PETITION FOR INCIDENTAL TAKE REGULATIONS
FOR OIL AND GAS ACTIVITIES IN COOK INLET, ALASKA
HILCORP ALASKA, HARVEST ALASKA, & ALASKA GASLINE DEVELOPMENT CORPORATION

Prepared for
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ACRONYMS AND ABBREVIATIONS

µPa  microPascal
2D  two-dimensional
3D  three-dimensional
4MP  Marine Mammal Monitoring and Mitigation Program
ADF&G  Alaska Department of Fish and Game
AGDC  Alaska Gasline Development Corporation
AGL  above ground level
AHT  Anchor handling tug
Alaska LNG  Alaska Liquified Natural Gas
AOGGC  Alaska Oil and Gas Conservation Commission
Apache  Apache Alaska Corporation
APDES  Alaska Pollutant Discharge Elimination System
ASL  above sea level
BA  Biological Assessment
bbl  barrels of oil
BLM  Bureau of Land Management
BMP  Best Management Practice
BOEM  Bureau of Ocean Energy Management
BOP  Blowout Preventer
BSEE  Bureau of Safety and Environmental Enforcement
CFR  Code of Federal Regulations
CI  Confidence Interval
CISPRI  Cook Inlet Spill Prevention and Response, Inc.
cm  centimeters
cui  cubic inches
dB re 1 µPa  decibels referenced to one microPascal
DFS  Damping Scaling Factor
DGPS/RTK  Differential Global Positioning System/roving units
DNR  Department of Natural Resources
DOG  Department of Oil and Gas
DP  Dynamic Positioning
DPS  Distinct Population Segment
DSV  Dive Support Vessel
EA  Environmental Assessment
EIS  Environmental Impact Statement
ER  Environmental Report
ESA  Endangered Species Act
EZ  Exclusion Zone
FEIS  Final Environmental Impact Statement
FERC  Federal Energy Regulatory Commission
FONSI  Finding of No Significant Impact
FR  Federal Register
ft  feet
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</tr>
<tr>
<td>USC</td>
<td>United States Code</td>
</tr>
<tr>
<td>USCG</td>
<td>United States Coast Guard</td>
</tr>
<tr>
<td>USDOT</td>
<td>United States Department of Transportation</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>USFWS</td>
<td>United States Fish and Wildlife Service</td>
</tr>
<tr>
<td>UT</td>
<td>Ultrasonic Testing</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>VSP</td>
<td>Vertical seismic profiling</td>
</tr>
<tr>
<td>WFA</td>
<td>weighting frequency adjustment</td>
</tr>
</tbody>
</table>
1.0 DESCRIPTION OF ACTIVITIES

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 NATURE OF REQUEST

The United States Fish and Wildlife Service (USFWS) administers regulations governing the issuance of Incidental Harassment Authorizations (IHAs) and Letters of Authorization (LOAs) through promulgation of Incidental Take Regulations (ITRs) permitting the incidental, but not intentional, take of marine mammals under certain circumstances. The regulations are codified in 50 Code of Federal Regulations (CFR) Part 216, Subpart I (Sections 216.101-216.108). The Marine Mammal Protection Act (MMPA) defines “take” to mean “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (50 CFR 216.316).

Hilcorp Alaska, LLC (Hilcorp Alaska), Harvest Alaska, LLC (Harvest Alaska), and the Alaska Gasline Development Corporation (AGDC), hereinafter referred to jointly as the “Applicant” hereby petition the USFWS to promulgate regulations pursuant to Section 101(a)(5) of the MMPA for the non-lethal unintentional taking of small numbers of marine mammals incidental to oil and gas exploration, development, and production activities in Cook Inlet, Alaska for the period of five years beginning April 1, 2019 extending through April 1, 2024. In the following sections, the components of all proposed activities are outlined in detail in this petition for promulgations of ITRs (Petition).

AGDC plans to construct one integrated liquefied natural gas (LNG) Project (Alaska LNG Project) within the Petition region. The environmental permitting process has been underway for several years; so, the level of details in the project description varies to an extent from the Hilcorp Alaska and Harvest Alaska description. It is important for the Alaska LNG project description to maintain consistency with the other applications and documents.

The geographic area of activity covers a total of approximately 2.7 million acres (10,926 square kilometers [km^2]) in Cook Inlet. It includes land and adjacent waters in Cook Inlet including both State of Alaska and Federal Bureau of Ocean Energy Management (BOEM) Outer Continental Shelf (OCS) waters (Figure 1). The area extends from the north at the Susitna Delta on the west side and Point Possession on the east side of Cook Inlet to southwest of Homer in lower Cook Inlet.

The incidental take regulations (ITRs) will identify: permissible methods of non-lethal take, measures to ensure the least practicable adverse impact on the species and on the availability of these species for subsistence uses, and the requirements for monitoring and reporting. In conjunction with issuance of the requested ITRs, the Applicant further petitions USFWS to engage in consultation under Section 7 of the Endangered Species Act (ESA) and to complete the associated environmental review pursuant to the National Environmental Policy Act (NEPA). An applicant-prepared Biological Assessment (BA) has been prepared for the Alaska LNG Project and submitted as part of an application to the Federal Energy Regulatory Commission (FERC). An Environmental Impact Statement (EIS) for the Alaska LNG Project is also currently prepared by FERC.
Figure 1. Geographic region for the Petition.
1.1.1 Regulatory Context

1.1.1.1 Marine Mammal Protection Act

Section 101(a)(5) of the MMPA, 16 United States Code (USC) Section 1371(a)(5)(A) authorizes the Secretary of Interior through USFWS to promulgate regulations that allow the incidental, but not intentional, taking of small numbers of marine mammals associated with specified activities (other than commercial fishing), provided that the total of such taking will have no more than a negligible impact on the affected marine mammal species or stocks, and does not have an unmitigable adverse impact on the availability of these species or stocks for subsistence uses. United States citizens seeking to carry out activities (other than commercial fishing) that may result in the incidental taking of small numbers of these marine mammals may petition the USFWS to issue ITRs for the specified activities in a specified geographical region. The following key terms and definitions have been promulgated in federal regulations implementing the MMPA at 50 Code of Federal Regulations (CFR) Section 18.27(c):

- **Take** means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.
- **Harassment** means any act of pursuit, torment, or annoyance which has the potential to: 1) injure a marine mammal or marine mammal stock in the wild (Level A harassment); or 2) 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).
- **Incidental, but not intentional taking** means takings which are infrequent, unavoidable, or accidental. It does not mean that the taking must be unexpected.
- **Negligible impact** is an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.
- **Unmitigable adverse impact** means an impact resulting from the specified activity: 1) that is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs (i) by causing the marine mammals to abandon or avoid hunting areas, (ii) directly displacing subsistence users, (iii) or placing physical barriers between the marine mammals and the subsistence hunters; and 2) that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

ITRs promulgated under Section 101(a)(5)(A) of the MMPA do not permit, approve, or otherwise allow any individual or class of commercial, industrial, or development activity to occur. Rather, each regulation establishes a regulatory framework, linked to a specified area and a specified time frame not to exceed five years, pursuant to which United States citizens may apply to USFWS for an LOA. The ITRs identify a suite of regulatory requirements that may be applied by USFWS depending upon the nature of an activity, as well as its location, timing, and duration. Each LOA issued by USFWS under promulgated ITRs imposes specific enforceable mitigation, monitoring, and reporting tailored to the activity addressed in the LOA to ensure that interactions with the identified marine mammal species or stocks occur in small numbers and with no more than a negligible impact.

1.1.1.2 Endangered Species Act

The ESA establishes a comprehensive statutory scheme intended to conserve fish, wildlife, and plants facing extinction. Section 4 of the ESA, 16 USC Section 1533, provides authority for the listing of species...
as either “threatened” or “endangered,” and for the designation of “critical habitat” for listed species. Once a species has been listed, the provisions of the ESA afford protection to such species and to designated critical habitat in the form of various procedural and substantive requirements and prohibitions.

Under Section 7 of the ESA, 16 USC Section 1536, all federal agencies must ensure, through consultation with the National Marine Fisheries Service (NMFS) or the USFWS, that actions authorized, funded, or carried out by such agencies are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat designated for such species. If, as a result of consultation, NMFS or USFWS concludes that the proposed action is not likely to jeopardize listed species or to destroy or adversely modify designated critical habitat, it will issue an Incidental Take Statement (ITS) authorizing take expected to occur as a result of the action. Importantly, as to ESA-listed marine mammals, under Section 7(b)(4)(C) of the ESA, no ITS may be issued with respect to a marine mammal unless authorization for the incidental take has been obtained pursuant to Section 105(a)(5)(A) of the MMPA.

In addition to the consultation requirements of Section 7, Section 9 of the ESA, 16 USC Section 1538, broadly prohibits any person from the taking of any endangered species in the U.S. or on the high seas, except pursuant to an incidental take authorization issued by USFWS or NMFS, or as otherwise allowed by statutory exemption. The ESA defines a take to mean to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (50 CFR Section 17.3). In contrast to the MMPA, take under the ESA has been defined to encompass “harm,” which has in turn been defined to include “significant habitat modification or degradation where it injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.” The take prohibition does not apply to species listed as “threatened.” Instead, under Section 4(d) of the ESA, 1 USC Section 1533(d), a regulation may be promulgated applying the taking prohibitions of Section 9 to threatened species.

1.1.1.3 National Environmental Policy Act

Section 102 of NEPA, 42 USC Section 4332(C), mandates a thoughtful and reasonably thorough analysis of the probable environmental impacts of a proposed major federal action, including analysis of both a reasonable range of alternatives that achieve the purpose and need for the project, and analysis of the no action alternative. An environmental assessment (EA) is a concise document that provides sufficient information and analysis to determine whether preparation of an environmental impact statement (EIS) is necessary. NEPA requires preparation of an EIS for major federal actions that significantly affect the quality of the human environment. An EIS is not required if, after preparation of an EA, a federal agency issues a finding of no significant impact (FONSI). The requirements of NEPA are entirely procedural.

Accordingly, while NEPA mandates a thoughtful and thorough analysis, it does not establish any substantive USFWS standards or compel a decision to approve, modify, or disapprove a proposal. USFWS must comply with the NEPA process as a part of its analysis and promulgation of an ITR. The proposed action – the ITR – does not permit, authorize, or otherwise allow any oil and gas activity. Rather, the agency action being analyzed is authorization of non-lethal incidental (unintentional) take of small numbers of marine mammals over a five-year period in a defined geographic area, that have no more than a negligible impact on these species and that have no unmitigable adverse impact on the availability of these species for subsistence uses by Alaska Natives. Because the proposed action must necessarily have no more than a negligible impact, we anticipate that USFWS may, as in the past, satisfy NEPA through an EA and FONSI process or to incorporate the review of the Alaska LNG Project within the EIS being completed by FERC.
1.1.1.4 **Federal Energy Regulatory Commission**

AGDC has submitted an application to the FERC for authorization to construct the Alaska LNG Project under the Section 3 of the Natural Gas Act (NGA). A full description of the Project is provided in Resource Report No. 1 within the Environmental Report (ER) submitted with the application. An EIS is being prepared, with FERC as the lead agency, as part of the regulatory review under NEPA. This EIS will include the activities described in the ER as well as this petition. FERC is also the lead agency for Section 7 consultation with NMFS and USFWS under the ESA for authorization of the Alaska LNG Project under the NGA. A draft Applicant-prepared Biological Assessment (BA) has been prepared as part of this consultation effort, and can be viewed as Appendix C to Resource Report No. 3 in the FERC application. FERC will finalize the BA in consultation with NMFS and USFWS in the course of the development of the Draft EIS.

1.2 **PURPOSE AND NEED**

1.2.1 **Hilcorp Alaska and Harvest Alaska**

The purpose and need of the Petition is to allow for the Hilcorp Alaska and Harvest Alaska to continue to conduct exploration and production activities in Cook Inlet. Cook Inlet is a mature oil and gas field that reached peak oil production in 1970 and peak natural gas production in 1994. Decades of gradual oil production decline followed, reaching a low point of 8,900 barrels per day in 2010. At the same time, natural gas reserves were projected to soon be insufficient to meet continued local utility demand.

Prior to Hilcorp Alaska’s efforts to revive Cook Inlet oil and gas production, aging platform infrastructure was considered to be nearing its functional end of life. Hilcorp Alaska is the first operator in more than ten years to believe that Cook Inlet facilities have decades of economic life remaining while previous operators were actively planning infrastructure removal prior to recent reinvestments. Following Hilcorp Alaska’s 2012 entry to the Cook Inlet field with the purchase of assets from both Chevron and Marathon, their efforts have led to the development of increased oil production and the continued supply of affordable natural gas for Alaskans which have addressed recent concerns for a reliable and affordable energy supply in the surrounding communities.

Despite low oil prices in recent years, Hilcorp Alaska has continued to invest in Cook Inlet including acquiring additional assets, upgrading facilities, and drilling new wells. More recent Cook Inlet acquisitions include XTO’s Middle Ground Shoal (MGS) field assets, which include two platforms and an onshore production facility and the acquisition of ConocoPhillips’ Cook Inlet facilities which include the North Cook Inlet Gas Field, Beluga River Gas Field, and the Tyonek Platform. Hilcorp Alaska has continued introducing improvements and efficiencies while investing over $1.8 billion in the Cook Inlet field, making Hilcorp Alaska one of the largest investors in the region. Most recently in 2017, Hilcorp Alaska invested $320 million in the Cook Inlet field including drilling nine new oil wells and has increased its overall Cook Inlet crude oil production from approximately 12,000 barrels per day in January 2017 to a projected 15,500 barrels per day by the end of 2017.

Hilcorp Alaska’s investment in Cook Inlet infrastructure and leases demonstrates a corporate commitment to long term production of oil and gas in the region, continuing the economic and social benefits the industry has provided to Alaska in general, and Kenai Peninsula communities in particular, for over 60 years.

The petroleum industry’s importance in Alaska is indisputable. Despite declines in recent years, Alaska’s oil and gas industry is still the single largest source of state government revenue and provides the state’s
highest-paying private sector jobs (RDC 2017). Key economic contributions from Alaska’s oil and gas industry include:

- In 2017, 65% of the State of Alaska Government’s unrestricted revenue originates from taxes and royalties affiliated with the petroleum industry and unrestricted tax revenues from the industry and this revenue source is forecast to nearly double in 2018 as petroleum prices and production levels both increase from 2017 levels (ADRTX 2017).

- There are 28 producing oil and gas fields on the Kenai Peninsula and offshore Cook Inlet. This area has produced a cumulative total of over 1.3 billion barrels of oil and 7.75 trillion cubic feet of natural gas. The largest oil field, the McArthur River Field, is expected to recover 639,000 barrels of oil. The largest gas field, the Kenai Field, is ultimately projected to produce 2.427 trillion cubic feet of natural gas (RDC 2017).

- During 2017, a Federal Cook Inlet OCS lease sale resulted in 14 tracks (over 31,000 acres) being awarded to Hilcorp Alaska and a State of Alaska lease sale resulted in 6 tracks (over 24,000 acres) being awarded to Hilcorp Alaska. These recent lease sales and activity demonstrates the continued renaissance of oil and gas development in Cook Inlet which began in earnest in 2011 and since then has resulted in over 250 lease tracks awarded for the Cook Inlet area. (BOEM 2018; ADNR 2018)

- Anchorage is the primary headquarters for Alaska’s oil and gas industry. In 2016, the most recent year for which economic impact estimates are available, 2,265 workers residing in Anchorage were directly employed by the oil and gas industry with a direct payroll of $409 million contribution to the Anchorage economy. Indirect and induced impact of the statewide oil and gas industry within Anchorage was estimated to be 24,050 jobs and $1.235 billion in payroll (McDowell 2017).

- The oil and gas industry has been important to the economy of the Kenai Peninsula for over 60 years. In 2016, the most recent year for which economic impact estimates are available, direct employment by the oil and gas industry on the Kenai Peninsula has been estimated at 810 jobs with a payroll of $142 million and an additional 1,615 oil and gas support services employees with wages of $153 million. Indirect and induced economic impacts are estimated to be an additional 2,620 jobs and $105 million in payroll for a total economic impact on the Kenai Peninsula of 5,045 jobs and $400 million in payroll, which was 20% of the area’s employment and 25% of the area’s payroll. Annual property tax payments for the oil and gas industry to the Kenai Peninsula Borough were reported at $11.6 million, and 6 of the top 10 property tax payers in the borough were oil and gas industry companies (McDowell 2017).

1.2.2 AGDC Alaska LNG Project

The Alaska LNG Project would be a world-class LNG project constructed in the United States that would have an estimated cost of $40 to $45 billion. If authorized, the Alaska LNG Project will achieve the long-sought goal of unlocking and bringing to market the vast natural gas resources on Alaska’s North Slope and realizing the economic, environmental and security benefits that will flow from these valuable resources. As currently envisioned, AGDC intends to streamline and expedite the project development schedule to provide for initial in-service date of 2024.

AGDC proposes this infrastructure project, of major national and global significance, to create numerous long-lasting benefits to the nation, the State of Alaska and regional and local communities. By unlocking the valuable natural gas resources on the North Slope, the Alaska LNG Project will be able to meet the demand for natural gas both globally and within parts of Alaska. In addition, the Alaska LNG Project will
have an extremely beneficial impact on national, regional, and local economies. AGDC estimates that the Project will create up to 15,000 jobs during peak construction and approximately 730 permanent jobs to operate the Project facilities. The Project will use more than 1,288 km (800 miles [mi]) of pipeline, 647,000 tons of pipeline steel, 2.2 million horsepower of gas-fired turbines, compressors, and power generation. A substantial portion of the components needed for these facilities could be produced and manufactured in the United States.

The Alaska LNG Project will increase tax revenues for state and local governments, provide additional royalty revenues to the State, improve the nation’s trade balance with foreign countries, and increase the energy security of the United States and our allies. In addition, the Alaska LNG Project will result in the substitution of clean-burning natural gas for other hydrocarbon fuel, thereby reducing carbon and other greenhouse gas emissions in the countries importing the LNG, as well as in Alaska. Thus, in addition to its economic and other benefits, the Project also will have a net positive impact on the environment.

1.3 DESCRIPTION OF HILCORP ALASKA AND HARVEST ALASKA ACTIVITIES

The scope of this Petition includes four stages of activity, including exploration, development, production, and decommissioning activities within the Applicant’s area of operations (Figure 2) in and adjacent to Cook Inlet within the Petition’s geographic area (Figure 1). Because Cook Inlet has had active oil and gas activities for over 60 years, this Petition includes all four stages in different areas. Table 1 summarizes the planned activities within the geographic scope of this Petition and the following text describes these activities in more detail. This section is organized into two primary areas within Cook Inlet: lower Cook Inlet (south of the Forelands to Homer) and middle Cook Inlet (north of the Forelands to Susitna/Point Possession).

Figure 2. Hilcorp Alaska and Harvest Alaska existing infrastructure in Petition region.
Table 1. Summary of planned Hilcorp Alaska and Harvest Alaska activities included in ITR Petition.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Cook Inlet Region</th>
<th>Year(s) Planned</th>
<th>Seasonal Timing</th>
<th>Anticipated Duration</th>
<th>Anticipated Noise Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor Point 2D seismic survey</td>
<td>Lower Cook Inlet, Anchor Point to Kasilof</td>
<td>2021 or 2022</td>
<td>April-October</td>
<td>30 days</td>
<td>Marine: 1 source vessel with airgun, 1 node vessel Onshore/Intertidal: Shot holes, tracked vehicles, helicopters</td>
</tr>
<tr>
<td>OCS 3D seismic survey</td>
<td>Lower Cook Inlet OCS</td>
<td>2019</td>
<td>April-June</td>
<td>90 days</td>
<td>2 source vessels with airguns, 2 support vessels, 1 mitigation vessel potentially</td>
</tr>
<tr>
<td>OCS geohazard survey</td>
<td>Lower Cook Inlet OCS</td>
<td>2019 or 2020</td>
<td>Fall 2019 or spring 20202</td>
<td>30 days</td>
<td>1 vessel with echosounders and/or sub-bottom profilers</td>
</tr>
<tr>
<td>OCS exploratory wells</td>
<td>Lower Cook Inlet OCS</td>
<td>2020-2022</td>
<td>April-October</td>
<td>40-60 days per well, 2-4 wells per year</td>
<td>1 jack-up rig, drive pipe installation, vertical seismic profiling, 2-3 tugs for towing rig, support vessels, helicopters</td>
</tr>
<tr>
<td>Inskin Peninsula exploration and development</td>
<td>Lower Cook Inlet, west side</td>
<td>2019-2020</td>
<td>April-October</td>
<td>180 days</td>
<td>Construction of causeway, vibratory sheet pile driving, dredging, vessels</td>
</tr>
<tr>
<td>Platform &amp; pipeline maintenance</td>
<td>Middle Cook Inlet</td>
<td>2019-2024</td>
<td>April-October</td>
<td>180 days</td>
<td>Vessels, water jets, hydraulic grinders, pingers, helicopters, and/or sub-bottom profilers</td>
</tr>
<tr>
<td>North Cook Inlet Unit subsea well geohazard survey</td>
<td>Middle Cook Inlet</td>
<td>2020</td>
<td>May</td>
<td>14 days</td>
<td>1 vessel with echosounders and/or sub-bottom profilers</td>
</tr>
<tr>
<td>North Cook Inlet Unit well abandonment activity</td>
<td>Middle Cook Inlet</td>
<td>2020</td>
<td>May-July</td>
<td>90 days</td>
<td>1 jack-up rig, tugs towing rig, support vessel, helicopters</td>
</tr>
<tr>
<td>Trading Bay area geohazard survey</td>
<td>Middle Cook Inlet</td>
<td>2020</td>
<td>May</td>
<td>30 days</td>
<td>1 vessel with echosounders and/or sub-bottom profilers</td>
</tr>
<tr>
<td>Trading Bay area exploratory wells</td>
<td>Middle Cook Inlet</td>
<td>2020</td>
<td>May-October</td>
<td>120-150 days</td>
<td>1 jack-up rig, drive pipe installation, tugs towing rig, support vessel, helicopters</td>
</tr>
<tr>
<td>Drift River terminal decommissioning</td>
<td>Lower Cook Inlet, west side</td>
<td>2023</td>
<td>April-October</td>
<td>120 days</td>
<td>Vessels</td>
</tr>
</tbody>
</table>
1.3.1 Activities within Lower Cook Inlet

The lower Cook Inlet region is comprised of both Bureau of Ocean Energy Management (BOEM) OCS and State of Alaska Department of Natural Resources (DNR) Division of Oil and Gas (DOG) leases. Over the last 40 years, there have been OCS lease sales in the Cook Inlet Planning Area, but there were no active leases until 2017 when BOEM held Lease Sale 244 in June 2017, offering 224 OCS blocks for sale. A Final EIS (FEIS) was prepared by BOEM (BOEM 2016). Hilcorp acquired 14 lease blocks in Lease Sale 244 and intends to start exploration activities in their leases. Under the BOEM OCS 2017-2022 Leasing Plan, another Cook Inlet lease sale is anticipated in 2021 (BOEM 2018). Hilcorp Alaska may acquire more leases in this region in this lease sale.

The State of Alaska DNR DOG holds annual lease sales under AS 38.05.035(e) and AS 38.05.180. Under these statutes, land that is subject to a best interest finding issued within the previous 10 years may be offered for oil and gas leasing. The current areawide leasing best interest finding is for 2009-2018 (DNR 2009). Hilcorp Alaska holds State leases throughout the Cook Inlet. Hilcorp Alaska may acquire more leases in this region in future State lease sales. The following text outlines the type of activities and anticipated dates and duration in the lower Cook Inlet region (Figure 3).
Figure 3. Planned Hilcorp Alaska activities in lower Cook Inlet.
1.3.1.1 2D Seismic Survey

Based on potential future lease sales in both State and Federal waters, operators collect two-dimensional (2D) seismic data to determine the location of possible oil and gas prospects. Generally, 2D survey lines are spaced farther apart than three-dimensional (3D) surveys and are conducted in a regional pattern that provides less detailed geological information. 2D surveys are used to cover wider areas to map geologic structures on a regional scale. Airgun arrays sizes used during 2D surveys are similar to those used during 3D surveys.

During the time frame of this Petition, the region of interest to conduct a 2D survey is in the marine, intertidal, and onshore area on the eastern side of Cook Inlet from Anchor Point to Kasilof (Figure 3). The area of interest is approximately 8 km (5 miles [mi]) on each side of the coastline (Figure 3). The anticipated timing of the planned 2D survey is in the open water season (April through October) in either 2020 or 2021. The actual survey duration will take approximately 30 days in either year, including all activities associated with the 2D survey.

1.3.1.1.1 2D Seismic Survey Design

Specific details of the program are not developed at the time of this Petition, but the methods for acquiring 2D seismic data in this zone will be similar to what has been performed by Apache Alaska Corporation (Apache) in 2011 and 2012. Similar to this program, the anticipated Hilcorp Alaska work will include land, intertidal, and marine environments. However, the Apache survey was 3D and this planned survey is 2D. This Petition does not evaluate acoustic harassment associated with the land-based portion of the program because it is not anticipated to result in underwater sound levels exceeding USFWS thresholds.

The 2D seismic data are acquired using airguns in the marine zone, airguns in the intertidal zone when the tide is high and drilled shot holes in the intertidal zone when the tide is low and drilled shot holes in the land zone. The data are recorded using an autonomous nodal system (i.e., no cables) that are deployed in the marine, intertidal, and land zones. The planned source lines (airgun and shot holes) are approximately 16 km (10 mi) in length running perpendicular to the coastline (Figure 3). The source lines are spaced every 8 km (5 mi) in between Anchor Point and Kasilof, with approximately 9-10 lines over the area of interest (Figure 3). Additional details on the sources and recorders are provided in the following text.

1.3.1.1.2 Marine 2D Seismic Source

In the marine and high tide intertidal zones, data will be acquired using a shallow water airgun towed behind one source vessel. Although the precise volume of the airgun array is unknown at this time, Hilcorp Alaska will use an airgun array similar to what has been used for surveys in Cook Inlet by Apache (2011-2013) and SAExploration (2015): either a 2,400 cubic inch (cui) or 1,760 cui array. In addition, the source vessel will be equipped with a 440 cui shallow water source which it can deploy at high tide in the intertidal area in less than 1.8 meter (m, 6 feet [ft]) of water. Source lines are oriented along the node line.

A single vessel is capable of acquiring a source line in approximately 1-2 hours (hrs). In general, only one source line will be collected in one day to allow for all the node deployments and retrievals, and intertidal and land zone shot holes drilling. There are up to 10 source lines, so if all operations run smoothly, there will only be 2 hr per day over 10 days of airgun activity. Hilcorp Alaska anticipates the entire operation to take approximately 30 days to complete to account for weather and equipment contingencies.
1.3.1.1.3 Onshore/Intertidal 2D Seismic Source

In the land and low tide intertidal zones, data will be acquired using shot holes drilled every 50 m (165 ft) along the source lines (Figure 3). To access the onshore shot hole sites, Hilcorp Alaska may use a combination of helicopter portable and tracked vehicle drills. At each source location, Hilcorp Alaska will drill to the prescribed hole depth of approximately 10 m (35 ft) and load it with 4 kilograms (kg) (8.8 pounds [lbs]) of explosive. The hole will be capped with a “smart cap” that will make it impossible to detonate the explosive without the proper blaster.

1.3.1.1.4 Recording System

The recording system that will be employed is an autonomous system “nodal” (i.e., no cables), which is expected to be made up of at least two types of nodes; one for the land and one for the intertidal and marine environment (Figure 4). For the land environment, this will be a single-component sensor land node; for the intertidal and marine zone, this will be a submersible multi-component system made up of three velocity sensors and a hydrophone. These systems have the ability to record continuous data. Inline receiver intervals for the node systems are approximately 50 m (165 ft). For 2D seismic surveys, the nodes are deployed along the same line as the seismic source. The deployment length is restricted by battery duration and data storage capacity.

The marine nodes will be placed using one node vessel; the intertidal and land nodes will be placed by personnel using tracked vehicles.

Figure 4. Land-based nodal technology (left) and water-based nodal technology (right).

1.3.1.1.5 Sensor Positioning

In the marine environment, once the nodes are placed on the seafloor, the exact position of each node is required. There are several techniques used to locate the nodes on the seafloor, depending on the depth of the water. In very shallow water, the node positions are either surveyed by a land surveyor when the tide is low, or the position is accepted based on the position at which the navigator has laid the unit. In deeper water, a hull or pole mounted pinger to send a signal to the transponder which is attached to each node will be used. The transponders are coded and the crew will know which transponder goes with which node prior to the layout. The transponders response (once pinged) is added together with several other responses to create a suite of range and bearing between the pinger boat and the node. Those data are then calculated to precisely position the node. In good conditions, the nodes can be interrogated as they are laid out. It is also common for the nodes to be pinged after they have been laid out.
Onshore and intertidal locating of source and receivers will be accomplished with Differential Global Positioning System/roving units (DGPS/RTK) equipped with telemetry radios which will be linked to a base station established on the source vessel. Survey crews will have both helicopter and light tracked vehicle support. Offshore source and receivers will be positioned with an integrated navigation system (INS) utilizing DGPS/RTK link to the land base stations. The integrated navigation system will be capable of many features that are critical to efficient safe operations. The system will include a hazard display system that can be loaded with known obstructions, or exclusion zones.

1.3.1.1.6 Vessels

The source and node vessels have not yet been confirmed but will be similar vessels to those used by Apache and SAExploration in Cook Inlet for previous surveys. Details of each vessel are provided in Table 2.

<table>
<thead>
<tr>
<th>Name</th>
<th>Primary Activity</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/V Peregrine Falcon</td>
<td>Source vessel</td>
<td>26 m length x 26 m breadth</td>
</tr>
<tr>
<td>(or similar)</td>
<td></td>
<td>197 gross tonnage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 berths</td>
</tr>
<tr>
<td>M/V Miss Diane I</td>
<td>Node vessel</td>
<td>26 m length x 26 m breadth</td>
</tr>
<tr>
<td>(or similar)</td>
<td></td>
<td>53 gross tonnage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 berths</td>
</tr>
</tbody>
</table>

1.3.1.1.7 Fuel Storage

Any fuel storage will be located away from waterways and lakes and positioned within a secondary containment area (SCA). The capacity of the SCA will be 110% of the largest storage tank within the SCA. All storage fuel sites will be equipped with spill response equipment and supplies. Any transfer of fuel for offshore activities will comply with United States Coast Guard (USCG) regulations (33 CFR 154.300).

1.3.1.2 3D Seismic Survey

Based on potential future lease sales in both State and Federal waters, operators collect 3D seismic data to determine the location of possible oil and gas prospects. Generally, 3D survey lines are spaced in a grid pattern concentrated on a specific area of interest. These surveys provide the resolution needed for detailed geological evaluation and data resolution for placement of drill rigs or platforms.

During the time frame of this Petition, Hilcorp Alaska plans to collect 3D seismic data for approximately 60-70 days starting April 1, 2019 over 11 of the 14 OCS lease blocks in lower Cook (Figure 3). The 3D seismic survey is comprised of an area of approximately 55 km$^2$ (mi$^2$) through 11 blocks (6162, 6310, 6357, 6360, 6405, 6406, 6407, 6410, 6455, 6456, 6457, 6458, 7064). Hilcorp Alaska submitted an application for an IHA in late 2017 for a planned survey in 2018 but withdrew the application and now plan for the survey to take place in 2019. The survey program is anticipated to begin April 1, 2019 and last for approximately 60-70 days through June 2019 in compliance with identified BOEM lease stipulations. The length of the survey will depend on weather, equipment, and marine mammal delays (contingencies of 20% weather, 10% equipment, 10% marine mammal).

1.3.1.2.1 3D Seismic Survey Design

The 3D seismic data will be acquired using a specially designed marine seismic vessel towing 8-12 x ~2,500-m (1.5 mi) recording cables with a dual air gun array. The survey will involve one source vessel, one support vessel, one chase vessel, and potentially one mitigation vessel. The anticipated seismic source
to be deployed from the source vessel is a 24-airgun array with a total volume of 2,400 cui, although the seismic contractor has not yet been selected. Crew changes are expected to occur every four to six weeks using a helicopter from shore bases in lower Cook Inlet.

Because of the high background noise associated with the strong tides and currents in Cook Inlet, seismic data will only be collected during slack tides. Seismic data will be collected for approximately 2.5 hrs around each of the four slack tide periods each day, for a total of approximately 10-12 hrs per day. The array will be towed at a speed of approximately 7.41 km/hr (4 knots), equating to approximately four line passes per day, recording approximately a 430 m (1,410 ft) swath of data for each pass.

The data will be shot parallel to the Cook Inlet shorelines in a southwest/northeast direction or northeast/southwest direction going straight into or out of the tides. This operational direction will keep recording equipment/streamers in line with Cook Inlet currents and tides and keep the equipment away from shallow waters on the east and west sides. Seismic data will be collected continuously during each pass.

The turn radius on the seismic vessel is approximately 2,500 m (1.5 mi). The airguns will typically be turned off during the turns and in between tides while setting up for the next slack tidal cycle. Note that the vessel will be turning into the tides to ensure the recording cables/streamers remain in line behind the vessel. A diagram showing the relative positions of the source and streamer cables is provided in Figure 5.

![Figure 5. Diagram of typical seismic vessel with streamers and source.](image)

### 1.3.1.2.2 Airguns

As the seismic contractor has not yet been selected, the precise airgun array is not yet known. Hilcorp Alaska will use an airgun array similar to what has been used for similar surveys in Cook Inlet by Apache: either a 2,400 cui array or 1,760 cui array. One proposed array is a Bolt 1900 LLXT dual gun array each with 12 airguns ranging in volume from 40 to 100 cui for a total of 2,010 cui as shown in the configuration provided in Figure 6. The airguns will be configured as two linear arrays or “strings;” each string will have 12 airguns. The first and last are spaced approximately 14 m (45.9 ft) apart and the strings are separated by
approximately 10 m (32.8 ft). The two airgun strings will be distributed across an approximate area of 30 x 14 m (98.4 x 45.9 ft) behind the source vessel and will be towed 10-100 m (32.8-328 ft) behind the vessel at a depth of 5 m (16.4 ft). The firing pressure of the array is 2,000 pounds per square inch (psi). The airgun will fire every 25 m or 6 seconds (s), depending on the exact speed of the vessel. When fired, a brief (25 milliseconds [ms] to 140 ms) pulse of sound is emitted by all airguns nearly simultaneously. Hilcorp Alaska confirms that this array provides for the lowest possible sound source to collect the target data. Hilcorp Alaska proposes to use a single 40 cui airgun, the smallest airgun in the array, for mitigation purposes.

Array: 2010T_050_2000_100

![Diagram of airgun array](image)

Figure 6. Layout of a 2,010 cui airgun array. Symbol sizes and labels indicate the volumes of the airguns in cubic inches. Tow direction is to the left.
1.3.1.2.3 Streamers

Hilcorp Alaska intends to use 8 to 12 Sercel-type solid streamers or functionally similar for recording the seismic data (Figure 5. Diagram of typical seismic vessel with streamers and source.). Each streamer will be approximately 2,500 m (1.5 mi) in length and will be towed approximately 15 m (49.2 ft) or deeper below the surface of the water. The streamers will be placed approximately 50 m (165 ft) apart to provide a total streamer spread of 350-550 m (1,148-1,804 ft). Solid streamers are now recognized as best in class for marine data acquisition because of unmatched reliability, signal to noise ratio, low frequency content, and noise immunity.

1.3.1.2.4 Vessels

The seismic contractor has not yet been identified, but the survey will involve one source vessel, one support vessel, one chase vessel, and potentially one mitigation vessel. The source vessel tows the airgun array and the streamers. The support vessel provides general support for the source vessel, including supplies, crew changes, etc. The chase vessel monitors the in-water equipment and maintains a security perimeter around the streamers. The mitigation vessel provides a viewing platform to augment the marine mammal monitoring program. Details of anticipated vessels are provided in Table 3. Figure 7 shows a picture of a typical, modern source vessel.

<table>
<thead>
<tr>
<th>Name</th>
<th>Primary Activity</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/V Apollo (or similar)</td>
<td>Source vessel</td>
<td>107 m length x 19.2 m breadth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.5 m draft</td>
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<td></td>
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<td>7,131 gross tonnage</td>
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<td></td>
<td></td>
<td>Built in 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bahamas flag</td>
</tr>
<tr>
<td>M/V Thor Alpha (or similar)</td>
<td>Support vessel</td>
<td>55 m length x 12.5 m breadth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.8 m draft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,051 gross tonnage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Built in 2008</td>
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<td></td>
<td></td>
<td>Faroese flag</td>
</tr>
<tr>
<td>TBD</td>
<td>Chase vessel</td>
<td>Approximate</td>
</tr>
<tr>
<td></td>
<td>Maintains security around streamers</td>
<td>37 m length x 8.5 m breadth</td>
</tr>
<tr>
<td>TBD</td>
<td>Mitigation vessel</td>
<td>Approximate</td>
</tr>
<tr>
<td></td>
<td>(for marine mammal monitoring)</td>
<td>37 m length x 8.5 m</td>
</tr>
</tbody>
</table>
1.3.1.3 Geohazard and Geotechnical Surveys

After completing a 3D seismic survey and prior to conducting exploratory wells, operators perform a geohazard survey to evaluate any potential geological hazards; document any potential cultural resources or benthic communities to identify shallow hazards such as old pipelines or wrecks; obtain engineering data for placement of structures (e.g., proposed platform locations and pipeline routes); and detect subsurface geologic hazards (e.g., faults and gas pockets).

Upon completion of the 3D seismic survey over the lower Cook Inlet OCS leases, Hilcorp Alaska plans to conduct a geohazard survey on site-specific regions within the area of interest prior to conducting exploratory drilling. The precise location is not known, as it depends on the results of the 3D seismic survey, but the location will be within the lease blocks. The anticipated timing of the activity is in either the fall of 2019 or the spring of 2020. The actual survey duration will take approximately 30 days.

The suite of equipment used during a typical geohazards survey consists of single beam and multi-beam echosounders, which provide water depths and seafloor morphology; a side scan sonar that provides acoustic images of the seafloor; a sub-bottom profiler which provides 20 to 200 m (66 to 656 ft) sub-seafloor penetration with a 6- to 20-centimeter (cm, 2.4-7.9-inch [in]) resolution. Magnetometers, to detect ferrous items, may also be used. Geotechnical surveys are conducted to collect bottom samples to obtain physical and chemical data on surface and near sub-surface sediments. Sediment samples typically are collected using a gravity/piston corer or grab sampler.

The echosounders and sub-bottom profilers are generally hull-mounted or towed behind a single vessel. The ship travels at 3-4.5 knots (5.6-8.3 km/hr). Surveys are site specific and can cover less than one lease block in a day, but the survey extent is determined by the number of potential drill sites in an area. BOEM guidelines at NTL-A01 require data to be gathered on a 150 by 300 m (492 by 984 ft) grid within 600 m (1,969 ft) of the surface location of the drill site, a 300 by 600 m (984 by 1,969 ft) grid along the wellbore path out to 1,200 m (3,937 ft) beyond the surface projection of the conductor casing, and extending an additional 1,200 m beyond that limit with a 1,200 by 1,200 m grid out to 2,400 m (7,874 ft) from the well site.

1.3.1.4 Exploratory Drilling

Operators will drill exploratory wells based on mapping of subsurface structures using 2D and 3D seismic data and historical well information.
Hilcorp Alaska plans to conduct the exploratory drilling program April to October between 2020 and 2022. The exact start date is currently unknown and is dependent on the results of the seismic survey, geohazard survey, and scheduling availability of the drill rig. It is expected that each well will take approximately 40-60 days to drill and test. Beginning in spring 2020, Hilcorp Alaska plans to possibly drill two and as many as four exploratory wells, pending results of the 3D seismic survey in the lower Cook Inlet OCS leases. After testing, the wells may be plugged and abandoned (P&A).

1.3.1.4.1 Drilling Rig

Hilcorp Alaska proposes to conduct its exploratory drilling using a rig similar to the Spartan 151 drill rig. The Spartan 151 is a 150 H class independent leg, cantilevered jack-up drill rig with a drilling depth capability of 7,620 m (25,000 ft) that can operate in maximum water depths up to 46 m (150 ft). To maintain safety and work efficiency, the Spartan 151 or equivalent will be equipped with the following:

- Either a 5,000, 10,000, or 15,000 psi blowout preventer (BOP) stack, for drilling in higher pressure formations found at greater depths in Cook Inlet;
- Sufficient variable deck load to accommodate the increased drilling loads and tubular for deeper drilling;
- Reduced draft characteristics to enable the rig to easily access shallow water locations;
- Riser tensioning system to adequately deal with the extreme tides/currents in up to 46 m (150 ft) water depth;
- Steel hull designed to withstand -10 degrees Celsius (°C) to eliminate the risk of steel failure during operations in Cook Inlet (i.e., built for North Sea arctic conditions); and
- Ability to cantilever over existing platforms for working on development wells.

1.3.1.4.2 Rig Mobilization

Depending on the rig selection and location, the drilling rig will be towed on site using up to three ocean-going tugs licensed to operate in Cook Inlet. Rig moves will be conducted in a manner to minimize any potential risk regarding safety as well as cultural or environmental impact. While under tow to the well sites, rig operations will be monitored by Hilcorp Alaska and the drilling contractor management. Very High Frequency (VHF) radio, satellite, and cellular phone communication systems will be used while the rig is under tow. Helicopter transport will also be available.

1.3.1.4.3 Oil Field Support Services

The rig will be stocked with most of the drilling supplies required to complete a full summer program. Deliveries of remaining items, including crew transfers, will be performed by support vessels and helicopters. The majority of the oilfield support services contractors have offices, shops, and additional equipment located in Anchorage, Kenai, and Nikiski that will support their remote field operations. The tugs used to mobilize the rig will be released once the rig is in place and workboat(s) staged at the Offshore Systems Kenai (OSK) Dock in Nikiski or at the Homer Dock in Homer for supporting operations.

1.3.1.4.4 Helicopter Operations

Helicopter logistics for project operations will include transportation for personnel, groceries, and supplies. Helicopter support will consist of a twin turbine Bell 212 (or similar) helicopter certified for instrument flight rules for land and over water operations. The helicopter will be based at the Kenai Airport, OSK Heliport, and/or Homer Airport to support rig crew changes and cargo handling. Fueling will take place at these facilities. No helicopter refueling will take place on the rig.
Helicopter flights to and from the rig are expected to average two per day. Flight routes will follow a direct route to and from the rig location, and flight heights will be maintained 300 to 450 m (1,000 to 1,500 ft), as practicable, above ground level (AGL) to avoid acoustical harassment of marine mammals. The aircraft will be dedicated to the drilling operation and will be available for service 24 hrs a day.

1.3.1.4.5 Supply Vessels Operations

Major supplies will be staged on-shore at the OSK Dock in Nikiski. Required supplies and equipment will be moved from the staging area by contracted supply vessels and loaded aboard the rig when the rig is established on a drilling location and will include fuel, drilling water, mud materials, drilling tools, cement, casing, and well service equipment. Supply vessels also will be outfitted with fire-fighting systems as part of fire prevention and control as required by Cook Inlet Spill Prevention and Response, Inc. (CISPRI). The specific supply vessels have not been identified; however, typical offshore drilling support work vessels are of steel construction with strengthened hulls to provide the capability of working in extreme conditions. Supply vessels are capable of moving personnel when severe weather will not allow helicopter flights.

1.3.1.4.6 Fuel

Rig equipment will use diesel fuel or electricity from generators. Personnel associated with fuel delivery, transfer, and handling will be knowledgeable of Industry Best Management Practices (BMP) related to fuel transfer and handing, drum labeling, secondary containment guidelines, and the use of liners/drip trays.

The jack-up rig will take on a maximum fuel load prior to operations to reduce fuel transfers during drilling. Commercial tank farms in the Nikiski or Kenai area will supply fuel transported by workboats as needed. The Rig Barge Master will be in charge of re-fueling and fluid transfers between the rig and fuel workboats, and subsequent transfers between tanks on the rig.

1.3.1.4.7 Drilling Program and Well Operations

The drilling program for the well will be described in detail in an Exploration Plan to BOEM. The Exploration Plan will present information on the drilling mud program; casing design, formation evaluation program; cementing programs; and other engineering information. After rig up/rig acceptance by Hilcorp Alaska, the wells will be spudded and drilled to bottom-hole depths of approximately 2,100 to 4,900 m (7,000 to 16,000 ft) depending on the well. It is expected that each well will take about 40-60 days to drill and up to 10-21 days of well testing. If two wells are drilled, it will take approximately 80-120 days to complete the full program; if four wells are drilled, it will take approximately 160-240 days to complete the full program.

1.3.1.4.8 Blowout Prevention Program and Equipment

All operating procedures on the rig, whether automated or controlled by company or contractor personnel, are specifically designed to prevent a loss of well control. The primary method of well control utilizes the hydrostatic pressure exerted by a column of drilling mud of sufficient density to prevent an undesired flow of formation fluid into the well bore. In the unlikely event that primary control is lost, surface BOP equipment would be used for secondary control. Hilcorp Alaska will use a 5,000, 10,000 or 15,000 psi BOP stack depending on the anticipated formation pressures to be encountered and offset well information.

1.3.1.4.9 Well Plugging and Abandonment (P&A)

When planned and permitted operations are completed, the well will be suspended according to Bureau of Safety and Environmental Enforcement (BSEE) regulations. The well casings will be landed in a mudline
hanger after each hole section is drilled. When the well is abandoned, the production casing is sealed with mechanical plugging devices and cement to prevent the movement of any reservoir fluids between various strata. Each casing string will be cutoff below the surface and sealed with a cement plug. A final shallow cement plug will be set to approximately 3.05 m (10 ft) below the mudline. At this point, the surface casing, conductor, and drive pipe will be cutoff and the three cutoff casings and the mudline hanger are pulled to the deck of the jack-up rig for final disposal. The P&A procedures are part of the Well Plan which is reviewed by BSEE prior to being issued an approved Permit to Drill.

1.3.1.4.10 Waste Management Program

All drilling waste, wastewater, recyclables, hazardous waste, and municipal solid waste will be stored, transported, and disposed of in accordance with local, state, and federal regulations.

1.3.1.4.11 Drilling Fluids and Cuttings

Drilling wastes include drilling fluids, known as mud, and rock cuttings which will be circulated from downhole to the jack-up mud pit system. Non-hydrocarbon based drilling wastes will be discharged to the Cook Inlet under an approved Alaska Pollution Discharge Elimination System (APDES) general permit or sent to an approved waste disposal facility. Hydrocarbon based drilling wastes will be delivered to an onshore permitted location for disposal. Hilcorp Alaska will follow BMP and all stipulations of the applicable permits for this activity.

1.3.1.4.12 Drive Pipe and Conductor Installation

A drive pipe is a relatively short, large-diameter pipe driven into the sediment prior to the drilling of oil wells. The drive pipe serves to support the initial sedimentary part of the well, preventing the looser surface layer from collapsing and obstructing the wellbore. Drive pipes are installed using pile driving techniques. Hilcorp Alaska proposed to drive approximately 60 m (195 ft) of 76.2-cm (30-in) pipe at each well site prior to drilling using a Delmar D62-22 impact hammer (or similar). This hammer has an impact weight of 6,200 kg (13,640 lbs). The drive pipe driving event is expected to last one to three days at each well site, although actual pounding of the pipe will only occur intermittently during this period. Conductors are slightly smaller diameter pipes than the drive pipes used to transport or “conduct” drill cuttings to the surface. For these wells, a 50.8-cm (20-in) conductor pipe may be drilled, not hammered, inside the drive pipe, dependent on the integrity of surface formations.

1.3.1.4.13 Vertical Seismic Profiling

Once the well is drilled, accurate follow-up seismic data may be collected by placing a receiver at known depths in the borehole and shooting a seismic airgun at the surface near the borehole, called vertical seismic profiling (VSP). These data provide high-resolution images of the geological layers penetrated by the borehole and can be used to accurately correlate original surface seismic data. The actual size of the airgun array is not determined until the final well depth is known, but typical airgun array volumes are between 600 and 880 cui. VSP typically takes less than two full days at each well site.

1.3.1.5 Iniskin Peninsula Exploration Project

Hilcorp Alaska initiated baseline exploratory data collection in 2013 for a proposed land-based oil and gas exploration and development project on the Iniskin Peninsula of Alaska, near Chinitna Bay (Figure 3). The proposed project is approximately 97 km (60 mi) west of Homer on the west side of Cook Inlet in the Fitz Creek drainage. New project infrastructure includes material sites, a 6.9 km (4.3 mi) long access road, prefabricated bridges to cross four streams, an air strip, barge landing/staging areas, fuel storage facilities,
water wells and extraction sites, an intertidal causeway, a camp/staging area, and a drill pad. Construction is anticipated to start in 2020.

Initial delivery of construction equipment to the project location will be provided by low-draft tug and barge vessels. Barge landing/staging areas at Camp Point and Fitz Creek will be used for storage and stockpiling of supplies, equipment, and fuel during construction. To take advantage of favorable tides, some equipment and materials may be staged initially at the Camp Point staging area before being consolidated at the Fitz Creek staging area.

A mooring buoy with two mooring lines may be installed in Chinitna Bay, approximately 0.9 km (0.5 nautical miles [nm]) north of Camp Point. Maximum swing radius of buoy, mooring line(s), and any attached barge(s) will not exceed 122 m (400 ft).

An intertidal rock causeway is proposed to be constructed adjacent to the Fitz Creek staging area to improve the accessibility of the barge landing during construction and drilling operations. The causeway will extend seaward from the high tide line approximately 366 m (1,200 ft) to a landing area 46 m (150 ft) wide. Rock fill will be sourced from the Gaikema material site. The causeway will enable more consistent use of the Fitz Creek staging area to receive freight and fuel with fewer limitations due to short high tide windows and result in less dependency on the Camp Point staging area. The causeway will also enable quicker response to emergency incidents (including spill events) and reduce the risk associated with materials logistics and fuel deliveries. After the causeway is no longer needed for the project, it is proposed that the rock fill be removed and relocated to a landowner-approved upland fill area, exposing the natural mud flat surface. Tidal action, wave action, and currents will be free to naturally fill and cover the area disturbed by project’s causeway. The project camp site is located along the historic road alignment at a location where bedrock can be quarried and the pad developed by cutting to grade and utilizing excavated rock for fill.

A dock face will be constructed around the rock causeway so that barges will be able to dock along the causeway. The causeway will need to be 75% built before the construction of the dock face will start. The dock face will be constructed with 18-m (60-ft) tall Z-sheet piles, all installed using a vibratory hammer. It will take approximately 14-25 days, depending on the length of the work shift, assuming approximately 25% of the day actual pile driving. The timing of pile driving will be in late summer or early winter, after the causeway has been partially constructed.

1.3.2 Activities within Existing Cook Inlet Assets

Hilcorp Alaska operates multiple assets throughout Cook Inlet in State of Alaska waters, including gathering facilities and platforms while Harvest Alaska operates the transmission pipelines, the Drift River Terminal, and the Christy Lee loading platform (Figure 2).

On the west side of Cook Inlet, Hilcorp Alaska operates the following onshore units: Ivan River, Lewis River, Pretty Creek, Stump Lake, and Beluga River. In the northern Kenai Peninsula, the company operates the Birch Hill Unit, the Swanson River Unit, the Beaver Creek Unit, the Sterling Unit, the Kenai Unit, and the Cannery Loop Unit. In the southern Kenai Peninsula, the company operates the Deep Creek Unit, the Ninilchik Unit, and the Nikolaevsk Unit. Operations within these units are onshore, so they do not have the potential to result in acoustic harassment of marine mammals in Cook Inlet and are, therefore, only provided as a reference for the scope of the Applicant’s operations in this Petition.

Offshore, Hilcorp Alaska and Harvest Alaska operate the North Cook Inlet Unit, the Granite Point Unit, the Middle Ground Shoal Unit, the Trading Bay Unit, and the North Trading Bay Unit and associated
McArthur River Field. The following text provides an overview of the existing Hilcorp Alaska and Harvest Alaska assets and planned activities within these areas (Figure 8).

1.3.2.1 Onshore Activities

Hilcorp Alaska is a major lease holder in Cook Inlet (Figure 2). Not all of these assets have the potential to result in acoustic harassment of marine mammals in Cook Inlet as they are located on inland, terrestrial habitat. A brief description of these assets is provided below.

1.3.2.1.1 Kenai Assets

Hilcorp Alaska’s natural gas assets located within Kenai are what heats most homes in southcentral Alaska. The Kenai assets are divided into refuge and non-refuge assets. Refuge assets are located within the Kenai National Wildlife Refuge (KNWR) and the Susitna Flats State Game Refuge (Susitna Flats). The Swanson River Field, Beaver Creek Production Facility, and Birch Hill Unit are located within the KNWR. The Pretty Creek, Ivan River, and Lewis River Units are located within Susitna Flats.

Swanson River and Beaver Creek are oil and gas production facilities that are managed by the Bureau of Land Management (BLM), so Hilcorp Alaska requests approval from the BLM for downhole and surface activities at these locations.

Product is taken to market from Swanson River via the 20-cm (8-in) Swanson River Oil Pipeline, which is designated as a crude oil transmission pipeline and is partially regulated by the United States Department of Transportation (USDOT). Oil departs Beaver Creek via tanker truck. Swanson River is the birthplace of the oil and gas industry in Alaska and was the catalyst for statehood. Swanson River was acquired from Chevron in 2012. The Swanson River Oil Pipeline was acquired from Tesoro in 2013. Beaver Creek was acquired from Marathon in 2013.

The non-refuge Kenai assets include the Stirling, Cannery Loop, Ninilchik, Deep Creek, Nikolaevsk, and Beluga River Units.

The Kenai Gas Field is also located outside of the refuges and has seven pads of gas production, located off Kalifornsky Beach Road. The facility also includes gas storage and a grind-and-inject facility. While not on the refuge, the Kenai Gas Field is managed by the BLM.
Figure 8. Planned Hilcorp Alaska activities in middle Cook Inlet.
1.3.2.2 Onshore Gathering Facilities

Hilcorp Alaska also operates three onshore gathering facilities within Cook Inlet to support the offshore platforms. These assets do not have the potential to result in acoustic harassment of marine mammals in Cook Inlet as they are located on inland, terrestrial habitat. A brief description of the onshore gathering facilities is provided below.

1.3.2.2.1 Granite Point Tank Farm

The Granite Point Tank Farm (GPTF) receives oil production from the, Anna, Bruce, and Granite Point platforms. Crude oil is transferred to market via Cook Inlet Pipeline to Drift River Terminal where it is loaded on a tanker at the Christy Lee loading platform (Figure 8). One flow line connects both Anna and Bruce to the GPTF while another connects Granite Point platform; these three platforms are located in the Granite Point Unit. This facility was acquired from Chevron in 2012. The Spark and Spurr platforms located in the North Trading Bay Unit are also connected to the GPTF but are currently lighthoused (i.e., no production).

1.3.2.2.2 Trading Bay Production Facility (TBPF)

The Trading Bay Production Facility (TBPF) processes all of the oil from the south end platforms: King Salmon, Grayling, Dolly Varden, Steelhead, and Monopod platforms (Figure 8). These five platforms are located in the Trading Bay Unit. This facility transfers oil to market via Cook Inlet Pipeline to Drift River Terminal and loaded on a tanker at the Christy Lee loading platform. This facility was acquired from Chevron in 2012.

1.3.2.2.3 Middle Ground Shoal Onshore Facility

The Middle Ground Shoal Onshore Facility (MGSOF) services the Middle Ground Shoal Unit, receiving oil production from platforms A and C platforms and sends it to market via a tie in to Tesoro’s terminal (Figure 8). This facility was acquired from XTO in 2015. The Baker and Dillon platforms are also located in Middle Ground Shoal Unit but are currently lighthoused (i.e., no production).

1.3.2.3 Offshore Production Platforms

Of the 17 production platforms in central Cook Inlet, 15 are owned by Hilcorp Alaska (Figure 8). The two remaining platforms are owned by Furie (KLU Platform A) and Glacier Oil and Gas (Osprey). Table 4 summarizes each of the Hilcorp Alaska-owned platforms.

Hilcorp Alaska performs routine construction on their platforms, depending on needs of the operations. Construction activities may take place up to 24 hrs a day. In-water activities include support vessels bringing supplies five days a week up to two trips per day between OSK and the platform. Depending on the needs, there may also be barges towed by tugs with equipment and helicopters for crew and supply changes.
### Table 4. Hilcorp Alaska production platforms in Cook Inlet.

<table>
<thead>
<tr>
<th>Platform Name</th>
<th>Unit</th>
<th>Location (Lat/Lon)</th>
<th>Installation Date</th>
<th>Hilcorp Alaska Acquisition Date</th>
<th>Water Depth (at MLLW)</th>
<th>Number of Wells</th>
<th>Platform Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Middle Ground Shoal</td>
<td>60.79521 151.49781</td>
<td>1964</td>
<td>2015</td>
<td>83 ft</td>
<td>15 producers, 1 disposal</td>
<td>Active</td>
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<tr>
<td>Anna</td>
<td>Granite Point</td>
<td>60.97638 151.31509</td>
<td>1966</td>
<td>2012</td>
<td>77 ft</td>
<td>56</td>
<td>Active</td>
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<tr>
<td>Baker</td>
<td>Middle Ground Shoal</td>
<td>60.82868 151.48584</td>
<td>1965</td>
<td>2012</td>
<td>102 ft</td>
<td>36</td>
<td>Lighthoused</td>
</tr>
<tr>
<td>Bruce</td>
<td>Granite Point</td>
<td>60.99845 151.30017</td>
<td>1966</td>
<td>2012</td>
<td>62 ft</td>
<td>32</td>
<td>Active</td>
</tr>
<tr>
<td>C</td>
<td>Middle Ground Shoal</td>
<td>60.76341 151.50429</td>
<td>1967</td>
<td>2015</td>
<td>73 ft</td>
<td>13 producers, 1 disposal</td>
<td>Active</td>
</tr>
<tr>
<td>Dillon</td>
<td>Middle Ground Shoal</td>
<td>60.73491 151.51502</td>
<td>1966</td>
<td>2012</td>
<td>92 ft</td>
<td>21</td>
<td>Lighthoused</td>
</tr>
<tr>
<td>Dolly Varden</td>
<td>Trading Bay</td>
<td>60.80712 151.63504</td>
<td>1967</td>
<td>2012</td>
<td>112 ft</td>
<td>70</td>
<td>Active</td>
</tr>
<tr>
<td>Granite Point</td>
<td>Granite Point</td>
<td>60.95758 151.33374</td>
<td>1966</td>
<td>2013</td>
<td>75 ft</td>
<td>40</td>
<td>Active</td>
</tr>
<tr>
<td>Grayling</td>
<td>Trading Bay</td>
<td>60.83919 151.61529</td>
<td>1967</td>
<td>2012</td>
<td>125 ft</td>
<td>61</td>
<td>Active</td>
</tr>
<tr>
<td>King Salmon</td>
<td>Trading Bay</td>
<td>60.86485 151.60804</td>
<td>1967</td>
<td>2012</td>
<td>73 ft</td>
<td>53</td>
<td>Active</td>
</tr>
<tr>
<td>Monopod</td>
<td>Trading Bay</td>
<td>60.89629 151.58100</td>
<td>1966</td>
<td>2012</td>
<td>66 ft</td>
<td>106</td>
<td>Active</td>
</tr>
<tr>
<td>Spark</td>
<td>North Trading Bay</td>
<td>60.92833 151.53055</td>
<td>1968</td>
<td>2013</td>
<td>62 ft</td>
<td>6</td>
<td>Lighthoused</td>
</tr>
<tr>
<td>Spurr</td>
<td>North Trading Bay</td>
<td>60.91944 151.55722</td>
<td>1968</td>
<td>2013</td>
<td>67 ft</td>
<td>6</td>
<td>Lighthoused</td>
</tr>
<tr>
<td>Steelhead</td>
<td>Trading Bay</td>
<td>60.83126 151.60423</td>
<td>1986</td>
<td>2012</td>
<td>183 ft</td>
<td>36</td>
<td>Active</td>
</tr>
<tr>
<td>Tyonek</td>
<td>North Cook Inlet</td>
<td>61.07583 150.950277</td>
<td>1968</td>
<td>2016</td>
<td>100 ft</td>
<td>19</td>
<td>Active</td>
</tr>
</tbody>
</table>

### 1.3.2.4 Offshore Production Drilling

Hilcorp Alaska routinely conducts development drilling activities at offshore platforms on a regular basis to meet the asset’s production needs. Development drilling activities occur from existing platforms within the Cook Inlet through either open well slots or existing wellbores in existing platform legs. All Hilcorp Alaska platforms have a potential for development drilling activities. Drilling activities from platforms within Cook Inlet are accomplished by using conventional drilling equipment from a variety of rig configurations.

Some other platforms in Cook inlet have permanent drilling rigs installed that operate under power provided by the platform power generation systems, while others do not have drill rigs, and the use of a mobile drill rig is required. Mobile offshore drill rigs may be powered by the platform power generation (if compatible with the platform power system) or self-generate power with the use of diesel fired generators.
Helicopter logistics for development drilling programs operations will include transportation for personnel and supplies. The helicopter support will be managed through existing offshore services based at the OSK Heliport to support rig crew changes and cargo handling. Helicopter flights to and from the platform while drilling is occurring is anticipated to increase (on average) by two flights per day from normal platform operations.

Major supplies will be staged on-shore at the OSK Dock in Nikiski. Required supplies and equipment will be moved from the staging area to the platform in which drilling occurring by existing supply vessels that are currently in use supporting offshore operations within Cook Inlet. Vessel trips to and from the platform while drilling is occurring is anticipated to increase (on average) by two trips per day from normal platform operations. During mobile drill rig mobilization and demobilization, one support vessel is used continuously for approximately 30 days to facilitate moving rig equipment and materials.

1.3.2.5 Oil and Gas Pipelines

Natural gas is supplied to Southcentral Alaska via pipeline from the Kenai assets. The Applicant has the ability to ship gas via either the west or east side of Cook Inlet up to Anchorage. Gas is transported across Cook Inlet via the CIGGS line and is boosted with a compressor station located at KPL Junction, which makes having the redundant system for gas supply possible. From the Tyonek platform, the Tyonek Pipeline goes directly to the KPL Junction and former ConocoPhillips LNG plant area. When owned by ConocoPhillips, the Tyonek Pipeline was used to supply gas to the ConocoPhillips LNG plant that is now inactive. Harvest Alaska and Hilcorp Alaska currently tie the Tyonek Pipeline into the existing KBPL gas pipelines near the KPL junction.

The Cook Inlet Pipeline takes product from GPTF and TBPF to market via tanker from Drift River Terminal and the Christy Lee loading platform. The Drift River Terminal currently has two of its four possible 270,000-barrels of oil (bbl) tanks in service to store oil that accumulates from the platforms via the gathering facilities. There is a road on top for heavy equipment to access the tank farm.

1.3.2.6 Routine Maintenance

Each year, Hilcorp Alaska must verify the structural integrity of their platforms and pipelines located within Cook Inlet. Routine maintenance activities include: subsea pipeline inspections, stabilizations, and repairs; platform leg inspections and repairs; and anode sled installations and/or replacement. Through a five-year United States Army Corps of Engineers (USACE) Nationwide Permit 3, the Applicant has received a Letter of Concurrence (LOC) from NMFS for the period 2017-2024. To ensure these maintenance activities are covered through April 1, 2024, these activities are included in this Petition.

Table 5 provides the timing and durations of the proposed maintenance and repair activities. As this is a five-year plan, the exact dates each year are not known. In general, pipeline stabilization and pipeline repair are anticipated to occur in succession for a total of 6-10 weeks. However, if a pipeline stabilization location also requires repair, the divers will repair the pipeline at the same time they are stabilizing it. Pipeline repair activities are only to be conducted on an as-needed basis whereas pipeline stabilization activities will occur annually. During underwater inspections, if the divers identify an area of the pipeline that requires stabilization, they will place Sea-Crete bags at that time rather than waiting until the major pipeline stabilization effort that occurs later in the season.
### 1.3.2.6.1 Subsea Pipelines

Natural gas and oil pipelines located on the seafloor of the Cook Inlet are inspected on an annual basis using ultrasonic testing (UT), cathodic protection surveys, multi-beam sonar surveys, and sub-bottom profilers. Deficiencies identified are corrected using pipeline stabilization methods or USDOT-approved pipeline repair techniques.

**Pipeline Inspections**

The Applicant employs dive teams to conduct physical inspections and evaluate cathodic protection status and thickness of subsea pipelines on an annual basis. If required for accurate measurements, divers may use a water jet to provide visual access to the pipeline. For stabilization, inspection dive teams may place Sea-Crete bags beneath the pipeline to replace any materials removed by the water jet. Results of the inspections are recorded and significant deficiencies are noted for repair.

Multi-beam sonar and sub-bottom profilers may also be used to obtain images of the seabed along and immediately adjacent to all subsea pipelines. Strong currents within the Cook Inlet can scour and erode the seafloor beneath the pipelines, creating potentially significant integrity issues. Specifically, multi-beam sonar is used to evaluate and identify:

- Significant subsea topographic anomalies located within 3.05 m (10 ft) of all pipelines
- Unsupported pipeline spans of 15 m (50 ft) or greater
- Pipeline alignment
- Location of pipeline crossings
- Locations and tracking of the M/V Monarch shipwreck
- Up-to-date current velocity data

---

**Table 5. Timing and durations of Cook Inlet maintenance and repair activities.**

<table>
<thead>
<tr>
<th>Location</th>
<th>Activity</th>
<th>Description</th>
<th>Estimated Timing</th>
<th>Estimated Duration</th>
<th>Frequency</th>
<th>Dive Support</th>
<th>Multi-Beam Sonar</th>
<th>Water jet</th>
<th>Sea-Crete</th>
<th>Heli Support</th>
<th>RA Team</th>
<th>Drones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsea Pipelines</td>
<td>Pipeline Inspections</td>
<td>Pipelines are evaluated for cathodic protection status, pipeline thickness, and scour using either tactile surveys or multi-beam sonar.</td>
<td>April/May</td>
<td>2 weeks</td>
<td>Annual</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pipeline Stabilization</td>
<td>Results from Pipeline Inspection efforts are used to guide Pipeline Stabilization activities. Pipelines identified during inspection efforts are visually inspected and grouted using Sea-Crete concrete bags at certain locations greater than 50 feet.</td>
<td>June - October</td>
<td>3-5 weeks</td>
<td>Annual</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pipeline Repair</td>
<td>Pipeline integrity issues identified during pipeline inspection are repaired using DOT-approved clamps and/or fiber glass tape. If material is removed from below the pipeline for repairs, Sea-Crete bags are placed to stabilize the pipeline.</td>
<td>June - October</td>
<td>3-5 weeks</td>
<td>As needed</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Platform Legs</td>
<td>Platform Leg Inspection and Repair - Subsea</td>
<td>Platform legs, braces, and pipe-to-platform connections are evaluated for cathodic protection status, structure thickness, excessive marine growth, damage, and scour. Repairs are completed as necessary to maintain the integrity of the platform legs.</td>
<td>April - June</td>
<td>3 weeks</td>
<td>Annual</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Platform Leg Inspection and Repair - Total Zone</td>
<td>Platform legs, braces, and pipe-to-platform connections are inspected using either commercially-priced drones or certified R/V access (RA) teams. Repairs are completed as necessary.</td>
<td>May - July</td>
<td>3 weeks per wrap</td>
<td>As needed</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Anode Sleds</td>
<td>Anode Sled Installation/ Replacement</td>
<td>Galvanic or impregnated current anodes are installed and/or replaced as necessary to maintain cathodic protection of pipelines and platforms.</td>
<td>May - August</td>
<td>2-3 weeks</td>
<td>As needed</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Elements of pipeline inspections that could produce underwater noise include:

- Dive Support Vessel (DSV)
- Water jet
- Multi-beam sonar/sub-bottom profiler and vessel

**Pipeline Stabilization**
Scour spans beneath pipelines greater than 23 m (75 ft) have the potential to cause pipeline failures. To be conservative, scour spans of 15 m (50 ft) or greater identified using multi-beam sonar surveys are investigated using dive teams. Divers perform tactile inspections to confirm spans greater than 15 m (50 ft). The pipeline is stabilized along these spans with Sea-Crete concrete bags.

While in the area, the divers will also inspect the external coating of the pipeline and take cathodic protection readings if corrosion wrap is found to be absent.

Elements of pipeline stabilization that could produce underwater noise include:

- DSV
- Water jet

**Pipeline Repair**
Significant pipeline deficiencies identified during pipeline inspections are repaired as soon as practicable using methods including, but not limited to, USDOT-approved clamps and/or fiber glass wraps, bolt/flange replacements, and manifold replacements. In some cases, a water jet may be required to remove sand and gravel from under or around the pipeline to allow access for assessment and repair. The pipeline surface may also require cleaning using a hydraulic grinder to ensure adequate repair. If pipeline replacement is required, an underwater pipe cutter such as a diamond wire saw or hydraulically-powered Guillotine saw may be used.

Elements of pipeline repair that could produce underwater noise include:

- DSV
- Water jet
- Hydraulic grinder
- Underwater pipe cutter

**1.3.2.6.2 Platform Legs**
Hilcorp Alaska’s platforms in Cook Inlet are inspected on a routine basis. Divers and certified rope access (RA) technicians visually inspect subsea platform legs. These teams also identify and correct significant structural deficiencies.

**Platform Leg Inspection and Repair - Subsea**
Platform leg integrity and pipeline-to-platform connections beneath the water surface are evaluated by divers on a routine basis (Table 5). Platform legs, braces, and pipeline-to-platform connections are evaluated for cathodic protection status, structure thickness, excessive marine growth, damage, and scour. If required, divers may use a water jet to clean or provide access to the structure. Material removed from the seafloor may be replaced by Sea-Crete bags to stabilize the pipeline. Cathodic protection of the platform legs and associated pipelines are evaluated using a submersible Silver Chloride half-cell coupled to a digital multi-meter. Cathodic protection readings are taken continuously while the divers travel down legs, along...
members/pipelines, and at all inspected nodes. Measurements are collected while the cathodic protection system remains active.

RA teams may use magnetic particle inspection (MPI) to detect structure surface and near-surface flaws. If necessary, remedial grinding using a hydraulic under water grinder may be required to determine extent damage and/or to prevent further crack propagation. All inspection results are recorded and significant deficiencies are noted for repair.

Elements of subsea platform leg inspection and repair that could produce underwater noise include:

- DSV
- Hydraulic grinder
- Water jet

**Platform Leg Inspection and Repair—Tidal Zone**

Platform leg integrity along the tidal zone is inspected on a routine basis. Difficult-to-reach areas may be accessed using either commercially-piloted unmanned aerial systems (UAS) or certified RA teams.

Commercially-piloted UASs may be deployed from the top-side of the platform to obtain images of the legs. These images are then used to direct further inspections using RA Teams. Platform legs and braces are evaluated for cathodic protection status, structure thickness, excessive marine growth, and damage. All welds and corrosion leg wraps along the platform leg are inspected for damage or peeling. Significant structural deficiencies identified during inspections are repaired as soon as practicable using methods including, but not limited to, coarse metal repair such as welding seams or patches or replacing wraps.

Platform leg braces may be repaired as necessary to maintain the structural integrity of the platform. Loose bolts or evidence of cracking may be repaired by replacing bolts, installing new clamps, applying a composite material, or replacing the entire brace. In some situations, filling the brace with a composite material may be the most effective method of repair.

Elements of tidal zone work that could disturb marine mammals include:

- UAS

**1.3.2.6.3 Anode Sled Installation and/or Replacement**

Galvanic and impressed current anode sleds are used to provide cathodic protection for the pipelines and platforms in Cook Inlet. Galvanic anode sleds do not require a power source and may be installed along the length of the pipelines on the seafloor. Impressed current anode sleds are located on the seafloor at each of the corners of each platform and are powered by rectifiers located on the platform.

Anodes are placed at the seafloor using dive vessels and hand tools. If necessary, a water jet may be used to provide access for proper installation. Anodes and/or cables may be stabilized using Sea-Crete bags.

Elements of anode sled inspection and repair that could produce underwater noise include:

- DSV
- Water jet

**1.3.2.6.4 Vessel Traffic**

Hilcorp Alaska’s maintenance activities will require the use of dive vessels, typically ranging up to 21 m (70 ft) in length x 7.3 m (24 ft) in width x 2.1 m (7 ft) draft capable of approximately 13 km/hr (7 knots),
traveling with the speed of the incoming/outgoing tide. On average, vessels may travel approximately 13 km (8 mi) per day, three times each day for a total of about 77 km (48 mi) per day during normal operations.

1.3.2.6.5 Pingers

Several types of moorings are deployed in support of Hilcorp Alaska operations; all of which require an acoustic pinger for location or release. The pinger is deployed over the side a vessel and a short signal is emitted to the mooring device. The mooring device responds with a short signal to indicate that the device is working, to indicate range and bearing data, or to illicit a release of the unit from the anchor. These are used for very short periods of time when needed.

1.3.2.7 North Cook Inlet Unit Subsea Well P&A Activity

The discovery well in the North Cook Inlet Unit was drilled over 50 years ago and is planned to be abandoned, so Hilcorp Alaska plans to conduct a geohazard survey to locate the well and conduct P&A activities for a previously drilled subsea exploration well in 2020 (Figure 8).

The geohazard survey location is approximately 402-804 m (¼-½ mi) south of the Tyonek platform and will take place over approximately seven days with a grid spacing of approximately 250 m (820 ft). The suite of equipment used during a typical geohazards survey consists of single beam and multi-beam echosounders, which provide water depths and seafloor morphology; a side scan sonar that provides acoustic images of the seafloor; a sub-bottom profiler which provides 20 to 200 m (66 to 656 ft) sub-seafloor penetration with a 6- to 20-cm (2.4-7.9-in) resolution. The echosounders and sub-bottom profilers are generally hull-mounted or towed behind a single vessel. The vessel travels at 3-4.5 knots (5.6-8.3 km/hr).

After the well has been located, Hilcorp Alaska plans to conduct P&A activities over a 60-90 day time period in May through July in 2020. The jack-up rig will be similar to what is described in Section 1.5.4.1. (the Spartan 151 drill rig, or similar). The rig will be towed onsite using up to three ocean-going tugs. Once the jack-up rig is on location, divers working off a boat will assist in preparing the subsea wellhead and mudline hanger for the riser to tie the well to the jack-up. Once the riser is placed, the BOP equipment is made up to the riser. At this point, the well will be entered and well casings will be plugged with mechanical devices and cement and then cutoff and pulled. A shallow cement plug will be set in the surface casing to 3.05 m (10 ft) below the mudline hanger. The remaining well casings will be cutoff and the mudline hanger will be recovered to the deck of the jack-up rig for disposal. The well abandonment will be performed in accordance to Alaska Oil and Gas Conservation Commission (AOGCC) regulations.

1.3.2.8 Trading Bay Area Exploratory Drilling

Hilcorp Alaska plans to conduct exploratory drilling activities in the Trading Bay area. The specific sites of interest have not yet been identified, but the general area is shown in Figure 8. Hilcorp Alaska will conduct geohazard surveys over the areas of interest to locate potential hazards prior to drilling with the same suite of equipment as described in Section 2.1.3. The survey is expected to take place over 30-60 days in 2019 from a single vessel.

The exploratory drilling and well completion activities will take place in site-specific areas based on the geohazard survey. Hilcorp Alaska plans to drill 1-2 exploratory wells in this area in the open water season of 2020 with the same equipment and methods as described in Section 1.5.3.
1.3.2.9 Drift River Terminal Decommissioning

If the pipeline from the Drift River Terminal to Christy Lee is abandoned during the period of this Petition, the Drift River Terminal will be abandoned in place (i.e., no in-water work other than vessels).

1.4 DESCRIPTION OF ALASKA LNG PROJECT

AGDC plans to construct one integrated LNG Project (Alaska LNG Project) with interdependent facilities for liquefying supplies of natural gas from Alaska, from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaskan North Slope (North Slope), for export in foreign commerce and for in-state deliveries of natural gas. The Project includes a Liquefaction Facility on the Kenai Peninsula. The location of the Project is depicted in Figure 9. This petition addresses and requests coverage for only those Project activities that are associated with the construction of the Project within Cook Inlet (see Figure 10) and that could have direct or indirect effects on marine mammal species managed by USFWS. These Project activities are:

• Construction of the proposed Marine Terminal in Cook Inlet, including construction of a temporary Material Offloading Facility (MOF) and a permanent Product Loading Facility (PLF).
• Construction of the Mainline across Cook Inlet, including the potential construction of a Mainline MOF on the west side of Cook Inlet.

Components of proposed construction activities in Cook Inlet that have the potential to result in acoustical exposures that rise to the level of takes of marine mammals include:

• Vibratory and impact pile driving associated with MOF and PLF construction.
• Anchor handling associated with pipelay across the Cook Inlet.

1.4.1 Marine Terminal

The proposed Marine Terminal would be constructed adjacent to the proposed onshore LNG Plant near Nikiski, Alaska, (Figure 11) and would allow LNG carriers (LNGCs) to dock and be loaded with LNG for export. Primary components of the Marine Terminal include a PLF and the Temporary MOF (Figure 12).
Figure 9. Alaska LNG Project overview.
Figure 10. Planned activities for AKNLG Project.
Figure 11. Location of Alaska LNG Project marine terminal.
1.4.1.1 Product Loading Facility

The proposed PLF would be a permanent facility used to load LNGCs for export. It consists of two loading platforms, two berths, a Marine Operations Platform, and an access trestle that supports the piping that delivers LNG from shore to LNGCs and include all the equipment to dock LNGCs. Analyzed elements of the PLF are shown in Figure 11 and Figure 12, and are described as follows.

- **PLF Loading Platforms** – Two loading platforms, one located at either end of the north-south portion of the trestle (Figure 12) would support the loading arm package, a gangway, and supporting piping, cabling, and equipment. The platforms would be supported above the seafloor on steel-jacketed structures called quadropods.

- **PLF Berths** – Two berths would be located in natural water depths greater than -16 m (-53 ft) mean lower low water (MLLW) and would be approximately 488 m (1,600 ft) apart at opposite ends of the north-south portion of the trestle.

- Each berth would have four concrete pre-cast breasting dolphins and six concrete pre-cast mooring dolphins (Figure 13). The mooring and breasting dolphins would be used to secure vessels alongside the berth for cargo loading operations. The mooring and breasting dolphins would be supported over the seabed on quadropods. A catwalk, supported on two-pile bents, would connect the mooring dolphins to the loading platforms.
• **Marine Operations Platform** – A Marine Operations Platform would be located along the east-west portion of the access trestle (Figure 12) and would support the proposed Marine Terminal Building; an electrical substation, and piping, cabling, and other equipment used to monitor the loading operations. The platform would be supported above the seafloor on four-pile bents.

• **Access Trestle** – This structure is T-shaped with a long east-west oriented section and a shorter north-south oriented section, and carries pipe rack, roadway, and walkway. The pipe rack contains LNG loading system pipelines, a fire water pipeline, utility lines, power and instrument cables, and lighting. The east-west portion of the trestle extends from shore, seaward, for a distance of approximately 1,113 m (3,650 ft), and would be supported on three-pile and four-pile bents at 37-m (120-ft) intervals. The north-south oriented portion of the access trestle is approximately 475 m (1,560 ft) long, and is supported on five-pile quadropods.

![Image of Alaska LNG Project berth layout – plan view.](image)

**Figure 13. Alaska LNG Project berth layout – plan view.**

### 1.4.1.1.1 Construction of the Product Loading Platforms and Berths

Construction methods would be both overhead (conducted with equipment located on a cantilever bridge extending from shore) construction and marine (conducted with equipment located on barges/vessels) construction.

The PLF would be constructed using both overhead and marine construction methods. As planned, the PLF would be constructed over the course of four ice-free seasons (Seasons 1–4); however, Season 1 activities associated with PLF construction include only installation of onshore portions of the PLF, and are therefore not described or analyzed in this Petition. Activities in Seasons 2 through 4 are described below. Each season extends from 1 April through 31 October, during which construction crews would be working 12 hours per day, six days per week.
In Season 2, the marine construction spread would be mobilized and the cantilever bridge would be commissioned. A total of 35 bents and quadropod structures would be installed for part of the east-west access trestle, and eight quadropods would be installed to support the berth loading platforms.

In Season 3, the remainder of the bents for the east-west access trestle would be installed. Additionally, bents supporting the Marine Operations Platform and north-south trestle would be installed. A total of 26 bent and quadropod structures would be installed.

In Season 4, installation of the mooring quadropods would be completed, and the bents supporting the catwalk between the loadout platforms and the mooring dolphins would be installed. A total of 18 bent and quadropod structures would be installed.

The numbers and types of piles that would be installed in Seasons 2–4 are listed in Table 6, Table 7, and Table 8. All PLF bents and quadropods are expected to be installed with impact hammers. The anticipated production rate for installation of the bents is one bent per six construction days, and for quadropods it is one quadropod per eight work days. Pile driving is expected to occur during only two of the six days for bents and two of the eight days for quadropods. It is also assumed the impact hammer would only be operated approximately 25% of time during the two days of pile driving.

Table 6. Pile structures to be installed for the Alaska LNG Project PLF in Season 2.

<table>
<thead>
<tr>
<th>PLF Element</th>
<th>Structure Type</th>
<th>Number of Structures</th>
<th>Number of Piles</th>
<th>Hammer Method</th>
<th>Days</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-W Trestle</td>
<td>3-pile bent ¹</td>
<td>11</td>
<td>48-inch Piles</td>
<td>Impact ²</td>
<td>22</td>
<td>April–June</td>
</tr>
<tr>
<td>E-W Trestle</td>
<td>4-pile bent</td>
<td>10</td>
<td>40-inch Piles</td>
<td>Impact ³</td>
<td>20</td>
<td>June–August</td>
</tr>
<tr>
<td>Berth 1</td>
<td>quadropod</td>
<td>4</td>
<td>-</td>
<td>Impact ³</td>
<td>8</td>
<td>April–May</td>
</tr>
<tr>
<td>Berth 2</td>
<td>quadropod</td>
<td>4</td>
<td>-</td>
<td>Impact ³</td>
<td>8</td>
<td>April–May</td>
</tr>
<tr>
<td>N-S Trestle</td>
<td>quadropod</td>
<td>8</td>
<td>60-inch Piles</td>
<td>-</td>
<td>16</td>
<td>May–June</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>35</td>
<td>80</td>
<td>--</td>
<td>74</td>
<td>April–June</td>
</tr>
</tbody>
</table>

¹ Four three-pile bents for the E-W (east-west) access trestle would be installed in Season 2; however, two of them are onshore and two are in the intertidal and would be installed when the tide is out.
² Two impact hammers are expected to be used from the barges.
³ One impact hammer is expected to be used from the overhead cantilever bridge.
⁴ Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure, pile driving would occur during only a portion of each day.
Table 7. Pile structures to be installed for the Alaska LNG Project PLF Season 3.

<table>
<thead>
<tr>
<th>PLF Element</th>
<th>Structure Type</th>
<th>Number of Structures</th>
<th>Number of Piles</th>
<th>Hammer</th>
<th>Method</th>
<th>Days</th>
<th>Month(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>48-inch</td>
<td>60-inch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-W Trestle</td>
<td>4-pile bent</td>
<td>7</td>
<td>7</td>
<td>28</td>
<td>Impact</td>
<td>marine</td>
<td>14</td>
</tr>
<tr>
<td>Operations Platform</td>
<td>4-pile bent</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Impact</td>
<td>marine</td>
<td>6</td>
</tr>
<tr>
<td>Breasting Dolphins</td>
<td>quadropod</td>
<td>8</td>
<td>8</td>
<td>32</td>
<td>Impact</td>
<td>overhead</td>
<td>16</td>
</tr>
<tr>
<td>Mooring Dolphin</td>
<td>quadropod</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>Impact</td>
<td>overhead</td>
<td>4</td>
</tr>
<tr>
<td>N-S Trestle</td>
<td>quadropod</td>
<td>6</td>
<td>6</td>
<td>30</td>
<td>Impact</td>
<td>overhead</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>--</td>
<td>26</td>
<td>40</td>
<td>80</td>
<td>--</td>
<td>--</td>
<td>52</td>
</tr>
</tbody>
</table>

1 Three impact hammers are expected to be used from the barges.
2 One impact hammer is expected to be used from the overhead cantilever bridge.
3 Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure, pile driving would occur during only a portion of each day.

Table 8. Pile structures to be installed for the Alaska LNG Project PLF in Season 4.

<table>
<thead>
<tr>
<th>PLF Element</th>
<th>Structure Type</th>
<th>Number of Structures</th>
<th>Number of Piles</th>
<th>Hammer</th>
<th>Method</th>
<th>Days</th>
<th>Month(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>48-inch</td>
<td>60-inch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mooring Dolphin</td>
<td>quadropod</td>
<td>10</td>
<td>10</td>
<td>40</td>
<td>Impact</td>
<td>marine</td>
<td>20</td>
</tr>
<tr>
<td>Catwalk</td>
<td>2-pile bent</td>
<td>4</td>
<td>-</td>
<td>8</td>
<td>Impact</td>
<td>marine</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>--</td>
<td>18</td>
<td>10</td>
<td>48</td>
<td>--</td>
<td>--</td>
<td>36</td>
</tr>
</tbody>
</table>

1 Two impact hammers are expected to be used from the barges.
2 Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure, pile driving would occur during only a portion of each day.

### 1.4.1.1.2 Temporary Material Offloading Facility

The proposed Temporary MOF, to be located near the PLF in Nikiski (Figure 10, Figure 11, and Figure 12), would consist of three berths and a quay (Figure 14) that would be used during construction of the Liquefaction Facility to enable direct deliveries of equipment modules, bulk materials, construction equipment, and other cargo to minimize the transport of large and heavy loads over road infrastructure.

The MOF quay would be approximately 320 m (1,050 ft) long and 183 m (600 ft) wide, which would provide sufficient space for cargo discharge operations and accommodate 61,000 m² (200,000 ft²) of staging area. It would have a general dock elevation of +9.8 m (+32 ft) MLLW.
The quay would have of an outer wall consisting of combi-wall (combination of sheet piles and pipe piles) tied back to a sheet pile anchor wall, and 11 sheet pile coffer cells, backfilled with granular materials.

Berths at the MOF would include:

- One Lift-on/Lift-off (Lo-Lo) berth with a maintained depth alongside of -9.8 m (-32 ft) MLLW.
- One Roll-on/Roll-off (Ro-Ro) berth with a maintained depth alongside of -9.8 m (-32 ft) MLLW.
- One grounded barge bed with a ground pad elevation of +3.1 m (+10 ft) MLLW.

The MOF has been designed as a temporary facility and would be removed early in operations when it is no longer needed to support construction of the Liquefaction Facility.

1.4.1.1.3 Construction of the Temporary MOF

The Temporary MOF would be constructed over the course of two construction seasons (Seasons 1 and 2), with each season extending from 1 April through 31 October. The number of sheet pile and pipe pile structures that would be installed in each season, along with the methods and durations of the installation activities, are provided in Table 9.

The combi-wall and the first six of eleven coffer cells would be installed in Season 1. An equal amount of sheet pile anchor wall would be associated with the combi-wall, but this is not considered in the analysis or requested takes, as the anchor wall would be driven into fill and would not generate substantial underwater sound. Six 24-in template pipe piles would be installed with a vibratory hammer before the sheet pile is installed for each coffer cell and then removed when coffer cell installation is complete. The remaining five coffer cells and fill would be installed in Season 2, along with the quadropods for the dolphins for the RoRo berth.

The Temporary MOF would be constructed using both land-based (from shore and subsequently from constructed portions of the MOF) and marine construction methods. Crews are expected to work 12 hours per day, six days per week. The anticipated production rate for installation of combi-wall and coffer cells is 25 linear ft per day per crew, with two crews operating, and vibratory hammers operating 40% of each 12-hr construction day. The anticipated production rate for quadropod installation is the same as described previously.
Table 9. Sheet and pile structures to be installed as part of Alaska LNG Project Temporary MOF construction.

<table>
<thead>
<tr>
<th>Season</th>
<th>Structure Type</th>
<th>Number of Structures</th>
<th>Number of Piles</th>
<th>Sheetc Pile (feet)</th>
<th>Method</th>
<th>Hammer</th>
<th>Days¹</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>combi-wall ²</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>35</td>
<td>land</td>
<td>vibratory</td>
<td>21.5</td>
</tr>
<tr>
<td>1</td>
<td>coffer cell</td>
<td>6</td>
<td>36 ³</td>
<td>-</td>
<td>2,454</td>
<td>land</td>
<td>vibratory</td>
<td>55.1</td>
</tr>
<tr>
<td>2</td>
<td>coffer cell</td>
<td>5</td>
<td>30 ³</td>
<td>-</td>
<td>2,447</td>
<td>land</td>
<td>vibratory</td>
<td>53.9</td>
</tr>
<tr>
<td>2</td>
<td>quadropod ⁴</td>
<td>7</td>
<td>28</td>
<td>7</td>
<td>-</td>
<td>marine</td>
<td>impact</td>
<td>14</td>
</tr>
<tr>
<td>All</td>
<td>-</td>
<td>19</td>
<td>94 7</td>
<td>35</td>
<td>-</td>
<td>-</td>
<td>132.5</td>
<td>Apr-Oct</td>
</tr>
</tbody>
</table>

¹ Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure for pile driving, 25 feet per day per crew for sheet pile and combi-wall. Pile driving would occur during only a portion of each of these days.

² Combi-wall is a wall made of sheet piles with pipe piles at interval along the wall for support. These piles and sheet wall are installed from land but are located in water, therefore these components were used in Level A and B evaluation. There would also be an equal length of anchor wall with no pipe piles installed in fill, on land and therefore no underwater sound is anticipated and was not used in Level A and B evaluation.

³ These are 24-in piles or spuds driven in the seafloor to form templates for the circular sheet pile.

⁴ Five-pile quadropods for the MOF RoRo dolphins

Dredging would be conducted over two ice free seasons, with some maintenance over the seven-year construction period of the Alaska LNG plant. Dredging at the MOF may be conducted with either an excavator or clamshell (both mechanical dredges). Various bucket sizes may be used. Sediment removed would be placed in split hull or scow/hopper barges tended by tugs that would transport the material to the location of dredge material placement.

Dredging at the MOF during the second season, and during the maintenance over the Alaska LNG Plant construction time period, may be conducted with either a hydraulic (cutter head) dredger or a mechanical dredger. For a hydraulic dredger, the dredged material would be pumped from the dredge area to the disposal location or pumped into split-hull barges for transport to the placement location. If split-hull barges are used rather than direct piping of material, a manifold system may be set up to load multiple barges simultaneously. For a mechanical dredger, two or more sets of equipment would likely be required to achieve total dredging production to meet the Project schedule. Personnel transfer, support equipment, and supply would be similar to the first season.
1.4.2 Mainline Material Offloading Facility

A MOF may be required on the west side of Cook Inlet to support installation of the Cook Inlet shoreline crossing, and onshore construction between the South of Beluga Landing shoreline crossing and the Yentna River. The Mainline MOF would be located near, but at a reasonable distance, from the existing Beluga Landing. Use of the existing landing is not considered to be feasible without significant re-design and construction effort.

The Mainline MOF would consist of a quay, space for tugs, and berths including:

- Lo-Lo Berth for unloading pipes and construction materials.
- Ro-Ro Berth and ramp dedicated to Ro-Ro operations.
- Fuel berth dedicated to unloading fuel.

The quay would be 137 m (450 ft) long (along the shoreline) and 95 m (310 ft) wide (extending into the Cook Inlet). A Ro-Ro ramp (approximately 24 m by 37 m [80 ft by 120 ft]) would be constructed adjacent to the quay. Both the quay and the Ro-Ro ramp would consist of anchored sheet pile walls backed by granular fill. The sources for the granular material would be onshore. Surfacing on the quay would be crushed rock. Some fill material for the quay and Ro-Ro ramp are expected to be generated by excavation of the access road. Any additional needed fill materials and crushed rock for surfacing, would be barged in.
The quay and the Ro-Ro ramp are located within the 0-m (0-ft contour, so berths would be practically dry at low tide. No dredging is planned; vessels would access the berths and ground themselves during high tide cycles. The proposed top level of the Mainline MOF is +11 m (+36 ft) MLLW, which is about 3.3 m (11 ft) above MHHW.

1.4.2.1 Construction of the Mainline MOF

Approximately 387 m (1,270 ft) of sheet pile would be installed for construction of the quay and Ro-Ro ramp, and a corresponding length of sheet pile would be installed as anchor wall; however, only 204 m (670 ft) of sheet pile would be installed in the waters of Cook Inlet. The remainder would be installed as anchor wall in fill material, or in the intertidal area when the tide is out and would not result in underwater sound.

The Mainline MOF would be constructed in a single construction season (Season 1), which would extend from 1 April to 31 October. A break-down of activities per season is provided below (Table 10). Crews are expected to work 12 hrs per day, six days per week. The sheet pile would be installed using marine equipment, with the first 50% of embedment conducted using a vibratory hammer and the remaining 50% conducted using an impact hammer. Hammers would be expected to be operated either 25% of a 12-hr construction day (impact hammer) or 40% of a 12-hr construction day (vibratory hammer).

Table 10. Structures to be installed in Cook Inlet as part of the Alaska LNG Project Mainline MOF construction.

<table>
<thead>
<tr>
<th>Season</th>
<th>Structure Type</th>
<th>Structure s</th>
<th>Sheet Pile (feet)</th>
<th>Pipe Pile (number)</th>
<th>Hammer</th>
<th>Method</th>
<th>Days 1</th>
<th>Months 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>quay</td>
<td>1</td>
<td>470</td>
<td>-</td>
<td>vibratory / impact</td>
<td>marine</td>
<td>10</td>
<td>Apr-May</td>
</tr>
<tr>
<td>1</td>
<td>RoRo ramp 3</td>
<td>1</td>
<td>200</td>
<td>-</td>
<td>vibratory / impact</td>
<td>marine</td>
<td>4</td>
<td>Apr-May</td>
</tr>
<tr>
<td>All</td>
<td>-</td>
<td>2 3</td>
<td>670 4</td>
<td>-</td>
<td>vibratory / impact</td>
<td>marine</td>
<td>14</td>
<td>Apr-May</td>
</tr>
</tbody>
</table>

1 Number of days on which pile-driving would occur based on expected progress rate of 25 linear ft per day per crew (2 crews) for sheet pile; however, pile driving would occur during only a portion of each of these days – approximately 40% of work day when operating vibratory hammer and 25% of work day with impact hammer.
2 Months during which some of the pile driving is expected to occur.
3 The quay and the RoRo ramp are adjoining parts of the Mainline MOF.
4 Itemized sheet pile is for only sheet pile installed in the water; additional sheet pile would be installed in the dry (183 m [600 ft], in intertidal area when tide is out) and additional sheet pile installed in fill as anchor wall. These piles are not included in table or analyzed in the document as installation would not result in significant underwater sound.
5 The first 15 m (50 ft) of embedment would be conducted with a vibratory hammer, and the remainder with an impact hammer – assume half of the pile driving days with each hammer type.
1.4.3 Mainline Crossing of Cook Inlet

The proposed Mainline, a 107-cm (42-in) diameter, natural gas pipeline, would cross the Cook Inlet shoreline on the west side of the inlet (north landfall) south of Beluga Landing at pipeline milepost (MP) 766.3, traverse Cook Inlet in a generally southward direction for approximately 43 km (26.7 mi), and cross the east Cook Inlet shoreline near Suneva Lake at MP 793.1 (south landfall) (Figure 10). The pipe would be trenched into the seafloor and buried from the shoreline out to a water depth of approximately 11-14 m (35-45 ft) MLLW on both sides of the inlet, approximately 2,682 m (8,800 ft) from the north landfall and 2,012 m (6,600 ft) from the south landfall. Burial depth (depth of top of pipe below the seafloor) in these areas would be 0.9-1.8 m (3–6 ft). Seaward of these sections, the concrete coated pipeline would be placed on the seafloor.

1.4.3.1 Pre-installation Surveys

Geophysical surveys would be conducted just prior to pipeline construction. A detailed bathymetric profile (longitudinal and cross) would be conducted. Types of geophysical equipment expected to be used for the surveys would be similar to those described in Section 1.3.1.3, except would not include a sub-bottom profiler.

1.4.3.2 Trenching, Pipelay, and Burial

The pipeline would be trenched and buried in the nearshore portions of the route across the Cook Inlet. Dimensions of these trenches are provided in Table 11.

Table 11. Expected volumes to be excavated from subsea pipe trenches in Cook Inlet for the Alaska LNG Project.

<table>
<thead>
<tr>
<th>Site</th>
<th>Subsea Trench Length</th>
<th>Overcut (ft)</th>
<th>Trench Slope (Depth: Width)</th>
<th>Subsea Trench Cross Sectional Area (square feet)</th>
<th>Seafloor Area Trenched (cubic yards)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To -35 ft</td>
<td>To -45 ft</td>
<td>5</td>
<td>1:3</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:6</td>
<td>900</td>
</tr>
<tr>
<td>Beluga Landing</td>
<td>8,300</td>
<td>8,800</td>
<td></td>
<td>1:3</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:6</td>
<td>900</td>
</tr>
<tr>
<td>Suneva Lake</td>
<td>6,400</td>
<td>6,600</td>
<td></td>
<td>1:3</td>
<td>500</td>
</tr>
</tbody>
</table>

The nearshore portion of the trench is expected to be constructed using amphibious or barge-based excavators. This portion of the trench would extend from the shoreline out to a transition water depth where a dredge vessel can be employed. On the west side of the inlet (Beluga Landing) this is expected to be from the shore out 200 m (655 ft), and on the east side (Suneva Lake) from the shoreline out 197 m (645 ft). The trench basis is to excavate a shallow slope trench that would not retain sediments (i.e., a self-cleaning trench). A backhoe dredge may also be required to work in this portion of the crossing.

From the transition water depth to water depths of the -11 m or - 14 m (-35 ft or -45 ft) MLLW, a trailing suction hopper dredger would be used to excavate a trench for the pipeline. Alternative burial techniques, such as plowing, backhoe dredging, or clamshell dredging, would be considered if conditions become problematic for the dredger. After installation of the nearshore pipelines, a jet sled or mechanical burial sled could be used to achieve post dredge burial depths.
Pipeline joints would be welded together onshore in 305-m (1,000-ft)-long strings and laid on the ground surface in an orientation that approximates the offshore alignment. A pipe pull barge would be anchored offshore near the seaward end of the trench and would then be used to pull the pipe strings from their onshore position, out into the trench.

Following pipeline installation, the trench is expected to backfill naturally through the movement of seafloor sediments. If manual backfilling is required, the backfill would be placed by reversing the flow of the trailing suction hopper dredger used offshore (see below) or mechanically with the use of excavators.

1.4.3.3 Offshore Pipeline Installation

Seaward of the trenched sections, the pipeline would be laid on the seafloor across Cook Inlet using conventional pipelay vessel methods. The pipelay vessel would likely employ 12 anchors to keep it positioned during pipelay and provide resistance as it is winched ahead 24 m (80 ft) each time an additional 24-m (80-ft) section of pipe is added/welded on the pipe string. Dynamic positioning may be used in addition to the conventional mooring system. Mid-line buoys may be used on the anchor chains when crossing other subsea infrastructure (i.e., pipelines and cables). A pipelay rate of 610 to 762 m (2,000 to 2,500 ft) per 24-hour period is expected. It is anticipated that three anchor handling attendant tugs would be used to repeatedly reposition the anchors, thereby maintaining proper position and permitting forward movement.

1.4.3.4 Construction Schedule for the Mainline Crossing

The pipeline crossing of Cook Inlet would be installed in two consecutive construction seasons (Seasons 3 and 4). The construction season extends from 1 April through 31 October. All work from the pipelay vessel and pull barge would be conducted 24 hrs per day, seven days per week, until the work planned for that season is completed. Anchor handling durations were estimated differently for the two construction seasons. Anchor handling is expected to be conducted 25% of the time that the pull barge is on site in Season 3. The estimate for anchor handling duration in Season 4 was based on the proposed route length, the total numbers of individual anchors moves (Table 12) and the estimated time required to retrieve and reset each anchor (approximately 30 minutes per anchor to retrieve and reset). A breakdown of activities per season is provided below.

Season 3

- Conduct onshore enabling works including establishing winch/laydown and welding area, and excavation of a trench through onshore sections of the shore approach (open cut the shoreline).
- Excavate trench in very nearshore waters using land and amphibious excavation equipment.
- Conduct pre-lay excavation of the pipe trench out to depths of -11 to -14 m (-35 to -45 ft) MLLW using various subsea excavation methods.
- Install the pipe in the nearshore trenches using a pull barge.
  - Anchor handling would occur for approximately six (5.75 days) 24-hr periods in Season 3.
- Cap installed nearshore sections and leave in place until the next year.

Season 4

- Lay unburied offshore section of Mainline across Cook Inlet using conventional pipelay vessel.
The Applicant estimates that anchor handling would occur over 13 24-hr periods in Season 4.

- Tie-in the offshore section to the buried nearshore sections on both sides of the Cook Inlet.
- Flood, hydrotect, and dry the Mainline pipeline with Cook Inlet.

Table 12. Anchors to be handled during installation of the offshore portion of Alaska LNG Project mainline crossing.

<table>
<thead>
<tr>
<th>Season</th>
<th>Offshore Route (ft)</th>
<th>Lay Rate (ft/day)</th>
<th>Anchors Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>$132,440$</td>
<td>$2,500$</td>
<td>$636$</td>
</tr>
</tbody>
</table>
2.0 DATES, DURATION, AND REGION OF ACTIVITY

The dates and duration of such activity and the specific geographical region where it will occur.

The scope of this Petition includes exploration, development, production, and decommissioning activities within Hilcorp Alaska, Harvest Alaska, and AGDC area of activities in and adjacent to Cook Inlet within the Petition’s geographic area (Figure 1) for the period of five years beginning April 1, 2019 extending through April 1, 2024.

The geographic area of activity covers a total of approximately 2.7 million acres (10,926 km²) in Cook Inlet. It includes land and adjacent waters in Cook Inlet including both State of Alaska and Federal OCS waters (Figure 1). The area extends from the north at the Susitna Delta on the west side (61°10’48 N, 151°0’55 W) and Point Possession on the east side (61°2’11 N, 150°23’30 W) to the south at Ursus Cove on the west side (59°26’20 N, 153°45’5 W) and Nanwalek on the east side (59°24’5 N, 151°56’30 W).
3.0 TYPE AND ABUNDANCE OF MARINE MAMMALS IN PROJECT AREA

The species and numbers of marine mammals likely to be found within the activity area.

Marine mammal species under USFWS jurisdiction that occur in the Petition region are listed in Table 13 and described in Section 4.

Table 13. Species, conservation status, and abundance estimates of northern sea otters in the Petition region.

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Status</th>
<th>Stock</th>
<th>Minimum Population Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern sea otter (Enhydra lutris kenyoni)</td>
<td>ESA – Threatened</td>
<td>Southwest Alaska Stock</td>
<td>45,064&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>ESA – Not Listed</td>
<td>Southcentral Alaska Stock</td>
<td>18,327&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>USFWS 2014c
<sup>2</sup>USFWS 2014a
ESA = Endangered Species Act
4.0 DESCRIPTION OF MARINE MAMMALS IN PROJECT AREA

A description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals likely to be affected by such activities.

A description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals under USFWS jurisdiction is listed in Table 13 and is presented in the following pages.

4.1 NORTHERN SEA OTTER

4.1.1 Description

The northern sea otter is the smallest marine mammal species and a member of the weasel family (Mustelidae) (USFWS 2005). They are the only marine mammals who do not rely on blubber for insulation; sea otters' dense waterproof undercoats contain more follicles per square inch than any other mammal, and keep air bubbles trapped close to their bodies for heat retention (Alaska Department of Fish and Game [ADF&G] 2008). Sea otters forage in nearshore waters at depths of around 40 m (131 ft), and serve as keystone predators for coastal benthic ecosystems (Marshall 2014). They spend approximately 40% of their daily activity foraging, and primarily feed on benthic invertebrates, including; mussels, crabs, urchins, sea cucumbers, and clams. Red sea cucumbers (Parastichopus californicus) and sea urchins (Strogylocentrotus spp.), found among shell debris, are also important otter prey.

The average sea otter life span ranges between 15 and 20 years. Females become sexually mature between ages 2 and 5 years, and may breed annually for their entire lives, while males mature between 4 and 6 years and may not hold a breeding territory until many years later (USFWS 2005). Mating occurs throughout the year, but most pups are born in springtime. Average adult length for both sexes is 1.4 m (4.5 ft); females weigh approximately 18-27 kg (40-60 lbs) and males weigh 32-41 kg (70-90 lbs) and may even reach up to 45 kg (100 lbs; USFWS 2005).

4.1.2 Abundance

Northern sea otter populations in Cook Inlet are generally confined to lower Cook Inlet, or south of the Forelands to Homer. Sea otter densities in central lower Cook Inlet between the Kenai and Alaska peninsulas have generally been reported as low, potentially due to the 100 km (62 mi) stretch of open water between the two peninsulas, with water depths around 100 m (328 ft; Bodkin and Udevitz 1999; USFWS 2005). The most recent aerial survey for northern sea otter distribution and abundance around central lower Cook Inlet was performed between May and August, 2002 (Bodkin et al. 2003b). The surveyed area contained 399 transects for a total of 2,847 km (1,769 mi) surveyed. Transects consisted of 341 high density transects (water < 40 m [131 ft] deep, or < 400 m [1,312 ft] from shore) spaced 3 km (1.9 mi) apart, and 58 low density transects (water 40-100 m [13-328 ft] deep, and > 400 m [1,312] from shore) spaced 12 km (7.5 mi) apart. Total survey time was 70 hrs, and a total of 731 otters were detected; 480 along high density transects (298 were counted as part of groups on/between transects). Correction factors of 2.48 and 1.68 were used to adjust abundance estimates for west Cook Inlet and east Cook Inlet/Kenai Peninsula surveys, respectively, to account for missed otters. The survey yielded a total abundance estimate of 9,591 otters.

NMFS has conducted annual beluga whale aerial surveys over Cook Inlet since 1991, for most years. The most recent survey was performed in 2016 and recorded 102 sea otter sightings, or 1,835 animals, of which 19 sightings (69 total otters, or 3.7% of the total animals counted) were recorded “mid-inlet off Kachemak
Bay” (Shelden et al. 2017), which is the area nearest to/intersecting the Petition region (proposed Hilcorp Alaska 2D and 3D seismic survey areas). USFWS conducted aerial surveys in May 2017 within three density units in lower Cook Inlet (Figure 15); Kachemak Bay, Western Cook Inlet (includes upper west Cook Inlet and Kamishak Bay), and Eastern Cook Inlet (includes upper east Cook Inlet and outer Kenai) (K. Klein, personal communication, February 6, 2018). Of these, the Western and Eastern Cook Inlet survey units have area which overlaps the Petition region. The Western Cook Inlet survey yielded a total unit abundance estimate of 10,737 sea otters. The unit was divided at Chinitna Point into two density regions; Upper West Cook Inlet to the north which yielded a density estimate of 0.026 sea otters per km², and Kamishak Bay to the south which yielded a density estimate of 3.53 sea otters per km². The Kamishak bay area does not overlap the proposed Petition region. The Eastern Cook Inlet unit yielded a density estimate of 1.71 sea otters per km². Excluding Kachemak Bay, the total population estimate for lower Cook Inlet from the 2017 surveys was 13,901 animals (K. Klein, personal communication, February 6, 2018).

Because the 2017 surveys did not include central lower Cook Inlet, 2017 survey data were consolidated with the 2002 USGS aerial survey (Bodkin et al. 2003b) data to infer sea otter density for the extent of the central lower Cook Inlet Petition region. Sea otter density in areas surveyed by Bodkin et al. (2003b) only was adjusted to reflect population growth from 2002-2017. The 2002 survey yielded a total sea otter abundance estimate of 7,675 animals in Cook Inlet (Bodkin et al. 2003b; USFWS unpublished data). Comparison of the 2002 estimate with the 2017 survey abundance estimate of 19,889 animals is suggestive of a growth correction factor of 2.6. Therefore, the low-abundance central lower Cook Inlet density estimate of 0.01 from Bodkin et al. (2003b) was updated to 0.026 sea otters per km².

There are currently no density estimates for sea otters in middle Cook Inlet (north of the Forelands to Susitna/Possession Point) or upper Cook Inlet (north of Possession Point) (K. Klein, personal communication, February 5, 2018). The total estimated range of northern sea otters extends northward to just south of Kalgin Island, therefore no population abundance surveys have taken place north of Kalgin Island. Because no survey data exist for middle or upper Cook Inlet and it is unlikely sea otters are utilizing the area north of Kalgin Island, we assume a conservative estimate of 0.010 sea otters per km² for all Petition region north of Kalgin Island, based on previous low-abundance estimates (Bodkin et al. 2003b).

4.1.3 Distribution

Northern sea otters occur year-round throughout lower Cook Inlet (Garshelis 1987), which spans southwest from the Forelands to the inlet mouth between English Bay and Cape Douglas. Otters do not occur in middle or upper Cook Inlet, although the northern range limit of lower Cook Inlet is not well established (Gill et al. 2009; USFWS 2005). Sea otters are found in nearshore coastal waters, typically within 40 m (131 ft) of depth to maintain consistent access to benthic foraging habitat (Garshelis and Garshelis 1984; Reidman and Estes 1990).

Although individuals can cover long distances (> 100 km [62 mi]) sea otters are considered non-migratory, as movement is generally restricted by geography, energy requirements, and social behavior, and individuals tend to remain within a home range of < 30 km² (11.6 mi²; Reidman and Estes 1990; Garshelis and Garshelis 1984). Sea otter movement is also affected by tidal and wind patterns, and inclement weather. Storm conditions often cause otters to seek shelter in protected bays, inlets, or lees; however, in calmer conditions otters may be sighted farther from the shore (Lensink 1962; Kenyon 1969). If transiting through open water, otters may be seen rafting together (Schneider 1976).
The Southwest and Southcentral sea otter stocks’ habitat range overlap in the Hilcorp Alaska and Harvest Alaska lower Cook Inlet Petition region (Figure 15), but not in the Alaska LNG Project area in the middle Cook Inlet Petition region (Figure 16). The Southwest distinct population segment (DPS) range along the western shore of lower Cook Inlet, and throughout Alaska Peninsula and Bristol Bay coasts, as well as the Aleutian, Barren, Kodiak, and Pribilof Islands (USFWS 2014a). Whereas the Southcentral Alaska Stock extends from Cape Yakataga to the eastern shoreline of lower Cook Inlet, including Prince William Sound, Kachemak Bay, and the Kenai Peninsula coast (Gorbics and Bodkin 2001; Allen and Angliss 2014; USFWS 2014a), and is mostly localized to Kachemak Bay, and south and east of Prince William Sound (Gill et al. 2009; USFWS 2005). As a result, it is likely sea otters observed in or adjacent to the action area could be from either stock. Otters do not occur in middle or upper Cook Inlet, although the northern range limit of lower Cook Inlet is not well established (Gill et al. 2009; USFWS 2005). Very few otters occur north of Anchor Point (Rugh et al. 2005; Gill et al. 2009; Doroff and Badajos 2010), especially during winter months (Hansen and Hubbard 1999). Forty-four sea otters were radio-tagged in Kachemak Bay, and none of the animals traveled north of Anchor Point during the three-year study, with the exception of one animal which was harvested for subsistence purposes and found on a Ninilchik beach (Doroff and Badajos 2010). We do not expect Petition activities to have substantial effects on sea otters in this area.

4.1.4 Status

Three sea otter populations are identified in Alaska including Southeast, Southcentral, and Southwest. Of these, two distinct stocks occur in lower Cook Inlet; the Southwest Alaska Stock and the Southcentral Alaska Stock. The Southwest Alaska Stock is listed as threatened under the ESA, and ranges along the western shore of lower Cook Inlet, and throughout Alaska Peninsula and Bristol Bay coasts, as well as the Aleutian, Barren, Kodiak, and Pribilof Islands (USFWS 2014a). The non-listed Southcentral Alaska Stock extends from Cape Yakataga to the eastern shoreline of lower Cook Inlet, including Prince William Sound, Kachemak Bay, and the Kenai Peninsula coast (Gorbics and Bodkin 2001; Allen and Angliss 2014; USFWS 2014a).
Figure 15. Northern sea otter density distribution and critical habitat in lower Cook Inlet Hilcorp Alaska Petition region.
Figure 16. Northern sea otter density distribution and critical habitat in middle Cook Inlet Alaska LNG Project Petition region.
4.2 SOUTHWEST ALASKA STOCK

4.2.1 Abundance

Data collected from aerial surveys between 2000 and 2008 form the current population estimate for the Southwest Alaska Stock. In 2000, Doroff et al. (2003) surveyed the Aleutian Islands and counted 2,442 otters in nearshore waters; a correction factor of 3.58, to account for discrepancies between aerial and skiff counts, was applied to this number for a final result of 8,742 otters. Another aerial survey in 2000 was conducted from Unimak Island to Cape Seniavin along the northern Alaska Peninsula, and yielded an abundance estimate of 4,728 otters (Burn and Doroff 2005). Three surveys in 2001, performed offshore south Alaska Peninsula, nearshore south Alaska Peninsula, and around Unimak Island, resulted in respective abundance estimates of 2,392, 6,309, and 957 otters, after application of a correction factor (2.38) accounting for missed animals (Evans et al. 1997; Burn and Doroff 2005). Kamishak Bay and western lower Cook Inlet were surveyed in 2002, producing an abundance estimate of 6,309 otters (Bodkin et al. 2003b), and in 2004 an aerial survey of the Kodiak Archipelago estimated a total of 11,005 otters (USFWS unpublished data). A 2009 aerial survey was conducted around Katmai National Park, and resulted in an abundance estimate of 7,095 otters (Coletti et al. 2009), and a 2012 survey around the Park yielded an estimate of 8,644 otters (USFWS 2013b). Overall, the current population abundance estimate for the Southwest Alaska Stock is 45,064 otters, and the population seems to be stable (USFWS 2014c).

Efforts to monitor population trends for the Southwest Alaska Stock are ongoing; between 1993 and 2003 USFWS (2013b) and United States Geological Survey (USGS; unpublished data) compiled Aleutian survey data and found an average population decline rate of approximately 20% per year. Currently, the population is suggested to be stable, however, there is no evidence of recovery (USFWS 2013a; USFWS 2013b; USGS unpublished data).

Sea otters do not occur in middle or upper Cook Inlet, therefore there are no survey efforts to date north of Kalgin Island (K. Klein, personal communication, February 6, 2018) and we may assume the density of sea otters north of this landmark is 0.01 sea otters per km², based on previous low-abundance estimates (Bodkin et al. 2003b).

4.2.2 Status

In 2005, the Southwest Alaska Stock was listed as “threatened”, a classification pertaining to species which are likely to become endangered within their range. The Southwest Alaska Stock unexpectedly experienced a significant population decline of 70% between 1992 and 2000 (Doroff et al. 2003) within their Aleutian Island range. This decline has been attributed to killer whale predation (Estes et al. 1998). Threats to the northern sea otter population include but are not limited to predation (i.e., killer whale), oils spills, illegal takes, subsistence harvest, and infectious disease (USFWS 2013a). A 15,164 km² critical habitat area was designated for the southwest Alaska DPS in 2009 (74 Federal Register [FR] 51988), and in 2013 the most recent 5-year status review of the Southwest Alaska DPS was published in which USFWS recommended no change in status of the population (78 FR 24767; USFWS 2013b). The Petition region does not overlap the Southwest Alaska DPS critical habitat area.

4.2.3 Distribution

The Southwest Stock ranges along the western shore of lower Cook Inlet, and throughout Alaska Peninsula and Bristol Bay coasts, as well as the Aleutian, Barren, Kodiak, and Pribilof Islands (USFWS 2014a).
4.3 SOUTHCENTRAL ALASKA STOCK

4.3.1 Abundance

A series of aerial surveys conducted between 2000 and 2010 were used to estimate the current overall Southcentral Alaska Stock population size. In 2000, an aerial survey was conducted along the northern Gulf of Alaska coastline, yielding an estimate of 428 otters (USGS unpublished data), and a 2002 aerial survey estimated 962 otters within Eastern lower Cook Inlet (Bodkin et al. 2003b). Prince William Sound was surveyed in 2003, resulting in an abundance estimate of 11,989 otters (Bodkin et al. 2003a). In 2008, an aerial survey within Kachemak Bay documented an estimate of 3,596 otters (Gill et al. 2009), and a 2010 survey of Kenai Fjords National Park reported 1,322 otters (Coletti et al. 2011). The combined population estimates from the aerial surveys described above produces the current total estimate of 18,297 sea otters for the Southcentral Alaska stock (USFWS 2014a). Overall abundance assessments show a stable or increasing trend (Coletti et al. 2009; Estes at al. 2010; USFWS 2014a), and the Kachemak Bay population in particular experienced a 26% annual increase between 2002 and 2008 (Gill et al. 2009). Except at Kachemak Bay, this stock typically occurs at low densities throughout its range (Gill et al. 2009; USFWS 2014b).

Sea otters do not occur in middle or upper Cook Inlet, therefore there are no survey efforts to date north of Kalgin Island (K. Klein, personal communication, February 6, 2018) and we may assume the density of sea otters north of this landmark is 0.01 sea otters per km², based on previous low-abundance estimates (Bodkin et al. 2003b).

4.3.2 Status

The Southcentral Alaska Stock is classified as “non-strategic”, as the level of direct human-caused mortality does not exceed the Potential Biological Removal (PBR), and it is neither listed as a “depleted” under MMPA or listed as “threatened” or “endangered” under the ESA.

4.3.3 Distribution

The Southcentral Alaska Stock extends from Cape Yakataga to the eastern shoreline of lower Cook Inlet, including Prince William Sound, Kachemak Bay, and the Kenai Peninsula coast (Gorbics and Bodkin 2001; Allen and Angliss 2014; USFWS 2014a), and is mostly localized to Kachemak Bay and south and east of Prince William Sound. (Gill et al. 2009; USFWS 2005). Very few otters from the Southcentral Alaska Stock occur north of Anchor Point (Rugh et al. 2005; Gill et al. 2009; Doroff and Badajos 2010), especially during winter months (Hansen and Hubbard 1999). Forty-four sea otters from the Southcentral Alaska Stock were radio-tagged in Kachemak Bay, and none of the animals traveled north of Anchor Point during the three-year study, with the exception of one animal which was harvested for subsistence purposes and found on a Ninilchik beach (Doroff and Badajos 2010).
5.0 REQUESTED TYPE OF INCIDENTAL TAKING AUTHORIZATION

Hilcorp Alaska, Harvest Alaska, and AGDC request an ITR from USFWS for the incidental take by harassment (Level B as defined in 50 CFR 216.3) of small numbers of northern sea otters incidental to oil and gas exploration, development, production, and transportation activities in Cook Inlet of Alaska for period of five years beginning April 1, 2019 extending through April 1, 2023. The operations outlined in Section 1 have the potential to result in takes by harassment of otters by acoustic disturbance during Petition operations. The effects will depend on the distance and received level of the sound (Section 6). Temporary disturbance or localized displacement reactions are most likely to occur. With implementation of the mitigation and monitoring measures described in Sections 11 and 13, no takes by injury or mortality (Level A) are anticipated, and takes by disturbance (Level B) are expected to be minimized.
6.0 NUMBER OF INCIDENTAL TAKES BY ACTIVITIES

By age, sex, and reproductive condition, the number of marine mammals [by species] that may be taken by each type of taking, and the number of times such takings by each type of taking are likely to occur.

A detailed description of exploration and production activities that are planned in the geographic region (Figure 1) and during the scope of this Petition (April 1, 2019-2024) is provided in Section 1. The types of activities include all major activities associated with active oil and gas leases ranging from seismic surveys to facility decommissioning, as well as construction of the Alaska LNG Project. The planned activities that have the potential to temporarily disturb or displace small numbers of marine mammals in Cook Inlet are discussed in this section. These potential effects, as summarized in Section 7, will not exceed MMPA Level B harassment, as defined by 50 CFR 213.6. The mitigation measures to be implemented during various activities are based on the Level B harassment acoustic criteria defined below. No take by injury or death (Level A) is anticipated with the implementation of the mitigation and monitoring measures. This section provides information on the applicable noise criteria, a description of the noise sources for the activities, and a description of the methods used to calculate numbers of marine mammals that may be potentially encountered during the activities included in the scope of this ITR Petition.

6.1 APPLICABLE NOISE CRITERIA

Under the MMPA, USFWS has defined levels of harassment for marine mammals. Level A harassment is defined as “…any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild.” Level B harassment is defined as “…any act of pursuit, torment, or annoyance which 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.”

For Level A, the NOAA Technical Memorandum NMFS-OPR (NMFS 2016) provides guidelines for assessing the onset of permanent threshold shifts (PTS) from anthropogenic sound. Under this guideline, marine mammals are separated into five functional hearing groups; source types are separated into impulsive (e.g., seismic) and non-impulsive; and require analyses of the distance to the peak (Lpk) received sound pressure level (SPL) and 24-hr cumulative sound exposure level (SEL24h). For purposes of this Petition, the otariid functional group is considered a proxy for sea otters. USFWS also considers the Level A (injury) threshold for impulsive sound as 190 decibels referenced to one microPascal (dB re 1 µPa) root mean square (rms) and 180 dB re 1 µPa rms for non-impulsive sound. The current USFWS Level B (disturbance) threshold for assessing the onset of temporary threshold shifts (TTS) for both impulsive and non-impulsive sounds is 160 dB re 1 µPa rms.

Table 14 provides a summary of the disturbance guidelines. For purposes of this section, all underwater SPLs are reported as dB re 1 µPa.
Table 14. Summary of USFWS acoustic thresholds.

<table>
<thead>
<tr>
<th>Marine Mammals</th>
<th>Injury (Level A) Threshold</th>
<th>Disturbance (Level B) Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Impulsive¹</td>
<td>Non-Impulsive¹</td>
</tr>
<tr>
<td>Sea otters</td>
<td>232 dB L_{pk}</td>
<td>203 dB SEL</td>
</tr>
</tbody>
</table>

¹Based on NMFS acoustic criteria for otariid pinnipeds (NMFS 2016).

6.2 DESCRIPTION OF SOUND SOURCES FOR HILCORN ALASKA AND HARVEST ALASKA ACTIVITIES

Section 1 describes the various types of activities, as well as general location and timing of these activities in the geographic region and timing of this Petition. The acoustic characteristics of each of the activities are described in the following section and summarized in Table 15. Not all sources of noise will result in Level A or B acoustic harassment; each description identifies whether this source was included in the evaluation of harassment.

6.2.1 Vessels Operations

Vessels of various types and sizes are used to support all the Hilcorp Alaska and Harvest Alaska activities included in the scope of this Petition, specifically for crew and supplies transfer for rigs, platforms, and other maintenance activities. Vessels are major contributors to the overall acoustic environment (Richardson et al. 1995), particularly in the Alaska and the Arctic region (Huntington et al. 2015). In a 2012 Cook Inlet Vessel Traffic Study Report (Cape International, Inc. 2012), patterns of activities were described for vessels over 300 gross tons operating during 2010. Results showed that there were 480 port calls or transits through Cook Inlet, with 80% of the transits made by 15 ships for the purpose of crude oil and product transport, packaged commodity shipments, and passenger/vehicle carriage. This class of vessel is characterized with source levels of 160 to 200 dB re 1 μPa rms at 1 m within the 6 to 500 Hertz (Hz) range (Richardson et al. 1995).

Position-keeping in Cook Inlet is a challenge due to the strong currents, so some vessels use dynamic positioning (DP) with bow thrusters when anchoring is not possible. Ireland and Bisson (2016) measured source levels from 148.5 dB re 1 μPa rms at 1 m at 2,000 Hz to 174.5 dB re 1 μPa rms at 1 m at 10 Hz with 100% of all four thrusters.

Blackwell and Greene (2003) recorded underwater noise produced by both large and small vessels near the Port of Anchorage (POA). The Leo tugboat produced the highest broadband levels of 149 dB re 1 μPa at a distance of approximately 100 m, while the docked Northern Lights (cargo freight ship) produced the lowest broadband levels of 126 dB re 1 μPa at 100-400 m. Ship noise was generally below 1 kiloHertz (kHz).

Although vessels are a potential source of disturbance for marine mammals, USFWS does not generally regulate incidental harassment for transiting vessels; therefore, vessel noise was not used to evaluate potential Level A or B acoustic harassment in this Petition.
### Table 15. Summary of acoustic sources for Hilcorp Alaska and Harvest Alaska activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sound Pressure Levels (dB re 1 µPa)</th>
<th>Frequency</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>General vessel operations</td>
<td>145-175 dB rms at 1 m</td>
<td>10 Hz – 1,500 Hz</td>
<td>Richardson et al. 1995; Blackwell and Greene 2003; Ireland and Bisson 2016</td>
</tr>
<tr>
<td>General aircraft operations</td>
<td>100-124 dB rms at 1 m</td>
<td>&lt;500 Hz</td>
<td>Richardson et al. 1995</td>
</tr>
<tr>
<td>2D seismic survey (2400 cui airgun)</td>
<td>217 dB peak at 100 m, 185 dB SEL at 100 m, 197 dB rms at 100 m</td>
<td>&lt;300 Hz</td>
<td>Austin and Warner 2012; 81 FR 47239</td>
</tr>
<tr>
<td>3D seismic survey (2400 cui airgun)</td>
<td>217 dB peak at 100 m, 185 dB SEL at 100 m, 197 dB rms at 100 m</td>
<td>&lt;300 Hz</td>
<td>Austin and Warner 2012; 81 FR 47239</td>
</tr>
<tr>
<td>Geohazard Surveys</td>
<td>210-220 dB rms at 1 m</td>
<td>Echosounders &amp; side scan sonar: &gt;200 kHz; High resolution sub-bottom profiler: 2-24 kHz; Low resolution sub-bottom profiler: 1-4 kHz</td>
<td>Manufacturer specifications</td>
</tr>
<tr>
<td>Exploratory drilling rig</td>
<td>137 dB rms at 1 m</td>
<td>&lt;200 Hz</td>
<td>Marine Acoustics Inc. 2011</td>
</tr>
<tr>
<td>Tugs under load towing rig</td>
<td>167 dB rms at 1 m</td>
<td>&lt;500 Hz</td>
<td>Austin et al. 2013</td>
</tr>
<tr>
<td>Drive pipe installation</td>
<td>190 dB rms at 55 m</td>
<td>&lt;500 Hz</td>
<td>Illingworth &amp; Rodkin 2014</td>
</tr>
<tr>
<td>Vertical seismic profiling</td>
<td>227 dB rms at 1 m</td>
<td>&lt;500 Hz</td>
<td>Illingworth &amp; Rodkin 2014</td>
</tr>
<tr>
<td>Vibratory sheet pile driving for Iniskin</td>
<td>175 dB peak at 10 m, 160 dB SEL at 10 m, 160 dB rms at 10 m</td>
<td>&lt;100-2,500 Hz</td>
<td>Illingworth &amp; Rodkin 2007</td>
</tr>
<tr>
<td>Offshore production platforms</td>
<td>97-111 dB rms at 0.3-19 km</td>
<td>&lt;500 Hz</td>
<td>Blackwell and Greene 2003</td>
</tr>
<tr>
<td>Water jet</td>
<td>176 dB rms at 1 m</td>
<td>500 Hz – 2 kHz</td>
<td>Austin 2017</td>
</tr>
<tr>
<td>Hydraulic grinder</td>
<td>159 dB at 1 m</td>
<td>&lt;1 kHz</td>
<td>Stanley 2014</td>
</tr>
<tr>
<td>Drones</td>
<td>100 dB rms at 1 m</td>
<td>&lt;500 Hz</td>
<td>Christiansen et al. 2016</td>
</tr>
<tr>
<td>Pingers</td>
<td>192 dB rms at 1 m</td>
<td>4-14 kHz</td>
<td>Manufacturer specifications</td>
</tr>
</tbody>
</table>

#### 6.2.2 Aircraft Operations

Helicopters and fixed wing aircraft are used to support all the activities included in the scope of this Petition. Helicopters are used for crew changes and supplies for platforms, drilling rigs, and with the 3D seismic survey. Flight routes will follow a direct route to and from the rig or platform location, and flight heights will be maintained 300 to 450 m (1,000 to 1,500 ft), as practicable, AGL to avoid acoustical harassment of marine mammals.

Helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft generally are <500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported that received sound levels in water from aircraft flying at an altitude of 152 m...
(approximately 500 ft) were 109 dB re 1 μPa for a Bell 212 helicopter, 101 dB re 1 μPa for a small fixed-wing aircraft, 107 dB re 1 μPa for a twin otter, and 124 dB re 1 μPa for a P-3 Orion.

Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles >13 degrees from vertical, much of the sound is reflected and does not penetrate (Richardson et al. 1995). Duration of underwater sound from passing aircraft is much shorter in water than air; for example, a helicopter passing at an altitude of 152 m (approximately 500 ft), audible in air for 4 minutes, may be detectable underwater for 38 seconds at 3 m (10 ft) depth, and 11 seconds at 18 m (59 ft) depth (Richardson et al. 1995).

Because aircraft operations will maintain an altitude of greater than 300 m (1,000 ft) when practicable, levels are anticipated to be below the USFWS criteria; therefore, aircraft was not used to evaluate potential Level A or B acoustic harassment of marine mammals in this Petition.

6.2.3 2D Seismic Survey

As described in Section 1.3.1.1, Hilcorp Alaska plans to collect 2D seismic data on the eastern side of Cook Inlet from Anchor Point to Kasilof in the marine and intertidal zones (Figure 3) over a 30-day period in 2020 or 2021. The two types of acoustic sources are airguns for the marine environment and shot holes for the land environment. The acoustic characteristics associated with the 2D seismic survey are summarized in Table 15 and described below.

6.2.3.1 Marine/Intertidal Source

The precise volume of the airgun array for the 2D survey is unknown at this time, but Hilcorp Alaska plans to use an airgun array similar to previous surveys in Cook Inlet by Apache and SAExploration: either a 2,400 cui array or 1,760 cui array. In addition, the source vessel will be equipped with a 440 cui shallow water source which can be deployed at high tide in the intertidal area in less than 1.8 m (6 ft) of water.

Apache conducted a sound source verification (SSV) for the 440 cui and 2,400 cui arrays in 2012 (Austin and Warner 2012; 81 FR 47239). The location of the SSV was in Beshta Bay on the western side of Cook Inlet (between Granite Point and North Forelands). Water depths ranged from 30-70 m (98-229 ft).

For the 440 cui array, the measured levels for the broadside direction were 217 dB peak, 190 dB SEL, and 201 dB rms at a distance of 50 m. The estimated distance to the 160 dB rms (90th percentile) threshold assuming the empirically measured transmission loss of 20.4 log R was 2,500 m. Sound levels near the source were highest between 30 and 300 Hz in the endfire direction and between 20 Hz and 300 Hz in the broadside direction.

For the 2,400 cui array, the measured levels for the endfire direction were 217 dB peak, 185 dB SEL, and 197 dB rms at a distance of 100 m. The estimate distance to the 160 dB rms (90th percentile) thresholds assuming the empirically measured transmission loss of 16.9 log R was 7,770 m. Sound levels near the source were highest between 30 and 150 Hz in the endfire direction and between 50 and 200 Hz in the broadside direction.

These measured levels were used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.2.3.2 Onshore/Intertidal Source

The onshore source effort will be shot holes. At each source location, a hole will be drilled to the prescribed depth of approximately 10 m (35 ft) and loaded with 4 kg (8.8 lbs) of explosive. At the request of NMFS,
Apache conducted an SSV in 2011 of the onshore shot hole to determine if underwater received sound levels exceeded the NMFS thresholds (81 FR 47239).

The results of the SSV verified received sound levels did not exceed the USFWS 160 dB threshold; therefore, onshore sources are not used to evaluate potential Level A or B acoustic harassment of marine mammals in this Petition.

6.2.4 3D Seismic Survey

As described in Section 1.3.1.2, Hilcorp Alaska plans to collect 3D seismic data in the Federal OCS waters in lower Cook Inlet over a 60-70 day period in 2019 (Figure 3). Although the precise volume of the airgun array is unknown at this time, Hilcorp Alaska will use an airgun array similar to what has been used for surveys in Cook Inlet by Apache and SAExploration, particularly the 2,400 cui array. Apache conducted an SSV for the 440 cui and 2,400 cui arrays in 2012 (Austin and Warner 2012; 81 FR 47239). The location of the SSV was in Beshta Bay on the western side of Cook Inlet (between Granite Point and North Forelands). Water depths ranged from 30-70 m (98-229 ft).

For the 2,400 cui array, the measured levels for the endfire direction were 217 dB peak, 185 dB SEL, and 197 dB rms at a distance of 100 m. The estimate distance to the 160 dB rms (90th percentile) thresholds assuming the empirically measured transmission loss of 16.9 log R was 7,770 m. Sound levels near the source were highest between 30 and 150 Hz in the endfire direction and between 50 and 200 Hz in the broadside direction.

These measured levels were used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.2.5 Geohazard and Geotechnical Survey

Hilcorp Alaska plans to collect geohazard and geotechnical data in the Federal OCS waters in lower Cook Inlet in 2019 or 2020 after the 3D seismic survey and before drilling the exploratory wells (Section 1.3.1.3, Figure 3), in the Trading Bay area in 2019 prior to drilling the exploratory wells, and to locate the discovery well in the North Cook Inlet Unit in 2020 (Section 1.3.1.3, Figure 8). The typical survey duration in each location is approximately 30 days. The surveys are conducted from a single support vessel. The suite of equipment used during a typical geohazards survey consists of single beam and multi-beam echosounders, side scan sonar, sub-bottom profiler, and magnetometer. Sub-bottom profilers and magnetometers are typically towed from the vessel, while echosounders and side scan sonars are typically hull-mounted. The acoustic characteristics for each piece of equipment are summarized in Table 16 and in the following text.

USFWS does not consider sounds over 200 kHz to be harmful to marine mammals; therefore, only reported levels for equipment under 200 kHz (i.e., sub-bottom profilers) are used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.2.5.1 Multibeam Echosounder

The proposed multi-beam echosounder operates at source level of a maximum of 220 dB re 1 μPa rms at 1 m. The multibeam echosounder emits high frequency (240 kHz) energy in a fan-shaped pattern of equidistant or equiangular beam spacing. The beam width of the emitted sound energy in the along-track direction is 1.5 degrees, while the across track beam width is 1.8 degrees. The maximum ping rate of the multibeam echosounder is 40 Hz.
The proposed single-beam echosounder operates at source level of approximately 220 dB re 1 µPa rms at 1 m. The transducer selected uses a frequency of 210 kHz and has a ping rate of up to 20 Hz. The transducer’s beam width is approximately 3 degrees.

6.2.5.2 Side Scan Sonar

The proposed side scan sonar system will operate at about 400 kHz and 900 kHz. The source level is 215 dB re 1µPa rms at 1 m. The sound energy is emitted in a narrow fan-shaped pattern, with a horizontal beamwidth of 0.45 degrees for 400 kHz and 0.25 degrees at 900 kHz, with a vertical beam width of 50 degrees. The maximum ping rate is 75 Hz.

6.2.5.3 Sub-Bottom Profiler

The proposed high-resolution sub-bottom profiler operates at source level of 210 dB re 1 µPa rms at 1 m. The proposed system emits energy in the frequency bands of 2 to 24 kHz. The beam width is 15 to 24 degrees. Typical pulse rate is between 3 and 10 Hz. The secondary low-resolution sub-bottom profiler will be utilized as necessary to increase sub-bottom profile penetration. The proposed system emits energy in the frequency bands of 1 to 4 kHz.

6.2.5.4 Magnetometer

A marine magnetometer will be used for the detection of magnetic deflection generated by geologic features and buried or exposed ferrous objects which may be related to archaeological artifacts or modern man-made debris. The magnetometer will be towed at a sufficient distance behind the vessel to avoid data pollution by the vessel's magnetic properties. Magnetometers passively measure changes in magnetic fields over the seabed and do not impact marine mammals.

Table 16. Typical acoustic characteristics of geohazard sources.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Model (or similar)</th>
<th>Source Level</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single beam echosounder</td>
<td>Odom SMBB200</td>
<td>220 dB re 1 µPa at 1 m</td>
<td>210 kHz</td>
</tr>
<tr>
<td>Multi-beam echosounder</td>
<td>Reson 7101</td>
<td>220 dB re 1 µPa at 1 m</td>
<td>240 kHz</td>
</tr>
<tr>
<td>Side scan sonar</td>
<td>Edgetech 4125</td>
<td>215 dB re 1 µPa at 1 m</td>
<td>400 kHz / 900 kHz</td>
</tr>
<tr>
<td>High resolution sub-bottom profiler</td>
<td>Edgetech 3200</td>
<td>210 dB re 1 µPa at 1 m</td>
<td>2-24 kHz</td>
</tr>
<tr>
<td>Low resolution sub-bottom profiler</td>
<td>Applied Acoustics AA251</td>
<td>212 dB re 1 µPa at 1 m</td>
<td>1-4 kHz</td>
</tr>
</tbody>
</table>

6.2.6 Exploratory Drilling

Hilcorp Alaska plans to drill 2-4 exploratory wells in the Federal OCS waters in lower Cook Inlet starting in 2020 (Section 1.3.1.4, Figure 3), 1-2 exploratory wells in the Trading Bay area in 2020 (Section 1.3.2.8, Figure 8), and conduct P&A activities in North Cook Inlet Unit in 2020 (Section 1.3.2.7, Figure 8). It is expected that each exploratory well in both lower Cook Inlet and Trading Bay area will take approximately 40-60 days to drill and test. P&A activities will take 60-90 days to complete on the North Cook Inlet Unit. The acoustic sources associated with drilling and P&A activities include the jack-up rig, mobilization of the rig, helicopter operations, vessel operations, and pipe driving. The acoustic characteristics of vessel and helicopters were described earlier in this section; the acoustic characteristics of the drilling, mobilization, pipe driving, and VSP are described below.
6.2.6.1 Drilling Rig

Hilcorp Alaska proposes to conduct its exploratory drilling and P&A activities using a jack-up rig similar to the Spartan 151 drill rig. Furie Operating Alaska, LLC (Furie) performed detailed underwater acoustic measurements in the vicinity of the Spartan 151 in 2011 (Marine Acoustics, Inc. 2011) northeast of Nikiski Bay in water depths of 24.4-27.4 m (80-90 ft). Primary sources of rig-based acoustic energy were identified as coming from the D399/D398 diesel engines, the PZ-10 mud pump, ventilation fans (and associated exhaust), and electrical generators. The source level of one of the strongest acoustic sources, the diesel engines, was estimated to be 137 dB re 1 µPa rms at 1 m in the 141-178 Hz bandwidth. Based on this measured level, the 160 dB rms acoustic received level isopleth would be less than 50 m (154 ft) away from where the energy enters the water (jack-up leg or drill riser).

Because these measured levels do not exceed the USFWS criteria, noise from drilling was not considered further to evaluate potential Level A or Level B acoustic harassment in this Petition.

6.2.6.2 Rig Mobilization

Depending on the rig selection and location, the drilling jack-up rig will be towed on site using up to three ocean-going tugs licensed to operate in Cook Inlet. Vessel speed during the rig tow is generally less than 5 knots. Three tugs are needed to maintain control and precisely position the rig at the drill site. The exact tugs are not known at this time but will be similar to what has been used for previous drilling projects in Alaska.

For purposes of this Petition, the SSV for Shell’s drilling activities in 2012 in the Chukchi Sea of the tug Lauren Foss towing the Tuq was used (Austin et al. 2013). The source level was estimated to be 167 dB at 1 µPa rms at 1 m (3.05 ft), with the estimated distance of 19 m (62 ft) to the 160 dB rms threshold. USFWS does not generally regulate incidental harassment for vessels, but the activity of towing the rig onsite is not considered “typical” vessel activity. Therefore, the measured sound levels from the Lauren Foss were used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.2.6.3 Drive Pipe and Conductor Installation

Drive pipes are installed using pile driving techniques. Hilcorp Alaska plans to drive approximately 60 m of 76.2-cm (30-in) pipe at each well site prior to drilling using a Delmar D62-22 impact hammer (or similar). This hammer has an impact weight of 6,200 kg (13,640 lbs). The drive pipe driving event is expected to last one to three days at each well site, although actual pounding of the pipe will only occur intermittently during this period. Illingworth & Rodkin (2014) measured the hammer noise operating from the Endeavour for Buccaneer in 2013 and report the source level at 190 dB at 55 m (180 ft), with underwater levels exceeding 160 dB rms threshold at 1.63 km (1 mi).

Conductors are slightly smaller diameter pipes than the drive pipes used to transport or “conduct” drill cuttings to the surface. For these wells, a 50.8-cm (20-in) conductor pipe may be drilled, not hammered, inside the drive pipe, dependent on the integrity of surface formations. There are no noise concerns associated with the conductor pipe drilling.

The measured sound levels for the pipe driving was used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.
6.2.6.4 Vertical Seismic Profiling

Once the well is drilled, accurate follow-up seismic data may be collected by placing a receiver at known depths in the borehole and shooting a seismic airgun at the surface near the borehole, called VSP. The actual size of the airgun array is not determined until the final well depth is known, but typical airgun array volumes are between 600 and 880 cui. VSP typically takes less than two full days at each well site. Illingworth & Rodkin (2014) measured a 720 cui array for Buccaneer in 2013 and report the source level at 227 dB at 1 m, with underwater levels exceeding 190 dB rms at 120 m (394 ft), 180 dB rms at 240 m (787 ft), and 160 dB rms at 2.47 km (1.54 mi).

The measured sound levels for the VSP were used to evaluate potential Level A (227 dB rms at 1 m assuming 15 log transmission loss) and B (2,470 m distance to the 160 dB threshold) acoustic harassment of marine mammals in this Petition.

6.2.7 Iniskin Peninsula Exploration Project

As described in Section 1.3.1.5, an intertidal rock causeway is proposed to be constructed adjacent to the Fitz Creek staging area to improve the accessibility of the barge landing during construction and drilling operations. The causeway will extend seaward from the high tide line approximately 366 m (1,200 ft) to a landing area 46 m (150 ft) wide (Figure 3).

Measurements of underwater noise during rock placement have shown that the rock placement itself is not distinguishable from the vessel noise (Nedwell and Edwards 2004). Rock placement vessels are similar to dredging vessels. URS (2007) measured underwater sounds levels from clamshell dredging at the POA and report broadband levels of 136-141 dB re 1 μPa rms at 12-19 m (39-62 ft).

Although vessels placing rock are a potential source of disturbance for marine mammals, USFWS does not generally regulate incidental harassment for these type of vessels; therefore, rock placement noise was not used to evaluate potential Level A or B acoustic harassment in this Petition.

Vibratory pile drivers use a system of counter-rotating eccentric weights to transmit vertical vibrations into the pile. These vibrations “liquefy” the contacted sediments, allowing easy gravitational sinking into the sediment bed, facilitated by the heavy-weighted hammer. The dock face on the rock causeway will be comprises of sheet piles which will be installed using a vibratory hammer.

Illingworth & Rodkin (2007) compiled measured near-source (10 m [32.8 ft]) SPL data from vibratory pile driving for different pile sizes ranging in diameter from 30.5 to 243.8 cm (12 to 96 in). For this petition, the source level of the 61.0-cm (24-in) AZ steel sheet pile from Illingworth & Rodkin (2007) was used for the sheet pile (Table 15).

The vibratory sheet pile driving was used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.2.8 Offshore Production Platforms

There are 17 oil production platforms in Cook Inlet, 15 of which are owned by Hilcorp Alaska (Figure 8). The two remaining platforms are owned by Furie (KLU Platform A) and Glacier Oil and Gas (Osprey). Table 4 summarizes each of the Hilcorp Alaska-owned platforms. Measurements of broadband sound pressure levels near the Phillips A Platform ranged from 97 to 111 dB re 1 μPa rms at 0.3 to 19 km (0.18 to 11.8 mi; Blackwell and Greene 2003).
Because these measured levels do not exceed the USFWS criteria, noise from drilling was not considered further to evaluate potential Level A or Level acoustic harassment in this Petition.

6.2.9 Routine Maintenance

As described in Section 1.3.2.6, routine maintenance activities include: subsea pipeline inspections, stabilizations, and repairs; platform leg inspections and repairs; and anode sled installations and/or replacement. Underwater acoustic sources that may result in disturbance include the DSV, side scan sonar operations, sub-bottom profiler, water jet, hydraulic grinders, pipe cutters, helicopters, and drones (UAS). The acoustic characteristics of vessel operations, side scan sonar, sub-bottom profiler, and helicopter operations were described earlier in this section. The following text describes the water jet, hydraulic grinders, underwater pipe cutter, and drone acoustic characteristics.

6.2.9.1 Water Jet and Hydraulic Grinder

A water jet is a zero-thrust water compressor that is used for underwater removal of marine growth or rock debris underneath the pipeline. The system operates through a mobile pump which draws water from the location of the work. Water jets likely to be used in Cook Inlet include, but are not limited to, the CaviDyne CaviBlaster® and the Gardner Denver Liqua-Blaster. Noise generated during the use of the water jets would be very short in duration (30 minutes or less at any given time) and intermittent.

Hilcorp Alaska conducted underwater measurements during 13 minutes of CaviBlaster® use in Cook Inlet in April 2017 (Austin 2017). Received sound levels were measured up to 143 dB re 1 μPa rms at 170 m (558 ft) and up to 127 dB re 1 μPa rms at 1.1 km (0.7 mi). Sounds from the Caviblaster® were clearly detectable out to the maximum measurement range of 1.1 km (0.7 mi). Using the measured transmission loss of 19.5 log R, the source level for the Caviblaster® was estimated as 176 dB re 1 μPa at 1 m (3.05 ft). The sounds were broadband in nature, concentrated above 500 Hz with a dominant tone near 2 kHz.

Specifications for the GR 29 Underwater Hydraulic Grinder state that the SPL at the operator’s position would be 97 dB in air (Stanley 2014). There are no underwater measurements available for the grinder, so using a rough estimate of converting sound level in dB in air to water by adding 61.5 dB would result in an underwater level of approximately 159 dB.

1 Converting levels in air to water is not a preferred method as reference intensities used to compute sound levels in dB are different in water (1 μPa) and air (20 μPa) and the intensity of a sound wave depends on the density and sound speed of the medium through which the sound is traveling. The result is that sound waves with the same intensities in water and air when measured in watts per square meter have relative intensities that differ by 61.5 dB. This amount must be subtracted from sound levels in water referenced to 1 μPa to obtain the sound levels of sound waves in air referenced to 20 μPa that have the same absolute intensity in watts per square meter. The difference in reference pressures causes 26 dB of the 61.5 dB difference. The differences in densities and sound speeds account for the other 35.5 dB.
The measured sound levels for the water jet and grinder were used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.2.9.2 Underwater Pipe Cutter

If necessary, Hilcorp Alaska may use an underwater pipe cutter to replace existing pipeline segments in Cook Inlet. The following tools are likely to be used for pipeline cutting activities:

- A diamond wire saw used for remote cutting underwater structures such as pipes and I-Beams. These saws use hydraulic power delivered by a dedicated power source. The saw usually uses a method that pushes the spinning wire through the pipe.
- A hydraulically-powered Guillotine saw which uses an orbital cutting movement similar to traditional power saws.

Generally, sound radiated from the diamond wire cutter is not easily discernible from the background noise during the cutting operation. The Navy measured underwater sound levels when the diamond saw was cutting caissons for replacing piles at an old fuel pier at Naval Base Point Loma (Naval Base Point Loma Naval Facilities Engineering Command Southwest 2017). They reported an average SPL for a single cutter at 136.1-141.4 dB rms at 10 m (32.8 ft).

Specifications for the Guillotine saw state that the SPL at the operator’s position would be 86 dB in air (Wachs 2014). There are no underwater measurements available for the grinder, so using a rough estimate of converting sound level in dB in air to water by adding 61.5 dB would result in an underwater level of approximately 148 dB.

Because the measured levels for use of underwater saws do not exceed the USFWS criteria, the noise from underwater saws was not considered further to evaluate potential Level A or Level B acoustic harassment in this Petition.

6.2.9.3 Drones

Hilcorp may use drones for conducting surveys of structures as part of their routine maintenance activities. Christiansen et al. (2016) recorded in air and underwater noise levels from two small, less than 56 cm (22 in), quadcopter UASs. For airborne levels, the measured frequency was below 500 Hz for both types of UASs and airborne levels were measured around 80 dB re 20 µPa at 1 m (3.05 ft; assuming 10 log transmission loss). For underwater levels, the UAS was only detectable above ambient noise levels when flown at 5 or 10 m (16.4 or 32.8 ft) above the sea surface. The resulting underwater sound levels at those distances above sea surface were 91-101 dB rms at 1 µPa at 1 m (3.05 ft).

Because these measured levels do not exceed the USFWS criteria, noise from drones was not considered further to evaluate potential Level A or Level B acoustic harassment in this Petition.

6.2.9.4 Pingers

Hilcorp may deploy moorings for different purposes in Cook Inlet, such as underwater current profilers, bottom-mounted acoustic recorders, or other devices that use a pinger to locate and/or release using a transducer that sends a signal to interrogate the device. These signals range from 4-14 kHz with source levels typically 192 dB rms at 1 m. Chirps are very short, typically 2 ms, and generally are used for less than a few minutes during the interrogation. NMFS has historically not required evaluation of potential Level A or B acoustic harassment because of the very short duration and directional signal, but the USACE
has considered this during recent ESA consultations. Therefore, pingers have been included for USFWS consideration in this Petition.

Based on the very short duration of pinger use when needed, noise from pingers was not considered further to evaluate potential Level A or Level B acoustic harassment.

6.3 DESCRIPTION OF SOUND SOURCES FOR ALASKA LNG PROJECT

The two primary underwater sound sources associated with the Alaska LNG Project that could potentially affect marine mammals include:

- Impact and vibratory pile driving (sheet and pipe piles) associated with the Marine Terminal and Mainline MOF construction.
- Anchor handling associated with the pipelay of the Mainline across Cook Inlet.

6.3.1 Dredging and Trenching

Other underwater sound sources expected during the construction phase of the Alaska LNG Project include sound associated with dredging and trenching. URS (2007) measured underwater sounds levels from clamshell dredging at the Port of Anchorage and report broadband levels of 136-141 dB re 1 µPa rms at 12-19 m (39-62 ft). Dickerson et al. 2001 measured underwater levels during different phases of dredging in Cook Inlet in 1999 and 2000. The majority of underwater sounds produced by bucket dredging operations monitored in this study were in relatively low frequency ranges, primarily 20 to 1,000 Hz. Noise levels decreased with increasing distance from the source. Sound levels diminished from 15 to 30 dB re 1 µPa at 150-m (492-ft) and 5.5-km (3.4 mi) distances, respectively. In this study dredge sounds were audible at 5.5 km (3.4 mi), whereas at 7 km (4.3 mi) only the most intense event, that of the bucket striking the bottom, remained faintly audible. Calculated source levels at 1 m (3.05 ft) ranged from 107 to 139 dB rms (Table 17).

Because these measured levels do not exceed the USFWS criteria, noise from dredging and trenching were not considered further to evaluate potential Level A or Level B acoustic harassment in this Petition.
Table 17. Summary of acoustical sources of dredging and trenching activities for Alaska LNG Project.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sources</th>
<th>Measured Sound Pressure Level</th>
<th>Source Level (10 m)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredging</td>
<td>Clamshell dredge of mixed coarse sand/gravel</td>
<td>113 dB @ 179.4 m</td>
<td>136.5 dB</td>
<td>Dickerson et al. 2001</td>
</tr>
<tr>
<td></td>
<td>Clamshell dredge in soft sediments</td>
<td>107 dB @ 11 m</td>
<td>107 dB</td>
<td>Dickerson et al. 2001</td>
</tr>
<tr>
<td></td>
<td>Winching in/out</td>
<td>117 dB @ 164 m</td>
<td>140.5 dB</td>
<td>Dickerson et al. 2001</td>
</tr>
<tr>
<td></td>
<td>Dumping into barge</td>
<td>109 dB @ 164 m</td>
<td>132.5 dB</td>
<td>Dickerson et al. 2001</td>
</tr>
<tr>
<td></td>
<td>Empty barge at placement site</td>
<td>109 dB @ 345.6 m</td>
<td>139 dB</td>
<td>Dickerson et al. 2001</td>
</tr>
<tr>
<td></td>
<td>Clamshell dredge at the POA</td>
<td>141 dB @ 13.1 m</td>
<td>142.6 dB</td>
<td>URS 2007</td>
</tr>
<tr>
<td>Underwater trenching</td>
<td>With backhoe in shallow water</td>
<td>125 dB @ 109 m</td>
<td>145 dB</td>
<td>Greene et al. 2007</td>
</tr>
</tbody>
</table>

6.3.2 Impact Pile Driving

Illingworth & Rodkin (2007) compiled measured near-source (10 m [32.8 ft]) SPL data from impact pile driving for pile sizes ranging in diameter from 30.5 to 243.8 cm (12 to 96 in). As described in Section 1.4, the pile sizes associated for the Alaska LNG Project include 45.7, 61.0, 121.9, and 152.4 cm (18, 24, 48, and 60 in) and sheet piles. For this petition, the source level of the 61.0-cm (24-in) pile measured at a depth of 15 m (49.2 ft) from Illingworth & Rodkin (2007) was used for the Project’s 45.7-cm and 61.0-cm (18-in and 24-in) piles; the source level of the 152.4-cm (60-in) pile from Illingworth & Rodkin (2007) was used for the Project’s 121.9- and 152.4-cm (48- and 60-in) piles; and the source level of the 61.0-cm (24-in) AZ steel sheet pile from Illingworth & Rodkin (2007) was used for the Project’s sheet pile (Table 18).

The measured sound levels for the pipe driving was used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.
Table 18. Summary of acoustical sources of pile driving activities for Alaska LNG Project.

<table>
<thead>
<tr>
<th>Representative Pile Type and Size</th>
<th>Hammer Type</th>
<th>Sound Pressure Level (dB re 1 µPa)</th>
<th>Alaska LNG Project Pile Type and Size</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Peak</td>
<td>Rms</td>
<td>SEL</td>
</tr>
<tr>
<td>24-inch AZ sheet pile</td>
<td>Impact</td>
<td>205</td>
<td>190</td>
<td>180</td>
</tr>
<tr>
<td>24-inch AZ sheet pile</td>
<td>Vibratory</td>
<td>175</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>24-inch steel pipe pile</td>
<td>Impact</td>
<td>207</td>
<td>194</td>
<td>178</td>
</tr>
<tr>
<td>72-inch steel pipe piles</td>
<td>Vibratory</td>
<td>183</td>
<td>170</td>
<td>170</td>
</tr>
</tbody>
</table>

6.3.3 Vibratory Pile Driving

Vibratory pile drivers use a system of counter-rotating eccentric weights to transmit vertical vibrations into the pile. These vibrations “liquefy” the contacted sediments, allowing easy gravitational sinking into the sediment bed, facilitated by the heavy-weighted hammer.

Illingworth & Rodkin (2007) compiled measured near-source (10 m [32.8 ft]) SPL data from vibratory pile driving for pile sizes ranging in diameter from 30.5 to 243.8 cm (12 to 96 in). As described in Section 1, the pile sizes associated for this Project include 45.7, 61.0, 121.9, and 152.4 cm (18, 24, 48, and 60 in) and sheet piles. For this petition, the source level of the 36-in pile from Illingworth & Rodkin (2007) was used for the Project’s 45.7- and 61.0-cm (18- and 24-in) piles; the source level of the 182.9-cm (72-in) pile from Illingworth & Rodkin (2007) was used for the all of the Project’s 152.4-cm (60-in) vibratory piles per NMFS recommendation (personal communication Shane Guan); and the source level of the 61.0-cm (24-in) AZ steel sheet pile from Illingworth & Rodkin (2007) was used for the Project’s sheet pile (Table 20).

The measured sound levels for the pipe driving was used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.3.4 Vessel Sounds Associated with Construction Activities

Some vessels such as tugs and cargo ships can under some circumstances generate underwater sound exceeding the non-impulsive threshold of 160 dB due largely to the continuous cavitation sound produced from the propeller arrangement of both drive propellers and thrusters. Underwater sound levels associated with offshore pipelay operations include general sounds from the pipelay vessel such as those associated with winching of anchor cables, and thruster sound from the anchor handling tugs (AHTs) during anchor pulling. Large ships produce broadband SPLs of about 180 dB re 1 µPa rms at 1 m (3.05 ft; Richardson et al. 1995; Blackwell and Greene 2003).

Thrusters have generally smaller blade arrangements operating at higher rotations per minute (rpm) and, therefore, largely produce more cavitation sound than drive propellers. For example, Blackwell and Greene (2003) measured a tug pushing a full barge near the POA and recorded SPLs equating to 163.8 dB re 1 µPa rms at 1 m (3.05 ft). The sound emanating from the same tug increased dramatically to 178.9 dB re 1 µPa rms at 1 m (3.05 ft) when the tug was using its thrusters to maneuver the barge during docking.
The measured sound levels for the anchor handling was used to evaluate potential Level A and B acoustic harassment of marine mammals in this Petition.

6.4 ESTIMATES OF DENSITY

Current sea otter density estimates in Cook Inlet are available from aerial surveys conducted by the USFWS in 2017. To estimate sea otter density in the Petition region, we considered data from aerial sea otter surveys conducted in Cook Inlet by USGS in 2002 (Bodkin et al. 2003b). Both the 2017 and 2002 surveys were conducted using similar methodology and covered areas in eastern and western Cook Inlet, including Kachemak and Kamishak Bays. To determine whether 2002 survey data could be used to estimate current density in the lower Cook Inlet region, the changes in population abundance and distribution were evaluated between the 2002 survey and that of 2017.

The estimated total population size in 2002 was 9,591 otters in all surveyed areas of Cook Inlet and the Kenai Peninsula (95% Confidence Interval [CI]: 14,320 – 4,862). The 2017 surveys reported that the total abundance for all surveyed areas of Cook Inlet was 19,889 sea otters. This included western Cook Inlet (including Kamishak Bay) (10,737; 95% CI: 9,624 – 11,850), eastern Cook Inlet including the outer coast of the Kenai Peninsula (3,164; 95% CI: 1,917 – 4,411), and Kachemak Bay (5,988; 95% CI: 4,761 – 7,215). These surveys suggest the sea otter population in and near Cook Inlet has at least doubled in a 15-year time frame.

The distribution of otters in 2002 was compared with that in 2017 by examining overlapping survey regions in Cook Inlet. In 2002, approximately 12% of the Cook Inlet population (excluding the outer coast of the Kenai peninsula) occupied the east side of Cook Inlet while in 2017, 16% were found there. In 2002, 61% were in western Cook Inlet and 26% in Kachemak Bay. In 2017, 54% were in western Cook Inlet and 30% in Kachemak Bay. This pattern suggests that as the overall population in Cook Inlet has grown, the distribution of animals has shifted slightly toward the east.

Because mid-Cook inlet was not surveyed in 2017, other data sources to evaluate were also evaluated to determine whether changes in sea otter distribution could also be detected in mid-Cook Inlet since 2002. NMFS has conducted aerial surveys of Cook Inlet beluga whales in May, June, or July of most years since 1993. Anecdotal sightings of sea otters were recorded in all survey years. Location data for sea otter sightings were available for years 1994 –2012, 2014, and 2016. Hobbs et al. (2015), Rugh et al. (2000, 2005) and Shelden et al. (2013) described survey effort by year. In all years except 1995 and 1997, surveys included some coverage of the middle of Cook Inlet. These surveys reported a total of 1,132 groups of 12,707 sea otters throughout Cook Inlet during 20 survey years.

The locations of sea otter observations from all survey years were plotted. In the combined area, 25 groups of 75 individual sea otters were reported, accounting for 2.2% of groups and 0.6% of all individual sea otters observed during beluga surveys in Cook Inlet. Although the highest detection rate of otters (2.8% or 51 animals) occurred in the latest survey year (2016), no significant trend could be detected in the number of otters by year (Spearman rank correlation coefficient R² = 0.37, n = 20). Although the proportion of Cook Inlet’s otters using the lower Cook Inlet area may be increasing, there is not sufficient evidence from anecdotal sightings on beluga surveys to confirm this assumption or to determine at what rate.

The 2002 survey reported 0.01 otters per km² (Bodkin et al. 2003b). The population growth rate in mid-Cook Inlet since 2002 was assumed to be equivalent to that detected throughout Cook Inlet as a whole between 2002 and 2017. Estimated abundance in Cook Inlet (excluding the outer coast of the Kenai
Peninsula) was approximately 7,675 otters (derived from Bodkin et al. 2003b and unpublished USFWS). Estimates from 2017 were 19,889 otters (unpublished USFWS). This suggests overall growth by a factor of 2.6. The density in lower Cook Inlet was then estimated by multiplying the density of 0.01 from Bodkin et al. (2003b) by 2.6. This yielded a density of 0.026 otters per km². The densities used for the Hilcorp Alaska activities are shown on Figure 15 and summarized in Table 19.

Because there are no data for sea otters in the middle Cook Inlet region north of the Forelands, we use the calculated low density from the 2002 survey of 0.01 per km² (Table 19). Figure 16 shows available density data relative to the Alaska LNG Project.

<table>
<thead>
<tr>
<th>Region</th>
<th># Otters/km²</th>
<th>Petition Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamishak Bay</td>
<td>3.530</td>
<td>None</td>
</tr>
<tr>
<td>Upper west Cook Inlet</td>
<td>0.026</td>
<td>Lower Cook Inlet OCS leases (3D seismic, geohazard, drilling, drive pipe installation, VSP, tugs towing swath; Iniskin pile driving)</td>
</tr>
<tr>
<td>East Cook Inlet north of Kachemak</td>
<td>1.705</td>
<td>Lower Cook Inlet 2D seismic survey</td>
</tr>
<tr>
<td>Middle Cook Inlet (north of Forelands)</td>
<td>0.01</td>
<td>Middle Cook Inlet activities (Hilcorp Alaska and Alaska LNG)</td>
</tr>
</tbody>
</table>

6.5 ESTIMATING POTENTIAL EXPOSURES

The numbers of each marine mammal species that could potentially be exposed to sound associated with the specific aspects of the program expected to exceed USFWS acoustic harassment criteria were estimated using the methods described below. We multiplied the following variables: 1) area of ensonification (in km²), 2) the duration of the activity, and 3) the density of marine mammals (# of marine mammals/km²).

The acoustic characteristics of the different project activities were described in Section 6.2. While each activity may result in underwater sounds and potential disturbance to marine mammals, not all of the activities are expected to exceed USFWS Level A and B acoustic harassment criteria. Only those specific activities identified in that section were used to evaluate the potential for Level A and B harassment. Specifically, those Hilcorp Alaska activities include 2D/3D seismic surveys, vibratory driving of sheet piles at the Iniskin causeway, sub-bottom profilers used in geohazard surveys (i.e., high- and low-resolution), drive pipe installation, VSP, tugs towing the rig for exploratory wells and P&A activities, and water jets/hydraulic grinders used during routine maintenance. The Alaska LNG activities include pile driving and anchor handling.

6.5.1 Hilcorp Alaska and Harvest Alaska Exposure Estimates

6.5.1.1 Distances to USFWS Thresholds

The distances to the Level A thresholds for otariids were calculated using the NMFS Acoustical Guidance Spreadsheet (NMFS 2016) based on the type of source and using source levels shown in Table 15. All were calculated assuming a transmission loss of 15 log R. The assumptions are summarized in Table 20. The distances to the thresholds are provided in Table 21.
### Table 20. Assumptions for calculation of distances to Level A thresholds for otariid pinnipeds for Hilcorp Alaska and Harvest Alaska activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Type of Source</th>
<th>Source Level</th>
<th>Weighting Factor Adjustment</th>
<th>Source Velocity</th>
<th>Pulse Duration</th>
<th>Repetition Rate</th>
<th>Duration per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>217 dB peak @ 100 m 185 dB SEL @ 100 m</td>
<td>1 kHz</td>
<td>2.05 m/s</td>
<td>N/A</td>
<td>every 6 s</td>
<td>N/A</td>
</tr>
<tr>
<td>2D/3D seismic</td>
<td>mobile, impulsive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-bottom profiler</td>
<td>mobile, impulsive</td>
<td>212 dB rms @ 1 m</td>
<td>4 kHz</td>
<td>2.05 m/s</td>
<td>0.02 s</td>
<td>every 0.30 s</td>
<td>N/A</td>
</tr>
<tr>
<td>Pipe driving</td>
<td>stationary, impulsive</td>
<td>195 dB rms @ 55 m</td>
<td>2 kHz</td>
<td>N/A</td>
<td>0.02 s</td>
<td>600 strikes/hr</td>
<td>2 hrs/day</td>
</tr>
<tr>
<td>VSP</td>
<td>stationary, impulsive</td>
<td>227 dB rms @ 1 m</td>
<td>1 kHz</td>
<td>N/A</td>
<td>0.02 s</td>
<td>Every 6 s</td>
<td>4 hrs/day</td>
</tr>
<tr>
<td>Vibratory sheet pile driving</td>
<td>stationary, non-impulsive</td>
<td>160 dB rms @ 10 m</td>
<td>2.5 kHz</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4 hrs/day</td>
</tr>
<tr>
<td>Water jet</td>
<td>stationary, non-impulsive</td>
<td>176 dB rms @ 1 m</td>
<td>2 kHz</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.5 hrs/day</td>
</tr>
<tr>
<td>Hydraulic grinder</td>
<td>stationary, non-impulsive</td>
<td>159 dB rms @ 1 m</td>
<td>2 kHz</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.5 hrs/day</td>
</tr>
<tr>
<td>Tugs towing</td>
<td>mobile, non-impulsive</td>
<td>179 dB rms @ 1 m</td>
<td>1.5 kHz</td>
<td>1.54 m/s</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Assumptions summarized in Table 20.

**Weighting Factor Adjustment (WFA) only used for SEL calculation**

Assumes 15 log practical spreading loss.

### Table 21. Calculated distance in meters (m) to USFWS thresholds for Hilcorp Alaska and Harvest Alaska activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Level A – NMFS Otariid</th>
<th>Level A – USFWS</th>
<th>Level B - USFWS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Impulsive</td>
<td>Non-Impulsive</td>
<td>Impulsive</td>
</tr>
<tr>
<td>2D/3D seismic</td>
<td>232 dB Lpk</td>
<td>203 dB SEL</td>
<td>219 dB SEL</td>
</tr>
<tr>
<td>Sub-bottom profiler</td>
<td>10</td>
<td>1.32</td>
<td>N/A</td>
</tr>
<tr>
<td>Pipe driving</td>
<td>0.05</td>
<td>0.80</td>
<td>N/A</td>
</tr>
<tr>
<td>VSP</td>
<td>0.19</td>
<td>5.21</td>
<td>N/A</td>
</tr>
<tr>
<td>Vibratory sheet pile driving</td>
<td>0.46</td>
<td>284.84</td>
<td>N/A</td>
</tr>
<tr>
<td>Water jet</td>
<td>N/A</td>
<td>N/A</td>
<td>0.63</td>
</tr>
<tr>
<td>Hydraulic grinder</td>
<td>N/A</td>
<td>N/A</td>
<td>0.56</td>
</tr>
<tr>
<td>Tugs towing</td>
<td>N/A</td>
<td>N/A</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Assumptions summarized in Table 20.

Weighting Factor Adjustment (WFA) only used for SEL calculation.

Assumes 15 log practical spreading loss.

#### 6.5.1.2 Areas of Ensonification

The area of ensonification is calculated differently depending on the type of the source. For impulsive mobile sources (2D/3D seismic, sub-bottom profiler), the area was calculated by multiplying the distances to the USFWS thresholds by the distance of the line to be surveyed each day. The area of a circle ($\pi r^2$) where $r$ is the distance to the USFWS thresholds was used to calculate the area of ensonification for
impulsive stationary sources (pipe driving, VSP), non-impulsive stationary sources (water jets, hydraulic grinders, vibratory pile driving), and non-impulsive mobile sources (tugs towing rigs and anchor handling). The areas of ensonification are summarized in Table 22.

The area of ensonification for the 2D seismic survey was calculated by multiplying the distances (in km) to the USFWS thresholds by the distance of the line (in km) to be surveyed each day. The in-water source line is 6 km in length and only one line will be surveyed each day. **Therefore, the line length surveyed each day for the 2D seismic survey is 6 km.**

The area of ensonification for the 3D seismic survey was calculated by multiplying the distances (in km) to the USFWS thresholds by the distance of the line (in km) to be surveyed each day. Because of the high background noise associated with the strong tides and currents in Cook Inlet, seismic data can only be collected during slack tides. Seismic data will be collected for approximately 2.5 hrs around each of the four slack tide periods each day, for a total of approximately 10-12 hrs per day. The distance of transect lines surveyed during each tidal cycle was calculated by multiplying the speed of the vessel (4 knots or 7.5 km/hr) by the duration of the tidal cycle during which the airgun will be operating (2.5 hrs) resulting in a distance of 18.52 km surveyed in one tidal cycle. Assuming four tidal cycles in one day, the resulting total distance surveyed per day is 74.08 km. **Therefore, the line length to be surveyed each day for the 3D seismic survey is 74.08 km.**

The area of ensonification for the sub-bottom profiler used during the geohazard surveys for the well sites was calculated by multiplying the distances (in km) to the USFWS thresholds by the distance of the line (in km) to be surveyed each day. The maximum required monitoring distance from the well site per BOEM is 2,400 m (or a total length of 4,800 m in diameter) and the minimum transect width is 150 m, so the total maximum number of transects to be surveyed is 32 (4,800 m / 150 m). The total distance to be surveyed is 153.60 km (4.8 km x 32 transects). Assuming a vessel speed of 4 knots (7.41 km/hr), it will take approximately 0.65 hrs (38 minutes) to survey a single transect of 4.8 km (time = distance / rate). Assuming the team is surveying for 50% of the day (or 12 hrs), the total number of days it will take to survey the total survey grid is 7.77 days (0.65 hr x 12 hr). **The total line length to be surveyed per day is 19.76 km (total distance to be surveyed 153.6 km / total days 7.77).**

The area of ensonification for the sub-bottom profiler used during geohazard surveys for the pipeline maintenance was calculated by multiplying the distances (in km) to the USFWS thresholds by the distance of the line (in km) to be surveyed each day. The assumed transect grid is 300 m by 300 m with 150 m transect widths, so the total to be surveyed is 2,400 m (2.4 km). Assuming a vessel speed of 4 knots (7.41 km/hr), it will take approximately 0.08 hrs (4.86 min) to survey a single transect. The total number of days it will take to survey the grid is 1 day. **The total line length to be surveyed per day is 2.4 km.**

**6.5.1.3 Duration of Activities**

The duration was estimated for each activity and location. For some projects, like the 3D seismic survey, the design of the project is well developed; therefore, the duration is well-defined. However, for some projects, the duration is not well developed, such as activities around the lower Cook Inlet well sites, because the duration depends on the results of previous studies and equipment availability. The assumptions regarding these activities, which were used to estimate duration, are discussed in the following sections. The durations used for each activity are provided in Table 22.
For the 2D seismic survey, a single vessel is capable of acquiring a source line in approximately 1-2 hrs and only one source line will be collected in one day to allow for all the node deployments and retrievals, and intertidal and land zone shot holes drilling. There are up to 10 source lines, so assuming all operations run smoothly, there will only be 2 hrs per day over 10 days of airgun activity. The duration that was used to assess exposures from the 2D seismic survey is 10 days.

The total anticipated duration of the 3D seismic survey is 60 days, including delays due to equipment, weather, tides, and marine mammal shut downs. The duration that was used to assess exposures from the 3D seismic survey is 60 days.

Assuming the geohazard team is surveying 50% of the day (or 12 hrs), the total number of days it will take to survey the total geohazard survey grid for a single well is 7.77 days. This duration was multiplied by the number of wells per site resulting in 31.1 days for the four Lower Cook Inlet OCS wells, 7.7 days for the North Cook Inlet Unit well, and 15.5 days for the two Trading Bay area wells.

The total number of days it will take to survey the geohazard survey grid for a pipeline maintenance is 1 day. This duration was multiplied by the number of anticipated surveys per year (high estimate of 3 per year), for a total of 3 days.

The tugs towing the rig will be coming from south of the Petition region. The duration of active towing was estimated assuming 5 days from the south to the lower Cook Inlet well area, 10 days to the North Cook Inlet Unit well, and 8 days to the Trading Bay area wells. It was assumed that there will be 1 day of towing between wells and adjusting the rig onsite. The total duration for active towing activity was calculated by adding the number of days towing to and from the well and days towing in between wells and multiplying this by the total number of wells. The resulting number of days per site is 14 days for the lower Cook Inlet wells, 21 days for the North Cook Inlet well, and 18 days for the Trading Bay area wells. It is important to note that calculating individual durations for each location is a worst-case scenario because it is likely that the North Cook Inlet and Trading Bay wells will be conducted in the same year to save on costs for the drill rig.

It takes approximately 3 days to install the drive pipe per well with only 25% of the day necessary for actual pipe driving. Drive pipe installation is not part of the P&A activities at the North Cook Inlet Unit site. This duration was multiplied by the number of wells per site resulting in 3 days for the four lower Cook Inlet wells and 1.5 days for the two Trading Bay area wells.

It takes approximately 2 days to perform the VSP per well with only 25% of the day necessary for actual seismic work. VSP is not part of the P&A activities at the North Cook Inlet site This duration was multiplied by the number of wells per site, resulting in 2 days for the four lower Cook Inlet wells and 1 day for the two Trading Bay area wells. Water jets and hydraulic grinders are only used when needed for maintenance, therefore, the annual duration was estimated to evaluate exposures. Each water jet and hydraulic grinder event was estimated to be 30 minutes or less in duration. It was estimated that a water jet event occurs 3 times a month, resulting in only 1.5 hrs per month of water jet operation. Water jets and grinders are used during ice-free months, so this duration was multiplied by 7 months (May-November) resulting 10.5 days.

The total number of days expected to install the sheet pile dock face using vibratory hammers on the rock causeway is 14 days with only 25% of the day for actual pile driving, resulting in 3.5 days of sound for the Iniskin project.
6.5.1.4 Take Estimates Per Activity Per Location

The numbers of each marine mammal species that could potentially be exposed to sounds associated with Petition activities that exceed USFWS acoustic harassment criteria was estimated per project activity and per location. The specific years when these activities might occur are not known at this time, so this method of per activity per location allows for flexibility in operations and provides USFWS with appropriate information for assessing potential exposures. The estimated exposures (without any mitigation) per activity per location was calculated by multiplying the density of marine mammals (# of marine mammals/km²) by the area of ensonification (km²) and the duration (days per year).

The estimated number of sea otters without mitigation per activity per location potentially exposed to sound levels exceeding Level A thresholds is less than 1 animal for each activity and less than 5 animals for all activities combined (Table 22).

The estimated number of sea otters without mitigation per activity per location potentially exposed to sound levels exceeding Level B thresholds depends on the type of activity (Table 22). For the 2D seismic survey, the estimated total number of Level B exposures is estimated to be approximately 750 sea otters. The high number is based on the higher density of animals in that nearshore region, but the overall total seismic sound is approximately 2-3 hours per day over 10 days. For the 3D seismic survey, the estimated total number of Level B exposures is estimated to be approximately 850 sea otters. The eastern side of the 3D seismic survey area is in the higher density area, so a higher number of exposures is expected when the survey is in that area. For the operations in the lower Cook Inlet OCS leases, the estimated total number of Level B exposures ranges up to 35-47 sea otters for the pipe driving and sub-bottom profiler, respectively. For operations in the middle Cook Inlet region, the total number of Level B exposures range from 0 to 9 sea otters depending on the activity. Sea otters are not expected to be observed in this area, so the use of a density of 0.01 otters/km² is a conservative estimate.
### Table 22. Estimated Level A and B exposures for Hilcorp Alaska and Harvest Alaska activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Density (# ind/km²)</th>
<th>Area of Ensonification (km²)</th>
<th>Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Impulsive</td>
<td>Non-Impulsive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>232 pk</td>
<td>203 SEL</td>
</tr>
<tr>
<td>2D seismic(^1)</td>
<td>1.705</td>
<td>0.060</td>
<td>0.047</td>
</tr>
<tr>
<td>3D seismic(^1)</td>
<td>0.026</td>
<td>0.741</td>
<td>0.586</td>
</tr>
<tr>
<td>Vibratory sheet pile driving</td>
<td>0.026</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sub-bottom profiler - LCI(^1)</td>
<td>0.026</td>
<td>0.001</td>
<td>0.016</td>
</tr>
<tr>
<td>Sub-bottom profiler - NCI(^1)</td>
<td>0.010</td>
<td>0.001</td>
<td>0.016</td>
</tr>
<tr>
<td>Sub-bottom profiler - TB(^1)</td>
<td>0.010</td>
<td>0.001</td>
<td>0.016</td>
</tr>
<tr>
<td>Sub-bottom profiler - MCI(^1)</td>
<td>0.010</td>
<td>0.000</td>
<td>0.002</td>
</tr>
<tr>
<td>Pipe driving - LCI(^2)</td>
<td>0.026</td>
<td>0.000</td>
<td>0.040</td>
</tr>
<tr>
<td>Pipe driving - TB(^2)</td>
<td>0.010</td>
<td>0.000</td>
<td>0.040</td>
</tr>
<tr>
<td>VSP – LCI(^2)</td>
<td>0.026</td>
<td>0.000</td>
<td>0.195</td>
</tr>
<tr>
<td>VSP – TB(^2)</td>
<td>0.010</td>
<td>0.000</td>
<td>0.195</td>
</tr>
<tr>
<td>Hydraulic grinder(^2)</td>
<td>0.010</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Water jet(^2)</td>
<td>0.010</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Tugs towing rig – LCI(^3)</td>
<td>0.026</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Tugs towing rig - NCI(^3)</td>
<td>0.010</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Tugs towing rig - TB(^3)</td>
<td>0.010</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

1Area for all mobile, impulsive sources calculated by multiplying line length in km surveyed per day by distance in km to threshold. Distances to thresholds in are provided in Table 21 and converted to km.
2Area for stationary, impulsive and non-impulsive sources calculated by area of circle \((A=\pi r^2)\) where \(r\) is distance to threshold (Table 21) converted to km.
3Area for mobile, non-impulsive source calculated by area of circle \((A=\pi r^2)\) where \(r\) is distance to threshold (Table 21) converted to km.
6.5.2 Alaska LNG Project Estimates

As noted in Section 1, the Alaska LNG Project is being permitted through FERC and has been underway for several years. To maintain consistency with other documents, the methods for estimating exposures are the same as used for Hilcorp Alaska and Harvest Alaska, but the description is different.

The numbers of sea otters that could potentially be exposed to sound associated with the Alaska LNG Project were estimated using the methods described below. We multiplied the following variables: 1) the area of ensonification for the various Level A and B thresholds, 2) the total duration in days for each season for each type of activity; and 3) the density (number of marine mammals/unit area).

6.5.2.1 Level A Ensonification Area

Using the peak SPL and SEL source levels from Illingworth & Rodkin (2007) for each pile type, the distances to the Level A thresholds for otariid pinnipeds were calculated using the NMFS Acoustical Guidance Spreadsheet (NMFS 2016) assuming the following:

- **Impact Pile Driving**
  - Weighting Factor Adjustment (WFA) of 2 kHz.
  - Actual pile driving occurs during 25% of a 12-hr day.
  - Number of strikes per hour of 1,560 (based on 26 beats per minute of typical impact hammer).
  - Spreading loss of 15 log R (practical spreading).

- **Vibratory Pile Driving**
  - WFA of 2.5 kHz.
  - Actual pile driving occurs during 40% of a 12-hr day.
  - Spreading loss of 15 log R (practical spreading).

- **Anchor Handling**
  - WFA of 1.5 kHz.
  - Vessel speed of 1.54 m/s or 3 knots.
  - Spreading loss of 17.8 log R (based on Blackwell and Greene 2003).

Underwater sound propagation depends on many factors including sound speed gradients in water, depth, temperature, salinity, and bottom composition. In addition, the characteristics of the sound source like frequency, source level, type of sound, and depth of the source will also affect propagation. For ease in estimating distances to thresholds, simple transmission loss (TL) can be calculated using the logarithmic spreading loss with the formula:

\[ TL = B \times \log_{10}(R) \]

where TL is transmission loss, B is logarithmic loss, and R is radius.

The three common spreading models are cylindrical spreading for shallow water, or 10 log R; spherical spreading for deeper water, or 20 log R; and practical spreading, or 15 log R. Several projects have measured the TL associated with pile driving in Cook Inlet. At Port MacKenzie in upper Cook Inlet, Blackwell (2005) measured levels associated with impact and vibratory hammer of 36-in steel pipe and report a TL of 17.5 log R for impact driving and 21.8 to 28 log R for vibratory driving. URS (2007) and SFS (2009) measured levels associated with impact and vibratory pile driving at the Port of Anchorage and used 20 log R to estimate distances NMFS thresholds, but did not characterize the TL. Illingworth & Rodkin (2013) measured levels from impact hammering of conductor pipe in lower Cook Inlet and report a TL of 20.4 log R. Based on measurements in Cook Inlet with similar types of construction, the 20 log R TL
represents the average of the measured TLs; however, AGDC has agreed to use a TL of 15 log R for assessment of potential exposures from pile driving. For the anchor handling, the measurements of tugs docking in Cook Inlet conducted by Blackwell and Greene (2003) represent a similar source level, similar environment, and similar operations; so the measured source level of 149 dB at 100 m (328 ft) and TL of 17.8 log R best approximate conditions expected for the project.

The area is then calculated using the formula for area of a circle \(A = \pi r^2\) where \(r\) is the distance to the threshold. For pile driving, the area is then divided by two, as the sound would only propagate in water (half of a circle); a full circle was used for anchor handling.

The estimated distances to the thresholds for pile driving and anchor handling are summarized in Table 26. For the Level A peak thresholds for impact pile driving, the estimated distances are less than 1 m (3.05 ft) and resulting areas of ensonification are 0 km² (0 mi²). For the Level A SEL thresholds for impact pile driving, the estimated distances are less than 150 m (492 ft) and the resulting area of ensonification is approximately 0.03 km² (0.02 mi²). It is important to note that the distance for SEL includes the amount of accumulated time over the 24-hr period, so the size will change if the time varies. For the Level A rms thresholds for impact pile driving, the estimated distances are less than 22 m (72 ft) and the resulting area is 0.001 km² (0.0004 mi²). For the Level A SEL thresholds for vibratory pile driving, the estimated distances are approximately 3.3 m (10.8 ft) and the resulting area of ensonification is close to 0 km² (0 mi²). For the Level A rms thresholds for vibratory pile driving, the estimated distances are less than 3 m (9.8 ft) and the resulting areas of ensonification are close to 0 km² (0 mi²).

6.5.2.2 Level B Ensonification Area

The distances to the Level B thresholds were calculated assuming the following:

- **Pile Driving**
  - Using the rms source levels from Illingworth & Rodkin (2007) for each pile as summarized in Table 18.
  - Spreading loss of 15 log R (practical spreading).
- **Anchor Handling**
  - Spreading loss of 17.8 log R (based on Blackwell and Greene, 2003).

The ensonified area is calculated using the formula for area of a circle \(A = \pi r^2\) where \(r\) is the distance to the threshold (converted to km). For pile driving, the area is then divided by two, as the sound would only propagate in water (half of a circle); a full circle was used for anchor handling.

The estimated distances to the Level B thresholds for pile driving and anchor handling are summarized in Table 26. The estimated distances are approximately 1 to 2.2 km (0.6 to 1.4 mi) for impact pile driving of all sizes of piles and approximately 10 to 47 m (32.8 to 154.2 ft) for vibratory pile driving. Anchor handling does not exceed the USFWS Level B threshold. The resulting areas of ensonification range from 0 to 7.3 km² (0 to 2.8 mi²) for impact pile driving and from 0 to 0.003 km² (0 to 0.001 mi²) for vibratory pile driving.
Table 23. Calculated distance in meters (m) to USFWS thresholds for Alaska LNG Project.

<table>
<thead>
<tr>
<th>Activity1</th>
<th>SELcum</th>
<th>Level A</th>
<th></th>
<th>Level B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Impulsive</td>
<td>Non-</td>
<td>Impulsive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pk 232 dB</td>
<td>Impulsive</td>
<td>SEL 203 dB</td>
</tr>
<tr>
<td>18- and 24-inch pipe, impact</td>
<td>215</td>
<td>0.22</td>
<td>50.53</td>
<td>N/A</td>
</tr>
<tr>
<td>48- and 60-inch pipe, impact</td>
<td>222</td>
<td>0.34</td>
<td>147.99</td>
<td>N/A</td>
</tr>
<tr>
<td>all sizes pipe, vibratory</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3.30</td>
</tr>
<tr>
<td>Sheet pile, impact</td>
<td>217</td>
<td>0.16</td>
<td>68.69</td>
<td>NA</td>
</tr>
<tr>
<td>Sheet pile, vibratory</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.71</td>
</tr>
<tr>
<td>Anchor handling</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Distance for vibratory pile driving assumes 15 log R transmission loss, 40% work for each 12-hour work day.
Distance for impact pile driving assumes 15 log R transmission loss, 25% work for each 12-hour work day.

6.5.2.3 Duration of Sound per Activity

Estimated durations in total number of 24-hr days were estimated per season, per facility, and by pile type and size are provided in Table 24. The total number of structures (bents or quadropods) and needed days for driving the piles are based on an assumed period of April through October, a 12-hr work day, 25% of actual driving for impact pile driving, and 40% of actual driving for vibratory pile driving.

The total duration per season of anchor handling was calculated differently for the two seasons. In Season 3 the duration was calculated by assuming actual anchor handling would occur 25% of each day that anchor handling is ongoing. In Season 4 anchor handling duration was estimated by calculating the likely number of times individual anchors would be reset (based on resetting all 12 anchors once per day and a lay rate of 762 m (2,500 ft) per day) and assuming it takes 15 minutes to pull the anchor and 15 minutes to reset (Table 25).
Table 24. Calculation of duration of pile driving in total days for each facility and season for Alaska LNG Project.

<table>
<thead>
<tr>
<th>Season</th>
<th>Element</th>
<th>Number of Piles/Length of Sheet Pile</th>
<th>Number of Structures</th>
<th>Number of Pile Driving Days per Structure</th>
<th>Total 24-hour Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>18-inch</td>
<td>24-inch</td>
<td>48-inch</td>
<td>60-inch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>E-W Access Trestle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>33</td>
</tr>
<tr>
<td>2</td>
<td>E-W Access Trestle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Berth 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Berth 2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>N-S Access Trestle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>E-W Access Trestle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>3</td>
<td>Operations Platform</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Breasting Dolphin Berth 1 &amp; 2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Breasting Dolphin Berth 1 &amp; 2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>Mooring Dolphin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Mooring Dolphin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>N-S Access Trestle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Mooring Dolphin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Mooring Dolphin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Catwalk</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
</tbody>
</table>

Temporary Material Offloading Facility

<table>
<thead>
<tr>
<th></th>
<th>MOF comi wall</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>35</th>
<th>-</th>
<th>Vibratory</th>
<th>July</th>
<th>1</th>
<th>10.75</th>
<th>4.30</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MOF comi wall</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>Vibratory</td>
<td>July</td>
<td>1</td>
<td>10.75</td>
<td>4.30</td>
</tr>
<tr>
<td>1</td>
<td>MOF cell</td>
<td>36</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1075</td>
<td>Vibratory</td>
<td>July–October</td>
<td>1</td>
<td>27.54</td>
<td>11.02</td>
</tr>
<tr>
<td>1</td>
<td>MOF cell</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2454</td>
<td>Vibratory</td>
<td>July–October</td>
<td>1</td>
<td>27.54</td>
<td>11.02</td>
</tr>
<tr>
<td>2</td>
<td>MOF cell</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2447</td>
<td>Vibratory</td>
<td>April–June</td>
<td>1</td>
<td>26.97</td>
<td>10.79</td>
</tr>
<tr>
<td>2</td>
<td>MOF cell</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2477</td>
<td>Vibratory</td>
<td>April–June</td>
<td>1</td>
<td>26.97</td>
<td>10.79</td>
</tr>
<tr>
<td>2</td>
<td>MOF Ro-Ro Dolphin Quads</td>
<td>-</td>
<td>-</td>
<td>28</td>
<td>-</td>
<td>-</td>
<td>Impact</td>
<td>April–June</td>
<td>3.5</td>
<td>2</td>
<td>1.75</td>
</tr>
<tr>
<td>2</td>
<td>MOF Ro-Ro Dolphin Quads</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>Impact</td>
<td>April–June</td>
<td>3.5</td>
<td>2</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Mainline Material Offloading Facility

<table>
<thead>
<tr>
<th></th>
<th>Mainline MOF sheet pile</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>670</th>
<th>Vibratory</th>
<th>April–May</th>
<th>1</th>
<th>6.7</th>
<th>3.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mainline MOF sheet pile</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>670</td>
<td>Impact</td>
<td>April–May</td>
<td>1</td>
<td>6.7</td>
<td>2.00</td>
</tr>
</tbody>
</table>
Table 25. Calculation of duration of anchor handling in total days for each season for Alaska LNG Project.

<table>
<thead>
<tr>
<th>Season</th>
<th>Activity</th>
<th>Anchors Reset</th>
<th>Reset Time (hours)</th>
<th>Days</th>
<th>Percent of Day</th>
<th>Total 24-hour Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>9 days mooring, 14 days pipe trenching</td>
<td>--</td>
<td>--</td>
<td>23</td>
<td>25%</td>
<td>5.75</td>
</tr>
<tr>
<td>4</td>
<td>Pipeline days at rate of 2,500 feet per day</td>
<td>636</td>
<td>0.5</td>
<td>53</td>
<td>25%</td>
<td>13.25</td>
</tr>
</tbody>
</table>

1 Includes 15 minutes to pull an anchor and 15 minutes to reset (lower and then tension up)

These are estimates, the actual production rates and durations would be dependent on weather, conditions of substrate, equipment, and other delays.

6.5.2.4 Take Estimates by Season

The numbers of each marine mammal species that could potentially be exposed to sounds associated with Petition activities that exceed USFWS acoustic harassment criteria was estimated per season. The estimated exposures (without any mitigation) per activity per location was calculated by multiplying the density of marine mammals (# of marine mammals/km²) by the area of ensonification (km²) and the duration (days per year). These estimates do not include any reductions from mitigation measures, such as shutdowns or construction windows, or reductions from the variability in seasonal habitat use or distribution of the sea otters in Cook Inlet.

The total estimated number of sea otters without mitigation potentially exposed to sound levels exceeding Level A thresholds is less than 1 animal and less than 5 animals for Level B (Table 26). Sea otters are not expected to be observed in this area, so the use of a density of 0.01 otters/km² is a conservative estimate.
### Table 26. Estimated Level A and B exposures for Alaska LNG Project activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Density (# ind/km²)</th>
<th>Area of Esonification (km²)</th>
<th>Exposures</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(days)</td>
<td>Impulsive</td>
<td>Impulsive</td>
<td>Impulsive</td>
<td>Impulsive</td>
<td>Both</td>
</tr>
<tr>
<td></td>
<td></td>
<td>232 pk  203 SEL  219 SEL  190 rms  180 rms  160 rms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Loading Facility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48-inch impact</td>
<td>0.010</td>
<td>0.000  0.034 --  0.001 --</td>
<td>7.291</td>
<td>14.000</td>
<td>0.000</td>
<td>0.005</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>60-inch impact</td>
<td>0.010</td>
<td>0.000  0.034 --  0.001 --</td>
<td>7.291</td>
<td>26.500</td>
<td>0.000</td>
<td>0.009</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>Temporary MOF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-inch vibratory</td>
<td>0.010</td>
<td>--  --  0.000 --  0.000 --  0.003</td>
<td>21.804</td>
<td>--</td>
<td>--</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>24-inch impact</td>
<td>0.010</td>
<td>0.000  0.004 --  0.001 --</td>
<td>5.364</td>
<td>1.750</td>
<td>0.000</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>48-inch impact</td>
<td>0.010</td>
<td>0.000  0.034 --  0.001 --</td>
<td>7.291</td>
<td>1.750</td>
<td>0.000</td>
<td>0.001</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>60-inch vibratory</td>
<td>0.010</td>
<td>--  --  0.000 --  0.000 --  0.003</td>
<td>4.300</td>
<td>--</td>
<td>--</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>sheet vibratory</td>
<td>0.010</td>
<td>--  --  0.000 --  0.000 --  0.000</td>
<td>26.104</td>
<td>--</td>
<td>--</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>Mainline MOF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sheet vibratory</td>
<td>0.010</td>
<td>--  --  0.000 --  0.000 --  0.000</td>
<td>2.68</td>
<td>--</td>
<td>--</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
</tr>
<tr>
<td>sheet impact</td>
<td>0.010</td>
<td>0.00  0.01 --  0.00 --  1.57</td>
<td>1.68</td>
<td>0.000</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
<td>--</td>
</tr>
<tr>
<td>Anchor handling</td>
<td>0.010000</td>
<td>--  --  0.00 --  0.00 --  0.00</td>
<td>19.00</td>
<td>--</td>
<td>--</td>
<td>0.000</td>
<td>--</td>
<td>0.000</td>
</tr>
</tbody>
</table>
6.6  REQUESTED TAKES

6.6.1  Hilcorp Alaska and Harvest Alaska

The estimates of Level B exposures by activity and location discussed above are not representative of the estimated exposures per year (i.e., annual takes). It is difficult to characterize each year accurately because of the uncertainty in timing of projects in this Petition period. The annual take given per year will be based on the details provided in each LOA application submitted by the Applicant. For purposes of estimating the percent of the sea otter stocks, Table 27 summarizes the requested takes per activity

The Applicant is committed to the conservation of the species and will implement the robust monitoring and mitigation program outlined in Sections 11 and 13 to avoid Level A exposures and minimize Level B exposures.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimated Level B Exposures</th>
<th>Southwest Stock Estimate (45,064)</th>
<th>Southcentral Stock Estimate (18,237)</th>
<th>Total Population Estimate (63,301)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D seismic</td>
<td>750</td>
<td>1.66%</td>
<td>4.11%</td>
<td>1.18%</td>
</tr>
<tr>
<td>3D seismic</td>
<td>850</td>
<td>1.88%</td>
<td>4.64%</td>
<td>1.34%</td>
</tr>
<tr>
<td>Vibratory sheet pile driving</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Sub-bottom profiler - LCI</td>
<td>47</td>
<td>0.10%</td>
<td>0.26%</td>
<td>0.07%</td>
</tr>
<tr>
<td>Sub-bottom profiler - NCI</td>
<td>5</td>
<td>0.01%</td>
<td>0.02%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Sub-bottom profiler - TB</td>
<td>9</td>
<td>0.02%</td>
<td>0.05%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Sub-bottom profiler - MCI</td>
<td>&lt;1</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Pipe driving - LCI</td>
<td>35</td>
<td>0.08%</td>
<td>0.19%</td>
<td>0.05%</td>
</tr>
<tr>
<td>Pipe driving - TB</td>
<td>10</td>
<td>0.01%</td>
<td>0.04%</td>
<td>0.01%</td>
</tr>
<tr>
<td>VSP – LCI</td>
<td>&lt;1</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>VSP – TB</td>
<td>&lt;1</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hydraulic grinder</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Water jet</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Tugs towing rig - LCI</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Tugs towing rig - NCI</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Tugs towing rig - TB</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

6.6.2  Alaska LNG Project

The estimates of Level B exposures by facility are very low because of the low density of sea otters expected in the Alaska LNG Project area. The annual takes given per year will be based on the details provided in each LOA application submitted by the Applicant. For purposes of estimating the percent of the sea otter stocks, the requested number of takes is 5 sea otters by facility (Table 28). Because anchor handling does not exceed Level B harassment levels, no authorized takes are needed.

The Applicant is committed to the conservation of the species and will implement the robust monitoring and mitigation program outlined in Sections 11 and 13 to avoid Level A exposures and minimize Level B exposures.
### Table 28. Requested Level B takes and percent of population for the Alaska LNG Project.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimated Level B Exposures</th>
<th>Southwest Stock Estimate (45,064)</th>
<th>Southcentral Stock Estimate (18,237)</th>
<th>Total Population Estimate (63,301)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Loading Facility</td>
<td>5</td>
<td>0.01%</td>
<td>0.03%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Temporary MOF</td>
<td>5</td>
<td>0.01%</td>
<td>0.03%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Mainline MOF</td>
<td>5</td>
<td>0.01%</td>
<td>0.03%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Anchor handling</td>
<td>0</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
7.0 DESCRIPTION OF IMPACT ON MARINE MAMMALS

The anticipated impact of the activity upon the species or stock.

7.1 GENERAL EFFECTS OF NOISE ON MARINE MAMMALS

The proposed Petition activities have the potential to impact local sea otters for brief periods during operations, however, disruptions are unlikely to be significant enough to displace otters from important feeding or breeding grounds for prolonged periods of time. Sea otters have similar hearing thresholds in-air and underwater to otarids and the underwater audiogram in Ghoul and Reichmuth (2014) shows the typical mammalian U-shape; sea lions’ in-air hearing range is 0.250–30 kHz, with a region of best hearing sensitivity from 5–14.1 kHz (Muslow and Reichmuth 2010). The range of best hearing was from 1 to 16 kHz. Higher hearing thresholds indicating poorer sensitivity were observed for signals below 16 kHz and above 25 kHz (Kastelein et al. 2005). Northern sea otters have a functional hearing range of 60 Hz to 39 kHz with highest sensitivity between 2 and 16 kHz (NMFS 2016; Ghoul and Reichmuth 2011).

Ghoul and Reichmuth (2014) suggest that although sea otters are adapted to an aquatic lifestyle, they retain in-air hearing sensitivity compared to terrestrial carnivores; overall in-water hearing sensitivity is reduced in comparison to other amphibious marine mammals (e.g., pinnipeds); and sea otters lack the ability to detect sounds imbedded in background noise, as seen in other marine carnivores. Due to functional similarities, and lack of specific data on otter reactions to noise, northern sea otters are placed within the otariid pinniped hearing group; general pinniped discussion (as well as information pertaining to marine mammals in general) provided herein applies directly to northern sea otters.

Marine mammals use hearing and sound transmission to perform vital life functions. Introducing sound into their environment could be disrupting to those behaviors. Sound (hearing and vocalization/echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. The distances to which noise associated with the Petition activities is audible depends upon source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the receptor (Richardson et al. 1995).

The effects of sounds from industrial activities on marine mammals might include one or more of the following: tolerance, behavioral disturbance, sound masking, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995). In assessing potential effects of noise, Richardson et al. (1995) has suggested four criteria for defining zones of influence. These zones are described below from greatest influence to least:

**Zone of hearing loss, discomfort, or injury** – the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. This includes TTS (temporary loss in hearing) or PTS (loss in hearing at specific frequencies or deafness). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage.

**Zone of masking** – the area within which the noise may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.
Zone of responsiveness – the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound is dependent upon a number of factors, including: 1) acoustic characteristics the noise source of interest; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995; Southall et al. 2007). However, temporary behavioral effects are often simply evidence that an animal has heard a sound and may not indicate lasting consequence for exposed individuals (Southall et al. 2007).

Zone of audibility – the area within which the marine mammal might hear the noise. Northern sea otters have a functional hearing range of 60 Hz to 39 kHz, with highest sensitivity between 2 and 16 kHz (NMFS 2016; Ghoul and Reichmuth 2011). There are no applicable criteria for the zone of audibility due to difficulties in human ability to determine the audibility of a particular noise for a particular species.

7.2 POTENTIAL EFFECTS OF SOUNDS ON NORTHERN SEA OTTERS

7.2.1 Potential Effects of Airgun Sounds

The following text describes the potential impacts of noise from proposed Hilcorp Alaska Petition activities on northern sea otters. Due to the mitigation measures discussed in the Marine Mammal Monitoring and Mitigation Plan (4MP; Appendix B), it is unlikely there would be any temporary or especially permanent hearing impairment, or non-auditory physical effects on otters. In addition, most of Cook Inlet is a poor acoustic environment because of its shallow depth, soft bottom, and high background noise from currents and glacial silt which greatly reduces the distance sound travels (Blackwell and Greene 2003).

7.2.1.1 Tolerance

Studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers, but they do not necessarily cause behavioral disturbances. Numerous studies have shown that marine mammals at distances over a few kilometers from operating seismic vessels often show no apparent response. That is often true even when pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Pinnipeds infrequently react behaviorally to airgun pulses under some conditions, and in general are more tolerant of exposure to airgun pulses than other marine mammals such as baleen whales (reviewed in Richardson et al. 1995).

7.2.1.2 Noise Induced Threshold Shift

Animals exposed to intense sound may experience reduced hearing sensitivity for some period of time following exposure. This increased hearing threshold is known as noise induced threshold shift (TS). The amount of TS incurred in the animal is influenced by a number of noise exposure characteristics, such as amplitude, duration, frequency content, temporal pattern, and energy distribution (Kryter 1985; Richardson et al. 1995; Southall et al. 2007). It is also influenced by characteristics of the animal, such as behavior, age, history of noise exposure and health. The magnitude of TS generally decreases over time after noise exposure and if it eventually returns to zero, it is known as TTS. If TS does not return to zero after some time (generally on the order of weeks), it is known as PTS. TTS is not considered to be auditory injury and does not constitute ‘Level A Harassment’ as defined by the MMPA. Sound levels associated with TTS onset are generally considered to be below the levels that will cause PTS, which is considered to be auditory injury.
Temporary threshold shift has been studied in captive odontocetes and pinnipeds (reviewed in Southall et al. 2007), however there is no published information on TTS in sea otters due to the majority of their time spent at the surface.

Many marine mammal species avoid ships and/or seismic operations. This behavior in and of itself should be sufficient to avoid TTS onset. In addition, monitoring and mitigation measures often implemented during seismic surveys are designed to detect marine mammals near the airgun array and avoid exposing them to sound pulses that may cause hearing impairment. For example, it is standard protocol for many seismic operators to ramp up airgun arrays, which should allow animals near the airguns at startup time to move away from the source and thus avoid TTS. If animals do incur TTS, it is a temporary and reversible phenomenon unless exposure exceeds the TTS-onset threshold by an amount sufficient to cause PTS. The following subsections summarize the available data on noise-induced hearing impairment in marine mammals.

7.2.1.2.1 Sound Exposure Level (SEL)

Sound exposure level is a measure of sound energy, calculated as 10 times the logarithm of the integral (with respect to duration) of the mean-square sound pressure, referenced to 1 µPa²s (Kastak et al. 2005; Southall et al. 2007). It is useful for assessing the cumulative level of exposure to multiple sounds because it allows sounds with different durations and involving multiple exposures to be compared in terms of total energy. This type of comparison assumes that sounds with equivalent total energy will have similar effects on exposed subjects, even if the sounds differ in SPL, duration and/or temporal exposure patterns. Sound exposure level likely over estimates TTS and PTS arising from complex noise exposures because it does not take varying levels and temporal patterns of exposure and recovery into account (Southall et al. 2007). Some support for the use of SEL to evaluate TTS and PTS has been shown for marine mammals (e.g., Finneran et al. 2002, 2005), and this measure will be referred to in the following sections of this document.

7.2.1.2.2 Temporary Threshold Shift (TTS)

Temporary threshold shift is the mildest form of hearing impairment that can occur during exposure to loud sound (Kryter 1985). It is not considered to represent physical injury, as hearing sensitivity recovers relatively quickly after the sound ends. It is, however, an indicator that physical injury is possible if the animal is exposed to higher levels of sound. The onset of TTS is defined as a temporary elevation of the hearing threshold by at least 6 dB (Schlundt et al. 2000). Several physiological mechanisms are thought to be involved with inducing TTS. These include reduced sensitivity of sensory hair cells in the inner ear, changes in the chemical environment in the sensory cells, residual middle-ear muscular activity, displacement of inner ear membranes, increased blood flow, and post-stimulatory reduction in efferent and sensory neural output (Kryter 1994; Ward 1997).

Temporary threshold shift has been measured for only three pinniped species: harbor seals, California sea lions, and northern elephant seals, and only one study has examined TTS in response to exposure to underwater pulses (Finneran et al. 2003). Of the three species for which data are available, the harbor seal exhibits TTS onset at the lowest exposure levels to non-pulsed sounds. A 25-minute exposure to a 2.5 kHz sound elicited TTS in a harbor seal at an SPL of 152 dB re 1 µPa (SEL 183 dB re 1µPa²s), as compared to 174 dB re 1 µPa (SEL 206 dB re 1µPa²s) for the California sea lion and 172 dB re 1 µPa (SEL 204 dB re 1µPa²s) for the elephant seal (Kastak et al. 2005).

The auditory response of pinnipeds to underwater pulsed sounds has been examined in only one study. Finneran et al. (2003) measured TTS onset in two captive California sea lions exposed to single underwater
pulses produced by an arc-gap transducer. No measurable TTS was observed following exposures up to a peak SPL of 183 dB re 1 μPa peak-to-peak (SEL 163 dB re 1μPa^2s). Finneran et al. (2003) suggest that the equal energy rule may apply to pinnipeds, however Kastak et al. (2005) found that for harbor seals, California sea lions, and elephant seals exposed to prolonged non-impulse noise, higher SELs were required to elicit a given TTS if exposure duration was short than if it was longer. For example, for a non-impulse sound, doubling the exposure duration from 25 to 50 min (a 3 dB increase in SEL) had a greater effect on TTS than an increase of 15 dB (95 vs 80 dB) in exposure level. These results are similar to those reported by Mooney et al. (2009a, b) for bottlenose dolphins and emphasize the need for taking both SPL and duration into account when evaluating the effect of sound exposure on marine mammal auditory systems.

As mentioned earlier, there is no published information on TTS in sea otters due to the majority of their time spent at the surface. While foraging for benthic invertebrates, otters spend approximately 85 to 149 s underwater for each of about 9 dives per forage (Bodkin et al. 2004; Wolt et al. 2012); this short duration of time spent underwater reduces overall risk of exposure to underwater noise. Sea otters on the surface have been reported to show a lack of reaction to seismic noise as a result of underwater pressure effects limiting sound transmittal from underwater to the surface (Reidman 1983, 1984).

7.2.1.2.3 Permanent Threshold Shift (PTS)

Permanent threshold shift is defined as ‘irreversible elevation of the hearing threshold at a specific frequency (Yost 2000). It involves physical damage to the sound receptors in the ear and can be either total or partial deafness or impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Some causes of PTS are severe extensions of effects underlying TTS (e.g., irreparable damage to sensory hair cells). Others involve different mechanisms, for example exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of inner ear fluids (Ward 1997; Yost 2000). The onset of PTS is determined by pulse duration, peak amplitude, rise time, number of pulses, inter-pulse interval, location, species and health of the receivers ear (Ketten 1994).

The relationships between TTS and PTS thresholds have not been studied in marine mammals and there is currently no evidence that exposure to airgun pulses can cause PTS in any marine mammal, however there has been speculation about that possibility (e.g., Richardson et al. 1995; Gedamke et al. 2008). In terrestrial mammals, prolonged exposure to sounds loud enough to elicit TTS can cause PTS. Similarly, shorter term exposure to sound levels well above the TTS threshold can also cause PTS (Kryter 1985). Terrestrial mammal PTS thresholds for impulse sounds are thought to be at least 6 dB higher than TTS thresholds on a peak-pressure basis (Southall et al. 2007). Also, pulses with rapid rise times can result in PTS even when peak levels are only a few dB higher than the level causing slight TTS.

Southall et al. (2007) used available marine mammal TTS data and precautionary extrapolation procedures based on terrestrial mammal data to estimate exposures that may be associated with PTS onset. For terrestrial mammals, TTS exceeding 40 dB generally requires a longer recovery time than smaller TTS, which suggests a higher probability of irreversible damage (Ward 1970) and possibly different underlying mechanisms (Kryter 1994; Nordman et al. 2000). Based on this, and the similarities in morphology and functional dynamics among mammalian cochleae, Southall et al. (2007) assumed that PTS would be likely if the hearing threshold was increased by more than 40 dB and assumed an increase of 2.3 dB in TTS with each additional dB of sound exposure. This translates to an injury criterion for pulses that is 15 dB above the SEL of exposures causing TTS onset.
There are no data on the sound level of pulses that would cause TTS onset in pinnipeds. Southall et al. (2007) therefore assumed that known pinniped-to-cetacean differences in TTS-onset for non-pulsed sounds also apply to pulse sounds. Harbor seals experience TTS onset at received levels that are 12 dB lower than those required to elicit TTS in beluga whales (Kastak et al. 2005; Finneran et al. 2002). Therefore, TTS onset in pinnipeds exposed to a single underwater pulse was estimated to occur at an SEL of 171 dB re 1µPa²s. Adding 15 dB results in a PTS onset of 186 dB re 1µPa²s for pinnipeds exposed to a single pulse. This is likely to be a precautionary estimate as the harbor seal is the most sensitive pinniped species studied to date and these results are based on measurements taken from a single individual (Kastak et al. 1999, 2005). It is unlikely that PTS would be an issue for sea otters due to sporadic amounts of time (less than 3 minutes per dive) spent underwater and at risk to seismic noise.

It is unlikely that a marine mammal would remain close enough to a large airgun array long enough to incur PTS. As discussed in the TTS section, the levels of successive pulses received by a marine mammal will increase and then decrease gradually as the seismic vessel approaches, passes and moves away, with periodic decreases also caused when the animal goes to the surface to breathe, reducing the probability of the animal being exposed to sound levels large enough to elicit PTS.

7.2.1.3 Masking

Masking of marine mammal calls and other natural sounds are expected to be limited in the presence of seismic noise, although there are very few specific data of relevance. Otter vocalizations are thought to be suitable for short distance communication between familiar individuals. Vocalizations include whines or whistles, hisses, snarls or growls, coos, grunts, barks, squeals, cries, and screams. McShane et al. (1995) analyzed the scream call which is produced at the surface between mothers and pups. These screams are detectable by humans approximately 1 km (0.6 mi) from the source (McShane et al. 1995; Ghoul and Reichmuth 2011), and would unlikely be compromised by the negligible levels of seismic noise breeching the surface.

Literature does not indicate that sea otters use sound to locate prey. Rather, otters rely on tactile cues from their whiskers and forepaws to detect and capture benthic invertebrates (Hines and Loughlin 1980; Marshall et al. 2014), therefore, it is unlikely that seismic noise would interfere with sea otter foraging behavior.

7.2.1.4 Disturbance Reactions and Behavioral Response

Reactions to sound, if any, depend on state of maturity, experience, current activity, reproductive state, time of day, environmental conditions, and many other factors (Richardson et al. 1995). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a short distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, which is not anticipated in the proposed seismic program, impacts on the animals could be significant. Given the many uncertainties in predicting the quantity and types of impacts of sound on sea otters, it is common practice to estimate how many animals were present within a particular distance of industrial activities, or exposed to a particular level of industrial sound to assess behavioral disturbance. However, this procedure likely overestimates the numbers of otters that are affected in some biologically important manner.

The sound criteria used to estimate how many sea otters might be disturbed to some biologically important but unknown degree by a seismic program are based on behavioral observations during studies of several species. However, information is largely lacking for many species including those species likely to occur
in the project areas. Detailed studies have been done on other species found elsewhere in Alaska waters including gray whales, bowhead whales, and ringed seals. The criteria established for these marine mammals, which are applied to others are conservative and have not been demonstrated to significantly affect individuals or populations of marine mammals in Alaska waters. Therefore, the effect of the 3D seismic program on the behavior of sea otters should be no more than negligible for reasons stated earlier.

Pinnipeds frequently do not avoid the area within a few hundred meters of operating airgun arrays, even for airgun arrays much larger than that planned for the proposed project (e.g., Harris et al. 2001). Sea otters were monitored along the California coast during seismic activity. When sea otters were exposed to the noise pulses, no disturbance was documented as the ship past as close as 1.85 and 0.9 km. Foraging otters continued to dive and feed, and no reactions were observed among otters rafting, grooming, swimming, mating or interacting with pups. Some rafting otters showed interest in the boat. Observations were made nearshore. There are no data on otter responses at distance > 400 m offshore (as reviewed in Richardson et al. 1995).

Sea otter reactions to the planned seismic surveys are expected to be very localized and confined to relatively small distances and durations, with no long-term effects on individuals or populations. Otters are only exposed to underwater noise while foraging, which comprises only about 40% of daily activity (Tinker et al. 2007), thus the level of exposure is further limited by these short dives. The planned seismic surveys will not likely affect sea otters because the proposed project is located outside of critical habitat, and mitigation measures described in Section 11 will be implemented to reduce the impacts from noise associated with the seismic activity on sea otters.

7.2.1.5 Strandings and Mortality

There is no evidence in the literature that airgun pulses can cause serious injury, death, or stranding of marine mammals even in the case of larger airgun arrays than planned for the proposed program (76 FR 58473). Although sea otters may spend their entire lives in water they are capable of spending time on land and transitioning easily between land and water; thus, stranding would not be an issue for otters.

7.2.2 Effects of Noise from Additional Petition Activities

7.2.2.1 Vessel Disturbance

Vessels will be used for support and transport during Petition activities. Worldwide, vessels are major contributors to increased ocean noise levels (Andrew et al. 2002, McDonald et al. 2006). Sound levels and frequency produced by vessels are generally related to the size and speed of the vessel; however, the primary sound sources from vessels are propeller cavitation, propeller singing and propulsion or other machinery (Richardson et al. 1995). Section 6.2.1 describes sound levels from noise associated with vessel activity in Cook Inlet.

Marine mammal responses to vessels are generally associated with noise and depend on changes in the engine and propeller speed (Richardson et al. 1995). Visual cues may contribute to marine mammal’s reactions to nearby vessels (Richardson et al. 1995). A detailed review of marine mammal responses to vessels is available in Richardson et al. (1995).

Sea otters’ response to vessels is highly variable. There are few systematic studies on sea otter responses to vessel disturbance. As with other marine mammals, visual cues and sound generated by the vessel as well as the behavioral state of the animal contribute to the type of response (USFWS 2013a). Sea otters’ responses to vessels include, but are not limited to, no reaction and diving or traveling away from the source.
Sea otters in groups (e.g., rafting) may disperse (reviewed in USFWS 2013a); however, rafting otters have showed interest in a boat passing within a few 100 m (reviewed in Richardson et al. 1995). Sea otters often show no reaction to boats approaching or transiting through an area; however, there are observations of sea otters avoiding areas with heavy vessel traffic, but returning during the seasons when vessel traffic is less frequent. Curland (1997) observed sea otters traveling greater distances in areas with vessel disturbance than areas without. Sea otters on land have also been observed moving into the water when small boats approach within 100 m of the shore (reviewed in Richardson et al. 1995).

The risk of vessel activity threatening the recovery of the Southwest Alaska DPS of northern sea otters is unlikely to be significant (USFWS 2013a). Therefore, vessel noise associated with the proposed project is not anticipated to adversely affect sea otters in the action area. To minimize the effects of noise associated with vessel activity on sea otters in the area, Hilcorp Alaska will follow NMFS’s Marine Mammal Viewing Guidelines and Regulations (NMFS undated).

### 7.2.2.2 Aircraft Disturbance

Helicopters, drones, and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for these types of aircraft generally are <500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported that received sound levels in-water from aircraft flying at an altitude of 152 m (500 ft) were 109 dB re 1 μPa for a Bell 212 helicopter, and 101 dB re 1 μPa for a small fixed-wing aircraft. Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles >13° from vertical, much of the sound is reflected and does not penetrate (Richardson et al. 1995). Duration of underwater sound from passing aircraft is much shorter in-water than air; for example, a helicopter passing at an altitude of 152 m (500 ft), audible in air for 4 minutes, may be detectable underwater for 38 seconds at 3 m (10 ft) depth, and 11 seconds at 18 m (59 ft) depth (Richardson et al. 1995). During Hilcorp Alaska Petition activities, helicopters may support operations by transporting supplies and personnel to the vessels. Helicopters may make one to three flights per day during the program from shore bases in Kenai, Nikiski, Homer, or Anchorage.

Marine mammal response to aircraft noise varies with aircraft type, altitude, and flight pattern. As with vessels, visual cues are likely involved with the marine mammal reactions to aircraft presence. There are few studies on sea otter responses to aircraft disturbance. It is likely sea otter would react similarly to aircraft disturbance as pinnipeds. Reactions to aircraft noise and/or sight of the aircraft by pinnipeds hauled out on land or ice include increased vigilance and/or rushing into the water. The presence of aircraft can also trigger stampedes causing increase pup mortality due to crushing or pup abandonment. Responses from pinnipeds in-water to aircraft presence may include diving. Pinnipeds react more if the aircraft flies at low altitudes, passes directly overhead or there are changes in aircraft sound. Helicopters may have more of an effect on pinnipeds’ reactions; however, more studies on sound pressure levels are needed (reviewed in Richardson et al. 1995). Bodkin and Udevitz (1999), observed sea otters diving, swimming away from the aircraft or swimming erratically in the presence of the aircraft during an aerial survey. Aircraft is not likely to adversely affect sea otters present in the action area and mitigation measure will be implemented to reduce impacts of aircraft noise.

### 7.2.2.3 Sonar Systems

The proposed geohazard surveys will use acoustic equipment including a single and multibeam echosounder, sidescan sonar, and high- and low-resolution sub-bottom profiler, to obtain a variety of bathymetric data and seafloor profiles. These instruments have the potential to emit sounds which could
cause disturbances to marine mammals including hearing impairment, masking, and behavioral responses. Northern sea otters have a functional hearing range of 60 Hz to 39 kHz with highest sensitivity between 2 and 16 kHz (NMFS 2016; Ghoul and Reichmuth 2011). The single and multibeam echosounders and the sidescan sonar do not produce frequencies within the hearing range of sea otters that could occur in the project area, therefore exposure to sound frequencies generated by this equipment does not present a risk of potential physiological damage, hearing impairment, or behavioral responses. High- and low-resolution sub-bottom profilers produce sound frequencies of 2-24 kHz and 1-4 kHz, respectively, and would be audible to sea otters within the project area, potentially causing behavioral responses. Although animals would not likely be exposed to strong enough signals for extended times such that PTS would occur it is possible that sea otters under the vessel, or swimming in the same direction at the same speed, could be affected. If responses occur, they are expected to be short term and have negligible overall individual or population-level biological consequences.

7.2.2.4 Exploratory Drilling

Literature suggests that pinnipeds may be tolerant of underwater industrial sounds, and they are less sensitive to lower frequency sounds. Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris et al. 2001; Reiser et al. 2009). Southall et al. (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound and reported that the limited data suggest exposures between ~90 and 140 dB re 1 μPa rms generally do not appear to induce strong behavioral responses in pinnipeds exposed to nonplused sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies of pinnipeds responding to nonplused exposures in water, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded more strongly at lower levels than did animals in the field. Again, contextual issues are the likely cause of this difference.

7.2.2.5 Pile Driving

A drive pipe is a relatively short, large-diameter pipe driven into the sediment prior to the drilling of oil wells, which serves to support the initial sedimentary part of the well by preventing the looser surface layer from collapsing and obstructing the wellbore. During Petition activities, AGDC proposes to conduct vibratory and impact pile driving associated with MOF and PLF construction, and Hilcorp Alaska proposes to drive approximately 60 m of 76.2-cm pipe at each proposed well site prior to drilling. Drive pipes are installed using pile driving techniques, and proposed equipment for use during Petition activities includes a Delmar D62-22 impact hammer (or similar) which produces impulsive noise, and a vibratory hammer. Blackwell (2005) measured the noise produced by a Delmar D62–22 driving 91.4-cm (36-in) steel pipe in Cook Inlet and found that sound pressure levels exceeded 190 dB re 1mPa-m (rms) at about 60 m (200 ft), 180 dB re 1mPa-m (rms) at about 250 m (820 ft), and 160 dB re 1mPa-m (rms) at just less than 1.9 km (1.2 mi). Noise-producing activity during pipe driving will consist of intermittent hammering over 1-3 days, and it is anticipated that sea otters will move away from any sound disturbance caused by this short-term pipe driving or become habituated by it.

7.2.2.6 Dredging

For the proposed Alaska LNG Petition activities, dredging would be conducted over two ice free seasons with minor maintenance dredging over the remaining five to seven years of the Alaska LNG plant
construction. Various types of dredging equipment would be used, including either an excavator or clamshell (both mechanical dredges), and either a hydraulic (cutter head) or mechanical dredger. From the transition water depth to water depths of the -10.6 m or -13.7 m (-35 ft or -45 ft) MLLW, a trailing suction hopper dredger would be used to excavate a trench for the pipeline. Alternative burial techniques, such as plowing, backhoe dredging, or clamshell dredging, would be considered if conditions become problematic for the dredger. After installation of the nearshore pipelines, a jet sled or mechanical burial sled could be used to achieve post dredge burial depths.

Dredging emits low frequency sound (typically below 1 kHz), and although slight behavioral effects and masking may occur, noise from dredging is not likely to cause any damage to northern sea otter auditory systems (Todd et al. 2015). Further, the proposed dredging area is situated north of Kalgin Island in waters where northern sea otters have not been observed to date, therefore we may assume that noise from dredging will negligibly impact otters.
8.0  DESCRIPTION OF IMPACT ON SUBSISTENCE USES

The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

8.1  SUBSISTENCE USES

Petition activities would occur closest to subsistence areas used by Tyonek, Nikiski, Seldovia, Port Graham, Kenai, Anchorage and Nanwalek. Residents of Seldovia, Port Graham, and Nanwalek are the primary subsistence harvesters of the lower Kenai Peninsula. Under the MMPA, Alaska Native residing in coastal areas are allowed to harvest marine mammals for subsistence purposes at any time of the year. Subsistence resources provide more than dietary benefits. They also provide materials for personal and family use, and sharing resources helps maintain traditional family organization (Boraas 2013). Harbor seals, sea lions and sea otters are the most commonly harvested species by the communities discussed below and there are no harvest limits imposed for these species.

8.1.1  Marking, Tagging and Reporting Program Harvest

Federal data for subsistence harvest of sea otters in southwest Alaska are collected by a mandatory Marking, Tagging and Reporting Program (MTRP) administered by the USFWS since 1989.

Unpublished updates to the MTRP data through 2017 were provided to Fairweather Science from USFWS on February 5, 2018. Between the years 1989 and 2017, Alaska Natives harvested a total of 879 sea otters hunting from the community of Homer, while Port Graham reported 228, Seldovia 127, Kenai 51 (includes Soldotna records), and Nanwalek 39 animals harvested (USFWS MTRP unpublished data; Figure 17). Anchorage and Ninilchik sea otter harvest totals were recorded up to 2014, and Anchorage reported a total of 8, and Ninilchik 16 animals harvested from 1989-2014 (USFWS MTRP unpublished data). The mean reported annual subsistence take of sea otters from all hunt origins in or near Petition region from 1989-2017 (includes Homer, Port Graham, Seldovia, Nanwalek, and Kenai) is 46 total animals per year (USFWS MTRP unpublished data).

The majority of harvest (83%) of sea otters from the Southwest stock occurs in the Kodiak Archipelago, not in areas of project activities (Muto et al. 2016a,b). The mean reported annual subsistence take during the past five complete calendar years (2006 to 2010) was 293 animals (Muto et al. 2016a,b). The number of sea otters harvested for subsistence in Cook Inlet is relatively small compared to other areas. The majority of the harvest has occurred in northern and eastern Prince William Sound and not in Tribes within Cook Inlet.
8.1.2 Alaska Department of Fish and Game Subsistence Division

The ADF&G conducted a study to support the Alaska LNG Project to document the harvest and use of wild resources by residents of communities on the east and west side of Cook Inlet (Jones et al. 2015; Jones and Kostick 2016). Data on wild resource harvest and use were collected, including basic information about who, what, when, where, how, and how much wild resources are being used to develop fishing and hunting opportunities for Alaska residents (Table 29). Tyonek was surveyed in 2013 (Jones et al. 2015), and Nanwalek, Port Graham, Seldovia, and Nikiski were surveyed in 2014 (Jones and Kostick 2016). Kenai, Anchorage, and Ninilchik were not included in the scope of these surveys. Additionally, the last surveys conducted in Kenai and Ninilchik were in 2008 and 1998, respectively, and these data are considered too old for this analysis. Marine mammals were harvested by four (Nikiski, Seldovia, Nanwalek, Port Graham) of the five communities surveyed but at relatively low rates (Table 29). The harvests consisted of harbor seals, Steller sea lions, and northern sea otters. Sea otters are the only species presented in this table.

Marine mammals are harvested in low numbers in the communities closest to the middle Cook Inlet activities (Nikiski and Tyonek). Higher marine mammal harvest occurs in the communities that are not accessible by the road system of Seldovia, Nanwalek, and Port Graham (Table 29). In general, residents of Seldovia, Port Graham and Nanwalek harvest seals, sea lions, and sea otters around Yukon Island and Tutka Bay (Wolfe et al. 2008). Species of direct consumption importance to the communities of Port Graham and Nanwalek are sea lions and harbor seals. Sea otters are used in handicrafts and harvested for populations control purposes due to their impact on shellfish populations (Stantek 1985).
Table 29. Northern sea otter harvest by Tyonek in 2013 and Nikiski, Port Graham, Seldovia, and Nanwalek in 2014.

<table>
<thead>
<tr>
<th>Village</th>
<th>Households Attempting Harvest number (% of residents)</th>
<th>Number of Northern Sea Otter(s) Harvested</th>
<th>Percent Northern Sea Otter Harvest</th>
<th>Percent Households Using Northern Sea Otter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyonek¹</td>
<td>0 (0 %)</td>
<td>0</td>
<td>0 (0 %)</td>
<td>0 (0 %)</td>
</tr>
<tr>
<td>Nikiski²</td>
<td>0 (0 %)</td>
<td>0</td>
<td>0 (0 %)</td>
<td>0 (0 %)</td>
</tr>
<tr>
<td>Seldovia²</td>
<td>2 (1 %)</td>
<td>3</td>
<td>33 (33%)</td>
<td>1.1 (1.1%)</td>
</tr>
<tr>
<td>Nanwalek²</td>
<td>17 (7 %)</td>
<td>1</td>
<td>4 (4%)</td>
<td>1.8 (1.8%)</td>
</tr>
<tr>
<td>Port Graham²</td>
<td>27 (18 %)</td>
<td>24</td>
<td>59 (59%)</td>
<td>7.3 (7.3%)</td>
</tr>
</tbody>
</table>

1 Jones et al. 2015  
2 Jones and Kostick 2016

Tyonek, on the western side of lower Cook Inlet, has a subsistence harvest area that extends from the Susitna River south to Tuxedni Bay (BOEM 2016). Moose and salmon are the most important subsistence resources measured by harvested weight (Stanek 1994). Data from the ADF&G survey, Tyonek and Nikiski did not report harvest of northern sea otters. One male otter carcass was found on the beach at Ninilchik, but the animal had been subsistence harvested [skinned] and may have been killed elsewhere (Doroff and Badajos 2010).

In Seldovia, 33% of the marine mammal harvest reported was northern sea otter although harbor seals made up the entirety of the pounds useable weight as sea otters are not eaten. Sea otters are used for fur only and are not consumed. Sea otter harvest in 2014 occurred in January; approximately three sea otters were harvested. A harvest map of marine mammals was not produced by the ADF&G for the community of Seldovia but anticipated hunt and harvest activities are close to shore in protected bays near Seldovia.

In Nanwalek, for fur only, one sea otter, or 4% of the total marine mammal harvest, was harvested by a Nanwalek household in the month of May (2014). In Port Graham, sea otters comprised 59% of the total marine mammal harvest in 2014.

In 2014, Port Graham households harvested approximately 24 sea otters and all that attempted to harvest sea otters were successful (5% of the households). Like the other communities, sea otters were harvested for their fur only. In Port Graham, 24 sea otters were harvested in November and December 2014. Port Graham residents hunted and harvested marine mammals, including sea otters close to the community in Port Graham Bay but also traveled south. Search and harvest areas outside of the immediate vicinity of Port Graham Bay included the coast south of Nanwalek and Point Bede and into Koyuktoklik Bay. Additional hunting and harvesting sites were document at the mouth of Seldovia Bay north of Port Graham as well as in waters of Cook Inlet northeast and northwest of the community of Nanwalek. Hunt and harvest areas are close to shore and concentrated near the community and therefore no interaction with Petition activities are expected.
Figure 18. Subsistence use areas by community from ADF&G in the Petition region. Species are not differentiated in these data.
8.2 POTENTIAL IMPACTS ON AVAILABILITY FOR SUBSISTENCE USES

Section 101(a)(5)(A) of the MMPA requires USFWS to determine that the taking would not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. USFWS has defined ‘‘unmitigable adverse impact’’ in 50 CFR 216.103 as an impact resulting from the specified activity: (1) that is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) causing the marine mammals to abandon or avoid hunting areas; (ii) directly displacing subsistence users; or (iii) placing physical barriers between the marine mammals and the subsistence hunters; and (2) that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Petition activities could result in disturbances of marine mammals including sea otters within the Petition region. Activities that could impact sea otter subsistence harvest patterns include seafloor disturbance and habitat alteration as sea otters depend on these resources, discharges, noise, physical presence, and vessel and aircraft traffic. Although Petition activities could have minor impacts as a result of the potential impacts listed above, the impacts are expected to be short-term and localized.

Direct impacts to subsistence resources from noise may result in altered distributions of sea otters, and as a consequence, the altered availability of the sea otters to subsistence harvesters. Noise may impact subsistence harvest patterns by temporarily displacing or deflecting the sea otters. Indirect effects from underwater noises may be that subsistence harvesters need to alter their locations, timing, or levels of effort to harvest the amounts necessary for subsistence. Sea otters may be most affected, and consequently not be available at traditional harvest locations or at times when subsistence hunting occurs.

Data show that sea otter harvest typically occurs in the winter and early spring: 2014 harvest in Seldovia occurred in January, in Nanwalek in May and in Port Graham between November and December. The timing and location of the proposed activities and the timing and location of subsistence harvest activities and patterns, as reported through the MTRP (Jones and Kostick 2016; Jones et al. 2015) indicate that Petition activities will not interfere with sea otter hunting and harvest effort. Noise impacts to subsistence harvest patterns are expected to be short-term and localized, and thus minor.

Areas used by the residents of Seldovia, Port Graham, and Nanwalek are located more than 29 km (18 mi) south of proposed activities and any associated zones of influence due to the generation of underwater sound during operations. It is unlikely that sea otter subsistence activities would occur offshore where Petition activities are centralized. Additionally, harvest of sea otters per community was low compared to other species of marine mammals such as harbor seals, and sea otters are not harvested for consumption. While Petition activities would occur within the traditional area for hunting marine mammals, no relevant subsistence uses of marine mammals would be impacted. The impact of operations is unlikely to affect any sea otter sufficient to render it unavailable for subsistence harvest in the future. For these reasons, we conclude that these activities will not impact the availability of sea otters for subsistence harvest in Cook Inlet. In addition, mitigation measures would be implemented to ensure protection of sea otter habitat.
9.0 DESCRIPTION OF IMPACT ON MARINE MAMMAL HABITAT

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

9.1 IMPACTS ON LOWER COOK INLET HABITAT

Lower Cook Inlet spans southwest from the Forelands to the inlet mouth between English Bay and Cape Douglas. The Alaska Coastal Current circulates nutrient-rich water northward along the Kenai Peninsula shore to upper Cook Inlet, where mixing with freshwater occurs as the current turns westward (Field and Walker 2003; Minerals Management Service [MMS] 1996). In central lower Cook Inlet water depth ranges from approximately 60 to 80 m (197 to 262 ft; Muench et al. 1978). Bottom sediment is composed of coarse gravel and sand, transitioning southwardly into mud and fine grain sand (Bouma et al. 1978).

9.1.1 Seafloor Disturbance

The sediment structure and high nutrient upwelling rate in lower Cook Inlet support a rich diversity of benthic invertebrates, though species generally occur at low abundances. (Saupe et al. 2005; Field and Walker 2003). Benthic communities are dominated by polychaetes, bivalves, and flatfish (Field and Walker 2003). Otters primarily feed on benthic invertebrates, including; mussels, crabs, urchins, sea cucumbers, and clams. Doroff et al. (2010) found Kachemak Bay sea otter diet composition to consist of about 41% mussels, 32% crabs, and 12% clams, and diet was shown to shift in the fall season to include a higher proportion of mussels and clams (75-80% of diet). Razor clams (*Siliqua patula*) occur in intertidal zones and are found throughout Kenai Peninsula beaches. Red sea cucumbers and sea urchins, found among shell debris, are also important otter prey.

Hilcorp Alaska proposed to drive approximately 60 m (196 ft) of 76.2-cm (30-in) pipe at 2-4 well sites per year, as well as utilize a jack-up rig for exploratory purposes, which would result in some seafloor disturbance and temporary increases in water column turbidity. Seafloor disturbance would occur in the area where the three legs of the rig are established and where the actual well would be drilled. The casing would be in place only during drilling activities at each potential well location, and the total footprint of the wells represents a negligible fraction of the entire area of Cook Inlet and available sea otter foraging habitat. Potential damage to the Cook Inlet benthic community will be limited to pipe driving area and the actual surface area that form the ‘foot’ of each leg; therefore, the presence of the jack-up rig and associated pipe driving operations is not expected to result in any direct loss of sea otter habitat.

9.1.2 Drilling Discharges

Hilcorp Alaska Petition activities may result in drilling-related discharges, which are permitted under Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category [40 CFR part 435]), include drilling fluids and drill cuttings, deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blowdown, fire control system test water, uncontaminated ballast water, bilge water, excess cement slurry, mud cuttings cement at sea floor, and completion fluids. Mud cuttings will be constantly tested. Hydrocarbon-contaminated muds will be hauled offsite. Non-drilling wastewater, which his permitted under the APDES, includes deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blowdown, fire control test water, bilge water, noncontact cooling water, and uncontaminated ballast water. Solid waste (e.g., packaging, domestic trash) will be classified, segregated, labeled, and stored in containers at designated accumulation areas until it can be packaged and transported to an approved onshore disposal facility.
Discharging drill cuttings or other liquid waste streams generated by the drilling rig could potentially affect marine mammal habitat. Toxins could persist in the water column, which could have an impact on marine mammal prey species. However, despite a considerable amount of investment in research on exposures of marine mammals to organochlorines or other toxins, no marine mammal deaths in the wild can be conclusively linked to the direct exposure to such substances (O’Shea et al. 1999). Drilling muds and cuttings discharged to the seafloor can lead to localized increased turbidity and increase in background concentrations of barium and occasionally other metals in sediments and may affect lower trophic organisms. Effects on benthic communities are nearly always restricted to a zone within about 100 to 150 m (328 to 492 ft) of the discharge, where cuttings accumulations are greatest. No water quality impacts are anticipated from permitted discharges that would negatively affect habitat for sea otters.

9.1.3 Petroleum Release

During Hilcorp Alaska Petition activities, large and small quantities of hazardous materials, including diesel fuel and gasoline, would be handled, transported, and stored following the rules and procedures described in the Spill Prevention, Control, and Countermeasure (SPCC) Plan. Spills and leaks of oil or wastewater arising from the Project activities that reach marine waters could result in direct impacts to the health of exposed marine mammals. Individual marine mammals could show acute irritation or damage to their eyes, blowhole or nares, and skin; fouling of baleen, which could reduce feeding efficiency; and respiratory distress from the inhalation of vapors (Geraci and St. Aubin 1990). Long-term impacts from exposure to contaminants to the endocrine system could impair health and reproduction (Geraci and St. Aubin 1990). Ingestion of contaminants could cause acute irritation to the digestive tract, including vomiting and aspiration into the lungs, which could result in pneumonia or death (Geraci and St. Aubin 1990).

Indirect impacts from spills or leaks could occur through the contamination of lower-trophic-level prey, which could reduce the quality and/or quantity of marine-mammal prey. In addition, individuals that consume contaminated prey could experience long-term effects to health (Geraci and St. Aubin, 1990).

9.1.4 Other Discharges

All vessels with toilet facilities must have Type II or Type III marine sanitation devices (MSDs) that comply with 40 CFR 140 and 33 CFR 159 for sanitary wastes. A Type II MSD macerates waste solids so that the discharge contains <150 milligrams per liter (mg/L) of suspended solids and a bacteria count <200 per 100 milliliters (mL). Type III MSDs are more commonly used systems designed to retain or treat the sanitary waste until it can be disposed of at proper onshore facilities. State and local governments regulate domestic and gray water discharges that consist of materials discharged from sinks, showers, laundries, safety showers, eyewash stations, hand-wash stations, and galleys. Gray water discharges are not regulated outside the state’s territory.

9.1.5 Invasive Species

Vessels can impact habitat quality for marine mammals through the introduction of aquatic invasive organisms. Construction vessel traffic would arrive from Asia and could potentially transport non-native tunicates, green crab (Carcinus maenas), and Chinese mitten crab (Eriocheir sinensis) (ADF&G 2002), which impact food webs and can outcompete native invertebrates, resulting in habitat degradation.

All vessels brought into the State of Alaska or federal waters are subject to USCG 33 CFR 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Management of ballast water discharge is regulated by federal regulations (33 CFR 151.2025) that prohibit discharge of untreated ballast
water into the waters of the United States unless the ballast water has been subject to a mid-ocean ballast water exchange (at least 200 nm offshore). Vessel operators are also required to remove “fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations” (33 CFR 151.2035(a)(6). Adherence to the USCG 33 CFR 151 regulations would reduce the likelihood of Project-related vessel traffic introducing aquatic invasive species.

9.1.6 Potential Impacts on Food Sources from Sound Generation

Otters forage frequently in water depths of ≤ 40 m, thus nearshore areas play the most important role in supporting these animals. Only a small fraction of the potentially available habitat in Cook Inlet would be impacted by noise from the proposed Petition activities at any given time during Petition activities. Furthermore, the constant movement of vessels and the short duration of sound sources would result in short-term, temporary, and very localized acoustic impacts on prey species. No adverse impacts on benthic populations would be expected due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortalities or impacts that might occur because of operations is negligible compared to the naturally occurring high reproductive and mortality rates.

9.2 IMPACTS ON MIDDLE COOK INLET HABITAT

Middle Cook Inlet is defined as the portion of the Cook Inlet waterbody that is north of the Forelands extending to Susitna/Point Progression and has an average water depth of 18.3 m (60 ft) between the Forelands and Fire Island (MMS 2000). The Susitna and Knik Arm rivers contribute substantially to the glacial sediment found in Cook Inlet. Cook Inlet is influenced by strong rip tides which reverse in middle/upper Cook Inlet, exposing approximately 100 km² (38.6 mi²) of mudflats on the return flow (Oey et al. 2007). Northern sea otters do not occur in middle Cook Inlet, nor in any further northward upper regions of Cook Inlet; thus, Petition activities, including Hilcorp Alaska, Harvest Alaska, and Alaska LNG occurring in this region would have no impacts which would affect important habitat used by these animals.
10.0 DESCRIPTION OF IMPACT FROM LOSS OR MODIFICATION TO HABITAT

The proposed Petition activities will not result in any permanent impact on habitats used by sea otters, or to their food sources. Any impacts to prey resources is considered minor or negligible, and no long-term effects would occur.

Short-term turbidity is a water quality effect of most in-water work, including installing piles. A study conducted during pile driving measured water quality before, during, and after pile removal and pile replacement (Roni and Weitkamp 1996) and found that construction activity at the site had “little or no effect on dissolved oxygen, water temperature, and salinity”, and turbidity (measured in nephelometric turbidity units [NTU]) at all depths nearest the construction activity was typically less than 1 NTU higher than stations farther from the construction area throughout construction. No sea otters are expected to be close enough to the pile driving activity to experience turbidity. Coupled with the fact that Cook Inlet currently carries a heavy sediment load naturally in the water column, the impact from increased turbidity levels is expected to be discountable to marine mammals.

For Hilcorp Alaska activities, bottom disturbance would occur in the area where the three legs (14 m [46 ft] diameter) of the rig would be set down and where the actual well would be drilled (the well casing would be a 76-cm [30-in] diameter pipe extending from the seafloor to the rig floor). The casing would be in place only during drilling activities at each potential well location. The total area of disturbance calculated by other operators in Cook Inlet was 0.54 acres. For all proposed four exploratory well locations, the collective 3.24-acre footprint of the wells represents a very small fraction of the entire Cook Inlet.

Dredging and dredge spoil placement would temporarily impact the benthic resources within the dredging and spoils footprint. However, few benthic resources are expected where the dredging would occur. Indirect impacts are primarily caused by ensonification of habitat from noise; all sound produced by Petition activities will be localized and short term. The acoustic environment created by the seismic activity could, however, result in habitat displacement for otters choosing to avoid the higher noise levels.

Because invertebrate prey important to sea otters (e.g., mussels, clams, and crabs) have neither auditory systems nor swim bladders, they are not expected to be negatively affected by sound. There is little evidence of invertebrate hearing, or reaction to high noise levels, in literature (Hawkins and Popper 2012). A 1994 study on Dungeness crabs (*Cancer magister*) showed no effects to larvae exposed to an SPL of 231 dB re 1 µPa at 1 m (3.05 ft; Pearson et al. 1994), and Christian et al. (2004) found that snow crabs (*Chionoecetes opilio*) exposed to seismic noise showed no significant evidence health or behavioral impacts.

Ensonification from Petition activities should have no more than a negligible effect on sea otter habitat because:

- No studies have demonstrated that industry noise affects the life stages, condition, or amount of food resources (benthic invertebrates) comprising habitats used by otters. Christian et al. (2004) reported a reduced speed of egg development in Dungeness crabs exposed to an SPL of 221 dB re 1 µPa at 1 m (3.05 ft). Thus, the proposed survey would have little, if any, impact on sea otters feeding in the area where Petition activities is planned.
• The specific project activities within the Petition region covers a small percentage of the potentially available habitat used by otters in Cook Inlet allowing them to move away from any Petition activity sounds to feed, rest, or conduct other elements of their life history.

• Thus, Petition activities are not expected to have any habitat-related effects that could cause significant or long-term consequences for individual otters or their populations, because operations will be limited in duration, location, timing, and intensity.
11.0 MEASURES TO REDUCE IMPACTS TO MARINE MAMMALS

The availability and feasibility [economic and technological] of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The Applicants will implement a robust monitoring and mitigation program for marine mammals using USFWS-approved Protected Species Observers (PSOs) for Petition activities. Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the ITRs promulgated by USFWS. The Applicants recognize some details of the monitoring and mitigation may change upon receipt of the individual LOAs issued by NMFS each year. Specific mitigation measures will depend on the specific project.

11.1 HILCORP ALASKA AND HARVEST ALASKA

11.1.1 Description of Exclusion and Safety Zones

The Exclusion Zone (EZ) is defined as the area in which all operations are shut down in the event a marine mammal enters or is about to enter this zone. For activities included in this Petition, there are different EZs depending on the species and sound source. The EZ for sea otters is based on USFWS requirements which are different than NMFS for Level A. The Safety Zone (SZ) is an area larger than the EZ and is defined as the area within which operations may power down in the event a sea otter enters, is about to enter or may be considered a Level B harassment.

The distances for the EZ and SZ for the activities are summarized in Table 30 and described in the following text.

1) The distances to the Level A thresholds for the 2D/3D seismic activity were calculated using the methods described in Section 6 and the Level B is based on Apache field-verified distance (81 FR 47239). The EZ is rounded up to 50 m and the SZ is 7,300 m.

2) The distances to the Level A and B thresholds for the vibratory sheet pile driving were calculated using the methods described in Section 6. The EZ is rounded up to 50 m and the SZ is rounded up to 100 m.

3) The distances to the thresholds for the sub-bottom profiler were calculated using the methods described in Section 6. The EZ is rounded up to 50 m and the SZ is 3,000 m.

4) The distances to the Level A thresholds for the pipe driving were calculated using methods described in Section 6 and the distance to the Level B is based on Illingworth & Rodkin (2014) measurements of 55 m to the 190 dB zone and 1,600 m to the 160 dB zone. The EZ is 55 m and the SZ is 1,600 m.

5) The distances to the Level A thresholds for the VSP are based on Illingworth & Rodkin (2014) m measurements of 120 m to the 190 dB threshold and 2.47 km to the 160 dB threshold. The EZ is 120 m and the SZ is rounded up to 2.5 km.

6) The distances to the Level A thresholds for the water jet were calculated using methods described in Section 6 and the distance to the Level B is based on Austin (2017) measurements of 860 m to the 120 dB zone. The EZ is rounded up to 15 m and the SZ is rounded up 50 m.

7) The distance to the Level A thresholds for the hydraulic grinder was calculated using methods described in Section 6 of the ITR Petition. The EZ is rounded up to 15 m and the SZ is rounded up 50 m.
8) The distance to the Level B threshold for the tugs towing the rig was calculated using methods described in Section 6 of the ITR Petition. There is no EZ and the SZ is rounded up to 25 m.

### Table 30. Radii of exclusion zone and safety zone for Hilcorp Alaska and Harvest Alaska activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Exclusion Zone Radius</th>
<th>Safety Zone Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D/3D seismic survey</td>
<td>50 m</td>
<td>7,300 m</td>
</tr>
<tr>
<td>Vibratory sheet pile driving</td>
<td>50 m</td>
<td>100 m</td>
</tr>
<tr>
<td>Sub-bottom profiler</td>
<td>50 m</td>
<td>3,000 m</td>
</tr>
<tr>
<td>Pipe driving</td>
<td>55 m</td>
<td>1,600 m</td>
</tr>
<tr>
<td>Vibratory sheet pile driving</td>
<td>50 m</td>
<td>100 m</td>
</tr>
<tr>
<td>Water jet</td>
<td>15 m</td>
<td>50 m</td>
</tr>
<tr>
<td>Hydraulic grinder</td>
<td>15 m</td>
<td>50 m</td>
</tr>
<tr>
<td>Tugs towing rig</td>
<td>N/A</td>
<td>25 m</td>
</tr>
</tbody>
</table>

11.1.2 Sound Source Verification Survey

When site-specific measurements are not available for noise sources of concern for acoustic exposure, USFWS often requires an SSV to characterize the sound levels, propagation, and to verify the monitoring zones (EZ and SZ). Hilcorp Alaska plans to perform an SSV for the 3D seismic survey in lower Cook Inlet. Hilcorp Alaska will work with NMFS to determine if an SSV is needed for other activities occurring in the Petition region. AGDC may perform an SSV for the different sizes of pile types and pile if required by NMFS, but because sea otters are not commonly observed in the Alaska LNG Project area, an SSV is not planned for USFWS.

11.1.3 Aircraft Mitigation Measures

To minimize the possibility of adverse effects from aircraft noise on marine mammals, Hilcorp Alaska will ensure that helicopters used to transport equipment and personnel will maintain an altitude of 304 m (1,000 ft) as practicable when transiting over Cook Inlet waters. Practicability is determined by the pilot in command. Conditions that would make it impracticable to maintain this altitude may include: adverse weather conditions, safety considerations, and reduced flight time (e.g., very short platform to platform flights do not have the time to reach 1,000 ft).

11.1.4 Seismic and Geohazard Survey Mitigation Measures

For the 2D survey, PSOs will be stationed on the source vessel during all seismic operations and geohazard surveys when the sub-bottom profilers are used. Because of the proximity to land, PSOs may also be stationed on land to augment the viewing area. For the 3D survey, PSOs will be stationed on at least two of the project vessels, the source vessel and the chase vessel. For the VSP, PSOs will be stationed on the drilling rig. For geohazard surveys, PSOs will be stationed on the survey vessel. The viewing area may be augmented by placing PSOs on a vessel specifically for mitigation purposes or using UAS. PSOs will implement the following mitigation measures.

11.1.4.1 Clearing the Exclusion Zone

Prior to the start of daily seismic, geohazard surveys, or when activities have been stopped for longer than a 30 minute period, the PSOs will clear the EZ for a period of 30 minutes. Clearing the EZ means no marine mammals have been observed within the EZ for that 30 minute period. If any marine mammals have been observed within the EZ, ramp up cannot start until the marine mammal has left the EZ or has not been observed for a 30-minute period.
11.1.4.2 Power Down Procedure

A power down procedure involves reducing the number of airguns in use, which reduces the EZ or SZ radius. In contrast, a shut down procedure occurs when all airgun activity is suspended immediately. During a power down, a mitigation airgun is operated. Operation of the mitigation gun allows the size of the EZ to decrease to the size of the SZ for marine mammals. If a marine mammal is detected outside the safety radius (either SZ or EZ) but is likely to enter that zone, the airguns may be powered down before the animal is within the safety radius, as an alternative to a complete shutdown. Likewise, if a marine mammal is already within the SZ when first detected, the airguns will be powered down if this is a reasonable alternative to an immediate shutdown. If a marine mammal is already within the EZ when first detected, the airguns will be shut down immediately.

Following a power down, airgun activity will not resume until the marine mammal has cleared the SZ. The animal will be considered to have cleared the SZ if it:

- Is visually observed to have left the SZ, or
- Has not been seen within the SZ for 15 min in the case of pinnipeds, sea otters, and harbor porpoise, or
- Has not been seen within the SZ for 30 min in the case of cetaceans.

11.1.4.3 Shut Down Procedure

A shut down occurs when all airgun or sub-bottom profilers activity is suspended. The operating airguns or profiler will be shut down completely if a marine mammal approaches the EZ. The shut down procedure will be accomplished within several seconds (of a “one shot” period) of the determination that a marine mammal is either in or about to enter the EZ.

Following a shut down, airgun or sub-bottom profiler activity will not resume until the marine mammal has cleared the EZ. The animal will be considered to have cleared the EZ if it:

- Is visually observed to have left the EZ, or
- Has not been seen within the EZ for 15 min in the case of pinnipeds, sea otters, and harbor porpoise, or
- Has not been seen within the EZ for 30 min in the case of cetaceans.

11.1.4.4 Ramp Up and Power Up Procedures

A “ramp up” procedure gradually increases airgun volume at a specified rate. Ramp up is used at the start of airgun operations, including after a power down, shut down, and after any period greater than 10 minutes in duration without airgun operations. USFWS normally requires that the rate of ramp up be no more than 6 dB per 5-minute period. Ramp up will begin with the smallest gun in the array that is being used for all airgun array configurations. During the ramp up, the EZ for the full airgun array will be maintained.

If the complete EZ has not been visible for at least 30 minutes prior to the start of operations, ramp up will not commence unless the mitigation gun has been operating during the interruption of seismic survey operations. This means that it will not be permissible to ramp up the 24-gun source from a complete shut down in thick fog or at other times when the outer part of the EZ is not visible. Ramp up of the airguns will not be initiated if a marine mammal is sighted within or near the EZ at any time.
The following information has been included from NMFS’ Biological Opinion to Lease Sale 244. Figure 19 shows a flow diagram indicating some seismic exploration mitigation measures under various scenarios described in mitigation measures 2c-2j in the NMFS Biological Opinion to Lease Sale 244.

11.1.4.5 Speed or Course Alteration

If a marine mammal is detected outside the EZ and, based on its position and relative motion, is likely to enter the EZ, the vessel’s speed and/or direct course may, when practical and safe, be changed. This technique also minimizes the effect on the seismic program. This technique can be used in coordination with a power down procedure. The marine mammal activities and movements relative to the seismic and support vessels will be closely monitored to ensure that the marine mammal does not approach within the EZ. If the mammal appears likely to enter the EZ, further mitigative actions will be taken, i.e., either further course alterations, power down, or shut down of the airguns.

11.1.5 Pipe and Sheet Pile Driving Mitigation Measures

Soon after the drill rig is positioned on the well head, the conductor pipe will be driven as the first stage of the drilling operation. Two PSOs (one operating at a time) will be stationed aboard the rig during this two to three day operation monitoring an EZ of 1.6-km (1-mi). The impact hammer operator will be notified to shutdown hammering operations at the approach of a marine mammal to the EZ. A ramp up of the hammering will begin at the start of each hammering session. The ramp-up procedure involves initially starting with three soft strikes, 30 seconds apart. This delayed-strike start alerts marine mammals of the pending hammering activity and provides them time to vacate the area. Monitoring will occur during all hammering sessions.

A dock face will be constructed on the rock causeway in Iniskin Bay. Two PSOs will be stationed either on a vessel or land during the 14-21 day operation to monitor the SZ and EZ. PSOs will implement similar monitoring and mitigation strategies as the pipe installation.

Figure 19. A flow diagram of suggested mitigation gun procedures in the NMFS Biological Opinion to Lease Sale 244.
For impact hammering, "soft-start" technique shall be used at the beginning of each day's pipe/pile driving activities or if pipe/pile driving has ceased for more than one hour to allow any marine mammal that may be in the immediate area to leave before pile driving reaches full energy.

- The EZ will be cleared 30 minutes prior to a soft-start to ensure no marine mammals are within or entering the EZ.
- Begin impact hammering soft-start with an initial set of three strikes from the impact hammer at 40% energy, followed by a one minute waiting period, then two subsequent 3-strike sets.
- Immediately shut down all hammers at any time a marine mammal is detected entering or within the EZ. Hammering operations will not begin until the EZ has been visually inspected for at least 30 minutes to ensure the absence of marine mammals.
- Initial hammering starts will not begin during periods of poor visibility (e.g., night, fog, wind).
- Any shut-down due to a marine mammal sighting within the EZ must be followed by a 30-minute all-clear period and then a standard, full ramp-up.
- Any shut-down for other reasons resulting in the cessation of the sound source for a period greater than 30 minutes, must also be followed by full ramp-up procedures

11.1.6 Water Jet and Hydraulic Grinder Measures

A PSO will be present on the dive support vessel when divers are using the water jet or hydraulic grinder. Prior to in-water use of the water jet, an EZ of 860 m around the DSV will be established. They hydraulic grinder use, an EZ of 250 m will be established. The water jet or hydraulic grinder will be shut down if marine mammals are observed within the EZ.

11.1.7 Tugs Towing Rig Measures

Two PSOs will be stationed on one of the tugs when the drilling rig is being towed to the site. The tugs are not able to shut down operations, but can reduce power to reduce sound levels if marine mammals are sighted within the EZ.

11.2 ALASKA LNG PROJECT

The activities of most concern regarding noise harassment to marine mammals include vibratory and impact pile driving. Pile driving is considered a discreet, non-routine action with the potential for Level A harassment. Anchor handling is of short duration and allows ample time for marine mammals to move away from the stimulus. Implementation of mitigation measures for anchor handling, such as shutdown zones, is impractical because to ensure safety and sound constructability of the pipeline, the process cannot be stopped once it has begun. Thus, mitigation measures are focused on pile driving. The Applicant will perform an SSV at the beginning of the pile driving to characterize the sound levels associated with different pile and hammer types, as well as to establish the marine mammal monitoring and mitigation zones.

The primary means of minimizing impacts to marine mammals include:

- Establishing shutdown safety zones for pile driving to ensure marine mammals are not injured by noise levels exceeding Level A injury thresholds.
- Establishing shutdown safety zones for pile driving to ensure listed marine mammals are not injured by noise levels exceeding Level B injury thresholds.
- Ensuring the observation area is clear of marine mammals before starting.
• Soft starting the impact hammer (low energy initial strikes), thereby alerting marine mammals of impending hammering noise and allowing them to vacate the general area before they become exposed to harassing sound levels.

• Measures detailed in the Project Waste Management Plan provided in Resource Report No. 8, Appendix J, would be implemented, including:
  o Proper handling and disposal of any food wastes including use of bear-proof dumpsters at Project locations.
  o Proper handling, removal, and disposal of any animal carcasses.
  o Management procedures for the control and containment of waste containers and food.

• All Project-related vessels would comply with USCG 33 CFR 151 for ballast water discharge.

• Oil spill response plans for vessel groundings or other accidental releases of oil would be implemented.

11.2.1 Protected Species Observers

PSOs would be used during anchor handling activities to identify any sea otters that may come into proximity of these activities. PSOs would be used for monitoring of marine mammals during anchor handling procedures, which cannot be stopped once the activity has started due to the need to ensure safety and sound constructability of the pipeline. During pile driving, PSOs would be given the authority to immediately stop construction and/or lower sound levels when marine mammals are visible within the various acoustic zones. The location of the PSOs would be determined based on the best vantage point, but would likely be stationed on land near the pile driving activity. The proposed zones are as follows:

Shutdown and harassment zones for pile driving:

• AGDC is proposing a 100-m shut down zone for all pile driving operations to prevent Level A take by injury.

• AGDC is proposing a 2.2 km Level B harassment zone for impact and vibratory pile driving operations based on the calculated distance to the 160 dB threshold for pipe piles.

Anchor handling does not exceed USFWS Level B criteria.

11.2.2 Sound Source Verification Survey

AGDC may perform an SSV for the different sizes of pile types and pile if required by NMFS, but because sea otters are not commonly observed in the Alaska LNG Project area, an SSV is not planned for USFWS.
12.0 ARCTIC PLAN OF COOPERATION

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, you must submit either a plan of cooperation (POC) or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

Regulations at 50 CFR 216.104(a)(12) require applicants for activities that take place in Arctic waters to provide a Plan of Cooperation or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes. USFWS regulations define Arctic waters as waters above 60° N. latitude. Much of Cook Inlet is north of 60° latitude. USFWS makes distinctions between waters in Cook Inlet and waters of the Chukchi and Beaufort Seas.

As presented in Section 8, northern sea otters are harvested by three communities in lower Cook Inlet (Seldovia, Nanwalek, Port Graham) but at relatively low rates. Because the marine mammal subsistence harvest is not substantial in the Petition region, a detailed Plan of Cooperation is not provided.

Because of the short-term, temporary, localized nature of activities, and relatively low marine mammal subsistence harvest, the Applicants concludes that impacts to any marine mammal harvest potential would be negligible.

12.1 HILCORP ALASKA AND HARVEST ALASKA

Hilcorp Alaska has developed a Stakeholder Engagement Plan (SEP) and will implement this plan throughout the duration of the Petition. The SEP will help coordinate activities with local stakeholders and thus subsistence users, minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the subsistence hunts. The Plan is provided in Appendix B.

Presentations will be given at various local forums. Hilcorp Alaska is working with a contractor to update/verify our existing stakeholder list. Meetings and communication will be coordinated with: commercial and sport fishing groups/associations, various Native fisheries and entities as it pertains to subsistence fishing and/or hunting, marine mammal co-management groups, Cook Inlet Regional Citizens Advisory Council, local landowners, government and community organizations, and environmental NGOs.

12.2 ALASKA LNG PROJECT

AGDC has met and would continue to meet with stakeholders throughout Cook Inlet, including many of the villages and traditional councils throughout the Cook Inlet region.
13.0 MONITORING AND REPORTING

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

13.1 MONITORING

13.1.1 Protected Species Observers

The Applicants will implement a robust monitoring and mitigation program for marine mammals using USFWS-approved PSOs for Petition activities. Much of the Hilcorp Alaska activities will use vessel-based PSOs, but land-based or platform-based PSOs may also be used to augment project-specific activities. Much of the Alaska LNG activities will use land-based PSOs during pile driving. Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the ITRs promulgated by USFWS. The Applicants recognize some details of the monitoring and mitigation program may change upon receipt of the individual LOAs issued by USFWS each year.

The main purposes of PSOs are: to conduct visual watches for marine mammals; to serve as the basis for implementation of mitigation measures; to document numbers of marine mammals present; to record any reactions of marine mammals to Petition activities; and, to identify whether there was any possible effect on accessibility of marine mammals to subsistence hunters in Cook Inlet. These observations will provide the real-time data needed to implement some of the key measures.

The specific objectives of the monitoring and mitigation program provide:

- the basis for real-time mitigation, as required by the various permits;
- the information needed to estimate the number of “takes” of marine mammals by harassment, which must be reported to USFWS;
- data on the occurrence, distribution, and activities of marine mammals in the areas where the Petition activity was conducted; and,
- information to compare the distances, distributions, behaviors, and movements of marine mammals relative to the Petition activities.

PSOs will be on watch during all daylight periods for project-specific activities. The observer(s) will watch for marine mammals from the best available vantage point on the vessel or station. Ideally this vantage point is an elevated stable platform from which the PSO has an unobstructed 360° view of the water. The PSOs will scan systematically with the naked eye and with binoculars. When a mammal sighting is made, the following information about the sighting will be carefully and accurately recorded:

- Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the PSO, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace.
- Time, location, speed, activity of the vessel, sea state, ice cover, visibility, and sun glare.
• The positions of other vessel(s) in the vicinity of the PSO location.
• The vessel’s position, speed, water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

An electronic database or paper form will be used to record and collate data obtained from visual observations.

13.2 REPORTING
The results of the PSO monitoring, including estimates of exposure to key sound levels, will be presented in weekly, monthly, and 90-day reports. Reporting will address the requirements established by USFWS in the LOAs. The technical report(s) will include the list below.

• Summaries of monitoring effort: total hours, total distances, and distribution of marine mammals throughout the study period compared to sea state, and other factors affecting visibility and detectability of marine mammals;
• Analyses of the effects of various factors influencing detectability of marine mammals: sea state, number of observers, and fog/glare;
• Species composition, occurrence, and distribution of marine mammal sightings including date, water depth, numbers, age/size/gender categories (when discernable), group sizes, and ice cover;
• Analyses of the effects of seismic program:
  o Sighting rates of marine mammals during periods with and without project activities (and other variables that could affect detectability),
  o Initial sighting distances versus project activity,
  o Closest point of approach versus project activity,
  o Observed behaviors and types of movements versus project activity,
  o Numbers of sightings/individuals seen versus project activity,
  o Distribution around the vessels versus project activity,
  o Summary of implemented mitigation measures, and
  o Estimates of “take by harassment”.

14.0 RESEARCH COORDINATION

| Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects. |

Observations of sea otters, including any observed reactions to the Petition operations will be recorded and reported to USFWS. Further, to ensure that there will be no adverse effects resulting from the planned activities, the Applicants will continue to coordinate with NMFS, BOEM, and other state and federal agencies to assess measures that can be taken to eliminate or minimize any impacts from planned activities.

Prior to the start of any Petition activities, the Applicants will identify other monitoring programs in middle and lower Cook Inlet so that information on species sightings can be shared among programs to minimize impacts. The Applicants are aware of scientific research programs that will be occurring in Cook Inlet in 2019, including two new recent ADF&G grants for continuing acoustic monitoring and photo identification of Cook Inlet beluga whales. Hilcorp Alaska will share sighting information with USFWS, NMFS, and ADF&G to continue to improve information on marine mammal distribution and abundance in lower Cook Inlet.
15.0 REFERENCES


BOEM 2016. Cook Inlet Planning Area Oil and Gas Lease Sale 244 In the Cook Inlet, Alaska Final Environmental Impact Statement Volume 1. Chapters 1-5. Section 3.3.3 : Subsistence Harvest Patterns. https://www.boem.gov/Cook-Inlet-Lease-Sale-244-Final-EIS-Volume-1/


Schneider, K.B. 1976. Assessment of the Abundance and Distribution of Sea Otters along the Kenai Peninsula, Kamishak Bay and the Kodiak Archipelago. OCSEAP Final Reports of Principal Investigators, Vol. 37. Boulder, CO and Anchorage, AK: ISDOC, NOAA and USDOI, BLM.


USFWS unpublished data. Available from USFWS, Marine Mammals Management, Anchorage Regional Office, 1011 E Tudor Road, MS-341, Anchorage, AK 99503.


USGS unpublished data. Available from the USGS Alaska Science Center, 4210 University Drive, Anchorage, AK 99508.


APPENDIX A
HILCORP ALASKA MARINE MAMMAL MONITORING & MITIGATION PLAN
APPENDIX B
HILCORP ALASKA STAKEHOLDER ENGAGEMENT PLAN