up to 16 whales) are likely to be from the ESA-listed Mexico Distinct Population Segment (DPS) of humpback whales.

6.4.1.1.2 Phase 2

Based on 1) the estimated occurrence rate of 2 groups of 2 individuals every 7 days, 2) the anticipated timeframe of Phase 2 pile driving to occur over the course of 27 days, and 3) the estimated proportion of humpback whales in Southeast Alaska that belong to the ESA-listed Mexico DPS (6.1 percent), NMFS determined that 1 Mexico DPS humpback whale (2 x 2 / 7 x 27 x 0.061 = 0.94, rounded to 1) may be exposed to project-related underwater noise during Phase 2 (NMFS 2019).

6.4.1.1.3 Total

In total, an estimated 278 humpback whales (262 + 16 = 278) may be exposed to project-related underwater noise during the two years of construction. Of these, an estimated 17 humpback whales (6.1 percent) are likely to be from the ESA-listed Mexico DPS of humpback whales (16 whales from Phase 1, and 1 whale from Phase 2 activities).

The maximum distance at which a humpback whale may be exposed to noise levels that exceed Level A thresholds is 523 m during impact driving of 30-inch piles (see Table 14**Error! Reference source not found.**). PSOs will be stationed to ensure effective monitoring and shutdown of this zone before humpback whales enter the Level A zone to avoid Level A take. No Level A takes for Mexico DPS humpback whales are anticipated.

Table 18. Amount of proposed incidental harassment (takes) of Mexico DPS humpback whales from construction noise. 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	17

In the *Response Analysis* (Section 6.5) we apply the best scientific and commercial data to describe the expected responses of humpback whales to these exposures.

6.4.2 Exposure to vessel noise

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

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

6.4.2.1.1 Results of Vessel Noise Exposure

There are two phases of vessel noise and associated disturbance related to the proposed action. The first is vessel noise associated with construction, and the second is vessel noise associated with operation of the Ketchikan International Airport shuttle ferries.

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

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

The numbers of airport shuttle ferries and ferry crossings are not anticipated to increase in the near future; therefore, NMFS does not expect vessel noise to increase beyond the baseline condition as a result of this project.

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

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 continuous sound produced by pile installation and removal, rock socketing, 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

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

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 continuous noise sources.

Between March 2020 and February 2022, 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 6 instances of exposure by Mexico DPS humpback whales to noise levels sufficient to cause Level B harassment. All level B instances of take are anticipated to occur at received levels ≥ 120 dB or 160 dB for continuous and impulsive noise sources, respectively.

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

These instances of exposure assume a uniform distribution of animals and do not account for avoidance. The implementation of mitigation measures to reduce exposure to high levels of pile driving noise, the short duration of pile driving operations, and movement of animals reduce the likelihood that exposure to pile driving would cause a behavioral response that may affect vital functions (reproduction or survival), or would result in temporary threshold shift (TTS) or permanent threshold shift (PTS).

As discussed in the *Status of the Species* section, we have no data on baleen whale hearing so we assume that baleen whale vocalizations are partially representative of their hearing sensitivities. While there is no direct data on hearing in low-frequency cetaceans, the applied frequency range is anticipated to be between 7 Hz to 35 kHz (NMFS 2018).

Humpback whales produce a wide variety of sounds. 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; Thompson et al. 1986; Winn et al. 1970). Source levels average 155 dB and range from 144 to 174 dB (Thompson et al. 1979). 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 (Silber 1986; Tyack and Whitehead 1983). 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 animals to the feeding activity (D'Vincent et al. 1985; Sharpe and Dill 1997).

This information leads us to conclude that humpback whales exposed to sounds produced by pile driving/removal and rock socketing activities are likely to respond if they are exposed to low-frequency sounds. However, because whales are not likely to communicate at source levels that would damage the tissues of other members of their species, this evidence suggests that received levels of up to 175–192 dB are not likely to damage the tissues of humpback whales (Thompson et al. 1986).

Humpback whale distribution in the action area varies seasonally, with whales occurring more frequently in summer than winter. Regardless of the time of year, humpback whales are not anticipated to occur in high numbers in the ensonified area associated with the proposed action.

Pile driving/removal and rock socketing activities would likely impact Mexico DPS humpback whales, although the level of disturbance depends on whether the whales are feeding or migrating, as well as other factors such as the age of the animal, whether it tolerates the sound, etc. In addition to targeted studies in marine mammals indicating that frequency (beyond just differing sensitivities at different frequencies) can affect the likelihood of auditory impairment incurred, there is increasing evidence that contextual factors other than received sound level, including activity states of exposed animals, the nature and newness of the sound, and the relative spatial positions of sound and receiver, can strongly affect the probability of behavioral response (Ellison et al. 2012).

6.5.1.1 Physical Responses

Systemic stressors usually elicit direct physical or physiological responses and, therefore do not require high-level cognitive processing of sensory information (Anisman and Merali 1999; de Kloet et al. 2005; Herman and Cullinan 1997; Wright et al. 2007). These physical responses are not influenced by the animal’s assessment of whether a potential stressor poses a threat or risk.

6.5.1.1.1 Temporary Threshold Shift (TTS)

TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1970). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes or hours to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data 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 2016b).

Although some Level B exposures may occur, the noise thresholds for the onset TTS are conservative and not all instances of take will result in TTS.

6.5.1.1.2 Permanent Threshold Shift (PTS)

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

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

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

6.5.1.2 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/removal or rock socketing 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 (Crespi et al. 2013; Jessop et al. 2003; Lankford et al. 2005). 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)

As discussed throughout the *Response Analysis* of this opinion, we expect a small number of individuals may experience TTS (but are not likely to experience PTS), may experience masking, and may exhibit behavioral responses from project activities. Therefore, we expect ESA-listed whales may experience stress responses. 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. Similarly, if whales are exposed to sounds from rock socketing, we expect a stress response will accompany a brief startle response. However, in any of the above scenarios, we do not expect significant or long-term harm to individuals from a stress response.

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

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Finneran et al. 2003; Ridgway et al. 1997). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices, but also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; Nowacek et al. 2007; Thorson and Reyff 2006; Wartzok et al. 2003). Responses to continuous sound, such as vibratory pile installation, have not been documented as 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 expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

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

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

6.5.1.4 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 fitness in survival and reproduction. If the coincident (masking) sound were anthropogenic, it could be potentially harassing if it disrupted hearing-related behavior. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs only during the sound exposure. Because masking (without resulting in threshold shift) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

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

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

Noise from pile driving and drilling activities is relatively short-term. It is possible that pile driving/removal noise resulting from this proposed action may mask acoustic signals important to Mexico DPS humpback whales, but the 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*.

6.5.1.5 Anticipated Effects on Habitat

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

6.5.1.6 Effects on Potential Prey

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

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

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

The most likely impact to fish from pile driving and drilling activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving 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 unlikely.

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

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

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

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

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

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

The applicant's proposed activities are spatially and temporally localized. Pile removal, installation, and drilling are expected to occur over 167 non-consecutive days in a 2-year period.

In summary, up to 17 individual Mexico DPS humpback whales may be exposed to Level B harassment sound levels during the proposed action. While mitigation measures include shut-down zones to prevent Level A exposure, if animals approach within the corresponding thresholds shown in Table 14, Level B harassment may occur. At these distances (1–12 km), a marine mammal that perceived pile installation or removal operations is likely to ignore such a signal and devote its attentional resources to stimuli in its local environment. If animals do respond, some listed species are likely to change their behavioral state – reduce the amount of time they spend at the ocean's surface, increase their swimming speed, change their swimming direction to avoid pile driving, change their respiration rates, increase dive times, reduce feeding behavior, and/or alter vocalizations and social interactions (Frid and Dill 2002; Funk et al. 2010; Koski et al. 2009; Melcon et al. 2012).

6.5.3 Responses to vessel traffic and noise

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

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

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

1. *Number of vessels*. The behavioral repertoire marine mammals have used to avoid interactions with surface vessels appears to depend on the number of vessels in their perceptual field (the area within which animals detect acoustic, visual, or other cues) and the animal's assessment of the risks associated with those vessels (the primary index of risk is probably vessel proximity relative to the animal's flight initiation distance).

2. *Below a threshold number of vessels* (which probably varies from one species to another, although groups of marine mammals probably share sets of patterns), studies have shown that whales will attempt to avoid an interaction using horizontal avoidance behavior. Above that threshold, studies have shown that marine mammals will tend to avoid interactions using vertical avoidance behavior, although some marine mammals will combine horizontal avoidance behavior with vertical avoidance behavior (Christiansen et al. 2010; Lusseau 2003).

3. *Distance between vessel and marine mammals* when the animal perceives that an approach has started, and during the course of the interaction (Au and Perryman 1982; David 2002; Kruse 1991).

4. Vessel's speed and vector (David 2002).

5. *Predictability of the vessel's path*. That is, cetaceans are more likely to respond to approaching vessels when vessels stay on a single or predictable path (Lusseau 2003; Williams et al. 2002) than when it engages in frequent course changes (Evans et al. 1994; Lusseau 2006; Williams et al. 2002).

6. *Noise associated with the vessel* (particularly engine noise) and the rate at which the engine noise increases, which the animal may treat as evidence of the vessel's speed (David 2002; Lusseau 2003; Lusseau 2006).

7. *Type of vessel* (displacement versus planing), which marine mammals may be interpret as evidence of a vessel's maneuverability (Goodwin and Cotton 2004).

8. *Behavioral state of the marine mammals* (David 2002; Lusseau 2003; Lusseau 2006). For example, Wursig et al. (1998) concluded that whales were more likely to engage in avoidance responses when the whales were 'milling' or 'resting' than during other behavioral states.

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

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

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

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

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

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

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

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

6.5.4 Probable responses to vessel traffic and noise

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

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

Vessels involved in the action travel only short distances at slow speeds. Additionally, the infrequent occurrence of humpback whales in the action area, and vessels following the Alaska Humpback Whale Approach Regulations and Marine Mammal Code of Conduct should prevent close approaches and additional harassment of humpback whales. The impact of vessel traffic on Mexico DPS humpback whales is not anticipated to cause significant disruption to behavior.

7. CUMULATIVE EFFECTS

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

Some continuing non-Federal activities are reasonably certain to contribute to climate change within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the *Environmental Baseli*ne (Section 5).

All of the activities described in the *Environmental Baseline* are expected to continue into the future. The Tongass Narrows Project is intended to increase the accessibility of Gravina Island and development on the island, which may increase vessel traffic between Gravina and Revillagigedo islands. Tourism and community development are expected to continue, likely increasing the demands for transportation, goods, and services. Tongass Narrows will continue to function as the main transportation corridor for the City of Ketchikan and surrounding communities. We do not expect the cumulative effects of these activities to hinder population growth of Mexico DPS humpback whales.

8. INTEGRATION AND SYNTHESIS

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

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

8.1 Mexico DPS Humpback Whale Risk Analysis

Based on the results of the exposure analysis, we expect a maximum of 278 humpback whales may be exposed to noise from pile driving, and 6.1% or 17 of those humpback whales are anticipated to be from the Mexico DPS. Exposure to vessel noise from transit and potential for vessel strike may occur, but adverse effects from vessel disturbance and noise are likely to be insignificant due to the small marginal increase in such activities relative to the environmental baseline and the transitory nature of vessels. Adverse effects from vessel strike are considered discountable because of the few additional vessels introduced by the action and the unlikelihood of these type of interactions.

Humpback whales' probable response to pile installation and removal includes brief startle reactions or short-term behavioral modification. These reactions and behavioral changes are expected to subside quickly when the exposures cease. The primary mechanism by which the behavioral changes we have discussed affect the fitness of individual animals is through the animals' energy budget, time budget, or both (the two are related because foraging requires time). Large whales such as humpbacks have 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. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to reduce the energy budgets of humpback whales, and their probable exposure to noise sources are not likely to reduce their fitness. As discussed in the *Description of the Proposed Action* and *Status of the Species* sections, this action does not overlap in space or time with humpback whale breeding. 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.

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. Critical habitat has not been designated or proposed for this species, therefore, none will be affected.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species unless there is a special exemption.[15] "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR 402.02). Based on recent NMFS guidance, the term "harass" under the ESA means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (16 U.S.C. §1362(18)(A)(i) and (ii)). For this consultation, NMFS anticipates that any take will be by harassment only. No Level A takes are contemplated or authorized.

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

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

The terms and conditions described below are nondiscretionary. PR1 and ADOT&PF have a continuing duty to regulate the activities covered by this ITS. In order to monitor the impact of incidental take, PR1 and ADOT&PF must monitor the progress of the action and its impact on the species as specified in the ITS (50 CFR 402.14(i)(3)). If PR1 or ADOT&PF (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.

[15] Although Section 9 of the ESA only prohibits take of endangered species, not threatened species, NMFS extended all the prohibitions of section 9 to Mexico DPS humpback whales through a rule issued pursuant to ESA section 4(d). 81 FR 62259 (Sept. 8, 2016).

10.1 Amount of Extent of Take

Section 7 regulations require NMFS to estimate the number of individuals that may be taken by proposed actions or utilize a surrogate (*e.g.*, other species, habitat, or ecological conditions) if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (50 CFR § 402.14 (i)(1); see also 80 FR 26832 (May 11, 2015). Table 19 lists the amount and timing of authorized take (incidental take by harassment) for this action.

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

The method for estimating the number of animals exposed to sound levels expected to result in Level B harassment was described in Section 6.4. NMFS anticipates that 278 Level B takes of humpback whales may occur. Of these 278 animals, 6.1% or 17 animals are predicted to be from the Mexico DPS. Therefore, NMFS is authorizing 17 Level B harassment takes under the ESA. For every 16 humpback whales observed in the Level B harassment zone, one whale will be assumed to be from the Mexico DPS and will be considered as a Level B take. As a result, NMFS will not consider that ADOT&PF has reached its take limit until 278 humpback whales have been observed in a Level B zone during pile driving activities.

All pile installation and removal will be shut down 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 was requested nor is authorized for humpback whales.

Table 19. Summary of anticipated instances of exposure to sound from pile installation and pile removal resulting in the incidental take of Mexico DPS humpback whales by behavioral harassment. These take numbers reflect only the individuals that are expected to be from the ESA-listed DPS that may be present in the action area.

Mexico DPS humpback whale	Total Amount of Take Associated with Proposed Action		Anticipated Temporal Extent of Take
	Level A	Level B	
Total	0	17	March 2020–February 2022

10.2 Effect of the Take

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

In Section 9 of this 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 nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02).

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

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

2. The taking of Mexico DPS humpback whales will be by incidental harassment only. The taking by serious injury or death is prohibited and will result in the modification, suspension, or revocation of the ITS. ADOT&PF will immediately report the take of listed marine mammals by serious injury or mortality to NMFS AKR.

3. ADOT&PF and PR1 will implement a monitoring and reporting program that includes all items described in the mitigation measures section of this biological opinion (Section 2.1.3) and allows NMFS AKR to evaluate the exposure estimates contained in this biological opinion and that underlie this ITS.

4. ADOT&PF and PR1 will implement any additional mitigation measures required by the IHA to be issued by NMFS Permits Division.

10.4 Terms and Conditions

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

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

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

To carry out RPM #1, ADOT&PF, PR1, or its authorization holder must undertake the following:

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

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

To carry out RPM #2, ADOT&PF, PR1, or its authorization holder must undertake the following:

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

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

5. ADOT&PF will immediately notify NMFS AKR, Protected Resources Division at 907-586-7636, when a total of 209 humpback whales have been detected in the Level B zone while construction activities that would expose them to noise levels exceeding the Level B threshold were underway. (This would equate to 12 takes of Mexico DPS humpback whales, and three-fourths of the authorized take for this action.)

To carry out RPMs #3 and 4, ADOT&PF, PR1, or its authorization holder must undertake the following:

6. Comply with all monitoring and reporting requirements as detailed in the mitigation measures of this biological opinion (Section 2.1.4) and the IHA issued by NMFS under section 101(a)(5) of the MMPA.

11. CONSERVATION RECOMMENDATIONS

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

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

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

12. REINITIATION OF CONSULTATION

As provided in 50 CFR 402.16, reinitiation of 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, the FHA, the City of Ketchikan, ADOT&PF, and the general public. These consultations help to fulfill multiple legal obligations of the named agencies. The information is also useful and of interest to the general public as it describes the manner in which public trust resources are being managed and conserved. The information presented in these documents and used in the underlying consultations represents the best available scientific and commercial information and has been improved through interaction with the consulting agency.

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

13.2 Integrity

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

13.3 Objectivity

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

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this 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.

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