DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XD165

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Buccaneer Energy Drilling Activities in Upper Cook Inlet, 2014

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from Buccaneer Alaska Operation, LLC (Buccaneer) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to conducting a multi-well offshore exploratory drilling program in upper Cook Inlet during the 2014 open water season. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to Buccaneer to incidentally take, by Level B harassment only, marine mammals during the specified activity.

DATES: Comments and information must be received no later than May 7, 2014.

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Supervisor, Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing email comments is *ITP.Nachman@noaa.gov.* NMFS is not responsible for email comments sent to addresses other than the one provided here. Comments sent via email, including all attachments, must not exceed a 25-megabyte file size.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.nmfs.noaa.gov/pr/permits/incidental.htm* without change. All Personal Identifying Information (e.g., name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

An electronic copy of the application containing a list of the references used in this document may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**), or visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Candace Nachman, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking, other means of effecting the least practicable impact on the species or stock and its habitat, and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . 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.''

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: ''Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].''

Summary of Request

On August 30, 2013, NMFS received an IHA application from Buccaneer for the taking of marine mammals incidental to a multi-well, multi-year offshore exploratory drilling program in upper Cook Inlet during the 2014 open water season (typically mid-April through October). This request was for 1-year of the program. NMFS determined that the application was adequate and complete on November 25, 2013. However, on February 13, 2014, Buccaneer informed NMFS that a portion of the activity contained in the application is no longer proposed. As described in more detail below, Buccaneer proposes to drill four wells instead of six during this multi-year program.

Buccaneer proposes to drill up to four exploratory wells during this multi-year program and will likely drill up to two wells each year at locations in upper Cook Inlet. The proposed activity for this IHA (if issued) would occur during the open water months in 2014, which is typically from April through October. The following specific aspects of the proposed activities are likely to result in the take of marine mammals: Driving of the conductor pipe; exploratory drilling; towing of the jack-up drill rig; and vertical seismic profiling (VSP). Take, by Level B harassment only, of six marine mammal species is anticipated to result from the specified activity.

Description of the Specified Activity

Overview

Buccaneer proposes to conduct exploratory drilling operations at multiple well sites in upper Cook Inlet during the 2014 summer and fall open water (ice-free) season, using the *Endeavour-Spirit of Independence* (*Endeavour*) jack-up drill rig. The rig will be towed between drilling locations and winter moorage by ocean-going tugs. The activities of relevance to this IHA request include: Mobilization and demobilization of the drill rig to and from the well locations at the start and end of the season; driving of the conductor pipe; exploratory drilling; and VSP seismic operations. Buccaneer proposes to utilize both helicopters and vessels to conduct resupply, crew change, and other logistics during the exploratory drilling program.

Dates and Duration

The 2014 exploratory drilling program (which is the subject of this IHA request) would occur during the 2014 open water season (April 15 through October 31). Drilling will take approximately 30 to 75 days per well, and well testing will take another 7 to 15 days per well. Buccaneer proposes to drill at up to two well locations in 2014 in upper Cook Inlet. During this time period, conductor pipe driving would only occur for a period of 1 to 3 days at each location, and VSP seismic operations would only occur for a period of less than 1 to 2 days at each location. The rig tows will take approximately 2 days to complete during mobilization and demobilization from upper Cook Inlet, and the shorter tow between the two well locations in upper Cook Inlet will take a few hours. This IHA (if issued) would be effective from date of issuance through October 31, 2014.

Specified Geographic Region

Buccaneer's proposed program would occur at up to two of four possible well locations in upper Cook Inlet. The Tyonek Deep well sites are the priority for the 2014 season. However, we are analyzing that activity could occur at either Tyonek Deep #1, Tyonek Deep #2, Southern Cross #1, or Southern Cross #2 to allow for operational flexibility. Figure 1 in Buccaneer's IHA application depicts the location of these four well sites. All of these wells are located in State of Alaska oil and gas leases in Cook Inlet.

Detailed Description of Activities

1. Drill Rig Mobilization and Towing

Buccaneer proposes to conduct the exploratory drilling program using the *Endeavour,* which is an independent leg, cantilevered jack-up drill rig of the *Marathon LeTourneau* Class 116–C and is capable of drilling up to 25,000 ft in water depths from 15–300 ft. Additional specifications can be found in Appendix A of the IHA application. The rig will be towed between drilling locations and winter moorage by ocean-going tugs licensed to operate in Cook Inlet. While under tow, the rig operations will be monitored by Buccaneer and the drilling contractor management, both aboard the rig and onshore.

The jack-up rig would be towed up to three times during the summer and fall seasons of 2014. It is estimated that the longer tows will take 2 days to complete, while the shorter tows between the upper Cook Inlet wells will take but a few hours (distance between the two wells is less than 5 miles).

The rig will be wet-towed by two or three ocean-going tugs licensed to operate in the Cook Inlet. Tugs generate their loudest sounds while towing due to propeller cavitation. While these continuous sounds have been measured at up to 171 dB re 1 μPa-m (rms) at 1-meter source (broadband), they are generally emitted at dominant frequencies of less than 5 kHz (Miles *et al.,* 1987; Richardson *et al.,* 1995, Simmonds *et al.,* 2004). The distance to the 120-dB isopleth, assuming a 171 dB source, is 1,715 feet (523 meters) using Collins *et al.'*s (2007) 171–18.4 Log(R)—0.00188 R spreading model developed from Cook Inlet. For the most part, the dominant noise frequencies from propeller cavitation are significantly lower than the dominant hearing frequencies for pinnipeds and toothed whales, including beluga whales (Wartzok and Ketten, 1999).

2. Conductor Pipe Driving

A conductor pipe is a relatively short, large-diameter pipe driven into the sediment prior to the drilling of oil wells. This section of tubing serves to support the initial sedimentary part of the well, preventing the looser surface layer from collapsing and obstructing the wellbore. The pipe also facilitates the return of cuttings from the drill head. Conductor pipes are usually installed using drilling, pile driving, or a combination of these techniques. In offshore wells, the conductor pipe is also used as a foundation for the wellhead. Buccaneer proposes to drive approximately 300 ft (90 m) of 30-inch conductor pipe at each of the upper Cook Inlet wells prior to drilling using a Delmar D62–22 impact hammer. This hammer has impact weight of 13,640 pounds (6,200 kg) and reaches a maximum impact energy of 165,215 foot-pounds (224 kilonewton-meters) at a drop height of 12 feet (3.6 meters).

Blackwell (2005) measured the noise produced by a Delmar D62–22 driving 36-inch steel pipe in upper Cook Inlet and found sound pressure levels to exceed 190 dB re 1μPa-m (rms) at about 200 ft (60 m), 180 dB re 1μPa-m (rms) at about 820 ft (250 m), and 160 dB re 1μPa-m (rms) at just less than 1.2 mi (1.9 km). Each conductor pipe driving event is expected to last 1 to 3 days, although actual sound generation (pounding) would occur only intermittently during this period.

3. Exploratory Drilling and Standard Operation

The jack-up drilling rig *Endeavour'*s drilling platform and other noise-generating equipment is located above the sea's surface, and there is very little surface contact with the water compared to drill ships and semi-submersible drill rigs; therefore, lattice-legged jack-up drill rigs are relatively quiet (Richardson *et al.,* 1995; Spence *et al.,* 2007).

The *Spartan 151,* the only other jack-up drilling rig operating in the Cook Inlet, was hydro-acoustically measured by Marine Acoustics, Inc. (2011) while operating in 2011. The survey results showed that continuous noise levels exceeding 120 dB re 1μPa extended out only 164 ft (50 m), and that this sound was largely associated with the diesel engines used as hotel power generators.

The *Endeavour* was hydro-acoustically tested during drilling activities by Illingworth and Rodkin (2013a) in May 2013 while the rig was operating at a lower Cook Inlet well site (Cosmopolitan #1). The results from the sound source verification indicated that noise generated from drilling or generators were below ambient sound levels. The generators used on the *Endeavour* are mounted on pedestals specifically to reduce noise transfer through the infrastructure, and they are enclosed in an insulated engine room, which may further have reduced underwater sound transmission to levels below those generated by the *Spartan 151.* Also, as mentioned above, the lattice legs limit transfer of noise generated from the drilling table to the water.

The sound source verification revealed that the submersed deep-well pumps that charge the fire-suppression system and cool the generators (in a closed water system) generate sound levels exceeding 120 dB re 1μPa out a distance of approximately 984 ft (300 m). It was not clear at the time of measurements whether the sound was a direct result of the pumps or was from the systems discharge water falling approximately 40 ft (12 m) from the deck. Thus, after the falling water was enclosed in pipe extending below the water surface in an effort to reduce sound levels, the pump noise levels were re-measured in June 2013 (I&R, 2013b) with results indicating that piping the falling water had a modicum of effect on reducing underwater sound levels; nevertheless, the 120-dB radius still extended out to 853 ft (260 m) in certain directions. Thus, neither drilling operations nor running generators on the *Endeavour* drill rig generate underwater sound levels exceeding 120 dB re 1μPa. However, the *Endeavour'*s submersed deep-well pumps generate continuous sound exceeding 120 dB re 1μPa to a maximum distance of 853 ft (260 m).

4. Vertical Seismic Profiling

Once a well is drilled, accurate follow-up seismic data can be collected by placing a receiver at known depths in the borehole and shooting a seismic airgun at the surface near the borehole. This gathered data provides not only high resolution images of the geological layers penetrated by the borehole but can be used to accurately correlate (or correct) the original surface seismic data. The procedure is known as VSP.

Buccaneer intends to conduct VSP operations at the end of drilling each well using an array of airguns with total volumes of between 600 and 880 cubic inches (in^3). Each VSP operation is expected to last less than 1 or 2 days. Assuming a 1-meter source level of 227 dB re 1μPa (based on manufacturer's specifications) for an 880 in^3 array and using Collins *et al.'*s (2007) transmission loss model for Cook Inlet (227—18.4 Log(R)—0.00188), the 190 dB radius from the source was estimated at 330 ft (100 m), the 180 dB radius at 1,090 ft (332 m), and the 160 dB radius at 1.53 mi (2.46 km).

Illingworth and Rodkin (2013c) measured the underwater sound levels associated with the July 2013 VSP operation using a 720 in^3 array and found sound levels exceeding 160 dB re 1 μPa (rms) extended out 1.54 mi (2.47 km), virtually identical to the modeled distance. The measured radius to 190 dB was 246 ft (75 m) and to 180 dB was 787 ft (240 m). The best fit model for the empirical data was 227—19.75 log(R)—0.0 (I&R 2013c).

5. Helicopter and Supply Vessel Support

Helicopter logistics for project operations will include transportation for personnel, groceries, and supplies. Helicopter support will consist of a twin turbine Bell 212 (or equivalent) helicopter certified for instrument flight rules land and over water operations. Helicopter crews and support personnel will be housed in existing Kenai area facilities. The helicopter will be based at the Kenai 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 1,000 to 1,500 feet above ground level to avoid take of marine mammals (Richardson *et al.,* 1995). At these altitudes, there are not expected to be impacts from sound generation on marine mammals. The aircraft will be dedicated to the drilling operation and will be available for service 24 hours per day. A replacement aircraft will be available when major maintenance items are scheduled.

Major supplies will be staged on-shore at the Kenai OSK Dock. 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. Major supplies will include fuel, drilling water, mud materials, 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. The specific supply vessels have not been identified; however, typical offshore drilling support work vessels are of steel construction with strengthened hulls to give the capability of working in extreme conditions. Additional information about logistics and fuel and waste management can be found in Section 1.2 of Buccaneer's IHA application.

Description of Marine Mammals in the Area of the Specified Activity

The marine mammal species under NMFS's jurisdiction that could occur near the exploratory drilling sites in upper Cook Inlet include two cetacean species, both odontocetes (toothed whales): beluga whale (*Delphinapterus leucas*) and harbor porpoise (*Phocoena phocoena*) and one pinniped species: harbor seal (*Phoca vitulina richardsi*). The marine mammal species that is likely to be encountered most widely (in space and time) throughout the period of the planned surveys is the harbor seal. While killer whales (*Orcinus orca*) and Steller sea lions (*Eumetopias jubatus*) have been sighted in upper Cook Inlet, their occurrence is considered rare in that portion of the Inlet. There have also been a few sightings in the last couple of years of gray whales (*Eschrichtius robustus*) in the upper inlet; however occurrence is rare. Gray whales, killer whales, Steller sea lions, minke whales (*Balaenoptera acutorostrata*), and Dall's porpoises (*Phocoenoides dalli*) are more likely to occur in lower Cook Inlet (where rig towing would occur).

Of these marine mammal species, Cook Inlet beluga whales and the western distinct population segment (DPS) of Steller sea lions are listed as endangered under the Endangered Species Act (ESA). The eastern DPS was recently removed from the endangered species list (78 FR 66139, November 4, 2013) but currently retains its status as ''depleted'' under the MMPA along with the western DPS and Cook Inlet beluga whales.

Despite these designations, Cook Inlet beluga whales and the western DPS of Steller sea lions have not made significant progress towards recovery. Data indicate that the Cook Inlet population of beluga whales has been decreasing at a rate of 1.1 percent annually between 2001 and 2011 (Allen and Angliss, 2013). A recent review of the status of the population indicated that there is an 80% chance that the population will decline further (Hobbs and Shelden 2008). Counts of non-pup Steller sea lions at trend sites in the Alaska western stock increased 11% from 2000 to 2004 (Allen and Angliss, 2013). These were the first region-wide increases for the western stock since standardized surveys began in the 1970s and were due to increased or stable counts in all regions except the western Aleutian Islands. Between 2004 and 2008, Alaska western non-pup counts increased only 3%: eastern Gulf of Alaska (Prince William Sound area) counts were higher and Kenai Peninsula through Kiska Island counts were stable, but western Aleutian counts continued to decline. Johnson (2010) analyzed western Steller sea lion population trends in Alaska and concluded that the overall 2000–2008 trend was a decline 1.5% per year; however, there continues to be considerable regional variability in recent trends (Allen and Angliss, 2013). NMFS has not been able to complete a non-pup survey of the AK western stock since 2008, due largely to weather and closure of the Air Force base on Shemya in 2009 and 2010.

Pursuant to the ESA, critical habitat has been designated for Cook Inlet beluga whales and Steller sea lions. The proposed action falls within critical habitat designated in Cook Inlet for beluga whales but is not within critical habitat designated for Steller sea lions. Buccaneer's Southern Cross and Tyonek Deep well sites occur in areas identified as Area 2 in the critical habitat designation. The wells are located south of the Area 1 critical habitat designation where belugas are particularly vulnerable to impacts due to their high seasonal densities and the biological importance of the area for foraging, nursery, and predator avoidance. Area 2 is based on dispersed fall and winter feeding and transit areas in waters where whales typically appear in smaller densities or deeper waters (76 FR 20180, April 11, 2011).

Buccaneer did not request take of beluga whales or Steller sea lions. Informal consultation pursuant to section 7 of the ESA was conducted for this project, and it was determined that the activity is not likely to adversely affect listed species or critical habitat based upon the nature of the activities and specific mitigation measures to ensure that take of these species or adverse habitat impacts are unlikely. This is discussed further in the ''Proposed Mitigation'' section later in this document.

Other species of mysticetes that have been observed infrequently in lower Cook Inlet include: humpback whale (*Megaptera novaeangliae*) and fin whale (*Balaenoptera physalus*). Because of their infrequent occurrence Cook Inlet, they are not included in this proposed IHA notice. Sea otters also occur in Cook Inlet. However, sea otters are managed by the U.S. Fish and Wildlife Service and are therefore not considered further in this proposed IHA notice. Information summaries for the species for which take is requested is provided next.

Cetaceans

1. Killer Whales

In general, killer whales are rare in upper Cook Inlet, where transient killer whales are known to feed on beluga whales, and resident killer whales are known to feed on anadromous fish (Shelden *et al.,* 2003). The availability of these prey species largely determines the likeliest times for killer whales to be in the area. Between 1993 and 2004, 23 sightings of killer whales were reported in the lower Cook Inlet during aerial surveys by Rugh *et al.* (2005). Surveys conducted over a span of 20 years by Shelden *et al.* (2003) reported 11 sightings in upper Cook Inlet between Turnagain Arm, Susitna Flats, and Knik Arm. No killer whales were spotted during recent surveys by Funk *et al.* (2005), Ireland *et al.* (2005), Brueggeman *et al.* (2007a, 2007b, 2008), or Prevel Ramos *et al.* (2006, 2008). Eleven killer whale strandings have been reported in Turnagain Arm, six in May 1991 and five in August 1993. Therefore, very few killer whales, if any, are expected to approach or be in the vicinity of the action area.

2. Harbor Porpoise

The most recent estimated density for harbor porpoises in Cook Inlet is 7.2 per 1,000 km^2 (Dahlheim *et al.,* 2000) indicating that only a small number use Cook Inlet. Harbor porpoise have been reported in lower Cook Inlet from Cape Douglas to the West Foreland, Kachemak Bay, and offshore (Rugh *et al.,* 2005). Small numbers of harbor porpoises have been consistently reported in upper Cook Inlet between April and October, except for a recent survey that recorded higher than usual numbers (Prevel Ramos *et al.,* 2008). Prevel Ramos *et al.* (2008) reported 17 harbor porpoises from spring to fall 2006, while other studies reported 14 in the spring of 2007 (Brueggeman *et al.* 2007) and 12 in the fall of 2007 (Brueggeman *et al.* 2008). During the spring and fall of 2007, 129 harbor porpoises were reported between Granite Point and the Susitna River; however, the reason for the increase in numbers of harbor porpoise in the upper Cook Inlet remains unclear and the disparity with the result of past sightings suggests that it may be an anomaly. The spike in reported sightings occurred in July, which was followed by sightings of 79 harbor porpoises in August, 78 in September, and 59 in October 2007. It is important to note that the number of porpoises counted more than once was unknown, which suggests that the actual numbers are likely smaller than those reported. In addition, recent passive acoustic research in Cook Inlet by the Alaska Department of Fish and Game and the National Marine Mammal Laboratory have indicated that harbor porpoises occur in the area more frequently than previously thought, particularly in the West Foreland area in the spring (NMFS 2011); however overall numbers are still unknown at this time.

3. Gray Whale

The gray whale is a large baleen whale known to have one of the longest migrations of any mammal. This whale can be found all along the shallow coastal waters of the North Pacific Ocean.

The Eastern North Pacific stock, which includes those whales that travel along the coast of Alaska, was delisted from the ESA in 1994 after a distinction was made between the western and eastern populations (59 FR 31094, June 16, 1994). It is estimated that approximately 18,000 individuals exist in the eastern stock (Allen and Angliss, 2012).

Although observations of gray whales are rare within Cook Inlet, marine mammal observers noted individual gray whales on nine occasions in upper Cook Inlet in 2012 while conducting marine mammal monitoring for seismic survey activities under an IHA NMFS issued to Apache Alaska Corporation: four times in May; twice in June; and three times in July (Apache, 2013). Annual surveys conducted by NMFS in Cook Inlet since 1993 have resulted in a total of five gray whale sightings (Rugh *et al.,* 2005). Although Cook Inlet is not believed to comprise either essential feeding or social ground, and gray whales are typically not observed within upper Cook Inlet, there may be some encounters in lower Cook Inlet during towing activities and perhaps an incidental encounter in the upper Inlet.

4. Minke Whale

Minke whales are the smallest of the rorqual group of baleen whales. There are no population estimates for the North Pacific, although estimates have been made for some portions of Alaska. Zerbini *et al.* (2006) estimated the coastal population between Kenai Fjords and the Aleutian Islands at 1,233 animals. During Cook Inlet-wide aerial surveys conducted from 1993 to 2004, minke whales were encountered only twice (1998, 1999), both times off Anchor Point 16 mi northwest of Homer. A minke whale was also reported off Cape Starichkof in 2011 (A. Holmes, pers. comm.) and 2013 (E. Fernandez and C. Hesselbach, pers. comm.), suggesting this location is regularly used by minke whales, including during the winter. There are no records north of Cape Starichkof, and this species is unlikely to be seen in upper Cook Inlet. There is a chance of encountering this whale during towing operations through lower Cook Inlet.

5. Dall's Porpoise

Dall's porpoise are widely distributed throughout the North Pacific Ocean including Alaska, although they are not found in upper Cook Inlet and the shallower waters of the Bering, Chukchi, and Beaufort Seas (Allen and Angliss, 2013). The Alaskan population has been estimated at 83,400 animals (Allen and Angliss, 2013), making it one of the more common cetaceans in the state. Dall's porpoise have been observed in lower Cook Inlet, including Kachemak Bay and near Anchor Point (Glenn Johnson, pers. comm.), but sightings there are rare. There is only the remote chance that Dall's porpoise might be observed during Buccaneer towing operations through lower Cook Inlet.

Pinnipeds

1. Harbor Seals

Harbor seals inhabit the coastal and estuarine waters of Cook Inlet and are one of the more common marine mammal species in Alaskan waters. Harbor seals are non-migratory; their movements are associated with tides, weather, season, food availability, and reproduction. The major haulout sites for harbor seals are located in lower Cook Inlet, and their presence in the upper inlet coincides with seasonal runs of prey species. For example, harbor seals are commonly observed along the Susitna River and other tributaries along upper Cook Inlet during the eulachon and salmon migrations (NMFS, 2003). During aerial surveys of upper Cook Inlet in 2001, 2002, and 2003, harbor seals were observed 24 to 96 km (15 to 60 mi) south-southwest of Anchorage at the Chickaloon, Little Susitna, Susitna, Ivan, McArthur, and Beluga Rivers (Rugh *et al.,* 2005). Montgomery *et al.* (2007) recorded over 200 haulout sites in lower Cook Inlet alone. However, only a few dozen to a couple hundred seals seasonally occur in upper Cook

Inlet (Rugh *et al.,* 2005), mostly at the mouth of the Susitna River where their numbers vary in concert with the spring eulachon and summer salmon runs (Nemeth *et al.,* 2007, Boveng *et al.,* 2012). Montgomery *et al.* (2007) also found seals elsewhere in Cook Inlet to move in response to local steelhead and salmon runs. However, aerial surveys conducted in June 2013 for the proposed Susitna Dam project noted nearly 700 harbor seals in the Susitna Delta region (Alaska Energy Authority, 2013). Harbor seals may be encountered during rig tows to and from Cape Starichkof, and possibly during drilling in upper Cook Inlet.

As mentioned previously, take of marine mammals listed under the ESA will not occur because of mitigation measures to ensure no take of those species. Buccaneer's application contains information on the status, distribution, seasonal distribution, and abundance of each of the species under NMFS jurisdiction mentioned in this document. Please refer to the application for that information (see **ADDRESSES**). Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The Alaska 2012 SAR is available on the Internet at: *http://www.nmfs.noaa.gov/pr/sars/pdf/ak2012.pdf*.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that the types of stressors associated with the specified activity (e.g., driving of the conductor pipe; exploratory drilling; towing of the jack-up drill rig; and VSP) have been observed to or are thought to impact marine mammals. This section may include a discussion of known effects that do not rise to the level of an MMPA take (for example, with acoustics, we may include a discussion of studies that showed animals not reacting at all to sound or exhibiting barely measurable avoidance). The discussion may also include reactions that we consider to rise to the level of a take and those that we do not consider to rise to the level of a take. This section is intended as a background of potential effects and does not consider either the specific manner in which this activity will be carried out or the mitigation that will be implemented or how either of those will shape the anticipated impacts from this specific activity. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analysis'' section will include the analysis of how this specific activity will impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, the ''Mitigation'' section, and the ''Anticipated Effects on Marine Mammal Habitat'' section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

The likely or possible impacts of the proposed drilling program in upper Cook Inlet on marine mammals could involve both non-acoustic and acoustic stressors. Potential non-acoustic stressors could result from the physical presence of the equipment and personnel. Petroleum development and associated activities introduce sound into the marine environment. Impacts to marine mammals are expected to primarily be acoustic in nature. Potential acoustic effects on marine mammals relate to sound produced by drilling activity, conductor pipe driving, and rig towing, as well as the VSP airgun array.

Acoustic Impacts

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms have been derived using auditory evoked potentials, anatomical modeling, and other data, Southall *et al.* (2007) designate ''functional hearing groups'' for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low frequency cetaceans (13 species of mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 30 kHz;
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High frequency cetaceans (eight species of true porpoises, six species of river dolphins, Kogia, the franciscana, and four species of cephalorhynchids): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz;
- Phocid pinnipeds in Water: Functional hearing is estimated to occur between approximately 75 Hz and 100 kHz; and
- Otariid pinnipeds in Water: Functional hearing is estimated to occur between approximately 100 Hz and 40 kHz.

As mentioned previously in this document, six marine mammal species (five cetacean and one phocid pinniped) may occur in the exploratory drilling area or in the rig tow area. Of the five cetacean species likely to occur in the proposed project area and for which take is requested, two are classified as low-frequency cetaceans (i.e., minke and gray whales), one is classified as a mid-frequency cetacean (i.e., killer whale), and two are classified as a high-frequency cetaceans (i.e., harbor and Dall's porpoises) (Southall *et al.,* 2007). A species' functional hearing group is a consideration when we analyze the effects of exposure to sound on marine mammals.

1. Tolerance

Numerous studies have shown that underwater sounds from industry activities are often readily detectable by marine mammals in the water at distances of many kilometers. Numerous studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response to industry activities of various types (Miller *et al.,* 2005; Bain and Williams, 2006). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound such as airgun pulses or vessels under some conditions, at other times mammals of all three types have shown no overt reactions (e.g., Malme *et al.,* 1986; Richardson *et al.,* 1995; Madsen and Mohl, 2000; Croll *et al.,* 2001; Jacobs and Terhune, 2002; Madsen *et al.,* 2002; Miller *et al.,* 2005). Weir (2008) observed marine mammal responses to seismic pulses from a 24 airgun array firing a total volume of either 5,085 in^3 or 3,147 in^3 in Angolan waters between August 2004 and May 2005. Weir recorded a total of 207 sightings of humpback whales (n = 66), sperm whales (n = 124), and Atlantic spotted dolphins (n = 17) and reported that there were no significant differences in encounter rates (sightings/hr) for humpback and sperm whales according to the airgun array's operational status (i.e., active versus silent). The airgun arrays used in the Weir (2008) study were much larger than the array proposed for use during the limited VSP (total discharge volumes of 600 to 880 in^3 for 1 to 2 days per well). In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al.* (1995b) found that vessel noise does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al.* (1995b) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels.

2. Masking

Masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, avoiding predators, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000). Masking, or auditory interference, generally occurs when sounds in the environment are louder than, and of a similar frequency as, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

Masking occurs when anthropogenic sounds and signals (that the animal utilizes) overlap at both spectral and temporal scales. The sounds generated by the proposed equipment for the exploratory drilling program will consist of low frequency sources (most under 500 Hz). Lower frequency man-made sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey noise. There is little concern regarding masking near the jack-up rig during exploratory drilling operations, as the species most likely to be found in the vicinity are mid- to high-frequency cetaceans or pinnipeds and not low-frequency cetaceans. Additionally, masking is not expected to be a concern from airgun usage due to the brief duration of use (less than a day to up to 2 days per well) and the low-frequency sounds that are produced by the airguns. However, at long distances (over tens of kilometers away), due to multipath propagation and reverberation, the durations of airgun pulses can be ''stretched'' to seconds with long decays (Madsen *et al.,* 2006), although the intensity of the sound is greatly reduced.

This could affect communication signals used by low frequency mysticetes when they occur near the noise band and thus reduce the communication space of animals (e.g., Clark *et al.,* 2009) and cause increased stress levels (e.g., Foote *et al.,* 2004; Holt *et al.,* 2009); however, no baleen whales are expected to occur within the proposed action area in the upper Inlet. A few may be encountered in the lower Inlet during the rig towing. Marine mammals are thought to sometimes be able to compensate for masking by adjusting their acoustic behavior by shifting call frequencies, and/or increasing call volume and vocalization rates. For example, blue whales are found to increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio and Clark, 2010). The North Atlantic right whales (*Eubalaena glacialis*) exposed to high shipping noise increase call frequency (Parks *et al.,* 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller *el al.,* 2000). Additionally, beluga whales have been known to change their vocalizations in the presence of high background noise possibly to avoid masking calls (Au *et al.,* 1985; Lesage *et al.,* 1999; Scheifele *et al.,* 2005). Although some degree of masking is inevitable when high levels of manmade broadband sounds are introduced into the sea, marine mammals have evolved systems and behavior that function to reduce the impacts of masking. Structured signals, such as the echolocation click sequences of small toothed whales, may be readily detected even in the presence of strong background noise because their frequency content and temporal features usually differ strongly from those of the background noise (Au and Moore, 1988, 1990). The components of background noise that are similar in frequency to the sound signal in question primarily determine the degree of masking of that signal.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as the usual types of masking studies might suggest (Richardson *et al.,* 1995). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio. In the cases of higher frequency hearing by the bottlenose dolphin, beluga whale, and killer whale, empirical evidence confirms that masking depends strongly on the relative directions of arrival of sound signals and the masking noise (Penner *et al.,* 1986; Dubrovskiy, 1990; Bain *et al.,* 1993; Bain and Dahlheim, 1994). Toothed whales, and probably other marine mammals as well, have additional capabilities besides directional hearing that can facilitate detection of sounds in the presence of background noise. There is evidence that some toothed whales can shift the dominant frequencies of their echolocation signals from a frequency range with a lot of ambient noise toward frequencies with less noise (Au *et al.,* 1974, 1985; Moore and Pawloski, 1990; Thomas and Turl, 1990; Romanenko and Kitain, 1992; Lesage *et al.,* 1999). A few marine mammal species are known to increase the source levels or alter the frequency of their calls in the presence of elevated sound levels (Dahlheim, 1987; Au, 1993; Lesage *et al.,* 1993, 1999; Terhune, 1999; Foote *et al.,* 2004; Parks *et al.,* 2007, 2009; Di Iorio and Clark, 2009; Holt *et al.,* 2009).

These data demonstrating adaptations for reduced masking pertain mainly to the very high frequency echolocation signals of toothed whales. There is less information about the existence of corresponding mechanisms at moderate or low frequencies or in other types of marine mammals. For example, Zaitseva *et al.* (1980) found that, for the bottlenose dolphin, the angular separation between a sound source and a masking noise source had little effect on the degree of masking when the sound frequency was 18 kHz, in contrast to the pronounced effect at higher frequencies. Directional hearing has been demonstrated at frequencies as low as 0.5–2 kHz in several marine mammals, including killer whales (Richardson *et al.,* 1995a). This ability may be useful in reducing masking at these frequencies. In summary, high levels of sound generated by anthropogenic activities may act to mask the detection of weaker biologically important sounds by some marine mammals. This masking may be more prominent for lower frequencies. For higher frequencies, such as that used in echolocation by toothed whales, several mechanisms are available that may allow them to reduce the effects of such masking.

3. Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (in both nature and magnitude) an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately pre-disposed to respond to certain sounds in certain ways; Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of a sound to biologically relevant sounds in the animal's environment (i.e., calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007). Individuals (of different age, gender, reproductive status, etc.) among most populations will have variable hearing capabilities and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (i.e., proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone.

Exposure of marine mammals to sound sources can result in (but is not limited to) no response or any of the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; avoidance; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification have the potential to be biologically significant if the change affects growth, survival, or reproduction. Examples of significant behavioral modifications include:

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

Detailed studies regarding responses to anthropogenic sound have been conducted on humpback, gray, and bowhead whales and ringed seals. Less detailed data are available for some other species of baleen whales, sperm whales, small toothed whales, and sea otters. The following sub-sections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the different sensitivities of marine mammal species to sound. However, baleen whales are unlikely to occur in the vicinity of the well sites and are only somewhat likely to occur in the lower portions of Cook Inlet during rig towing activities.

Baleen Whales—Richardson *et al.* (1995a) reported changes in surfacing and respiration behavior and the occurrence of turns during surfacing in bowhead whales exposed to playback of underwater sound from drilling activities. These behavioral effects were localized and occurred at distances up to 1.2–2.5 mi (2–4 km).

Richardson *et al.* (2008) reported a slight change in the distribution of bowhead whale calls in response to operational sounds on BP's Northstar Island. The southern edge of the call distribution ranged from 0.47 to 1.46 mi (0.76 to 2.35 km) farther offshore, apparently in response to industrial sound levels. This result however, was only achieved after intensive statistical analyses, and it is not clear that this represented a biologically significant effect.

Richardson *et al.* (1995a) and Moore and Clarke (2002) reviewed a few studies that observed responses of gray whales to aircraft. Cow-calf pairs were quite sensitive to a turboprop survey flown at 1,000 ft (305 m) altitude on the Alaskan summering grounds. In that survey, adults were seen swimming over the calf, or the calf swam under the adult (Ljungblad *et al.,* 1983, cited in Richardson *et al.,* 1995b and Moore and Clarke, 2002). However, when the same aircraft circled for more than 10 minutes at 1,050 ft (320 m) altitude over a group of mating gray whales, no reactions were observed (Ljungblad *et al.,* 1987, cited in Moore and Clarke, 2002). Malme *et al.* (1984, cited in Richardson *et al.,* 1995b and Moore and Clarke, 2002) conducted playback experiments on migrating gray whales. They exposed the animals to underwater noise recorded from a Bell 212 helicopter (estimated altitude=328 ft [100 m]), at an average of three simulated passes per minute. The authors observed that whales changed their swimming course and sometimes slowed down in response to the playback sound but proceeded to migrate past the transducer. Migrating gray whales did not react overtly to a Bell 212 helicopter at greater than 1,394 ft (425 m) altitude, occasionally reacted when the helicopter was at 1,000–1,198 ft (305–365 m), and usually reacted when it was below 825 ft (250 m; Southwest Research Associates, 1988, cited in Richardson *et al.,* 1995b and Moore and Clarke, 2002). Reactions noted in that study included abrupt turns or dives or both. Green *et al.* (1992, cited in Richardson *et al.,* 1995b) observed that migrating gray whales rarely exhibited noticeable reactions to a straight-line overflight by a Twin Otter at 197 ft (60 m) altitude. Restrictions on aircraft altitude will be part of the proposed mitigation measures (described in the ''Proposed Mitigation'' section later in this document) during the proposed drilling activities, and overflights are likely to have little or no disturbance effects on baleen whales. Any disturbance that may occur would likely be temporary and localized.

Southall *et al.* (2007, Appendix C) reviewed a number of papers describing the responses of marine mammals to non-pulsed sound, such as that produced during exploratory drilling operations. In general, little or no response was observed in animals exposed at received levels from 90–120 dB re 1 μPa (rms). Probability of avoidance and other behavioral effects increased when received levels were from 120–160 dB re 1 μPa (rms). Some of the relevant reviews contained in Southall *et al.* (2007) are summarized next.

Baker *et al.* (1982) reported some avoidance by humpback whales to vessel noise when received levels were 110–120 dB (rms) and clear avoidance at 120–140 dB (sound measurements were not provided by Baker but were based on measurements of identical vessels by Miles and Malme, 1983).

Malme *et al.* (1983, 1984) used playbacks of sounds from helicopter overflight and drilling rigs and platforms to study behavioral effects on migrating gray whales. Received levels exceeding 120 dB induced avoidance reactions. Malme *et al.* (1984) calculated 10%, 50%, and 90% probabilities of gray whale avoidance reactions at received levels of 110, 120, and 130 dB, respectively. Malme *et al.* (1986) observed the behavior of feeding gray whales during four experimental playbacks of drilling sounds (50 to 315 Hz; 21- min overall duration and 10% duty cycle; source levels of 156–162 dB). In two cases for received levels of 100–110 dB, no behavioral reaction was observed. However, avoidance behavior was observed in two cases where received levels were 110–120 dB.

Richardson *et al.* (1990) performed 12 playback experiments in which bowhead whales in the Alaskan Arctic were exposed to drilling sounds. Whales generally did not respond to exposures in the 100 to 130 dB range, although there was some indication of minor behavioral changes in several instances.

McCauley *et al.* (1996) reported several cases of humpback whales responding to vessels in Hervey Bay, Australia. Results indicated clear avoidance at received levels between 118 to 124 dB in three cases for which response and received levels were observed/measured.

Palka and Hammond (2001) analyzed line transect census data in which the orientation and distance off transect line were reported for large numbers of minke whales. The authors developed a method to account for effects of animal movement in response to sighting platforms. Minor changes in locomotion speed, direction, and/or diving profile were reported at ranges from 1,847 to 2,352 ft (563 to 717 m) at received levels of 110 to 120 dB.

Biassoni *et al.* (2000) and Miller *et al.* (2000) reported behavioral observations for humpback whales exposed to a low-frequency sonar stimulus (160- to 330-Hz frequency band; 42-s tonal signal repeated every 6 min; source levels 170 to 200 dB) during playback experiments. Exposure to measured received levels ranging from 120 to 150 dB resulted in variability in humpback singing behavior. Croll *et al.* (2001) investigated responses of foraging fin and blue whales to the same low frequency active sonar stimulus off southern California. Playbacks and control intervals with no transmission were used to investigate behavior and distribution on time scales of several weeks and spatial scales of tens of kilometers. The general conclusion was that whales remained feeding within a region for which 12 to 30 percent of exposures exceeded 140 dB.

Frankel and Clark (1998) conducted playback experiments with wintering humpback whales using a single speaker producing a low-frequency ''M-sequence'' (sine wave with multiple-phase reversals) signal in the 60 to 90 Hz band with output of 172 dB at 1 m. For 11 playbacks, exposures were between 120 and 130 dB re 1 μPa (rms) and included sufficient information regarding individual responses. During eight of the trials, there were no measurable differences in tracks or bearings relative to control conditions, whereas on three occasions, whales either moved slightly away from (n=1) or towards (n=2) the playback speaker during exposure. The presence of the source vessel itself had a greater effect than did the M-sequence playback.

Finally, Nowacek *et al.* (2004) used controlled exposures to demonstrate behavioral reactions of northern right whales to various non-pulse sounds. Playback stimuli included ship noise, social sounds of conspecifics, and a complex, 18-min ''alert'' sound consisting of repetitions of three different artificial signals. Ten whales were tagged with calibrated instruments that measured received sound characteristics and concurrent animal movements in three dimensions. Five out of six exposed whales reacted strongly to alert signals at measured received levels between 130 and 150 dB (i.e., ceased foraging and swam rapidly to the surface). Two of these individuals were not exposed to ship noise, and the other four were exposed to both stimuli. These whales reacted mildly to conspecific signals. Seven whales, including the four exposed to the alert stimulus, had no measurable response to either ship sounds or actual vessel noise.

Baleen whale responses to pulsed sound (e.g., seismic airguns) have been studied more thoroughly than responses to continuous sound (e.g., drill rigs). Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much greater distances (Miller *et al.,* 2005). However, baleen whales exposed to strong noise pulses often react by deviating from their normal migration route (Richardson *et al.,* 1999). Migrating gray and bowhead whales were observed avoiding the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors (Schick and Urban, 2000; Richardson *et al.,* 1999; Malme *et al.,* 1983). Baleen whale responses to pulsed sound however may depend on the type of activity in which the whales are engaged. Some evidence suggests that feeding bowhead whales may be more tolerant of underwater sound than migrating bowheads (Miller *et al.,* 2005; Lyons *et al.,* 2009; Christie *et al.,* 2010).

Results of studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μPa rms range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 2.8–9 mi (4.5–14.5 km) from the source. For the much smaller airgun array used during the VSP survey (total discharge volume between 600 and 880 in^3), the distance to a received level of 160 dB re 1 μPa rms is estimated to be 1.53 mi (2.47 km). Baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and recent studies have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160–170 dB re 1 μPa rms.

Malme *et al.* (1986, 1988) studied the responses of feeding eastern gray whales to pulses from a single 100 in^3 airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50% of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1 μ Pa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast and on observations of the distribution of feeding Western Pacific gray whales off Sakhalin Island, Russia, during a seismic survey (Yazvenko *et al.,* 2007).

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. While it is not certain whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years, certain species have continued to use areas ensonified by airguns and have continued to increase in number despite successive years of anthropogenic activity in the area. Gray whales continued to migrate annually along the west coast of North America despite intermittent seismic exploration and much ship traffic in that area for decades (Appendix A in Malme *et al.,* 1984). In any event, the brief exposures to sound pulses from the proposed airgun source (the airguns will only be fired for a few hours at a time over the course of 1 to 2 days per well) are highly unlikely to result in prolonged effects.

Toothed Whales—Most toothed whales have the greatest hearing sensitivity at frequencies much higher than that of baleen whales and may be less responsive to low-frequency sound commonly associated with oil and gas industry exploratory drilling activities. Richardson *et al.* (1995a) reported that beluga whales did not show any apparent reaction to playback of underwater drilling sounds at distances greater than 656–1,312 ft (200–400 m). Reactions included slowing down, milling, or reversal of course after which the whales continued past the projector, sometimes within 164–328 ft (50–100 m). The authors concluded (based on a small sample size) that the playback of drilling sounds had no biologically significant effects on migration routes of beluga whales migrating through pack ice and along the seaward side of the nearshore lead east of Point Barrow in spring.

At least six of 17 groups of beluga whales appeared to alter their migration path in response to underwater playbacks of icebreaker sound (Richardson *et al.,* 1995a). Received levels from the icebreaker playback were estimated at 78–84 dB in the ⅓-octave band centered at 5,000 Hz, or 8–14 dB above ambient. If beluga whales reacted to an actual icebreaker at received levels of 80 dB, reactions would be expected to occur at distances on the order of 6.2 mi (10 km). Finley *et al.* (1990) also reported beluga avoidance of icebreaker activities in the Canadian High Arctic at distances of 22–31 mi (35–50 km). In addition to avoidance, changes in dive behavior and pod integrity were also noted. However, no icebreakers will be used during this proposed program.

Patenaude *et al.* (2002) reported changes in beluga whale diving and respiration behavior, and some whales veered away when a helicopter passed at ≤820 ft (250 m) lateral distance at altitudes up to 492 ft (150 m). However, some belugas showed no reaction to the helicopter. Belugas appeared to show less response to fixed-wing aircraft than to helicopter overflights.

In reviewing responses of cetaceans with best hearing in mid-frequency ranges, which includes toothed whales, Southall *et al.* (2007) reported that combined field and laboratory data for mid-frequency cetaceans exposed to non-pulse sounds did not lead to a clear conclusion about received levels coincident with various behavioral responses. In some settings, individuals in the field showed profound (significant) behavioral responses to exposures from 90–120 dB, while others failed to exhibit such responses for exposure to received levels from 120–150 dB. Contextual variables other than exposure received level, and probable species differences, are the likely reasons for this variability. Context, including the fact that captive subjects were often directly reinforced with food for tolerating noise exposure, may also explain why there was great disparity in results from field and laboratory conditions—exposures in captive settings generally exceeded 170 dB before inducing behavioral responses. A summary of some of the relevant material reviewed by Southall *et al.* (2007) is next.

Buckstaff (2004) reported elevated dolphin whistle rates with received levels from oncoming vessels in the 110 to 120 dB range in Sarasota Bay, Florida. These hearing thresholds were apparently lower than those reported by a researcher listening with towed hydrophones. Morisaka *et al.* (2005) compared whistles from three populations of Indo-Pacific bottlenose dolphins. One population was exposed to vessel noise with spectrum levels of approximately 85 dB/Hz in the 1- to 22-kHz band (broadband received levels approximately 128 dB) as opposed to approximately 65 dB/Hz in the same band (broadband received levels approximately 108 dB) for the other two sites. Dolphin whistles in the noisier environment had lower fundamental frequencies and less frequency modulation, suggesting a shift in sound parameters as a result of increased ambient noise.

Morton and Symonds (2002) used census data on killer whales in British Columbia to evaluate avoidance of non-pulse acoustic harassment devices (AHDs). Avoidance ranges were about 2.5 mi (4 km). Also, there was a dramatic reduction in the number of days ''resident'' killer whales were sighted during AHD-active periods compared to pre- and post-exposure periods and a nearby control site.

Monteiro-Neto *et al.* (2004) studied avoidance responses of tucuxi (*Sotalia fluviatilis*), a freshwater dolphin, to Dukane® Netmark acoustic deterrent devices. In a total of 30 exposure trials, approximately five groups each demonstrated significant avoidance compared to 20 pinger off and 55 no-pinger control trials over two quadrats of about 0.19 mi² (0.5 km²). Estimated exposure received levels were approximately 115 dB.

Awbrey and Stewart (1983) played back semi-submersible drillship sounds (source level: 163 dB) to belugas in Alaska. They reported avoidance reactions at 984 and 4,921 ft (300 and 1,500 m) and approach by groups at a distance of 2.2 mi (3.5 km; received levels were approximately 110 to 145 dB over these ranges assuming a 15 log R transmission loss). Similarly, Richardson *et al.* (1990) played back drilling platform sounds (source level: 163 dB) to belugas in Alaska. They conducted aerial observations of eight individuals among approximately 100 spread over an area several hundred meters to several kilometers from the sound source and found no obvious reactions. Moderate changes in movement were noted for three groups swimming within 656 ft (200 m) of the sound projector.

Two studies deal with issues related to changes in marine mammal vocal behavior as a function of variable background noise levels. Foote *et al.* (2004) found increases in the duration of killer whale calls over the period 1977 to 2003, during which time vessel traffic in Puget Sound, and particularly whale-watching boats around the animals, increased dramatically. Scheifele *et al.* (2005) demonstrated that belugas in the St. Lawrence River increased the levels of their vocalizations as a function of the background noise level (the ''Lombard Effect'').

Several researchers conducting laboratory experiments on hearing and the effects of non-pulse sounds on hearing in mid-frequency cetaceans have reported concurrent behavioral responses. Nachtigall *et al.* (2003) reported that noise exposures up to 179 dB and 55-min duration affected the trained behaviors of a bottlenose dolphin participating in a temporary threshold shift (TTS) experiment. Finneran and Schlundt (2004) provided a detailed, comprehensive analysis of the behavioral responses of belugas and bottlenose dolphins to 1-s tones (received levels 160 to 202 dB) in the context of TTS experiments. Romano *et al.* (2004) investigated the physiological responses of a bottlenose dolphin and a beluga exposed to these tonal exposures and demonstrated a decrease in blood cortisol levels during a series of exposures between 130 and 201 dB. Collectively, the laboratory observations suggested the onset of a behavioral response at higher received levels than did field studies. The differences were likely related to the very different conditions and contextual variables between untrained, free-ranging individuals vs. laboratory subjects that were rewarded with food for tolerating noise exposure.

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but, in general, there seems to be a tendency for most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing. Nonetheless, there have been indications that small toothed whales sometimes move away or maintain a somewhat greater distance from the vessel when a large array of airguns is operating than when it is silent (e.g., Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003). The beluga may be a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 6.2–12.4 mi (10–20 km) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 6.2–12.4 mi (10–20 km) (Miller *et al.,* 2005).

Observers stationed on seismic vessels operating off the United Kingdom from 1997–2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone, 2003; Gordon *et al.,* 2004). Killer whales were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. The displacement of the median distance from the array was approximately 0.5 km (0.3 mi) or more. Killer whales also appear to be more tolerant of seismic shooting in deeper water.

Captive bottlenose dolphins and beluga whales exhibit changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.,* 2002, 2005). However, the animals tolerated high received levels of sound (p–p level >200 dB re 1 μPa) before exhibiting aversive behaviors.

Pinnipeds—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 approximately 90 and 140 dB generally do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies, 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.

Jacobs and Terhune (2002) observed harbor seal reactions to AHDs (source level in this study was 172 dB) deployed around aquaculture sites. Seals were generally unresponsive to sounds from the AHDs. During two specific events, individuals came within 141 and 144 ft (43 and 44 m) of active AHDs and failed to demonstrate any measurable behavioral response; estimated received levels based on the measures given were approximately 120 to 130 dB.

Costa *et al.* (2003) measured received noise levels from an Acoustic Thermometry of Ocean Climate (ATOC) program sound source off northern California using acoustic data loggers placed on translocated elephant seals. Subjects were captured on land, transported to sea, instrumented with archival acoustic tags, and released such that their transit would lead them near an active ATOC source (at 939-m depth; 75-Hz signal with 37.5-Hz bandwidth; 195 dB maximum source level, ramped up from 165 dB over 20 min) on their return to a haul-out site. Received exposure levels of the ATOC source for experimental subjects averaged 128 dB (range 118 to 137) in the 60- to 90-Hz band. None of the instrumented animals terminated dives or radically altered behavior upon exposure, but some statistically significant changes in diving parameters were documented in nine individuals. Translocated northern elephant seals exposed to this particular non-pulse source began to demonstrate subtle behavioral changes at exposure to received levels of approximately 120 to 140 dB.

Kastelein *et al.* (2006) exposed nine captive harbor seals in an approximately 82 × 98 ft (25 × 30 m) enclosure to non-pulse sounds used in underwater data communication systems (similar to acoustic modems). Test signals were frequency modulated tones, sweeps, and bands of noise with fundamental frequencies between 8 and 16 kHz; 128 to 130 [± 3] dB source levels; 1- to 2-s duration [60–80 percent duty cycle]; or 100 percent duty cycle. They recorded seal positions and the mean number of individual surfacing behaviors during control periods (no exposure), before exposure, and in 15-min experimental sessions (n = 7 exposures for each sound type). Seals generally swam away from each source at received levels of approximately 107 dB, avoiding it by approximately 16 ft (5 m), although they did not haul out of the water or change surfacing behavior. Seal reactions did not appear to wane over repeated exposure (i.e., there was no obvious habituation), and the colony of seals generally returned to baseline conditions following exposure. The seals were not reinforced with food for remaining in the sound field.

Potential effects to pinnipeds from aircraft activity could involve both acoustic and non-acoustic effects. It is uncertain if the seals react to the sound of the helicopter or to its physical presence flying overhead. Typical reactions of hauled out pinnipeds to aircraft that have been observed include looking up at the aircraft, moving on the ice or land, entering a breathing hole or crack in the ice, or entering the water. Ice seals hauled out on the ice have been observed diving into the water when approached by a low-flying aircraft or helicopter (Burns and Harbo, 1972, cited in Richardson *et al.,* 1995a; Burns and Frost, 1979, cited in Richardson *et al.,* 1995a). Richardson *et al.* (1995a) note that responses can vary based on differences in aircraft type, altitude, and flight pattern.

Blackwell *et al.* (2004a) observed 12 ringed seals during low-altitude overflights of a Bell 212 helicopter at Northstar in June and July 2000 (9 observations took place concurrent with pipe-driving activities). One seal showed no reaction to the aircraft while the remaining 11 (92%) reacted, either by looking at the helicopter (n=10) or by departing from their basking site (n=1). Blackwell *et al.* (2004a) concluded that none of the reactions to helicopters were strong or long lasting, and that seals near Northstar in June and July 2000 probably had habituated to industrial sounds and visible activities that had occurred often during the preceding winter and spring. There have been few systematic studies of pinniped reactions to aircraft overflights, and most of the available data concern pinnipeds hauled out on land or ice rather than pinnipeds in the water (Richardson *et al.,* 1995a; Born *et al.,* 1999).

Reactions of harbor seals to the simulated sound of a 2-megawatt wind power generator were measured by Koschinski *et al.* (2003). Harbor seals surfaced significantly further away from the sound source when it was active and did not approach the sound source as closely. The device used in that study produced sounds in the frequency range of 30 to 800 Hz, with peak source levels of 128 dB at 1 m at the 80- and 160-Hz frequencies.

Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources proposed for use. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds and only slight (if any) changes in behavior. Monitoring work in the Alaskan Beaufort Sea during 1996–2001 provided considerable information regarding the behavior of Arctic ice seals exposed to seismic pulses (Harris *et al.,* 2001; Moulton and Lawson, 2002). These seismic projects usually involved arrays of 6 to 16 airguns with total volumes of 560 to 1,500 in^3. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson, 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to a few hundreds of meters, and many seals remained within 100–200 m (328–656 ft) of the trackline as the operating airgun array passed by. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Similarly, seals are often very tolerant of pulsed sounds from seal-scaring devices (Mate and Harvey, 1987; Jefferson and Curry, 1994; Richardson *et al.,* 1995a). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.,* 1998). Even if reactions of the species occurring in the present study area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations.

4. Threshold Shift (Noise-Induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity (i.e., sounds must be louder for an animal to detect them) following exposure to an intense sound or sound for long duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (i.e., there is complete recovery), can occur in specific frequency ranges (i.e., an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced initially by only 6 dB or reduced by 30 dB). PTS is permanent, but some recovery is possible. PTS can also occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Kryter *et al.,* 1966; Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, prolonged exposure to sounds strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985). However, in the case of the proposed exploratory drilling program, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS.

PTS is considered auditory injury (Southall *et al.,* 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For marine mammals, published data are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et al.,* 2000, 2002b, 2003, 2005a, 2007, 2010a, 2010b; Finneran and Schlundt, 2010; Lucke *et al.,* 2009; Mooney *et al.,* 2009a, 2009b; Popov *et al.,* 2011a, 2011b; Kastelein *et al.,* 2012a; Schlundt *et al.,* 2000; Nachtigall *et al.,* 2003, 2004). For pinnipeds in water, data are limited to measurements of TTS in harbor seals, an elephant seal, and California sea lions (Kastak *et al.,* 1999, 2005; Kastelein *et al.,* 2012b).

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (i.e., recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS would occur during the proposed exploratory drilling program in Cook Inlet. However, several of the sound sources do not even emit sound levels at levels high enough to potentially even cause TTS.

5. Non-Auditory Physical Effects

Non-auditory physical effects might occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. Some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds.

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.,* 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: Behavioral responses; autonomic nervous system responses; neuroendocrine responses; or immune responses.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical ''fight or flight'' response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with ''stress.'' These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuroendocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995), altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.,* 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called ''distress'' (sensu Seyle, 1950) or ''allostatic loading'' (sensu McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). Although no information has been collected on the physiological responses of marine mammals to anthropogenic sound exposure, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as ''distress'' upon exposure to anthropogenic sounds.

For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (e.g., elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (i.e., goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, we assume that reducing a marine mammal's ability to gather information about its environment and communicate with other members of its species would induce stress, based on data that terrestrial animals exhibit those responses under similar conditions (NRC, 2003) and because marine mammals use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses. Marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS. However, as stated previously in this document, the source level of the jack-up rig is not loud enough to induce PTS or likely even TTS.

Resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum *et al.,* 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses. Additionally, no beaked whale species occur in the proposed project area.

In general, very little is known about the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns, which are not proposed for use during this program. For the most part, only low-level continuous sounds would be produced during the exploratory drilling program. In addition, marine mammals that show behavioral avoidance of industry activities, including belugas and some pinnipeds, are especially unlikely to incur non-auditory impairment or other physical effects.

6. Stranding and Mortality

Marine mammals close to underwater detonations of high explosive can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.,* 1993; Ketten, 1995). Airgun pulses are less energetic and their peak amplitudes have slower rise times. To date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays. Additionally, the airguns used during VSP are used for short periods of time. The continuous sounds produced by the drill rig are also far less energetic.

It should be noted that strandings related to sound exposure have not been recorded for marine mammal species in Cook Inlet. Beluga whale strandings in Cook Inlet are not uncommon; however, these events often coincide with extreme tidal fluctuations (''spring tides'') or killer whale sightings (Shelden *et al.,* 2003). For example, in August 2012, a group of Cook Inlet beluga whales stranded in the mud flats of Turnagain Arm during low tide and were able to swim free with the flood tide. NMFS does not expect any marine mammals will incur serious injury or mortality in Cook Inlet or strand as a result of the proposed exploratory drilling program.

Vessel Impacts

Vessel activity and noise associated with vessel activity will temporarily increase in the action area during Buccaneer's exploratory drilling program as a result of the operation of a jack-up drill rig and the use of tow and other support vessels. While under tow, the rig and the tow vessels move at slow speeds (2–4 knots). The support barges supplying pipe to the drill rig can typically run at 7–8 knots but may move slower inside Cook Inlet. Based on this information, NMFS does not anticipate and does not propose to authorize take from vessel strikes.

Odontocetes, such as beluga whales, killer whales, and harbor porpoises, often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice, shallow water, or were previously harassed by vessels (Richardson *et al.,* 1995). Beluga whale response to vessel noise varies greatly from tolerance to extreme sensitivity depending on the activity of the whale and previous experience with vessels (Richardson *et al.,* 1995). Reactions to vessels depends on whale activities and experience, habitat, boat type, and boat behavior (Richardson *et al.,* 1995) and may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson, 1994; Erbe and Farmer, 2000); fast swimming; changes in vocalizations (Lesage *et al.,* 1999; Scheifele *et al.,* 2005); and changes in dive, surfacing, and respiration patterns.

There are few data published on pinniped responses to vessel activity, and most of the information is anecdotal (Richardson *et al.,* 1995). Generally, sea lions in water show tolerance to close and frequently approaching vessels and sometimes show interest in fishing vessels. They are less tolerant when hauled out on land; however, they rarely react unless the vessel approaches within 100–200 m (330–660 ft; reviewed in Richardson *et al.,* 1995).

The addition of the jack-up rig and a few support vessels and noise due to rig and vessel operations associated with the exploratory drilling program would not be outside the present experience of marine mammals in Cook Inlet, although levels may increase locally. Given the large number of vessels in Cook Inlet and the apparent habituation to vessels by Cook Inlet marine mammals that may occur in the area, vessel activity and noise is not expected to have effects that could cause significant or long-term consequences for individual marine mammals or their populations.

Oil Spill and Discharge Impacts

As noted above, the specified activity involves the drilling of exploratory wells and associated activities in upper Cook Inlet during the 2014 open water season. The primary stressors to marine mammals that are reasonably expected to occur will be acoustic in nature. The likelihood of a large or very large oil spill occurring during Buccaneer's proposed exploratory drilling program is remote. Offshore oil spill records in Cook Inlet during 1994–2011 show three spills during oil exploration (ADNR Division of Oil and Gas, 2011 unpub. data): Two oil spills at the UNOCAL Dillion Platform in June 2011 (two gallons) and December 2001 (three gallons); and one oil spill at the UNOCAL Monopod Platform in January 2002 (one gallon). During this same time period, 71 spills occurred offshore in Cook Inlet during oil production. Most spills ranged from 0.0011 to 1 gallon (42 spills), and only three spills were larger than 200 gallons: 210 gallons in July 2001 at the Cook Inlet Energy Stewart facility; 250 gallons in February 1998 at the King Salmon platform; and 504 gallons in October 1999 at the UNOCAL Dillion platform. All 71 crude oil spills from the offshore platforms, both exploration and production, totaled less than 2,140 gallons. Based on historical data, most oil spills have been small. Moreover, during more than 60 years of oil and gas exploration and development in Cook Inlet, there has not been a single oil well blowout, making it difficult to assign a specific risk factor to the possibility of such an event in Cook Inlet. However, the probability of such an event is thought to be of extremely low probability.

Buccaneer will have various measures and protocols in place that will be implemented to prevent oil releases from the wellbore. Buccaneer has planned formal routine rig maintenance and surveillance checks, as well as normal inspection and equipment checks to be conducted on the jack-up rig daily. The following steps will be in place to prevent oil from entering the water:

- Required inspections will follow standard operating procedures.
- Personnel working on the rig will be directed to report any unusual conditions to appropriate personnel.
- Oily equipment will be regularly wiped down with oil absorbent pads to collect free oil. Drips and small spillage from equipment will be controlled through use of drip pans and oil absorbent drop clothes.
- Oil absorbent materials used to contain oil spills or seeps will be collected and disposed of in sealed plastic bags or metal drums and closed containers.
- The platform surfaces will be kept clean of waste materials and loose debris on a daily basis.
- Remedial actions will be taken when visual inspections indicate deterioration of equipment (tanks) and/or their control systems.
- Following remedial work, and as appropriate, tests will be conducted to determine that the systems function correctly.

Drilling and completion fluids provide primary well control during drilling, work over, or completion operations. These fluids are designed to exert hydrostatic pressure on the wellbore that exceeds the pore pressures within the subsurface formations. This prevents undesired fluid flow into the wellbore. Surface mounted blowout preventer (BOP) equipment provides secondary well control. In the event that primary well control is lost, this surface equipment is used to contain the influx of formation fluid and then safely circulate it out of the wellbore.

The BOP is a large, specialized valve used to seal, control, and monitor oil and gas wells. BOPs come in variety of styles, sizes, and pressure ratings. For Cook Inlet, the BOP equipment used by Buccaneer will consist of:

- Three BOPs pressure safety levels of: (1) 5,000 pounds per square inch (psi) (2) 10,000 psi, and (3) 15,000 psi;
- A minimum of three 35 cm (13 ⅝ in), 10,000 psi WP ram type preventers;
- One 35 cm (13 ⅝ in) annular preventer;
- Choke and kill lines that provide circulating paths from/to the choke manifold;
- A two choke manifold that allows for safe circulation of well influxes out of the well bore; and
- A hydraulic control system with accumulator backup closing.

The wellhead, associated valves, and control systems provide blowout prevention during well production. These systems provide several layers of redundancy to ensure pressure containment is maintained. Well control planning is performed in accordance with Alaska Oil and Gas Conservation Commission (AOGCC) and Bureau of Safety and Environment Enforcement (BSEE) regulations. The operator's policies and recommended practices are, at a minimum, equivalent to BSEE regulations. BOP test drills are performed on a frequent basis to ensure the well will be shut in quickly and properly. BOP testing procedures will meet American Petroleum Institute Recommended Practice No. 53 and AOGCC specifications. The BOP tests will be conducted with a nonfreezing fluid when the ambient temperature around the BOP stack is below 0 °C (32 °F). Tests will be conducted at least weekly and before drilling out the shoe of each casing string. The AOGCC will be contacted before each test is conducted, and will be onsite during BOP tests unless an inspection waiver is approved.

Buccaneer developed an Oil Discharge Prevention and Contingency Plan (ODPCP). Alaska's Department of Environmental Conservation (ADEC) approved Buccaneer's ODPCP on August 29, 2012. NMFS reviewed the ODPCP during the ESA consultation process and found that with implementation of the safety features mentioned above that the risk of an oil spill was discountable.

Despite concluding that the risk of serious injury or mortality from an oil spill in this case is extremely remote, NMFS has nonetheless evaluated the potential effects of an oil spill on marine mammals. While an oil spill is not a component of Buccaneer's specified activity for which NMFS is proposing to authorize take, potential impacts on marine mammals from an oil spill are discussed in more detail next.

1. Potential Effects of Oil on Cetaceans

The specific effects an oil spill would have on cetaceans are not well known. While mortality is unlikely, exposure to spilled oil could lead to skin irritation, baleen fouling (which might reduce feeding efficiency), respiratory distress from inhalation of hydrocarbon vapors, consumption of some contaminated prey items, and temporary displacement from contaminated feeding areas. Geraci and St. Aubin (1990) summarize effects of oil on marine mammals. The number of cetaceans that might be contacted by a spill would depend on the size, timing, and duration of the spill and where the oil is in relation to the animals. Whales may not avoid oil spills, and some have been observed feeding within oil slicks (Goodale *et al.,* 1981).

There is no direct evidence that oil spills, including the much studied Santa Barbara Channel and Exxon Valdez spills, have caused any deaths of cetaceans (Geraci, 1990; Brownell, 1971; Harvey and Dahlheim, 1994). It is suspected that some individually identified killer whales that disappeared from Prince William Sound during the time of the Exxon Valdez spill were casualties of that spill. However, no clear cause and effect relationship between the spill and the disappearance could be established (Dahlheim and Matkin, 1994). The AT–1 pod of transient killer whales that sometimes inhabits Prince William Sound has continued to decline after the Exxon Valdez oil spill (EVOS). Matkin *et al.* (2008) tracked the AB resident pod and the AT–1 transient group of killer whales from 1984 to 2005. The results of their photographic surveillance indicate a much higher than usual mortality rate for both populations the year following the spill (33% for AB Pod and 41% for AT–1 Group) and lower than average rates of increase in the 16 years after the spill (annual increase of about 1.6% for AB Pod compared to an annual increase of about 3.2% for other Alaska killer whale pods). In killer whale pods, mortality rates are usually higher for non-reproductive animals and very low for reproductive animals and adolescents (Olesiuk *et al.,* 1990, 2005; Matkin *et al.,* 2005). No effects on humpback whales in Prince William Sound were evident after the EVOS (von Ziegesar *et al.,* 1994). There was some temporary displacement of humpback whales out of Prince William Sound, but this could have been caused by oil contamination, boat and aircraft disturbance, displacement of food sources, or other causes.

Migrating gray whales were apparently not greatly affected by the Santa Barbara spill of 1969. There appeared to be no relationship between the spill and mortality of marine mammals. The higher than usual counts of dead marine mammals recorded after the spill represented increased survey effort and therefore cannot be conclusively linked to the spill itself (Brownell, 1971; Geraci, 1990). The conclusion was that whales were either able to detect the oil and avoid it or were unaffected by it (Geraci, 1990).

Schwake *et al.* (2013) studied two populations of common bottlenose dolphins in the Gulf of Mexico following the Deepwater Horizon oil spill to evaluate sublethal effects. They conducted health assessments in Barataria Bay, Louisiana, an area that received heavy and prolonged oiling and in a reference site, Sarasota Bay, Florida, where oil was not observed. Several disease conditions were noted for the Barataria Bay dolphins, including hypoadrenocorticism, pulmonary abnormalities, and tooth loss (Schwake *et al.,* 2013). Even though several of the observed health effects are consistent with exposure to petroleum hydrocarbons because the researchers did not have prespill health data for the Barataria Bay dolphins, they cannot rule out that other pre-existing environmental stressors made this population particularly vulnerable to effects from the oil spill (Schwake *et al.,* 2013).

Whales rely on a layer of blubber for insulation, so oil would have little if any effect on thermoregulation by whales. Effects of oiling on cetacean skin appear to be minor and of little significance to the animal's health (Geraci, 1990). Histological data and ultrastructural studies by Geraci and St. Aubin (1990) showed that exposures of skin to crude oil for up to 45 minutes in four species of toothed whales had no effect. They switched to gasoline and applied the sponge up to 75 minutes. This produced transient damage to epidermal cells in whales. Subtle changes were evident only at the cell level. In each case, the skin damage healed within a week. They concluded that a cetacean's skin is an effective barrier to the noxious substances in petroleum. These substances normally damage skin by getting between cells and dissolving protective lipids. In cetacean skin, however, tight intercellular bridges, vital surface cells, and the extraordinary thickness of the epidermis impeded the damage. The authors could not detect a change in lipid concentration between and within cells after exposing skin from a white-sided dolphin to gasoline for 16 hours in vitro.

Whales could ingest oil if their food is contaminated, or oil could also be absorbed through the respiratory tract. Some of the ingested oil is voided in vomit or feces but some is absorbed and could cause toxic effects (Geraci, 1990). When returned to clean water, contaminated animals can depurate this internal oil (Engelhardt, 1978, 1982). Oil ingestion can decrease food assimilation of prey eaten (St. Aubin, 1988). Cetaceans may swallow some oil-contaminated prey, but it likely would be only a small part of their food. It is not known if whales would leave a feeding area where prey was abundant following a spill. Some zooplankton eaten by baleen whales consume oil particles, and bioaccumulation can result. Tissue studies by Geraci and St. Aubin (1990) revealed low levels of naphthalene in the livers and blubber of baleen whales. This result suggests that prey have low concentrations in their tissues, or that baleen whales may be able to metabolize and excrete certain petroleum hydrocarbons. However, baleen whale species are uncommon in the location of Buccaneer's proposed well sites. Baleen whales are more likely to be encountered in the lower Inlet during rig towing, far away from the drill sites. Whales exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage (Geraci and St. Aubin, 1980, 1982), and this kind of damage has not been reported (Geraci, 1990).

Some cetaceans can detect oil and sometimes avoid it, but others enter and swim through slicks without apparent effects (Geraci, 1990; Harvey and Dahlheim, 1994). Bottlenose dolphins in the Gulf of Mexico apparently could detect and avoid slicks and mousse but did not avoid light sheens on the surface (Smultea and Wursig, 1995). After the Regal Sword spill in 1979, various species of baleen and toothed whales were observed swimming and feeding in areas containing spilled oil southeast of Cape Cod, MA (Goodale *et al.,* 1981). For months following EVOS, there were numerous observations of gray whales, harbor porpoises, Dall's porpoises, and killer whales swimming through light-to-heavy crude-oil sheens (Harvey and Dalheim, 1994, cited in Matkin *et al.,* 2008). However, if some of the animals avoid the area because of the oil, then the effects of the oiling would be less severe on those individuals.

2. Potential Effects of Oil on Pinnipeds

Externally oiled phocid seals often survive and become clean, but heavily oiled seal pups and adults may die, depending on the extent of oiling and characteristics of the oil. Adult seals may suffer some temporary adverse effects, such as eye and skin irritation, with possible infection (MMS, 1996). Such effects may increase stress, which could contribute to the death of some individuals. There is a likelihood that newborn seal pups, if contacted by oil, would die from oiling through loss of insulation and resulting hypothermia.

Reports of the effects of oil spills have shown that some mortality of seals may have occurred as a result of oil fouling; however, large scale mortality had not been observed prior to the EVOS (St. Aubin, 1990). Effects of oil on marine mammals were not well studied at most spills because of lack of baseline data and/or the brevity of the post-spill surveys. The largest documented impact of a spill, prior to EVOS, was on young seals in January in the Gulf of St. Lawrence (St. Aubin, 1990). Brownell and Le Boeuf (1971) found no marked effects of oil from the Santa Barbara oil spill on California sea lions or on the mortality rates of newborn pups.

Intensive and long-term studies were conducted after the EVOS in Alaska. There may have been a long-term decline of 36% in numbers of molting harbor seals at oiled haul-out sites in Prince William Sound following EVOS (Frost *et al.,* 1994a). However, in a reanalysis of those data and additional years of surveys, along with an examination of assumptions and biases associated with the original data, Hoover-Miller *et al.* (2001) concluded that the EVOS effect had been overestimated. The decline in attendance at some oiled sites was more likely a continuation of the general decline in harbor seal abundance in Prince William Sound documented since 1984 (Frost *et al.,* 1999) rather than a result of EVOS. The results from Hoover-Miller *et al.* (2001) indicate that the effects of EVOS were largely indistinguishable from natural decline by 1992. However, while Frost *et al.* (2004) concluded that there was no evidence that seals were displaced from oiled sites, they did find that aerial counts indicated 26% fewer pups were produced at oiled locations in 1989 than would have been expected without the oil spill. Harbor seal pup mortality at oiled beaches was 23% to 26%, which may have been higher than natural mortality, although no baseline data for pup mortality existed prior to EVOS (Frost *et al.,* 1994a). There was no conclusive evidence of spill effects on Steller sea lions (Calkins *et al.,* 1994). Oil did not persist on sea lions themselves (as it did on harbor seals), nor did it persist on sea lion haul-out sites and rookeries (Calkins *et al.,* 1994). Sea lion rookeries and haul out sites, unlike those used by harbor seals, have steep sides and are subject to high wave energy (Calkins *et al.,* 1994).

Adult seals rely on a layer of blubber for insulation, and oiling of the external surface does not appear to have adverse thermoregulatory effects (Kooyman *et al.,* 1976, 1977; St. Aubin, 1990). Contact with oil on the external surfaces can potentially cause increased stress and irritation of the eyes of ringed seals (Geraci and Smith, 1976; St. Aubin, 1990). These effects seemed to be temporary and reversible, but continued exposure of eyes to oil could cause permanent damage (St. Aubin, 1990). Corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes were observed in captive ringed seals placed in crude oil-covered water (Geraci and Smith, 1976) and in seals in the Antarctic after an oil spill (Lillie, 1954).

Marine mammals can ingest oil if their food is contaminated. Oil can also be absorbed through the respiratory tract (Geraci and Smith, 1976; Engelhardt *et al.,* 1977). Some of the ingested oil is voided in vomit or feces but some is absorbed and could cause toxic effects (Engelhardt, 1981). When returned to clean water, contaminated animals can depurate this internal oil (Engelhardt, 1978, 1982, 1985). In addition, seals exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage (Geraci and St. Aubin, 1980, 1982).

Although seals may have the capability to detect and avoid oil, they apparently do so only to a limited extent (St. Aubin, 1990). Seals may abandon the area of an oil spill because of human disturbance associated with cleanup efforts, but they are most likely to remain in the area of the spill. One notable behavioral reaction to oiling is that oiled seals are reluctant to enter the water, even when intense cleanup activities are conducted nearby (St. Aubin, 1990; Frost *et al.,* 1994b, 2004).

Seals that are under natural stress, such as lack of food or a heavy infestation by parasites, could potentially die because of the additional stress of oiling (Geraci and Smith, 1976; St. Aubin, 1990; Spraker *et al.,* 1994). Female seals that are nursing young would be under natural stress, as would molting seals. In both cases, the seals would have reduced food stores and may be less resistant to effects of oil than seals that are not under some type of natural stress. Seals that are not under natural stress (e.g., fasting, molting) would be more likely to survive oiling. In general, seals do not exhibit large behavioral or physiological reactions to limited surface oiling or incidental exposure to contaminated food or vapors (St. Aubin, 1990; Williams *et al.,* 1994). Effects could be severe if seals surface in heavy oil slicks in leads or if oil accumulates near haul-out sites (St. Aubin, 1990).

Anticipated Effects on Marine Mammal Habitat

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by the exploratory drilling program (i.e. the drill rig and the airguns). However, other potential impacts are also possible to the surrounding habitat from physical disturbance, discharges, and an oil spill (should one occur). This section describes the potential impacts to marine mammal habitat from the specified activity. Because the marine mammals in the area feed on fish and/or invertebrates there is also information on the species typically preyed upon by the marine mammals in the area.

Common Marine Mammal Prey in the Proposed Drilling Area

Fish are the primary prey species for marine mammals in upper Cook Inlet. Beluga whales feed on a variety of fish, shrimp, squid, and octopus (Burns and Seaman, 1986). Common prey species in Knik Arm include salmon, eulachon and cod. Harbor seals feed on fish such as pollock, cod, capelin, eulachon, Pacific herring, and salmon, as well as a variety of benthic species, including crabs, shrimp, and cephalopods. Harbor seals are also opportunistic feeders with their diet varying with season and location. The preferred diet of the harbor seal in the Gulf of Alaska consists of pollock, octopus, capelin, eulachon, and Pacific herring (Calkins, 1989). Other prey species include cod, flat fishes, shrimp, salmon, and squid (Hoover, 1988). Harbor porpoises feed primarily on Pacific herring, cod, whiting (hake), pollock, squid, and octopus (Leatherwood *et al.,* 1982). In the upper Cook Inlet area, harbor porpoise feed on squid and a variety of small schooling fish, which would likely include Pacific herring and eulachon (Bowen and Siniff, 1999; NMFS, unpublished data). Killer whales feed on either fish or other marine mammals depending on genetic type (resident versus transient respectively). Killer whales in Knik Arm are typically the transient type (Shelden *et al.,* 2003) and feed on beluga whales and other marine mammals, such as harbor seal and harbor porpoise. The Steller sea lion diet consists of a variety of fishes (capelin, cod, herring, mackerel, pollock, rockfish, salmon, sand lance, etc.), bivalves, squid, octopus, and gastropods.

Potential Impacts From Seafloor Disturbance on Marine Mammal Habitat

There is a possibility of seafloor disturbance or increased turbidity in the vicinity of the drill sites. Seafloor disturbance could occur with bottom founding of the drill rig legs and anchoring system. These activities could lead to direct effects on bottom fauna, through either displacement or mortality. Increase in suspended sediments from seafloor disturbance also has the potential to indirectly affect bottom fauna and fish. The amount and duration of disturbed or turbid conditions will depend on sediment material.

The potential direct habitat impact by the Buccaneer drilling operation is limited to the actual drill-rig footprint defined as the area occupied and enclosed by the drill-rig legs. The jack-up rig will temporarily disturb up to two offshore locations in upper Cook Inlet, where the wells are proposed to be drilled. Bottom disturbance would occur in the area where the three legs of the rig would be set down and where the actual well would be drilled. The jack-up drill rig footprint would occupy three steel piles at 14 m (46 ft) diameter. The well casing would be a 76 cm (30 in) diameter pipe extending from the seafloor to the rig floor. The casing would only be in place during drilling activities at each potential well location. The total area of disturbance was calculated as 0.54 acres during the land use permitting process. The collective 2-acre footprint of the wells represents a very small fraction of the 7,300 square mile Cook Inlet surface area. Potential damage to the Cook Inlet benthic community will be limited to the actual surface area of the three spud cans (1,585 square feet each or 4,755 square feet total) that form the ''foot'' of each leg. Given the high tidal energy at the well site locations, drilling footprints are not expected to support benthic communities equivalent to shallow lower energy sites found in nearshore waters where harbor seals mostly feed. The presence of the drill rig is not expected to result in direct loss of marine mammal habitat.

Potential Impacts From Sound Generation

With regard to fish as a prey source for odontocetes and seals, fish are known to hear and react to sounds and to use sound to communicate (Tavolga *et al.,* 1981) and possibly avoid predators (Wilson and Dill, 2002). Experiments have shown that fish can sense both the strength and direction of sound (Hawkins, 1981). Primary factors determining whether a fish can sense a sound signal, and potentially react to it, are the frequency of the signal and the strength of the signal in relation to the natural background noise level.

Fishes produce sounds that are associated with behaviors that include territoriality, mate search, courtship, and aggression. It has also been speculated that sound production may provide the means for long distance communication and communication under poor underwater visibility conditions (Zelick *et al.,* 1999), although the fact that fish communicate at low-frequency sound levels where the masking effects of ambient noise are naturally highest suggests that very long distance communication would rarely be possible. Fishes have evolved a diversity of sound generating organs and acoustic signals of various temporal and spectral contents. Fish sounds vary in structure, depending on the mechanism used to produce them (Hawkins, 1993). Generally, fish sounds are predominantly composed of low frequencies (less than 3 kHz).

Since objects in the water scatter sound, fish are able to detect these objects through monitoring the ambient noise. Therefore, fish are probably able to detect prey, predators, conspecifics, and physical features by listening to environmental sounds (Hawkins, 1981). There are two sensory systems that enable fish to monitor the vibration-based information of their surroundings. The two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system.

Although the hearing sensitivities of very few fish species have been studied to date, it is becoming obvious that the intra- and inter-specific variability is considerable (Coombs, 1981). Nedwell *et al.* (2004) compiled and published available fish audiogram information. A noninvasive electrophysiological recording method known as auditory brainstem response is now commonly used in the production of fish audiograms (Yan, 2004). Generally, most fish have their best hearing in the low-frequency range (i.e., less than 1 kHz). Even though some fish are able to detect sounds in the ultrasonic frequency range, the thresholds at these higher frequencies tend to be considerably higher than those at the lower end of the auditory frequency range.

Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) Pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes. Popper *et al.* (2003/2004) also published a paper that reviews the effects of anthropogenic sound on the behavior and physiology of fishes.

Potential effects of exposure to continuous sound on marine fish include TTS, physical damage to the ear region, physiological stress responses, and behavioral responses such as startle response, alarm response, avoidance, and perhaps lack of response due to masking of acoustic cues. Most of these effects appear to be either temporary or intermittent and therefore probably do not significantly impact the fish at a population level. The studies that resulted in physical damage to the fish ears used noise exposure levels and durations that were far more extreme than would be encountered under conditions similar to those expected during Buccaneer's proposed exploratory drilling activities.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona, 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas *et al.,* 1993). In general, fish react more strongly to pulses of sound rather than a continuous signal (Blaxter *et al.,* 1981), such as the type of sound that will be produced by the drillship, and a quicker alarm response is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level.

Investigations of fish behavior in relation to vessel noise (Olsen *et al.,* 1983; Ona, 1988; Ona and Godo, 1990) have shown that fish react when the sound from the engines and propeller exceeds a certain level. Avoidance reactions have been observed in fish such as cod and herring when vessels approached close enough that received sound levels are 110 dB to 130 dB (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988). However, other researchers have found that fish such as polar cod, herring, and capeline are often attracted to vessels (apparently by the noise) and swim toward the vessel (Rostad *et al.,* 2006). Typical sound source levels of vessel noise in the audible range for fish are 150 dB to 170 dB (Richardson *et al.,* 1995a). (Based on models, the 160 dB radius for the jack-up rig would extend approximately 33 ft [10 m]; therefore, fish would need to be in close proximity to the drill rig for the noise to be audible). In calm weather, ambient noise levels in audible parts of the spectrum lie between 60 dB to 100 dB.

Buccaneer also proposes to conduct VSP surveys with an airgun array for a short period of time during the drilling season (only a few hours over 1–2 days per well over the course of the entire proposed drilling program). Airguns produce impulsive sounds as opposed to continuous sounds at the source. Short, sharp sounds can cause overt or subtle changes in fish behavior. Chapman and Hawkins (1969) tested the reactions of whiting (hake) in the field to an airgun. When the airgun was fired, the fish dove from 82 to 180 ft (25 to 55 m) depth and formed a compact layer. The whiting dove when received sound levels were higher than 178 dB re 1 μPa (Pearson *et al.,* 1992).

Pearson *et al.* (1992) conducted a controlled experiment to determine effects of strong noise pulses on several species of rockfish off the California coast. They used an airgun with a source level of 223 dB re 1 μPa. They noted:

- Startle responses at received levels of 200–205 dB re 1 μPa and above for two sensitive species, but not for two other species exposed to levels up to 207 dB;
- Alarm responses at 177–180 dB for the two sensitive species, and at 186 to 199 dB for other species;
- An overall threshold for the above behavioral response at about 180 dB;
- An extrapolated threshold of about 161 dB for subtle changes in the behavior of rockfish; and
- A return to pre-exposure behaviors within the 20–60 minute exposure period.

In summary, fish often react to sounds, especially strong and/or intermittent sounds of low frequency. Sound pulses at received levels of 160 dB re 1 μPa may cause subtle changes in behavior. Pulses at levels of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins, 1969;

Pearson *et al.,* 1992; Skalski *et al.,* 1992). It also appears that fish often habituate to repeated strong sounds rather rapidly, on time scales of minutes to an hour. However, the habituation does not endure, and resumption of the strong sound source may again elicit disturbance responses from the same fish. Underwater sound levels from the drill rig and other vessels produce sounds lower than the response threshold reported by Pearson *et al.* (1992), and are not likely to result in major effects to fish near the proposed drill sites.

Based on a sound level of approximately 140 dB, there may be some avoidance by fish of the area near the jack-up while drilling, around the rig under tow, and around other support and supply vessels when underway. Any reactions by fish to these sounds will last only minutes (Mitson and Knudsen, 2003; Ona *et al.,* 2007) longer than the vessel is operating at that location or the drill rig is drilling. Any potential reactions by fish would be limited to a relatively small area within about 33 ft (10 m) of the drill rig during drilling. Avoidance by some fish or fish species could occur within portions of this area.

The lease areas do not support major populations of cod, Pollock, and sole, although all four salmon species and smelt migrate through the area to spawning rivers in upper Cook Inlet (Shields and Dupuis, 2012). Residency time for the migrating finfish in the vicinity of an operating platform would be short-term, limiting fish exposure to noise associated with the proposed drilling program.

Some of the fish species found in Cook Inlet are prey sources for odontocetes and pinnipeds. A reaction by fish to sounds produced by Buccaneer's proposed operations would only be relevant to marine mammals if it caused concentrations of fish to vacate the area. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all due to the low energy sounds produced by the majority of equipment proposed for use. Impacts on fish behavior are predicted to be inconsequential. Thus, feeding odontocetes and pinnipeds would not be adversely affected by this minimal loss or scattering, if any, which is not expected to result in reduced prey abundance. The proposed drilling area is not a common feeding area for baleen whales.

Potential Impacts From Drilling Discharges

The drill rig *Endeavour* will operate under the Alaska Pollutant Discharge Elimination System (APDES) general permit AKG–31–5021 for wastewater discharges (ADEC, 2012). This permit authorizes discharges from oil and gas extraction facilities engaged in exploration under the Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category (40 CFR Part 435). Twelve effluents are authorized for discharge into Cook Inlet once ADEC discharge limits have been met. The authorized discharges include: Drilling fluids and drill cuttings, deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blow down, fire control system test water, uncontaminated ballast water, bilge water, excess cement slurry, mud cuttings cement at sea floor, and completion fluids. Areas prohibited from discharge in the Cook Inlet are 10-meter (33-foot) isobaths, 5-meter (16-foot) isobaths, and other geographic area restrictions (AKG–31–5021.I.C.). The *Endeavour* is also authorized under EPA's Vessel General Permit for deck wash down and runoff, gray water, and gray water mixed with sewage discharges. The effluent limits and related requirements for these discharges in the Vessel General Permit are to minimize or eliminate to the extent achievable using control measures (best management practices) (EPA, 2011).

Drilling wastes include drilling fluids, known as mud, rock cuttings, and formation waters. Drilling wastes (non-hydrocarbon) will be discharged to the Cook Inlet under the approved APDES general permit. Drilling wastes (hydrocarbon) will be delivered to an onshore permitted location for disposal. During drilling, the onsite tool pusher/driller and qualified mud engineers will direct and maintain desired mud properties, and maintain the quantities of basic mud materials on site as dictated by good oilfield practice. Buccaneer will follow best management practices to ensure that a sufficient inventory of barite and lost circulation materials are maintained on the drilling vessel to minimize the possibility of a well upset and the likelihood of a release of pollutants to Cook Inlet waters. These materials can be re-supplied, if required, using the supply vessel. Because adverse weather could prevent immediate re-supply, sufficient materials will be available on board to completely rebuild the total circulating volume. Buccaneer will conduct an Environmental Monitoring Study of relevant hydrographic, sediment hydrocarbon, and heavy metal data from surveys conducted before and during drilling mud disposal and up to a least one year after drilling operations cease in accordance with the APDES general permit for discharges of drilling muds and cuttings.

Non-drilling wastewater includes deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blow down, fire control test water, bilge water, non-contact cooling water, and uncontaminated ballast water. Non-drilling wastewater will be discharged into Cook Inlet under the approved APDES general permit or delivered to an onshore permitted location for disposal. Mud cuttings will be constantly tested. No hydrocarboned muds will be permitted to be discharged into Cook Inlet. They will be hauled offsite. Solid waste (e.g., packaging, domestic trash) will be classified, segregated, and labeled as general, universal, and Resource Conservation and Recovery Act exempt or non-exempt waste. It will be stored in containers at designated accumulation areas. Then, it will be packaged and palletized for transport to an approved on-shore disposal facility. No hazardous wastes should not be generated as a result of this project. However, if any hazardous wastes were generated, it would be temporarily stored in an onboard satellite accumulation area and then transported offsite for disposal at an approved facility.

With oil and gas platforms presently operating in Cook Inlet, there is concern for continuous exposure to potentially toxic heavy metals and metalloids (i.e., mercury, lead, cadmium, copper, zinc, and arsenic) that are associated with oil and gas development and production. These elements occur naturally in the earths' crust and the oceans but many also have anthropogenic origins from local sources of pollution or from contamination from atmospheric distribution.

Discharging drill cuttings or other liquid waste streams generated by the drilling vessel 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, there have been no marine mammal deaths in the wild that can be conclusively linked to the direct exposure to such substances (O'Shea, 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. Drilling muds are composed primarily of bentonite (clay), and the toxicity is therefore low. Heavy metals in the mud may be absorbed by benthic organisms, but studies have shown that heavy metals do not bio-magnify in marine food webs (Neff *et al.,* 1989). Effects on benthic communities are nearly always restricted to a zone within about 328 to 492 ft (100 to 150 m) of the discharge, where cuttings accumulations are greatest. Discharges and drill cuttings could impact fish by displacing them from the affected area.

Beluga whales analyzed for heavy metals and other elements (cadmium, mercury, selenium, vanadium, and silver) were generally lower in the livers of Cook Inlet animals than in the other beluga whale stocks, while copper was higher (Becker *et al.,* 2001). Hepatic methyl mercury levels were similar to those reported for other beluga whales (Geraci and St. Aubin, 1990). The relatively high hepatic concentration of silver found in the eastern Chukchi Sea and Beaufort Sea stocks of belugas was also found in the Cook Inlet animals, suggesting a species-specific phenomenon. However, because of the limited discharges no water quality impacts are anticipated that would negatively affect habitat for Cook Inlet marine mammals.

Potential Impacts From Drill Rig Presence

The horizontal dimensions of the jack-up rig are 160 ft by 35 ft (48.8 m by 10.7 m). The dimensions of the drill rig (less than one football field on either side) are not significant enough to cause a large-scale diversion from the animals' normal swim and migratory paths. Any deflection of marine mammal species due to the physical presence of the drill rig would be very minor. The drill rig's physical footprint is small relative to the size of the geographic region it will occupy and will likely not cause marine mammals to deflect greatly from their typical migratory route. Also, even if animals may deflect because of the presence of the drill rig, Cook Inlet is much larger in size than the length of the drill rig (many dozens of miles vs. less than one football field), and animals would have other means of passage around the drill rig. In sum, the physical presence of the drill rig is not likely to cause a significant deflection to migrating marine mammals.

Potential Impacts From an Oil Spill

Lower trophic organisms and fish species are primary food sources for marine mammals likely to be found in the proposed project vicinity. Any diminishment of feeding habitat during the summer months due to an oil spill or response could affect the energy balance of marine mammals. If oil found its way into upper Cook Inlet in the area of the Susitna and Little Susitna rivers during the summer months, a large portion of Cook Inlet beluga whale Area 1 critical habitat could be impacted. If an oil spill were to occur later in the season, it could become trapped in or under the ice or travel with the thinner ice pans.

Due to their wide distribution, large numbers, and rapid rate of regeneration, the recovery of marine invertebrate populations is expected to occur soon after the surface oil passes. Spill response activities are not likely to disturb the prey items of whales or seals sufficiently to cause more than minor effects. Spill response activities could cause marine mammals to avoid the disturbed habitat that is being cleaned. However, by causing avoidance, animals would avoid impacts from the oil itself. Additionally, the likelihood of an oil spill is expected to be very low, as discussed earlier in this document.

Based on the preceding discussion of potential types of impacts to marine mammal habitat, overall, the proposed specified activity is not expected to cause significant impacts on habitats used by the marine mammal species in the proposed project area or on the food sources that they utilize.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant). Later in this document in the ''Proposed Incidental Harassment Authorization'' section, NMFS lays out the proposed conditions for review, as they would appear in the final IHA (if issued).

While the drill rig does not emit sound levels that require shutdowns to avoid Level A harassment (injury), because take of beluga whales is not authorized, shutdown procedures will be required to avoid Level B take of this species. For continuous sounds, such as those produced by drilling operations and rig tow, NMFS uses a received level of 120-dB (rms) to indicate the onset of Level B harassment. For impulse sounds, such as those produced by the airgun array during the VSP surveys or the impact hammer during conductor pipe driving, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. The current Level A (injury) harassment threshold is 180 dB (rms) for cetaceans and 190 dB (rms) for pinnipeds. Table 1 in this document outlines the various applicable radii for which different mitigation measures would apply.

TABLE 1—APPLICABLE MITIGATION AND SHUTDOWN RADII FOR BUCCANEER'S PROPOSED UPPER COOK INLET EXPLORATORY DRILLING PROGRAM

	190 dB radius	180 dB radius	160 dB radius	120 dB radius
Impact hammer during conductor pipe driving	60 m (200 ft)	250 m (820 ft)	2 km (1.24 mi)	NA.
Airguns during VSP	75 m (246 ft)	240 m (787 ft)	2.5 km (1.55 mi)	NA.
Rig tow	NA	NA	NA	600 m (2,000 ft).
Deep well pumps on the jack-up rig	NA	NA	NA	260 m (853 ft).

Rig tow source levels do not exceed 171 dB (rms); Jack-up rig source levels without deep well pumps is below ambient sound levels; NA = Not applicable.

Mitigation Measures Proposed by Buccaneer

For the proposed mitigation measures, Buccaneer listed the following protocols to be implemented during its exploratory drilling program in Cook Inlet.

1. Conductor Pipe Driving Measures

Protected species observers (PSOs) will observe from the drill rig during this 2–3 day portion of the proposed program out to the 160 dB (rms) radius of 2 km (1.24 mi). If marine mammal species for which take is not authorized enter this zone, then use of the impact hammer will cease. If cetaceans for which take is authorized enter within the 180 dB (rms) radius of 250 m (820 ft) or if pinnipeds for which take is authorized enter within the 190 dB (rms) radius of 60 m (200 ft), then use of the impact hammer will cease. Following a shutdown of impact hammering activities, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

Buccaneer proposes to follow a ramp-up procedure during impact hammering activities. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then Buccaneer can initiate impact hammering using a ''soft start'' technique. Hammering will begin with an initial set of three strikes at 40 percent energy followed by a 1 min waiting period, then two subsequent three-strike sets. This ''soft-start'' procedure will be implemented anytime impact hammering has ceased for 30 minutes or more. Impact hammer ''soft-start'' will not be required if the hammering downtime is for less than 30 minutes and visuals surveys are continued throughout the silent period and no marine mammals are observed in the applicable zones during that time. Monitoring will occur during all hammering sessions.

2. VSP Airgun Measures

PSOs will observe from the drill rig during this 1–2 day portion of the proposed program out to the 160 dB radius of 2.5 km (1.55 mi). If marine mammal species for which take is not authorized enter this zone, then use of the airguns will cease. If cetaceans for which take is authorized enter within the 180 dB (rms) radius of 240 m (787 ft) or if pinnipeds for which take is authorized enter within the 190 dB (rms) radius of 75 m (246 ft), then use of the airguns will cease. Following a shutdown of airgun operations, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

Buccaneer proposes to follow a ramp-up procedure during airgun operations. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then Buccaneer can initiate airgun operations using a ''ramp-up'' technique. Airgun operations will begin with the firing of a single airgun, which will be the smallest gun in the array in terms of energy output (dB) and volume (in^3). Operators will then continue ramp-up by gradually activating additional airguns over a period of at least 30 minutes (but not longer than 40 minutes) until the desired operating level of the airgun array is obtained. This ramp-up procedure will be implemented anytime airguns have not been fired for 30 minutes or more. Airgun ramp-up will not be required if the airguns have been off for less than 30 minutes and visuals surveys are continued throughout the silent period and no marine mammals are observed in the applicable zones during that time. Monitoring will occur during all airgun usage.

3. Rig Tow and Drill Rig Operation

As mentioned previously, these activities do not generate sounds that require implementation of mitigation measures to avoid injury. However, PSOs will be stationed on the helicopter platform (bow) of the drill rig (positioned about 100 ft above the waterline) to watch for marine mammals. With the exception of the operation of the deep-well pump on the jack-up rig, the other machinery generates sound levels below ambient. PSOs will observe from the drill rig during this portion of the proposed program out to the 120 dB radius of 260 m (853 ft). If marine mammal species for which take is not authorized enter this zone, then the deep well pumps will be turned off. The PSOs will operate from multiple stations on the rig, recognizing that the shutdown radius begins from the submersed pump housed inside the forward jack-up leg.

4. Oil Spill Plan

Buccaneer developed an ODPCP. ADEC approved Buccaneer's ODPCP on August 29, 2012. NMFS reviewed the ODPCP during the ESA consultation process and found that with implementation of the safety features mentioned above that the risk of an oil spill was discountable.

5. Pollution Discharge Plan

When the drill rig is towed or otherwise floating it is classified as a vessel (like a barge). During those periods, it is covered under a form of National Pollutant Discharge Elimination System permit known as a Vessel General Permit. This permit remains federal and is a ''no discharge permit,'' which allows for the discharge of storm water and closed system fire suppression water but no other effluents.

When the legs are down, the drill rig becomes a facility. During those periods, it is covered under an approved APDES. Under the APDES, certain discharges are permitted. However, Buccaneer is not permitted to discharge gray water, black water, or hydrocarboned muds. They are all hauled off and not discharged.

Mitigation Measures Proposed by NMFS

NMFS proposes that when Buccaneer utilizes helicopters for support operations that the helicopters must maintain an altitude of at least 1,000 ft (305 m), except during takeoffs, landings, or emergency situations.

Mitigation Conclusions

NMFS has carefully evaluated Buccaneer's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

- The manner in which, and the degree to which, the successful implementation of the measures are expected to minimize adverse impacts to marine mammals;
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and
- The practicability of the measure for applicant implementation.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

1. Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

2. A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels

of seismic airguns, impact hammers, drill rig deep well pumps, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

3. A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of seismic airguns impact hammers, drill rig deep well pumps, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

4. A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of seismic airguns impact hammers, drill rig deep well pumps, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing the severity of harassment takes only).

5. Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.

6. For monitoring directly related to mitigation—an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking''. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Buccaneer submitted information regarding marine mammal monitoring to be conducted during seismic operations as part of the IHA application. That information can be found in Appendix C of the application. The monitoring measures may be modified or supplemented based on comments or new information received from the public during the public comment period.

Monitoring measures proposed by the applicant or prescribed by NMFS should accomplish one or more of the following top-level goals:

1. An increase in our understanding of the likely occurrence of marine mammal species in the vicinity of the action, i.e., presence, abundance, distribution, and/or density of species.

2. An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammal species to any of the potential stressor(s) associated with the action (e.g. sound or visual stimuli), through better understanding of one or more of the following: The action itself and its environment (e.g. sound source characterization, propagation, and ambient noise levels); the affected species (e.g. life history or dive pattern); the likely co-occurrence of marine mammal species with the action (in whole or part) associated with specific adverse effects; and/or the likely biological or behavioral context of exposure to the stressor for the marine mammal (e.g. age class of exposed animals or known pupping, calving or feeding areas).

3. An increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).

4. An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: The long-term fitness and survival of an individual; or the population, species, or stock (e.g. through effects on annual rates of recruitment or survival).

5. An increase in our understanding of how the activity affects marine mammal habitat, such as through effects on prey sources or acoustic habitat (e.g., through characterization of longer-term contributions of multiple sound sources to rising ambient noise levels and assessment of the potential chronic effects on marine mammals).

6. An increase in understanding of the impacts of the activity on marine mammals in combination with the impacts of other anthropogenic activities or natural factors occurring in the region.

7. An increase in our understanding of the effectiveness of mitigation and monitoring measures.

8. An increase in the probability of detecting marine mammals (through improved technology or methodology), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals.

Proposed Monitoring Measures

1. Visual Monitoring

PSOs will be required to monitor the area for marine mammals aboard the drill rig during rig tow, exploratory drilling operations, conductor pipe driving, and VSP operations. Standard marine mammal observing field equipment will be used, including reticule binoculars, Big-eye binoculars, inclinometers, and range-finders. If conductor pipe driving or VSP operations occur at night, PSOs will be equipped with night scopes. At least one PSO will be on duty at all times when operations are occurring. Shifts shall not last more than 4 hours, and PSOs will not observe for more than 12 hours in a 24-hour period.

2. Sound Source Verification Monitoring

A sound source verification (SSV) of the underwater sound pressures emanating from the active drilling rig will be conducted by an acoustical engineer. The measurements would be made in a boat that is drifting near the rig in the current. Measuring while drifting will minimize the noise contamination caused by strumming of the hydrophone lines and flow noise. Measurements will be made with a two-channel system that will provide measurements at two specified depths up to 100 feet. The underwater sound levels would be measured using hydrophones, sound level meters, and recording devices.

Measurements would be made by hydrophones that have a flat frequency response and are omnidirectional over a frequency range of 10 to 20,000 Hz. The signals shall be fed into an appropriate date-logging device, such as an integrating sound level meter. The systems will have the capability to make quality recordings using a digital audio recorder (either solid state or tape). The accuracy of the measurement system shall be 1 dB from 10 to 10,000 Hz referenced to 1 micro Pascal (μPa). The measurement system shall be able to measure the unweighted or C-weighted root-mean-square (rms) sound pressure levels in dB referenced to 1 μPa. The measurement systems will have the capability to provide a real time readout display of underwater sound levels. The real-time display shall provide the unweighted peak sound pressure and the sound pressure level. During drilling, measurements were made out to beyond the 120 dB isopleth. During any other activity (e.g., conductor driving and VSP operations), measurements were or will be made to at least one kilometer from the rig. To date, SSVs have been conducted for drilling operations, generators, submersed pumps, and VSP operations (I&R, 2013a, b, c). SSV of the conductor pipe driving activity is planned to occur.

Recordings of sounds will be conducted so that subsequent analysis could be provided and certain sounds could be identified or at least described. The subsequent analysis would include providing frequency spectra for different sounds or distances from the rig. The spectra data would be provided in ⅓rd octave bands for sounds in the 10 to 10,000 Hz range.

In addition to the underwater sound measurements, measurements of sea temperature, wind speed, and sea state will be (or were) taken as well.

Reporting Measures

1. SSV Report

The SSV report will describe the source of the sound, the environment, the measurements, and the methodology employed to make the measurements. Results will be presented as overall sound pressure levels and displays of 1/3rd octave band sound levels. Preliminary findings relative to the 120 dB, 160 dB, 180 dB, and 190 dB isopleths will be provided within 1 week of SSV completion.

2. 90-Day Technical Report

Daily field reports will be prepared that include daily activities, marine mammal monitoring efforts, and a record of the marine mammals and their behaviors and reactions observed that day. These daily reports will be used to help generate the 90-day technical report. A report will be due to NMFS no later than 90 days after the expiration of the IHA (if issued). The Technical Report will include the following:

- Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals).
- Analyses of the effects of various factors influencing detectability of marine mammals (e.g., 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 (if determinable), group sizes, and ice cover.
- Analyses of the effects of operations.
- Sighting rates of marine mammals (and other variables that could affect detectability), such as: (i) Initial sighting distances versus operational activity state; (ii) closest point of approach versus operational activity state; (iii) observed behaviors and types of movements versus operational activity state; (iv) numbers of sightings/individuals seen versus operational activity state; (v) distribution around the drill rig versus operational activity state; and (vi) estimates of take by Level B harassment based on presence in the Level B harassment zones.

3. Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA (if issued), such as an injury (Level A harassment), serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), Buccaneer would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Alaska Regional Stranding Coordinators. The report would include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with Buccaneer to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Buccaneer would not be able to resume their activities until notified by NMFS via letter, email, or telephone.

In the event that Buccaneer discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), Buccaneer would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. Activities would be able to continue while NMFS reviews the circumstances of the incident. NMFS would work with Buccaneer to determine whether modifications in the activities are appropriate.

In the event that Buccaneer discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Buccaneer would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. Buccaneer would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. Only take by Level B behavioral harassment of some species is anticipated as a result of the proposed drilling program. Anticipated impacts to marine mammals are associated with noise propagation from the sound sources (e.g., drill rig and tow, airguns, and impact hammer) used in the drilling program. Additional disturbance to marine mammals may result from visual disturbance of the drill rig or support vessels. No take is expected to result from vessel strikes because of the slow speed of the vessels (2–4 knots while rig is under two; 7–8 knots of supply barges).

Buccaneer requests authorization to take six marine mammal species by Level B harassment. These six marine mammal species are: Gray whale; minke whale; killer whale; harbor porpoise; Dall's porpoise; and harbor seal. Take of Cook Inlet beluga whales is not requested, expected, or proposed to be authorized. NMFS Section 7 ESA biologists concluded that Buccaneer's proposed exploratory drilling program is not likely to adversely affect Cook Inlet beluga whales. Mitigation measures requiring shutdowns of activities before belugas enter the Level B harassment zones will be required in any issued IHA.

As noted previously in this document, for continuous sounds, such as those produced by drilling operations and rig tow, NMFS uses a received level of 120-dB (rms) to indicate the onset of Level B harassment. For impulse sounds, such as those produced by the airgun array during the VSP surveys or the impact hammer during conductor pipe driving, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. The current Level A (injury) harassment threshold is 180 dB (rms) for cetaceans and 190 dB (rms) for pinnipeds. Table 2 outlines the current acoustic criteria.

TABLE 2—CURRENT ACOUSTIC EXPOSURE CRITERIA USED BY NMFS

Criterion	Criterion definition	Threshold
Level A Harassment (injury)	Permanent Threshold Shift (PTS) (Any level above that which is known to cause TTS)	180 dB re 1 microPa-m (cetaceans)/190 dB re 1 microPa-m (pinnipeds) root mean square (rms).
Level B Harassment	Behavioral Disruption (for impulse noises)	160 dB re 1 microPa-m (rms).
Level B Harassment	Behavioral Disruption (for continuous, noise)	120 dB re 1 microPa-m (rms).

Section 6 of Buccaneer's application contains a description of the methodology used by Buccaneer to estimate takes by harassment, including calculations for the 120 dB (rms) and 160 dB (rms) isopleths and marine mammal densities in the areas of operation (see **ADDRESSES**), which is also provided in the following sections. NMFS verified Buccaneer's methods, and used the density and sound isopleth measurements in estimating take. However, NMFS also include a duration factor in the estimates presented below, which is not included in Buccaneer's application.

Simply, the proposed take estimates presented in this section for harbor porpoise and harbor seal were calculated by multiplying summer density for the species (which constitutes the best available density information) by the area of ensonification for each type of activity by the total number of days that each activity would occur. For the other four species (minke, gray, and killer whales and Dall's porpoise), there are no available density estimates because of their low occurrence rates in Cook Inlet. Therefore, take requests for those species are based on opportunistic sightings data and typical group size for each species. Additional detail is provided next.

Ensonified Areas

1. Rig Tow

The jack-up rig will be towed three times during 2014. It is estimated that the longer tows will take 2 days to complete. The rig will be wet-towed by at least two ocean-going tugs licensed to operate in Cook Inlet. Tugs generate their loudest sounds while towing due to propeller cavitation. While these continuous sounds have been measured at up to 171 dB re 1 μPa-m (rms) at source (broadband), they are generally emitted at dominant frequencies of less than 5 kHz (Miles *et al.,* 1987; Richardson *et al.,* 1995; Simmonds *et al.,* 2004).

For the most part, the dominant noise frequencies from propeller cavitation are less than the dominant hearing frequencies for pinnipeds and toothed whales. Because it is currently unknown which tug or tugs will be used to tow the rig, and there are few sound signatures for tugs in general, the potential area that could be ensonified by disturbance-level noise is calculated based on an assumed 171 dB re 1 μPa-m source. Using Collins *et al.'*s (2007) 171—18.4 Log(R)—0.00188 spreading model determine from hydroacoustic surveys in Cook Inlet, the distance to the 120 dB isopleth would be at 1,715 ft (523 m). The associated ZOI (area ensonified by noise greater than 120 dB) is, therefore, 212 acres (0.86 km^2).

2. Conductor Pipe Driving

The Delmar D62–22 diesel impact hammer proposed to be used by Buccaneer to drive the 30-inch conductor pipe was previously acoustically measured by Blackwell (2005) in upper Cook Inlet. She found that sound exceeding 190 dB Level A noise limits for pinnipeds extend to about 200 feet (60 meters), and 180 dB Level A impacts to cetaceans to about 820 feet (250 meters). Level B disturbance levels of 160 dB extended to just less than 1.2 miles (1.9 kilometers). The associated ZOI (area ensonified by noise greater than 160 dB) is 4.4 mi^2 (11.3 km^2).

3. Deep-Well Pumps (Jack-Up Rig)

Buccaneer proposes to use the jack-up drilling rig *Endeavour* for the Cook Inlet program. Because the drilling platform and other noise-generating equipment on a jack-up rig are located above the sea's surface, and there is very little surface contact with the water compared to drill ships and semisubmersible drill rigs, lattice-legged jack-up drill rigs are relatively quiet (Richardson *et al.,* 1995; Spence *et al.,* 2007).

The *Spartan 151,* the only other jack-up drill rig currently operating in the Cook Inlet, was hydroacoustically measured by Marine Acoustics, Inc. (2011) in 2011. The survey results showed that continuous noise levels exceeding 120 dB re 1 μPa extended out only 50 m (164 ft), and that this noise was largely associated with the diesel engines used as hotel power generators, rather than the drilling table. Similar, or lesser, noise levels were expected to be generated by the *Endeavour* because generators are mounted on pedestals specifically to reduce noise transfer through the infrastructure, and enclosed in an insulated engine room, with the intent of reducing underwater noise transmission to levels even lower than the *Spartan 151.* This was confirmed during an SSV test on the *Endeavour* by Illingworth and Rodkin (2013a) in May 2013 where it was determined that the noise levels associated with drilling and operating generators are below ambient.

However, the SSV identified another sound source, the submersed deep-well pumps, which were emitting underwater noise exceeding 120 dB. In the initial testing (I&R 2013a), the noise from the pump and the associated falling (from deck level) water discharge was found to exceed 120 dB re 1 μPa out a distance just beyond 984 ft (300 m). After the falling water was piped as a mitigation measure to reduce noise levels, the pump noise was retested (I&R 2013b) with the results indicating that the primary deep-well pump, operating inside the bow leg, still exceeded 120 dB re 1 μPa at a maximum of 853 ft (260 m). For calculating potential incidental harassment take, the 853-ft (260-m) distance to the 120 dB isopleth will be used giving a ZOI of 52.5 acres (0.21 km²).

4. VSP Airguns

Illingworth and Rodkin (2013c) measured noise levels during VSP operations associated with Buccaneer post-drilling operations at the Cosmopolitan #1 site in lower Cook Inlet during July 2013. The results indicated that the 720 cubic inch airgun array used during the operation produced noise levels exceeding 160 dB re 1 μPa out to a distance of approximately 8,100 ft (2,470 m). Based on these results, the associated ZOI would be 7.4 mi² (19.2 km²).

Marine Mammal Densities

Density estimates were derived for harbor porpoises and harbor seals as described next. Because of their low numbers, there are no available Cook Inlet density estimates for the other marine mammals that occasionally inhabit Cook Inlet north of Anchor Point.

1. Harbor Porpoise

Hobbs and Waite (2010) calculated a Cook Inlet harbor porpoise density estimate of 0.013 per km² based on sightings recorded during a summer 1998 aerial survey targeting beluga whales. They derived the value by dividing estimated number of harbor porpoise inhabiting Cook Inlet (249) by the area of the entire inlet (18,948 km²).

2. Harbor Seal

Boveng *et al.* (2003) estimated the harbor seal population that inhabits Cook Inlet at 5,268 seals based on summer/early fall surveys. Dividing that value by the area of the inlet (18,948 km²) provides a Cook Inlet-wide density of 0.278 seals per km².

Proposed Take Estimates

As noted previously in this document, the potential number of harbor porpoises and harbor seals that might be exposed to received continuous SPLs of ≥120 dB re 1 μPa (rms) and pulsed SPLs of ≥160 dB re 1 μPa (rms) was calculated by multiplying:

- The expected species density;
- the anticipated area to be ensonified by the 120 dB re 1 μPa (rms) SPL (rig tow and deep-well pumps) and 160 dB re 1 μPa (rms) SPL (VSP airgun operations and impact hammering); and
- the estimated total duration of each of the activities expressed in days (24 hrs).

To derive at an estimated total duration for each of the activities the following assumptions were made:

- The total duration for rig tow over the entire season would be 5 days.
- It is estimated to take between 30 and 75 days to drill one well. Assuming the maximum time needed to drill a well and that up to two wells may be drilled under this IHA (if issued), the total duration of deep-well pump usage for two wells would be 150 days.
- The total duration of impact hammering during conductor pipe driving for two wells would be 6 days.
- The total duration of the two VSP data acquisition runs is estimated to be 4 days.

Using all of these assumptions, Table 3 outlines the total number of Level B harassment exposures for harbor seals and harbor porpoises from each of the four activities.

TABLE 3—POTENTIAL NUMBER OF EXPOSURES TO LEVEL B HARASSMENT THRESHOLDS DURING BUCCANEER'S PROPOSED EXPLORATORY DRILLING PROGRAM DURING THE 2014 OPEN WATER SEASON

Species	Rig tow	Deep-well pump	Pipe driving	VSP	Total
Harbor porpoise	0.05	3	0.9	1	5
Harbor Seal	1.2	9	18.8	21.4	51

For the less common marine mammals such as gray, minke, killer whales, and Dall's porpoise, population estimates within central and upper Cook Inlet are too small to calculate density estimates. Still, at even very low densities, it is possible to encounter these marine mammals during Buccaneer operations, especially during towing operations through lower Cook Inlet. Marine mammals may approach the drilling rig out of curiosity, and animals may approach in a group. Thus, requested take authorizations for these species are primarily based on group size and the potential for attraction.

Table 4 here outlines the density estimates used to estimate Level B takes, the proposed Level B harassment take levels, the abundance of each species in Cook Inlet, the percentage of each species or stock estimated to be taken, and current population trends.

TABLE 4—DENSITY ESTIMATES, PROPOSED LEVEL B HARASSMENT TAKE LEVELS, SPECIES OR STOCK ABUNDANCE, PERCENTAGE OF POPULATION PROPOSED TO BE TAKEN, AND SPECIES TREND STATUS

Species	Density (#/km²)	Proposed Level B take	Abundance	Percentage of population	Trend
Harbor Seal	0.278	51	22,900	0.22	Stable.
Harbor Porpoise	0.013	5	25,987	0.02	No reliable information.
Killer Whale	NA	5	1,123 (resident)	0.45	Resident stock possibly increasing.
			552 (transient)	0.91	Transient stock stable.

TABLE 4—DENSITY ESTIMATES, PROPOSED LEVEL B HARASSMENT TAKE LEVELS, SPECIES OR STOCK ABUNDANCE, PERCENTAGE OF POPULATION PROPOSED TO BE TAKEN, AND SPECIES TREND STATUS—Continued

Species	Density (#/km²)	Proposed Level B take	Abundance	Percentage of population	Trend
Gray whale	NA	2	18,017	0.01	Stable/increasing.
Minke whale	NA	2	810–1,233	0.16–0.25	No reliable information.
Dall's porpoise	NA	5	83,400	0.01	No reliable information.

Analysis and Preliminary Determinations

Negligible Impact

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'' (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, feeding, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, effects on habitat, and the status of the species.

No injuries or mortalities are anticipated to occur as a result of Buccaneer's proposed exploratory drilling program, and none are proposed to be authorized. Injury, serious injury, or mortality could occur if there were a large or very large oil spill. However, as discussed previously in this document, the likelihood of a spill is extremely remote. Buccaneer has implemented many design and operational standards to mitigate the potential for an oil spill of any size. NMFS does not propose to authorize take from an oil spill, as it is not part of the specified activity. Additionally, animals in the area are not expected to incur hearing impairment (i.e., TTS or PTS) or non-auditory physiological effects. Instead, any impact that could result from Buccaneer's activities is most likely to be behavioral harassment and is expected to be of limited duration.

None of the species for which take is proposed to be authorized are listed as threatened or endangered under the ESA nor as depleted under the MMPA. Additionally, no critical habitat exists for these species. Buccaneer's proposed exploratory drilling program will occur south of critical habitat designated as priority Area 1 for Cook Inlet beluga whales, but activities will occur in habitat designated as priority Area 2. During the proposed period of operations, the majority of Cook Inlet beluga whales will be in Area 1 critical habitat, north of the proposed drilling area. The proposed activities are not anticipated to destroy or adversely modify beluga whale critical habitat, and mitigation measures and safety protocols are in place to reduce any potential even further.

Sound levels emitted during the proposed program are anticipated to be low. The continuous sounds produced by the drill rig do not even rise to the level thought to cause auditory injury in marine mammals. Additionally, impact hammering and airgun operations will occur for extremely limited time periods (for a few hours at a time for 1–3 days per well and for a few hours at a time for 1–2 days per well, respectively). Moreover, auditory injury has not been noted in marine mammals from these activities either. Mitigation measures proposed for inclusion in any issued IHA will reduce these potentials even further.

Potential impacts to marine mammal habitat were discussed previously in this document (see the ''Anticipated Effects on Habitat'' section). Although some disturbance is possible to food sources of marine mammals, the impacts are anticipated to be minor enough as to not affect annual rates of recruitment or survival of marine mammals in the area. Based on the size of Cook Inlet where feeding by marine mammals occurs versus the localized area of drilling program activities, any missed feeding opportunities in the direct project area would be minor based on the fact that other feeding areas exist elsewhere. Additionally, drilling operations will not occur in the primary beluga feeding and calving habitat.

Taking into account the mitigation measures that are planned, effects on marine mammals are generally expected to be restricted to avoidance of a limited area around the drilling operation and short-term changes in behavior, falling within the MMPA definition of ''Level B harassment''. Animals are not expected to permanently abandon any area that is part of the drilling operations, and any behaviors that are interrupted during the activity are expected to resume once the activity ceases. Only a small portion of marine mammal habitat will be affected at any time, and other areas within Cook Inlet will be available for necessary biological functions. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from Buccaneer's proposed exploratory drilling program will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers

The requested takes proposed to be authorized represent 0.45 percent of the Alaska resident stock and 0.91 percent of the Gulf of Alaska, Aleutian Island and Bering Sea stock of killer whales (1,123 residents and 552 transients), 0.02 percent of the Gulf of Alaska stock of approximately 25,987 harbor porpoises, 0.01 percent of the Alaska stock of approximately 83,400 Dall's porpoises, 0.16–0.25 percent of the Alaska stock of approximately 810–1,233 minke whales, and 0.01 percent of the eastern North Pacific stock of approximately 18,017 gray whales. The take request presented for harbor seals represent 0.22 percent of the Cook Inlet/Shelikof stock of approximately 29,175 animals. These take estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once. The numbers of marine mammals taken are small relative to the affected species or stock sizes. In addition, the mitigation and monitoring measures (described previously in this document) proposed for inclusion in the IHA (if issued) are expected to reduce even further any potential disturbance to marine mammals. NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

Relevant Subsistence Uses

The subsistence harvest of marine mammals transcends the nutritional and economic values attributed to the animal and is an integral part of the cultural identity of the region's Alaska Native communities. Inedible parts of the whale provide Native artisans with materials for cultural handicrafts, and the hunting itself perpetuates Native traditions by transmitting traditional skills and knowledge to younger generations (NOAA, 2007).

The Cook Inlet beluga whale has traditionally been hunted by Alaska Natives for subsistence purposes. For several decades prior to the 1980s, the Native Village of Tyonek residents were the primary subsistence hunters of Cook Inlet beluga whales. During the 1980s and 1990s, Alaska Natives from villages in the western, northwestern, and North Slope regions of Alaska either moved to or visited the south central region and participated in the yearly subsistence harvest (Stanek, 1994). From 1994 to 1998, NMFS estimated 65 whales per year (range 21–123) were taken in this harvest, including those successfully taken for food and those struck and lost. NMFS has concluded that this number is high enough to account for the estimated 14 percent annual decline in the population during this time (Hobbs *et al.,* 2008). Actual mortality may have been higher, given the difficulty of estimating the number of whales struck and lost during the hunts. In 1999, a moratorium was enacted (Public Law 106–31) prohibiting the subsistence take of Cook Inlet beluga whales except through a cooperative agreement between NMFS and the affected Alaska Native organizations. Since the Cook Inlet beluga whale harvest was regulated in 1999 requiring cooperative agreements, five beluga whales have been struck and harvested. Those beluga whales were harvested in 2001 (one animal), 2002 (one animal), 2003 (one animal), and 2005 (two animals). The Native Village of Tyonek agreed not to hunt or request a hunt in 2007, when no co-management agreement was to be signed (NMFS, 2008a).

On October 15, 2008, NMFS published a final rule that established long-term harvest limits on the Cook Inlet beluga whales that may be taken by Alaska Natives for subsistence purposes (73 FR 60976). That rule prohibits harvest for a 5-year period (2008–2012), if the average abundance for the Cook Inlet beluga whales from the prior five years (2003–2007) is below 350 whales. The next 5-year period that could allow for a harvest (2013–2017), would require the previous five-year average (2008–2012) to be above 350 whales. The 2008 Cook Inlet Beluga Whale Subsistence Harvest Final Supplemental Environmental Impact Statement (NMFS, 2008a) authorizes how many beluga whales can be taken during a 5-year interval based on the 5-year population estimates and 10-year measure of the population growth rate. Based on the 2008–2012 5-year abundance estimates, no hunt occurred between 2008 and 2012 (NMFS, 2008a). The Cook Inlet Marine Mammal Council, which managed the Alaska Native Subsistence fishery with NMFS, was disbanded by a unanimous vote of the Tribes' representatives on June 20, 2012. At this time, no harvest is expected in 2013 or 2014. Residents of the Native Village of Tyonek are the primary subsistence users in Knik Arm area.

Data on the harvest of other marine mammals in Cook Inlet are lacking. Some data are available on the subsistence harvest of harbor seals, harbor porpoises, and killer whales in Alaska in the marine mammal stock assessments. However, these numbers are for the Gulf of Alaska including Cook Inlet, and they are not indicative of the harvest in Cook Inlet.

Some detailed information on the subsistence harvest of harbor seals is available from past studies conducted by the Alaska Department of Fish & Game (Wolfe *et al.,* 2009). In 2008, only 33 harbor seals were taken for harvest in the Upper Kenai-Cook Inlet area. In the same study, reports from hunters stated that harbor seal populations in the area were increasing (28.6%) or remaining stable (71.4%). The specific hunting regions identified were Anchorage, Homer, Kenai, and Tyonek, and hunting generally peaks in March, September, and November (Wolfe *et al.,* 2009).

Potential Impacts to Subsistence Uses

Section 101(a)(5)(D) also requires NMFS to determine that the authorization will not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. NMFS 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.

The primary concern is the disturbance of marine mammals through the introduction of anthropogenic sound into the marine environment during the proposed exploratory drilling operation. Marine mammals could be behaviorally harassed and either become more difficult to hunt or temporarily abandon traditional hunting grounds. If a large or very large oil spill occurred, it could impact subsistence species. However, as previously mentioned one is not anticipated to occur, and measures have been taken to prevent a large or very large oil spill. The proposed exploratory drilling program should not have any impacts to beluga harvests as none currently occur in Cook Inlet, and no takes of belugas are anticipated or proposed to be authorized. Additionally, subsistence harvests of other marine mammal species are limited in Cook Inlet.

Plan of Cooperation or Measures To Minimize Impacts to Subsistence Hunts

Regulations at 50 CFR 216.104(a)(12) require IHA 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. NMFS regulations define Arctic waters as waters above 60° N. latitude. The proposed mitigation measures described earlier in this document will reduce impacts to any hunts of harbor seals or other marine mammal species that may occur in Cook Inlet. These measures will ensure that marine mammals are available to subsistence hunters.

Unmitigable Adverse Impact Analysis and Preliminary Determination

The project will not have any effect on current beluga whale harvests because no beluga harvest will take place in 2014. Moreover, no take of belugas is anticipated or proposed to be authorized. Additionally, the proposed drilling area is not an important native subsistence site for other subsistence species of marine mammals. Also, because of the relatively small proportion of marine mammals utilizing Cook Inlet, the number harvested is expected to be extremely low. Therefore, because the proposed program would result in only temporary disturbances, the drilling program would not impact the availability of these other marine mammal species for subsistence uses.

The timing and location of subsistence harvest of Cook Inlet harbor seals may coincide with Buccaneer's project, but because this subsistence hunt is conducted opportunistically and at such a low level (NMFS, 2013c), Buccaneer's program is not expected to have an impact on the subsistence use of harbor seals. Moreover, hunts are unlikely to occur in mid-channel waters of Cook Inlet where drilling associated activities would occur.

NMFS anticipates that any effects from Buccaneer's proposed exploratory drilling program on marine mammals, especially harbor seals and Cook Inlet beluga whales, which are or have been taken for subsistence uses, would be short-term, site specific, and limited to inconsequential changes in behavior. NMFS does not anticipate that the authorized taking of affected species or stocks will reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (1) Causing the marine mammals to abandon or avoid hunting areas; (2) directly displacing subsistence users; or (3) placing physical barriers between the marine mammals and the subsistence hunters; and that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met. In the unlikely event of a major oil spill in Cook Inlet, there could be major impacts on the availability of marine mammals for subsistence uses. As discussed earlier in this document, the probability of a major oil spill occurring over the life of the project is low. Additionally, Buccaneer developed an ODPCP, which was reviewed by NMFS and approved by ADEC on August 29, 2012. Based on the description of the specified activity, the measures described to minimize adverse effects on the availability of marine mammals for subsistence purposes, and the proposed mitigation and monitoring measures, NMFS has preliminarily determined that there will not be an unmitgable adverse impact on marine mammal availability for subsistence uses from take incidental to Buccaneer's proposed activities.

Endangered Species Act (ESA)

Cook Inlet beluga whales are listed as endangered under the ESA. The U.S. Army Corps of Engineers consulted with NMFS on this proposed project pursuant to Section 7 of the ESA. On March 23, 2012, NMFS concluded that the proposed exploratory drilling program in upper Cook Inlet is not likely to adversely affect beluga whales or their critical habitat. On May 9, 2013, NMFS received a letter requesting reinitiation of consultation for Buccaneer's proposed operations due to modifications to the project plan of operations. On July 8, 2013, NMFS again concluded that Buccaneer's proposed exploratory drilling program in upper Cook Inlet is not likely to adversely affect beluga whales or their designated critical habitat. Mitigation measures laid out in the Section 7 Letters of Concurrence to ensure no take of beluga whales have been proposed for inclusion in any issued IHA. Therefore, NMFS' Office of Protected Resources does not intend to initiate formal consultation under Section 7 of the ESA.

National Environmental Policy Act (NEPA)

NMFS is currently conducting an analysis, pursuant to NEPA, to determine whether this proposed IHA may have a significant effect on the human environment. This analysis will be completed prior to the issuance or denial of this proposed IHA.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to Buccaneer for conducting an exploratory drilling program in upper Cook Inlet during the 2014 open water season, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

1. This IHA is valid from date of issuance through October 31, 2014.

2. This IHA is valid only for activities associated with Buccaneer's upper Cook Inlet exploratory drilling program. The specific areas where Buccaneer's exploratory drilling operations will occur are described in the August 2013 IHA application and depicted in Figure 1 of the application.

3. Species Authorized and Level of Take

a. The incidental taking of marine mammals, by Level B harassment only, is limited to the following species in the waters of Cook Inlet:

i. Odontocetes: 5 harbor porpoise; 5 Dall's porpoise; and 5 killer whales.

ii. Mysticetes: 2 gray whales and 2 minke whales.

iii. Pinnipeds: 51 harbor seals.

iv. If any marine mammal species not listed in conditions 3(a)(i) through (iii) are encountered during exploratory drilling operations and are likely to be exposed to sound pressure levels (SPLs) greater than or equal to 160 dB re 1 μPa (rms) for impulse sources or greater than or equal to 120 dB re 1 μPa (rms), then the Holder of this IHA must shut-down the sound source to avoid take.

b. The taking by injury (Level A harassment) serious injury, or death of any of the species listed in condition 3(a) or the taking of any kind of any other species of marine mammal is prohibited and may result in the modification, suspension or revocation of this IHA.

4. The authorization for taking by harassment is limited to the following acoustic sources (or sources with comparable frequency and intensity) and from the following activities:

a. airgun array with a total discharge volume of 720 in^3;

b. continuous drill rig sounds during active drilling operations and from rig tow; and

c. impact hammer during conductor pipe driving.

5. The taking of any marine mammal in a manner prohibited under this Authorization must be reported immediately to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS or her designee.

6. The holder of this IHA must notify the Chief of the Permits and Conservation Division, Office of Protected Resources, at least 48 hours prior to the start of exploration drilling activities (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible).

7. Mitigation and Monitoring Requirements: The Holder of this Authorization is required to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable impact on affected marine mammal species or stocks:

a. Utilize a sufficient number of NMFS-qualified, vessel-based Protected Species Observers (PSOs) to visually watch for and monitor marine mammals near the drill rig during daytime operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during start-ups of sound sources day or night. PSOs shall have access to reticle binoculars, big-eye binoculars, and night vision devices. PSO shifts shall last no longer than 4 hours at a time. PSOs shall also make observations during daytime periods when the sound sources are not operating for comparison of animal abundance and behavior, when feasible. When practicable, as an additional means of visual observation, drill rig or vessel crew may also assist in detecting marine mammals.

b. When a mammal sighting is made, the following information about the sighting will be recorded:

i. 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;

ii. Time, location, speed, activity of the vessel, sea state, ice cover, visibility, and sun glare;

iii. The positions of other vessel(s) in the vicinity of the PSO location (if applicable);

iv. The rig's position, speed if under tow, and 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.

c. Within safe limits, the PSOs should be stationed where they have the best possible viewing;

d. PSOs should be instructed to identify animals as unknown where appropriate rather than strive to identify a species if there is significant uncertainty;

e. Conductor Pipe Driving Mitigation Measures:

i. PSOs will observe from the drill rig during impact hammering out to the 160 dB (rms) radius of 2 km (1.24 mi). If marine mammal species for which take is not authorized enter this zone, then use of the impact hammer will cease.

ii. If cetaceans for which take is authorized enter within the 180 dB (rms) radius of 250 m (820 ft) or if pinnipeds for which take is authorized enter within the 190 dB (rms) radius of 60 m (200 ft), then use of the impact hammer will cease. Following a shutdown of impact hammering activities, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

iii. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then Buccaneer can initiate impact hammering using a ''soft start'' technique. Hammering will begin with an initial set of three strikes at 40 percent energy followed by a 1 min waiting period, then two subsequent three-strike sets. This ''soft-start'' procedure will be implemented anytime impact hammering has ceased for 30 minutes or more. Impact hammer ''soft-start'' will not be required if the hammering downtime is for less than 30 minutes and visuals surveys are continued throughout the silent period and no marine mammals are observed in the applicable zones during that time.

f. VSP Airgun Mitigation Measures:

i. PSOs will observe from the drill rig during airgun operations out to the 160 dB radius of 2.5 km (1.55 mi). If marine mammal species for which take is not authorized enter this zone, then use of the airguns will cease.

ii. If cetaceans for which take is authorized enter within the 180 dB (rms) radius of 240 m (787 ft) or if pinnipeds for which take is authorized enter within the 190 dB (rms) radius of 75 m (246 ft), then use of the airguns will cease. Following a shutdown of airgun operations, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

iii. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then Buccaneer can initiate airgun operations using a ''ramp-up'' technique. Airgun operations will begin with the firing of a single airgun, which will be the smallest gun in the array in terms of energy output (dB) and volume (in^3). Operators will then continue ramp-up by gradually activating additional airguns over a period of at least 30 minutes (but not longer than 40 minutes) until the desired operating level of the airgun array is obtained. This ramp-up procedure will be implemented anytime airguns have not been fired for 30 minutes or more. Airgun ramp-up will not be required if the airguns have been off for less than 30 minutes and visuals surveys are continued throughout the silent period and no marine mammals are observed in the applicable zones during that time.

g. No initiation of survey operations involving the use of sound sources is permitted from a shutdown position at night or during low-light hours (such as in dense fog or heavy rain).

h. Field Source Verification: The Holder of this IHA is required to conduct sound source verification tests for the drill rig, impact hammer, and the airgun array. Sound source verification shall consist of distances where broadside and endfire directions at which broadband received levels reach 190, 180, 170, 160, and 120 dB re 1 μPa (rms) for all active acoustic sources that may be used during the activities. Initial results must be provided to NMFS within 1 week of completing the analysis.

i. Helicopters must maintain an altitude of at least 1,000 ft (305 m), except during takeoffs, landings, or emergency situations.

8. Reporting Requirements: The Holder of this IHA is required to:

a. Submit an SSV report that describes the source of the sound, the environment, the measurements, and the methodology employed to make the measurements. Results will be presented as overall sound pressure levels and displays of 1/3rd octave band sound levels. Preliminary findings relative to the 120 dB, 160 dB, 180 dB, and 190 dB isopleths will be provided within 1 week of SSV completion.

b. Submit a draft Technical Report on all activities and monitoring results to NMFS' Permits and Conservation Division within 90 days of expiration of the IHA. The Technical Report will include:

i. Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

ii. Analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

iii. Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover;

iv. Analyses of the effects of drilling operation activities;

v. Sighting rates of marine mammals during periods with and without drilling operation activities (and other variables that could affect detectability), such as: (A) Initial sighting distances versus activity state; (B) closest point of approach versus activity state; (C) observed behaviors and types of movements versus activity state; (D) numbers of sightings/individuals seen versus activity state; (E) distribution around the drill rig versus activity state; and (F) estimates of take by Level B harassment based on presence in the 120 dB and 160 dB harassment zones.

c. Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, within 30 days after receiving comments from NMFS on the draft technical report. If NMFS has no comments on the draft technical report, the draft report shall be considered to be the final report.

9. a. In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this IHA, such as an injury (Level A harassment), serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), Buccaneer shall immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the Alaska Regional Stranding Coordinators. The report must include the following information:

i. Time, date, and location (latitude/longitude) of the incident;

ii. The name and type of vessel involved;

iii. The vessel's speed during and leading up to the incident;

iv. Description of the incident;

v. Status of all sound source use in the 24 hours preceding the incident;

vi. Water depth;

vii. Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);

viii. Description of marine mammal observations in the 24 hours preceding the incident;

ix. Species identification or description of the animal(s) involved;

x. The fate of the animal(s); and

xi. Photographs or video footage of the animal (if equipment is available).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with Buccaneer to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Buccaneer may not resume their activities until notified by NMFS via letter or email, or telephone.

b. In the event that Buccaneer discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), Buccaneer will immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the NMFS Alaska Stranding Hotline. The report must include the same information identified in the Condition 9(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with Apache to determine whether modifications in the activities are appropriate.

c. In the event that Buccaneer discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in Condition 2 of this Authorization (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Buccaneer shall report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, the NMFS Alaska Stranding Hotline (1–877–925–7773), and the Alaska Regional Stranding Coordinators within 24 hours of the discovery. Buccaneer shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. Activities may continue while NMFS reviews the circumstances of the incident.

10. Activities related to the monitoring described in this IHA do not require a separate scientific research permit issued under section 104 of the MMPA.

11. A copy of this Authorization must be in the possession of all contractors and PSOs operating under the authority of this IHA.

12. Penalties and Permit Sanctions: Any person who violates any provision of this IHA is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA.

13. This IHA may be modified, suspended or withdrawn if the Holder fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or if there is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

Request for Public Comments

NMFS requests comment on our analysis, the draft authorization, and any other aspect of the Notice of Proposed IHA for Buccaneer's proposed upper Cook Inlet exploratory drilling program. Please include with your comments any supporting data or literature citations to help inform our final decision on Buccaneer's request for an MMPA authorization.

Dated: March 31, 2014.

Perry F. Gayaldo,

Acting Deputy Director, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2014–07601 Filed 4–4–14; 8:45 am]

BILLING CODE 3510–22–P