Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with Planned Exploration Drilling Program During 2012 Near Camden Bay in the Beaufort Sea, Alaska

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List of Acronyms

°	degree
°C	degrees Celsius
4MP	Marine Mammal Monitoring and Mitigation Plan
μPa	micropascal
ADF&G	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
AHD	acoustic harassment devices
ASL	above sea level
ATOC	Acoustic Thermometry of Ocean Climate
bbl/hr	barrels per hour
BCB	Bering-Chukchi-Beaufort stock (bowheads)
BOEMRE	U.S. Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
BOWFEST	Bowhead Whale Feeding Ecology Study
BWASP	Bowhead Whale Aerial Survey Program
CAA	Conflict Avoidance Agreement
CFR	Code of Federal Regulations
CI	Confidence Interval
Com Center	Communication and Call Center
cm^3	cubic meters
CD	cadmium
Discoverer	*Motor Vessel Noble Discoverer*
dB	decibel(s)
DNV	Det Norske Veritas
DP	Dynamic Positioning
DPS	distinct population segment
EP	Exploration Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
Exploration Drilling Program	Camden Bay 2012 Exploration Drilling Program
ft	feet
ft^2	square feet
Hz	hertz
ICAS	Inupiat Community of the Arctic Slope
IHA	Incidental Harassment Authorization
in.	inches
in^3	cubic inches
IUCN	International Union for the Conservation of Nature
kg	kilogram(s)
kHz	kiloHertz
km	kilometer(s)
km^2	kilometers squared
km/hr	kilometers per hour
Kulluk	conical drilling unit *Kulluk*
KSOP	Kuukpik Subsistence Oversight Panel

m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/hr	cubic meters per hour
MAWP	maximum anticipated wellhead pressure
mi	statute miles
mi/hr	miles per hour
Mikhail Ulyanov	Motor Vessel Mikhail Ulyanov
min	minute(s)
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MONM	Marine Operations Noise Model (JASCO)
N/A	not applicable
NMFS	National Marine Fisheries Service
Noble	Noble Drilling
Nordica	Motor Vessel Nordica
NPDES	National Pollution Discharge Elimination System
NSB	North Slope Borough
NWAB	Northwest Arctic Borough
OCS	Outer Continental Shelf
ODPCP	Oil Discharge Prevention and Contingency Plan
OSR	Oil Spill Response
OST	Oil Spill Tanker
OSV	offshore supply vessel
psi	pounds per square inch
POC	Plan of Cooperation
PTS	Permanent Threshold Shift
RL	received level
rms	root mean square
ROV	remotely operated vehicle
SA	Subsistence Advisor
SAR	Search and Rescue
SEL	sound exposure level
Shell	Shell Offshore Inc.
SIWAC	Shell Ice and Weather Advisory Center
TAH	total aromatic hydrocarbons
TK	Traditional Knowledge
TTS	temporary threshold shift
U.S.	United States
USFWS	United States Fish and Wildlife Service
VOSS	Vessel of Opportunity Skimming System
VSI	Vertical Seismic Imager
VSP	vertical seismic profile
Zn	zinc
ZVSP	zero-offset vertical seismic profile

Executive Summary

Shell Offshore Inc. (Shell) plans to drill two exploration wells at two drill sites in the eastern Beaufort Sea on Outer Continental Shelf (OCS) leases acquired from the United States (U.S.) Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) during the 2012 drilling season. Shell plans to use the conical drilling unit *Kulluk* (*Kulluk*) or the Motor Vessel (M/V) *Noble Discoverer* (*Discoverer*) drillship for exploration drilling in Camden Bay, but not both. Either drilling vessel would be attended by a minimum of 11 support vessels for the purposes of ice management, anchor handling, oil spill response (OSR), refueling, and resupply. The *Discoverer* is an industry-standard, ice-reinforced drillship similar to those used previously in the Beaufort and Chukchi Seas, as well as elsewhere in the world's oceans. The *Kulluk* has an Arctic Class IV hull designed to maintain its location in drilling mode in moving ice with thickness up to 4 feet (ft) (1.2 meters [m]). Either drilling vessel will be accompanied by ice management vessels throughout its service during the 2012 drilling season. During exploration drilling and associated operations, either the *Kulluk* or *Discoverer* will emit near continuous non-pulse sounds that ensonify only very limited areas of the ocean bottom and intervening water column. Within the timeframe of exploration drilling operations, Shell may also conduct a particular type of short-duration vertical seismic profile (VSP) survey known as a zero-offset VSP, or ZVSP at the end of each drill hole. The ZVSPs emit pulse sounds that also ensonify very limited areas of the ocean bottom and intervening water column for only approximately 10-14 hours at the end of each drill hole. For Camden Bay exploration drilling during 2012, Shell also has committed to collect drilling mud, and drill cuttings with adhered mud, plus selected wastewater streams and not discharge these, but dispose of them at an onshore facility.

Since the early 1990s, the National Marine Fisheries Service (NMFS) has issued incidental harassment authorizations (IHAs) to industry for the non-lethal taking of small numbers of marine mammals related to the non-pulse, continuous sounds generated by offshore exploration drilling and impulse sounds generated during seismic surveys. Shell requests an IHA pursuant to Section 101 (a) (5) (D) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. § 1371 (a) (5), to allow non-lethal takes of whales and seals incidental to Shell's 2012 exploration drilling program, including ZVSP surveys, and related activities.

Shell has calculated the estimated take of marine mammals from both the low-level continuous sound generated during exploration drilling operations and impulse sound generated during a short-duration ZVSP survey likely to occur at the end of each drill hole. As detailed herein, it is assumed that any takes that might result from the proposed operations would be temporary and not be of biological significance to marine mammal populations. Any impacts from these sounds to whales and seals would be temporary and result in only short-term displacement of seals and whales from within ensonified zones produced by such sound sources.

An impact analysis of underwater sound generated by the planned exploration drilling during 2012 with either the *Kulluk* or *Discoverer* and ZVSP surveys (included herein; summarized in Table ES-1) determined that a maximum number of the following marine mammals may be exposed to sounds ≥120 decibels (dB) re 1 micropascal (μPa) from exploration drilling activities or a very limited amount of icebreaking activities or ≥160 dB from ZVSP surveys (see Table 4-1 for marine mammal populations and Tables 6-4 through 6-12 for estimates of marine mammals exposed to sound from the exploration drilling operations, icebreaking, or ZVSPs associated with this exploration drilling program):

Table ES-1 Summary of Incidental Takes of Marine Mammals by Season (Summer and Fall)

	Bowhead	Beluga	Bearded Seal	Ringed Seal
Kulluk (summer)	23	4	41	798
Kulluk (fall)	5,575	6		
Discoverer (summer)	1	0	3	49
Discoverer (fall)	1,387	0		
ZVSP (summer)	2	0	3	60
ZVSP (fall)	N/A[a]	0		
Icebreaking (summer)	8	1	11	211
Icebreaking (fall)	0	3		

[a] Estimates for exposures to ZVSP activities during the fall have been included in the calculations from drilling (see Tables 6-4 and 6-5).
Note: The results presented in this table for the *Kulluk* and *Discoverer* should not be summed, as the operations will only be conducted from one of the drilling vessels.

The same impact analysis determined that other species that may occur in the Beaufort Sea were unlikely to be exposed to industrial sounds at these levels, but minimal numbers of exposures are possible base on chance encounters.

As a consequence of Shell's planned mitigation measures for operations in the Beaufort Sea, including a commitment to halt exploration drilling during the Kaktovik and Nuiqsut bowhead whale subsistence hunts, any effects on the bowhead whale as a subsistence resource also will be negligible.

The organization of this request for IHA follows the organization of Chapter 50 Code of Federal Regulations (CFR) § 216.104 (a). The remainder of this document is organized as to follow 50 CFR § 216.104 (a) (1)-(14).

Shell relied on guidance in 50 CFR § 216.104, Submission of Requests, to prepare its request for this IHA:

> (a) In order for the National Marine Fisheries Service (NMFS) to consider authorizing the taking by U.S. citizens of small numbers of marine mammals incidental to a specified activity (other than commercial fishing), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to the Assistant Administrator. All requests must include the following information for their activity:

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

The specific activities that can be expected to result in incidental taking of marine mammals pursuant to the requested IHA are limited to Shell's exploration drilling program and related activities, including ZVSP surveys. Shell has not included the potential impacts arising from a hypothetical oil spill in its consideration of "specified activity" in this IHA application for two reasons.

First, oil spill impacts would not be "substantially similar" to the primarily acoustic impacts that can be expected to result from exploration drilling and the ZVSP surveys. In identifying the "specified activity" at issue in this IHA, Shell has followed the instruction of the U.S. Court of Appeals for the Ninth Circuit in *Center for Biological Diversity v. Kempthorne*, 588 F.3d 701 (9th Cir. 2009). In that case, the court held that, to be consistent with the purpose of the Marine Mammal Protection Act (MMPA), "specified activities" are properly defined so that the "anticipated effects are substantially similar." *Id.* at 709. The activities specified in this IHA application – exploration drilling, ZVSP surveys, and related activities – all have the potential to cause primarily acoustic impacts and thus are substantially similar. In contrast the potential impacts from a spill would be substantially dissimilar from the primarily acoustic impacts for which this IHA is sought.

Second, impacts from speculative events, such as an oil spill, are not properly included in an IHA application. The Ninth Circuit instructed that when determining whether an activity will have a "negligible impact" on the affected marine mammal population, the analysis should focus on "effects that are 'reasonably expected' and 'reasonably likely,' but not those effects that are speculative or uncertain.'" *Id.* at 710-11. Oil spills are highly unlikely events and are not reasonably expected to occur during the course of exploration drilling and ZVSP surveys (*See* [Analysis of the Probability of an "Unspecified Activity" and Its Impacts: Oil Spill; Attachment H of this application). Thus, an analysis of whether the impacts resulting from the "specified activity" will be negligible should not include the impacts from a "speculative" oil spill.

For these reasons, Shell believes that the MMPA and NMFS's regulations implementing that statute instruct that Shell should not seek "authorization" for an action it does not intend to take, and, in fact, has expended substantial resources to prevent. Accordingly, the "specified activities" for which Shell seeks this IHA are restricted to exploration drilling, ZVSP surveys, and related activities.

Exploration Drilling

Shell plans to conduct an exploration drilling program on BOEMRE Alaska OCS leases located north of Point Thomson near Camden Bay in the Beaufort Sea during the 2012 drilling season (Camden Bay 2012 Exploration Drilling Program, hereinafter, the "exploration drilling program"*)* (Figure 1-1).

The leases were acquired during Beaufort Sea Oil and Gas Lease Sales 195 (March 2005) and 202 (April 2007). During the exploration drilling of 2012, Shell plans to drill two exploration wells at two drill sites, one well each on the Torpedo prospect (NR06-04 Flaxman Island lease block 6610, OCS-Y-1941 [Flaxman Island 6610 – Torpedo "H" drill site] or NR06-04 Flaxman Island lease block 6559, OCS-Y-1936 [Flaxman Island 6559 – Torpedo "J" drill site]) and the Sivulliq prospect (NR06-04 Flaxman Island lease block 6658, OCS-Y 1805 [Flaxman Island 6658 – Sivulliq "N" or "G" drill sites] Table 1-1). All drilling is planned to be vertical.

Table 1-1 Shell Lease Blocks Covered in the Camden Bay Exploration Drilling Program Starting in 2012

Drill Site	Lease File Number	NR06-04 Flaxman Island Lease Block No.	Surface Location (NAD 83)*		Distance to Mainland Shore mi (km)
			Latitude (N)	Longitude (W)	
Sivulliq G	OCS-Y 1805	6658	70° 23' 46.82"	146° 01' 03.46"	16.6 (26.7)
Sivulliq N**	OCS-Y 1805	6658	70° 23' 29.58"	145° 58' 52.53"	16.2 (26.1)
Torpedo H**	OCS-Y 1941	6610	70° 27' 01.62"	145° 49' 32.07"	20.8 (33.5)
Torpedo J	OCS-Y 1936	6559	70° 28' 56.94"	145° 53' 47.15"	23.1 (37.2)

*North American Datum 1983
**Drill sites from approved Camden Bay EP

Shell plans to drill a Torpedo prospect well (Torpedo "H" or "J") first, followed by a Sivulliq well (Sivulliq "N" or "G"), unless adverse surface conditions or other factors dictate a reversal of drilling sequence. In that case, Shell will mobilize to the Sivulliq prospect and drill there first. As with any Arctic exploration program, weather and ice conditions will dictate actual operations. As such, Shell's actual sequence for completing the identified exploration wells may vary.

One of two drilling vessels, the *Kulluk* (owned by Shell and operated by Noble Drilling [(Noble]) or *Discoverer* (owned and operated by Noble) will be used in Camden Bay during 2012 exploration drilling activities, but not both. Rig specifications for the *Kulluk and Discoverer* are located in Attachment A.

Kulluk

The *Kulluk* has an Arctic Class IV hull design, is capable of drilling in up to 600 ft (182.9 m) of water and is moored using a 12-point anchor system. The *Kulluk's* mooring system consists of 12 Hepburn winches located on the outboard side of the main deck, anchor wires lead off the bottom of each winch drum inboard for approximately 55 ft (16.8 m). The wire is then redirected by a sheave, down through a hawse pipe to an underwater, ice protected, swivel fairlead. The wire travels from the fairlead directly under the hull to the anchor system on the seafloor. The *Kulluk* would have an anchor radius maximum of 3,117 ft (950 m) for the Sivulliq and Torpedo drill sites. While on location at the drill sites, the *Kulluk* will be affixed to the seafloor using 12, 15 metric ton Stevpris anchors arranged in a radial array.

The *Kulluk* is designed to maintain its location in drilling mode in moving ice with thickness up to 4 ft (1.2 m) without the aid of any active ice management. With the aid of the ice management vessels, the *Kulluk* would be able to withstand more severe ice conditions. In more open water conditions, the *Kulluk* can maintain its drilling location during storm events with wave heights up to 18 ft (5.5 m) while drilling, and can withstand wave heights of up to 40 ft (12.2 m) when not drilling and disconnected (assuming a storm duration of 24 hours).

Discoverer

The *Discoverer* is a true drillship, and is a largely self-contained drillship that offers full accommodations for a crew of up to 140 persons. The *Discoverer* is an anchored drillship with an 8-point anchored mooring system and would likely have a maximum anchor radius of 2,969-2,986 ft (905-910 m) at either the Sivulliq or Torpedo drill sites. While on location at the drill sites, the *Discoverer* will be affixed to the seafloor using eight 7,000 kilogram (kg) Stevpris anchors arranged in a radial array. The underwater fairleads prevent ice fouling of the anchor lines. Turret mooring allows orientation of vessel's bow into the prevailing ice drift direction to present minimum hull exposure to drifting ice. The vessel is rotated around the turret by hydraulic jacks. Rotation can be augmented by the use of the fitted bow and stern thrusters. The hull has been reinforced for ice resistance. Ice-strengthened sponsons have been retrofitted to the ship's hull.

The *Discoverer* is classed by Det Norske Veritas (DNV) as a Mobile Offshore Drilling Unit for worldwide service. It is a "1A1 Ship-Shaped Drilling Unit l" and is capable of performing drilling operations offshore Alaska. The *Discoverer* has been issued with a DNV Appendix to Class stating:

"the structural strength and material quality of the 'Ice Belt' formed by the sponsons below the 8950mm A/B level, have been reviewed against the requirements for the DNV ICE-05 Additional Class Notation and found to meet those requirements (as contained in DNV Rules for Classification of Ships, Pt 5 Ch 1, July 2006) for a design temperature of -15 degrees C."

Vessels

During 2012 exploration drilling activities, the *Kulluk* or *Discoverer* will be attended by a minimum of 11 vessels that will be used for ice management, anchor handling, oil spill response (OSR), refueling, resupply, drill mud/cuttings and wastewater transfer, equipment and waste holding, and servicing of the drilling operations (Tables 1-1a and 1-1b). A small number of workboats associated with OSR training, and stored on an oil spill response barge (OSR barge) are included in Table 1-1b, but are not counted among the 11 attending vessels. All vessels will either be in transit or staged (i.e., on anchor) in the Beaufort Sea during the exploration drilling activities.

Table 1-1a Camden Bay Exploration Drilling Program – Proposed Support Vessel List

Specification	Ice Management Vessel [1]	Anchor Handler [2,7]	OSV [3]	West Dock Supply Vessel[4]	OSV[5]	Deck Barge[6]	Waste Barge
Length	380.5 ft (116 m)	360.6 ft (110 m)	280 ft (85.4 m)	134 ft (50.3 m)	280 ft (85.4 m)	360 ft (110 m)	500 ft (152.4 m)
Width	85 ft (26 m)	80 ft (24.4 m)	60 ft (18.29 m)	32 ft (11.6 m)	60 ft (18.29 m)	100 ft (30.5 m)	74 ft (22.6 m)
Draft	27.5 ft (8.4 m)	24 ft (7.3 m)	19.24 ft (5.87 m)	7 ft (2.1 m)	16.5 ft (5.0 m)	14 ft (4.3 m)	27.5 ft (8.4 m)
Accommodations (persons) (berths)	82	64	29	17	26	10	-
Maximum Speed	16 knots (30 km/hr)	15 knots (27.8 km/hr)	15 knots (25 km/hr)	10 knots (18.5 km/hr)	13.5 knots (25 km/hr)	10 knots (18.5 km/hr)	-
Fuel Capacity	11,070 bbl	12,575 bbl	8,411 bbl (normal) 11,905 bbl (max)	667 bbl	6,235 bbl (normal)	2,381 bbl	155,000 bbl

1 Based on *Nordica,* or similar vessel
2 Based on *Hull 247,* or similar vessel
3 Based on the *Carol Chouest,* or similar vessel
4 Based on *Arctic Seal,* or similar vessel
5 Based on *Harvey Spirit,* or similar vessel
6 Based on *Southeast Provider* & *Ocean Ranger*
7 Hull 247 is under construction by Chouest Offshore. By 2012, she will be christened under a name to be determined.

The M/V *Nordica (Nordica)* or a similar vessel, will serve as the primary ice management vessel in support of the *Kulluk* or *Discoverer*. *Hull 247* will provide anchor handling duties, serve as the berthing (accommodations) vessel for the OSR crew and will also serve as a secondary ice management vessel. When managing ice, the *Nordica* (or similar vessel) and *Hull 247* will generally be confined to a 40 degree (^{o}) arc up to 3.1 statute mile (mi) (4.9 kilometers [km]) upwind originating at the drilling vessel (Figure 1-3). It is anticipated that the ice management vessels will be managing ice for up to 38 percent of the time when within 25 mi (40 km) of the *Kulluk* or *Discoverer*. Active ice management involves using the ice management vessel to steer larger floes so that their path does not intersect with the drill site. Around-the-clock ice forecasting using realtime satellite coverage (available through Shell Ice and Weather Advisory Center [SIWAC]) will support the ice management duties. When the *Nordica* and *Hull 247* are not needed for ice management, they will reside outside the 25 mi (40 km) radius from the *Kulluk* or *Discoverer* if it is safe to do so. These vessels will enter and exit the Beaufort Sea with the *Kulluk* or *Discoverer*.

As anchor handler, *Hull 247*'s duties include setting and removing anchors, berthing (accommodations) vessel for the OSR barge crew, providing supplemental oil recovery capability (Vessel of Opportunity Skimming System ([VOSS]) and managing smaller ice floes that may pose a potential safety issue to the *Kulluk* or *Discoverer* and the support vessels that will service the *Kulluk or Discoverer*.

The exploration drilling operations will require the transfer of supplies between the Deadhorse/West Dock shorebase or Dutch Harbor and the *Kulluk* or *Discoverer*. While the *Kulluk* or *Discoverer* is anchored at a drill site, Shell has allowed for 24 visits/tie-ups (if the *Kulluk* is the drilling vessel being used) or 8 visits/tie-ups (if the *Discoverer* is being used) throughout the drilling season from support vessels. The *Harvey Spirit* (or similar vessel), a 280 ft (85.3 m) offshore supply vessel (OSV) with Dynamic Positioning (DP), will shuttle supplies from the *Arctic Seal* (or similar vessel) and/or the *Southeast Provider* (aka deck barge) to the *Kulluk* or *Discoverer.* During the resupply trips, the *Harvey Spirit* will be used to remove the mud/cuttings and other. The mud/cuttings and other waste streams will be transported to the *Southeast Provider* (deck barge) or waste barge. Other waste streams (sanitary waste, domestic waste, bilge water, ballast water) will also be transferred to the deck barge, or the waste barge for temporary storage. These waste streams will also be brought south for disposal at the end of the drilling season. While the *Kulluk* or *Discoverer* leaves Camden Bay temporarily during the Kaktovik and Nuiqsut (Cross Island) subsistence whale hunts, Shell will resupply the *Kulluk* or *Discoverer* with drilling supplies and equipment brought in from Dutch Harbor and stored on the *Carol Chouest,* also an OSV, or the *Harvey Spirit*. The *Carol Chouest* will be used as a backup supply vessel and shuttle between Camden Bay and Dutch Harbor. When exploration drilling starts up again after the bowhead whaling hunts have concluded, additional resupply may be required from West Dock via the *Arctic Seal* via transfer to the *Harvey Spirit* to the drilling vessel.

Removal of waste and resupply to the drilling vessels will be conducted the same way regardless of drilling vessel.

Oil Spill Response Vessels

The OSR vessels will include a primary OSR barge (the *Arctic Endeavor* and Point Class Tug, or similar vessel), *Hull 247* will act as a berthing (quartering) vessel and a VOSS and an oil spill tanker (OST - M/V *Mikhail Ulyanov* (*Mikhail Ulyanov*) (or a similar vessel). The *Harvey Spirit* will also act as a VOSS.

The OSR barge will have associated smaller workboats called Kvichaks. There are three 34-ft (10 m) Kvichaks that will support the OSR barge by laying out booms. One 47-ft (14 m) Rozema will provide skimming services. The Berthing Vessel (*Hull 247*) will be dedicated to the revised Camden Bay EP exploration drilling program and remain in the vicinity of the *Kulluk* or *Discoverer*, with the OSR barge and the OST being staged to respond as needed to a discharge. In the unlikely event of a spill, the *Hull 247* can also be used to lighter recovered oil, emulsions and free water to the *Mikhail Ulyanov*. Specifications for these vessels are provided below in Table 1-1a and 1-1b.

An additional barge housing the oil spill containment system will be centrally located in the Beaufort Sea. The barge will be supported by an Invader Class Tug and possibly an anchor handler. The tug tending the OSR containment system barge will either drift or motor under "slow-steam" movement with the barge. An anchor handler is included in this plan only as an additional tending option for the OSR containment system barge, if Shell deems it necessary in advance of the season to anchor the OSR containment system barge. Shell does not assume the OSR containment system barge will be anchored or that the anchor handler is necessary, but includes the option of anchoring the barge and it being also tended by an anchor handler in case that option is chosen.

The *Mikhail Ulyanov* or similar vessel with similar liquid storage capacity would be staged such that it would arrive at a recovery site, if needed, within 24 hours of departure from their staging location. The purpose of the OST would be to provide a place to store large volumes of recovered crude oil, emulsion and free water in the unlikely event of a spill and OSR operations. Surplus storage capacity aboard the OST beyond what is required for response at a recovery site may be allocated to store other liquid commodities consumed by the drilling vessel and support vessels, including diesel fuel.

Table 1-1b Camden Bay Exploration Drilling Program – Proposed Oil Spill Response Vessel List

Specification	OSR Barge[1,2]		OST[1,3]	OSR Containment System[1,4]		
	Barge	Tug		Barge	Tug	Anchor Handler[5]
Length	205 ft (62.5 m)	90 ft (27.4 m)	853 ft (260 m)	400 ft (122 m)	136 ft (41.5 m)	275 ft (83.5 m)
Width	90 ft (27.4 m)	32 ft (9.8 m)	112 ft (34 m)	100 ft (30.5 m)	36 ft 11 m	59 ft (18.0 m)
Draft	8.5 ft (2.6 m)		44.6 ft (13.6 m)	12 ft (3.7 m)	20 ft (6.1 m)	20 ft (6.1 m)
Accommodations	--	8	25	--	8	23
Maximum Speed	--	7 knots (13 km/hr)	16 knots (30 km/hr)	--	8 knots (15 km/hr)	16 knots (30 km/hr)
Fuel Storage	--	1,428 bbl (227 m^3)	440,000 bbl (69,952 m^3)	--	3,690 bbl (587 m^3)	7,485 bbl (1,190 m^3)
Liquid Storage	18,636 bbl		513,000 bbl additional 221,408 bbl (35,200 m^3) in separate ballast tanks	80,000 bbl (12,719 m^3)	NA	37,462 bbl (5,956 m^3)
Workboats	(1) 47 ft (14 m) skim boat (3) 34 ft (10 m) work boats (4) mini-barges		NA	NA	NA	

[1] Or similar vessel
[2] Based on the *Arctic Endeavor* & Point Class tug
[3] Based on the *Mikhail Ulyanov*
[4] Based on a standard deck barge, Crowley Invader class ocean going tug, and a *Tor Viking*-style anchor handler.
[5] Vessel included for planning purposes only, not assumed necessary but as an additional tending option if deemed necessary by Shell.

Aircraft

An AW139 or Sikorsky S-92 helicopter based in Deadhorse will be used for flights between the shorebase and drill sites (Table 13.a-3). It is expected that on average, up to two flights per day (approximately 12 flights per week) will be necessary to transport supplies and rotate crews. A Sikorsky S92 based in Barrow will be used for search and rescue operations.

Marine Mammal Observer (MMO) overflights will utilize a de Havilland Twin Otter aircraft. The de Havilland Twin Otter is expected to fly daily.

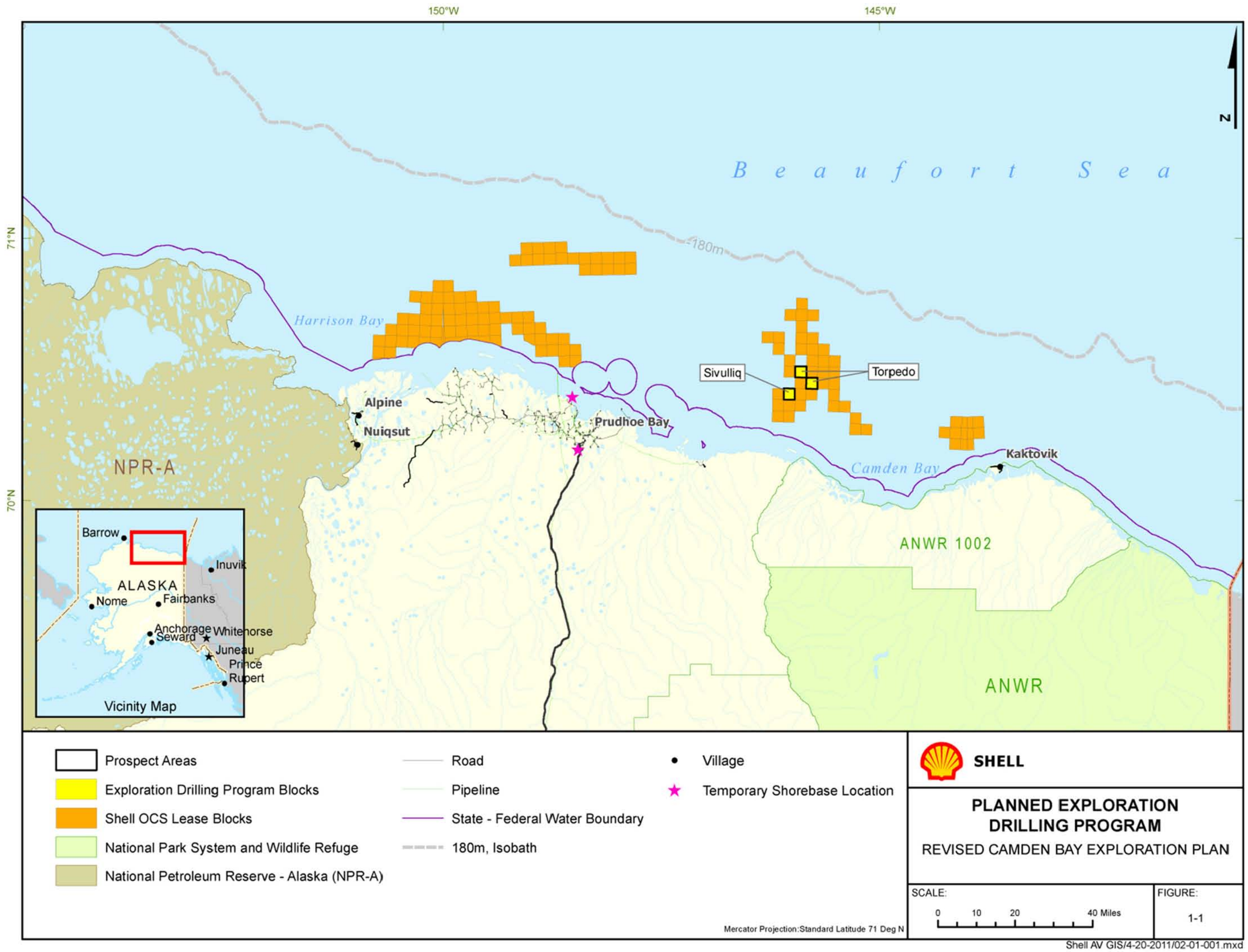
Table 1-1c presents the aircraft planned to support the exploration drilling program. This includes crew changes via helicopter and search-and-rescue via helicopter, and a fixed wing aircraft for aerial monitoring of marine mammals.

Table 1-1c Camden Bay Exploration Drilling Program – Proposed Aircraft List

Aircraft	Flight Frequency
Aircraft (or similar)	
Sikorsky S-92, AW139 or similar – crew rotation	Two round trips between the shorebase and offshore vessels per day (approximately 12/week) throughout the 2012 drilling season
(1) Sikorsky S-92 or AW139 Helicopter – SAR	Trips made only in emergency; training flights
(1) deHavilland Twin Otter (DHC-6) – Used for 4MP	Daily, beginning 5-7 days before drilling and ending 5-7 days after drilling ends

The *Kulluk* or *Discoverer* and their associated support vessels will transit through the Bering Strait into the Chukchi Sea on July 1 or later, arriving on location near Camden Bay approximately July 10. Exploration drilling activities at the Sivulliq or Torpedo drill sites are planned to begin on or about July 10 and run through 31 October 2012, with a suspension of all operations beginning August 25 for the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts. During the suspension for the whale hunts, the drilling fleet will leave the Camden Bay project area and move to an area north of latitude 71°25'N and west of longitude 146° 4'W. Shell will consult with the Whaling Captain's Associations of Kaktovik and Nuiqsut to ascertain the conclusion of their respective subsistence bowhead whale hunts. The *Kulluk* or *Discoverer* and support vessels will return to resume activities after the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts conclude. Activities will extend through October 31, depending on ice and weather. At the end of the drilling season, the *Kulluk* or *Discoverer*, ice management vessels, and all remaining support vessels will transit west into and through the Chukchi Sea.

Figure 1-1 Camden Bay Exploration Drilling Program Lease Block Locations



Vertical Seismic Profile

At the end of each drill hole Shell may conduct a geophysical survey referred to as ZVSP at each drill site where a well is drilled in 2012. During ZVSP surveys, an airgun array is deployed at a location near or adjacent to the drilling vessel, while receivers are placed (temporarily anchored) in the wellbore. The sound source (airgun array) is fired repeatedly, and the reflected sonic waves are recorded by receivers (geophones) located in the wellbore. The geophones, typically in a string, are then raised up to the next interval in the wellbore and the process is repeated until the entire wellbore has been surveyed. The purpose of the ZVSP is to gather geophysical information at various depths, which can then be used to tie-in or ground-truth geophysical information from the previous seismic surveys with geological data collected within the wellbore.

Shell will be conducting a particular form of VSP known as a ZVSP, in which the sound source is maintained at a constant location near the wellbore (Figure 1-2). A typical sound source that would be used by Shell in 2012 is the ITAGA eight-airgun array, which consists of four 150 cubic inches (in^3) (2,458 cubic centimeters [cm^3]) airguns and four 40 in^3 (655 cm^3) airguns. These airguns can be activated in any combination and Shell would utilize the minimum airgun volume required to obtain an acceptable signal. Current specifications of the array are provided in Table 1-2. The airgun array is depicted within its frame or sled, which is approximately 6 ft x 5 ft x 10 ft (see photograph below). Typical receivers would consist of a Schlumberger wireline four level Vertical Seismic Imager (VSI) tool, which has four receivers 50-ft (15-m) apart.

Photograph of the ITAGA 8-airgun Array in Sled

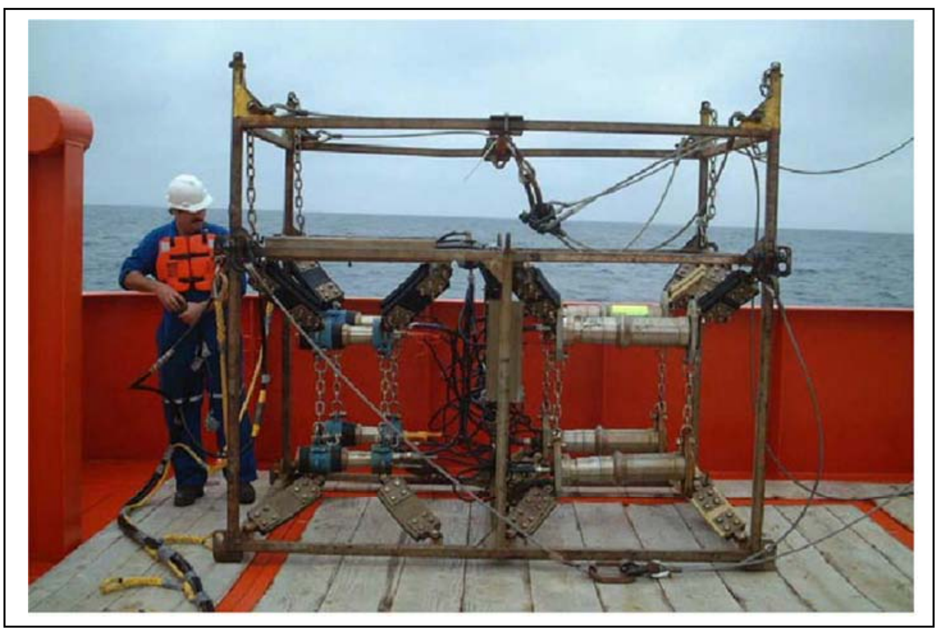


Figure 1-2 Schematic of ZVSP

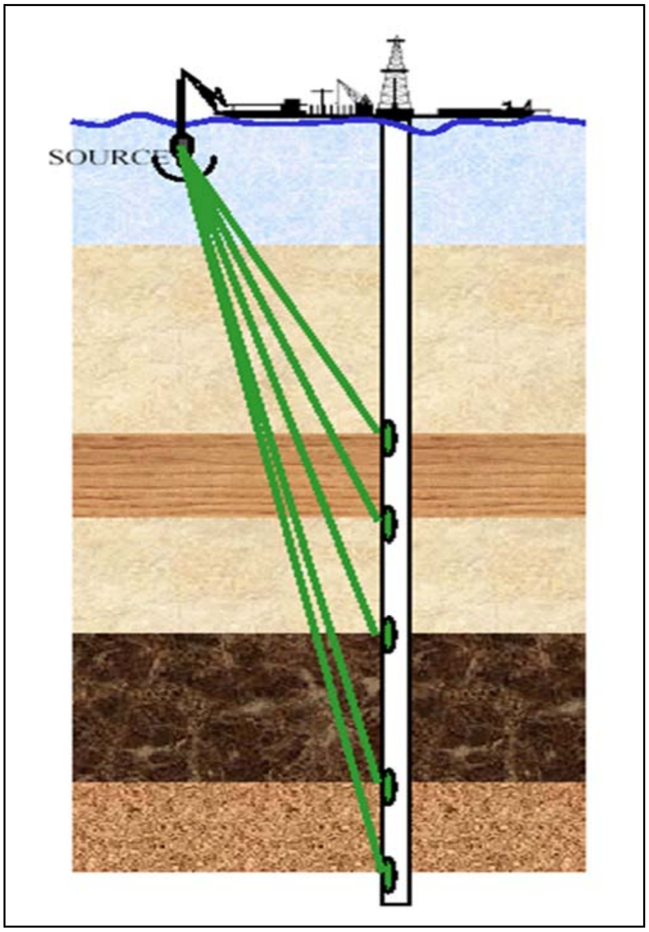


Table 1-2 Sound Source (airgun array) Specifications for ZVSP Surveys in Camden Bay in 2012

Source Type	No. Sources	Maximum Total Chamber Size	Pressure	Source Depth	Calibrated Peak-Peak Vertical Amplitude	Zero-Peak Sound Pressure Level
SLB, ITAGA Sleeve Array	8 airguns 4 X 150 in^3 (2458 cm^3) 4 X 40 in^3 (655 cm^3)	760 in^3 12,454 cm^3	2,000 psi 138 bar	9.8 ft / 3.0 m 16.4 ft / 5.0 m	16 bar @1 m 23 bar @1 m	238 dB re1µPa @1 m 241 dB re1µPa @1 m

A ZVSP survey is normally conducted at each well after total depth is reached but may be conducted at a shallower depth. For each survey, Shell would deploy the sound source (airgun array) over the side of the *Kulluk* or *Discoverer* with a crane (sound source will be 50-200 ft (15-61 m) from the wellhead depending on crane location), to a depth of approximately 10-23 ft (3-7 m) below the water surface. The VSI, with its four receivers, will be temporarily anchored in the wellbore at depth. The sound source will be pressured up to 2,000 pounds per square inch (psi), and activated 5-7 times at approximately 20-second intervals. The VSI will then be moved to the next interval of the wellbore and reanchored, after which the airgun array will again be activated 5-7 times. This process will be repeated until the entire well bore is surveyed in this manner. The interval between anchor points for the VSI usually is between 200-300 ft

(61-91 m). A normal ZVSP survey is conducted over a period of about 10-14 hours depending on the depth of the well and the number of anchoring points.

Ice Management and Forecasting

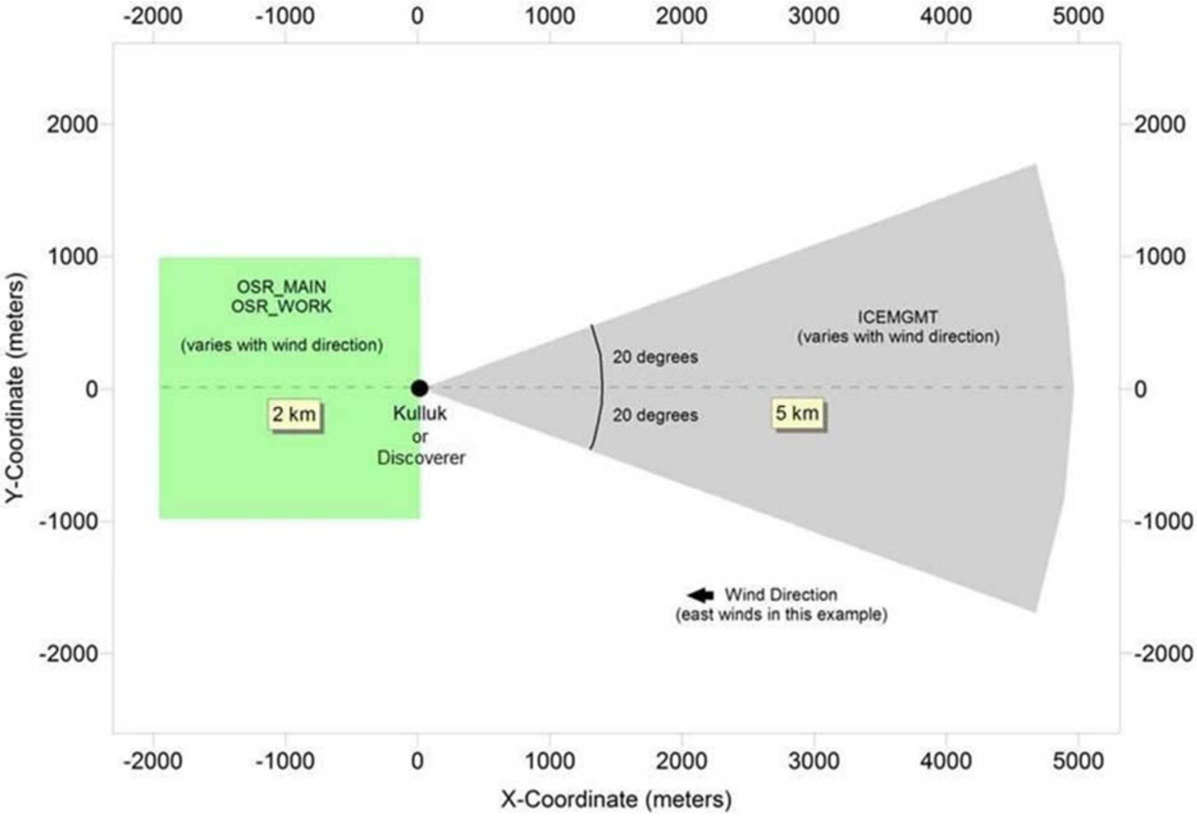
Shell recognizes the exploration drilling program is located in an area that is characterized by active sea ice movement, ice scouring, and storm surges. In anticipation of potential ice hazards that may be encountered, Shell will implement an Ice Management Plan (IMP) see Attachment B) to ensure real-time ice and weather forecasting to identify conditions that might put operations at risk and modify its activities accordingly. The IMP also contains ice threat classification levels depending on the time available to suspend exploration drilling operations, secure the well and escape from advancing hazardous ice. Realtime ice and weather forecasting will be available to operations personnel for planning purposes and to alert the fleet of impending hazardous ice and weather conditions. Ice and weather forecasting is provided by SIWAC. This center is continuously manned by experienced personnel who rely on a number of data sources for ice forecasting and tracking including:

- Radarsat and Envisat data - satellites with Synthetic Aperture Radar providing all-weather imagery of ice conditions with very high resolution;
- Moderate Resolution Imaging Spectroradiometer - a satellite providing lower resolution visual and near infrared imagery;
- Aerial reconnaissance - provided by specially deployed fixed wing or rotary wing aircraft for confirmation of ice conditions and position;
- Reports from Ice Specialists on the ice management vessel and anchor handler and from the Ice Observer on the drillship;
- Incidental ice data provided by commercial ships transiting the area; and
- Information from the National Oceanic and Atmospheric Administration ice centers and the University of Colorado.

Drift ice will be actively managed by ice management vessels, consisting of an ice management vessel and an anchor handling vessel. Ice management for safe operation of Shell's planned exploration drilling program will occur far out in the OCS, remote from the vicinities of any routine marine vessel traffic in the Beaufort Sea causing no threat to public safety or services that occurs near to shore. Shell vessels will also communicate movements and activities through the 2012 North Slope Communications Centers. Management of ice by ice management vessels will occur during a drilling season predominated by open water and thus will not contribute to ice hazards, such as ridging, override, or pileup in an offshore or nearshore environment.

The ice-management/anchor handling vessels would manage the ice by deflecting any ice floes that could affect the *Kulluk* or *Discoverer* when it is drilling and would also handle the *Kulluk* or *Discoverer's* anchors during connection to and separation from the seafloor. When managing ice, the *Nordica* and *Hull 247* will generally be operate a 40^{o} arc up to 3.1 mi (4.9 km) upwind originating at the *Kulluk* or *Discoverer* (Figure 1-3).

Figure 1-3 Ice Management Vessels Configuration for the *Kulluk* or *Discoverer*



It is anticipated that the ice management vessels will be managing ice for 38 percent of the time when within 25 mi (40 km) of the *Kulluk* or *Discoverer* (Figure 1-3). The ice floe frequency and intensity are unpredictable and could range from no ice to ice sufficiently dense that the fleet has insufficient capacity to continue operating, and the *Kulluk* or *Discoverer* would need to disconnect from its anchors and move off site. If ice is present, ice management activities may be necessary in early July and towards the end of operations in late October, but it is not expected to be needed throughout the proposed drilling season. Shell has indicated that when ice is present at the drill site, ice disturbance will be limited to the minimum needed to allow exploration drilling to continue. First-year ice will be the type most likely to be encountered. The ice-management vessels will be tasked with managing the ice so that it will flow easily around and past the *Kulluk* or *Discoverer* without building up in front of, or around it. This type of ice is managed by the ice-management vessel continually moving back and forth across the drift line, directly updrift of the *Kulluk* or *Discoverer* and making turns at both ends. During ice-management, the vessel's propeller is rotating at approximately 15–20 percent of the vessel's propeller rotation capacity. Ice management occurs with slow movements of the vessel using lower power and therefore slower propeller rotation speed (*i.e.,* lower cavitation), allowing for fewer repositions of the vessel, thereby reducing cavitation effects in the water. Occasionally, there may be multi-year ice ridges that would be managed at a much slower speed than that used to manage first-year ice.

During Camden Bay exploration drilling operations, Shell does not plan to conduct any icebreaking activities; rather, Shell will deploy its support vessels to manage ice as described herein. As detailed in Shell's IMP (see Attachment B), actual breaking of ice will occur only in the unlikely event that ice conditions in the immediate vicinity of operations create a safety hazard for the drilling vessel. In such a circumstance, operations personnel will follow the guidelines established in the IMP to evaluate ice conditions and make the formal designation of a hazardous, ice alert condition, which would trigger the procedures that govern any actual icebreaking operations. Historical data relative to ice conditions in the Beaufort Sea in the vicinity of Shell's planned operations, and during the timeframe for those operations, establish that there is a very low probability (e.g., minimal) for the type of hazardous ice conditions that might necessitate icebreaking (e.g., records of the National Naval Ice Center archives). This probability could be greater at the shoulders of the drilling season (early July or late October); therefore, for purposes of evaluating possible impacts of the planned activities, Shell has assumed limited icebreaking activities for a very limited period of time, and estimated incidental takes of marine mammals (see Section 6) from such activities.

Planned Mitigation

The *Kulluk* or *Discoverer* and all support vessels will operate in accordance with the provisions of a Plan of Cooperation Addendum (POC) (Attachment D), and presumed vessel operation mitigation measures included in past IHAs issued to Shell for arctic activities. Shell prepared a POC Addendum with affected North Slope subsistence communities to mitigate effects of Shell's planned exploration drilling program where activities would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses. The POC was prepared based upon Shell's experience (recent and past) since the 1980s in the Alaska OCS and in consultation with affected Beaufort and Chukchi Sea communities and marine mammal commissions. During these meetings, Shell focused on lessons learned from prior years' activities and presented mitigation measures for avoiding potential conflicts, which are outlined in the POC Addendum. Shell's Chukchi Sea POC Addendum addresses transit activities for vessels that will transit through the Chukchi Sea to operate in the Beaufort Sea. For the proposed Camden Bay exploration drilling program, Shell's Beaufort Sea POC Addendum addresses the issue of vessel transit, drilling, aerial support, and onsite vessel activities. The mitigation measures described in Section 12.3 are intended to minimize any adverse effects on the availability of marine mammals for subsistence uses.

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

Anticipated Duration of this Permit

Shell anticipates that the IHA issued by NMFS for the planned Camden Bay 2012 exploration drilling activities will be valid from the date of issuance through the conclusion of the 2012 drilling season.

Timing of Mobilization and Demobilization of the *Kulluk* or *Discoverer*

Shell's base plan is for two ice management vessels, the *Nordica* (primary ice management), the anchor handling vessel *Hull 247*(secondary ice management), the deck barge and tug, waste barge and tug, offshore supply vessels (OSVs; *Harvey Spirit* and *Carol Chouest*) and potentially some of the OSR vessels to accompany the *Kulluk* or *Discoverer* traveling north of Dutch Harbor through the Bering Strait, after 1 July 2012 then through the Chukchi Sea, around Pt. Barrow and east through the Alaskan Beaufort Sea, before arriving on location of the Torpedo H location on or about July 10, or Sivulliq N if adverse surface conditions or other factors dictate a reversal of drilling sequence. At the completion of the drilling season on or before 31 October 2012, one or two ice management vessels, along with various support vessels, such as the OSR fleet, deck and waste barges, and OSV(s) will accompany the *Kulluk* or *Discoverer* as it travels west through the Beaufort Sea, then south through the Chukchi Sea and the Bering Strait. Subject to ice conditions alternate exit routes and vessel departures may be considered.

Exploration Drilling

Shell plans to drill exploration wells at two drill sites located near Camden Bay during the 2012 drilling season: one at Torpedo H or J (lease blocks 6610 or 6559) and another at Sivulliq N or G (both on lease block 6658) (Figure 1-1 and Table 2-1). Shell will mobilize into the Beaufort Sea in early July and plans to commence drilling in Camden Bay as soon as ice, weather, and other conditions allow for safe drilling operations. Shell's plan assumes the *Kulluk* or *Discoverer* will be on location at Torpedo "H", or "J" by July 10, or Sivulliq "N" or "G" if ice or other adverse surface conditions dictate a different drilling sequence.

Table 2-1 Drill Site Locations and Water Depths

Drill Site	Distance From Shore	NR06-04 Lease Block No.	Surface Location (NAD 83)		Water Depth
	mi (km)		Latitude (north)	Longitude (west)	ft (m)
Sivulliq G	16.6 (26.7)	6658	70° 23' 46.82"	146° 01' 03.46"	110 (33.5)
Sivulliq N	16.2 (26.1)	6658	70° 23' 29.58"	145° 58' 52.53"	107 (32.6)
Torpedo H	20.8 (33.5)	6610	70° 27' 01.62"	145° 49' 32.07"	120 (36.6)
Torpedo J	23.1 (37.2)	6559	70° 28' 56.94"	145° 53' 47.15"	124 (37.8)

Activities associated with 2012 Camden Bay exploration drilling and analyzed herein include operation of the *Kulluk* or *Discoverer*, ZVSP survey at the completion of the drill hole, associated support vessels, crew change support and re-supply. The *Kulluk* or *Discoverer* will remain at the location of the designated exploration drill sites except when mobilizing and demobilizing to and from Camden Bay, transiting between drill sites, suspension of activities for the bowhead whale subsistence harvest described below, and temporarily moving off location if it is determined ice conditions require such a move to ensure the safety of personnel and/or the environment in accordance to Shell's IMP. Ice management vessels and OSR vessels will remain in close proximity to the drillship during exploration drilling operations. Crew change/re-supply vessels will transit to and from the *Kulluk* or *Discoverer* at the estimated frequency shown in Table 1-1c. Helicopter flight support from Deadhorse will provide crew changes, and fixed-wing aircraft may depart from Deadhorse also, for an aerial survey program used for marine mammal monitoring.

Exploration drilling activities at the Sivulliq or Torpedo drill sites are planned to begin on or about July 10 and run through 31 October 2012, with a suspension of all operations beginning August 25 for the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts. The *Kulluk* or *Discoverer* and support vessels will leave the Camden Bay project area and will return to resume activities after the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts conclude. During the suspension for the whale hunts the drilling fleet will leave the Camden Bay project area and move to an area north of latitude 71°25'N and west of longitude 146° 4'W. During the exploration drilling activities shutdown in the bowhead whale hunt areas, vessel and drilling vessel resupply would likely occur well away from bowhead whale hunt areas. Activities will extend through October 31, depending on ice and weather.

Shell will cease exploration drilling on or before October 31, after which the *Kulluk* or *Discoverer* will exit the Alaskan Beaufort Sea. In total, it is anticipated by Shell that the exploration drilling program will require approximately 78 drilling days, excluding weather, whaling shut-down or other operational delays. Shell assumes approximately 11 additional days will be needed for drilling vessel mobilization, drilling vessel moves between locations, and drilling vessel demobilization.

3. Species and Numbers of Marine Mammals in Area

Marine mammals that occur in the area of the planned Camden Bay 2012 exploration drilling program belong to three taxonomic groups: odontocetes (toothed cetaceans, such as beluga whale and narwhal), mysticetes (baleen whales), and carnivora (pinnipeds and polar bears). Cetaceans and pinnipeds (except Pacific walrus) are the subject of this IHA application to NMFS. The Pacific walrus and polar bear are managed by the U.S. Fish & Wildlife Service (USFWS).

Eight cetacean and four seal species under the jurisdiction of NMFS are known to or may occur in the area of the planned exploration drilling program. Two of these species, the bowhead and humpback whales, are listed as "endangered" under the U.S. Endangered Species Act (ESA). Humpback whales normally do not occur in the Beaufort Sea; however, a single humpback sighting of a cow/calf pair was recorded in western Harrison Bay in 2007 (Greene et al. 2007). Another sighting of a single humpback whale reported during the 2009 aerial survey program for the Bowhead Whale Feeding Ecology Study (BOWFEST) was also likely in the Beaufort Sea near Barrow (Goetz et al. 2010). Two species of seal (ringed seal and bearded seal) have been proposed for listing as "threatened" species under the ESA (NMFS 2010a,b). Both species are common and abundant in the Beaufort Sea during the open-water season.

To avoid redundancy, we have included the required information about the species that are known to or may be present and (insofar as it is known) numbers of these species in Section 4, below.

4. Status, Distribution and Seasonal Distribution of Affected Species or Stocks of Marine Mammals

Sections 3 and 4 are integrated here to minimize repetition.

Eight cetacean and four seal species could occur in the U.S. Beaufort Sea during the planned exploration drilling program (Table 4-1). Of these twelve species, two cetacean species (beluga and bowhead whales), and three seal species (ringed, bearded, and spotted seals) are likely to occur near the proposed exploration drilling operations. The marine mammal species that is likely to be encountered most widely (in space and time) throughout the period of the planned exploration drilling program is the ringed seal. Encounters with bowhead and beluga whales are expected to be limited to particular regions and seasons, as discussed below.

Table 4-1 The Habitat, Abundance (in the Beaufort Sea), and Conservation Status of Marine Mammals in Habiting the Area of the Planned Exploration Drilling Program

Species	Habitat	Abundance	ESA[1]	IUCN[2]	CITES[3]
Odontocetes Beluga whale (*Delphinapterus leucas*) (Eastern Chukchi Sea Stock	Offshore, Coastal, Ice edges	3,710 [4]	Not listed	NT	–
Beluga whale (Beaufort Sea Stock)	Offshore, Coastal, Ice edges	39,257 [5]	Not Listed	NT	–
Harbor Porpoise (*Phocoena phocoena*) (Bering Sea Stock)	Coastal, inland waters, shallow offshore waters	Uncommon	Not listed	LR-lc	–
Killer whale (*Orcinus orca*)	Widely distributed	Rare	Not listed	DD	–
Narwhal (*Monodon monoceros*)	Offshore, Ice edge	Rare [6]	Not listed	NT	–
Mysticetes Bowhead whale (*Balaena mysticetus*)	Pack ice & Shelf	10,545 [7] 12,631 [8]	Endangered	LR-lc	I
Gray whale (*Eschrichtius robustus*) (eastern Pacific population)	Coastal, lagoons	Uncommon	Not listed	LR-lc	I
Humpback whale (*Megaptera novaeangliae*)	Shelf, coastal	Rare	Endangered	LR-lc	I
Minke whale (*Balaenoptera acutorostrata*)	Shelf, coastal	Rare	Not listed	LR-lc	I
Pinnipeds Bearded seal (*Erignathus barbatus*)	Pack ice, shallow offshore waters	250,000-300,000[9] 155,000 [10]	Proposed Threatened	LR-lc	–
Ribbon seal (*Histriophoca fasciata*)	Offshore, pack ice	Rare	Not Listed	DD	–
Ringed seal (*Pusa hispida*)	Landfast & pack ice, offshore	18,000 [11] 326,500 [12]	Proposed Threatened	LR-lc	–
Spotted seal (*Phoca largha*)	Pack ice, coastal haulouts	59,214 [13] 1000 [14]	Arctic pop. Segments not listed	DD	–

[1] U.S. Endangered Species Act.
[2] Red List of Threatened Species (IUCN 2010). Codes for IUCN classifications: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LR = Lower Risk (nt = Near Threatened; lc = Least Concern); DD = Data Deficient.
[3] Convention on International Trade in Endangered Species of Wild Fauna and Flora (UNEP-WCMC 2004). Appendix I = endangered/threatened; Appendix II = threatened/at risk; Appendix III = some restrictions on trade of animals/animal parts
[4] Allen and Angliss (2010)
[5] Beaufort Sea population (IWC 2000, Allen and Angliss 2010).
[6] Population in Baffin Bay and the Canadian arctic archipelago is ~60,000 (DFO Canada 2004); very few enter the Beaufort Sea
[7] 2001 Population Estimate (Zeh and Punt 2005)
[8] 2004 Population Estimate (Koski et al. 2010)
[9] Popov (1976), Burns (1981a)
[10] Beringia Distinct Population Segment (NMFS 2010a)
[11] Beaufort Sea minimum estimate with no correction factor based on aerial surveys in 1996-1999 (Frost et al. 2002 *in* Allen and Angliss 2010)
[12] Alaskan Beaufort Sea population estimate (Amstrup 1995)
[13] Alaska stock based on aerial surveys in 1992 (Allen and Angliss 2010)
[14] Alaska Beaufort Sea population (USDI/MMS 1996)

Other cetacean species that have been observed in the Beaufort Sea but are uncommon or rarely identified in the project area include harbor porpoise, narwhal, killer whale, minke whale, humpback whale, and gray whale. These species could occur in the project area, but each of these species is uncommon or rare in the area and relatively few encounters with these species are expected during the exploration drilling program. The narwhal occurs in Canadian waters and occasionally in the Beaufort Sea, but it is rare there and is not expected to be encountered.

4.1 Odontocetes

(a) Beluga (Delphinapterus leucas)

Beluga whales are largely absent from the coast of the Alaskan Beaufort Sea during summer. A few beluga whales could be encountered there in late summer and autumn. There is a higher probability of encountering westward-migrating belugas farther offshore in the Beaufort Sea (>37 mi (60 km), or water depths >656 ft (200 m)) during late summer and autumn than in nearshore locations where exploration drilling related activities will be focused.

Beluga whale is an arctic and subarctic species that includes several populations in Alaska and northern European waters. It has a circumpolar distribution in the Northern Hemisphere and occurs between 50ºN and 80ºN (Reeves et al. 2002). It is distributed in seasonally ice-covered seas and migrates to warmer coastal estuaries, bays, and rivers in summer for molting (Finley 1982).

Pod structure in beluga groups appears to be along matrilineal lines, with males forming separate aggregations. Small groups are often observed traveling or resting together. Belugas often migrate in groups of 100 to 600 or more animals (Braham and Krogman 1977), although smaller groups are also seen commonly. The relationships between whales within groups are not known, although hunters have reported that belugas form family groups with whales of different ages traveling together (Huntington 2000).

In Alaska, beluga whales comprise five distinct stocks: Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet (O’Corry-Crowe et al. 1997). For the planned exploration drilling program near Camden Bay in the Beaufort Sea, only animals from the Beaufort Sea stock and eastern Chukchi Sea stock may be encountered. Some eastern Chukchi Sea animals enter the Beaufort Sea in late summer (Suydam et al. 2005).

The most recent estimate of the ***eastern Chukchi Sea*** population is 3,710 animals (Allen and Angliss 2010). This estimate was based on surveys conducted in 1989–1991. Survey effort was concentrated on the 106-mi (171-km) long Kasegaluk Lagoon where belugas are known to occur during the open-water season. The calculation was considered to be a minimum population estimate for the eastern Chukchi Sea stock because the surveys on which it was based did not include offshore areas where belugas are also likely to occur. This population is considered to be stable. It is assumed that beluga whales from the eastern Chukchi stock winter in the Bering Sea (Allen and Angliss 2010).

Although beluga whales are known to congregate in Kasegaluk Lagoon during summer, evidence from a small number of satellite-tagged animals suggests that some of these whales may subsequently range into the Arctic Ocean north of the Beaufort Sea. Suydam et al. (2005) put satellite tags on 23 beluga whales captured in Kasegaluk Lagoon in late June and early July 1998–2002. Five of these whales moved far into the Arctic Ocean and into the pack ice to 79°–80°N. These and other whales moved to areas as far as 685 mi (1,102 km) offshore between Barrow and the Mackenzie River Delta spending time in water with 90% ice coverage.

Belugas of the eastern Chukchi Sea stock could occur in the vicinity of the planned exploration drilling activities if they were to migrate into or through the Beaufort Sea as reported by Suydam et al. (2005). However, most belugas that may occur near the activities will likely be from the Beaufort Sea stock.

The ***Beaufort Sea population*** was estimated to contain 39,258 individuals as of 1992 (DeMaster 1995; Allen and Angliss 2010). This estimate was based on the application of a sightability correction factor of 2× to the 1992 uncorrected census of 19,629 individuals made by Harwood et al. (1996). This estimate was obtained from a partial survey of the known range of the Beaufort Sea population and may be an underestimate of the true population size. This population is not considered by NMFS to be a strategic stock and is believed to be stable or increasing (Allen and Angliss 2010).

Beluga whales of the Beaufort Sea stock winter in the Bering Sea, summer in the eastern Beaufort Sea, and migrate through offshore waters of western and northern Alaska (Allen and Angliss 2010). The majority of belugas in the Beaufort Sea stock migrate into the Beaufort Sea in April or May, although some whales may pass Point Barrow as early as late March and as late as July (Braham et al. 1984; Ljungblad et al. 1984; Richardson et al. 1995a).

Much of the Beaufort Sea seasonal population enters the Mackenzie River estuary for a short period during July–August to molt their epidermis, but they spend most of the summer in offshore waters of the eastern Beaufort Sea, Amundsen Gulf and more northerly areas (Davis and Evans 1982; Harwood et al. 1996; Richard et al. 2001). Belugas are rarely seen in the central Alaskan Beaufort Sea during the early summer, but a number were reported there during early July from aerial surveys in 2008 (Christie et al. 2010). During late summer and autumn, most belugas migrate westward far offshore near the pack ice or shelf break (Frost et al. 1988; Hazard 1988; Clarke et al. 1993; Miller et al. 1999, Moore et al. 2000). During fall aerial surveys in the Alaskan Beaufort Sea, Lyons et al. (2009) reported the highest beluga sighting rates during the first two weeks of September in the northern part of their survey area.

Moore (2000) and Moore et al. (2000) suggested that beluga whales select deeper water at or beyond the shelf break independent of ice cover. However, during the westward migration in late summer and autumn, small numbers of belugas are sometimes seen near the north coast of Alaska (e.g., Johnson 1979). Christie et al. (2010) reported higher beluga sighting rates at locations >37 mi (60 km) offshore than at locations nearer shore during aerial surveys in the Alaskan Beaufort Sea in 2006-2008. The main fall migration corridor of beluga whales is typically ~62+ mi (100+ km) north of the coast. Satellite-linked telemetry data show that some belugas of this population migrate west considerably farther offshore, as far north as 76º to 78ºN latitude (Richard et al. 1997, 2001).

In summary, beluga whales are largely absent from the coast of the Alaskan Beaufort Sea during summer, but a few beluga whales could be encountered there in late summer and autumn. There is a higher probability of encountering westward-migrating belugas farther offshore in the Beaufort Sea during late summer and autumn than in nearshore locations. Belugas of the eastern Chukchi population could also be encountered in the Beaufort Sea.

(b) Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is a small odontocete that inhabits shallow, coastal waters—temperate, subarctic, and Arctic—in the Northern Hemisphere (Read 1999). Harbor porpoises occur mainly in shelf areas where they can dive to depths of at least 220 m and stay submerged for more than 5 minutes (min) (Harwood and Wilson 2001) feeding on small schooling fish (Read 1999). Harbor porpoises typically occur in small groups of only a few individuals and tend to avoid vessels (Richardson et al. 1995a).

The subspecies *P. p. vomerina* ranges from the Chukchi Sea, Pribilof Islands, Unimak Island, and the southeastern shore of Bristol Bay south to San Luis Obispo, California. Point Barrow, Alaska, is the approximate northeastern extent of the regular range (Suydam and George 1992), though there are extralimital records east to the mouth of the Mackenzie River in the Northwest Territories, Canada and recent sightings in the Beaufort Sea in the vicinity of Prudhoe Bay during surveys in 2007 and 2008 (Christie et al. 2010). MMOs onboard industry vessels reported one harbor porpoise sighting in the Beaufort Sea in 2006 and no sightings were recorded in 2007 or 2008 (Savarese et al. 2010). Monnett and Treacy (2005) did not report any harbor porpoise sightings during aerial surveys in the Beaufort Sea from 2002 through 2004. Small numbers of harbor porpoises could occur in the general area of the planned Camden Bay exploration drilling program.

(c) Killer Whale (*Orcinus orca*)

Killer whales are cosmopolitan and globally fairly abundant. The killer whale is very common in temperate waters, but it also frequents the tropics and waters at high latitudes. Killer whales appear to prefer coastal areas, but are also found in deep water (Dahlheim and Heyning 1999). The greatest abundance is thought to be within 497 mi (800 km) of major continents (Mitchell 1975) and the highest densities occur in areas with abundant prey. Both resident and transient stocks have been described. These are believed to differ in several aspects of morphology, ecology, and behavior including dorsal fin shape, saddle patch shape, pod size, home range size, diet, travel routes, dive duration, and social integrity of pods (Allen and Angliss 2010).

Killer whales are known to inhabit almost all coastal waters of Alaska, extending from southeast Alaska through the Aleutian Islands to the Bering and Chukchi seas (Allen and Angliss 2010). Killer whales probably do not occur regularly in the Beaufort Sea although sightings have been reported (Lowry et al. 1987, George and Suydam 1998). George et al. (1994) reported that they and local hunters see a few killer whales at Point Barrow each year. Killer whales are more common southwest of Barrow in the southern Chukchi Sea and the Bering Sea. Based on photographic techniques, ~100 animals have been identified in the Bering Sea (ADF&G 1994). Killer whales from either the North Pacific resident or transient stock could occur in the Chukchi or Beaufort seas during the summer or fall.

(d) Narwhal (Monodon monoceros)

Narwhals have a discontinuous arctic distribution (Hay and Mansfield 1989; Reeves et al. 2002). A large population inhabits Baffin Bay, West Greenland, and the eastern part of the Canadian Arctic archipelago, and much smaller numbers inhabit the Northeast Atlantic/East Greenland area. The International Union for the Conservation of Nature (IUCN)-World Conservation Union lists the species as "near threatened" (IUCN 2010). Aerial surveys of four hunting grounds off the coast of Greenland in 2006 yielded abundance estimates of between 6,024 and

8,368 individuals in each area (Heide-Jørgensen et al. 2010). Innes et al. (2002) estimated a population size of 45,358 narwhals in the Canadian Arctic, although only part of the area was surveyed. More recent surveys of portions of Baffin Bay in the Canadian High Arctic resulted in a total population estimate of >60,000 individuals (Richard et al. 2010). The Alaskan Beaufort Sea is not defined as a portion of a narwhal population's range and it is considered extralimital in this region (Reeves et al. 2002). However, there are scattered records of narwhal in Alaskan waters, including reports by subsistence hunters. Thus, it is possible, but unlikely, that individuals could be encountered in the area of the planned exploration drilling program.

4.2 Mysticetes

(a) Bowhead Whale (*Balaena mysticetus*)

Few bowhead whales are expected in the project area at the commencement of the exploration drilling program in July. Shell anticipates more bowheads to be present in the area in the fall during the whales' westward migration. Mitigation measures built into Shell's operational plans will mitigate potential impacts on local subsistence bowhead whale hunting and will minimize impacts on the species during exploration drilling activities before and after the subsistence hunt.

Bowhead whales only occur at high latitudes in the northern hemisphere and have a disjunctive circumpolar distribution (Reeves 1980). The bowhead is one of only three whale species that spend their entire lives in the Arctic. Bowhead whales are found in four areas: the western Arctic (Bering, Chukchi, and Beaufort Seas) of northeastern Russia, Alaska, and northwestern Canada; the Canadian High Arctic and West Greenland (Nunavut, Baffin Bay, Davis Strait, and Hudson Bay); the Okhotsk Sea (eastern Russia); and the Northeast Atlantic from Spitzbergen westward to eastern Greenland. Those four stocks are recognized for management purposes. The largest population is the Western Arctic or Bering–Chukchi–Beaufort (BCB) stock, which includes whales that winter in the Bering Sea and migrate through the Bering Strait, Chukchi Sea and Alaskan Beaufort Sea to the Canadian Beaufort Sea, where they feed during the summer. These whales migrate west through the Alaskan Beaufort Sea in the fall as they return to wintering areas in the Bering Sea. Visual and satellite tracking data show that some bowhead whales continue migrating west past Barrow and through the Chukchi Sea to Russian waters where they may spend days to weeks apparently feeding before turning southeast toward the Bering Sea (Moore et al. 1995; Mate et al. 2000; Quakenbush et al. 2010). Some bowheads reach ~75°N latitude during the westward fall migration (Quakenbush et al. 2010).

The pre-exploitation population of bowhead whales in the Bering, Chukchi, and Beaufort Seas is estimated to have been 10,400-23,000 whales. Commercial whaling activities may have reduced this population to perhaps 3000 animals (Woodby and Botkin 1993). Up to the early 1990s, the population size was believed to be increasing at a rate of about 3.2% per year (Zeh et al. 1996) despite annual subsistence harvests of 14–74 bowheads from 1973 to 1997 (Suydam et al. 1995). A census in 2001 yielded an estimated annual population growth rate of 3.4% (95% Confidence Interval [CI] 1.7–5%) from 1978 to 2001 and a population size (in 2001) of ~10,470 animals (George et al. 2004) which was subsequently revised to 10,545 by Zeh and Punt (2005). A population estimate from photo identification data collected in 2004 was 12,631 (Koski et al. 2010) which further supports the estimated 3.4 percent population growth rate. Assuming a continuing annual population growth of 3.4%, the 2012 bowhead population may number around 15,232 animals. The large increases in population estimates that occurred from the late 1970s to the early 1990s were partly a result of actual population growth, but were also partly attributable to improved census techniques (Zeh et al. 1993). Although apparently recovering well, the BCB bowhead population is currently listed as endangered under the ESA and is classified as a strategic stock by NMFS and depleted under the MMPA (Allen and Angliss 2010).

The BCB stock of bowhead whales winters in the central and western Bering Sea and many of them summer in the Canadian Beaufort Sea and Amudsen Gulf (Moore and Reeves 1993). Spring migration through the Chukchi and the western Beaufort seas occurs through offshore ice leads, generally from mid-April to early June but with small numbers passing during March to mid-April and early- through mid-June (Braham et al. 1984; Moore and Reeves 1993; Koski et al. 2005).

Some bowheads arrive in coastal areas of the eastern Canadian Beaufort Sea and Amundsen Gulf in late May and June, but most may remain among the offshore pack ice of the Beaufort Sea until mid-summer. After feeding primarily in the Canadian Beaufort Sea and Amundsen Gulf, bowheads migrate westward from late August through mid- or late October. Industry funded aerial surveys of the Camden Bay area west of Kaktovik reported a number of whales feeding in that region in 2007 and 2008 (Lyons et al. 2009; Christie et al. 2010). Feeding activity in the Camden Bay area was previously reported by Würsig et al. (2002).

Fall migration into the Alaskan Beaufort Sea is primarily during September and October. However, small numbers of bowheads have been seen or heard offshore from the Prudhoe Bay region during the later half of August (Treacy 1993; LGL and Greeneridge 1996; Greene 1997; Greene et al. 1999; Blackwell et al. 2004, 2009a; Greene et al. 2007). Satellite tracking of bowheads has also shown that some whales move to the Chukchi Sea prior to September (ADF&G 2009). Consistent with this, Nuiqsut whalers have stated that the earliest arriving bowheads have apparently reached the Cross Island area earlier in recent years than formerly.

The BOEMRE (operating as the former Minerals Management Service [MMS]) has conducted or funded late-summer/autumn aerial surveys for bowhead whales in the Alaskan Beaufort Sea since 1979 (e.g., Ljungblad et al. 1986, 1987; Moore et al. 1989; Treacy 1988–1998, 2000, 2002a,b; Monnett and Treacy 2005; Treacy et al. 2006; Clarke et al. 2011a,b). Bowheads tend to migrate west in deeper water (farther offshore) during years with higher-than-average ice coverage than in years with less ice (Moore 2000; Treacy et al. 2006). In addition, the sighting rate tends to be lower in heavy ice years (Treacy 1997:67). During fall migration, most bowheads migrate west in water ranging from 49 to 656 ft (15 to 200 m) deep (Miller et al. 2002). Some individuals enter shallower water, particularly in light ice years, but very few whales are ever seen shoreward of the barrier islands in the Alaskan Beaufort Sea. Survey coverage far offshore in deep water is usually limited, and offshore movements may have been underestimated. However, the main migration corridor is over the continental shelf.

Although a few bowheads are sometimes present in the Beaufort Sea in late August, most westward-migrating bowhead whales typically reach the Kaktovik and Cross Island areas in early September when the subsistence hunts for bowheads typically begin at those locations (Kaleak 1996; Long 1996; Galginaitis and Koski 2002; Galginaitis and Funk 2004, 2005; Koski et al. 2005). In recent years the hunts at those two locations have usually ended by mid- to late September.

Westbound bowheads typically reach the Barrow area in mid-September, and are in that area until late October (e.g., Brower 1996). However, over the years, local residents report having seen a small number of bowhead whales feeding off Barrow or in the pack ice off Barrow during the summer. Recently, autumn bowhead whaling near Barrow has normally begun in mid-September to early October, but in earlier years it began as early as August if whales were observed and ice conditions were favorable (USDI/BLM 2005). The recent decision to delay harvesting whales until mid-to-late September has been made to prevent spoilage, which might occur if whales were harvested earlier in the season when the temperatures tend to be warmer. Whaling near Barrow can continue into October, depending on the quota and weather conditions.

Most spring-migrating bowhead whales will pass through the Beaufort Sea prior to the start of exploration drilling operations in early July. However, a few whales that may remain in the Barrow area or other parts of the Alaskan Beaufort Sea during the summer could be encountered during project activities or by transiting vessels. More encounters with bowhead whales would occur during the westward fall migration in September and October. Shell, however, will suspend exploration drilling activities beginning on August 25, before the beginning of the Kaktovik and Nuiqsut (Cross Island) fall subsistence harvest, and will not resume exploration drilling activities until the Kaktovik and Nuiqsut (Cross Island) hunts are concluded.

(b) Gray Whale (Eschrichtius robustus)

Gray whales originally inhabited both the North Atlantic and North Pacific oceans. The Atlantic populations are believed to have become extinct by the early 1700s. There are two populations in the North Pacific. A relic population that survives in the western Pacific summers near Sakhalin Island far from the planned area of the exploration drilling program. The larger eastern Pacific or California gray whale population recovered significantly from commercial whaling during its protection under the MMPA (and ESA until 1994) and numbered about 29,758 ±3122 in 1997 (Rugh et al. 2005). However, abundance estimates since 1997 indicate a consistent decline followed by stabilization or gradual recovery. Rugh et al. (2005) estimated the population to be 18,178 ±1780 in winter 2001–2002 and Rugh et al. (2008) estimated the population in winter 2006–2007 to have been 20,110 ±1766. The eastern Pacific stock is not considered by NMFS to be endangered or to be a strategic stock.

Eastern Pacific gray whales calve in the protected waters along the west coast of Baja California and the east coast of the Gulf of California from January to April (Swartz and Jones 1979; Jones and Swartz 1984). At the end of the calving season, most of these gray whales migrate about 4,971 mi (8,000 km), generally along the west coast of North America, to the main summer feeding grounds in the northern Bering and Chukchi seas (Tomilin 1957; Rice and Wolman 1971; Braham 1984; Nerini 1984; Moore et al. 2003; Bluhm et al. 2007). Most gray whales begin a southward migration in November with breeding and conception occurring in early December (Rice and Wolman 1971).

Most summering gray whales have historically congregated in the northern Bering Sea, particularly off St. Lawrence Island in the Chirikov Basin (Moore et al. 2000), and in the southern Chukchi Sea. More recently, Moore et al. (2003) suggested that gray whale use of Chirikov Basin has decreased, likely as a result of the combined effects of changing currents resulting in altered secondary productivity dominated by lower quality food. Coyle et al. (2007) noted that ampeliscid amphipod production in the Chirikov Basin had declined by 50% from the 1980s to 2002-2003 and that as little as 3-6% of the current gray whale population could consume 10-20% of the ampeliscid amphipod annual production. These data support the hypotheses that changes in gray whale distribution may be caused by changes in food production and that gray whales may be approaching, or have surpassed, the carrying capacity of their summer feeding areas. Bluhm et al. (2007) noted high gray whale densities along ocean fronts and suggested that ocean fronts may play an important role in influencing prey densities in eastern North Pacific gray whale foraging areas. The northeastern-most of the recurring feeding areas is in the northeastern Chukchi Sea southwest of Barrow (Clarke et al. 1989).

Gray whales occur regularly near Point Barrow, but historically only a small number of gray whales have been sighted in the Beaufort Sea east of Point Barrow. Hunters at Cross Island (near Prudhoe Bay) took a single gray whale in 1933 (Maher 1960). Only one gray whale was sighted in the central Alaskan Beaufort Sea during the extensive aerial survey programs funded by BOEMRE and industry from 1979 to 1997. However, during September 1998, small numbers of gray whales were sighted on several occasions in the central Alaskan Beaufort (Miller et al. 1999; Treacy 2000). More recently, a single sighting of a gray whale was made on 1 August 2001 near the Northstar production island (Williams and Coltrane 2002). Several gray whale sightings were reported during both vessel-based and aerial surveys in the Beaufort Sea in 2006-2008 (Christie et al. 2010; Saverese et al. 2010). Several single gray whales have been seen farther east in the Canadian Beaufort Sea (Rugh and Fraker 1981), indicating that small numbers must travel through the Alaskan Beaufort during some summers. In recent years, ice conditions have become reduced near Barrow, and gray whales may have become more common there and perhaps in the Beaufort Sea.

Given the infrequent occurrence and nearshore distribution of gray whales in the Beaufort Sea in summer, no more than a few gray whales are expected to be near the planned exploration drilling program in the Beaufort Sea. Beaufort Sea gray whales would be expected to remain close to shore and thus at some distance from much of the planned exploration drilling activity.

(c) Humpback Whale (*Megapter novaeangliae*)

Humpback whales are distributed in major oceans worldwide but have apparently been absent from Arctic waters of the North Pacific (Allen and Angliss 2010). In general, humpback whales spend the winter in tropical and sub-tropical waters where breeding and calving occur, and migrate to higher latitudes for feeding during the summer.

Humpback whales were hunted extensively during the 20th century and worldwide populations may have been reduced to ~10% of their original numbers. The International Whaling Commission banned commercial hunting of humpback whales in the Pacific Ocean in 1965 and humpbacks were listed as endangered under the ESA and depleted under the MMPA in 1973. Most humpback whale populations appear to be recovering well.

Humpbacks feed on euphausiids, copepods, and small schooling fish, notably herring, capelin, and sandlance (Reeves et al. 2002). As with other baleen whales, the food is trapped and filtered when large amounts of water are taken into the mouth and forced out through the baleen plates. Humpbacks have large, robust bodies and long pectoral flippers that may reach 1/3 of their body length. They are frequently observed breaching or engaged in other surface activities. Adult male and female humpback whales average 46-49 ft (14-15 m) in length, respectively (Wynne 1997). Most individual humpback whales can be identified by distinctive patterns on the tail flukes. The dorsal fin is variable in shape and located well back toward the posterior 1/3 of the body on a hump which is particularly noticeable when the back is arched during a dive (Reeves et al. 2002).

During the summer months humpback whales are common in Prince William Sound, and along the south side of the Alaska Peninsula to Unimak Pass. Humpback whales are less common in the Bering Sea and rare in the Chukchi Sea. Greene et al. (2007) reported and photographed a humpback whale cow/calf pair about 2 mi (4 km) east of Cape Simpson in western Harrison Bay in 2007, which is the first known occurrence of humpback whale in the Beaufort Sea. A second humpback whale sighting which was likely in the Beaufort Sea was reported near Barrow by Goetz et al. (2010). Humpback whales would be unlikely to occur near the planned exploration drilling program in Camden Bay.

(d) Minke Whale (Balaenoptera acutorostrata)

Minke whales have a cosmopolitan distribution at ice-free latitudes (Stewart and Leatherwood 1985), and also occur in some marginal ice areas. Allen and Angliss (2010) recognize two minke whale stocks in U.S. waters including (1) the Alaska stock, and (2) the California/Oregon/Washington stock. There is no abundance estimate for the Alaska stock. Provisional estimates of minke whale abundance based on surveys in 1999 and 2000 are 810 and 1,003 whales in the central-eastern and southeastern Bering Sea, respectively. These estimates have not been corrected for animals that may have been submerged or otherwise missed during the surveys, and only a portion of the range of the Alaskan stock was surveyed. Minke whales range into the Chukchi Sea but are not likely to occur in the Beaufort Sea. Savarese et al. (2010) reported one minke whale sighting in the Beaufort Sea in 2007 and 2008. Minke whales would be unlikely to be observed in the Beaufort Sea near the planned exploration drilling program.

4.3 Seals

(a) Bearded Seal (*Erignathus barbatus*)

Bearded seals are associated with sea ice and have a circumpolar distribution (Burns 1981a). They have occasionally been reported to maintain breathing holes in sea ice and broken areas within the pack ice, particularly if the water depth is <656 ft (<200 m) (e.g., Harwood et al. 2005). Bearded seals apparently also feed on ice-associated organisms when they are present, and this allows a few bearded seals to live in areas where water depth is considerably greater than 656 ft (200 m) (Cameron et al. 2009). During the summer period, bearded seals occur mainly in relatively shallow areas because they are predominantly benthic feeders (Burns 1981a). No reliable estimate of bearded seal abundance is available for the Beaufort Sea (Allen and Angliss 2010). The Alaska stock of bearded seals, part of the Beringia distinct population segment, has been proposed by NMFS for listing as threatened under the ESA (NMFS 2010a).

In Alaskan waters, bearded seals occur over the continental shelves of the Bering, Chukchi, and Beaufort Seas (Burns 1981a). The Alaska stock of bearded seals may consist of about 300,000–450,000 individuals (USDI/MMS 1996). However, there is currently no reliable population estimate for bearded seals in the Alaskan Beaufort and Chukchi Seas (Allen and Angliss 2010).

Seasonal movements of bearded seals are directly related to the advance and retreat of sea ice and to water depth (Kelly 1988). During winter, most bearded seals in Alaskan waters are found in the Bering Sea. In the Chukchi and Beaufort Seas, favorable conditions are more limited, and consequently, bearded seals are less abundant there during winter. From mid-April to June, as the ice recedes, some of the bearded seals that overwintered in the Bering Sea migrate northward through the Bering Strait. During the summer, they are found near the widely fragmented margin of multi-year ice covering the continental shelf of the Chukchi Sea and in nearshore areas of the central and western Beaufort Sea. In the Beaufort Sea, bearded seals rarely use coastal haulouts.

In some areas, bearded seals are associated with the ice year-round; however, they usually move shoreward into open water areas when the pack ice retreats to areas with water depths greater than 656 ft (200 m) (Cameron et al. 2009). In the Beaufort Sea, suitable habitat is limited to areas where the continental shelf is narrow because the pack ice edge frequently occurs seaward of the shelf and over water too deep for benthic feeding. The preferred habitat in the western and central Beaufort Sea during the open-water period is the continental shelf seaward of the scour zone, although a recent tagging study showed occasional movements of adult bearded seals seaward of the continental shelf (Cameron et al. 2009). WesternGeco conducted marine mammal monitoring during its open-water seismic program in the Alaskan Beaufort Sea from 1996 to 2001. Operations were conducted in nearshore waters, and of a total 454 seals that were identified to species while no airguns were operating, 4.4% were bearded seals, 94.1% were ringed seals and 1.5% were spotted seals (Moulton and Lawson 2002). Savarese et al. (2010) reported bearded seal densities in the Beaufort Sea ranging from $3.861x10^{-5}$ to 0.0220 seals/mi^2 (0.0001 to 0.0572 seals/km^2), during vessel-based surveys in 2006-2008.

(b) Ribbon Seal (Histriophoca fasciata)

Ribbon seals are found along the pack-ice margin in the southern Bering Sea during late winter and early spring and they move north as the pack ice recedes during late spring to early summer (Burns 1970; Burns 1981b). Little is known about their summer and fall distribution, but Kelly (1988) suggested that they move into the southern Chukchi Sea based on a review of sightings during the summer. However, ribbon seals appeared to be relatively rare in the Beaufort Sea during recent vessel-based surveys in summer and fall of 2006-2007 with only three sightings among 997 seal sightings identified to species (Savarese et al. 2010).

Ribbon seals do not normally occur in the Beaufort Sea; however, two ribbon seal sightings were reported during vessel-based activities near Prudhoe Bay in 2008 (Savarese et al. 2010). Regardless, ribbon seals are unlikely to occur in the vicinity of the planned exploration drilling program in Camden Bay in 2012.

(c) Ringed Seal (*Phoca hispida*)

Ringed seals have a circumpolar distribution and occur in all seas of the Arctic Ocean (King 1983). They are closely associated with ice, and in the summer often occur along the receding ice edges or farther north in the pack ice. In the North Pacific, they occur in the southern Bering Sea and range south to the seas of Okhotsk and Japan. They are found throughout the Beaufort, Chukchi, and Bering seas (Allen and Angliss 2010). The Alaska stock, part of the Arctic subspecies of ringed seal, has been proposed for listing as threatened under the ESA (NMFS 2010b).

Ringed seals are year-round residents in the Beaufort Sea and the ringed seal is the most frequently encountered seal species in the area. During winter, ringed seals occupy landfast ice and offshore pack ice of the Bering, Chukchi and Beaufort Seas. In winter and spring, the highest densities of ringed seals are found on stable shorefast ice. However, in some areas where there is limited fast ice but wide expanses of pack ice, including the Beaufort Sea, Chukchi Sea and Baffin Bay, total numbers of ringed seals on pack ice may exceed those on shorefast ice (Burns 1970; Stirling et al. 1982; Finley et al. 1983). Ringed seals maintain breathing holes in the ice and occupy lairs in accumulated snow (Smith and Stirling 1975). They give birth in lairs from mid-March through April, nurse their pups in the lairs for 5–8 weeks, and mate in late April and May (Smith 1973; Hammill et al. 1991; Lydersen and Hammill 1993).

No estimate for the size of the Alaska ringed seal stock is currently available (Allen and Angliss 2010). Past ringed seal population estimates in the Bering-Chukchi-Beaufort area ranged from 1–1.5 million (Frost 1985) to 3.3–3.6 million (Frost et al. 1988). Frost and Lowry (1981) estimated 80,000 ringed seals in the Beaufort Sea during summer and 40,000 during winter. More recent estimates based on extrapolation from aerial surveys and on predation estimates for polar bears (Amstrup 1995) suggest an Alaskan Beaufort Sea population at ~326,500 animals.

Moulton et al. (2002) reported ringed seal densities (uncorrected) ranging from 0.17-0.24 seal/mi^2 (0.43-0.63 seal/km^2) in nearshore areas (>10 ft (3 m) deep) during aerial surveys during late spring in the central Alaskan Beaufort Sea. Ringed seal will likely be the most abundant marine mammal species encountered in the vicinity of the planned exploration drilling program in Camden Bay.

(d) Spotted Seal (*Phoca largha*)

Spotted seals, also known as largha seals, occur in the Beaufort, Chukchi, Bering and Okhotsk seas, and south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977). They migrate south from the Chukchi Sea and through the Bering Sea in October (Lowry et al. 1998). Spotted seals overwinter in the Bering Sea and inhabit the southern margin of the ice during spring (Shaughnessy and Fay 1977).

An early estimate of the size of the world population of spotted seals was 370,000–420,000, and the size of the Bering Sea population, including animals in Russian waters, was estimated to be 200,000–250,000 animals (Bigg 1981). The total number of spotted seals in Alaskan waters is not known (Allen and Angliss 2010), but the estimate is most likely between several thousand and several tens of thousands (Rugh et al. 1997). During the summer spotted seals are found in Alaska from Bristol Bay through western Alaska to the Chukchi and Beaufort Seas. The ADF&G placed satellite transmitters on 4 spotted seals and estimated that the proportion of seals hauled out was 6.8%. Based on an actual minimum count of 4145 hauled out seals, Allen and Angliss (2010) estimated the Alaskan population at 59,214 animals. The Alaska stock of spotted seals is not classified as endangered, threatened, or as a strategic stock by NMFS (Allen and Angliss 2010). Although the southern distinct population segment (DPS) of spotted seals was recently listed as threatened, it occurs entirely outside of U.S. waters.

During spring when pupping, breeding, and molting occur, spotted seals are found along the southern edge of the sea ice in the Okhotsk and Bering seas (Quakenbush 1988; Rugh et al. 1997). In late April and early May, adult spotted seals are often seen on the ice in female-pup or male-female pairs, or in male-female-pup triads. Subadults may be seen in larger groups of up to two hundred animals. During the summer, spotted seals are found primarily in the Bering and Chukchi seas, but some range into the Beaufort Sea (Rugh et al. 1997; Lowry et al. 1998) from July until September. At this time of year, spotted seals haul out on land part of the time, but they also spend extended periods at sea. Spotted seals are commonly seen in bays, lagoons and estuaries, but also range far offshore as far north as 69–72ºN. In summer, they are rarely seen on the pack ice, except when the ice is very near shore. As the ice cover thickens with the onset of winter, spotted seals leave the northern portions of their range and move into the Bering Sea (Lowry et al. 1998).

Relatively low numbers of spotted seals are present in the Beaufort Sea. A small number of spotted seal haulouts are (or were) located in the central Beaufort Sea in the deltas of the Colville River and previously the Sagavanirktok River. Historically, these sites supported as many as 400–600 spotted seals, but in recent times <20 seals have been seen at any one site (Johnson et al. 1999). In total, there are probably no more than a few tens of spotted seals along the coast of the central Alaska Beaufort Sea during summer and early fall. A total of 12 spotted seals were positively identified near the source vessel during open-water seismic programs in the central Alaskan Beaufort Sea during the 6 years from 1996-2001 (Moulton and Lawson 2002, p. 317). Numbers seen per year ranged from zero (in 1998 and 2000) to four (in 1999). More recently Greene et al. (2007) reported 46 spotted seal sightings during barge operations between West Dock and Cape Simpson. Most sightings occurred from western Harrison Bay to Cape Simpson with only one sighting offshore of the Colville River delta. Some of these could have been repeat sightings of the same individuals as the barges traversed the same area on numerous occasions. Small numbers of spotted seals could occur in the vicinity of the planned exploration drilling program.

5. The type of incidental taking authorization that is being requested

Shell requests an IHA pursuant to Section 101(a)(5)(D) of the MMPA for incidental take by harassment of small numbers of cetaceans and pinnipeds during the specified activities, its planned exploration drilling activities in Camden Bay during July–October, 2012.

The operations outlined in sections 1 and 2 are reasonably expected or reasonably likely to have the potential to take marine mammals by “Level B” harassment as a result of sound energy introduced into the marine environment. Sounds that may “harass” marine mammals will include near continuous, non-pulse sounds generated by the exploration drilling activities and pulsed sounds generated by the airguns used during the ZVSP activities. The effects will depend on the species of cetacean or pinniped, the behavior of the animal at the time of reception of the stimulus, as well as the distance and received level of the sound (see section 7). Disturbance reactions are likely to vary among some of the marine mammals in the general vicinity of the sound source. No “take” by serious injury is reasonably expected or reasonably likely, given the nature of the specified activities and the mitigation measures that are planned (see section 12). No lethal takes are expected.

6. Numbers of marine mammals that may potentially be taken

Shell seeks authorization for potential “taking” of small numbers of marine mammals under the jurisdiction of NMFS in the planned area of activity. Species for which authorization is sought are bowhead, gray, humpback, minke, and beluga whales, narwhal, harbor porpoise, and ringed, spotted, bearded, and ribbon seals. Exposure estimates and requests for takes of ribbon seal, humpback whale, minke whale, harbor porpoise and narwhal are also included, but are very minimal as sightings of these species in the Beaufort Sea are very rare.

The only anticipated impacts to marine mammals are associated with noise propagation from the exploration drilling activities, ZVSP surveys, potential icebreaking activities, and associated support vessels. Impacts would consist of temporary displacement of marine mammals from locations within ensonified zones produced by such noise sources.

The exploration drilling program in Camden Bay planned by Shell is not expected to "take" more than small numbers of marine mammals, or have more than a negligible impact on their populations. Discussions of estimated "takes by harassment" are presented below.

All anticipated takes would be "takes by harassment", involving temporary changes in behavior. The mitigation measures to be applied, as described herein (see section 12), will minimize the possibility of injurious takes. However, there is no specific information demonstrating that injurious "takes" would occur even in the absence of the planned mitigation measures. The sections below describe methods to estimate "take by harassment" and present estimates of the numbers of marine mammals that might be affected during the planned exploration drilling program in Camden Bay. The estimates are based on data obtained during marine mammal surveys in and near the planned exploration drilling sites and on estimates of the sizes of the areas where effects could potentially occur. Adjustments to reported survey results or density estimates were made to account for seasonal distributions and population increases insofar as possible.

The main sources of distributional and numerical data used in deriving the estimates are described in the next subsection. There is some uncertainty about the representativeness of those data and the assumptions used below to estimate the potential "take by harassment". However, the approach used here is the best available at this time.

Basis for Estimating "Take by Harassment"

"Take by Harassment" is calculated in this section by multiplying the expected densities of marine mammals that may occur near the exploration drilling operations by the area of water likely to be exposed to near continuous, non-pulse sounds ≥120 dB re 1 μPa root mean square (rms) during exploration drilling operations or icebreaking activities, and impulse sounds ≥160 dB re 1 μPa rms created by seismic airguns during ZVSP activities. The single exception to this method is for the estimation of exposures of bowhead whales during the fall migration where more detailed data were available allowing an alternative approach to be used (described below).

Marine mammal occurrence near the operation is likely to vary by season and habitat, mostly related to the presence or absence of sea ice. This section provides descriptions of the estimated densities of marine mammals and areas of water exposed to the indicated sound levels over the course of the planned operations. There is no evidence that avoidance at received sound levels of ≥120 dB or ≥160 dB rms would have significant biological effects on individual animals or that the subtle changes in behavior or movements would "rise to the level of taking" according to guidance by the NMFS (2001). Any changes in behavior caused by sounds at or near the specified received levels would likely fall within the normal variation in such activities that would occur in the absence of exploration drilling operations.

To provide some allowance for the uncertainties, "maximum estimates" as well as "average estimates" of the numbers of marine mammals potentially affected have been derived. For a few marine mammal species, several density estimates were available, and in those cases the mean and maximum estimates were determined from the survey data. In other cases, no applicable estimate (or perhaps a single estimate) was available, so correction factors were used to arrive at "average" and "maximum" estimates. These are described in detail in the following sections.

During the fall, most bowhead whales will be migrating west past the exploration drilling program, so it is less accurate to assume that the number of individuals present in the area from one day to the next will be static. However, feeding, resting, and milling behaviors are not uncommon at this time and location. In order to incorporate the movement of whales past the planned operations, and because the necessary data are available, we have developed an alternative method of calculating the number of individual bowheads that may be exposed to sounds produced by the exploration drilling program (assuming no avoidance reactions).

The method is founded on estimates of the proportion of the population that would pass within the >120 dB or ≥160 dB zones on a given day during the migration while exploration drilling and associated activities are occurring. Based on data in Richardson and Thomson (2002), the number of whales expected to pass each day after conclusion of the bowhead subsistence hunts (assumed to be 15 September for purposes of these calculations) was estimated as a proportion of the estimated 2012 bowhead whale population. The number of whales passing each day was based on the 10-day moving average presented by Richardson and Thomson (2002; Appendix 9.1). Richardson and Thomson (2002) also calculated the proportion of animals within water depth bins (<66 ft [20 m], 66-131 ft [20-40 m], 131-656 ft [40-200 m], >656 ft [200 m]). Using this information we multiplied the total number of whales expected to pass the exploration drilling program each day by the proportion of whales that would be in each depth category to estimate how many individuals would be within each depth bin on a given day. The proportion of each depth bin falling within the ≥120 dB zone was then multiplied by the number of whales within the respective bins to estimate the total number of individuals that would be exposed on each day of exploration drilling or program activity, if they showed no avoidance of the operations.

Exploration drilling will be suspended on 25 August prior to the start of the bowhead subsistence hunts at Kaktovik and Nuiqsut (Cross Island). After the completion of the subsistence hunts (for purposes of these calculations this was assumed to be 15 September), exploration drilling activity will resume and continue as late as 31 October. Therefore, the daily calculations described above were repeated for all days from 15 September to 31 October and the results were summed to estimate the total number of bowhead whales that might be exposed to either continuous sounds ≥120 dB rms from exploration drilling or icebreaking activities and impulsive sounds ≥160 dB rms from ZVSP surveys during the migration period in the Beaufort Sea.

Marine Mammal Density Estimates

Marine mammal densities near the operation are likely to vary by season and habitat. However, sufficient published data allowing the estimation of separate densities during summer (July and August) and fall (September and October) are only available for beluga and bowhead whales. As noted above, exposures of bowhead whales during the fall are not calculated using densities (see detailed description below). So summer and fall densities have been estimated for beluga whales and a summer density has been estimated for bowhead whales. Densities of all other species have been estimated to represent the duration of both seasons.

Marine mammal densities are also likely to vary by habitat type. In the Alaskan Beaufort Sea, where the continental shelf break is relatively close to shore, marine mammal habitat is often defined by water depth. Bowhead and beluga occurrence within nearshore (0-131 ft [0-40 m]), outer continental shelf (131-656 ft [40-200 m]) slope (656-6,562 ft [200-2,000 m]), basin (>6,562 ft [2,000 m]), or similarly defined habitats have been described previously (Moore et al. 2000; Richardson and Thomson 2002). The presence of most other species has generally only been described relative to the entire continental shelf zone (0-656 ft [0-200 m]) or beyond. Sounds produced by the drilling vessel are expected to drop below 120 dB (continuous) and 160 dB (pulses) within the nearshore zone (0-131 ft [0-40 m] water depth).

In addition to water depth, densities of marine mammals are likely to vary with the presence or absence of sea ice (see below for descriptions by species). At times during either summer or fall, pack-ice may be present in some of the area around the exploration drilling operation. However, the retreat of sea ice in the Alaskan Beaufort Sea has been substantial in recent years so we have assumed that only 33% of the area exposed to sounds ≥120 dB rms or ≥160 dB rms by the exploration drilling program will be in ice margin habitat. Therefore ice-margin densities of marine mammals in both seasons have been multiplied by 33% of the area exposed to sounds by the exploration drilling and ZVSP activities, while open-water (nearshore) densities have been multiplied by the remaining 67% of the area.

Detectability bias, quantified in part by *f*(0), is associated with diminishing sightability with increasing lateral distance from the trackline. Availability bias [*g*(0)] refers to the fact that there is <100% probability of sighting an animal that is present along the survey trackline. Some sources of densities used below included these correction factors in their reported densities. In other cases the best available correction factors were applied to reported results when they had not been included in the reported data (e.g., Moore et al. 2000).

Cetaceans

As noted above, densities of beluga and bowhead whales present in the Beaufort Sea are expected to vary by season and location. During the early and mid-summer, most belugas and bowheads are found in the Canadian Beaufort Sea and Amundsen Gulf or adjacent areas. Low numbers are found in the eastern Alaskan Beaufort Sea. Belugas begin to move across the Alaskan Beaufort Sea in August, and bowheads do so toward the end of August.

Summer ***Beluga*** density estimates were derived from survey data in Moore et al. (2000). During summer, beluga whales are most likely to be encountered in offshore waters of the eastern Alaskan Beaufort Sea or areas with pack ice. The summer beluga whale nearshore density (Table 6-1) was based on 7,447 mi (11,985 km) of on-transect effort and 9 associated sightings that occurred in water ≤164 ft (50 m) in Moore et al. (2000; Table 2). A mean group size of 1.63, a f(0) value of 2.841, and a g(0) value of 0.58 from Harwood et al. (1996) were used in the density calculation. Moore et al. (2000) found that belugas were equally likely to occur in heavy ice conditions as open water or very light ice conditions in summer in the Beaufort Sea, so the same density was used for both nearshore and ice-margin estimates (Table 6-1). The fall beluga whale nearshore density was calculated by using 8,808 mi (14,175 km) of on-transect effort and 7 associated sightings that occurred in BWASP survey blocks 1, 4, and 5 in 2006-2009 (Clarke et al. 2011a; Clarke et al. 2011b; pers. comm. Janet Clarke and Megan Ferguson, 17 Aug, 2011).. A mean group size of 2.9, calculated from those 7 reported sightings, along with the same f(0) and g(0) values from Harwood et al. (1996) noted above, were used in the density calculation. Moore et al. (2000) found that during fall in the Beaufort Sea belugas occurred in moderate to heavy ice at higher rates than in light ice, so ice-margin densities were estimated to be twice the nearshore densities (Table 6-1). Maximum estimates in both season and habitats were estimated as four times the average estimates. Exposures of beluga whales during fall in the Beaufort Sea were not calculated in the same manner as described for bowhead whales (below) because of the relatively lower expected densities of beluga whales in nearshore habitat near the exploration drilling program and the lack of detailed data on the likely timing and rate of migration through the area.

Table 6-1 Expected Summer (July -- August) and Fall (September – October) Densities of Beluga and Bowhead Whales in the Eastern Alaskan Beaufort Sea. Densities are Corrected for f(0) and g(0) Biases. Species Listed Under the U.S. ESA as Endangered are shown in italics.

	Nearshore		Ice Margin	
Season Species	**Average Density (# / km^2)**	**Maximum Density (# / km^2)**	**Average Density (# / km^2)**	**Maximum Density (# / km^2)**
Summer				
Beluga	0.0030	0.0120	0.0030	0.0120
Bowhead whale	0.0186	0.0717	0.0186	0.0717
Fall				
Beluga	0.0035	0.0140	0.0070	0.0280
Bowhead whale	*N/A*	*N/A*	*N/A*	*N/A*

Eastward migrating ***bowhead whales*** were recorded during industry aerial surveys of the continental shelf near Camden Bay in 2008 until 12 July (Christie et al. 2010). No bowhead sightings were recorded again, despite continued flights, until 19 August. Aerial surveys by industry operators did not begin until late August of 2006 and 2007, but in both years bowheads were also recorded in the region before the end of August (Lyons et al. 2009). The late August sightings were likely of bowheads beginning their fall migration so the densities calculated from those surveys were not used to estimate summer densities in this region. The three surveys in July of 2008 resulted in density estimates of 0.0038, 0.0277, and 0.0072 bowhead whales/mi^2 (0.0099, 0.0717, and 0.0186 bowhead whales/km^2), respectively (Christie et al. 2010). The estimate of 0.0186 whales/km^2 was used as the average nearshore density and the estimate of 0.0277 whales/mi^2 (0.0717 whales/km^2) was used as the maximum (Table 6-1). Sea ice was not present during these surveys. Moore et al. (2000) reported that bowhead whales in the Alaskan Beaufort Sea were distributed uniformly relative to sea ice, so the same nearshore densities were used for ice-margin habitat.

During fall, most bowhead whales will be migrating west past the exploration drilling program, so it is less accurate to assume that the number of individuals present in the area from one day to the next will be static. However, feeding, resting, and milling behaviors are not uncommon at this time and location. In order to incorporate the movement of whales past the planned operations, and because the necessary data are available, we used the method described in the previous section *Basis for Estimating "Take by Harassment"*. The method was founded on estimates of the proportion of the population that would pass within the >120 dB rms or ≥160 dB rms zones on a given day during the exploration drilling or ZVSP activities. If the bowhead population has continued to grow at an annual rate of 3.4%, the 2012 population size would be

~15,232 individuals based on a 2001 population of 10,545 (Zeh and Punt 2005). The estimated population size of 15,232 was therefore used as the foundation of the calculations of exposures during the migration period. The estimate of the proportion of the population passing the exploration drilling operation on each day is based on a 10-day moving average and the calculations have been made over a substantial length of time, so it would take significant variation in the timing or nature of the migration to substantially deviate from the estimate calculated in this manner. Nonetheless, if a large portion of the migration were to be delayed or otherwise distributed closer to the area of the exploration drilling operations, more than the estimated number of whales could be exposed. Therefore, a maximum estimate of 2 times the average estimate has been calculated, although it is unlikely that a substantial enough variation in the migration timing and location would cause such an increase in the number of whales present near the operations.

For ***other cetacean species*** that may be encountered in the Beaufort Sea, densities are likely to vary somewhat by season, but differences are not expected to be great enough to require estimation of separate densities for the two seasons. Harbor porpoises and gray whales are not expected to be present in large numbers in the Beaufort Sea during the fall but small numbers may be encountered during the summer. They are most likely to be present in nearshore waters (Table 6-2). Narwhals are not expected to be encountered within the exploration drilling program area. However, there is a chance that a few individuals may be present if ice is nearby. The first record of humpback whales in the Beaufort Sea was documented in 2007 so their presence cannot be ruled out. Since these species occur so infrequently in the Beaufort Sea, little to no data are available for the calculation of densities. Minimal densities have therefore been assigned for calculation purpose and to allow for chance encounters (Table 6-2).

Seals

Extensive surveys of ringed and bearded seals have been conducted in the Beaufort Sea, but most surveys have been conducted over the landfast ice, and few seal surveys have occurred in open water or in the pack ice. Kingsley (1986) conducted ***ringed seal*** surveys of the offshore pack ice in the central and eastern Beaufort Sea during late spring (late June). These surveys provide the most relevant information on densities of ringed seals in the ice margin zone of the Beaufort Sea. The density estimate in Kingsley (1986) was used as the average density of ringed seals that may be encountered in the ice margin (Table 6-2). The average ringed seal density in the nearshore zone of the Alaskan Beaufort Sea was estimated from results of ship–based surveys at times without seismic operations reported by Moulton and Lawson (2002; Table 6-2).

Densities of ***bearded seals*** were estimated by multiplying the ringed seal densities by 0.051 based on the proportion of bearded seals to ringed seals reported in Stirling et al. (1982; Table 6-2). ***Spotted seal*** densities in the nearshore zone were estimated by summing the ringed seal and bearded seal densities and multiplying the result by 0.015 based on the proportion of spotted seals to ringed plus bearded seals reported in Moulton and Lawson (2002; Table 6-2). Minimal values were assigned as densities in the ice–margin zones (Table 6-2). Minimal values were used to estimate ***ribbon seal*** densities as their presence in the Beaufort Sea is very uncommon.

Table 6-2 Expected Densities of Cetaceans (Excluding Beluga and Bowhead Whale) and Seals in the Alaskan Beaufort Sea During Both Summer (July – August) and Fall (September – October) Seasons

Species	Nearshore		Ice Margin	
	Average Density (# / km^2)	Maximum Density (# / km^2)	Average Density (# / km^2)	Maximum Density (# / km^2)
Odontocetes				
Monodontidae				
Narwhal	0.0000	0.0000	0.0000	0.0001
Phocoenidae				
Harbor porpoise	0.0001	0.0004	0.0000	0.0000
Mysticetes				
Gray whale	0.0001	0.0004	0.0000	0.0000
Pinnipeds				
Bearded seal	0.0181	0.0724	0.0128	0.0512
Ribbon seal	0.0001	0.0004	0.0001	0.0004
Ringed seal	0.3547	1.4188	0.2510	1.0040
Spotted seal	0.0037	0.0149	0.0001	0.0004

Estimated Area Exposed to Sounds ≥120 dB or ≥160 dB re 1 μPa rms

Estimated Area Exposed to Continuous Sounds ≥120 dB re 1 μPa rms from Exploration Drilling Activities

Exploration drilling in Camden Bay will be conducted from either the *Kulluk* or the *Discoverer*. The two vessels are likely to introduce somewhat different levels of sound into the water during exploration drilling activities. Descriptions of the expected source levels and propagation distances from the two vessels are provided in this section. These distances and associated ensonified areas are then used in the following section to calculate separate estimates of potential exposures.

Sounds from the *Kulluk* were measured in the Beaufort Sea in 1986 and reported by Greene (1987a). The back propagated broadband source level from the measurements (185.5 dB re 1 μPa · m rms; calculated from the reported 1/3-octave band levels), which included sounds from a support vessel operating nearby, were used to model sound propagation at the Sivulliq prospect near Camden Bay. The model estimated that sounds would decrease to 120 dB rms at ~8.25 mi (13.27 km) from the *Kulluk* (JASCO 2007; Table 6-3). As a precautionary approach, that distance was multiplied by 1.5 and the resulting radius of 12.37 mi (19.91 km) was used to estimate the total area that may be exposed to continuous sounds ≥120 dB re 1 μPa rms by the *Kulluk* at each drill site. Assuming one well site will be drilled in each season (summer and fall), the total area of water ensonified to ≥120 dB rms in each season would be 481 mi^2 (1,245 km^2).

Table 6-3 Sound Propagation Modeling Results of Exploration Drilling, Icebreaking, and ZVSP Activities Near Camden Bay in the Alaskan Beaufort Sea

Source	Received Level (dB re 1 μPa)	Modeling Results (km)	Used in Calculations (km)
Kulluk	120	13.27	19.91
Discoverer	120	3.32	4.98
Icebreaking	120	7.63	9.50
ZVSP	160	3.67	5.51

Sounds from the *Discoverer* have not previously been measured in the Arctic. However, measurements of sounds produced by the *Discoverer* were made in the South China Sea in 2009 (Austin and Warner 2010). The results of those measurements were used to model the sound propagation from the *Discoverer* (including a nearby support vessel) at planned exploration drilling locations in the Chukchi and Beaufort seas (Warner and Hannay 2011). Broadband source levels of sounds produced by the *Discoverer* varied by activity and direction from the ship, but were generally between 177 and 185 dB re 1 µPa · m rms (Austin and Warner 2010). Propagation modeling at the Sivulliq and Torpedo prospects yielded somewhat different results, with sounds expected to propagate shorter distances at the Sivulliq site (Warner and Hannay 2011). As a precautionary approach, the larger distance to which sounds ≥120 dB (2.06 mi [3.32 km]) are expected to propagate at the Torpedo site have been used to estimate the area of water potentially exposed at both locations. The estimated (2.06 mi [3.32 km]) distance was multiplied by 1.5 (= 3.09 mi [4.98 km]) as a further precautionary measure before calculating the total area that may be exposed to continuous sounds ≥120 dB re 1 µPa rms by the *Discoverer* at each drill site (Table 6-3). Assuming one well will be drilled in each season (summer and fall), the total area of water ensonified to ≥120 dB rms in each season would be 30 mi^2 (78 km^2).

The acoustic propagation model used to estimate the sound propagation from both vessels in Camden Bay is JASCO's Marine Operations Noise Model (MONM). MONM computes received sound levels in rms units when source levels are specified also in those units. MONM treats sound propagation in range-varying acoustic environments through a wide-angled parabolic equation solution to the acoustic wave equation. The specific parabolic equation code in MONM is based on the Naval Research Laboratory's Range-dependent Acoustic Model. This code has been extensively benchmarked for accuracy and is widely employed in the underwater acoustics community (Collins 1993).

For analysis of the potential effects on migrating bowhead whales we calculated the total distance perpendicular to the east-west migration corridor ensonified to ≥120 dB rms in order to determine the number of migrating whales passing the activities that might be exposed to that sound level. For the *Kulluk*, that distance is two times 12.4 mi (19.9 km) (the estimated radius of the 120 dB rms zone), or 24.7 mi (39.8 km) (i.e. 12.4 mi [19.9 km] north and 12.4 mi [19.9 km] south of the drill site); for the *Discoverer*, that distance is two times 3.09 mi, or 6.19 mi, (4.98 km, or 9.96 km). At the two Sivulliq sites (G and N, which are located close together and positioned similarly relative to the 131 and 656 ft [40 and 200 m] bathymetric contours), the 24.7 mi (39.8 km) distance from the *Kulluk* covers all of the 23 mi (37 km) wide 0-131 ft (0-40 m) water depth category, and ~11% of the 22.1 mi (35.5 km) wide 131-656 ft (40-200 m) water depth category. The 9.96 km distance from the *Discoverer* covers 27% of the 0-131 ft (0-40 m) category and none of the 131-656 ft (40-200 m) category at the Sivulliq sites.

The two drill sites on the Torpedo prospect (designated as H and J) are not as close together as the Sivulliq sites, but their position relative to the 131 ft (40 m) and 656 ft (200 m) bathymetric contours are similar. For simplicity, only the slightly greater estimates resulting from calculations at the Torpedo "H" site are provided here and are used to represent activities at either of the two Torpedo sites. At the Torpedo "H" site, the 24.7 mi (39.8 km) distance from the *Kulluk* covers ~74% of the 37 km wide 0-131 ft (0-40 m) water depth category and ~35% of the 22.1 mi (35.5 km) wide 131-656 ft (40-200 m) water depth category. The 6.19mi (9.96 km) distance from the *Discoverer* covers 27% of the 0-131 ft (0-40 m) category and none of the 131-656 ft (40-200 m) category at either of the Torpedo sites.

As described above in the section *Basis for Estimating "Take by Harassment"*, the percentages of water depth categories described in the previous two paragraphs were multiplied by the estimated proportion of the whales passing within those categories on each day to estimate the number of bowheads that may be exposed to sounds ≥120 dB if they showed no avoidance of the exploration drilling operations.

Estimated Area Exposed to Continuous Sounds ≥120 dB re 1 μPa rms from Icebreaking Activities

Measurements of the icebreaking supply ship *Robert Lemeur* pushing and breaking ice during exploration drilling operations in the Beaufort Sea in 1986 resulted in an estimated broadband source level of 193 dB re 1 μPa · m (Greene 1987a; Richardson et al. 1995a). Measurements of the icebreaking sounds were made at five different distances and those were used to generate a propogation loss equation [RL=141.4–1.65R–10Log(R) where R is range in kilometers (Greene 1987a); converting R to meters results in the following equation: R=171.4–10log(R)–0.00165R]. Using that equation, the estimated distance to the 120 dB threshold level for continuous sounds from icebreaking is 4.74 mi (7.63 km). Since the measurements of the *Robert Lemeur* were taken in the Beaufort Sea under presumably similar conditions as would be encountered in 2012, an inflation factor of 1.25 was selected to arrive at a precautionary 120 dB distance of 5.9 mi (9.5 km) for icebreaking sounds.

If ice is present, icebreaking activities may be necessary in early July and towards the end of operations in late October, but it is not expected to be needed throughout the proposed exploration drilling season. Icebreaking activities would likely occur in a 40^o arc up to 3.1 mi (5 km) upwind of the *Kulluk* or *Discoverer* (see Section 1, Figure 1-3 and Attachment B of this application for additional details). This activity area plus a 5.9 mi (9.5 km) buffer around it results in an estimated total area of 162 mi^2 (420 km^2) that may be exposed to sounds ≥120 dB from icebreaking activities in each season.

Icebreaking is not expected to occur during the bowhead migration so additional take estimates during the migration period have not been calculated.

Estimated Area Exposed to Impulse Sounds ≥160 dB re 1μPa rms from ZVSP Activities

A typical sound source that would be used by Shell for the ZVSP survey in 2012 is the ITAGA eight-airgun array, which consists of four 150-in^3 (2,458-cm^3) airguns and four 40-in^3 (655-cm^3) airguns. The ≥160 dB re 1 μPa rms radius for this source was estimated from measurements of a similar seismic source used during the 2008 BP Liberty seismic survey (Aerts et al. 2008). The BP liberty source was also an eight-airgun array, but had a slightly larger total volume of 880 in^3. Because the number of airguns is the same, and the difference in total volume only results in an estimated 0.4 dB decrease in the source level of the ZVSP source, the 100th percentile propagation model from the measurements of the BP Liberty source is almost directly applicable. However, the BP Liberty source was towed at a depth of 5.9 ft (1.8 m), while the ZVSP source will be lowered to a target depth of 13 ft (4 m) (from 10-23 ft [3-7 m]). The deeper depth of the ZVSP source has the potential to increase the source strength by as much as 6 dB. Thus, the constant term in the propagation equation from the BP Liberty source was increased from 235.4 to 241.4 while the remainder of the equation (–18*LogR – 0.0047*R) was left unchanged. This equation results in the following estimated distances to maximum received levels: 190 dB = 524 m; 180 dB = 1,240 m; 160 dB = 3,670 m; 120 dB = 10,500 m. The ≥160 dB distance was multiplied by 1.5 (Table 6-4) for use in estimating the area ensonified to ≥160 dB rms around the drilling vessel during ZVSP activities. Therefore, the total area of water potentially exposed to received sound levels ≥160 dB rms by ZVSP operations at one exploration well sites during each season is estimated to be 73.7 mi^2 (190.8 km^2).

For analysis of potential effects on migrating bowhead whales, the ≥120 dB distance for exploration drilling activities was used on all days during the bowhead migration as described above. This is a precautionary approach in the case of the *Kulluk* since the ≥160 dB zone for the relatively brief ZVSP surveys is expected to be less than the ≥120 dB distance from the *Kulluk*. If the *Discoverer* were to be used, the slightly greater distance to the ≥160 dB threshold from the ZVSP airguns than the ≥120 dB distance from the *Discoverer* (Table 6-3) would result in only 3% more of the 0-131 ft (0-40 m) depth category being ensonified on up to two days. This would result in an estimated increase of ~10 bowhead whales compared to the estimates shown in (Table 6-7).

Sound propagation measurements will be performed on the *Kulluk* or *Discoverer* (whichever is used), and the ZVSP airgun source in 2012, once they are on location near Camden Bay. The results of those measurements will be used during the season to implement mitigation measures as required by the permit.

Potential Number of "Takes by Harassment"

This subsection provides estimates of the number of individuals potentially exposed to continuous sound levels ≥120 dB re 1 μPa rms from exploration drilling or icebreaking activities and pulsed sound levels ≥160 dB re 1 μPa rms by ZVSP activities. The estimates are based on a consideration of the number of marine mammals that might be disturbed appreciably by operations in Camden Bay and the anticipated area exposed to those sound levels.

The number of different individuals of each species potentially exposed to received levels of continuous drilling related sounds ≥120 dB re 1 μPa (rms) or to pulsed airgun sounds ≥160 dB re 1 μPa (rms) within each season and habitat zone was estimated by multiplying:

- the anticipated area to be ensonified to the specified level in each season and habitat zone to which a density applies, by
- the expected species density.

The estimate for bowhead whales during the migration period was calculated differently as described in the previous sections. The numbers of exposures were then summed for each species across the seasons and habitat zones.

Numbers of marine mammals that might be present and potentially disturbed are estimated below based on available data about mammal distribution and densities at different locations and times of the year as described above. Exposure estimates are based on a single drilling vessel (*Kulluk* or *Discoverer*) operating in Camden Bay beginning in July. Shell will not operate the drilling vessel (*Kulluk* or *Discoverer*) and associated vessels in Camden Bay during the 2012 Kaktovik and Nuiqsut (Cross Island) fall bowhead whale subsistence hunts. Shell will suspend exploration activities on August 25, prior to the beginning of the hunts, and will resume activities in Camden Bay after conclusion of the subsistence hunts. Shell expects exploration drilling activities to be completed on or before 31 October 2012.

At times during either summer (July-August) or fall (September-October), pack-ice may be present in some of the area around the exploration drilling operation. However, the retreat of sea ice in the Alaskan Beaufort Sea has been substantial in recent years so we have assumed that only 33% of the area exposed to sounds ≥120 dB or ≥160 dB by the exploration drilling program and ZVSP activities will be in ice-margin habitat. Therefore ice-margin densities of marine mammals in both seasons have been multiplied by 33% of the area exposed to sounds by the drilling and ZVSP activities, while open-water (nearshore) densities have been multiplied by the remaining 67% of the area. Since any icebreaking activities would only occur in ice-margin habitat, the entire area exposed to sounds ≥120 dB from icebreaking was multiplied by the ice-margin densities.

Many of the animals exposed to sound levels near 120 dB rms would not react to those sound levels, particularly seals, and exposures to drilling sounds at this level should not be considered “takes”. Even for species that may change their behavior or alter their migration route, those changes are likely to be within the normal range of activities for the animals and may not rise to the level of “taking” based on guidance in NMFS (2001). Animals that divert around the activity at the lower sound levels would not approach close enough that they would alter their behavior to the degree that they would be “taken by harassment”. Thus, the actual number of animals that will be “taken” is likely less than the number estimated herein to potentially be exposed to ≥120 dB (or ≥160 dB from the ZVSP activities).

Cetaceans

Cetacean species potentially exposed to exploration drilling or icebreaking sounds with continuous received levels ≥120 dB rms or airgun sounds ≥160 dB rms may include both mysticetes (bowhead, gray, humpback, and minke whales), and odontocetes (beluga, narwhal, harbor porpoise, and killer whale. Species with an estimated average number of individuals exposed equal to zero are included here for completeness, but are not likely to be encountered.

Separate estimates for beluga and bowhead whales are provided based on whether the *Kulluk* (Table 6-4) or the *Discoverer* (Table 6-5) is used as the drilling vessel in 2012. The results presented in those two tables should not be summed, as the operations will only be conducted from one of the drilling vessels. Estimates from icebreaking activities, should these occur, are shown in Table 6-6. Estimates of exposure to airgun pulses from ZVSP activities are provided in Table 6-7.

If the *Kulluk* is used, the best (average) estimates of the number of individual belugas and bowheads exposed to continuous sounds ≥120 dB from exploration drilling activities during both summer and fall are 10 and 5,598, respectively (Table 6-4). The smaller size of the expected ≥120 dB zone around the *Discoverer* resulted in an estimated 0 and 1,388 beluga and bowhead whales potentially being exposed to sounds ≥120 dB during summer and fall, respectively (Table 6-5). Should icebreaking activities occur in both seasons, an additional 4 beluga and 8 bowhead whales may be exposed to continuous received sounds ≥120 dB (Table 6-6). Because of the relatively small airgun source and short duration of the ZVSP surveys, they are not expected to contribute substantially to the estimated number of beluga and bowheads exposed by the activities (Table 6-7). The estimated exposure of bowheads to these sounds during the migration has already been included in the estimates for the *Kulluk* (Table 6-4). The slightly greater distance to the ≥160 dB threshold from the ZVSP airguns than the ≥120 dB distance from the *Discoverer* (Table 6-3) would result in only 3% more of the 0-131 ft (0-40 m) depth category being ensonified on up to two days. This would result in an estimated increase of ~10 bowhead whales compared to the estimate shown in (Table 6-5).

Few other cetaceans are likely to be present in the area of the planned operations and the very small estimated densities for those species were not large enough for the calculations to result in estimates >1% from the *Kulluk* (Table 6-8), *Discoverer* (Table 6-9), icebreaking activities (Table 6-10) or ZVSP activities (Table 6-11).

Table 6-4 Estimates of the Numbers of Beluga and Bowhead Whales in Areas Where Maximum Received Sound Levels in the Water Would Be ≥120 dB from operations conducted by *Kulluk* During Shell's Planned Exploration Drilling Program in Summer (July – August) and Fall (September – October) near Camden Bay in the Beaufort Sea, Alaska, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed to these Sound Levels.

	Number of Individuals Exposed to Sound Levels ≥120 dB from *Kulluk*					
Season	**Nearshore**		**Ice Margin**		**Total**	
Species	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Summer						
Beluga	3	10	1	5	4	15
Bowhead whale	16	60	8	29	23	89
Fall						
Beluga	3	12	3	12	6	23
Bowhead whale [a]	5,575	11,150	*N/A*	*N/A*	5,575	11,150

[a] See text for description of bowhead whale estimates for the Fall in the Beaufort Sea

Table 6-5 Estimates of the Numbers of Beluga and Bowhead Whales in Areas Where Maximum Received Sound Levels in the Water Would Be ≥120 dB from operations conducted by *Discoverer* During Shell's Planned Exploration Drilling Program in Summer (July – August) and Fall (September – October) near Camden Bay in the Beaufort Sea, Alaska, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed to these Sound Levels.

	Number of Individual Exposures to Sound Levels ≥120 dB from *Discoverer*					
Season	**Nearshore**		**Ice Margin**		**Total**	
Species	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Summer						
Beluga	0	1	0	0	0	5
Bowhead whale	1	4	0	2	1	6
Fall						
Beluga	0	1	0	1	0	5
Bowhead whale [a]	1,387	2,774	*N/A*	*N/A*	1,387	2,774

[a] See text for description of bowhead whale estimates for the Fall in the Beaufort Sea

Table 6-6 Estimates Of The Numbers Of Beluga And Bowhead Whales In Areas Where Maximum Received Sound Levels In The Water Would Be ≥120 dB From Icebreaking Activities During Shell's Planned Exploration Drilling Program In Summer (July – August) And Fall (September – October) Near Camden Bay In The Beaufort Sea, Alaska, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed To These Sound Levels.

	Number of Individuals Exposed to Sound Levels ≥120 dB from Icebreaking					
Season	**Nearshore**		**Ice Margin**		**Total**	
Species	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Summer						
Beluga	0	0	1	5	1	5
Bowhead whale	0	0	8	30	8	30
Fall						
Beluga	0	0	3	12	3	12
Bowhead whale[a]	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

[a] See text for description of bowhead whale estimates for the Fall in the Beaufort Sea.

Table 6-7 Estimates of the Numbers of Beluga and Bowhead Whales in Areas Where Maximum Received Sound Levels in the Water Would Be ≥160 dB from ZVSP Activities During Shell's Planned Exploration Drilling Program in Summer (July – August) and Fall (September – October) near Camden Bay in the Beaufort Sea, Alaska, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed to these Sound Levels.

	Number of Individuals Exposed to Sound Levels ≥160 dB from ZVSP					
Season	**Nearshore**		**Ice Margin**		**Total**	
Species	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Summer						
Beluga	0	1	0	0	0	5
Bowhead whale	1	4	1	2	2	7
Fall						
Beluga	0	1	0	1	0	5
Bowhead whale [a]	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

[a] See text for description of bowhead whale estimates for the Fall in the Beaufort Sea. Estimates for ZVSP activities have been included in the calculations from drilling (Table 6-4 or 6-5)

Table 6-8 Estimates of the Numbers of Marine Mammals (Excluding Beluga and Bowhead Whales, Which are Shown in Table 6-7) in Each Offshore area where maximum received sound levels in the water would be ≥120 dB from the *Kulluk* during Shell's Planned Exploration Drilling Program near Camden Bay in the Beaufort Sea, Alaska, July – October 31, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed to these Sound Levels.

	Number of Individuals Exposed to Sound Levels ≥120 dB from *Kulluk*					
	Nearshore		**Ice Margin**		**Total**	
Species	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
Odontocetes						
Monodontidae						
Narwhal	0	0	0	0	0	5
Phocoenidae						
Harbor porpoise	0	1	0	0	0	5
Mysticetes						
Gray whale	0	1	0	0	0	5
Pinnipeds						
Bearded seal	30	121	11	42	41	163
Ribbon seal	0	1	0	0	0	5
Ringed seal	592	2367	206	825	798	3192
Spotted seal	6	25	0	0	6	25

Table 6-9 Estimates of the Numbers of Marine Mammals (Excluding Beluga and Bowhead Whales, Which are Shown in Table 6-7) in Each Offshore area where maximum received sound levels in the water would be ≥120 dB from the *Discoverer* during Shell's Planned Exploration Drilling Program near Camden Bay in the Beaufort Sea, Alaska, July – October 31, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed to these Sound Levels.

	Number of Individulas Exposed to Sound Levels ≥120 dB from *Discoverer*					
	Nearshore		Ice Margin		Total	
Species	Avg	Max	Avg	Max	Avg	Max
Odontocetes						
Monodontidae						
Narwhal	0	0	0	0	0	5
Phocoenidae						
Harbor porpoise	0	0	0	0	0	5
Mysticetes						
Gray whale	0	0	0	0	0	5
Pinnipeds						
Bearded seal	2	7	1	3	3	10
Ribbon seal	0	0	0	0	0	5
Ringed seal	37	146	13	52	49	198
Spotted seal	0	2	0	0	0	5

Table 6-10 Estimates Of The Numbers Of Marine Mammals (Excluding Beluga And Bowhead Whales, Which Are Shown In Table 6-7) In Each Offshore Area Where Maximum Received Sound Levels In The Water Would Be ≥120 dB From Icebreaking During Shell's Planned Exploration Drilling Program Near Camden Bay In The Beaufort Sea, Alaska, July – October 31, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed To These Sound Levels.

	Number of Individuals Exposed to Sound Levels≥120 dB from Icebreaking					
	Nearshore		Ice Margin		Total	
Species	Avg	Max	Avg	Max	Avg	Max
Odontocetes						
Monodontidae						
Narwhal	0	0	0	0	0	5
Phocoenidae						
Harbor porpoise	0	0	0	0	0	5
Mysticetes						
Gray whale	0	0	0	0	0	5
Pinnipeds						
Bearded seal	0	0	11	43	11	43
Ribbon seal	0	0	0	0	0	5
Ringed seal	0	0	211	843	211	843
Spotted seal	0	0	0	0	0	5

Table 6-11 Estimates of the Numbers of Marine Mammals (Excluding Beluga and Bowhead Whales, Which are Shown in Table 6-7) in Each Offshore area where maximum received sound levels in the water would be ≥160 dB from ZVSP Activities during Shell's Planned Exploration Drilling Program near Camden Bay in the Beaufort Sea, Alaska, July – October 31, 2012. Not All Marine Mammals Will Change Their Behavior When Exposed to these Sound Levels.

	Number of Individuals Exposed to Sound Levels ≥160 dB from ZVSP					
	Nearshore		Ice Margin		Total	
Species	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
Odontocetes						
Monodontidae						
Narwhal	0	0	0	0	0	5
Phocoenidae						
Harbor porpoise	0	0	0	0	0	5
Mysticetes						
Gray whale	0	0	0	0	0	5
Pinnipeds						
Bearded seal	2	9	1	3	3	12
Ribbon seal	0	0	0	0	0	5
Ringed seal	44	178	16	63	60	241
Spotted seal	0	2	0	0	0	5

Seals

The ringed seal is the most widespread and abundant pinniped in ice-covered arctic waters, and there appears to be a great deal of year-to-year variation in abundance and distribution of these marine mammals. As a result of their high abundance, ringed seals account for a large number of marine mammals expected to be encountered during the exploration drilling program, and hence exposed to sounds with received levels ≥120 dB or ≥160 dB rms. If the *Kulluk* is used, calculations based on the average density result in an estimate of 798 ringed seals that might be exposed during summer and fall to sounds with received levels ≥120 dB from the exploration drilling program (Table 6-8). Should the *Discoverer* be used, the estimated number of ringed seals exposed to ≥120 dB during summer and fall is 49 (Table 6-9). If icebreaking occurred during both seasons, an additional 211 ringed seals may be exposed to continuous sounds ≥120 dB (Table 6-10). The ZVSP activities are estimated to expose 60 ringed seals to pulsed airgun sounds ≥160 dB (Table 6-11).

Two additional seal species are expected to be encountered with lower frequency than ringed seals. Estimates based on average densities of bearded seals and spotted seals are 41 and 6, respectively, during summer and fall if the exploration drilling program is conducted by the *Kulluk* (Table 6-8). If the *Discoverer* is used, the estimates are reduced to 3 and 0 for bearded and spotted seals, respectively (Table 6-9). Should icebreaking occur in both seasons an additional 11 bearded seals may be exposed to continuous sounds with received levels ≥120 dB (Table 6-10). Exposures of individuals from either species to sound levels ≥160 dB from the ZVSP activities are expected to be quite low due to the relative small area expected to be exposed to those sounds (Table 6-11). The ribbon seal is unlikely to be encountered, but the presence of a few individuals cannot be ruled out.

Conclusions

Effects on marine mammals are generally expected to be restricted to avoidance of the area around the planned activities and short-term changes in behavior, falling within the MMPA definition of "Level B harassment". The planned exploration drilling program in Camden Bay will involve one drilling vessel that will introduce continuous sounds into the ocean and up to two brief periods of airgun activity during ZVSP surveys. Other routine vessel operations are conventionally assumed not to affect marine mammals sufficiently to constitute "taking".

Cetaceans

Using the 120 dB criterion for continuous sounds from the exploration drilling and icebreaking activities and the 160 dB criterion for pulsed airgun sounds from the ZVSP activities, the best (average) estimates of the numbers of individual cetaceans potentially exposed represent varying proportions of the populations of each species in the Beaufort Sea and adjacent waters. If the *Kulluk* is used for the exploration drilling operation the calculations suggest ~5,600 bowheads (Table 6-12) may be exposed to sounds at the specified levels, nearly all of which would occur during the fall migration. This number is ~37% of the estimated 2012 BCB population of >15,232 assuming 3.4% annual population growth from the 2001 estimate of >10,545 animals (Zeh and Punt 2005). If the *Discoverer* were to be used, the estimate falls to ~1,390 bowheads (Table 6-5), or ~9.1% of the 2012 population estimate. The small numbers of other mysticetes whales that may occur in the Beaufort Sea are unlikely to be present around the planned operations. The few that might occur would represent a very small proportion of their respective populations.

Some monodontids may be exposed to sounds produced by the exploration drilling program, and the numbers potentially affected are small relative to the population sizes. Assuming the *Kulluk* is used, the best estimate of the number of belugas that might be exposed to continuous drilling or icebreaking sounds ≥120 dB or pulsed airgun sounds ≥160 dB rms from ZVSP surveys is 14 (Table 6-12). This represents <1% of the Beaufort Sea stock. Narwhals are extremely rare in the U.S. Beaufort Sea and few, if any, are expected to be encountered during the survey.

Seals

Several seal species could be encountered in the study area, but ringed seal is by far the most abundant in this area. Assuming the *Kulluk* is used to conduct the exploration drilling program, the estimates calculated using average densities suggest the numbers of individuals exposed to sounds at received levels ≥120 dB during the exploration drilling program and icebreaking or ≥160 dB during ZVSP surveys are as follows (Table 6-12): ringed seals (1,069), bearded seals (55), and spotted seals (7), (representing <1% of their respective Beaufort Sea populations). If the *Discoverer* is used, the estimates decrease to 320 ringed seals, 16 bearded seals, and a minimal number of spotted seals. Most seals are unlikely to react to continuous sounds until they are much stronger than 120 dB, so it is probable that only a small percentage of these animals would actually be disturbed.

Table 6-12 Total Estimated Numbers Of Marine Mammals Potentially Exposed To Continuous Received Sound Levels ≥120 dB From Drilling Or Icebreaking Activities And Pulsed Received Sound Levels ≥160 dB From ZVSP Activities During Shell's Planned Exploration Drilling Program Near Camden Bay In The Beaufort Sea, Alaska, July – October 31, 2012. These Totals Include The Larger Estimates Resulting From Use Of The *Kulluk* Drilling Vessel. Not All Marine Mammals Will Change Their Behavior When Exposed To These Sound Levels.

Species	Total Number of Individuals Exposed to Sound Levels ≥120 dB or ≥160 dB	
	Avg.	Max.
Odontocetes		
Monodontidae		
Beluga	14	38
Narwhal	0	15
Phocoenidae		
Harbor porpoise	0	15
Mysticetes		
Bowhead whale [a]	5,608	11,276
Gray whale	0	15
Pinnipeds		
Bearded seal	55	218
Ribbon Seal	0	15
Ringed seal	1,069	4,276
Spotted seal	7	35

[a] See text for description of bowhead whale estimate calculation

7. The anticipated impact of the activity on the species or stock

The reasonably expected or reasonably likely impacts of the specified activities (planned offshore exploration drilling program and brief ZVSP surveys) on marine mammals will be related primarily to acoustic effects. Petroleum development and associated activities in marine waters introduce sound into the environment. The acoustic sense of marine mammals probably constitutes their most important distance receptor system, and underwater sounds could (at least in theory) have several types of effects on marine mammals. Potential acoustic effects relate to sound produced by exploration drilling activity, vessels and aircraft.

7.1 Noise Characteristics and Effects

The effects of sound on marine mammals are highly variable, and can be categorized as follows (based on Richardson et al. 1995a):

(1) The sound may be too weak to be heard at the location of the animal, i.e. lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both.

(2) The sound may be audible but not strong enough to elicit any overt behavioral response. This has been demonstrated upon exposure of bowhead whales to low levels of seismic, drilling, dredge, or icebreaker sounds (Richardson et al. 1986; 1990; 1995a,b).

(3) The sound may elicit reactions of variable conspicuousness and variable relevance to the well being of the animal. These can range from subtle effects on respiration or other behaviors (detectable only by statistical analysis) to active avoidance reactions.

(4) Upon repeated exposure, animals may exhibit diminishing responsiveness (habituation), or disturbance effects may persist. The latter is most likely with sounds that are highly variable in characteristics, unpredictable in occurrence, and associated with situations that the animal perceives as a threat.

(5) Any man made sound that is strong enough to be heard has the potential to reduce (mask) the ability of marine mammals to hear natural sounds at similar frequencies, including calls from conspecifics, echolocation sounds of odontocetes, and environmental sounds such as ice or surf noise.

(6) Very strong sounds have the potential to cause temporary or permanent reduction in hearing sensitivity. Effects of non-explosive sounds on hearing thresholds of some marine mammals have been studied. However, some data are now available for two species of odontocetes exposed to a single strong noise pulse lasting 1 second (Ridgway et al. 1997 and pers. comm.) and for three species of pinnipeds exposed to moderately strong sound for 20-22 minutes (Kastak et al. 1999). Received sound levels must far exceed the animal's hearing threshold for there to be any temporary threshold shift (TTS). The TTS threshold depends on duration of exposure; the sound level necessary to cause TTS is higher for short sound exposures than for long sound exposures. Received levels must be even higher to risk permanent hearing impairment (probably at least 10 dB above the TTS threshold).

Exploration Drilling Sounds

Exploration drilling will be conducted from the *Kulluk* or *Discoverer,* vessels specifically prepared for such operations in the Arctic. Underwater sound propagation results from the use of generators, drilling machinery, and the rig itself. Sound levels during vessel-based operations may fluctuate depending on the specific type of activity at a given time. Underwater sound levels may also depend on the specific equipment in operation. Lower sound levels have been reported during well logging than during exploration drilling operations (Greene 1987b), and underwater sound appeared to be lower at the bow and stern aspects than at the beam (Greene 1987a).

Most drilling sounds generated from vessel-based operations occur at relatively low frequencies below 600 Hertz (Hz) although tones up to 1,850 Hz were recorded by Greene (1987a) during exploration drilling operations in the Beaufort Sea. At a range of 0.11 mi (0.17 km) the 20-1,000 Hz band level was 122-125 dB for the drillship *Explorer I*. Underwater sound levels were slightly higher (134 dB) during drilling activity from the *Explorer II* at a range of 0.12 mi (0.20 km) although tones were only recorded below 600 Hz. Underwater sound measurements from the *Kulluk* at 0.61 mi (0.98 km) were higher (143 dB) than from the other two vessels.

Vertical Seismic Profile Sounds

A typical eight airgun array (4×40 in^3 [655 cm^3] airguns and 4×150 in^3 [2,458 cm^3] airguns) would be used to perform ZVSP surveys, if conducted after the completion of each exploratory well. Typically, a single ZVSP survey will be performed when the well has reached PTD or final depth although, in some instances, a prior ZVSP will have been performed at a shallower depth. A typical survey will last 10–14 hours, depending on the depth of the well and the number of anchoring points, and include firings of the full array, plus additional firing of a single 40-in^3 (655 cm^3) airgun to be used as a "mitigation airgun" while the geophones are relocated within the wellbore. The estimated source level used to model sound propagation from the airgun array is ~241 dB re 1µPa · m rms, with most energy between 20 and 140 Hz.

Airguns function by venting high-pressure air into the water. The pressure signature of an individual airgun consists of a sharp rise and then fall in pressure, followed by several positive and negative pressure excursions caused by oscillation of the resulting air bubble. The sizes, arrangement, and firing times of the individual airguns in an array are designed and synchronized to suppress the pressure oscillations subsequent to the first cycle. A typical high-energy airgun arrays emit most energy at 10–120 Hz. However, the pulses contain significant energy up to 500–1,000 Hz and some energy at higher frequencies (Goold and Fish 1998; Potter et al. 2007).

Aircraft Noise

Helicopters may be used for personnel and equipment transport to and from the drilling vessel. Under calm conditions, rotor and engine sounds are coupled into the water within a 26º cone beneath the aircraft. Some of the sound will transmit beyond the immediate area, and some sound will enter the water outside the 26º area when the sea surface is rough. However, scattering and absorption will limit lateral propagation in the shallow water.

Dominant tones in noise spectra from helicopters are generally below 500 Hz (Greene and Moore 1995). Harmonics of the main rotor and tail rotor usually dominate the sound from helicopters; however, many additional tones associated with the engines and other rotating parts are sometimes present.

Because of Doppler shift effects, the frequencies of tones received at a stationary site diminish when an aircraft passes overhead. The apparent frequency is increased while the aircraft approaches and is reduced while it moves away.

Aircraft flyovers are not heard underwater for very long, especially when compared to how long they are heard in air as the aircraft approaches an observer. Helicopters flying to and from the drilling vessel will generally maintain straight-line routes at altitudes of 1,500 ft (457 m) above sea level (ASL) or greater, thereby limiting the received levels at and below the surface.

Vessel Noise

In addition to the drillship, various types of vessels will be used in support of the operations including ice management vessels, anchor handler, OSV(s), barges and tugs, and oil-spill response vessels. Sounds from boats and vessels have been reported extensively (Greene and Moore 1995; Blackwell and Greene 2002, 2005, 2006). Numerous measurements of underwater vessel sound have been performed in support of recent industry activity in the Chukchi and Beaufort seas. Results of these measurements were reported in various 90-day and comprehensive reports since 2007. For example, Garner and Hannay (2009) estimated sound pressure levels of 100 dB at distances ranging from ~1.5-2.3 mi (2.4-3.7 km) from various types of barges. MacDonald et al. (2008) estimated higher underwater sound pressure levels from the seismic vessel *Gilavar* of 120 dB at ~13 mi (21 km) from the source, although the sound level was only 150 dB at 85 ft (26 m) from the vessel. Like other industry-generated sound, underwater sound from vessels is generally at relatively low frequencies.

The primary sources of sounds from all vessel classes are propeller cavitation, propeller singing, and propulsion or other machinery. Propeller cavitation is usually the dominant noise source for vessels (Ross 1976). Propeller cavitation and singing are produced outside the hull, whereas propulsion or other machinery noise originates inside the hull. There are additional sounds produced by vessel activity, such as pumps, generators, flow noise from water passing over the hull, and bubbles breaking in the wake. Icebreakers contribute greater sound levels during ice-breaking activities than ships of similar size during normal operation in open water (Richardson et al. 1995a). This higher sound production results from the greater amount of power and propeller cavitation required when operating in thick ice.

7.2 Summary of Potential Effects of Exposure to Underwater Sounds from Exploration Drilling

The potential effects of sounds from the proposed exploration drilling activities might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995a). It is unlikely that there would be any cases of temporary or especially permanent hearing impairment, or non-auditory physical effects.

Tolerance

Numerous studies have shown that underwater sounds from industry activities are often readily detectable 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. 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 under some conditions, at other times mammals of all three types have shown no overt reactions. In general, pinnipeds, small odontocetes, and sea otters seem to be more tolerant of exposure to some types of underwater sound than are baleen whales.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Based on NMFS (2001, p. 9293), we assume that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, it is meant "in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations".

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant. In predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals were present within a particular distance of industrial activities, or exposed to a particular level of industrial sound. This practice, however, likely overestimates the numbers of marine mammals that are affected in some biologically-important manner.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically-important degree by industrial sounds are based on behavioral observations during studies of several species. Detailed studies have been done on humpback, gray, and bowhead whales, and on ringed seals. Less detailed data are available for some other species of baleen whales, sperm whales, small toothed whales, and sea otters.

Baleen Whales—Richardson et al. (1995b) reported changes in surfacing and respiration behavior, and the occurrence of turns during surfacing in bowhead whales exposed to playback of underwater sound from exploration drilling activities. These subtle behavioral effects were temporary and localized, and occurred at distances up to 1-2 mi (2-4 km). Safety radii for the proposed exploration drilling activities are expected to be small and are not expected to result in significant disturbance to baleen whales.

Some bowheads appeared to divert from their migratory path after exposure to projected icebreaker sounds. Other bowheads however, tolerated projected icebreaker sound at levels 20 dB and more above ambient sound levels. The source level of the projected sound however, was much less than that of an actual icebreaker, and reaction distances to actual ice breaking may be much greater than those reported here for projected sounds.

Brewer et al. (1993) and Hall et al. (1994) reported numerous sightings of marine mammals including bowhead whales in the vicinity of offshore exploration drilling operations in the Beaufort Sea. One bowhead whale sighting was reported within ~1,312 ft (400 m) of a drilling vessel although most other bowhead sightings were at much greater distances. Few bowheads were recorded near industrial activities by aerial observers. After controlling for spatial autocorrelation in aerial survey data from Hall et al. (1994) using a Mantel test, Schick and Urban (2000) found that the variable describing straight line distance between the rig and bowhead whale sightings was not significant, but that a variable describing threshold distances between sightings and the rig was significant. Thus, although the aerial survey results suggested substantial avoidance of the operations by bowhead whales, observations by vessel-based observers indicate that at least some bowheads may have been closer to industrial activities than was suggested by results of aerial observations.

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 0.47-1.46 mi (0.76-2.35 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.

Patenaude et al. (2002) reported fewer behavioral responses to aircraft overflights by bowhead compared to beluga whales. Behaviors classified as reactions consisted of short surfacings, immediate dives or turns, changes in behavior state, vigorous swimming, and breaching. Most bowhead reaction resulted from exposure to helicopter activity and little response to fixed-wing aircraft was observed. Most reactions occurred when the helicopter was at altitudes ≤492 ft

(150 m) and lateral distances ≤820 ft (250 m). Restriction on aircraft altitude will be part of the mitigation measures during the proposed exploration drilling activities and likely to have little or no disturbance effects on baleen whales. Any disturbance that did 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. In general, little or no response was observed in animals exposed at received levels from 90-120 dB. Probability of avoidance and other behavioral effects increased when received levels were 120-160 dB. Some of the relevant reviews of Southall et al. (2007) are summarized below.

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 playback of sound 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 156 to 162 dB). In two cases for received levels of 100 to 110 dB, no behavioral reaction was observed. Avoidance behavior was observed in two cases where received levels were 110 to 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 118-124 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. Minor changes in locomotion speed, direction, and/or diving profile were reported at ranges from 1,847-2,352 ft (563-717 m) at received levels (RLs) of 110 to 120 dB.

Frankel & 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 3 ft (1 m). For 11 playbacks, exposures were between 120 and 130 dB re: 1 μPa 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 nonpulse 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.

***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 industry 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 playback of drilling sound 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 Pt. 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. 1995b). Received levels from the icebreaker playback were estimated at 78-84 dB in the 1/3-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 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. Beluga whales have also been report to avoid active seismic vessels at distances of 6-12 mi (10-20 km) (Miller et al. 2005). It is likely that at least some beluga whales may avoid the vicinity of the proposed activities thus reducing the potential for exposure to high levels of underwater sound.

Patenaude et al. (2002) reported that beluga whales appeared to be more responsive to aircraft overflights than bowhead whales. Changes were observed in 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 nonpulse 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. Below we summarize some of the relevant material reviewed by Southall et al. (2007).

LGL and Greeneridge (1986) and Finley et al. (1990) documented belugas and narwhals congregated near ice edges reacting to the approach and passage of icebreaking ships. Beluga whales responded to oncoming vessels by (1) fleeing at speeds of up to 12 miles per hour (mi/hr) (20 kilometers per hour [km/hr]) from distances of 12-50 mi (20-80 km), (2) abandoning normal pod structure, and (3) modifying vocal behavior and/or emitting alarm calls. Narwhals, in contrast, generally demonstrated a “freeze” response, lying motionless or swimming slowly away (as far as 23 mi (37 km) down the ice edge), huddling in groups, and ceasing sound production. There was some evidence of habituation and reduced avoidance 2 to 3 days after onset.

The 1982 season observations by LGL & Greeneridge (1986) involved a single passage of an icebreaker with both ice-based and aerial measurements on 28 June 1982. Four groups of narwhals (n = 9 to 10, 7, 7, and 6) responded when the ship was 6.4 km away (received levels of ~100 dB in the 150- to 1,150-Hz band). At a later point, observers sighted belugas moving away from the source at > 12 mi (20 km) (received levels of ~90 dB in the 150- to 1,150-Hz band). The total number of animals observed fleeing was about 300, suggesting approximately 100 independent groups (of three individuals each). No whales were sighted the following day, but some were sighted on 30 June, with ship noise audible at spectrum levels of approximately 55 dB/Hz (up to 4 kiloHertz [kHz]).

Observations during 1983 (LGL & Greeneridge 1986) involved two ice-breaking ships with aerial survey and ice-based observations during seven sampling periods. Narwhals and belugas generally reacted at received levels ranging from 101 to 121 dB in the 20- to 1,000-Hz band and at a distance of up to 40 mi (65 km). Large numbers (100s) of beluga whales moved out of the area at higher received levels. As noise levels from icebreaking operations diminished, a total of 45 narwhals returned to the area and engaged in diving and foraging behavior. During the final sampling period, following an 8-hour quiet interval, no reactions were seen from 28 narwhals and 17 belugas (at received levels ranging up to 115 dB).

The final season (1984) reported in LGL & Greeneridge (1986) involved aerial surveys before, during, and after the passage of two icebreaking ships. During operations, no belugas and few narwhals were observed in an area approximately17 mi (27 km) ahead of the vessels, and all whales sighted over 12-50 mi (20-80 km) from the ships were swimming strongly away. Additional observations confirmed the spatial extent of avoidance reactions to this sound source in this context.

Gordon et al. (1992) conducted opportunistic visual and acoustic monitoring of sperm whales in New Zealand exposed to nearby whale-watching boats (within 1,476 ft [450 m]). Sperm whales respired significantly less frequently, had shorter surface intervals, and took longer to start clicking at the start of a dive descent when boats were nearby than when they were absent. Noise spectrum levels of whale watching boats ranged from 109-129 dB/Hz. Over a bandwidth of 100-6,000 Hz, equivalent broadband source levels were ~157 dB; received levels at a range of 1,476 ft (450 m) were ~104 dB.

Buckstaff (2004) reported elevated dolphin whistle rates with RLs from oncoming vessels in the 110 to < 120 dB. 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 (*Tursiops aduncus*). One population was exposed to vessel noise with spectrum levels of ~85 dB/Hz in the 1- to 22-kHz band (broadband received levels ~128 dB) as opposed to ~65 dB/Hz in the same band (broadband RL ~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 nonpulse acoustic harassment devices (AHDs). Avoidance ranges were about 2 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*) to Dukane® Netmark acoustic deterrent devices. In a total of 30 exposure trials, ~5 groups each demonstrated significant avoidance compared to 20 pinger off and 55 no-pinger control trials over two quadrats of about 0.19 mi^2 (0.5 km^2). Estimated exposure received levels were ~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 11,482 ft (3,500 m) (received levels ~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 ~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.

Finally, two recent papers deal with important 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 nonpulse 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 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 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.

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).

Blackwell et al. (2004) reported little or no reaction of ringed seals in response to pile-driving activities during construction of a man-made island in the Beaufort Sea. Ringed seals were observed swimming as close as 151 ft (46 m) from the island and may have been habituated to the sounds which were likely audible at distances <9,842 ft (3,000 m) underwater and 0.3 mi (0.5 km) in air. Moulton et al. (2003) reported that ringed seal densities on ice in the vicinity of a man-made island in the Beaufort Sea did not change significantly before and after construction and drilling activities.

Southall et al. (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound and reported that the limited data suggest exposures between ~90 and 140 dB generally do not appear to induce strong behavioral responses in pinnipeds exposed to nonpulse sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies of pinnipeds responding to nonpulse exposures in water, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded more strongly at lower levels than did animals in the field. Again, contextual issues are the likely cause of this difference.

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 ~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 3,081-ft [939-m] depth; 75-Hz signal with 37.5-Hz bandwidth; 195 dB max. source level, ramped up from 165 dB over 20 min) on their return to a haulout site. Received exposure levels of the ATOC source for experimental subjects averaged 128 dB (range 118-137) 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 nonpulse source began to demonstrate subtle behavioral changes at ~120-140 dB exposure RLs.

Kastelein et al. (2006) exposed nine captive harbor seals in a ~25 × 98 ft (30 m) enclosure to nonpulse 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-second duration [60-80% duty cycle]; or 100% 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 ~107 dB, avoiding it by ~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.

7.3 Summary of Potential Effects of Exposure to Underwater Sounds from Airguns

Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Numerous studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed 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 airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. In general, pinnipeds, small odontocetes, and sea otters seem to be more tolerant of exposure to airgun pulses than are baleen whales.

Masking

Masking effects of underwater sounds on marine mammal calls and other natural sounds are expected to be limited. Masking effects of pulsed sounds (even from larger arrays of airguns than proposed in this project) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data of relevance. Some whales however, are known to continue calling in the presence of pulsed sound. Their calls can be heard between the seismic pulses (e.g., Richardson et al. 1986; McDonald et al. 1995; Greene et al. 1999; Nieukirk et al. 2004). Although there has been one report that sperm whales cease calling when exposed to pulses from a very distant seismic ship (Bowles et al. 1994), a more recent study reported that sperm whales off northern Norway continued calling in the presence of seismic pulses (Madsen et al. 2002). Similar results were also reported during recent work in the Gulf of Mexico (Tyack et al. 2003). Bowhead whale calls are frequently detected in the presence of seismic pulses, although the numbers of calls detected may sometimes be reduced (Richardson et al. 1986; Greene et al. 1999; Blackwell et al. 2009a). Bowhead whales in the Beaufort Sea may decrease their call rates in response to seismic operations, although movement out of the area might also have contributed to the lower call detection rate (Blackwell et al. 2009a,b). Additionally, there is increasing evidence that, at times, there is enough reverberation between airgun pulses such that detection range of calls may be significantly reduced. In contrast, Di Iorio and Clark (2009) found evidence of increased calling by blue whales during operations by a lower-energy seismic source, a sparker. Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocete, given the intermittent nature of seismic pulses. Also, the sounds important to small odontocetes for communication are predominantly at much higher frequencies than are airgun sounds.

Disturbance Reactions

Baleen Whales**—**Baleen whale responses to pulsed sound have been studied more thoroughly than responses to continuous sound. 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. However, baleen whales exposed to strong noise pulses often react by deviating from their normal migration route. In the case of migrating gray and bowhead whales, observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors. 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 2.8-9.0 mi (4.5-14.5 km) from the source. For the much smaller airgun array used during the ZVSP survey, distances to received levels in the 170–160 dB re 1 μPa rms range are estimated to be 1.44- 2.28 mi (2.31-3.67 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. Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with avoidance occurring out to distances of 12-19 mi (20-30 km) from a medium-sized airgun source (Miller et al. 1999; Richardson et al. 1999). However, more recent research on bowhead whales (Miller et al. 2005) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1 μPa rms (Richardson et al. 1986; Ljungblad et al. 1988; Miller et al. 2005).

Malme et al. (1986, 1988) studied the responses of feeding eastern gray whales to pulses from a single 100 in^3 (1,639 cm^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 μPa 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. It is not known whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years. However, 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). Bowhead whales continued to travel to the eastern Beaufort Sea each summer despite seismic exploration in their summer and autumn range for many years (Richardson et al. 1987). Populations of both gray whales and bowhead whales grew substantially during this time. In any event, the brief exposures to sound pulses from the proposed airgun source are highly unlikely to result in prolonged effects.

Toothed Whales—Few systematic data are available describing reactions of toothed whales to noise pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized above have been reported for toothed whales. However, systematic work on sperm whales is underway (Tyack et al. 2003), and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone 2003; Smultea et al. 2004; Moulton and Miller 2005).

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 6-12 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 6-12 mi (10–20 km) (Miller et al. 2005).

Captive bottlenose dolphins and (of more relevance in this project) 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 (pk–pk level >200 dB re 1 μPa) before exhibiting aversive behaviors.

Reactions of toothed whales to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for mysticetes. A ≥170 dB disturbance criterion (rather than ≥160 dB) is considered appropriate for delphinids (and pinnipeds), which tend to be less responsive than other cetaceans. However, based on the limited existing evidence, belugas should not be grouped with delphinids in the "less responsive" category.

Pinnipeds—Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources that will be used. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior. Ringed seals frequently do not avoid the area within a few hundred meters of operating airgun arrays (Harris et al. 2001; Moulton and Lawson 2002; Miller et al. 2005). 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.

Hearing Impairment and Other Physical Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds ≥180 and ≥190 dB, respectively (NMFS 2000). Those criteria have been used in defining the safety (shut down) radii during seismic survey activities in the Arctic in recent years. However, those criteria were established before there were any data on the minimum received levels of sounds necessary to cause temporary auditory impairment in marine mammals. In summary,

- the 180 dB criterion for cetaceans is probably quite precautionary, i.e., lower than necessary to avoid TTS, let alone permanent auditory injury, at least for belugas and delphinids.
- the minimum sound level necessary to cause permanent hearing impairment is higher, by a variable and generally unknown amount, than the level that induces barely-detectable TTS.
- the level associated with the onset of TTS is often considered to be a level below which there is no danger of permanent damage.

NMFS is presently developing new noise exposure criteria for marine mammals that account for the now-available scientific data on TTS and other relevant factors in marine and terrestrial mammals (NMFS 2005b; D. Wieting in http://mmc.gov/sound/plenary2/pdf/plenary2summary-final.pdf; Scholik-Schlomer *in press*). New science-based noise exposure criteria are also proposed by a group of experts in this field, based on an extensive review and syntheses of available data on the effect of noise on marine mammals (Southall et al., 2007) and this review seems to confirm that the current 180 dB and 190 dB are conservative.

Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the drilling activities to avoid exposing them to underwater sound levels that might, at least in theory, cause hearing impairment. In addition, many cetaceans are likely to show some avoidance of the proposed activities. In those cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects might also 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. Beaked whales seem especially susceptible to injury and/or stranding when exposed to strong pulsed sounds.

However, as discussed below, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to industrial sound sources and beaked whales do not occur in the proposed study area. It is unlikely that any effects of these types would occur during the proposed project given the brief duration of exposure of any given mammal, and the planned monitoring and mitigation measures (see Section 12). The following subsections discuss in somewhat more detail the possibilities of TTS, permanent threshold shift (PTS), and non-auditory physical effects.

Temporary Threshold Shift (TTS) **—** TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple impulses of sound. [There are, however, recent data on TTS in dolphins caused by multiple pulses of sonar sound—Mooney et al. (2009).]

The distinction between TTS and PTS is not absolute. Although mild TTS is fully reversible and is not considered to be injury, exposure to considerably higher levels of sound causes more “robust” TTS, involving a more pronounced temporary impairment of sensitivity that takes longer to recover. There are very few data on recovery of marine mammals from substantial degrees of TTS, but in terrestrial mammals there is evidence that “robust” TTS may not be fully recoverable, i.e., TTS can grade into PTS (Le Prell *in press*).

The received energy level of a single seismic pulse that caused the onset of mild TTS in the beluga, as measured without frequency weighting, was ~186 dB re 1 $\mu Pa^2 \cdot s$ or 186 dB sound exposure level (SEL) (Finneran et al. 2002).[1] The rms level of an airgun pulse (in dB re 1 μPa measured over the duration of the pulse) is typically 10–15 dB higher than the SEL for the same pulse when received within a few kilometers of the airguns. Thus, a single airgun pulse might need to have a received level of ~196–201 dB re 1 μPa rms in order to produce brief, mild TTS. Exposure to several strong seismic pulses that each has a flat-weighted received level near 190 dB rms (175–180 dB SEL) could result in cumulative exposure of ~186 dB SEL (flat-weighted) or ~183 dB SEL (M_{mf}-weighted), and thus slight TTS in a small odontocete. That assumes that the TTS threshold upon exposure to multiple pulses is (to a first approximation) a function of the total received pulse energy, without allowance for any recovery between pulses.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. However, no cases of TTS are expected given the moderate size of the source, and the likelihood that baleen whales (especially migrating bowheads) would avoid the drilling and vessel activities before being exposed to levels high enough for there to be any possibility of TTS.

[1] If the low-frequency components of the watergun sound used in the experiments of Finneran et al. (2002) are downweighted as recommended by Southall et al. (2007) using their M_{mf}-weighting curve, the effective exposure level for onset of mild TTS was 183 dB re 1 $\mu Pa^2 \cdot s$ (Southall et al. 2007).

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures to sound suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak et al. 1999, 2005; Ketten et al. 2001; cf. Au et al. 2000). For harbor seal, which is closely related to the ringed seal, TTS onset apparently occurs at somewhat lower received energy levels than for odontocetes.

NMFS (1995, 2000) concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa (rms). NMFS is in the process of developing an EIS to establish new sound exposure criteria for marine mammals (NMFS 2005). New criteria are likely to include a time component in addition to sound pressure level which has been the only metric used previously when developing mitigation measures for industrial sound exposure for marine mammals. Due to the relatively small sound radii expected to result from the proposed exploration drilling and support activities, marine mammals would be unlikely to incur TTS without remaining very near the activities for some unknown time period. Given the proposed mitigation and the likelihood that many marine mammals are likely to avoid the proposed activities, exposure sufficient to produce TTS is unlikely to occur.

***Permanent Threshold Shift (PTS)* —** When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges.

There is no specific evidence that exposure to underwater industrial sound associated with oil exploration can cause PTS in any marine mammal. However, given the possibility that mammals might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to such activities might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage in terrestrial mammals. Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals (Southall et al. 2007, Le Prell *in press*). PTS might occur at a received sound level at least several decibels above that inducing mild TTS.

It is highly unlikely that marine mammals could receive sounds strong enough (and over a sufficient duration) to cause permanent hearing impairment during the proposed exploration drilling program. Marine mammals are unlikely to be exposed to received levels strong enough to cause even slight TTS. Given the higher level of sound necessary to cause PTS, it is even less likely that PTS could occur. In fact, even the levels immediately adjacent to the drillship may not be sufficient to induce PTS, even if the animals remain in the immediate vicinity of the activity. The planned monitoring and mitigation measures, including measurement of sound radii and visual monitoring when mammals are seen within “safety radii”, will minimize the already-minimal probability of exposure of marine mammals to sounds strong enough to induce PTS.

***Non-auditory Physiological Effects* —** Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, and other types of organ or tissue damage. If any such effects do occur, they probably would be limited to unusual situations when animals might be exposed at close range for unusually long periods. It is doubtful that any single marine mammal would be exposed to strong seismic sounds for sufficiently long that significant physiological stress would develop.

Until recently, it was assumed that diving marine mammals are not subject to the bends or air embolism. This possibility was first explored at a workshop (Gentry [ed.] 2002) held to discuss whether the stranding of beaked whales in the Bahamas in 2000 (Balcomb and Claridge 2001; NOAA and USN 2001) might have been related to bubble formation in tissues caused by exposure to noise from naval sonar. However, the opinions were inconclusive. Jepson et al. (2003) first suggested a possible link between mid-frequency sonar activity and acute and chronic tissue damage that results from the formation *in vivo* of gas bubbles, based on the beaked whale stranding in the Canary Islands in 2002 during naval exercises. Fernández et al. (2005a) showed those beaked whales did indeed have gas bubble-associated lesions as well as fat embolisms. Fernández et al. (2005b) also found evidence of fat embolism in three beaked whales that stranded 100 km north of the Canaries in 2004 during naval exercises. Examinations of several other stranded species have also revealed evidence of gas and fat embolisms (e.g., Arbelo et al. 2005; Jepson et al. 2005a; Méndez et al. 2005). Most of the afflicted species were deep divers. There is speculation that gas and fat embolisms may occur if cetaceans ascend unusually quickly when exposed to aversive sounds, or if sound in the environment causes the destabilization of existing bubble nuclei (Potter 2004; Arbelo et al. 2005; Fernández et al. 2005a; Jepson et al. 2005b). Even if gas and fat embolisms can occur during exposure to mid-frequency sonar, there is no evidence that that type of effect occurs in response to the types of sound produced during the proposed exploratory activities. Also, most evidence for such effects have been in beaked whales, which do not occur in the proposed project area.

Available data on the potential for underwater sounds from industrial activities to cause auditory impairment or other physical effects in marine mammals suggest that such effects, if they occur at all, would be temporary and limited to short distances. However, the available data do not allow for meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of the proposed activities, including most baleen whales, some odontocetes (including belugas), and some pinnipeds, are especially unlikely to incur auditory impairment or other physical effects.

Strandings 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). Underwater sound from drilling and support activities are less energetic and have slower rise times, and there is no proof that they can cause serious injury, death, or stranding. However, the association of mass strandings of beaked whales with naval exercises and, in one case, an academic seismic survey, has raised the possibility that beaked whales exposed to strong pulsed sounds may be especially susceptible to injury and/or behavioral reactions that can lead to stranding. The potential for stranding to result from exposure to strong pulsed sound suggests that caution be used when exposing marine mammals to pulsed or other underwater sound. Most of the stranding events associated with exposure of marine mammals to pulsed sound however, have involved beaked whales which do not occur in the proposed area. Additionally, the sound produced from the proposed activities will be at much lower levels than those reported during stranding events.

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

Subsistence hunting continues to be an essential aspect of Inupiat Native life, especially in rural coastal villages. The Inupiat participate in subsistence hunting activities in and around the Beaufort Sea. The animals taken for subsistence provide a significant portion of the food that will last the community through the year. Marine mammals represent on the order of 60-80% of the total subsistence harvest. Along with the nourishment necessary for survival, the subsistence activities strengthen bonds within the culture, provide a means for educating the young, provide supplies for artistic expression, and allow for important celebratory events. In this IHA application Shell specifically discusses the potential impact from the exploration drilling program to subsistence use of the bowhead whale, beluga, and seals, which are the primary marine mammals harvested for subsistence that are also covered under this authorization of incidental take by NMFS.

Bowhead Whale. Activities associated with Shell's planned exploration drilling program would have no or negligible effects on bowhead whales. Noise and general activity associated with exploration drilling and operation of vessels and aircraft have the potential to impact bowhead whales. However, as noted above in Section 7, though temporary diversions of the swim path of migrating whales have been documented, the whales have generally been observed to resume their initial migratory route within a distance of 6-20 mi or 10-30 km (Davis 1987; Brewer et al. 1993; Hall et al. 1994). Drilling noise has not been shown to block or impede migration even in narrow ice leads (Davis 1987; Richardson et al. 1991). Any effects on the bowhead whale, as a subsistence resource, would be negligible.

Exploration drilling operations could in some circumstances affect subsistence hunts by placing the animals further offshore or otherwise at a greater distance from villages thereby increasing the difficulty of the hunt or retrieval of the harvest, or creating a safety risk to the whalers. Residents of Kaktovik and Nuiqsut hunt bowheads during the fall migration. In 2012, Shell's operations will commence in July before the fall hunt begins, cease during these bowhead subsistence hunts, and resume after they are completed so the exploration program would have no direct impact on these subsistence activities. Any effects on bowhead behavior or movements would therefore have no impact on the Kaktovik or Nuiqsut (Cross Island) fall whaling as Shell's exploration drilling program will cease on August 25, prior to the start of the hunts, and will not resume until the hunts have concluded.

Helicopters (~2-trips/day, approximately 12/week) servicing the offshore operations could traverse areas utilized by Kaktovik or Nuiqsut (Cross Island) whalers for fall whaling from a Deadhorse shorebase location, but not while the hunts are ongoing. Helicopters traffic often evokes no response from bowheads, but the whales sometimes engage in hasty dives or abrupt turns (Richardson et al. 1985, 1995a). Bowhead whales tend to be more sensitive in shallow water (Richardson et al 1985). Any such behavioral responses would be momentary and have negligible effect on the subsistence resource and no effect on the subsistence activity. Aircraft shall not operate below 1,500 ft (457 m) unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or any other emergency situations. Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft (457 m) in areas of active whaling;

such areas to be identified through communications with the Com-Centers. Except for airplanes engaged in marine mammal monitoring, aircraft shall use a flight path that keeps the aircraft at least 5 mi (8 km) inland until the aircraft is directly south of its offshore destination, then at that point it shall fly directly north to its destination. In addition, aircraft will not get closer than 1,500 ft (457 m) of groups of whales.

No routine vessel traffic will traverse this subsistence area. Vessels within 900 ft (274 m) of marine mammals will reduce speed, avoid separating members from a group and will avoid multiple changes in direction. Vessel speeds will be reduced during inclement weather to avoid collisions with marine mammals.

The planned period of the exploration drilling program begins in July 2012, ceases on August 25 for the bowhead whale subsistence hunts by Kaktovik and Nuiqsut (Cross Island) hunters, and then restarts after the hunts have concluded. During this period most marine mammals are expected to be dispersed throughout the area, except during the peak of the bowhead whale migration in the Beaufort Sea, which occurs from late August into October. Bowhead whales are expected to be in the Canadian Beaufort Sea during much of the time prior to the subsistence whaling shutdown that occurs on August 25 and, therefore, are not expected to be affected by the exploration drilling program prior to that date. After the conclusion of the bowhead whale subsistence hunt, bowheads may travel in proximity to the exploration drilling program area and hear sounds from exploration drilling and associated vessel and aircraft traffic, and may be displaced by these activities. The potential impacts of exploration drilling to the fall bowhead whale migration during the subsistence hunts is eliminated by Shell’s commitment to shutdown the exploration drilling program during the Kaktovik and Nuiqsut (Cross Island) hunts.

Beluga. Beluga are not a prevailing subsistence resource in the communities of Kaktovik and Nuiqsut, the nearest communities to Shell’s planned 2012 exploration drilling program. Therefore, any such behavioral responses of avoidance of activity areas by beluga in the Beaufort Sea would have a no effect on the subsistence resource.

Seals. Seals are an important subsistence resource and ringed seals make up the bulk of the seal harvest. Most ringed and bearded seals are harvested in the winter or in the spring before Shell’s exploration drilling program would commence, but some harvest continues into the drilling season period and could possibly be affected by Shell’s planned activities. Spotted seals are also harvested during the summer. Shell lease blocks where exploration activities would occur are located more than 16 mi (26 km) offshore, so activities within the prospects would have no impact on subsistence hunting for seals. Helicopter traffic between the shorebase and the offshore exploration drilling operations could potentially disturb seals and, therefore, subsistence hunts for seals, but any such effects would be minor due to the small number of flights and the altitude at which they typically fly, and the fact that most seal hunting is done during the winter and spring. Any effects on subsistence hunts for seals would be negligible and temporary lasting only minutes after the flight has passed.

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

Shell's planned 2012 exploration drilling program will not result in any permanent impact on habitats used by marine mammals, or to their prey sources. With regard to migrating cetaceans and seals, any effects would be temporary and of short duration at any one place. The primary potential impacts to all marine mammals that are reasonably expected or reasonably likely are associated with elevated sound levels from exploration drilling operations, its support vessels, and aircraft. The effects to habitat of marine mammals by sounds from the planned exploration drilling program are expected to be negligible.

Although evaluation of speculative events such as oil spills is not properly included in the "negligible impacts" analysis, Shell recognizes the agency's interest in these remote risks. Therefore, [as a courtesy] Shell includes with this IHA application an analysis of the highly unlikely, unanticipated impact of a crude oil spill event during this exploration drilling program (Attachment E). This is an analysis of the impacts from a site-specific, very large oil spill scenario created for Shell's regional oil spill response plan (*Beaufort Sea Regional Oil Discharge Prevention and Contingency Plan* [ODPCP] – revised April 2011) which was submitted to BOEMRE contemporaneously with Shell's Camden Bay Exploration Plan (EP). Under 30 CFR 254.26(d) (1), Shell's oil spill response plan must envision a crude oil spill scenario from a worst case discharge lasting 30 days. Attachment E analyzes the impacts from such a site-specific scenario, and presents this analysis in light of the very large crude oil spill impact analyses already conducted for oil and gas exploration activities in the arctic by NMFS (NMFS 2008) and BOEMRE (MMS 2003). Given that a very large oil spill is a highly unlikely, and an unanticipated result of Shell's planned exploration drilling program, the analysis is not included within Section 9 of this IHA application which assesses the anticipated impacts of Shell's exploration drilling activity, but provided separately as Attachment E.

9.1 Potential Impacts from Seafloor Disturbance (Mooring and Mudline Cellar (MLC) Construction)

There will be some seafloor disturbance or temporary increased turbidity in the seabed sediments during anchoring and emplacement of the MLCs. The amount and duration of disturbed or turbid conditions will depend on sediment material and consolidation and specific activity. The *Kulluk* would be anchored using a 12-point anchor system held in place with 12, 15 metric ton Stevpris anchors and the *Discoverer* would be stabilized and held in place with a system of eight 7,000 kg Stevpris anchors during operations. The anchors from either drilling vessel are designed to embed into the seafloor. Prior to setting, the anchors will penetrate the seafloor and drag two or three times their length. Both the anchor and anchor chain will disturb sediments and create an "anchor scar" which is a depression in the seafloor caused by the anchor embedding. Anchor depressions commonly exceed the dimensions of the anchor itself.

For the *Kulluk*, each Stevpris anchor may impact an area of 2,928 square feet (ft^2) (272 m^2) whereas each Stevpris anchor from the *Discoverer* may impact an area of 2,027 ft^2 (188 m^2) of the seafloor. Minimum impact estimates of the seafloor from each well or mooring with the 12 anchors of the *Kulluk* is 35,136 ft^2 (3,264 m^2) or with the eight anchors of the *Discoverer* is

16,216 ft^2 (1,507 m^2). This estimate assumes that the anchors are set only once.. Shell plans to pre-set anchors at each drill site for whichever drillship is used for drilling. Unless moved by an outside force such as sea current, anchors should only need to be set once per drill site.

Once the *Kulluk* or *Discoverer* ends operation at a drill site, the anchors will be retrieved. Over time the anchor scars will be filled through natural movement of sediment. The duration of the scars depends upon the energy of the system, water depth, ice scour, and sediment type. Anchor scars were visible under low energy conditions in the North Sea for five to ten years after retrieval. Scars typically do not form or persist in sandy mud or sand sediments but may last for nine years in hard clays (Centaur Associates, Inc. 1984). The surficial Holocene soils at the Sivulliq and Torpedo prospects consist primarily of soft to stiff silts and clays with low to medium plasticity. The fine sand present in contact with underlying silts and clays is variable, as the sand tends to infill old gouges. Local depositional processes will strongly affect the range of properties for Holocene soils. The energy regime, plus possible effects of ice gouge in the Beaufort Sea suggests that anchor scars would be refilled faster than in the North Sea.

Excavation of each MLC by the *Kulluk* will displace about 24,579 ft^3 (696 m^3) of seafloor sediments and directly disturb approximately 452 ft^2 (42m^2) of seafloor. Excavation of each MLC by the *Discoverer* will displace about 17,128 ft^3 (485 m^3) of seafloor sediments and directly disturb approximately 314 ft^2 (29 m^2) of seafloor. The MLC excavation amounts range in volume because the MLC bits for the *Kulluk* and *Discoverer* differ in size and hence excavate different diameter MLCs. Material will be excavated from the MLCs using a large diameter drillbit. Pressurized air and water (no drilling mud used) will be used to assist in the removal of the excavated materials from the MLC. Some of the excavated sediments will be displaced to adjacent seafloor areas and some will be removed via the air lift system and discharged on the seafloor away from the MLC. These excavated materials will also have some indirect effects as they are deposited on the seafloor in the vicinity of the MLCs. Direct and indirect effects would include slight changes in seafloor relief and sediment consistency.

9.2 Potential Impacts on Habitat due to Sound Generation

Marine Mammals

Shell does not expect any significant or lasting impacts to marine mammals from sound energy created by exploration drilling activities in Camden Bay. Sound is crucial to marine mammals because they use it to navigate, communicate, find open water, avoid predators, and find food. There are a variety of sounds in the Beaufort Sea, especially during the drilling season, when the area is exposed to the peak level of man-made sound from oil and gas exploration activities and biological research surveys. Sound sources from Shell's exploration activities that could be heard by marine mammals include the drilling vessel, marine vessels, and support vessels. Sounds that are natural in the marine environment of the Beaufort Sea include sound from ice, surf, subsea landslides, and other animals. Concern has been expressed regarding the presence and intensity of impacts from sound energy on marine mammals. Concerns are mainly aimed at deflection of whales from hunting and migration areas, masking of natural sounds, and physiological damage to marine mammals' hearing. Based on previous studies regarding sound energy and effects on marine mammals, as well as the preventive mitigation measures planned for the project, Shell does not expect any significant or lasting impacts to marine mammals from sound energy resulting from exploration drilling activities in Camden Bay.

Avoidance behavior in response to sound energy by marine mammals, such as temporary deflection, is the most likely behavioral response expected as a result of Shell's exploration activities in Camden Bay. Depending upon the sound source, different mitigation measures will be implemented. Mitigation measures have been included in the 4MP that is included as Attachment C to this IHA application. That discussion and analysis of Shell's sound energy mitigation measures is incorporated here by reference.

MMOs will be stationed on all drilling and support vessels to survey inside the exclusion zone (areas within isopleths of certain sound levels for different species) for marine mammals. For support vessels in transit, if a marine mammal is sighted from a vessel within its respective safety radius, the Shell vessel will reduce activity (e.g. reduce speed) and sound energy level to ensure that the animal(s) are not exposed to sound above their respective safety level. Full activity will not be resumed until all marine mammals are outside of the vessel's exclusion zone and there are no other marine mammals likely to enter the exclusion zone. Regular overflight surveys and support vessel surveys for marine mammals will be conducted to further monitor drilling areas.

Anchored vessels, including the drilling vessel, will remain at anchor and continue ongoing operations if approached by a marine mammal. An approaching animal, not exhibiting avoidance behavior, is likely curious and not regarded as harassed. The anchored vessel will remain in place and continue ongoing operations to avoid possibly causing avoidance behavior by suddenly changing sound conditions. Moving vessels will avoid groups of whales by a distance of 1,500 ft (457 m), and will reduce speed if within 900 ft (274 m) of other marine mammals. MMOs use distance as an indicator of the safety radii, which is anticipated to be much smaller than 900 ft (274 m). These measures will reduce the sound energy received by the mammals. Shell will not be operating during the sensitive times such as pupping and molting. These important activities will be over by the time Shell activities start. If seals are hauled out on ice in the vicinity of operations temporary deflection is expected.

While observing the response of beluga whales to icebreakers, Finley and Davis (1984) reported avoidance behavior when ice breaker vessels approached at distances of 22-31 mi (35-50 km). Belugas are thought to have poor hearing below one Hz, the range of most drilling activities, but have shown some behavioral reactions to the sounds. Brewer et al. (1993) observed belugas within 2.3 mi (3.7 km) of the drilling vessel *Kulluk* during drilling.

Seals are not expected to be impacted by sound energy from Shell vessel traffic or exploration drilling. This was demonstrated during a study designed to assess ringed seals' reactions to drilling activity (Brewer et al. 1993). After observing the seals approach within 33 ft (10 m) of the drilling vessel *Kulluk*, the scientists concluded that they are not disturbed by drilling activity. The same conclusion was reached concerning bearded seals that approached within 656 ft (200 m) of ice breakers (Brewer et al. 1993). In another study involving the drillship *Explorer II*, seals were observed within 115 ft (35 m) of the ship during drilling (Gallagher et al. 1992).

Sound energy introduced into the environment of marine mammals could cause masking (the covering of sound that would otherwise have been heard). Masking can interfere with the detection of important natural sources. Underwater sound could possibly mask environmental sounds (Terhune 1981) or communication between marine mammals (Perry and Renouf 1987). However, in a study conducted by Cummings et al. (1984) in which breeding ringed seals were subjected to recordings of industrial sounds and there were no documented effects on ringed seal vocalizations.

Belugas primarily use high-frequency sounds to communicate and locate prey; therefore, masking by low-frequency sounds associated with drilling activities is not expected to occur (Gales 1982). If the distance between communicating whales does not exceed their distance from the drilling activity, the likelihood of potential impacts from masking would be low (Gales 1982). At distances greater than 660-1,300 ft (200-400 m), recorded sounds from drilling activities did not affect behavior of beluga whales even though the sound energy level and frequency were such that it could be heard several kilometers away (Richardson et al. 1995b). This exposure resulted in whales being deflected from the sound energy and changing behavior. These brief changes are expected to be temporary and are not expected to affect whale population (Richardson et al. 1991; Richard et al. 1998).

Threatened and Endangered Species

Sound is important to bowhead whales because they use it to navigate, communicate, find open water, avoid predators, and find areas of food abundance. Bowhead whales, along with being endangered, are a key subsistence resource of the Inupiat Eskimos of the North Slope. There is concern regarding potential impacts on the whales due to sound energy produced by exploration drilling activities. Potentially, sounds created by drilling activities could affect behavior, mask whale communication and other environmental sounds, or damage hearing mechanisms. There have been no conclusive studies on the sensitivity of bowhead whale hearing (Richardson et al. 1995b). It is likely that the range of hearing includes the frequency range used in their calls. Most frequencies used by bowhead whales are low (less than 1,000 Hz) (Richardson et al. 1995b). Mitigation measures are in place to minimize or eliminate impacts to the whales and, by extension, subsistence uses of the whales. Shell does not expect any lasting impacts on marine mammals from sound energy created during drilling activities in Camden Bay.

In order to limit the whales' close contact with ice management and other support vessels, MMOs will be stationed on all support vessels to survey inside the exclusion zone (areas within isopleths of certain sound levels for different species) for marine mammals. If a marine mammal is sighted from a vessel in transit within its respective safety radius, the Shell vessel will reduce activity (e.g. reduce speed) and sound energy level to ensure that the animal is not exposed to sound above its respective safety levels. Full activity will not be resumed until all marine mammals are outside of the exclusion zone and there are no other marine mammals likely to enter the exclusion zone before the next overflight survey. Regular overflight surveys and support vessel surveys for marine mammals will be conducted to further monitor drilling areas. Anchored vessels, including the drilling vessel, will remain at anchor and continue ongoing operations if approached by a marine mammal. An approaching animal, not exhibiting avoidance behavior, is likely curious and not regarded as harassed. The anchored vessel will remain in place and continue ongoing operations to avoid possibly causing avoidance behavior by suddenly changing sound energy conditions.

Avoidance behavior in response to sound by marine mammals such as temporary deflection from hunting and migration corridors is the most likely behavioral response expected as a result of Shell's exploration activities in Camden Bay. Bowhead whales, likely due to their hearing range, have been reported to react more to low frequency sounds than higher frequency sounds (Richardson et al. 1995b). Davis (1987) studied the responses exhibited by bowhead whales to drilling sound. The only response he saw was avoidance behavior in some whales. Davis (1987) concluded that avoidance behavior was temporary and sound energy from drilling did not impede migration of the whales. Recordings from the drilling ship *Explorer II* were projected in the Canadian Beaufort Sea during the drilling season (Richardson et al. 1985). Changes in behavior in response to the sounds were observed. Some whales showed avoidance behavior, but the deflection away from the sound was considered weak (Richardson et al. 1985). During the same study, Richardson et al. (1985) observed whales between 2.5 mi and 12.4 mi (4 and 20 km) while drilling activity was occurring, and he concluded that the whales were undisturbed. In a similar study where recordings from the drilling vessel *Kulluk* were projected, no deflection was seen until sound pressure levels reached 120 dB or higher (Wartzok et al. 1989).

Concern has been expressed that sound energy levels produced by drilling and ice management could cause masking. Masking can interfere with the detection of important natural sound sources. Underwater sound could possibly mask environmental sounds (Terhune 1981) or communication between marine mammals (Perry and Renouf 1987). Effects of sound energy from drilling and ice management will be temporary and localized, and are not expected to significantly impact marine mammals.

Loud sound (higher than 180 dB) could cause temporary (the duration would depend upon the level and duration of noise exposure) or permanent damage to hearing ability (Kryter 1985; Richardson and Malme 1993). Since bowhead whales have been shown to exhibit avoidance behaviors in the presence of lower level sound (115 dB) (Richardson et al. 1990), it is unlikely that they would approach such sound sources close enough to be exposed to sound levels that could be injurious (Richardson and Malme 1993).

Zooplankton

Sound energy generated by drilling activities will not negatively impact the diversity and abundance of zooplankton. The primary generators of sound energy are the drilling vessel and marine vessels. Ice management vessels are likely to be the most intense sources of sound associated with the exploration drilling program (Richardson et al. 1995a). Ice management vessels, during active ice management, may have to adjust course forward and astern while moving ice and thereby create greater variability in propeller cavitation than other vessels that maintain course with less adjustment. The drillship maintains station during drilling without activation of propulsion propellers. Richardson et al. (1995a) reported that the noise generated by an icebreaker pushing ice was 10-15 dB greater than the noise produced by the ship underway in open water. It is expected that the lower level of sound produced by the drilling vessel, ice management vessels conducting icebreaking, or other vessels would have less impact on zooplankton than seismic (survey) sound.

No appreciable adverse impact on zooplankton populations will occur due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortality or impacts on zooplankton as a result of Shell's operations is insignificant as compared to the naturally-occurring reproductive and mortality rates of these species. This is consistent with previous conclusions that crustaceans (such as zooplankton) are not particularly sensitive to sound produced by seismic sounds (Wiese 1996). Impact from sound energy generated by an ice breaker, other marine vessels, and drill ships would have less impact, as these activities produce lower sound energy levels (Burns et al. 1993). Historical sound propagation studies performed on the *Kulluk* by Hall et al. (1994) also indicate the *Kulluk* and similar drilling vessels would have lower sound energy output than three-dimensional seismic sound sources (Burns et al. 1993). The drillship *Discoverer* would emit sounds at a lower level than the *Kulluk* and therefore the impacts due to drilling noise would be even lower than the *Kulluk*. Therefore, zooplankton organisms would not likely be affected by sound energy levels by the vessels to be used during Shell's exploration activities in Camden Bay.

Benthos

There was no indication from benthic biomass or density that previous drilling activities at the Hammerhead prospect have had a measurable impact on the ecology of the immediate local area. To the contrary, the abundance of benthic communities in the Sivulliq area would suggest that the benthos were actually thriving there (Dunton et al. 2008).

Sound energy generated by drilling activities will not appreciably affect diversity and abundance of plants or animals on the seafloor. The primary generators of sound energy are the drilling vessel and marine vessels. Ice management vessels are likely to be the most intense sources of sound associated with the exploration drilling program (Richardson et al. 1995a). Ice management vessels, during active ice management, may have to adjust course forward and astern while moving ice and thereby create greater variability in propeller cavitation than other vessels that maintain course with less adjustment. The drillship maintains station during drilling without activation of propulsion propellers. Richardson et al. (1995a) reported that the noise generated by an icebreaker pushing ice was 10-15 dB greater than the noise produced by the ship underway in open water. The lower level of sound produced by either drilling vessel, ice management vessels conducting icebreaking, or other vessels will have less impact on bottom-dwelling organisms than seismic (survey) sound.

No appreciable adverse impacts on benthic populations would be expected due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortalities or impacts that might occur as a result of Shell's operations is insignificant compared to the naturally-occurring high reproductive and mortality rates. This is consistent with previous BOEMRE conclusions that the effect of seismic exploration on benthic organisms probably would be immeasurable (USDI/MMS 2007). Impacts from sound energy generated by ice breakers, other marine vessels, and drilling vessels would have less impact, as these activities produce much lower sound energy levels (Burns et al. 1993).

Fish

Fish react to sound and use sound to communicate (Tavolga et al. 1981). Experiments have shown that fish can sense both the intensity and direction of sound (Hawkins 1981). Whether or not fish can hear a particular sound depends upon its frequency and intensity. Wavelength and the natural background sound also play a role. The intensity of sound in water decreases with distance as a result of geometrical spreading and absorption. Therefore, the distance between the sound source and the fish is important. Physical conditions in the sea, such as temperature thermoclines and seabed topography, can influence transmission loss and thus the distance at which a sound can be heard.

The impact of sound energy from drilling and ice management activities will be negligible and temporary. Fish typically move away from sound energy above a level that is at 120dB or higher (Ona 1988).

Drilling vessel sound source levels during drilling can range from 90 dB within 31 mi (50 km) of the drilling vessel to 138 dB within a distance of 0.06 mi (0.1 km) from the drilling vessel (Greene 1985,1987b). These are predicted sound levels at various distances based on modeled transmission loss equations in the literature (Greene 1987b). Ice management vessel sound source levels can range from 174-184dB. At these intensity levels, fish may avoid the drilling vessel, ice management vessels, or other large support vessels. This avoidance behavior is temporary and limited to periods when a vessel is underway or drilling.

There have been no studies of the direct effects of ice management vessel sounds on fish. However, it is known that the ice management vessels produce sounds generally 10-15 dB higher when moving through ice rather than open water (Richardson et al. 1995b). In general, fish show greater reactions to a spike in sound energy levels, or impulse sounds, rather than a continuous high intensity signal (Blaxter et al. 1981).

Fish sensitivity to impulse sound varies depending on the species of fish. Fish such as mackerel, flatfish and other bottom-living species lack a swim bladder and are not capable of hearing sounds, unlike species such as cod and herring. Cod and herring have a well-developed swim bladder and therefore are sensitive to sound. An alarm response in these fish is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level (Blaxter et al. 1981).

9.3 Potential Impacts on Habitat from Drill Cuttings

General

For the Camden Bay exploration drilling program, Shell has committed to not discharge various waste streams during routine drilling operations, even though the waste streams are allowable discharges under the current U.S. Environmental Protection Agency (EPA) administered Arctic National Pollutant Discharge Elimination System (NPDES) General Permit AKG-28-0000 (GP AKG-28-0000). Shell will not discharge any of the following liquid waste streams; treated sanitary waste (black water), domestic waste (gray water), bilge water or ballast water, that are generated by the drilling vessel. Shell will not discharge drilling mud or cuttings that are generated below the depth at which the 20-in. (51-cm) diameter casing is set in each well. The mud and cuttings collected will be transferred to an OSV then to the deck or waste barge. Either barge will hold collected mud and cuttings, and collected wastewater for transport and disposal at an approved and licensed, onshore facility.

Cuttings generated while drilling the MLC, the 36- and 26-in. (91- and 66-cm) hole sections (all drilled with seawater and viscous sweeps only) plus cement discharged while cementing the 30- and 20-in. (76- and 51-cm) casing strings will be discharged on the surface of the seafloor under provisions of the previously mentioned NPDES GP.

The NPDES GP establishes discharge limits for drilling fluids (at the end of a discharge pipe) to a minimum 96-hr LC50 of 30,000 ppm. Both modeling and field studies have shown that discharged drilling fluids are diluted rapidly in receiving waters (Ayers et al. 1980a, 1980b; Brandsma et al. 1980; NRC 1983; O'Reilly et al. 1989; Nedwed et al. 2004; Smith et al. 2004; Neff 2005). The dilution rate is strongly affected by the discharge rate; the NPDES GP limits the discharge of cuttings and fluids to 750 bbl/hr (89 m^3/hr). For example, the EPA modeled hypothetical 750 bbl/hr (89 m^3/hr) discharges of drilling fluids in water depths of 66 ft (20 m) in the Beaufort and Chukchi Sea and predicted a minimum dilution of 1,326:1 at 330 ft (100 m).

Modeling of similar discharges offshore of Sakhalin Island predicted a 1,000-fold dilution within 10 minutes and 330 ft (100 m) of the discharge. In a field study (O'Reilly et al. 1989) of a drilling waste discharge offshore of California, a 270 bbl (43 m^3) discharge of drilling fluids was found to be diluted 183-fold at 33 ft (10 m) and 1,049-fold at 330 ft (100 m). Neff (2005) concluded that concentrations of discharged drilling fluids drop to levels that would have no effect within about two minutes of discharge and within 16 ft (5 m) of the discharge location.

Marine Mammals

The levels of drill cuttings and drilling mud discharges are regulated by the EPA's NPDES GP. The impact of the limited amount of drill cutting discharges would be localized to the drill sites and temporary. Drill cutting discharges could displace marine mammals a short distance from a drilling location. As noted above, drilling mud will not be discharged from the wells proposed under this exploration program in Camden Bay.

Gray whales will more than likely avoid drilling activities and not come into close contact with drill cuttings. However, gray whales are benthic feeders and the area of seafloor that will be covered by discharge will be unavailable to the whales for foraging purposes. This is not expected to impact individual whales or the population, because the areas of disturbance are insignificant compared to the area covered by the whales for foraging. Impacts on beluga whales from the discharge of drill cuttings are not likely.

It is anticipated that drill cuttings will only dispense up to 330 ft (100 m) from the drilling vessel. Therefore, it is highly unlikely that beluga whales will come into contact with any drilling discharge and impacts are not expected.

Seals are not expected to be impacted by drill cuttings. If seals remain within 330 ft (100 m) of the discharge source for an extended period of time, it is possible that physiological effects due to toxins could impact the animal. However, it is highly unlikely that a seal would remain within 330 ft (100 m) of the discharge source for any extended period of time.

Threatened and Endangered Species

Negative effects on endangered whales from drilling discharges are not expected. Baleen whales, such as bowheads, tend to avoid drilling rigs at distances up to 12 mi (20 km). Therefore, it is highly unlikely that the whales will swim or feed in close enough proximity of discharges to be affected.

The levels of drill cutting discharges are regulated by the EPA's NPDES GP. The impact of drill cutting discharges would be localized and temporary. Drill cutting discharges could displace endangered whales (bowhead and humpback whales) a short distance from a drilling location. Effects on the whales present within a few meters of the discharge point would be expected, primarily due to sedimentation. However, endangered whales are not likely to have long-term exposures to drill cuttings because of the episodic nature of discharges (typically only a few hours in duration).

Seals, including the proposed for threatened listing ringed and bearded seals, are not expected to be impacted by drill cuttings. If seals remain within 330 ft (100 m) of the discharge source for an extended period of time, it is possible that physiological effects due to toxins could impact the animal. However, it is highly unlikely that a seal would remain within 330 ft (100 m) of the discharge source for any extended period of time.

It is expected that any toxic effects on fish and fish larvae present within a few feet of the discharge point would be negligible and ephemeral.

Zooplankton

Studies by the EPA (2006) and Neff (2005) indicate that though planktonic organisms are extremely sensitive to environmental conditions (e.g., temperature, light, availability of nutrients, and water quality), there is little or no evidence of effects from drill cuttings discharges on plankton.

More than 30 OCS well sites have been drilled in the Beaufort Sea. The Warthog well was drilled in Camden Bay in 35 ft (11 m) of water (Thurston et al. 1999). The BOEMRE routinely monitored that well site for contaminants and found that it had no accumulated petroleum hydrocarbons or heavy metals (Brown et al. 2001).

The levels of drill cutting discharges are regulated by the EPA's NPDES GP. The impact by drill cuttings discharges would be localized and temporary. Effects on zooplankton present within a few meters of the discharge point would be expected, primarily due to sedimentation. However, zooplankton are not likely to have long-term exposures to drill cuttings because of the episodic nature of discharges (typically only a few hours in duration). Results of a recent study on a historical drill site in Camden Bay (HH-2) showed that movement of drilling mud and cuttings were restricted to within 330 ft (100 m) of the discharge site (Trefry and Trocine 2009).

Fine-grained particulates and other solids in drilling mud and cuttings could cause sublethal effects to organisms in the water column. However as noted above, Shell will not discharge drilling muds from the wells proposed under this exploration drilling program in Camden Bay. The responses observed following exposure to drilling mud include alteration of respiration and filtration rates and altered behavior. Zooplankton in the immediate area of discharge from exploration drilling operations could potentially be adversely impacted by sediments in the water column, which could clog respiratory and feeding structures, and they could suffer abrasions. This impact would likely not have more than a short-term impact and not affect population levels of zooplankton.

Benthos

Drill cutting discharges are regulated by the EPA's NPDES GP. The impact of drill cuttings discharges would be localized and temporary. Effects on benthic organisms present within a few meters of the discharge point would be expected, primarily due to sedimentation. However, benthic animals are not likely to have long-term exposures to drill cuttings because of the episodic nature of discharges (typically only a few hours in duration).

Significant heavy metal contamination of sediments and resulting effects on benthic organisms is not expected. The NPDES GP contains stringent limitations on the concentrations of mercury, cadmium, chromium, silver, and thallium allowed in discharged drilling fluids and cuttings. Additional limitations are placed on free oil, diesel oil, and total aromatic hydrocarbons (TAH) allowed in discharged drilling fluids and cuttings. Discharge rates are also controlled by the permit. Baseline studies at the 1985 Hammerhead drill site (Trefry and Trocine 2009) detected background levels aluminum, iron, zinc (Zn), cadmium (Cd) and mercury in all surface and subsurface sediment samples. Considering that drilling mud will not be discharged and the relatively small area that drill cutting sediment will be deposited, no significant impacts on sediment are expected to occur. The expected increased concentrations of Zn, Cd, and chromium in sediments near the drill site due to the discharge are in the range where no or low effects would result.

Studies in the 1980s, 1999, 2000, and 2002 (Brown et al. 2001 in USDI/MMS 2003) also found that benthic organism near drilling sites in the Beaufort have accumulated neither petroleum hydrocarbon nor heavy metals. In 2008 Shell investigated the benthic communities (Dunton et al. 2008) and sediments (Trefry and Trocine 2009) around the Sivulliq Prospect including the location of the historical Hammerhead drill site that was drilled in 1985. Benthic communities at the historical Hammerhead drill site were found not to differ statistically in abundance, community structure, or diversity, from benthic communities elsewhere in this portion of the Beaufort Sea, indicating that there was no long term effect. Because discharges from drill cuttings are composed of seawater, impacts to benthic organisms will be negligible and restricted to a very small area of the seafloor.

Fish

The levels of drill cuttings discharges are regulated by the EPA's NPDES GP. The impact of drill cuttings discharges would be localized and temporary. Drill cutting discharges could displace fish a short distance from a drilling location. Effects on fish and fish larvae present within a few meters of the discharge point would be expected, primarily due to sedimentation. However, fish and fish larvae that live in the water column are not likely to have long-term exposures to drill cuttings because of the episodic nature of discharges (typically only a few hours in duration).

Although unlikely at deeper offshore drilling locations, demersal fish eggs could be smothered if discharges occur in a spawning area during the period of egg production. No specific demersal fish spawning locations have been identified at the Sivulliq or Torpedo well locations. The most abundant and trophically important marine fish, the Arctic cod, spawns with planktonic eggs and larvae under the sea ice during winter and will therefore have little exposure to discharges.

Habitat alteration concerns apply to special or relatively uncommon habitats, such as those important for spawning, nursery, or overwintering. Important fish overwintering habitats are located in coastal rivers and nearshore coastal waters, but are not found in the proposed exploration drilling areas. Important spawning areas have not been identified in the Beaufort Sea, although gravelly areas along the coast are thought to be herring spawning areas. Kelp beds such as the Stefansson Sound boulder patch are important habitat for many species and are found in shallower and more coastal waters along Camden Bay. The known occurrences of kelp beds are more than 5 mi (8 km) from Shell's proposed drill sites.

9.4 Potential Impacts from Ice Management

Ice-management activities include the physical pushing or moving of ice in the proposed exploration drilling area and to prevent ice floes from striking the drilling vessel. Ringed, bearded, and spotted seals (along with the ribbon seal and walrus) are dependent on sea ice for at least part of their life history. Sea ice is important for life functions such as resting, breeding, and molting. These species are dependent on two different types of ice: pack ice and landfast ice. Shell does not expect to have to manage pack ice during the majority of the drilling season. The majority of the pack ice management should occur in the early and latter portions of the drilling season. Landfast ice would not be present during Shell's proposed operations.

The ringed seal is the most common pinniped species in the Camden Bay project area. While ringed seals use ice year-round, they do not construct lairs for pupping until late winter/early spring on the landfast ice. Therefore, since Shell plans to conclude exploration drilling on or before October 31, Shell's activities would not impact ringed seal lairs or habitat needed for breeding and pupping in the Camden Bay area. Ringed seals can be found on the pack ice surface in the late spring and early summer in the Beaufort Sea, the latter part of which may overlap with the start of Shell's planned exploration drilling activities. If an ice floe is managed into one that contains hauled out seals, the animals may become startled and enter the water when the two ice floes meet.

Bearded seals breed in the Bering and Chukchi Seas, as the Beaufort Sea provides less suitable habitat for the species.

Spotted seals are even less common in the Camden Bay area. This species does not breed in the Beaufort Sea. Therefore, ice used by bearded and spotted seals needed for life functions such as breeding and molting would not be impacted as a result of Shell's exploration drilling program since these life functions do not occur in the proposed project area.

For ringed seals, ice-management would occur during a time when life functions such as breeding, pupping, and molting do not occur in the proposed activity area. Additionally, these life functions normally occur on landfast ice, which will not be impacted by Shell's activity.

Therefore, it is determined that Shell's planned exploration drilling program in the Camden Bay area is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or on the food sources that they utilize.

9.5 Potential Impacts from Drilling Vessel Presence

The size of the *Kulluk*,(266 ft [81.0 m]) in diameter or length of the *Discoverer* (514 ft [156.7 m] long) are not significant enough to cause large-scale diversions from the animals' normal swim and migratory paths. Either drilling vessel's physical footprint is small relative to the size of the geographic region either would occupy, and will likely not cause marine mammals to deflect greatly from their typical migratory route. First, the eastward spring bowhead whale migration will occur prior to the beginning of Shell's proposed exploration drilling program. Second, the westward fall bowhead whale migration begins in late August/early September and lasts through October. Shell plans to suspend all operations on August 25 and the drilling fleet will leave the Camden Bay project area and move to an area north of latitude 71°25'N and west of longitude 146° 4'W. Shell will not resume exploration drilling activities until the close of the Kaktovik and Nuiqsut bowhead subsistence hunts. This will reduce the amount of time that the *Kulluk* or *Discoverer* spends in the bowheads' normal swim and migratory paths as they move through Camden Bay.

Any deflection of bowhead whales or other marine mammal species due to the physical presence of the *Kulluk* or *Discoverer* or its support vessels would be very minor. Even if animals may deflect because of the presence of either drilling vessel, the Beaufort Sea's migratory corridor is much larger in size than the diameter or length of either drilling vessel, and animals would have other means of passage around either drilling vessel.

In sum, the physical presence of either drilling vessel is not likely to cause a significant deflection to migrating marine mammals.

10. Anticipated impact of habitat loss or modification

The effects of the planned exploration drilling program are expected to be negligible. It is estimated that only a small portion of the animals utilizing the areas of the planned program would be temporarily displaced. During the period of the exploration drilling program (July 10-August 25, and the again from the end of Kaktovik and Nuiqsut (Cross Island) bowhead whale subsistence hunts to on or about October 31), most marine mammals would be dispersed throughout the area. The peak of the bowhead whale migration through the Beaufort Sea typically occurs in late August and October. Again, some bowheads might be temporarily displaced seaward during this time. The numbers of cetaceans and seals subject to displacement are small in relation to abundance estimates for the mammals addressed under this IHA application.

In addition, feeding does not appear to be an important activity by bowheads migrating through the eastern and central part of the Alaskan Beaufort Sea in most years. In the absence of important feeding areas, the potential diversion of a small number of bowheads is not expected to have any significant or long-term consequences for individual bowheads or their population. Bowheads, gray, or beluga whales are not predicted to be excluded from any habitat, nor are any seals predicted to be excluded from any habitat by the exploration drilling program.

The planned exploration drilling program is not expected to have any habitat-related effects that would produce long-term affects to marine mammals or their habitat due to the limited extent of the acquisition areas and timing of the program.

11. The availability and feasibility (economic and technological), methods, and manner of conducting such activity or means of effecting the least practicable impact upon affected species or stock, their habitat, and of their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance

Details of the planned mitigations are discussed in the Marine Mammal Monitoring and Mitigation Plan (4MP) (Attachment C).

12. A plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses

12.1 A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation.

Shell has prepared and will implement a POC pursuant to BOEMRE Lease Sale Stipulation No. 5, which requires that all exploration operations be conducted in a manner that prevents unreasonable conflicts between oil and gas activities and the subsistence activities and resources of residents of the North Slope. This stipulation also requires adherence to, and USFWS and NMFS regulations, which require an operator to implement a POC to mitigate the potential for conflicts between the proposed activity and traditional subsistence activities (50 CFR § 18.124(c)(4) and 50 CFR § 216.104(a)(12)). A POC was prepared and submitted with the initial Camden Bay EP that was submitted to BOEMRE in May 2009, and approved on 19 October 2009. Shell has prepared a POC Addendum (Attachment D) which updates the POC with information regarding proposed changes to the proposed exploration drilling program as compared to the initial Camden Bay EP. The POC Addendum includes documentation of meetings undertaken to specifically to inform the stakeholders of the revised exploration drilling program and obtain their input. The POC Addendum builds upon the previous POC.

The POC Addendum identifies the measures that Shell has developed in consultation with North Slope subsistence communities to minimize any adverse effects on the availability of marine mammals for subsistence uses and will implement during its Camden Bay and Chukchi Sea exploration drilling programs planned to begin in the summer of 2012. In addition, the POC

Addendum details Shell's communications and consultations with local subsistence communities concerning its planned exploration drilling program, potential conflicts with subsistence activities, and means of resolving any such conflicts (50 CFR § 18.128(d) and 50 CFR § 216.104(a) (12) (i), (ii), (iv)). Shell has documented its contacts with the North Slope subsistence communities, as well as the substance of its communications with subsistence stakeholder groups.

Shell's revised Camden Bay exploration drilling program is planned for the Sivulliq and Torpedo prospects in Camden Bay (Figure 1-1). This program is set-out in detail in a revised Camden Bay EP submitted to BOEMRE in May 2011 and the impacts of the project, as well as the measures Shell will implement to mitigate those impacts, are analyzed in the Camden Bay Environmental Impact Analysis Shell submitted to BOEMRE (Appendix F to the revised Camden Bay EP). Shell will implement this POC Addendum, and the mitigation measures set-forth herein, for its Camden Bay exploration program.

The potentially affected subsistence communities, identified in BOEMRE Lease Sale Stipulation No. 5, that were consulted regarding Shell's exploration drilling activities include: Barrow, Kaktovik, Nuiqsut, Wainwright, Point Lay and Point Hope. Shell presented its POC for the Camden Bay exploration drilling program to these potentially affected subsistence communities during these consultations. Shell also conducted POC meetings in the Chukchi Sea communities of Wainwright, Point Lay and Point Hope to discuss a planned Chukchi Sea exploration drilling program, while also describing the of mobilization Camden Bay exploration drilling program vessels through the Chukchi Sea to and from the Beaufort Sea. Additionally, Shell met with subsistence groups including the AEWC, Inupiat Community of the Arctic Slope (ICAS), and the Native Village of Barrow, and presented information regarding the proposed activities to the North Slope Borough (NSB) and Northwest Arctic Borough (NWAB) Assemblies, and NSB and NWAB Planning Commissions. Several one-on-one meetings were also held throughout the villages.

Beginning in early January 2009 and continuing into 2011, the one-on-one meetings Shell held included representatives from NSB and NWAB, subsistence-user group leadership, and Village Whaling Captain Association representatives. These meetings took place at the convenience of the community leaders and in various venues. Meetings were held starting on 12 January 2009 and have continued to date. Shell's primary purpose in holding individual meetings was to inform and prepare key leaders, prior to the public meetings, so that they would be prepared to give appropriate feedback on planned activities.

Shell attended the 2011 Conflict Avoidance Agreement (CAA) negotiation meetings in support of a limited program of marine environmental baseline activities in 2011 taking place in the Beaufort and Chukchi seas. Shell is committed to a CAA process and will demonstrate this by making a good-faith effort to negotiate an agreement every year it has planned activities. Shell held individual consultation meetings with representatives from the various marine mammal commissions to discuss the proposed 2012 exploration drilling program. Prior to exploration drilling in 2012, Shell has attended meetings with members of the marine mammal commissions and plans to hold additional consultation meetings with the affected communities and subsistence user groups, NSB, and NWAB to discuss the mitigation measures included in the EP and POC.

12.2 A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation.

In the POC Addendum report (Attachment D), Table 4.2-1 provides a list of public meetings attended by Shell since January 2009 to develop the POC and the POC Addendum. Attachment D, updated to April 2011, also includes sign-in sheets and presentation materials used at the POC meetings held in 2011 to present the revised Camden Bay EP. Comment analysis tables for numerous meetings held during 2011 summarize feedback from the communities on Shell planned activities beginning in the summer of 2012. These comments analysis tables, with responses from Shell and corresponding mitigation measures pertinent to the comment are included in Attachment D.

12.3 A description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing

The following mitigation measures, plans and programs, are integral to this POC and were developed during consultation with potentially affected subsistence groups and communities. These measures, plans, and programs to monitor and mitigate potential impacts to subsistence users and resources will be implemented by Shell during its exploration drilling operations in Camden Bay and mobilization to/from the Beaufort Sea via the Chukchi Sea. The mitigation measures Shell has adopted and will implement during its Camden Bay exploration drilling operations are listed and discussed below. These mitigation measures reflect Shell’s experience conducting exploration activities in the Alaska Arctic OCS since the 1980s and its ongoing efforts to engage with local subsistence communities to better understand their concerns and develop appropriate and effective mitigation measures to address those concerns. This most recent version of Shell’s planned mitigation measures was presented to community leaders and subsistence user groups starting in January 2009, and has evolved since in response to information learned during the consultation process.

Subsistence Mitigation Measures

To minimize any cultural or resource impacts to subsistence whaling activities from its exploration operations, Shell will suspend exploration drilling activities on 25 August 2012 prior to the start of the Kaktovik and Cross Island bowhead whale hunting season. The drilling vessel, either the *Kulluk* or *Discoverer* and associated vessels will remain outside of the Camden Bay area during the hunts. Shell will consult with the Whaling Captain’s Associations of Kaktovik and Nuiqsut to ascertain the conclusion of their respective subsistence bowhead whale hunts. Shell will resume exploration drilling operations after the conclusion of the hunt and, depending on ice and weather conditions, continue its exploration drilling activities through 31 October 2012. In addition to the adoption of this project timing restriction, Shell will implement the following additional measures to ensure coordination of its activities with local subsistence users to minimize further the risk of impacting marine mammals and interfering with the subsistence hunt:

Communications

- Shell has developed a Communication Plan and will implement this plan before initiating exploration drilling operations to coordinate activities with local subsistence users, as well as Village Whaling Captains' Associations, to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale hunt and other subsistence hunts. The Communication Plan includes procedures for coordination with Com Centers to be located in coastal villages along the Chukchi and Beaufort Seas during Shell's proposed exploration drilling activities.
- Shell will employ local SAs from the Beaufort and Chukchi Sea villages that are potentially impacted by Shell's exploration drilling activities. The SAs will provide consultation and guidance regarding the whale migration and subsistence activities. There will be one per village, working approximately 8-hr per day and 40-hr weeks during the drilling seasons. The subsistence advisor will use local knowledge (Traditional Knowledge) to gather data on subsistence lifestyle within the community and to advise in ways to minimize and mitigate potential negative impacts to subsistence resources during the drilling season. Responsibilities include reporting any subsistence concerns or conflicts; coordinating with subsistence users; reporting subsistence-related comments, concerns, and information; coordinating with the Com and Call Center personnel; and advising how to avoid subsistence conflicts. Subsistence advisors will have a handbook that will specify work tasks in more detail.

Aircraft Travel

- Aircraft shall not operate below 1,500 ft (457 m) unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, in poor weather (fog or low ceilings) in an emergency situation. Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft (457 m) in areas of active whaling; such areas to be identified through communications with the Com Centers. Except for airplanes engaged in marine mammal monitoring, aircraft shall use a flight path that keeps the aircraft at least 5 mi (8 km) inland until the aircraft is south of its offshore destination, then at that point it shall fly directly north through the Mary Sachs Entrance to its destination. Shell reserves the option to use an alternative flight route in the event that transit through the Mary Sachs Entrance is unsafe due to weather, other environmental conditions, or in the event of an emergency.
- Aircraft and vessels will not operate within 0.5 mi (0.8 km) of walrus or polar bears when observed on land or ice.
- Shell will also implement non-MMO flight restrictions prohibiting aircraft from flying within 1,000 ft (300 m) of marine mammals or below 1,500 ft (457 m) altitude (except during takeoffs and landings or in emergency situations) while over land or sea. This flight will also help avoid disturbance of and collisions with birds.

Vessel Travel

- The *Kulluk* or *Discoverer* and support vessels will enter the Chukchi Sea through the Bering Strait on or after July 1, minimizing effects on marine mammals and birds that frequent open leads and minimizing effects on spring and early summer bowhead whale hunting.

- Exploration drilling activities at the Sivulliq or Torpedo drill sites are planned to begin on or about July 10 following transit into the Beaufort Sea and run through October 31, with a suspension of all operations beginning August 25 for the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts. During the suspension for the whale hunts, the drilling fleet will leave the Camden Bay project area and move to an area north of latitude 71°25'N and west of longitude 146° 4'W. Should the drilling vessel or support vessels anchor during the suspension, none will anchor in known environmentally, or archaeologically sensitive areas. Shell will consult with the Whaling Captain's Associations of Kaktovik and Nuiqsut to ascertain the conclusion of their respective subsistence bowhead whale hunts. Shell will return to resume activities after the subsistence bowhead whale hunts conclude. Exploration drilling activities will be completed by October 31, depending on ice and weather.
- The drilling support fleet transit route will avoid known fragile ecosystems, including the Ledyard Bay Critical Habitat Unit,and will include coordination through Com Centers.
- To minimize impacts on marine mammals and subsistence hunting activities, the drilling vessel and support fleet will transit through the Chukchi Sea along a route that lies offshore of the polynya zone. In the event the transit outside of the polynya zone results in Shell having to break ice (as opposed to managing ice by pushing it out of the way), the drilling vessel and support vessels will enter into the polynya zone far enough so that ice breaking is not necessary. If it is necessary to move into the polynya zone, Shell will notify the local communities of the change in the transit route through the Com Centers. As soon as the fleet transits past the ice, it will exit the polynya zone and continue a path in the open sea toward the Camden Bay drill sites.
- MMOs will be aboard the *Kulluk* or *Discoverer* and all support vessels (see the 4MP in Appendix D of the revised Camden Bay EP).
- When within 900 ft (274 m) of marine mammals, vessels will reduce speed, avoid separating members from a group and avoid multiple changes of direction.
- Vessel speed is to be reduced during inclement weather conditions in order to avoid collisions with marine mammals.
- All vessels must maintain cruising speed not to exceed 9 knots while transiting the Beaufort Sea. This measure would reduce the risk of ship-whale collisions.
- Shell will communicate and coordinate with the Com Centers regarding all vessel transit.

<u>Drilling Operations</u>

- Shell will collect all drilling mud and cuttings with adhered mud from all well sections below the 26-in. (20-in. casing) hole section, as well as treated sanitary waste water, domestic wastes, bilge water and ballast water, and transport them outside the Arctic for proper disposal in an EPA-licensed treatment, storage, and disposal facility. These waste streams will not be discharged to the ocean.

- Drilling mud will be cooled to mitigate any potential permafrost thawing or thermal dissociation of any methane hydrates encountered during exploration drilling, if such materials are present at the drill site.
- Drilling muds will be recycled to the extent practicable based on operational considerations (e.g., whether mud properties have deteriorated to the point where they cannot be used further) so that the volume of the spent mud is reduced.
- Critical operations will not be started if potential hazards (ice floe, inclement weather, etc.) are in the vicinity and there is not sufficient time to complete the critical operation before the arrival of the hazard at the drill site (see COCP in Appendix J of the revised Camden Bay EP).
- All casing and cementing programs will be certified by a registered professional engineer.
- Airguns will be ramped up slowly during ZVSPs to warn cetaceans and pinnipeds in the vicinity of the airguns and provide time for them to leave the area and avoid potential injury or impairment of their hearing abilities. Ramp ups from a cold start when no airguns have been firing will begin by firing a single airgun in the array. A ramp up to the required airgun array volume will not begin until there has been a minimum of 30 min of observation of the safety zone by MMOs to assure that no marine mammals are present. The safety zone is the extent of the 180 dB radius for cetaceans and 190 dB for pinnipeds. The entire safety zone must be visible during the 30-min lead-in to an array ramp up. If a marine mammal(s) is sighted within the safety zone during the 30-min watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15-30 min: 15 min for small odontocetes and pinnipeds, or 30 min for baleen whales and large odontocetes.
- The blowout prevention program will be enhanced through the use of two sets of blind/shear rams, increased frequency of BOP performance tests from 14 days to 7 days, a remotely operated vehicle (ROV) control panel on the seafloor with sufficient pressured water-based fluid to operate the BOP, a containment system that includes both capping equipment and treatment and flaring capabilities, a fully-designed relief well drilling plan and provisions for a second relief well drilling vessel (*Discoverer* or *Kulluk*) to be available to drill the relief well if the primary drilling vessel is disabled and not capable of drilling its own relief well.
- Lighting on the drilling vessel will be shaded and has been replaced with ClearSky lighting. ClearSky lighting is designed to minimize the disorientation and attraction of birds to the lighted drilling vessel to reduce the possibility of a bird collision (see the Bird Strike Avoidance and Lighting Plan in Appendix I of the revised Camden Bay EP).

<u>Ice Management</u>

- Ice management will involve preferentially redirecting, rather than breaking, ice floes while the floes are well away from the drill site (see the Ice Management Plan Attachment B).

- Real time ice and weather forecasting will be from the SIWAC.

Oil Spill Response

- The primary OSR vessel will be on standby at all times when drilling into zones containing oil to ensure that oil spill response capability is available within one hour, if needed.
- Shell will deploy an OSR fleet that is capable of collecting oil on the water up to the calculated Worst Case Discharge flowrate of a blowout in the unlikely event that one should occur. The primary OSR vessel will be on standby when drilling into zones containing oil to ensure that oil spill response capability is available within one hour, if needed. The remainder of the OSR fleet will be fully engaged within 72 hours.
- In addition to the OSR fleet, oil spill containment equipment will be available for use in the unlikely event of a blowout. The barge will be centrally located in the Beaufort Sea and supported by an Invader Class Tug and possibly an anchor handler. The containment equipment will be designed for conditions found in the Arctic including ice and cold temperatures. This equipment will also be designed for maximum reliability, ease of operation, flexibility and robustness so it could be used for a variety of blowout situations.
- Capping stack equipment will be stored aboard one of the ice management vessels and will be available for immediate deployment in the unlikely event of a blowout. Capping stack equipment consist of subsea devices assembled to provide direct surface intervention capability with the following priorities:

    1. Attaching a device or series of devices to the well to affect a seal capable of withstanding the maximum anticipated wellhead pressure (MAWP) and closing the assembly to completely seal the well against further flows (commonly called “capping and killing”)
    2. Attaching a device or series of devices to the well and diverting flow to surface vessel(s) equipped for separation and disposal of hydrocarbons (commonly called “capping and diverting”)

- A polar bear culvert trap has been constructed in anticipation of OSR needs and will be deployed near Point Thomson or Kaktovik prior to drilling.
- Pre-booming is required for all fuel transfers between vessels.

13. The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on the population of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity

The planned marine mammal monitoring program for the Camden Bay exploration drilling program is included as Attachment C to this document addresses the issues in item 13.

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

Various agencies and programs may undertake marine mammal studies in the Beaufort Sea during the course of the drilling season. It is unclear if these studies might be relevant to Shell's planned exploration drilling program. Shell is prepared to share information obtained during implementation of our marine mammal monitoring program with a variety of groups who may find the data useful in their research. A suggested list of recipients includes:

- The NSB Department of Wildlife Management (T. Hepa)
- The USFWS Office of Marine Mammal Management (C. Perham and J. Garlic-Miller)
- The BOEMRE's Bowhead Whale Aerial Survey Program (C. Monnett)
- National Oceanic and Atmospheric Administration, National Marine Mammal Laboratory (Robyn Angliss)
- The Kuukpik Subsistence Oversight Panel (KSOP**)**
- Alaska Eskimo Whaling Commission (H. Brower -Barrow)
- Beluga Whale Committee (W. Goodwin -Kotzebue)
- Inupiat Community of the Arctic Slope (Martha Ipalook Faulk -Barrow)
- North Slope Science Initiative (J. Payne)
- BOEMRE Field Supervisor (Jeff Walker)
- Alaska Department of Natural Resources (D. Perrin)
- Alaska Department of Fish and Game

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Attachment A
Specifications for *Kulluk* and *Noble Discoverer*

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Kulluk Specifications

BeauDril

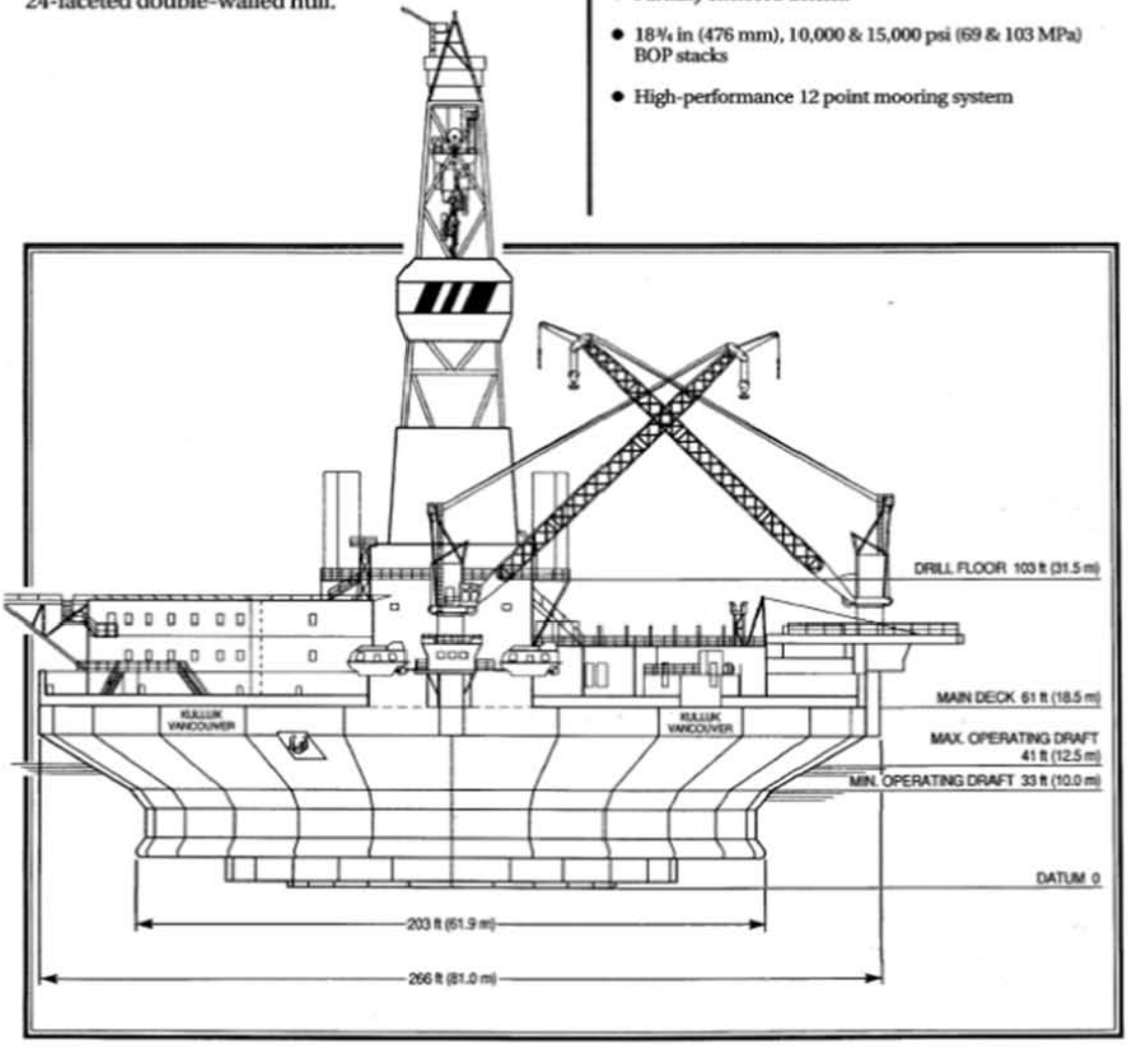
Kulluk

Kulluk is the first floating drilling vessel designed and constructed for extended season drilling operations in deep Arctic waters.

An improvement on the floating drillship concept, Kulluk is a conically shaped, ice strengthened floating drilling unit with a 24-faceted double-walled hull.

Key Features

- Unique, purpose-built conical Arctic Class IV hull design
- Operating water depth 60 to 600 ft (18.3 to 183 m), drilling depth up to 20,000 ft (6 096 m)
- Electrically driven Varco top drive drilling system
- 24 ft (7.3 m) diameter glory hole bit capable of drilling and setting a steel caisson 40 ft (12.2 m) into the seabed for ice scour protection
- Partially enclosed derrick
- 18¾ in (476 mm), 10,000 & 15,000 psi (69 & 103 MPa) BOP stacks
- High-performance 12 point mooring system



Classification

The unit has been designated as Arctic Class IV (by the Canadian Coast Guard) under Canadian Arctic Shipping Pollution Prevention Regulations, and as Ice Class 1AA by the American Bureau of Shipping.

Specifications

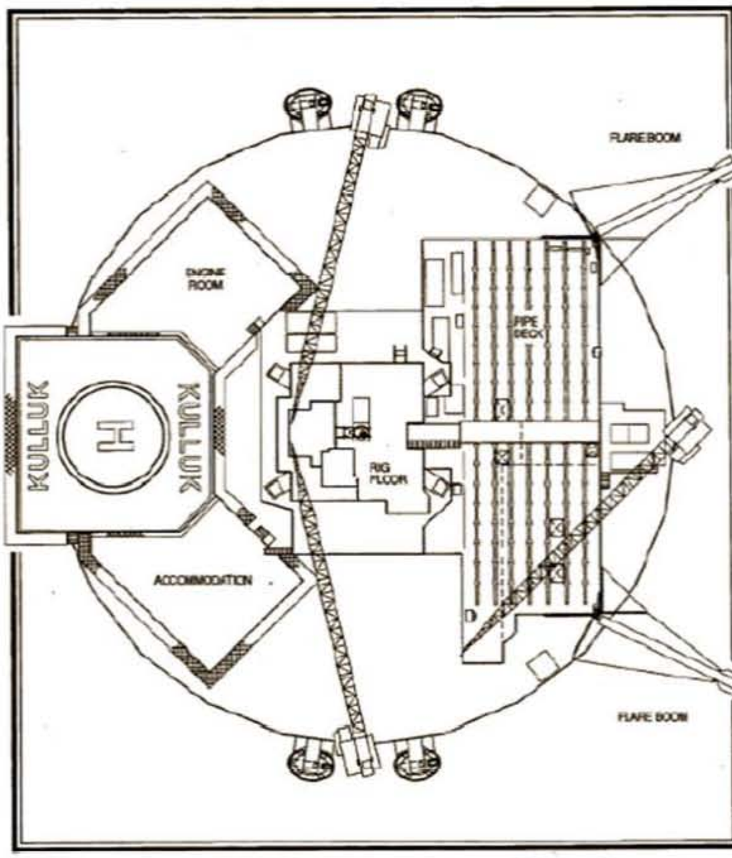
Owner:	BeauDril Limited
Flag:	Canadian
Rig Type:	Conical Drilling Unit (CDU)
Delivered:	1983
Rig Design:	Earl & Wright - Lavalin
Built By:	Mitsui Engineering and Shipbuilding, Japan

Dimensions

Diameter at main deck:	266 ft (81.0 m)
Diameter at pump deck:	196 ft (59.7 m)
Hull Depth:	61 ft (18.5 m)

Operations

Draft (max. operating): 41 ft (12.5 m)	
Draft (min. operating): 33 ft (10.0 m)	
Draft (light ship): 26 ft (8.0 m)	
Light Ship Displacement:	19,300 tons (17 510 tonnes)
Maximum Drilling Depth:	20,000 ft (6 096 m)
Operating Water Depth:	60 to 600 ft (18.3 to 183 m)



Variable Load

7,717 tons (7 000 tonnes)

Storage Capacities

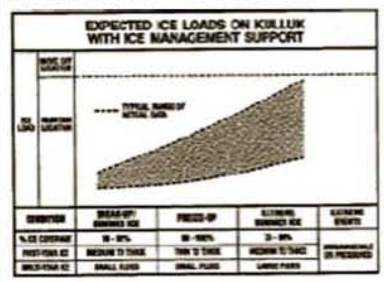
Barite & cement bulk:	21,471 cf (608 m³)
Liquid mud:	2,605 bbl (414 m³)
Drill water:	4,227 bbl (672 m³)
Fuel:	10,085 bbl (1 603 m³)
Potable water:	1,961 bbl (312 m³)
Ballast:	35,928 bbl (5 712 m³)
Pipe & casing (pipe deck):	1,543 tons (1 400 tonnes)
Brine:	2,010 bbl (320 m³)

Operational Limits

Stationkeeping Conditions

Kulluk was built to operate in the ice infested waters of the Arctic offshore. The unit was developed to extend the drilling season available to more conventional floating vessels by enabling operations to be carried out through spring breakup conditions, the summer months, and well into the early winter period.

Kulluk was designed to maintain location in a drilling mode in moving first-year ice of 4 ft (1.2 m) thickness. With ice management support provided by BeauDril's Arctic Class IV icebreakers, the unit can maintain location in more severe conditions as shown below.



In terms of Kulluk's open water performance, the drilling unit was designed to maintain location in storm conditions associated with maximum wave heights of 18 ft (5.5 m) while drilling and 40 ft (12.2 m) while disconnected (assumed storm duration of 24 hrs).

If ice or open water storm conditions become more severe than those indicated, the unit's mooring system, which incorporates acoustic release devices, is disconnected from the anchors and the unit moves off location.

Equipment

Drilling Equipment

Derrick
160 ft (44.8 m) Dreco dynamic with a 40 ft x 40 ft (12.2 m x 12.2 m) base, rated at 1,400,000 lb (623 000 daN) with 14 lines

Racking platform has capacity to hold 23,340 ft (7 115 m) of 5 in (127 mm) drill pipe plus bottom hole assembly

Drawworks
Ideco E-3000 electric drawworks complete with sand reel, Elmago model 7838 Baylor auxiliary brake, spinning and breakout catheads and three GE model 752 motors each rated at 1,000 hp (746 kW) continuous

Travelling Block
McKissick model 686, 650 ton (590 tonne) capacity with 7 sheaves grooved for 1⅝ in (41.3 mm) drilling line

Swivel
Ideco TL-500, 500 ton (454 tonne) capacity

Drill Pipe
20,000 ft (6 096 m) x 5 in (127 mm), 19.5 lb/ft (29 kg/m) with 4½ IF connections

Top Drive
Varco TDS-3 with one GE model 752 motor rated at 1,000 hp (746 kW) continuous and a 500 ton (454 tonne) hoisting capacity

Rotary Table
Ideco LR-495, 49.5 in (1 257 mm) driven by one GE model 752 motor, rated at 1,000 hp (746 kW) continuous, coupled to a two speed transmission

Drill String Compensator
NL Shaffer 18 ft (5.5 m) stroke 400,000 lb (178 000 daN) compensating capacity or a 1,000,000 lb (444 800 daN) locked capacity

Tensioner System
4 x 80,000 lb (35 600 daN) Western Gear riser tensioners, 48 ft (14.6 m) wireline travel with 1¾ in (44.5 mm) wire rope

6 x 16,000 lb (7 100 daN) Western Gear guideline/pod tensioners, 40 ft (12.2 m) wireline travel with ¾ in (19.1 mm) wire rope

Mud Pumps
2 x Ideco T1600 triplex, each driven by two GE model 752 motors rated at 1,000 hp (746 kW) continuous

Cementing Unit
Dowell owned R717 twin triplex powered by two GE model 752 motors each rated at 1,000 hp (746 kW) continuous, with 7,500 psi (52 MPa) and 10,500 psi (72 MPa) fluid ends

Rig Floor Pipe Handling System
Varco Iron Roughneck model IR-2000 Range: 2⅞ to 8 in (73 to 203 mm)

Mud Logging Room

Designed to accommodate equipment from any of the major mud logging companies. This room is an integral part of the rig and contains complete lab facilities

Testing Equipment

Complete testing system with a 10,000 BOPD (1 590 m³/day) capacity consisting of: data header, choke manifold, steam heater, 3-phase separator, surge tank, water degasser, transfer pumps, and flare booms

Mud Conditioning Equipment

4 x Thule United VSM-120 shale shakers
1 x Brandt SR-3 desander
1 x Brandt SE-24 desilter
1 x Thule VSM-200 mud cleaner
1 x Wagner Sigma-100 centrifuge
1 x Sharples DM 40 000 centrifuge
2 x Burgess Magna-Vac vacuum degassers
2 x Alfa-Laval AX30 mud coolers

Subsea Equipment

BOP System
1 x NL Shaffer 18¾ in (476 mm), 10,000 psi (69 MPa) BOP stack with annular, 4 ram type preventors, and Vetco H-4 E connector

1 x NL Shaffer 18¾ in (476 mm), 15,000 psi (103 MPa) BOP stack with annular rated at 10,000 psi (69 MPa), 4 ram type preventors, and Vetco H-4 E x F connector

Lower Marine Riser Packages
2 x 18¾ in (476 mm) with 10,000 psi (69 MPa) Shaffer annular, Regan 24 in (610 mm) CR-1 pressure compensated lower ball joint and Vetco H-4E connector

BOP Cranes
2 x Hepburn main bridge cranes, 85 ton (77 tonne) capacity each with 10 ton (9.1 tonne) auxiliary hoists

30 in (762 mm) Marine Riser System
3 x hydraulic pin connectors; 2 x 36 in (914 mm) Cameron and 1 x 30 in (762 mm) Dril-Quip

1 x Regan 28 in (711 mm) CR-1 pressure compensated lower ball joint

30 in (762 mm) riser consisting of 1 in (25.4 mm) wall casing with Hunting Lynx 52S connectors

1 x Regan 28 in (711 mm) telescoping riser joint with 45 ft (13.7 m) stroke

1 x Regan 28 in (711 mm) DR-1 upper ball joint

1 x Regan KFDS 28 in (711 mm) diverter

21¼ in (540 mm) Marine Riser System
21¼ in (540 mm) Cameron RCK riser with 10,000 psi (69 MPa) choke and kill lines

2 x Cameron telescoping riser joints, 1 x 40 ft (12.2 m), and 1 x 50 ft (15.2 m) stroke

1 x Regan 24 in (610 mm) DR-1 upper ball joint

1 x Regan KFDS 24 in (610 mm) diverter

Glory Hole Bit
1 x Brown Tornado, 24 ft (7.3 m) diameter hydraulically operated with airlift discharge. Capable of drilling a glory hole 40 ft (12.2 m) into the seabed for ice scour protection

Power Generation

Prime Movers:
3 x Electro-Motive Diesel rated at 2,817 hp (2 100 kW) each

Emergency Power:
1 x GM Detroit diesel rated 873 hp (651 kW)

Cranes

3 x Liebherr, BOS 65/850, rated at 72 ton (65 tonne) at 30 ft (9.1 m)

Safety Equipment

4 x Whittaker 54-person survival craft; two on port, two on starboard

1 x Hurricane Model 700-D emergency rescue boat

2 x RFD inflatable escape slides

Helideck

Capacity for Sikorsky 61 or similar with fueling station

Accommodation

Bunks for 108 people, recreation room, sauna, galley with seating for 36, offices, and hospital

Kulluk Mooring System

The Kulluk's mooring system consists of twelve Hepburn winches located on the outboard side of the main deck. Anchor wires lead off the bottom of each winch drum inboard for approximately 55 ft (17 m). The wire is then redirected by a sheave, down through a hawse pipe to an underwater, ice protected, swivel fairlead. The wire travels from the fairlead directly under the hull to the anchor system on the seafloor.

Specifications

Anchor Winch
12 x Hepburn single-drum winches with a 287 ton (260 tonne) operating tension

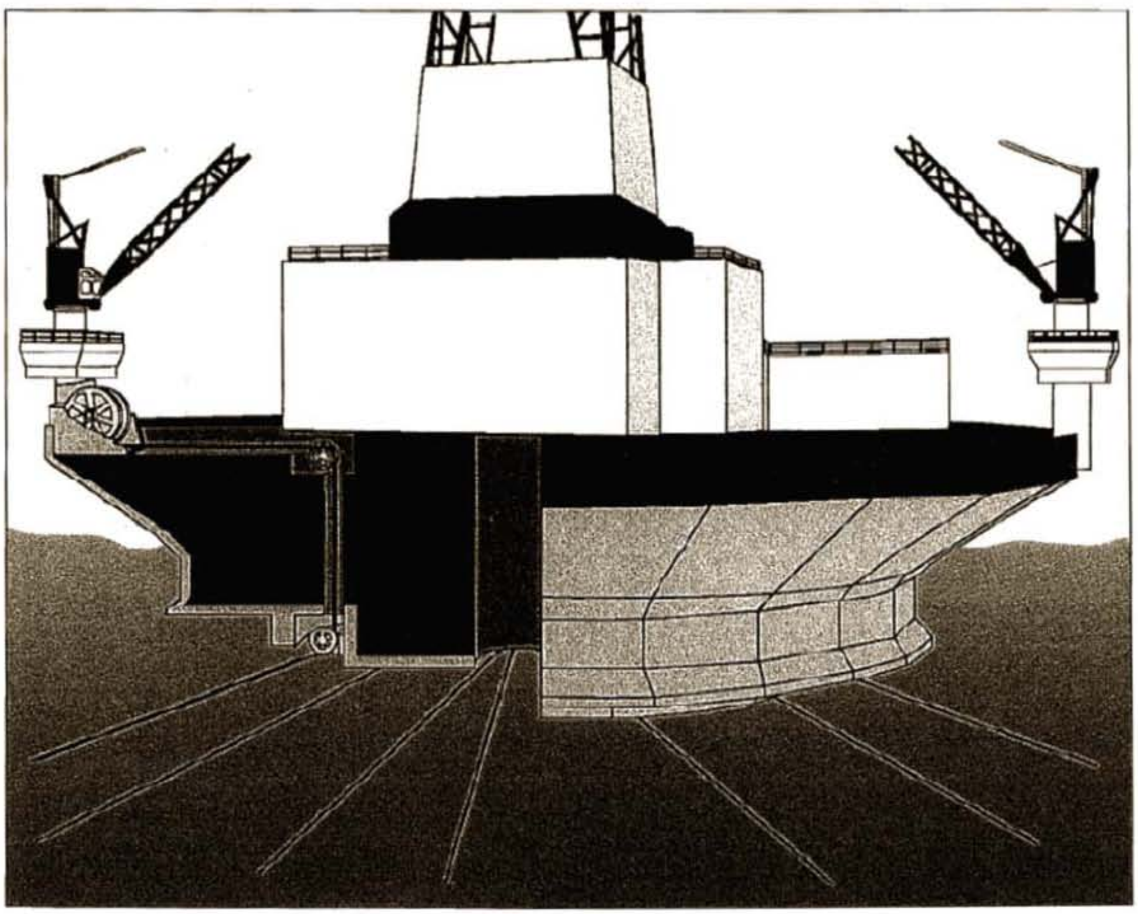
Mooring Wires and Anchors

Anchors:
Various sizes & quantities of anchors are available for use. Exact anchor configuration to be provided once location and seafloor conditions are specified

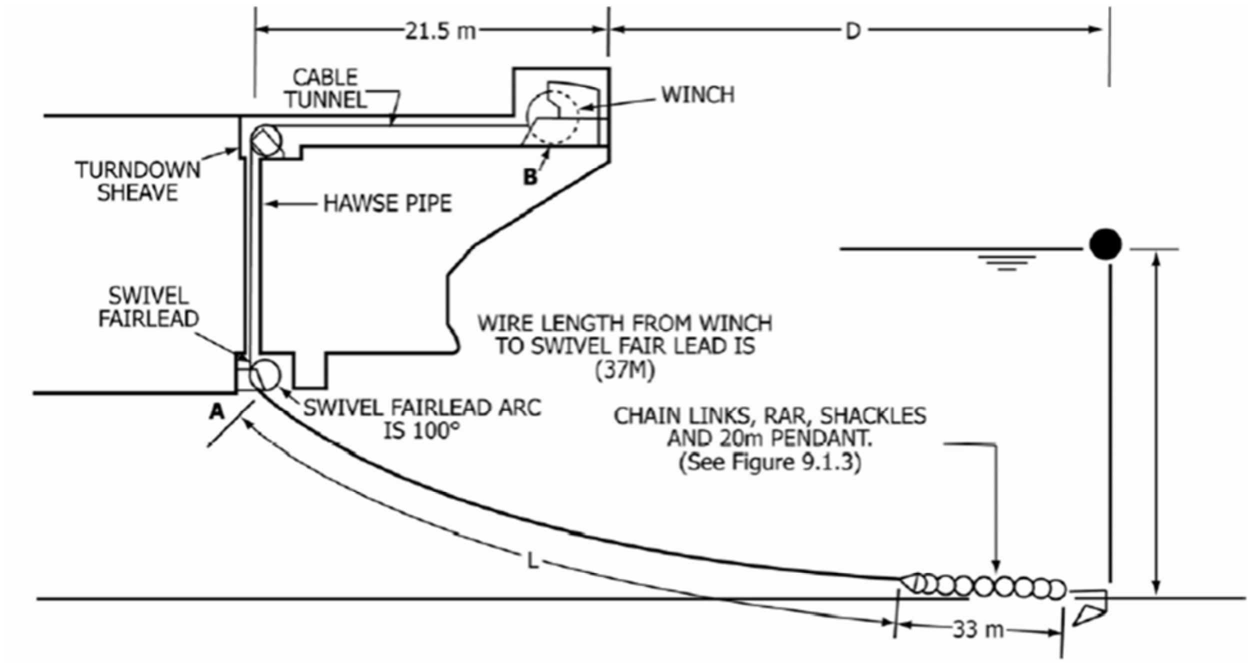
Wire ropes:
Each winch drum has capacity for 3,763 ft (1 147 m) of 3½ in (88.9 mm), 573 ton (520 tonne) breaking strength wireline

Anchor Release:
Each anchor wire contains a remote acoustic release (RAR) unit

FOR MORE INFORMATION ABOUT KULLUK CONTACT MANAGER BEAUDRIL AT (403) 233-[illegible]



Kulluk Anchoring Detail



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***Discoverer* Specifications**

***DISCOVERER* SPECIFICATIONS**	
TYPE-DESIGN	Drillship - Sonat Offshore Drilling *Discoverer* Class
SHAPE	Monohull with sponsons added for ice-resistance[1]
SHIP BUILDERS & YEAR	Namura Zonshno Shipyard, Osaka, Japan - hull number 355
YEAR OF HULL CONSTRUCTION	1965
YEAR OF CONVERSION	1976
DATE OF LAST DRY-DOCKING	2010

***DISCOVERER* DIMENSIONS**		
LENGTH	514 ft	156.7 m
LENGTH BETWEEN PERPINDICULARS (LBP)	486 ft	148.2 m
WIDTH	85 ft	26 m
MAXIMUM (MAX) HEIGHT (ABOVE KEEL)	274 ft	83.7 m
HEIGHT OF DERRICK ABOVE RIG FLOOR	175 ft	53.3 m

***DISCOVERER* MOORING EQUIPMENT**	
Anchor pattern symmetric 8 points system. The unit is fitted with Sonat Offshore Drilling patented roller turret mooring system giving the unit the ability to maintain favorable heading without an interruption of the drilling operations	
ANCHORS	Stevpris New Generation 15,400 lb each; 7,000 kilograms (kg) each (ea)
ANCHOR LINES	Chain Wire Combination
SIZE/GRADE	2.75 inch (in.) wire 3 in. ORQ Chain
LENGTH	2,750 ft (838 m) wire + 1,150 ft (351 m) chain (useable) per anchor

***DISCOVERER* OPERATING WATER DEPTH**		
MAX WATER DEPTH	1,000 ft (305 m) with present equipment (can be outfitted to 2,500 ft [762 m])	
MAX DRILLING DEPTH	20,000 ft	6,098 m

Table 1.c-2 *Discoverer* Specifications (continued)	
DRAW WORKS	EMSCO E-2,100 - 1,600 horsepower (hp)
ROTARY	National C-495 with 49-1/2 in. (1.3 m) opening
MUD PUMPS	2 ea. Continental Emsco Model FB-1600 Triplex Mud Pumps
DERRICK	Pyramid 170 ft. (51.8 m) with 1,300,000 lb nominal capacity
PIPE RACKING	BJ 3-arm system
DRILL STING COMPENSATOR	Shaffer 400,000 lb with 18-ft (5.5-m) stroke
RISER TENSIONS	8 ea. 80,000 lb Shaffer 50-ft (15.2-m) stroke tensioners
CROWN BLOCK	Pyramid with 9 ea. 60-in. (1.5 m) diameter sheaves rated at 1,330,000 lb
TRAVELING BLOCK	Continental - Emsco RA60-6
BLOWOUT PREVENTOR (BOP)	Cameron Type U 18. 3/4-in. x 10,000 pounds per square inch (psi)
RISER	Cameron RCK type (21-in.)
TOP DRIVE	Varco TSD-3S, with GE-752 motor, 500 ton
BOP HANDLING	Hydraulic skid based system, drill floor

***DISCOVERER* DISPLACEMENT**	
FULL LOAD	20,253 metric tons (mt)
DRILLING	18,780 mt (Drilling, max load, deep hole, deep water)

***DISCOVERER* DRAUGHT**	
DRAFT AT LOAD LINE	27 ft (8.2 m)
TRANSIT	27 ft (8.2 m) (fully loaded, operating , departure)
DRILLING	25.16 ft (7.7 m)

***DISCOVERER* HELIDECK**	
MAXIMUM HELICOPTER SIZE	Sikorsky S-92N
FUEL STORAGE	2 ea. 720-gallon (gal) tanks
***DISCOVERER* ACCOMODATIONS**	
NUMBER OF BEDS	140
SEWAGE TREATMENT UNIT	Hamworthy ST-10
***DISCOVERER* PROPULSION EQUIPMENT**	
PROPELLER	1 ea 15 ft 6 in. (4.8 m) diameter, fixed blade
PROPULSION DRIVE UNIT	Marine Diesel, 6 cylinder, 2 cycle, Crosshead type
HORSEPOWER	7,200 hp @ 135 revolutions per minute (RPM)
TRANSIT SPEED	8 knots

GENERAL STORAGE CAPACITIES	
SACK STORAGE AREA	934 cubic meters (m^3)
BULK STORAGE	
Bentonite / Barite	1.,132 bbl - 4 tanks
Bulk Cement	1.132 bbl - 4 tanks
LIQUID MUD	
Active	1,200 barrels (bbl)
Reserve	1,200 bbl
Total	2,400 bbl
POTABLE WATER	1,670 bbl (aft peak can be used as add. pot water tank)
DRILL WATER	5,798 bbl
FUEL OIL	6,497 bbl

[1] Sponsons designed and constructed to meet requirements of Det Norske Veritas (DNV) Additional Class Notation ICE-05.

Attachment B
Ice Management Plan

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SHELL OFFSHORE INC.
3601 C Street, Suite 1000
Anchorage, AK 99503

ICE MANAGEMENT PLAN
Beaufort Sea

Submitted to:

U. S. Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Alaska OCS Region

Submitted by:
Shell Offshore Inc.

Table of Contents

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I. INTRODUCTION

SCOPE

A Critical Operations and Curtailment Plan (COCP) will be in place for the Shell Offshore, Inc. (Shell) Camden Bay Exploration Program. As part of the COCP, this Ice Management Plan (IMP) has been developed. The description of notification of curtailment (an excerpt from the COCP) is presented in Attachment 1.

The IMP addresses the following activities:

- Vessels
- Shell Ice and Weather Advisory Center (SIWAC)
- Ice Alerts and Procedures
- Ice Management Philosophy
- Well Suspension Procedures
- Mooring System Recovery and Release
- Moving onto the Drill Site
- Training

The IMP:

- Defines Roles and Responsibilities
- Establishes Alert Levels; and
- Establishes Responses to Alert Levels.

The IMP facilitates appropriate decision-making and responses to the threat of hazardous ice and procedures set forth in the IMP prevent damage or harm to personnel, assets, or the environment.

Nothing in this document takes away the authority and accountability of the Master(s) of the vessels for the safety of their personnel and vessels and protection to the environment.

This plan is not a substitute for good judgment.

Guidance Note: This document is not intended to contain detailed procedures. Detailed procedures are contained within the vessel-specific operating manuals.

II. DEFINITIONS

A. Roles and Responsibilities

Responsibilities have been defined for key personnel in section V. In addition to the defined personnel, the following positions have a role in IMP,

Chief Officer /Second Officer/Third Officer	In addition to regular duties will assist the Ice Advisor (IA)
Shell Drilling Superintendent	Shell's Drilling Superintendent is the senior Shell shore-based manager responsible for all Shell well operations offshore Alaska.
Rig Manager	The senior shore-based manager (Alaska). Liaising with the Shell Drilling Superintendent.

B. Definitions and Abbreviations

AHTS	Anchor Handling Tug Supply
API	American Petroleum Institute
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
CFR	Code of Federal Regulations
COCP	Critical Operations Curtailment Plan
cm	centimeter(s)
Discoverer	Turret-moored Drillship Motor Vessel (M/V) *Noble Discoverer*
DNV	Det Norske Veritas
ft	foot/feet
FTP	file transfer protocol
FY	First-year ice. Sea ice of not more than one winter's growth, developing from young ice; 12 inches (in.) (30 centimeters [cm]) or greater. It may be subdivided into thin FY – sometimes referred to as white ice, medium FY and thick FY.
GFS	Global Forecast System
GIS	Geographic Information System
Hazardous Ice	Ice, which due to its size, stage of development, concentration, set and drift is considered to be a threat to the safety of personnel, the drilling vessel and well operations. Close proximity of an ice feature regardless of its set and drift may be determined to be hazardous ice. Guidance Note: Sea state as well as visibility may influence what is categorized as hazardous ice.
HOS	hang-off sub
HT	Hazard Time. The estimated time it will take for hazardous ice to reach the drill site.
IA	Ice Advisor
IMO	International Maritime Organization
IMP	Ice Management Plan

IMV	Ice management vessel. Any ice class vessel tasked with ice management duties in support of the drilling vessel. This includes the primary ice management vessel (IMV) and the ice class Anchor Handling Tug Supply (AHTS)
in.	inch(es)
Kulluk	conical drilling unit *Kulluk*
LMRP	Lower Marine Riser Package
m	meter(s)
MODU	Mobile Offshore Drilling Unit
MT	Move-off Time. The time required to clear decks on the anchor handler recover all anchors conventionally and move off the drill site in an orderly fashion.
M/V	Motor Vessel
MY	Multi-year ice. OI which has survived at least two summers' melt. Hummocks are smoother than on SY and the ice is almost salt-free. Where bare, this ice is usually blue in color. The melt pattern consists of large interconnecting, irregular puddles and a well developed drainage system.
NOAA	National Oceanic and Atmospheric Administration
Nordica	M/V *Nordica*
OI	Old ice. Sea ice which has survived at least one summer's melt. Topographic features generally are smoother than FY. It may be subdivided into SY and multiyear ice.
OSR	Oil Spill Response
OSV	Offshore Supply Vessel
PIC	Person in Charge
RP	Recommended Practice
SAR	Synthetic Aperture Radar
Shell	Shell Offshore Inc.
SIWAC	Shell Ice and Weather Advisory Center located in Anchorage. The center develops forecasts from various sources, and disseminates same.
Support Vessels	Includes all vessels defined in this plan (IMV/OSR/AHTS/OSV).
SY	Second-year ice. OI which has survived only one summer's melt. Thicker than FY, it stands higher out of the water. In contrast to MY, summer melting produces a regular pattern of numerous small puddles. Bare patches and puddles are usually greenish-blue.
ST	Secure Time. The time required to secure the well, disconnect the Lower Marine Riser Package (LMRP) from the blowout preventer (BOP), recover and secure the riser.
TD	total depth
T-Time	Total Time. The sum of ST + MT.
U.S.	United States
USCG	United States Coast Guard
VMT	Vessel Management Team. This team is headed by the Drilling Vessel Master and includes the Shell Drilling Foreman, Rig Superintendent, Drilling Vessel IA and the Chief Engineer.

III. VESSELS COVERED BY IMP

- Motor Vessel (M/V) Noble *Discoverer (Discoverer)* or conical drilling unit *Kulluk* – Drilling Vessel
- *M/V Nordica* (or similar) – Primary Ice Management Vessel (IMV)
- *Hull 247* (or similar) – Ice Management and Anchor Handling

Drilling is to be executed by the *Kulluk* or *Discoverer,* but not both.

<u>Kulluk</u>

The *Kulluk* has an Arctic Class IV hull design, is capable of drilling in up to 600 feet (ft) [182.9 meters (m)]) of water and is moored using a 12-point anchor system. The *Kulluk* mooring system consists of 12 Hepburn winches located on the outboard side of the main deck, Anchor wires lead off the bottom of each winch drum inboard for approximately 55 ft (16.8 m). The wire is then redirected by a sheave, down through a hawse pipe to an underwater, ice protected, swivel fairlead. The wire travels from the fairlead directly under the hull to the anchor system on the seafloor.

The *Kulluk* is designed to maintain its location in drilling mode in moving ice with thickness up to 4 ft (1.2 m) without the aid of any active ice management. With the aid of IMVs, the *Kulluk* would be able to withstand more severe ice conditions. In more open water conditions, the *Kulluk* can maintain its drilling location during storm events with wave heights up to 18 ft (5.5 m) while drilling, and can withstand wave heights of up to 40 ft (12.2 m) when not drilling and disconnected (assuming a storm duration of 24 hours).

The *Kulluk* will comply with the requirements of 30 Code of Federal Regulations (CFR) Part 250.417, the International Maritime Organization (IMO), the U.S. (United States) Coast Guard (USCG) and Det Norske Veritas (DNV). All drilling operations will be conducted under the provisions of 30 CFR 250, American Petroleum Institute (API) Recommended Practices (RP) 53, 65 Part 2 and 75, and other applicable regulations and notices, including those regarding the avoidance of potential drilling hazards and safety and pollution prevention control. Primary safety measures include: inflow detection and well control; monitoring for loss of circulation and seepage loss; and casing and cementing program designs. Primary pollution prevention measures consist of contaminated and non-contaminated drain systems, a mud drain system, and oily water processing.

Discoverer

The *Discoverer* is a true, self-contained drillship. The *Discoverer* is an anchored drillship with an 8-point anchored mooring system. Station keeping is accomplished using the turret-moored, 8-point anchor system. The underwater fairleads prevent ice fouling of the anchor lines. Turret mooring allows orientation of vessel's bow into the prevailing ice drift direction to present minimum hull exposure to drifting ice. The vessel is rotated around the turret by hydraulic jacks. Rotation can be augmented by the use of the fitted bow and stern thrusters.

The hull has been reinforced for ice resistance. Ice-strengthened sponsons have been retrofitted to the ship's hull.

The *Discoverer* is classed by DNV as a Mobile Offshore Drilling Unit (MODU) for worldwide service. It is a "1A1 Ship-Shaped Drilling Unit l" and is capable of performing drilling operations offshore Alaska. The *Discoverer* has been issued with a DNV Appendix to Class stating:

> "the structural strength and material quality of the 'Ice Belt' formed by the sponsons below the 8950mm A/B level, have been reviewed against the requirements for the DNV ICE-05 Additional Class Notation and found to meet those requirements (as contained in DNV Rules for Classification of Ships, Pt 5 Ch 1, July 2006) for a design temperature of -15 degrees C."

The *Discoverer* will comply with the requirements of 30 CFR Part 250.417, the IMO, the USCG and DNV. All drilling operations will be conducted under the provisions of 30 CFR Part 250 Subpart D, API RP 53, 65 Part 2 and 75 and other applicable regulations and notices including those regarding the avoidance of potential drilling hazards and safety and pollution control. Such measures as inflow detection and well control, monitoring for loss of circulation and seepage loss, and casing design will be the primary safety measures. Primary pollution prevention measures are the contaminated and non-contaminated drain systems, the mud drain system, and the oily water processing system.

Structurally, this is comparable to Canmar drillships used safely and successfully in exploration campaigns in the Beaufort and Chukchi Seas into the 1990s.

Details on the drilling vessels are included as Attachment 2.

Drilling Vessel Principal Dimensions

Dimension	*Discoverer*	*Kulluk*
Length Overall	514 ft (156.7 m)	266 ft (81.0 m) diameter
Draft	27 ft (8.2 m)	41 ft (12.5 m)
Width	85 ft (26 m)	266 ft (81.0 m) diameter

Ice Management Vessels

Ice management support to the drilling vessel will be provided by the *Nordica* (or similar) and *Hull 247* (or similar). The drilling vessel will be supported by these IMVs from the beginning of the campaign until the vessel departs the area. A description of these vessels is provided in Attachment 2.

Nordica (or similar vessel)

The *Nordica* (or similar vessel) is designated as the primary IMV. The *Nordica* is classed by the DNV as +1A1.

Designed for the management, maintenance and service of offshore oil wells, the 380.5-ft (116-m) *Nordica* is a multipurpose vessel specialized in marine construction and icebreaking. *Nordica* is equipped with diesel-electric propulsion systems and their innovative combination of capabilities, based on extensive design and engineering work, facilitates use of these systems in arctic conditions.

Hull 247 (or similar vessel)

Hull 247 is designated as the secondary IMV and anchor handler. *Hull 247* is currently in the construction phase and will be completed in March 2012. Engineered drawing and specifications are included in Attachment 2.

Ice Management Vessel Principal Dimensions

Dimension	*Nordica*	*Hull 247*
Length Overall	380.5 ft (116 m)	360.6 ft (110 m)
Draft	27.5 ft (8.4 m)	24 ft (7.3 m)
Width	85 ft (26 m)	80 ft (24.4 m)

Guidance Note: IMVs supporting the drilling vessel may be deployed to assist other vessels, as operations and ice conditions dictate. Diverting ice management resources away from the drilling vessel may require a curtailment of activities. This decision shall be made jointly by the Shell Drilling Foremen and the Master on the drilling vessel. The onshore Shell Drilling Superintendent (in consultation with the Rig Manager) will endorse the plan or set priorities if agreement cannot be reached at the field level.

IV. SHELL ICE AND WEATHER ADVISORY CENTER

SIWAC is an integrated forecasting service staffed 24/7 by industry-leading specialists under Shell contract in Anchorage, Alaska. SIWAC's primary function is to provide current and forecast ice and weather conditions directly to field operations and planning managers during the operational season. SIWAC provides information to decision makers and field principals to help them minimize risks when operating in the presence of ice. To provide quality and accurate information, SIWAC depends on skilled forecasters, subscription and public satellite imagery, numerical models, field observations, Geographic Information System (GIS) software tools, and a robust communication network.

SIWAC ICE DATA INPUTS

Ice forecasts are developed and issued daily. The Lead Ice Analyst compiles available data from subscription, specialized, and public services in ArcMAP (GIS Software) such as:

- MDA RadarSat 2 imagery
- MODIS satellite
- Canadian Ice Services
- National Ice Center
- Contract weather services
- Field observations
- IceNav images

Data Transmission

Effective communication of SIWAC ice and weather guidance and reciprocal feedback and field observations requires a robust and capable data network. The drilling vessel and IMVs are equipped with high-speed data and voice satellite service that has been proven to perform well in the U.S. Chukchi and Beaufort Seas.

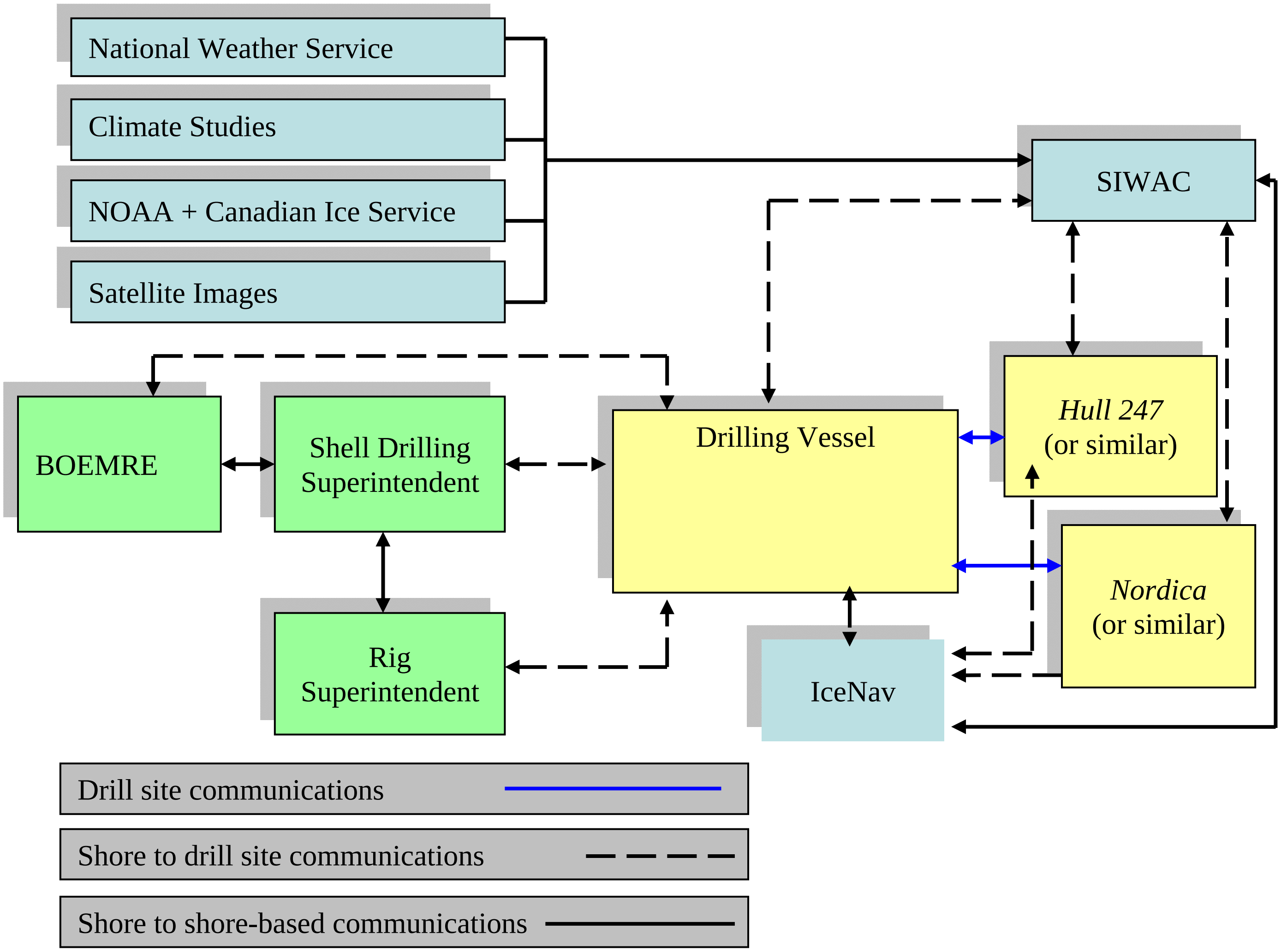
Data, including satellite imagery and observations, are relayed through a file transfer protocol (FTP) site between SIWAC and the field vessels using automated processes. This keeps both the field and forecasters continuously refreshed with the latest information. In addition, SIWAC maintains a secure website that allows direct, on demand access to all forecast reports and data products.

Additional information about SIWAC is in Attachment 3.

Ice Information Flow Chart

NOTE: The following graphic, Ice Management Communications Flow Chart, depicts the constant two-way communication that would occur between the various components of the system.

Ice Management Communications Flow Chart



NOAA = National Oceanic and Atmospheric Administration
BOEMRE = Bureau of Ocean Energy Management, Regulation and Enforcement

Guidance Note: Additional information regarding ice may be requested by the Master of the drilling vessel. Any means appropriate to the circumstances shall be used to provide this information. Where this information is to be obtained by aerial reconnaissance, the Shell Drilling Foreman will liaise with Shell Logistics to provide the appropriate resources.

V. ICE ALERT LEVELS AND PROCEDURES

These procedures define five Alert Levels that are linked to the time that hazardous ice is forecast to be at the drilling vessel location, and the time required to secure the well and move the drilling vessel off location if it becomes necessary. Roles, responsibilities and actions required are specified according to the Alert Level.

Ice Alert Levels

ALERT LEVEL	TIME CALCULATION	STATUS
Green	(HT – T-Time) is greater than 24 hours	Normal operations
Blue	(HT – T-Time) is greater than 12 hours and less than 24 hours	Initiate risk assessment. Validate secure times and move times.
Yellow	(HT – T-Time) is greater than 6 hours and less than 12 hours	Limited well operations in line with COCP. Commence securing well.
Red	(HT – MT) is less than 6 hours	Well-Securing Operations Completed. Commence anchor recovery operations.
Black	Drill site evacuated	Move drilling vessel to a safe location.

HT = Hazard Time
MT = Move-off Time
T-Time = Total Time

Guidance Note: If T-Time becomes greater than HT at any time, well securement and drill site evacuation contingency plans will be implemented.

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Ice Alert Roles and Responsibilities

The following table summarizes roles, responsibilities and actions required for each Ice Alert Level.

Alert	Drilling Vessel Master	Drilling Vessel IA	IMV IA (Shell)	IMV Master	Rig Superintendent	Shell Drilling Foreman
ROLES AND RESPONSIBILITIES FOR ALL ALERT LEVELS	The Drilling Vessel Master is the person in charge (PIC) of the drilling vessel. He is the final authority in regards to safety of the vessel, crew and complement. All changes of Alert level are issued by the Master. The responsibility to evacuate the drill site in response to a hazard rests with the Master Evaluates information from SIWAC, IAs and Vessel Management Team (VMT) Establishes Ice Alert Level and directs ice management operations. Establishes MTs in conjunction with the IMV Masters. Ensure Alert Level status is broadcast to fleet and internally throughout drilling vessel at intervals dependent on Alert Level or at change of alert Level	Collates and evaluates information from the SIWAC, IMV IAs and VMT Advises Master in establishing Ice Alert Level. Correlates Secure Time (ST) with information from rig operations. Establishes HT and MT in conjunction with IMVs and drilling vessel and advises Master and VMT. Works in conjunction with IAs on IMVs to develop and establish effective ice management strategies and advises Drilling Vessel Master. Ensures current ice drift is broadcast to fleet and liaises with SIWAC	The IA is Shell's representative onboard the IMVs and is the primary contact for all communications with the Drilling Vessel Master. He advises the IMV Master in executing the ice management strategies. Works in conjunction with Master of IMVs to determine the local ice conditions and hazardous ice. Works in conjunction with Drilling Vessel IA and Master of IMVs to develop and implement effective ice management strategies. Provides feedback on effectiveness of strategy and reports any anomalies pertaining to ice.	The Master is the PIC of the IMVs. He is the final authority in regards to safety of the vessel, crew and complement. Evaluates advice from the SIWAC and IA (drilling vessel & IMVs). Works in conjunction with IA on drilling vessel and IA of IMVs to develop and execute effective ice management strategies within the capability of the vessel. Provides feedback on effectiveness of the strategy to the IA on the IMVs. Reports to IMVs IA any condition which inhibits vessel performance	The Rig Superintendent is the on-site supervisor responsible for all rig functions and drilling-related operations aboard the drilling vessel. Establishes ST & informs VMT of ST and well conditions. Validates drilling team is aware of their duties under present Ice Alert Level. Validates well secure contingency plans	The Drilling Foreman is the senior on-site Shell supervisor with responsibility for overseeing drilling and well operations and for initiating spill response as the On-site Incident Commander for spills originating from the well site. Validates well ST in conjunction with the Rig Superintendent. Informs Drilling Vessel Master and Rig Superintendent regarding ongoing & upcoming critical operations and curtailment plans. Communicates status of well and Ice Alert level to Shell shore-based management Under the authority of the Shell Drilling Superintendent the Shell Drilling Foreman may raise the Ice Alert Level at any time, He may order the suspension of drilling operations, securing of the well.

Alert	Condition	VMT Comms Frequency	Drilling Vessel Master	Drilling Vessel IA	IMV IA (Shell)	IMV Master	Rig Superintendent	Shell Drilling Foreman
Green	(HT – T-Time) is greater than 24 hours	Every 24 hours, or more frequently as needed	Discharges duties as per accountabilities	Discharges duties as per accountabilities	Discharges duties as per accountabilities	Discharges duties as per accountabilities	Discharges duties as per accountabilities	Discharges duties as per accountabilities
Blue	(HT – T-Time) is greater than 12 hours and less than 24 hours	Every 12 hours, or more frequently as needed	Ensures readiness to execute contingency plans. Ensures primary IMV is available to execute Ice Management strategies for the given ice regime. Ensures anchor handling tug supply (AHTS) IMV readiness to manage ice and anchor handling operations.	Establish Ice Management Strategies in conjunction with IMVs and IA onboard IMVs.	Establishes Ice Management Strategies in conjunction with IMV Master and Drilling Vessel IA Validate readiness of IMV to execute ice management strategy	Executes Ice Management Strategies in conjunction with IA on IMVs Establishes and states readiness of IMV to execute ice management strategy	Establishes ST and assesses upcoming well operations for changes to ST Informs VMT of ST and well conditions Validates securing contingency plans Evaluates ongoing & upcoming stage of drilling program with regard to ST and COCP	Validates ST in conjunction with the Rig Superintendent Informs Drilling Vessel Master and Rig Superintendent regarding ongoing & upcoming COCP Reports Alert changes to Shell shore-based management
Yellow	(HT – T-Time) is greater than 6 hours and less than 12 hours	Every 6 hours, or more frequently as needed	Directs ice management operations Establishes and Validates MT Establishes departure strategy Ensures Alert status is broadcast to fleet and internally at 1-hour intervals or at change of Alert Level	Establishes HT & advises Master & VMT Works in conjunction with IA on IMVs to initiate ice management strategies Ensures current ice drift is broadcast to fleet	Implements ice management strategies as directed by Drilling Vessel Master in conjunction with IMV Master Provides feedback on effectiveness of strategy	Executes ice management strategies as directed by Drilling Vessel Master and IA on IMV Provides feedback on effectiveness of the strategy	Commences securing well in accordance with agreed upon plan, informs VMT of progress	Monitors Well Securing Operations and effectiveness of ice management operations Communicates overall drilling vessel status to Shell shore management
Red	(HT – MT) is less than 6 hours	Every hour	Initiates departure plans following confirmation from Rig Superintendent that lower marine riser package (LMRP) has been retrieved and secured and guide wires are released Ensures Alert Level status is broadcast to fleet and internally Directs IMV and AHTS activities	Assess effectiveness of Ice Management Strategy in line with ongoing operations, Assist Drilling Vessel Master as needed Ensures current ice drift is broadcast to fleet during anchor recovery operations	Continues to implement ice management strategies in support of drilling vessel and anchor recovery operations	Executes ice management strategies and or activities associated with releasing the drilling vessel from moorings as directed by Drilling Vessel Master and IMV IA	Confirms well is secured and that LMRP is disconnected, retrieved & secured Commences securing drill floor for departure from site	Monitors rig securing operations and departure plan Communicates status to Shell shore management Organizes additional support as needed for site departure operations (for example logistics)
Black	Drill site evacuated	As needed	Directs IMV support operations leading to safe departure from drill site to pre-agreed safe area Complies with all regulatory reporting requirements (internal and external) Works with VMT and IA and IMVs to establish further course of action	Continues to monitor ice conditions. Works in conjunction with IA on IMVs during transit Provides Master of Drilling Vessel and VMT with information to aid further decision making	Advises IMV Master on operations leading to safe transit from drill site to pre-agreed safe area Provides information to Drilling Vessel Master to aid further decision making	Works under direction of the Drilling Vessel Master and IMV IA during transit	Confirms drill floor and associated areas are secured and ready to depart drill site Provides information to Master and VMT to aid further decision making	Informs Shell shore management of evacuation Complies with all regulatory reporting requirements (internal and external) Provides information to Master and VMT to aid further decision making

VI. ICE MANAGEMENT PHILOSOPHY

An effective IMP is designed to enable execution of the exploration program, with the appropriate barriers in place to manage and mitigate against risks that are specific to exploration drilling operation in offshore Alaska (in this case, threat of ice). Additionally, the IMP identifies the “top” event caused by the failure of barriers and addresses the procedures to deal with consequences of escalation.

The “top” event, for the purpose of the IMP, is a yellow alert level that triggers the commencement of well suspension operations. This section addresses the activities associated with ice management as a barrier to the top event.

The strategy to prevent the top event is to have the following elements as effective barriers:

- proper equipment,
- skilled people,
- appropriate information, and
- work processes.

The key elements identified above are discussed herein.

Proper Equipment

- The IMVs will be capable IMVs, with the appropriate ice strengthening, and have been contracted to support the exploration campaign.
- IceNav: The drilling vessel and IMVs will be outfitted with IceNav Equipment (Enhanced radar imaging of ice)
- *Hull 247* (or similar vessel) is a high specification anchor handling vessel and will be the primary anchor handling vessel.
- *Nordica* (or similar vessel) designated as the primary IMV has anchor handling capability and could be used to supplement *Hull 247* if needed.

Skilled People

- The drilling vessel and IMVs will carry specialist IA, in addition to the regular crew complement.
- The drilling vessel and the *Nordica* (or similar vessel) will have two IAs onboard providing 24/7 coverage.
- The IAs supporting the exploration campaign will have documented experience of having performed ice management activities associated with supporting exploration activities.
- SIWAC will be staffed with world-class industry-acknowledged experts in weather, satellite and Ice Synoptic analysis.
- IMVs will have crews with ice management experience.

Appropriate Information

A multi-layered, systematic approach is taken to provide relevant information from SIWAC with a feedback loop from the vessels using:

- Wide Area Satellite Imagery
- High Resolution Satellite Imagery
- Meteorological Buoys
- Field Observation
- Numerical Models
- Local Radar
- Vessels are outfitted with Fit-for-Purpose Data and Communications link.

Work Processes

A systematic approach for risk mitigation is adopted by developing effective work processes.

- Development of effective ice management strategies based on available information (global and local)
- Deployment of assets to deliver strategy
  - Threat sectors identified
  - Assess manageability of ice feature
  - Appropriate management of ice feature (breaking/deflecting)
  - Primary IMV deployed at an effective perimeter to reduce floes to manageable size in advance of HT
- Scheduled VMT meetings (frequency dictated by Alert levels)
- Planning/Coordination meetings with specific focus on Ice Alert Levels

VII. WELL SUSPENSION PROCEDURES.

Effectiveness of the IMP depends on accurately establishing HT, ST and MT. Secure Time is time taken to secure the well, disconnect and retrieve the LMRP.

As part of securing the well, well suspension procedures will be established. These procedures will supplement the detailed well securing procedures that will be contained within the Rig Operations Procedures and will be specific to securing the well in response to the threat of hazardous ice.

Return to the drill site following exit due to the threat of hazardous ice is covered in Section IX.

Examples of well suspension options and procedures are presented in Attachment 4.

A. Well Suspension Options

Securing and suspending the well can be accomplished by several means. The base case is to suspend the well by plugging, (mechanical or cement). The chosen option or combination thereof will be dependent upon well conditions, environmental conditions, and (or) equipment limitations. Shell will employ the most effective suspension procedure under the specific circumstances at the time.

Relevant information associated with well suspension will be documented in the daily drilling reports. The BOEMRE field representative will be apprised, and relevant records will be submitted to BOEMRE.

Potential well suspension options are listed in the following table.

	Mechanical Plugging	Drillpipe Hang-off	Pull Out of Hole	Shearing Drill Pipe	Dropping String
Time Required / Preference	Requires most time. Is the base case procedure for securement.	Less time than plugging	Potentially less time depending upon position in hole.	Least amount of time ;Stuck pipe contingency	Comparable to shearing drillpipe. Contingency to cope with mechanical hoisting failure
Provides Wellbore Isolation	Yes	Yes (blind/shears closed)	Yes (blind/shears closed)	Yes (blind/shears closed)	Yes (blind/shears closed)
Hang-off Sub (HOS) Required	No	Yes (Emergency Drill Pipe Hang-off Tool)	No	No	No
Packers / Bridge Plug Required	Yes	No	No	No	No
Potential to Leave String in Hole	Yes, if suspended below packer.	Yes	No	Yes, but access to pump through sheared string is questionable.	String in hole but requires fishing trip and overshot to circulate
Remarks	Mechanical plugs are preferred method in cased hole.	In this case no downhole plugging has been assumed.	This method is acceptable in situations where casing has been run and cemented, but not drilled out yet. Pipe can be pulled and blind/shears closed without further containment.	Contingency for stuck pipe situation	Contingency to cope with mechanical hoisting failure
Advantages	Provides complete wellbore isolation. Equipment readily available.	Provides wellbore isolation via blind/shear rams. Equipment readily available. Can be done in a timely manner. Leaves kill string in place for potential well control requirements.	Requires less time in situations where casing has been run but not drilled out, or if already out of the hole as noted above, for logging or changing BHA.	Quickest way to secure the well and prepare for move-off	Next to shearing, quickest way to prepare rig for move-off. Also leaves the top of the string in the hole undamaged and ready for recovery or circulating via overshot and packoff
Disadvantages	Takes longer. Packers require additional tripping. Cementing requires mixing / pumping time and introduces potential for contamination.	No downhole wellbore isolation.	Not a preferred method with open hole conditions because no pipe is left in the hole for potential well control methods. No downhole wellbore isolation.	Potential to leave a deformed pipe profile complicating fishing and circulating operations	No downhole isolation is accomplished. Requires fishing trip to reestablish downhole circulation

VIII. MOORING SYSTEM RELEASE/ RECOVERY

A. Conditions Present to Initiate Mooring System Release and Recovery

This section addresses mooring system release and recovery if ice conditions have triggered an Ice Alert Level of yellow and escalated to a red. The following discussion assumes the well has been secured and all recoverable well-related equipment has been retrieved.

B. Release Options

Mooring system release /recovery can be accomplished by several means. The base case is to recover moorings in the conventional manner. The selection of a specific release option and the execution of the procedures rest with the Drilling Vessel Master who informs the VMT. Potential options are listed in the table below.

Mooring System Release/ Recovery

	Conventional Anchor Retrieval	Rig Anchor Release (RAR)	Running off Wires
Time Required / Preference	Requires most time. Is the base case procedure for retrieval	Less time than conventional recovery	Contingency plan if RARs fail to activate.
Advantages	System is intact. Ready for redeployment	Reduced MT	None
Disadvantages	None	Increased redeployment time. Requires back up equipment. Potential loss of buoys. Relies on activation by acoustic release.	Complicates redeployment. High potential for seabed fouling. Potential to compromise system.

IX. MOVING ONTO OR RETURNING TO THE DRILL SITE

The authority to move on to or return to the drill site will be issued by the Shell Drilling Superintendent with the concurrence of the Rig Manager. Relevant regulatory authorities will be notified in accordance with the requirements.

Upon authorization, the final decision to move on to or return to the drill site is dependent upon the Drilling Vessel Master and the VMT who are able to assess the various parameters properly with input from the IMV Masters and IA to determine the practicality of the decision.

X. TRAINING

All personnel will be made aware of their roles and responsibilities within this IMP through a training session on each vessel. This training will include a table-top exercise, which will be executed prior to beginning operations to provide exposure to and test communications and procedures of the COCP and the IMP. Participants at the table-top exercise will include:

- Shell and Drilling leadership
- Rig Crews (both Drilling and Marine Operations staff)
- Oil Spill Response (OSR) representative
- SIWAC representatives
- BOEMRE operations representatives
- IMVs
- IAs
- Alaska Logistics (Marine and Aviation) Representatives

Observations from the table-top exercise will be documented.

XI. ATTACHMENTS

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Attachment 1 – Extract from Critical Operations Curtailment Plan

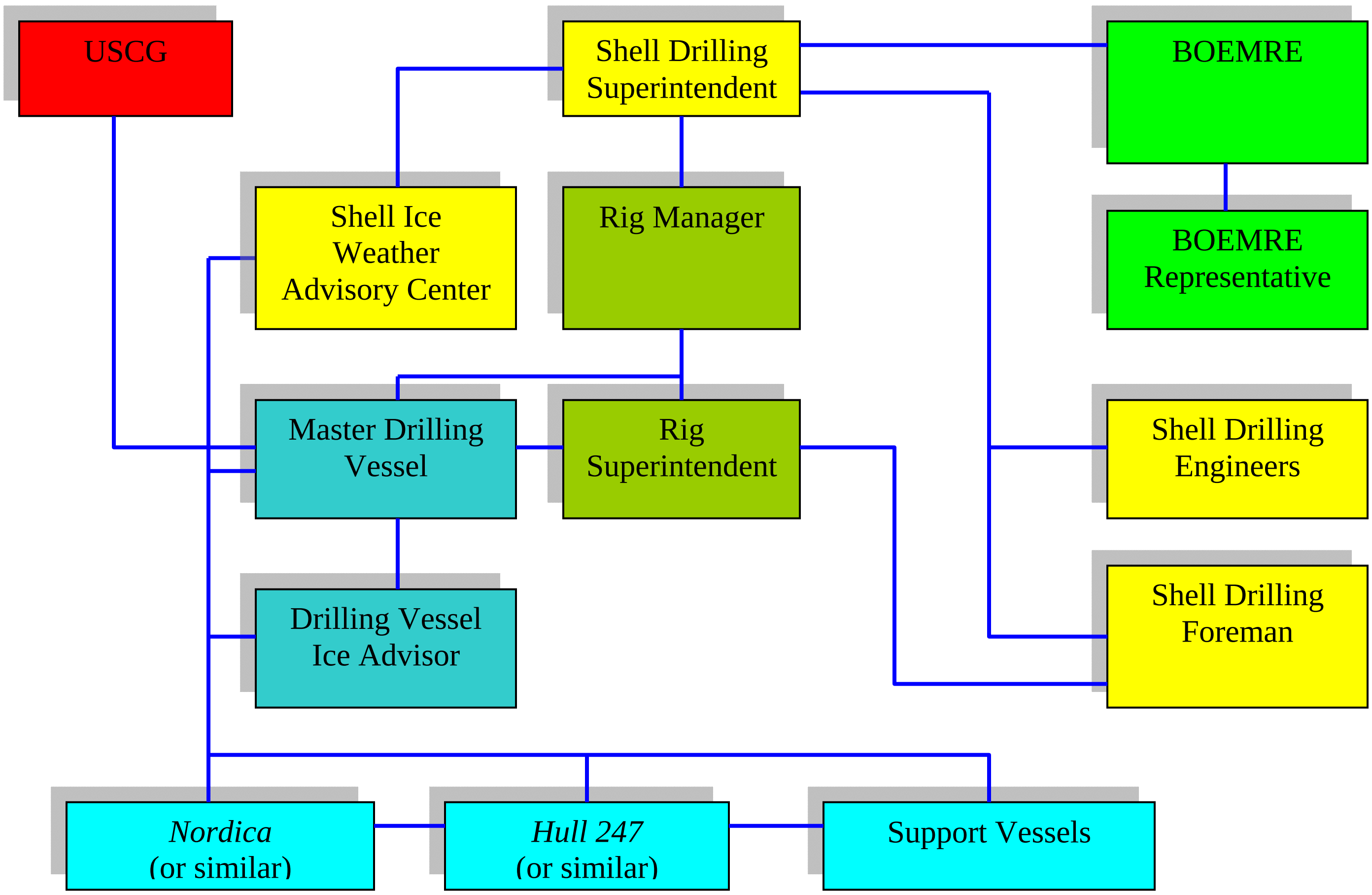
Per Section 10 of the COCP:

Notification of the decision for curtailments requiring the rig to disconnect from the well and depart location will be made as soon as practical, but not to interfere with the safety of the crew, environment, or vessel. This notification will be made either verbally to a representative on site or by telephone to a BOEMRE representative on duty; the notification may also be made in written form through the use of fax or email.

All operations curtailment decisions will be documented on the Shell Daily Operations Report. This information will be conveyed to BOEMRE on a weekly basis via the Well Activity Report and at the end of the well operations as part of the End of Operations Report.

The following flow chart depicts notifications in the event of curtailment.

Curtailment Notification Flow Chart (Attachment 1 continued)



Attachment 2 - Vessel Descriptions

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Kulluk Specifications

Kulluk

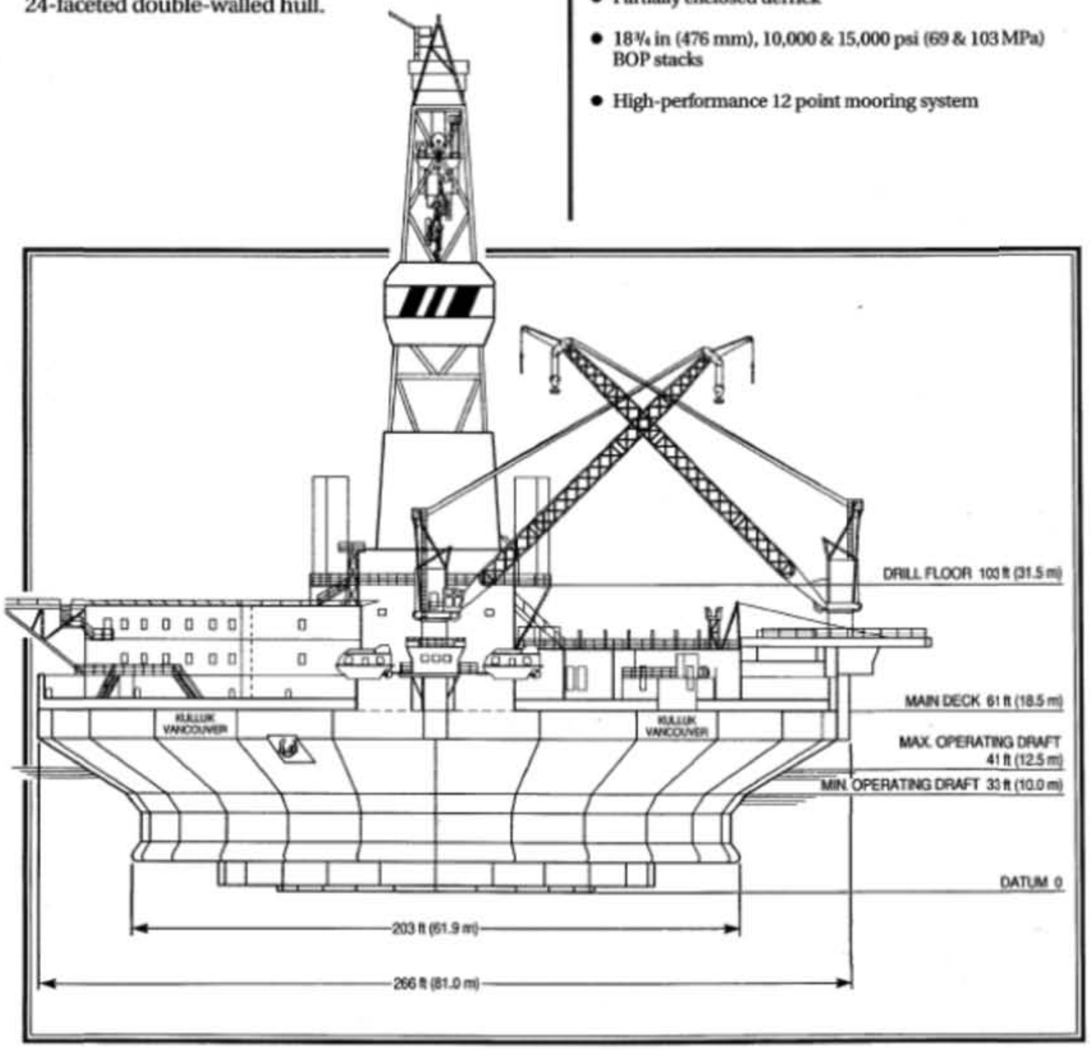
BeauDril

Kulluk is the first floating drilling vessel designed and constructed for extended season drilling operations in deep Arctic waters.

An improvement on the floating drillship concept, Kulluk is a conically shaped, ice strengthened floating drilling unit with a 24-faceted double-walled hull.

Key Features

- Unique, purpose-built conical Arctic Class IV hull design
- Operating water depth 60 to 600 ft (18.3 to 183 m), drilling depth up to 20,000 ft (6 096 m)
- Electrically driven Varco top drive drilling system
- 24 ft (7.3 m) diameter glory hole bit capable of drilling and setting a steel caisson 40 ft (12.2 m) into the seabed for ice scour protection
- Partially enclosed derrick
- 18¾ in (476 mm), 10,000 & 15,000 psi (69 & 103 MPa) BOP stacks
- High-performance 12 point mooring system



Classification

The unit has been designated as Arctic Class IV (by the Canadian Coast Guard) under Canadian Arctic Shipping Pollution Prevention Regulations, and as Ice Class 1AA by the American Bureau of Shipping.

Specifications

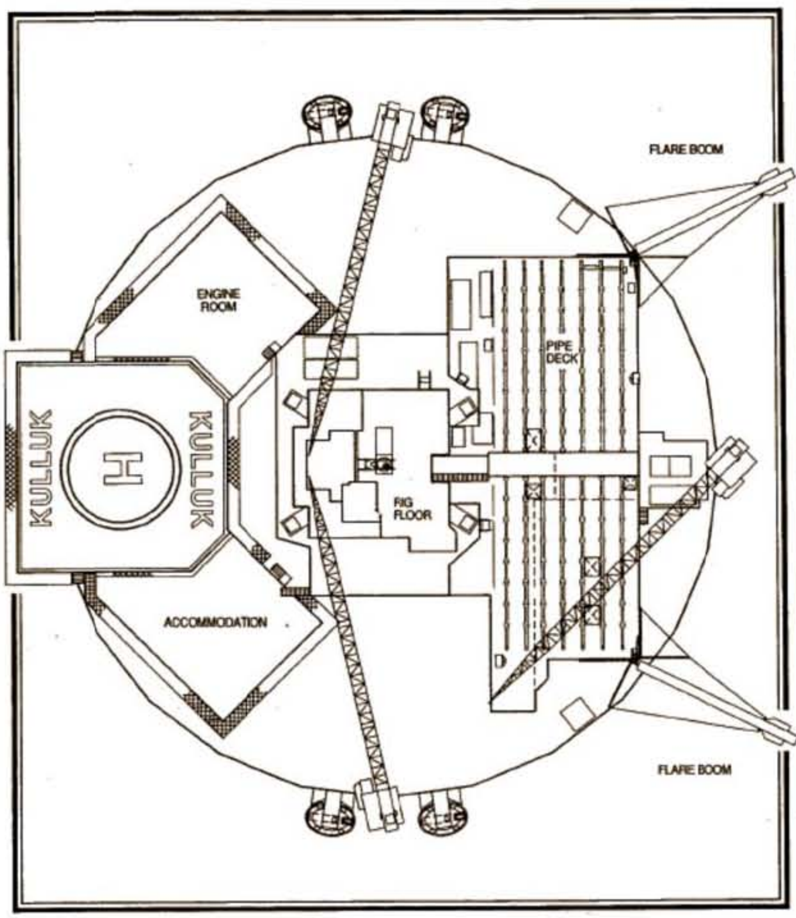
Owner:	BeauDril Limited
Flag:	Canadian
Rig Type:	Conical Drilling Unit (CDU)
Delivered:	1983
Rig Design:	Earl & Wright - Lavalin
Built By:	Mitsui Engineering and Shipbuilding, Japan

Dimensions

Diameter at main deck:	266 ft (81.0 m)
Diameter at pump deck:	196 ft (59.7 m)
Hull Depth:	61 ft (18.5 m)

Operations

Draft (max. operating):	41 ft (12.5 m)
Draft (min. operating):	33 ft (10.0 m)
Draft (light ship):	26 ft (8.0 m)
Light Ship Displacement:	19,300 tons (17 510 tonnes)
Maximum Drilling Depth:	20,000 ft (6 096 m)
Operating Water Depth:	60 to 600 ft (18.3 to 183 m)



Variable Load

7,717 tons (7 000 tonnes)

Storage Capacities

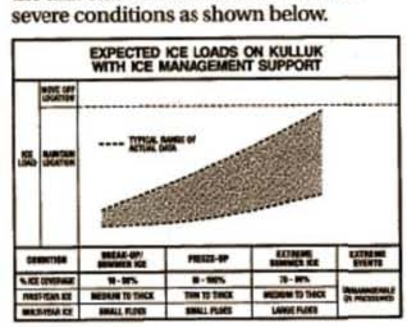
Barite & cement bulk:	21,471 cf (608 m³)
Liquid mud:	2,605 bbl (414 m³)
Drill water:	4,227 bbl (672 m³)
Fuel:	10,085 bbl (1 603 m³)
Potable water:	1,961 bbl (312 m³)
Ballast:	35,928 bbl (5 712 m³)
Pipe & casing (pipe deck):	1,543 tons (1 400 tonnes)
Brine:	2,010 bbl (320 m³)

Operational Limits

Stationkeeping Conditions

Kulluk was built to operate in the ice infested waters of the Arctic offshore. The unit was developed to extend the drilling season available to more conventional floating vessels by enabling operations to be carried out through spring breakup conditions, the summer months, and well into the early winter period.

Kulluk was designed to maintain location in a drilling mode in moving first-year ice of 4 ft (1.2 m) thickness. With ice management support provided by BeauDril's Arctic Class IV icebreakers, the unit can maintain location in more severe conditions as shown below.



In terms of Kulluk's open water performance, the drilling unit was designed to maintain location in storm conditions associated with maximum wave heights of 18 ft (5.5 m) while drilling and 40 ft (12.2 m) while disconnected (assumed storm duration of 24 hrs).

If ice or open water storm conditions become more severe than those indicated, the unit's mooring system, which incorporates acoustic release devices, is disconnected from the anchors and the unit moves off location.

Equipment

Drilling Equipment

Derrick
160 ft (44.8 m) Dreco dynamic with a 40 ft x 40 ft (12.2 m x 12.2 m) base, rated at 1,400,000 lb (623 000 daN) with 14 lines

Racking platform has capacity to hold 23,340 ft (7 115 m) of 5 in (127 mm) drill pipe plus bottom hole assembly

Drawworks
Ideco E-3000 electric drawworks complete with sandreel, Elmago model 7838 Baylor auxiliary brake, spinning and breakout catheads and three GE model 752 motors each rated at 1,000 hp (746 kW) continuous

Travelling Block
McKissick model 686, 650 ton (590 tonne) capacity with 7 sheaves grooved for 1⅝ in (41.3 mm) drilling line

Swivel
Ideco TL-500, 500 ton (454 tonne) capacity

Drill Pipe
20,000 ft (6 096 m) x 5 in (127 mm), 19.5 lb/ft (29 kg/m) with 4½ IF connections

Top Drive
Varco TDS-3 with one GE model 752 motor rated at 1,000 hp (746 kW) continuous and a 500 ton (454 tonne) hoisting capacity

Rotary Table
Ideco LR-495, 49.5 in (1 257 mm) driven by one GE model 752 motor, rated at 1,000 hp (746 kW) continuous, coupled to a two speed transmission

Drill String Compensator
NL Shaffer 18 ft (5.5 m) stroke 400,000 lb (178 000 daN) compensating capacity or a 1,000,000 lb (444 800 daN) locked capacity

Tensioner System
4 x 80,000 lb (35 600 daN) Western Gear riser tensioners, 48 ft (14.6 m) wireline travel with 1¾ in (44.5 mm) wire rope

6 x 16,000 lb (7 100 daN) Western Gear guideline/pod tensioners, 40 ft (12.2 m) wireline travel with ¾ in (19.1 mm) wire rope

Mud Pumps
2 x Ideco T1600 triplex, each driven by two GE model 752 motors rated at 1,000 hp (746 kW) continuous

Cementing Unit
Dowell owned R717 twin triplex powered by two GE model 752 motors each rated at 1,000 hp (746 kW) continuous, with 7,500 psi (52 MPa) and 10,500 psi (72 MPa) fluid ends

Rig Floor Pipe Handling System
Varco Iron Roughneck model IR-2000 Range: 2⅞ to 8 in (73 to 203 mm)

Mud Logging Room

Designed to accommodate equipment from any of the major mud logging companies. This room is an integral part of the rig and contains complete lab facilities

Testing Equipment

Complete testing system with a 10,000 BOPD (1 590 m³/day) capacity consisting of: data header, choke manifold, steam heater, 3-phase separator, surge tank, water degasser, transfer pumps, and flare booms

Mud Conditioning Equipment

4 x Thule United VSM-120 shale shakers
1 x Brandt SR-3 desander
1 x Brandt SE-24 desilter
1 x Thule VSM-200 mud cleaner
1 x Wagner Sigma-100 centrifuge
1 x Sharples DM 40 000 centrifuge
2 x Burgess Magna-Vac vacuum degassers
2 x Alfa-Laval AX30 mud coolers

Subsea Equipment

BOP System
1 x NL Shaffer 18¾ in (476 mm), 10,000 psi (69 MPa) BOP stack with annular, 4 ram type preventors, and Vetco H-4 E connector

1 x NL Shaffer 18¾ in (476 mm), 15,000 psi (103 MPa) BOP stack with annular rated at 10,000 psi (69 MPa), 4 ram type preventors, and Vetco H-4 E x F connector

Lower Marine Riser Packages
2 x 18¾ in (476 mm) with 10,000 psi (69 MPa) Shaffer annular, Regan 24 in (610 mm) CR-1 pressure compensated lower ball joint and Vetco H-4E connector

BOP Cranes
2 x Hepburn main bridge cranes, 85 ton (77 tonne) capacity each with 10 ton (9.1 tonne) auxiliary hoists

30 in (762 mm) Marine Riser System
3 x hydraulic pin connectors; 2 x 36 in (914 mm) Cameron and 1 x 30 in (762 mm) Dril-Quip

1 x Regan 28 in (711 mm) CR-1 pressure compensated lower ball joint

30 in (762 mm) riser consisting of 1 in (25.4 mm) wall casing with Hunting Lynx 52S connectors

1 x Regan 28 in (711 mm) telescoping riser joint with 45 ft (13.7 m) stroke

1 x Regan 28 in (711 mm) DR-1 upper ball joint

1 x Regan KFDS 28 in (711 mm) diverter

21¼ in (540 mm) Marine Riser System
21¼ in (540 mm) Cameron RCK riser with 10,000 psi (69 MPa) choke and kill lines

2 x Cameron telescoping riser joints, 1 x 40 ft (12.2 m), and 1 x 50 ft (15.2 m) stroke

1 x Regan 24 in (610 mm) DR-1 upper ball joint

1 x Regan KFDS 24 in (610 mm) diverter

Glory Hole Bit
1 x Brown Tornado, 24 ft (7.3 m) diameter hydraulically operated with airlift discharge. Capable of drilling a glory hole 40 ft (12.2 m) into the seabed for ice scour protection

Power Generation

Prime Movers:
3 x Electro-Motive Diesel rated at 2,817 hp (2 100 kW) each

Emergency Power:
1 x GM Detroit diesel rated 873 hp (651 kW)

Cranes

3 x Liebherr, BOS 65/850, rated at 72 ton (65 tonne) at 30 ft (9.1 m)

Safety Equipment

4 x Whittaker 54-person survival craft; two on port, two on starboard

1 x Hurricane Model 700-D emergency rescue boat

2 x RFD inflatable escape slides

Helideck

Capacity for Sikorsky 61 or similar with fueling station

Accommodation

Bunks for 108 people, recreation room, sauna, galley with seating for 36, offices, and hospital

Kulluk Mooring System

The Kulluk's mooring system consists of twelve Hepburn winches located on the outboard side of the main deck. Anchor wires lead off the bottom of each winch drum inboard for approximately 55 ft (17 m). The wire is then redirected by a sheave, down through a hawse pipe to an underwater, ice protected, swivel fairlead. The wire travels from the fairlead directly under the hull to the anchor system on the seafloor.

Specifications

Anchor Winch
12 x Hepburn single-drum winches with a 287 ton (260 tonne) operating tension

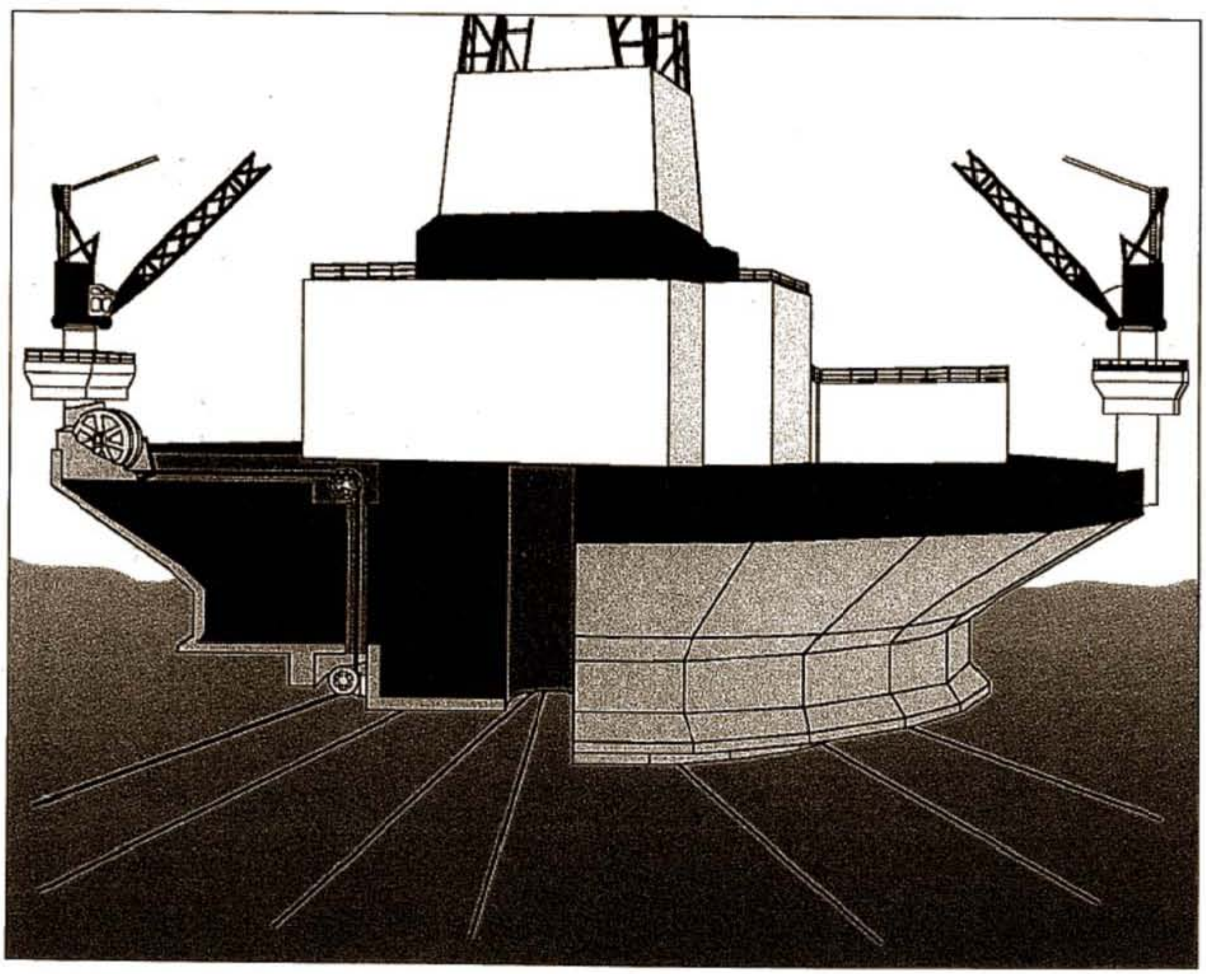
Mooring Wires and Anchors

Anchors:
Various sizes & quantities of anchors are available for use. Exact anchor configuration to be provided once location and seafloor conditions are specified

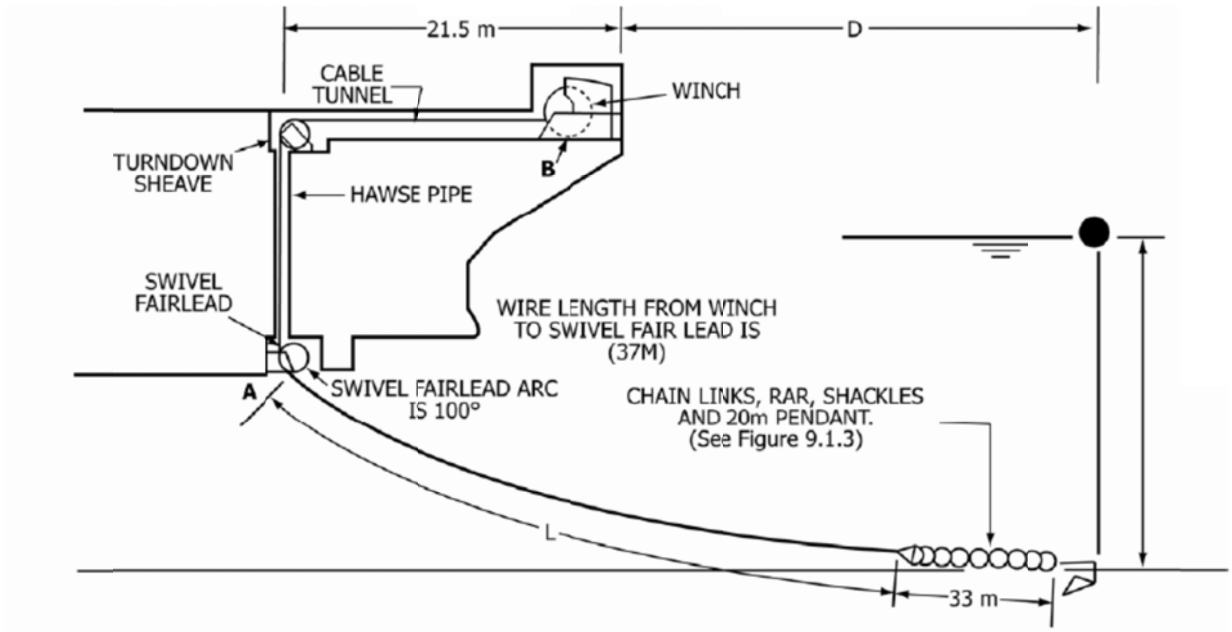
Wire ropes:
Each winch drum has capacity for 3,763 ft (1 147 m) of 3 1/2 in (88.9 mm), 573 ton (520 tonne) breaking strength wireline

Anchor Release:
Each anchor wire contains a remote acoustic release (RAR) unit

FOR MORE INFORMATION ABOUT KULLUK, CONTACT MANAGER BEAUDRIL AT (403) 233-3030.



Kulluk Anchoring Detail



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Discoverer Specifications

DISCOVERER SPECIFICATIONS	
TYPE-DESIGN	Drillship - Sonat Offshore Drilling *Discoverer* Class
SHAPE	Monohull with sponsons added for ice-resistance[1]
SHIP BUILDERS & YEAR	Namura Zonshno Shipyard, Osaka, Japan - hull number 355
YEAR OF HULL CONSTRUCTION	1965
YEAR OF CONVERSION	1976
DATE OF LAST DRY-DOCKING	2010

DISCOVERER DIMENSIONS		
LENGTH	514 ft	156.7 m
LENGTH BETWEEN PERPINDICULARS (LBP)	486 ft	148.2 m
WIDTH	85 ft	26 m
MAXIMUM (MAX) HEIGHT (ABOVE KEEL)	274 ft	83.7 m
HEIGHT OF DERRICK ABOVE RIG FLOOR	175 ft	53.3 m

DISCOVERER MOORING EQUIPMENT	
Anchor pattern symmetric 8 points system. The unit is fitted with Sonat Offshore Drilling patented roller turret mooring system giving the unit the ability to maintain favorable heading without an interruption of the drilling operations	
ANCHORS	Stevpris New Generation 7,000 kilograms (kg) each (ea) 15,400 pounds (lb) ea
ANCHOR LINES	Chain Wire Combination
SIZE/GRADE	2.75-in. wire 3-in. ORQ Chain
LENGTH	2,750 ft (838 m) wire + 1,150 ft (351 m) chain (useable) per anchor

DISCOVERER OPERATING WATER DEPTH		
MAX WATER DEPTH	1,000 ft (305 m) with present equipment (can be outfitted to 2,500 ft [762 m])	
MAX DRILLING DEPTH	20,000 ft	6,098 m

Table 1.c-2 *Discoverer* Specifications (continued)	
DRAW WORKS	EMSCO E-2,100 - 1,600 horsepower (hp)
ROTARY	National C-495 with 49 ½ -in. opening
MUD PUMPS	2 ea. Continental Emsco Model FB-1600 Triplex Mud Pumps
DERRICK	Pyramid 170 ft. with 1,300,000 lb nominal capacity
PIPE RACKING	BJ 3-arm system
DRILL STING COMPENSATOR	Shaffer 400,000 lb with 18-ft (5.5 m) stroke
RISER TENSIONS	8 ea. 80,000 lb Shaffer 50-ft (15.2 m) stroke tensioners
CROWN BLOCK	Pyramid with 9 ea. 60-in. (1.5 m) diameter sheaves rated at 1,330,000 lb
TRAVELING BLOCK	Continental - Emsco RA60-6
BLOWOUT PREVENTOR (BOP)	Cameron Type U 18 ¾ -in. (48 cm) x 10,000 pounds per square in. (psi)
RISER	Cameron RCK type, 21-in. (53 cm)
TOP DRIVE	Varco TDS-3S, with GE-752 motor, 500 ton
BOP HANDLING	Hydraulic skid based system, drill floor

DISCOVERER DISPLACEMENT	
FULL LOAD	20,253 metric tons (mt)
DRILLING	18,780 mt (Drilling, max load, deep hole, deep water)

DISCOVERER DRAUGHT		
DRAFT AT LOAD LINE	27 ft	8.20 m
TRANSIT	27 ft (fully loaded, operating , departure)	8.20 m
DRILLING	25.16 ft	7.67 m

DISCOVERER HELIDECK	
MAXIMUM HELICOPTER SIZE	Sikorsky 92N
FUEL STORAGE	2 ea. 720-gallon tanks

DISCOVERER ACCOMODATIONS	
NUMBER OF BEDS	140
SEWAGE TREATMENT UNIT	Hamworthy ST-10

DISCOVERER PROPULSION EQUIPMENT	
PROPELLER	1 ea 15 ft 7-in. (4.8 m) diameter, fixed blade
PROPULSION DRIVE UNIT	Marine Diesel, 6 cylinder, 2 cycle, Crosshead type
HORSEPOWER	7,200 hp @ 135 revolutions per minute (RPM)
TRANSIT SPEED	8 knots

GENERAL STORAGE CAPACITIES	
SACK STORAGE AREA	934 cubic meters (m^3)
BULK STORAGE	
Bentonite / Barite	180 m^3 - 4 tanks
Bulk Cement	180 m^3 - 4 tanks
LIQUID MUD	
Active	1,200 barrels (bbl)
Reserve	1,200 bbl
Total	2,400 bbl
POTABLE WATER	1,670 bbl / 265.5 m^3 (aft peak can be used as add. pot water tank)
DRILL WATER	5,798 bbl / 921.7 m^3
FUEL OIL	6,497 bbl / 1,033 m^3

[1] Sponsons designed and constructed to meet requirements of Det Norske Veritas (DNV) Additional Class Notation ICE-05.

Nordica Specifications

FINSTASHIP OFFSHORE

Powerful, high-tech, multipurpose vessels for global underwater oil field construction

Designed for the management, maintenance and service of offshore oil wells, the 97-metre Botnica is a multipurpose vessel specialised in marine construction and icebreaking, as are the 116-metre vessels Fennica and Nordica. They are equipped with diesel-electric propulsion systems and their innovative combination of capabilities, based on extensive design and engineering work, facilitates their use in both arctic and tropical conditions. All three of these multipurpose vessels are highly advanced, powerful and extremely well designed and built.

Unique technology for demanding conditions

These vessels are ideal for offshore operations. The working deck is about 1,000 m², making it exceptionally large and level for ships of this length. The deck was designed for fast equipment changes. Depending on the ship, such equipment may range from simple deck cranes to a 160-tonne pedestal active heave compensated crane, or from deepwater installation equipment to pipe-laying systems, underwater machinery control or the towing and installation of large pipelines.

With their 15,000 kW power output and 230-tonne bollard pull, the Nordica and the Fennica are ideal for seabed ploughing and towing, and they are also fully equipped for anchor-handling operations. The ships' main engine and generator solution makes it possible to perform heavy-duty maintenance tasks without affecting their operating ability.

Both the Fennica and the Nordica are also equipped with a stern roller.

Accurate, safe and highly suitable

The Botnica's moon pool and the large size of its working deck make this ship highly suitable for a variety of offshore operations. Different types of special tools and structures can be installed on the working deck. The attributes of the Botnica, a class 3 DP ship, are in keeping with the strict rules and stipulations demanded in oil well management, as well as the requirements on oil fields set by the Norwegian Maritime Directorate.

The multipurpose icebreakers are equipped with Kongsberg Simrad's Dynamic Positioning (DP) system, which has five independent control units operating their main propellers and three bow thrusters. Even in a sector in which ocean vessels equipped with DP systems are a normal sight, these vessels have performed their tasks exceptionally well in terms of manoeuvrability and accuracy. Their unusual asymmetrical and spacious navigation bridge was designed with an eye to the requirements placed on the ship's multiple applications, both on the open sea and in icebreaking and towing operations.

The vessels have a separate deck for the clients' use, with cabins and offices and a separate data network. The high quality facilities accommodate a total of 45-47 guests, depending on the ship.

Fennica

Dimensions

Length 116.00 m
Beam 26.00 m
Draught 8.40 m max.
Built 1993
Max. speed 16 knots

Class

DnV + 1A1 – Tug Supply Vessel – SF – EO – Icebreaker polar – 10, Dynpos, AUTR, Helideck

Dynpos

Simrad ADP 702

Accommodation

82 persons
24 cabins for client use (47 persons)
Client's offices: 1 operation centre on 4th bridge deck, 1 x 20 m² office

Helideck

Superpuma or similar

Deck

Working deck area 1090 m²
Anchor handling/winch
Aquamaster TAW 3000/3000 E

Machinery

Main engines
2 x Wärtsilä Diesel, Vasa 16V 32, each 6000 kW
2 x Wärtsilä Diesel, Vasa 12V 32, each 4500 kW
Generators
ABB Strömberg Drives
2 x HSG 1120 MP8, power 8.314 kVA, Volt 6.3 KV, speed750 rpm
2 x HSG 900 LR8, power 6.235 kVA, Volt 6.3 KV, speed 750 rpm
Propellers
2 x HSSOL 18/1654, output 7.500 kW each, ABB Strömberg Drives
2x Aquamater-Rauma US ARC 1, 7500 kW each,
FP propellers, variable RPM
Bow thrusters
3 x Brunvoll FV-80 LTC-2250, VP propellers 1.050 kW each

Bollard pull 234 tons

Crane(s) (optional)

Stb 30 tons/38 metre jib
Port 15 tons
A-frame 120 tons

Navigation Equipment

Robertson ECDIS Navigation System
Doppler speed log
Loran C
GPS
Fiber optic gyros
Differential GPS Gyro.
Navintra Ecdis
Direction finder
Echo sounder
Facsimile recorder

Communication Equipment

1 x Skanti TRP 8400D MF/HF SSB, including all GMDSS requirements
1 x Watch receiver
1 x Aero VHF. Helicopter communication
6 x VHF
1 x Navtex receiver
1 x Inmarsat B satellite comm. system
VSAT online satellite comm. system
3 x UHF walkie-talkie
3 x VHF walkie-talkie
2 x Freefloat EPRIB, 121,5 and 406 MHz
2 x Distress transponders, 96 Hz
Call signal OJAD

Nordica

Dimensions

Length 116.00 m
Beam 26.00 m
Draught 8.40 m max.
Built 1994
Max. speed 16 knots

Class

DnV + 1A1 – Tug Supply Vessel – SF – EO – Icebreaker polar – 10, Dynpos, AUTR, Helideck

Dynpos

Simrad ADP 702

Accommodation

82 persons
24 cabins for client use (47 persons)
Client's offices: 1 operation centre on 4th bridge deck, 1 x 20 m² office

Helideck

Superpuma or similar

Deck

Working deck area 1090 m²
Anchor handling/towing winch
Aquamaster TAW 3000/3000 E

Machinery

Main engines
2 x Wärtsilä Diesel, Vasa 16V 32, each 6000 kW
2 x Wärtsilä Diesel, Vasa 12V 32, each 4500 kW
Generators
ABB Strömberg Drives
2 x HSG 1120 MP8, power 8.314 kVA, Volt 6.3 KV, speed750 rpm
2 x HSG 900 LR8, power 6.235 kVA, Volt 6.3 KV, speed 750 rpm
Propellers
2 x HSSOL 18/1654, output 7.500 kW each, ABB Strömberg Drives
2x Aquamater-Rauma US ARC 1, 7500 kW each,
FP propellers variable RPM
Bow thrusters
3 x Brunvoll FV-80 LTC-2250, VP propellers 1.050 kW each

Bollard pull 234 tons

Main crane (optional)

Lifting capacity	160 T/9 m 30 T/32 m
Main winch	Active Heave Compensated Constant Tension
Heave amplitude	+ 3,5 m double part + 7 m single part
Operating depth	500 m–160 T (double part) 1000 m–80 T (single part)
Aux winch	10 T, 33 m, Constant Tension
Tugger winches	2 x 4 T Constant Tension
Port	15 tons

A-frame (optional) 120 tons

Navigation Equipment

Navintra ECDIS Navigation System
Doppler speed log
Loran C
GPS
Fiber Optic Gyros
Differential GPS Gyro.
Direction finder
Echo sounder
Facsimile recorder

Communication Equipment

1 x Skanti TRP 8400D MF/HF SSB, including all GMDSS requirements
1 x Watch receiver
1 x Aero VHF. Helicopter communication
6 x VHF
1 x Navtex receiver
1 x Inmarsat B satellite comm. system
VSAT online satellite comm. system
3 x UHF walkie-talkie
3 x VHF walkie-talkie
2 x Freefloat EPRIB, 121,5 and 406 MHz
2 x Distress transponders, 96 Hz
Call signal OJAE

Botnica

Dimensions

Length 96.70 m
Beam 24.00 m
Draught 7.2 to 8.5 m
Built 1998
Max. speed 15 knots

Class

DnV + 1A1 – Supply Vessel – SF – EO – Icebreaker Ice – 10,
Dynpos AUTRO, RPS
NMD Mobile offshore Units, DP UNIT, with equipment class 3

Dynpos

Simrad SDP22 + SDP12 backup
2 x HIPAP combined SSBL/MULBL hydroacoustic system
2 x Seatex DPS DGPS combined GPS/Glonass

Accommodation

72 persons
24 cabins for client use (45 pers.)
2 x client's office

Helideck

Superpuma or similar

Deck

Working deck area 1000 m²

Machinery

Main engines
12 x Caterpillar 3512B, 1257 kW, 1500 rpm
Main generators
6 x ABB-AMG 560, 2850 kVA, 3,3 kV 3 N, 50 Hz
Emergency generators
1 x Caterpillar 3406, 200 kW, 400 V, 3 N, 50 Hz
Main propulsion
Stern 2 x 5000 kW Azipod, FP
Bow thrusters
3 x Brunvol tunnel, variable pitch á 1150 kW

Bollard pull 117 tons

Crane(s) (optional)

1 x Hydralift, 160 tons
1 x 15 tons

Main cranes

Lifting capacity	160 T/9 m 30 T/32 m
Main winch	Active Heave Compensated Constant Tension
Heave amplitude	+ 4 m double part + 8 m single part
Operating Depth	550 m–160 T (double part) 1100 m– 80 (single part)
Aux winch	10 T, 33 m, Constant Tension

Moonpool 6.5 x 6.5 metres

Navigation and communication equipment

GMDSS
Inmarsat B
VSAT online satellite comm. system
Call signal OJAK

FINSTASHIP

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Phone +358 30 620 7000, fax +358 30 620 7030
e-mail: shipping@finstaship.fi
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GDV Maritime AS
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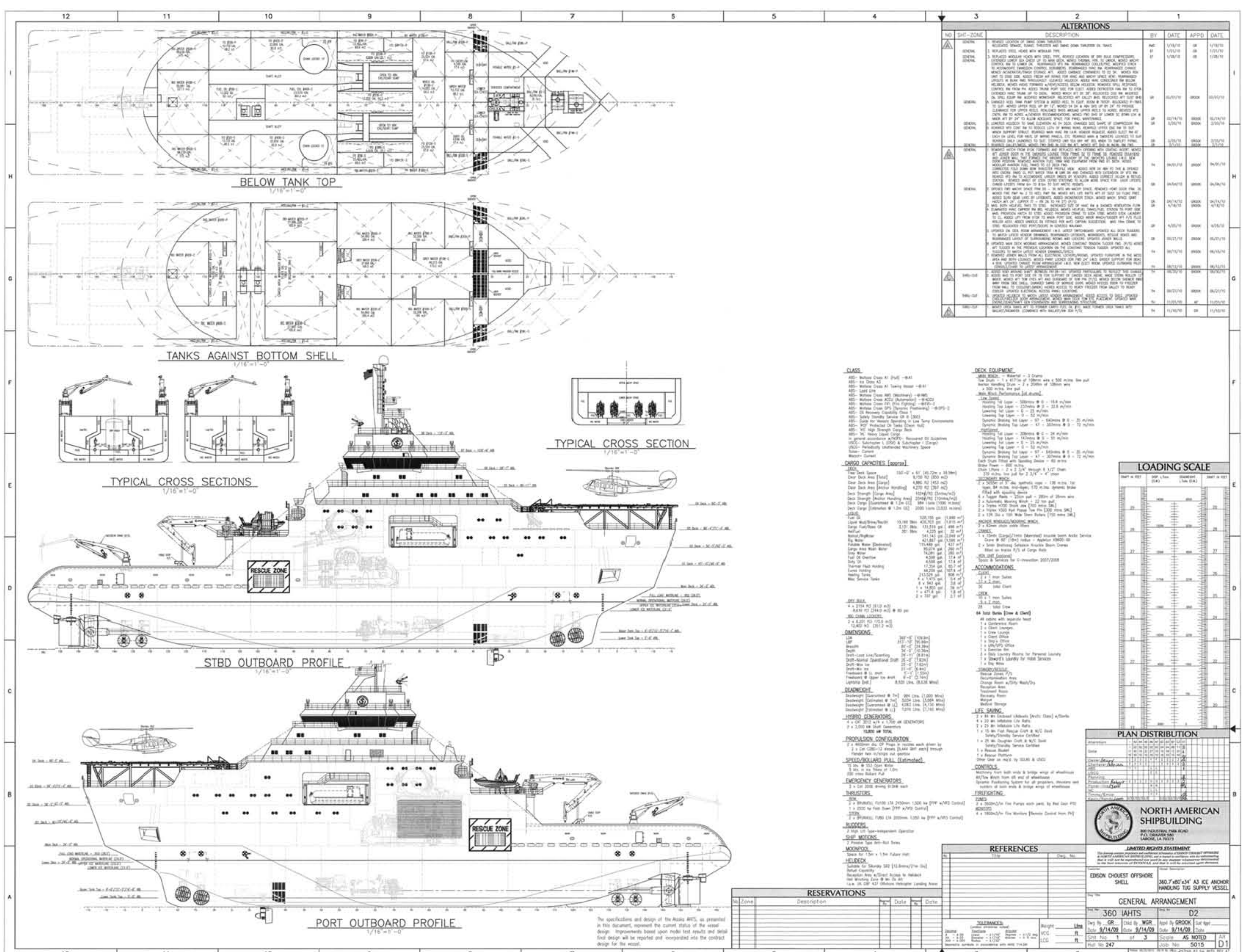
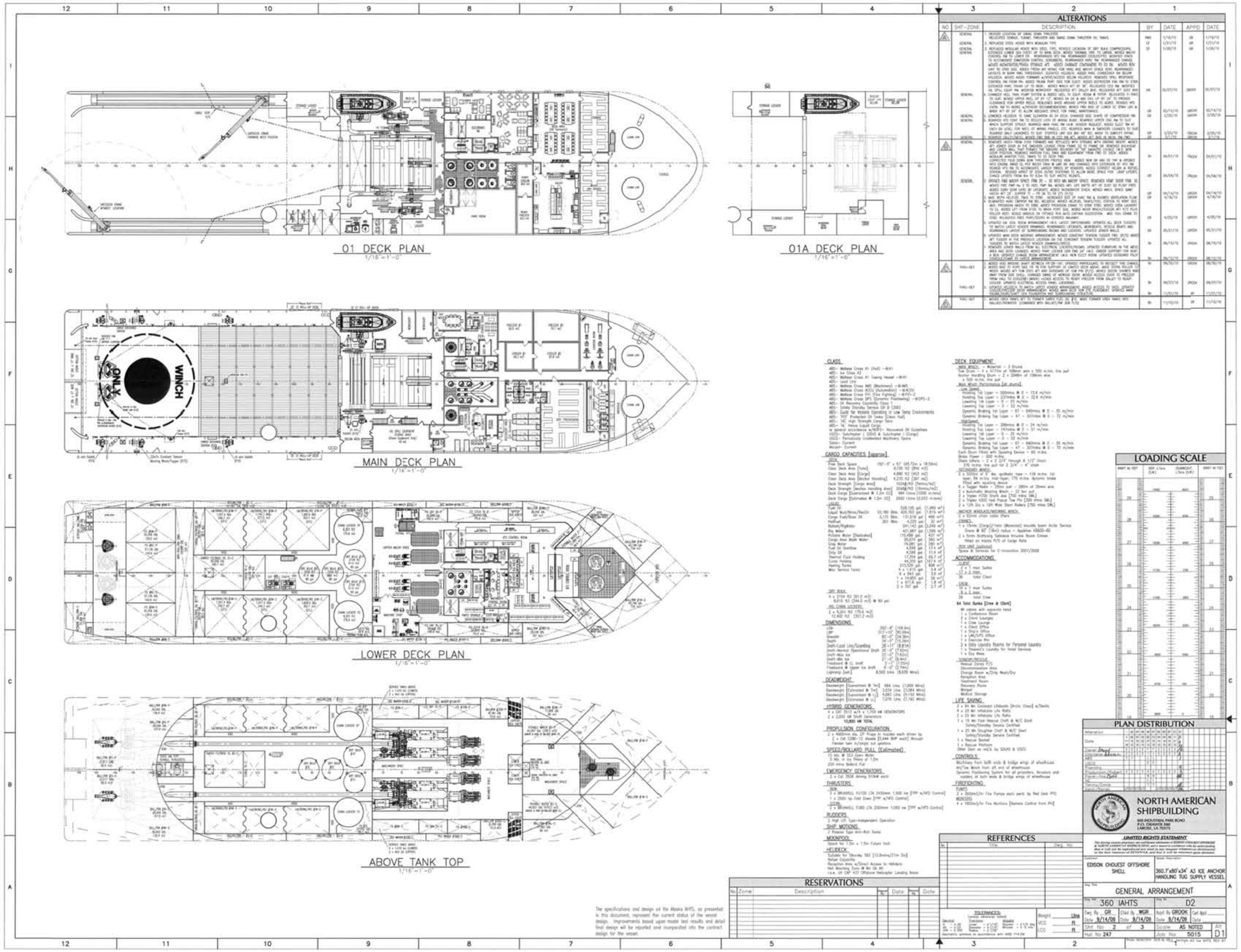
Phone +47 3701 2260, fax +47 3701 2862
e-mail: maritime@gdv.no
www.gdv.no

HULL 247 Specifications





ALTERATIONS
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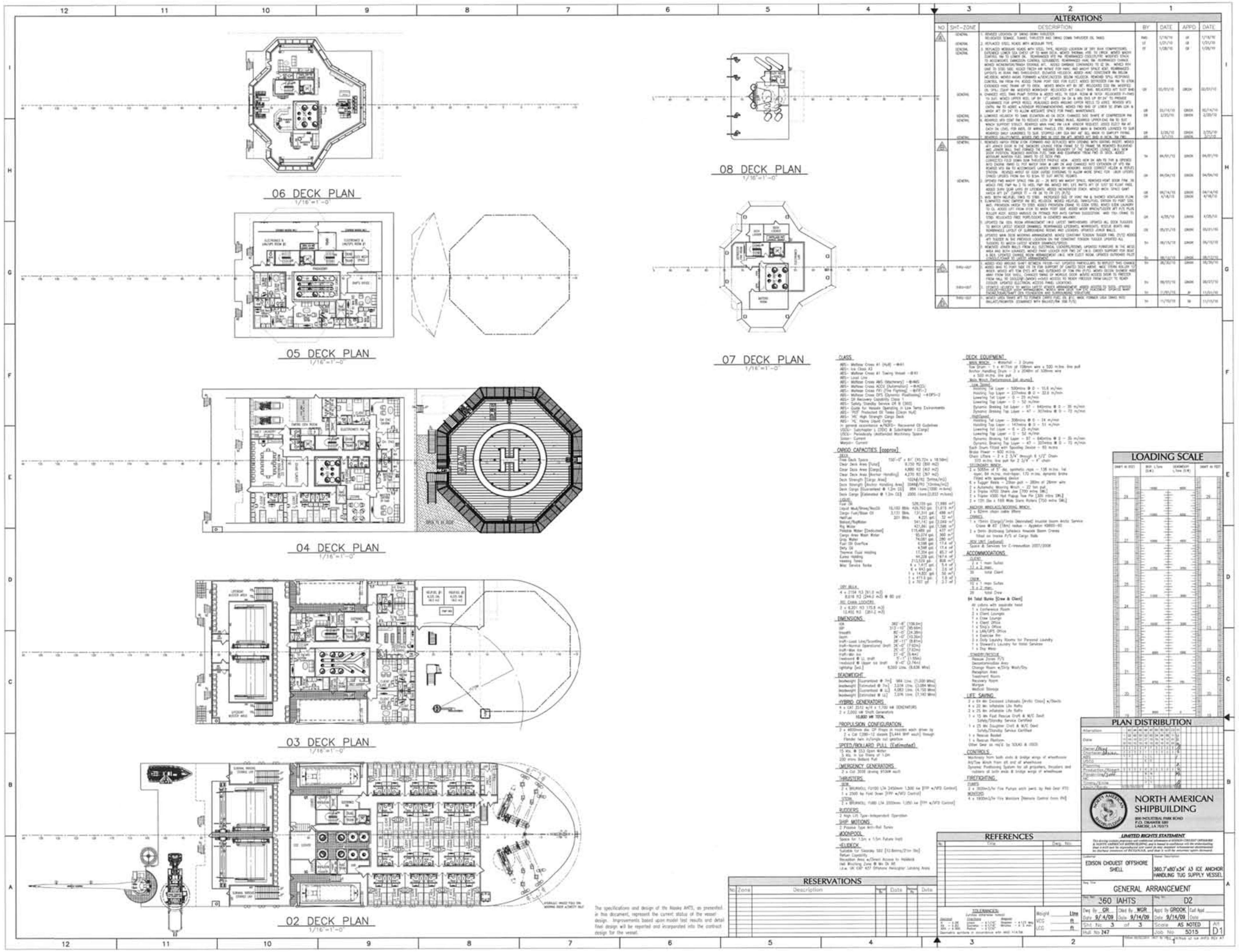
01A DECK PLAN
MAIN DECK PLAN
WINCH
LOWER DECK PLAN
ABOVE TANK TOP
LOADING SCALE
PLAN DISTRIBUTION
REFERENCES
RESERVATIONS
NORTH AMERICAN SHIPBUILDING
EDISON CHOUEST OFFSHORE SHELL
GENERAL ARRANGEMENT
360 IAHTS
D2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05 DECK PLAN
07 DECK PLAN
04 DECK PLAN
03 DECK PLAN
02 DECK PLAN
LOADING SCALE
PLAN DISTRIBUTION
NORTH AMERICAN SHIPBUILDING
REFERENCES
RESERVATIONS
EDISON CHOUEST OFFSHORE SHELL
360'x80'x34' A3 ICE ANCHOR HANDLING TUG SUPPLY VESSEL
GENERAL ARRANGEMENT
360 IAHTS

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Attachment 3 – Shell Ice and Weather Advisory Center

Operational Support Overview

Safe and efficient offshore operations in the Arctic are contingent upon quality and timely ice and weather forecasts. Using state-of-the art satellite technology, large areas of the Beaufort and Chukchi Seas are monitored remotely by the SIWAC to track and forecast movement of ice and make estimates of ice type and concentration.

Synthetic Aperture Radar (SAR) instruments on board the RADARSAT 2 satellite are contracted to acquire necessary images of sea ice over areas of interest several times per week. These images are transmitted to ground stations, processed, and made available for analysis within hours of acquisition. Interpretation of the ice edge and features are performed by experienced specialists using powerful mapping software to produce ice charts that are considerably more detailed than those available from national ice centers. These charts are then distributed to operational personnel and planning managers.

Knowing the location and composition of the ice at any given moment is a valuable tool. However, It is important to forecast how the ice may change over time. A complementary component of ice forecasting is quality weather information. Weather conditions in the Arctic are among the most severe on the planet and can change dramatically over a short time. The National Weather Service does not provide measurements and forecasts that sufficiently resolve the conditions over small areas or short time spans in the Arctic offshore. Therefore, dedicated meteorologists with Arctic forecasting experience are employed full time to produce accurate snapshots of the current conditions and reliable forecasts of weather conditions into the future.

Using the Global Forecast System (GFS) numerical weather model as a starting point, the meteorologists produce a high resolution grid in proprietary modeling software of weather parameters, such as atmospheric pressure, wind speed, and wave height that have been corrected based on local observations and weather instrumentation from Shell's vessels at sea, meteorological buoys, and coastal weather stations. The result is a model that accurately reflects current and forecast weather conditions over short distances in the Beaufort and Chukchi Seas, making marine operations and vessel transits safer and more responsible. Without this innovative forecast effort, weather products from other sources tend to describe the average or general conditions that one could expect over large areas, such as the entire U.S. Beaufort Sea, which results in reports of local conditions rarely matching what is forecast for the specific areas of operations.

The wind vectors, a set of points indicating the speed and direction of the wind distributed over the Beaufort and Chukchi Seas, and other output from the weather model are applied to the ice charts in the mapping software. This allows the ice analyst to assess the effect of wind and weather systems on the future movement and development of the ice.

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Attachment 4 – Well suspension Options and Contingencies

In all the following well suspension scenarios, the assumption is that a determination has been made by the Shell Drilling Superintendent, the Shell Drilling Foreman, the Drilling Superintendent, the Drilling Vessel Master and the VMT that a hazard exists and the well should be suspended. The Shell Drilling Foreman and the Drilling Superintendent in conjunction with the Shell Drilling Engineer and the Shell Drilling Superintendent will have analyzed the trip time, borehole stability, well control issues, operational parameters, depth of hole, and time available to decide upon the contingency steps most appropriate for well securement, and a detailed procedure will have been worked up. The Shell Drilling Foreman then presents the procedure to the BOEMRE Field Representative aboard the drilling vessel for comment and concurrence.

Well Suspension Scenario 1 – Mechanical Plugging

1. After determining that the well should be suspended under the assumptions described above, the Shell Drilling Foreman orders the Drilling Superintendent to stop all normal drilling operations and to commence circulating the hole.
2. The driller completes circulating at minimum a full "bottoms up."
3. The drilling assembly is pulled out of the hole and a mechanical packer suitable to the last casing or liner size is made up on the bottom of the drill string.
4. The packer is tripped in the hole, set approximately 200 ft above the last casing or liner shoe depth and pressure tested.
5. Depending on actual water depth, sufficient pipe is pulled to enable having the end of the string 200 ft above the top of the packer when hung off in the wellhead via the hang-off sub (HOS).
6. A full-opening safety valve and an inside blowout preventer (BOP) are made up in the top of the drill pipe, and one additional joint is added above these valves. The HOS is installed in the top of this joint. (The full opening safety valve is left in the *open* position.)
7. The HOS assembly is run in the hole on drill pipe to land the HOS in the wellhead bowl.
8. The proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Subsea Engineer and the system operating pressure is checked. Pipe rams in the BOP are closed on the HOS profile. The drill pipe is backed out from the HOS and the landing string is pulled from the riser. The blind/shear rams are closed and locked above the HOS. BOP failsafe valves are all left in the closed position.
9. The master bushings are removed and the riser spider is installed.
10. The diverter handling tool is made up and the diverter assembly is laid down.
11. The riser landing joint is made up into the slip joint inner barrel. The slip joint inner barrel is collapsed and the inner barrel is locked.
12. BOP stack functions are blocked, and the LMRP connector is unlocked.

13. The LMRP is pulled off the top of the BOP with the block motion compensator and riser tensioners.
14. Once the Shell Drilling Foreman has ascertained that the LMRP is released from the BOP, he advises the Drilling Vessel Master that he is free to initiate (or continue) mooring recovery and departure procedures.
15. The drill crew and Subsea Engineer pull the landing joint to surface. The landing joint, slip joint and riser are then layed down and the LMRP is secured on deck.
16. The Drilling Vessel Master confirms with the IA that the Ice Alert Level has reached "red" status (ice hazard is due to arrive within 6 hours of completing anticipated mooring recovery time). The Drilling Vessel Master advises the Drilling Superintendent to have the Subsea Engineer shear guidelines loose from the top of the BOP guideposts and to retrieve the lines to surface.
17. The drill floor and moonpool area are cleared and inspected in preparation for mobilizing the drilling vessel.
18. All decisions and supporting facts are recorded on the Daily Report and issued to the BOEMRE, SIWAC, and the normal distribution list.

Well Suspension Scenario 2 – Drillpipe Hang-off

1. After determining that the well should be suspended, the Shell Drilling Foreman orders the Drilling Superintendent to stop all normal drilling operations and to commence circulating the hole.
2. The driller completes circulating at minimum a full "bottoms up."
3. A pill of heavy, kill-weight drilling mud is mixed and spotted at total depth (TD), then the rig pulls the bottomhole assembly back into the casing such that the bit will be at least 200 ft above the shoe when the pipe has been hung off on the BOP rams.
4. After pulling the proper distance into the casing, a full-opening safety valve and an inside BOP are made up in the top of the drillpipe. (The full opening safety valve is left in the *open* position.) One additional joint of drillpipe is added above these valves and all connections made up properly.
5. Drill pipe is added to the top of the single, but the connection at the hang-off point is not fully tightened.
6. The drill string is lowered back into the well with the loose connection positioned just above a pipe ram.
7. The proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Drilling Superintendent and the system operating pressure is checked. Pipe rams in the BOP just below the loose drill pipe connection are closed. The drill string is lowered until all string weight is resting on the closed pipe ram. The loose connection is backed off and the remaining drill pipe is pulled from the riser. The blind/shear rams are closed and locked above the backed off drill pipe. BOP failsafe valves are all left in the closed position.
8. Proceed with steps 9 through 18 as indicated in Scenario 1 above.

Well Suspension Scenario 3 – Pull Out of Hole:

It is assumed the wellbore is isolated from the formation (i.e., a casing string has been run and cemented, but not yet drilled out). A drilling assembly has been run in the hole to the top of cement.

1. After determining that the well should be suspended, the Shell Drilling Foreman orders the Drilling Superintendent to pull out of the hole.
2. After pulling out of the hole, the proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Drilling Superintendent and the system operating pressure is checked.
3. The blind/shear rams are closed and locked. BOP fail-safe valves are left in the *closed* position.
4. Proceed with steps 9 through 18 as indicated in scenarios 1 and 2 above.

Well Suspension Scenario 4 – Shearing Drill Pipe

It is assumed the drill string is stuck and unable to be pulled from the hole.

1. After determining that the well should be suspended, the Shell Drilling Foreman orders the Drilling Superintendent to circulate at minimum a full "bottoms up" (assuming circulation is possible).
2. While circulating, the Drilling Superintendent and the Toolpusher calculate the location of the drill string tool joints below the rotary.
3. Once circulation is completed the proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Drilling Superintendent and the system operating pressure is checked.
4. Pipe rams are closed under the nearest connection.
5. The drill string is slacked down until all string weight is resting on the closed ram or the string weight has been transferred to the point at which pipe is stuck.
6. The blind/shear rams are closed, shearing the drill string above the hang-off point. The blind/shear rams are locked closed. BOP fail-safe valves are left in the *closed* position.
7. The cut section of drill string is pulled to surface.
8. Proceed with steps 9 through 18 as indicated in scenarios 1 and 2 above.

Well Suspension Scenario 5 – Dropping String

It is assumed that there has been a failure to the rig's hoisting capability; for example, failure of the drawworks to be able to pick up or position the string by lifting, and an approaching hazard has been identified. (Dropping the string is normally associated with being unable to shear the pipe across the shear rams, whether it is in the form of drill collars or heavywall casing, etc., and comes into play more often with a dynamically positioned vessel in a "drive off" situation.) Under most all circumstances with encroaching ice (barring mechanical failure), there is adequate time to trip drill collars out of the hole if across the stack or to install a crossover and run casing past the stack on drill pipe and then utilize a conventional hang-off tool.)

1. After determining that the well should be suspended and the string dropped because of a mechanical failure, the Shell Drilling Foreman orders the Drilling Superintendent to circulate at minimum a full bottoms up (if circulation is possible).
2. Once circulation is completed the proper hydraulic fluid volume to actuate the BOP annulars is confirmed by the Drilling Superintendent and the system operating pressure is checked.
3. Operating pressure for both annulars is increased to maximum, and both annulars are closed.
4. The string is slacked down until all string weight is supported by the closed annular elements.
5. Elevators are unlatched.
6. Opening pressure is applied to the annulars, releasing their hold upon the string and allowing it to fall downhole.
7. The blind/shear rams are closed and locked. BOP failsafe valves are left in the closed position.
8. At this point, the BOP stack functions are blocked, and the LMRP connector is unlocked. The LMRP is pulled off the top of the BOP with the riser tensioners alone, allowing it to clear the BOP sufficiently to enable moving off location.
9. Note that in this circumstance the LMRP is left hanging until the hoisting capabilities of the rig have been restored. Movement off location will thus have to take water depth into consideration and clearance between the bottom of the LMRP and the seabed.
10. Once hoisting capabilities have been restored, proceed beginning with step 9 in the scenarios above to get the diverter and slip joint layed down and the LMRP secured on deck.

Attachment C
Marine Mammal Monitoring and Mitigation Plan (4MP)

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MARINE MAMMAL MONITORING AND MITIGATION PLAN

for

Exploration Drilling of Selected Lease Areas in Camden Bay in the Alaskan Beaufort Sea in 2012

Shell Offshore Inc.

May 2011
Revised August 2011

TABLE OF CONTENTS

Tables

Figures

<u>Addendum</u>

ACRONYMS

~	approximately
°	degree
°C	degrees Celsius
°T	degrees True North
4MP	Marine Mammal Monitoring and Mitigation Plan
μPa	micropascal
ADF&G	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
CDs	compact discs
cm^3	cubic centimeters
Com Center	Communications and Call Centers
COPAC	Coastal and Offshore Pacific Corporation
DASAR	Directional Autonomous Seafloor Acoustic Recorder
dB	decibel(s)
Discoverer	Motor Vessel *Noble Discoverer*
GPS	Global Positioning System
ft	feet
ft^2	square feet
hr	hour
Hz	Hertz
IHA	Incidental Harassment Authorization
in^3	cubic inches
kHz	kilohertz
km	kilometer(s)
km^2	kilometers squared
km/hr	kilometers per hour
lb	pounds
Leq	noise equivalent level
LGL	LGL Alaska Research Associates, Inc.
LOA	Letter of Authorization
m	meter(s)
m^2	square meters
mi	mile(s)
MMPA	Marine Mammal Protection Act
MMO	Marine Mammal Observer
MMS	Minerals Management Service
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NSB	North Slope Borough
NVD	night-vision device
psi	pounds per square inch
rms	root mean square
Shell	Shell Offshore Inc.
Twin Otter	DeHavilland Twin Otter
USFWS	U.S. Fish and Wildlife Service
VSI	Vertical Seismic Imager
VSP	vertical seismic profile
ZVSP	zero-offset vertical seismic profile

INTRODUCTION

Shell Offshore Inc. (Shell) submits the following Marine Mammal Monitoring and Mitigation Program (4MP) for exploration drilling activities in Camden Bay in the Beaufort Sea during the 2012 open-water season. The 4MP developed for Shell's exploration drilling program is designed to protect the marine mammal resources in the area, fulfill reporting obligations to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS), and establish a means for gathering additional data on marine mammals for future operations planning.

Shell plans to conduct exploration drilling within existing lease holdings in Camden Bay of the Beaufort Sea. One drilling vessel, either the conical drilling unit *Kulluk* (*Kulluk*) owned by Shell, or the drillship Motor Vessel (*M/V) Noble Discoverer* (*Discoverer*) owned and operated by Noble Drilling will be used in the Beaufort Sea during the 2012 exploration drilling activities, but not both. The *Kulluk* is an ice-class drilling platform designed, engineered and constructed to safely operate in the Arctic. The *Discoverer* is an ice-class drillship also designed, engineered and constructed to safely operate in the Arctic. In addition to the drilling equipment, several support vessels will be used. The support vessels will include tugs and barges, a primary ice management vessel, an anchor handler/ice management vessel, resupply vessels, and oil spill response vessels.

At the completion of each well a zero-offset vertical seismic profile (ZVSP) likely will be conducted. During ZVSP surveys, an airgun array is deployed adjacent to the drillship, while receivers are placed (temporarily anchored) in the wellbore. The sound source (airgun array) is fired repeatedly, and the reflected sonic waves are recorded by receivers (geophones) located in the wellbore. The survey will last 10-14 hours as the receivers are moved through the length of the wellbore and the airguns are fired 5-7 times after each movement. The purpose of the ZVSP is to gather geophysical information at various depths, which can then be used to tie-in or ground-truth geophysical information from the previous seismic surveys with geological data collected within the wellbore.

Shell's 4MP is a combination of active monitoring of the area of operations and the implementation of mitigation measures designed to minimize project impacts to marine resources. Monitoring will provide information on the numbers of marine mammals potentially affected by the exploration operations and facilitate real time mitigation to prevent injury of marine mammals by industrial sounds or activities. These goals will be accomplished by conducting vessel-based, aerial, and acoustic monitoring programs to document the potential reactions of marine mammals in the area to the various sounds and activities and to characterize the sounds produced by the exploration drilling activities, support vessels, and ZVSP.

Monitoring during exploration drilling activity and periods when exploration drilling activity is not occurring will provide information on the numbers of marine mammals potentially affected by the exploration operations and facilitate real time mitigation to prevent impacts to marine mammals by industrial sounds or activities. Vessel-based marine mammal observers (MMOs) onboard the *Kulluk* or *Discoverer* and all support vessels will record the numbers and species of marine mammals observed in the exploration area and any observable reaction of marine mammals to the exploratory activities. Aerial monitoring, designed primarily for detecting cetaceans, will be used to identify any large scale distributional changes of cetaceans relative to the activities and add to the existing database on the abundance and distribution of observed species. The acoustic program will characterize the sounds produced by the exploration drilling activities and support vessels, and document the potential reactions of marine mammals in the area, particularly bowhead whales, to those sounds and activities.

VESSEL-BASED MARINE MAMMAL MONITORING PROGRAM

Introduction

The vessel-based operations of Shell's 4MP are designed to meet the requirements of the Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA) requested from NMFS and USFWS, respectively, for this project, and to meet any other stipulated agreements between Shell and other agencies or groups. The objectives of the program will be:

- to ensure that disturbance to marine mammals and subsistence hunts is minimized and all permit stipulations are followed;
- to document the effects of the proposed exploratory activities on marine mammals; and
- to collect data on the occurrence and distribution of marine mammals in the study area.

The 4MP will be implemented by a team of experienced MMOs, including both biologists and Inupiat personnel. MMOs will be stationed aboard the *Kulluk* or *Discoverer* and associated support vessels throughout the exploration drilling period. Reporting of the results of the vessel-based monitoring program will include the estimation of the number of "takes" as stipulated in the IHA and LOA.

The vessel-based portion of Shell's 4MP will be required to support the exploration drilling activities in the eastern Alaskan Beaufort Sea. The dates and operating areas will depend upon ice and weather conditions, along with Shell's arrangements with agencies and stakeholders. Exploration drilling activities are expected to begin July 10 through October 31, 2012. Vessel-based monitoring for marine mammals will begin 5–7 days before exploration drilling begins (i.e. anchors are deployed); will continue throughout the period of exploration drilling operations, and will cease 5-7 days after exploration drilling stops (i.e. anchors are pulled) to comply with anticipated provisions in the IHA and LOA that Shell expects to receive from NMFS and USFWS.

The vessel-based work will provide:

- the basis for real-time mitigation, if necessary, as required by the various permits that Shell receives;
- information needed to estimate the number of "takes" of marine mammals by harassment, which must be reported to NMFS and USFWS;
- data on the occurrence, distribution, and activities of marine mammals in the areas where the exploration drilling program is conducted;
- information to compare the distances, distributions, behavior, and movements of marine mammals relative to the *Kulluk* or *Discoverer* at times with and without exploration drilling activity;

- a communication channel to coastal communities including Inupiat whalers; and
- employment and capacity building for local residents, with one objective being to develop a larger pool of experienced Inupiat MMOs.

The 4MP will be operated and administered consistent with monitoring programs conducted during seismic and shallow hazards surveys in 2006–2010 or such alternative requirements as may be specified in the IHA and LOA received from NMFS and USFWS, respectively for this project. Any other stipulated agreements between Shell and agencies or groups such as BOEMRE, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC) will also be fully incorporated. All MMOs will be provided training through a program approved by NMFS, USFWS (if so stipulated) and Shell, as described later. At least one observer on each vessel will be an Inupiat who will have the additional responsibility of communicating with coastal communities and directly with Inupiat whalers during the whaling season. Details of the vessel-based marine mammal monitoring program are described below.

Mitigation Measures During Exploration Drilling Activities and Zero-Offset Vertical Seismic Profile Surveys

Shell's planned offshore exploration drilling program incorporates both design features and operational procedures for minimizing potential impacts on marine mammals and on subsistence hunts. The design features and operational procedures of the mitigation measures have been described in the IHA (Section 12 of the IHA application to which this 4MP is appended) and LOA applications submitted to NMFS and USFWS respectively, and are not repeated in entirety here. Survey design features include:

- timing and locating some exploration drilling and support activities to avoid interference with the annual fall bowhead whale hunts from Kaktovik, Nuiqsut (Cross Island), and Barrow;
- identifying transit routes and timing to avoid other subsistence use areas and communicate with coastal communities before operating in or passing through these areas;
- conducting pre-season sound propagation modeling to establish the appropriate safety and behavioral radii;
- vessel-based monitoring to implement appropriate mitigation if necessary, and to determine the effects of project activities on marine mammals;
- acoustic monitoring of the Kulluk and vessel sounds and marine mammal vocalizations; and
- seismic activity mitigation measures during performance of ZVSP surveys.

The potential disturbance of marine mammals during operations will be minimized further through the implementation of several vessel-based mitigation measures (see Section 12 of the IHA application to which this 4MP is appended) if mitigation becomes necessary.

Safety and Disturbance Zones

Under current NMFS guidelines (e.g., NMFS 2000), "safety radii" for marine mammals around industrial sound sources are customarily defined as the distances within which received sound levels are ≥180 decibels (dB) re 1 micropascal (μPa) root mean square (rms) for cetaceans and ≥190 dB re 1 μPa rms for pinnipeds. These safety criteria are based on an assumption that sound energy received at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels might have some such effects. Disturbance or behavioral effects to marine mammals from underwater sound may occur after exposure to sound at distances greater than the safety radii (Richardson et al. 1995). NMFS assumes that marine mammals exposed to underwater impulsive sounds at received levels ≥160 dB rms have the potential to exhibit behavioral reactions great enough to meet the definition of "harassment" in the Marine Mammal Protection Act (MMPA). For continuous sounds NMFS has established a similar disturbance threshold at ≥120 dB rms.

Exploration Drilling Activities

Initial safety and behavioral radii for the sound levels produced by the exploration drilling activities have been modeled. These radii will be used for mitigation purposes should they be necessary until direct measurements are available early during the exploration activities.

Sounds from the *Kulluk* have previously been measured in the Beaufort Sea (Greene 1987, Miles et al. 1987). The back-propagated source level estimated by Greene (1987) from these measurements was 185 dB re 1 μPa at 1 meter (m). These measurements were used as a proxy for modeling the sounds likely to be produced by exploration drilling activities from the *Kulluk*. Based on the models, source levels from exploration drilling are expected to fall below 180 dB rms approximately (~)43 ft (13 m) from the *Kulluk*. The 160 dB rms radius would extend ~180 ft (55 m) from the *Kulluk* and the 120 dB rms radius would be expected to be ~8 mi (~13 kilometer [km]) from the *Kulluk*.

Sounds from the *Discoverer* have not previously been measured in the Arctic. However, measurements of sounds produced by the *Discoverer* were made in the South China Sea in 2009 (Austin and Warner 2010). The results of those measurements were used to model the sound propagation from the *Discoverer* (including a nearby support vessel) at planned drilling locations in the Chukchi and Beaufort seas (Warner and Hannay 2011). Broadband source levels of sounds produced by the *Discoverer* varied by activity and direction from the ship, but were generally between 177 and 185 dB re 1 μPa at 1 m rms (Austin and Warner 2010). Propagation modeling at the Sivulliq and Torpedo prospects yielded somewhat different results, with sounds expected to propagate shorter distances at the Sivulliq site (Warner and Hannay 2011). As a precautionary approach, the larger distance to which sounds ≥120 dB (2.06 mi [3.32 km]) are expected to propagate at the Torpedo site have been used to estimate the area of water potentially exposed at both locations. The estimated 2.06 mi (3.32 km) distance was multiplied by 1.5 (= 3.09 mi [4.98 km]) as a further precautionary measure before calculating the total area that may be exposed to continuous sounds ≥120 dB re 1 μPa rms by the *Discoverer* at each drill site. Assuming one well will be drilled in each season (summer and fall), the total area of water ensonified to ≥120 dB rms in each season would be 30 mi^2 (78 square kilometers [km^2]). As noted above, broadband source levels from the *Discoverer* generally were close to 180 dB rms (Austin and Warner 2010). As a result, the distances to which sounds ≥160 dB rms are expected to propagate are estimated to be less than 33 ft (10 m) from the vessel and were not included in modeling results.

The source levels noted above for exploration drilling and support vessel activities are not high enough to cause a temporary reduction in hearing sensitivity or permanent hearing damage to marine mammals. Consequently, mitigation as described for seismic activities including ramp ups, power downs, and shut downs should not be necessary for exploration drilling activities, but will be employed during the ZVSP survey described below. Shell plans to use MMOs onboard the *Kulluk* or *Discoverer* and the various support vessels to monitor marine mammals and their responses to industry activities and to initiate mitigation measures should in-field measurements of the operations indicate conditions represent a threat to the health and well-being of marine mammals.

ZVSP Surveys

The sound source to be used by Shell for the ZVSP survey in 2012 is the ITAGA eight-airgun array, which consists of four 150 cubic inches (in^3) (2,458 cubic meters [cm^3]) airguns and four 40 in^3 (655 cm^3) airguns. These airguns can be activated in any combination and Shell would utilize the minimum airgun volume required to obtain an acceptable signal. A similar airgun source was used in the region in 2008 during the BP Liberty seismic survey. Preseason estimates of the propagation of airgun sounds from the ITAGA vertical seismic profiler (VSP) sound source have been estimated based on the measurements of the seismic source reported in BP's 90-day report (Aerts et al. 2008). The BP liberty source was also an eight-airgun array, but had a slightly larger total volume of 880 in^3 (14,421 cm^3). Because the number of airguns is the same, and the difference in total volume only results in an estimated 0.4 dB decrease in the source level of the ZVSP source, the 100th percentile propagation model from the measurements of the BP Liberty source is almost directly applicable. However, the BP Liberty source was towed at a depth of 5.9 ft (1.8 m), while the ZVSP source will be lowered to a target depth of 13 ft (4 m) (from 10-23 ft [3-7 m]). The lower depth of the ZVSP source has the potential to increase the source strength by as much as 6 dB. Thus, the constant term in the propagation equation from the BP Liberty source has been increased from 235.4 to 241.4 while the remainder of the equation (-18*LogR – 0.0047*R) has been left unchanged. This equation results in the following estimated distances to maximum received levels: 190 dB = 1,719 ft (524 m); 180 dB = 4,068 ft (1,240 m); 160 dB = 12,041 ft (3,670 m); 120 dB = 34,449 ft (10,500 m).

MMOs on the *Kulluk* or *Discoverer* will initially use these estimated safety radii for monitoring and mitigation purposes. An acoustics contractor will perform direct measurements of the received levels of underwater sound versus distance and direction from the ZVSP array using calibrated hydrophones. The acoustic data will be analyzed as quickly as reasonably practicable (within 5 days) in the field and used to verify (and if necessary adjust) the safety distances. The mitigation measures to be implemented will include pre-ramp up watches, ramp ups, power downs and shut downs as described below.

Ramp Ups

A ramp up of an airgun array provides a gradual increase in sound levels, and involves a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The purpose of a ramp up (or "soft start") is to "warn" cetaceans and pinnipeds in the vicinity of the airguns and to provide the time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

During the proposed ZVSP surveys, the operator will ramp up the airgun arrays slowly. Full ramp ups (i.e., from a cold start when no airguns have been firing) will begin by firing a single airgun in the array. A full ramp up will not begin until there has been a minimum of 30 minutes of observation of the safety zone by MMOs to assure that no marine mammals are present. The entire safety zone must be visible during the 30-minutes lead-in to a full ramp up. If the entire safety zone is not visible, then ramp up from a cold start cannot begin. If a marine mammal(s) is sighted within the safety zone during the 30-minutes watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15-30 minutes: 15 minutes for small odontocetes and pinnipeds, or 30 minutes for baleen whales and large odontocetes.

Power Downs and Shut Downs

A power down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shut down is the immediate cessation of firing of all energy sources. The arrays will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable safety zone of the full arrays, but is outside the applicable safety zone of the single source. If a marine mammal is sighted within the applicable safety zone of the single energy source, the entire array will be shut down (i.e., no sources firing).

Marine Mammal Observers

Vessel-based monitoring for marine mammals will be done by trained MMOs throughout the period of exploration drilling operations to comply with expected provisions in the IHA and LOA that Shell receives. The observers will monitor the occurrence and behavior of marine mammals near the *Kulluk* or *Discoverer* during all daylight periods during operation, and during most daylight periods when exploration drilling operations are not occurring. MMO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the exploration drilling operations; and documenting "take by harassment" as defined by NMFS.

Number of Observers

A sufficient number of MMOs will be required onboard each vessel to meet the following criteria:

- 100% monitoring coverage during all periods of exploration drilling operations in daylight;
- maximum of 4 consecutive hours on watch per MMO; and
- maximum of ~12 hours of watch time per day per MMO.

MMO teams will consist of Inupiat observers and experienced field biologists. An experienced field crew leader and an Inupiat observer will be members of every MMO team onboard the *Kulluk* or *Discoverer* and each support vessel during the exploration drilling program. The total number of MMOs may decrease later in the season as the duration of daylight decreases assuming NMFS does not require continuous nighttime monitoring. Inupiat MMOs will also function as Native language communicators with hunters and whaling crews and with the Communications and Call Centers (Com Centers) in Native villages along the Beaufort Sea coast.

Crew Rotation

Shell anticipates that there will be provision for crew rotation at least every three to six weeks to avoid observer fatigue. During crew rotations detailed hand-over notes will be provided to in incoming crew leader by the outgoing leader. Other communications such as email, fax, and/or phone communication between the current and oncoming crew leaders during each rotation will also occur when possible. In the event of an unexpected crew change Shell will facilitate such communications to insure monitoring consistency among shifts.

Observer Qualifications and Training

Crew leaders and most other biologists serving as observers in 2012 will be individuals with experience as observers during one or more of the 1996-2010 seismic or shallow hazards monitoring projects in Alaska, the Canadian Beaufort, or other offshore areas in recent years.

Biologist-observers will have previous marine mammal observation experience, and field crew leaders will be highly experienced with previous vessel-based marine mammal monitoring projects. Resumés for those individuals will be provided to NMFS so that NMFS (and USFWS if so stipulated) can review and accept their qualifications. Inupiat observers will be experienced in the region, familiar with the marine mammals of the area, and complete a NMFS approved (and USFWS if so stipulated) observer training course designed to familiarize individuals with monitoring and data collection procedures. A MMO handbook, adapted for the specifics of the planned Shell exploration drilling program, will be prepared and distributed beforehand to all MMOs (see below).

Most observers, including Inupiat observers, will also complete a two-day training and refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2012 drilling season. Any exceptions will have or receive equivalent experience or training. The training session(s) will be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based seismic monitoring programs.

Primary objectives of the training include:

- review of the 4MP for this project, including any amendments specified by NMFS or USFWS in the IHA or LOA, by BOEMRE, or by other agreements in which Shell may elect to participate;
- review of marine mammal sighting, identification (photographs and videos), and distance estimation methods including any amendments specified by NMFS or USFWS in the 2012 IHA or LOA;
- review of operation of specialized equipment (reticle binoculars, night vision devices, and GPS system);
- review of, and classroom practice with, data recording and data entry systems, including procedures for recording data on mammal sightings, monitoring operations, environmental conditions, and entry error control. These procedures will be implemented through use of a customized computer database and laptop computers; and

- review of the specific tasks of the Inupiat Communicator.

MMO Handbook

A MMO Handbook will be prepared for Shell's monitoring program. The handbook will contain maps, illustrations, and photographs, as well as copies of important documents, and descriptive text intended to provide guidance and reference information to trained MMOs. The following topics will be covered in the MMO Handbook for the Shell project:

- summary overview description of the project, marine mammals and underwater noise, the 4MP (vessel-based, aerial, acoustic measurements, special studies), the NMFS IHA and USFWS LOA and other regulations/permits/agencies, the MMPA;
- monitoring and mitigation objectives and procedures, initial safety radii;
- responsibilities of staff and crew regarding the 4MP;
- instructions for ship crew regarding the 4MP;
- data recording procedures: codes and coding instructions, common coding mistakes, electronic database; navigational, marine physical, field data sheet;
- use of specialized field equipment (reticle binoculars, night-vision devices (NVDs), laser rangefinders);
- reticle binocular distance scale;
- table of wind speed, Beaufort wind force, and sea state codes;
- data storage and backup procedures;
- list of species that might be encountered: identification, natural history;
- safety precautions while onboard;
- crew and/or personnel discord; conflict resolution among MMOs and crew;
- drug and alcohol policy and testing;
- scheduling of cruises and watches;
- communications;
- list of field gear that will be provided;
- suggested list of personal items to pack;
- suggested literature, or literature cited; and
- copies of the NMFS IHA and USFWS LOA when available.

Monitoring Methodology

The observer(s) will watch for marine mammals from the best available vantage point on the *Kulluk* or *Discoverer* and support vessels. Ideally this vantage point is an elevated stable platform from which the MMO has an unobstructed 360 degree (^{o}) view of the water. The observer(s) will scan systematically with the unaided eye and 7×50 reticle binoculars, supplemented with 20 x 60 image-stabilized Zeiss Binoculars or Fujinon 25 x 150 "Big-eye" binoculars and night-vision equipment when needed (see below). Personnel on the bridge will assist the MMOs in watching for marine mammals. New or inexperienced MMOs will be paired with an experienced MMO or experienced field biologist so that the quality of marine mammal observations and data recording is kept consistent.

Information to be recorded by MMOs will include the same types of information that were recorded during recent monitoring programs associated with Industry activity in the Arctic (e.g. Ireland et al. 2009). When a mammal sighting is made, the following information about the sighting will be carefully and accurately recorded:

- Species, group size, age/size/sex categories (if determinable);
- Physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- Behavior when first sighted and after initial sighting, heading (if consistent);
- Bearing and distance from observer, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;
- Time, location, speed, and activity of the vessel, sea state, ice cover, visibility, and sun glare; and
- The positions of other vessel(s) in the vicinity of the observer location.

The drilling vessel, or vessel's position, speed of support vessels, and water temperature, 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 minute during a watch, and whenever there is a change in any of those variables.

Distances to nearby marine mammals will be estimated with binoculars (Fujinon 7×50 binoculars) containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon.

Observers may use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water. However, previous experience showed that a Class 1 eye-safe device was not able to measure distances to seals more than about 230 feet (ft) (70 meters [m]) away. The device was very useful in improving the distance estimation abilities of the observers at distances up to about 1,968 ft (600 m)—the maximum range at which the device could measure distances to highly reflective objects such as other vessels. Humans observing objects of more-or-less known size via a standard observation protocol, in this case from a standard height above water, quickly become able to estimate distances within about ±20% when given immediate feedback about actual distances during training.

Monitoring At Night and In Poor Visibility

Night-vision equipment ("Generation 3" binocular image intensifiers, or equivalent units) will be available for use when/if needed. Past experience with NVDs in the Beaufort Sea and elsewhere has indicated that NVDs are not nearly as effective as visual observation during daylight hours (e.g., Harris et al. 1997, 1998; Moulton and Lawson 2002).

Specialized Field Equipment

Shell will provide or arrange for the following specialized field equipment for use by the onboard MMOs: reticle binoculars, Big-eye binoculars, global positioning system (GPS) unit, laptop computers, night vision binoculars, and possibly digital still and digital video cameras.

Field Data-Recording, Verification, Handling, and Security

The observers on the *Kulluk* or *Discoverer* and support vessels will record their observations onto datasheets or directly into handheld computers. During periods between watches and periods when operations are suspended, those data will be entered into a laptop computer running a custom computer database. The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered, and by subsequent manual checking of the database printouts. These procedures will allow initial summaries of data to be prepared during and shortly after the field season, and will facilitate transfer of the data to statistical, graphical or other programs for further processing. Quality control of the data will be facilitated by (1) the start-of-season training session, (2) subsequent supervision by the onboard field crew leader, and (3) ongoing data checks during the field season.

The data will be backed up regularly onto compact disks (CDs) and/or USB disks, and stored at separate locations on the vessel. If possible, data sheets will be photocopied daily during the field season. Data will be secured further by having data sheets and backup data CDs carried back to the Anchorage office during crew rotations.

Both Inupiat and trained-biologist observers will be encouraged to record comments about their observations into the “comment” field in the marine mammal sightings database. Observer training will emphasize the use of “comments” for sightings that may be considered unique or not fully captured by standard data codes.

In addition to the standard marine mammal sightings forms, a specialized form was developed for recording traditional knowledge and natural history observations. MMOs will be encouraged to use this form to capture observations related to any aspect of the arctic environment and the marine mammals found within it. Examples might include relationships between ice and marine mammal sightings, marine mammal behaviors, comparisons of observations among different years/seasons, etc. Copies of these records will be available to all observers for reference if they wish to prepare a statement about their observations for reporting purposes. If prepared, this statement would be included in the 90-day and final reports documenting the monitoring work.

Field Reports

Throughout the exploration drilling program, the observers will prepare a report each day or at such other interval as the IHA, LOA, or Shell may require summarizing the recent results of the monitoring program. The reports will summarize the species and numbers of marine mammals sighted. These reports will be provided to NMFS, USFWS, BOEMRE and Shell as required.

Reporting

The results of the 2012 vessel-based monitoring, including estimates of "take by harassment", will be presented in the 90-day and final technical report(s). Reporting will address the requirements established by NMFS in the IHA, and USFWS in the LOA (if so stipulated).

The technical report(s) will include:

- summaries of monitoring effort: total hours, total distances, and distribution of marine mammals 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 including sea state, number of observers, and fog/glare;
- species composition, occurrence, and distribution of marine mammal sightings including date, water depth, numbers, age/size/gender categories (when discernable), group sizes, and ice cover;
- analyses of the effects of exploration drilling operations:
  - sighting rates of marine mammals during periods with and without exploration drilling activities (and other variables that could affect detectability);
  - initial sighting distances versus drilling state;
  - closest point of approach versus drilling state;
  - observed behaviors and types of movements versus drilling state;
  - numbers of sightings/individuals seen versus drilling state;
  - distribution around the drillship and support vessels versus drilling state;
  - estimates of "take by harassment".

Shell will consider requests for data collected during the marine mammal monitoring only after the data have been put through a quality control/quality assurance program. Such requests may include incorporating the data with other companies' data and/or integrating the raw data with data from other marine mammal studies.

AERIAL SURVEY PROGRAM

Objectives

An aerial survey program will be conducted in support of the exploration drilling program in the Beaufort Sea during the summer and fall of 2012. The exploration drilling program may start in the Beaufort Sea as early as 10 July 2012. The objectives of the aerial survey will be:

- to advise operating vessels as to the presence of marine mammals (primarily cetaceans) in the general area of operation;
- to collect and report data on the distribution, numbers, movement and behavior of marine mammals near the exploration drilling operations with special emphasis on migrating bowhead whales;

- to support regulatory reporting related to the estimation of impacts of exploration drilling operations on marine mammals;
- to investigate potential deflection of bowhead whales during migration by documenting how far east of exploration drilling operations a deflection may occur, and where whales return to normal migration patterns west of the operations; and
- to monitor the accessibility of bowhead whales to Inupiat hunters.

Safety

Safety will be of primary importance in all decisions regarding the planning and conduct of the aerial surveys. Safety-related considerations during planning have included choice of aircraft, aircraft operator, and pilots; outfitting of the aircraft; lengths and locations of survey grids; and safety training. Safety during aerial survey operations will include careful and judicious consideration of weather and avoidance of flight in questionable conditions. Although the pilots will have ultimate authority, the aerial survey crew will also be required to make their own judgments and to avoid flying in questionable circumstances. To this end, the aerial survey teams will have a crew leader with experience conducting this type of survey in arctic conditions, and will have the authority to cancel or (in agreement with the pilots) amend flight operations as necessary for safety.

Selection of Aircraft

Specially-outfitted deHavilland Twin Otter (Twin Otter) aircraft are expected to be the survey aircraft and have an excellent safety record. These aircraft will be specially modified for survey work and have been used extensively by NMFS, Alaska Department of Fish and Game (ADF&G), Coastal and Offshore Pacific Corporation (COPAC), NSB, and LGL during many marine mammal projects in Alaska, including Industry funded projects as recent as the 2006–2008, and 2010 seasons. The aircraft will be provided with a comprehensive set of survival equipment appropriate to offshore surveys in the Arctic. For safety reasons, the aircraft will be operated with two pilots.

Survey Procedures

Flight and Observation Procedures

Aerial survey flights will begin 5 to 7 days before operations at the exploration well sites get underway. Surveys will be flown daily throughout exploration drilling operations, weather and flight conditions permitting, and continued for 5 to 7 days after all activities at the site have ended.

The aerial survey procedures will be generally consistent with those used during earlier industry studies (Davis et al. 1985; Johnson et al. 1986; Evans et al. 1987; Miller et al. 1997, 1998, 1999, 2002; Patterson 2007). This will facilitate comparison and pooling of data where appropriate. However, the specific survey grids will be tailored to Shell's operations. During the 2012 drilling season Shell will coordinate and cooperate with the aerial surveys conducted by BOEMRE/NMFS and any other groups conducting surveys in the same region.

It is understood that the timing, duration, and location (between identified well sites) of Shell's exploration drilling operations are subject to change as a result of unpredictable weather and ice conditions, as well as regulatory and stakeholder concerns. The aerial survey design is flexible and able to adapt at short notice to changes in the operations.

For marine mammal monitoring flights, aircraft will be flown at ~120 knots ground speed and usually at an altitude of 1,000 ft (305 m). Flying at a survey speed of 120 knots greatly increases the amount of area that can be surveyed, given aircraft limitations, with minimal effect on the ability to detect bowhead whales. Surveys in the Beaufort Sea are directed at bowhead whales and an altitude of 900-1,000 ft (274-305 m) is the lowest survey altitude that can normally be flown without concern about potential aircraft disturbance; it is also the altitude recommended by NMFS for IHA monitoring efforts for bowhead whales. Aerial surveys at an altitude of 1,000 ft (305 m) do not provide much information about seals but are suitable for both bowhead and beluga whales. The need for a 900-1000+ ft cloud ceiling will limit the dates and times when surveys can be flown. Selection of a higher minimum altitude for surveys (e.g. 1,500 ft [457 m]) would result in a significant reduction in the number of days where surveys would be possible, impairing the ability of the aerial program to meet its objectives. All other aircraft during the 2012 exploration drilling program will not operate below 1,500 ft (457 m) unless the aircraft is engaged in marine mammal monitoring, approaching, landing, taking off, under poor weather (low ceilings) conditions, engaged in providing assistance to a whaling vessel in distress, or any other emergency situations.

Two primary observers will be seated at bubble windows on either side of the aircraft and a third observer will observe part-time and record data the rest of the time. All observers need bubble windows to facilitate downward viewing. For each marine mammal sighting, the observer will dictate the species, number, size/age/sex class when determinable, activity, heading, swimming speed category (if traveling), sighting cue, ice conditions (type and percentage), and inclinometer reading to the marine mammal into a digital recorder. The inclinometer reading will be taken when the animal's location is 90° to the side of the aircraft track, allowing calculation of lateral distance from the aircraft trackline.

Transect information, sighting data and environmental data will be entered into a GPS-linked computer by the third observer, and simultaneously recorded on digital voice recorders for backup and validation. At the start of each transect, the observer recording data will record the transect start time and position, ceiling height (ft), cloud cover (in 10ths), wind speed (knots), wind direction degrees True North (°T) and outside air temperature degrees Celsius (°C). In addition, each observer will record the time, visibility (subjectively classified as excellent, good, moderately impaired, seriously impaired or impossible), sea state (Beaufort wind force), ice cover (in 10ths) and sun glare (none, moderate, severe) at the start and end of each transect, and at 2-minute intervals along the transect. This will provide data in units suitable for statistical summaries and analyses of effects of these variables (and position relative to the drillship) on the probability of detecting animals (see Davis et al. 1982; Miller et al. 1999; Thomas et al. 2002). The data logger will automatically record time and aircraft position (latitude and longitude) for sightings and transect waypoints, and at pre-selected intervals along the transects.

Supplementary Data

Ice observations during aerial surveys will be recorded and satellite imagery may be used, where available, during post-season analysis to determine ice conditions adjacent to the survey area. These are standard practices for surveys of this type, and are necessary in order to interpret factors responsible for variations in sighting rates.

Shell will, as a high priority, assemble the information needed to relate marine mammal observations to the locations of the *Kulluk* or *Discoverer*, and to the estimated received levels of industrial sounds at mammal locations. During the aerial surveys, Shell will record relevant information on other industry vessels, whaling vessels, low-flying aircraft, or any other human activities that are seen in the survey area.

Coordination with BOEMRE/NMFS Aerial Surveys

BOEMRE/NMFS are planning to continue its wide-ranging aerial surveys of bowhead whales and other marine mammals in the Beaufort Sea during the autumn of 2012. In 2012, the surveys will be contracted to the National Marine Mammal Laboratory (NMML) in Seattle. These surveys include the area where exploration drilling activities will occur. Shell will co-ordinate with BOEMRE/NMML to share data, both during the drilling season and for use in analyses and reports.

Shell will also consult with BOEMRE/NMML regarding coordination during the drilling season and real-time sharing of data. The aims will be:

- to ensure aircraft separation when both crews conduct surveys in the same general region;
- to coordinate the 2012 aerial survey projects in order to maximize consistency and minimize duplication;
- to use data from BOEMRE's broad-scale surveys to supplement the results of the more site-specific Shell surveys for purposes of assessing the effects of exploration drilling activities on whales and estimating "take by harassment";
- to maximize consistency with previous years' efforts insofar as feasible.

It is expected that raw bowhead sighting and flightline data will be exchanged between BOEMRE and Shell on a daily basis during the drilling season, and that each team will also submit its sighting information to NMFS in Anchorage each day. After the Shell and BOEMRE data files have been reviewed and finalized, they will be exchanged in digital form.

Shell is not aware of any other related aerial survey programs presently scheduled to occur in the Alaskan Beaufort Sea in areas where Shell is anticipated to be conducting exploration drilling operations during July–October 2012. If another aerial survey project were planned, Shell would seek to coordinate with that project to ensure aircraft separation, maximize consistency, minimize duplication, and share data.

Survey Design

During the late summer and fall, the bowhead whale is the primary species of concern, but belugas and gray whales are also present. Bowheads and belugas migrate through the Alaskan Beaufort Sea from summering areas in the central and eastern Beaufort Sea and Amundsen Gulf to their wintering areas in the Bering Sea (Clarke et al. 1993; Moore et al. 1993; Miller et al. 2002). Small numbers of bowheads are sighted in the eastern Alaskan Beaufort Sea starting mid-August and near Barrow starting late August, but the main migration does not start until early September. Recent surveys (COMIDA/BWASP 2009) and GPS tagging (ADF&G 2009) have also recorded some bowheads in the western Alaskan Beaufort Sea in July and August. The bowhead migration tends to be through nearshore and shelf waters, although in some years small numbers of whales are seen near the coast and/or far offshore. Bowheads frequently interrupt their migration to feed (Ljungblad et al. 1986; Lowry 1993; Landino et al. 1994; Würsig et al. 2002; Lowry et al. 2004) and their stop-overs vary in duration from a few hours to a few weeks (Koski et al. 2002). A commonly used feeding area is in and near Smith Bay, east of Barrow. Less consistently used feeding areas are in coastal and shelf waters near and east of Kaktovik. In 2007 and 2008, bowhead whales also used areas near Camden Bay to feed during the migration (Ireland et al. 2008; Funk et al. 2010).

To address concerns regarding deflection of bowheads at greater distances the survey pattern around exploration drilling operations has been designed to document whale distribution from about 25 mi (40 km) east of the exploration drilling operations to about 37 mi (60 km) west of operations (Figure 1). Aerial surveys will be conducted daily starting 5 to 7 days before exploration drilling operations begin.

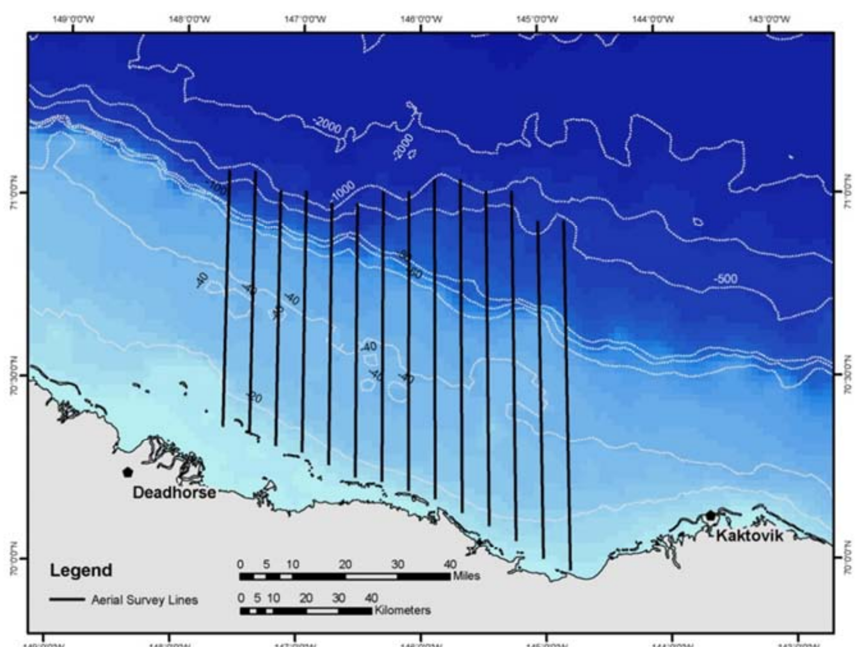

Figure 1. Central Alaskan Beaufort Sea showing a representative aerial survey pattern flown daily during late summer and fall. The survey grid will be moved east or west depending on the precise location of the Kulluk or Discoverer and lines will be shifted slightly within the grid for each survey in order to randomize their location and meet sampling design objectives.

Bowhead whale movements during the late summer/autumn are generally from east to west, and transects should be designed to intercept rather than parallel whale movements. The transect lines in the grid will be oriented north-south, equally spaced at 5 mi (8 km), and randomly shifted in the east-west direction for each survey by no more than the transect spacing. The survey grid will total about 808 mi (1,300 km) in length, requiring ~6 hours (hr) to survey at a speed of 137 mi/hr (220 km/hr) (120 knots), plus ferry time. Exact lengths and durations will vary somewhat depending on the position of the exploration drilling operation and thus of the grid, the sequence in which lines are flown (often affected by weather), and the number of refueling/rest stops.

Weather permitting, transects making up the grid in the Beaufort Sea will be flown in sequence from west to east. This decreases difficulties associated with double counting of whales that are (predominantly) migrating westward. The survey sequence around the exploration drilling operation is designed to monitor the distribution of whales around the exploration drilling operation.

The statistical power of any proposed sampling design is important in understanding the amount of sampling effort required to detect real differences in the densities of animals between areas affected by industry operations and those farther away from operations. A power analysis was performed to determine the amount effort that would be required to detect differences between 20 km and 30 km impact zones around the drill site and areas outside of the impact zones based on this survey design (Addendum 1). This analysis suggests the following:

1) Given the range of uncertainties taken into account in this analysis, the current survey design has a power of >90% for detecting a difference in densities if the impact zone is assumed to have a radius of 30 km (Table 1).

2) If the impact radius is 20 km, the power of the current survey design to detect differences in densities between the impact and outer zones drops off rapidly with densities in the impact zone which are greater than 25% that in the outer zone (Table 1).

3) Given an impact radius of 20 km, and assuming a doubling of effort in the impact zone (from 1,344 to 2,700 km by reducing the spacing between survey lines to 4 km), there is a 100% probability of detecting a difference if the density in the impact zone is half that of the outer zone (Table 2).

4) In order to achieve a power of 80% for detecting a difference where the 20 km impact zone density is 75% that in the outer zone, it would require 4,700 km of effort (~3.5 times the current design) in the impact zone (Table 2).

4a) There is a limit to the amount of effort achievable in the impact zone as dictated by the spacing of transect lines. Under the values for the detection function assumed in this exercise, it is not possible to increase effort in the impact zone (by decreasing spacing) by more than 3.5 times the base case because doing so would create overlapping detection areas and introduce the possibility of double counting.

Table 1 The power to detect a given difference in density in the impact zone (expressed as a percentage of the outer zone density), assuming a background density of 0.02 bowheads per km2 in the outer zone and radius of impact of either 20 or 30 km.

	impact zone density as % of outer zone density		
Radius of impact zone (km)	25%	50%	75%
20	1	0.225	0.001
30	1	1	0.960

Table 2. The power to detect a given difference in density in the impact zone (expressed as a percentage of the outer zone density), assuming a background density of 0.02 bowheads per km2 in the outer zone and radius of impact of 20 km is shown as a function of increasing survey effort in the impact zone. Effort of 1344 km corresponds to the base-case scenario and proposed tracklines. This corresponds to the expected amount of effort that would be achieved over the course of a survey season in the impact zone, given the proposed survey design. Increased effort in the impact zone was modeled by decreasing the spacing between those tracklines and reducing the amount of effort in the outer zone (assuming a constant annual survey effort equal of 18,000 km).

		impact zone density as % of outer zone density		
Impact zone effort multiplier	Effort in impact zone (km)	25%	50%	75%
Base case	1344	1	0.225	0.001
2.0 x	2700	1	1	0.157
2.5 x	3360	1	1	0.431
3.0 x	4000	1	1	0.698
3.5 x	4700	1	1	0.795

The results of the power analysis suggest that the proposed survey grid provides reasonable power to detect changes between an impact zone of 30 km and areas outside of the impact zone and for a 20 km zone if the size of the impact, as determined by changes in the density of the animals within each zone, were large. In order to increase the power of the survey design to detect more subtle changes in a 20 km impact zone we propose to alter the survey grid by decreasing the distance between survey transect lines from 8 km to 6 km across a 60 x 60 km area centered over the drill site (Figure 2). Spacing between the lines outside of this 60 x 60 km area would increase from 8 km to 10 km. These changes maintain a similar amount of trackline during each survey while increasing the aerial coverage of the impact zone. This design optimizes the power of the survey to detect changes while still allowing coverage of areas farther upstream and downstream of the drill site.

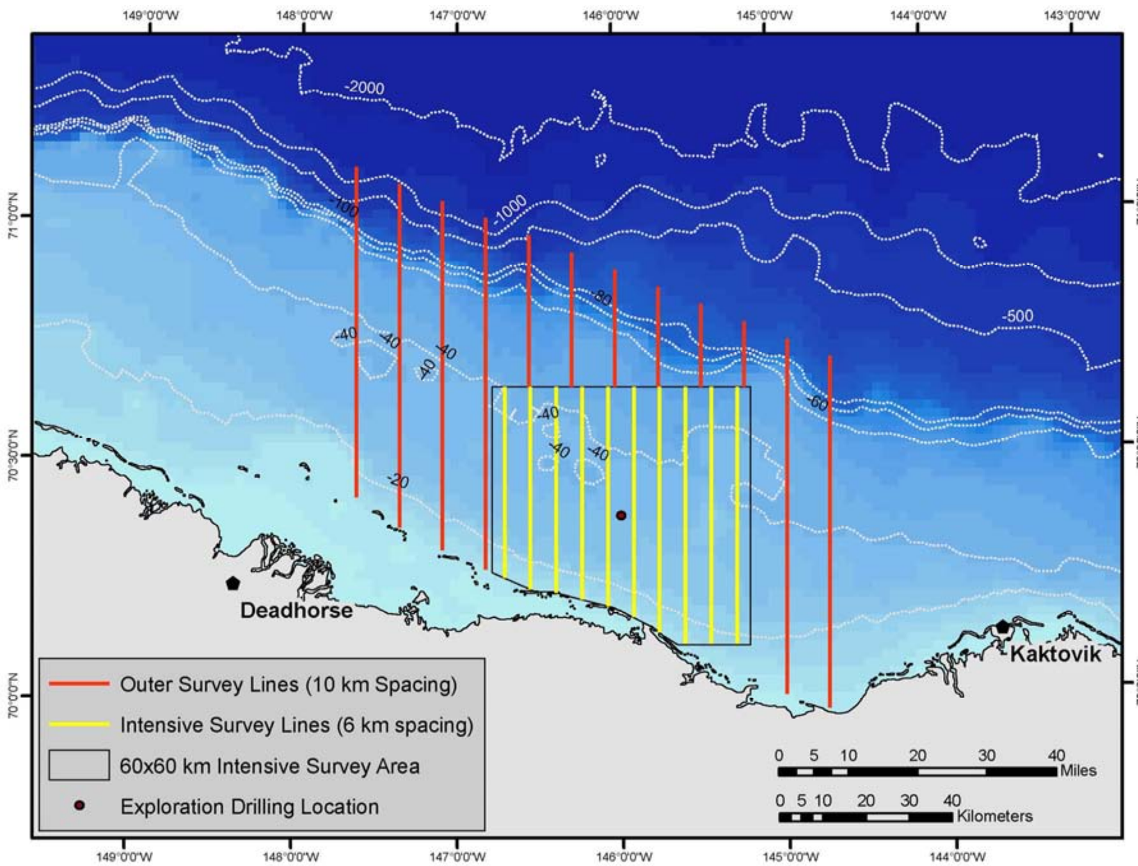

Figure 2. Central Alaskan Beaufort Sea showing a representative aerial survey pattern that would be flown daily during late summer and fall during industry exploration drilling activities. The survey grid will be moved east or west depending on the precise location of the Kulluk or Discoverer and lines will be shifted slightly within the grid for each survey in order to randomize their location and meet sampling design objectives. This proposed survey design increases the number of survey lines within a 60 x 60 km area centered over the drill site to increase the power of the sampling design to detect potential differences in marine mammal density around industry activities. Intensive survey lines would be 6 km apart while the outer survey lines would be spaced at 10 km.

A second analysis using the proposed modification of the spacing of transect lines in the impact zone indicated that this modified survey design has a high power to detect differences in underlying densities around industry activities. The results indicate that the chi-square test detected a difference 100% of the time if the 20 km impact zone density was either 25% or 50% that of the outer zone and >55% of the time if the impact zone was 75% that of the outer zone.

Analysis of Aerial Survey Data

During the field program, preliminary maps and summaries of the daily surveys will be provided to NMFS as normally required by the terms of the IHA, and USFWS and BOEMRE (if so stipulated). While in the field data, will be checked for entry errors and files will be backed up to CDs or portable memory drives. Two levels of analyses will be conducted at the end of the season. The first level will consist of basic summaries that are required for the 90-day report specified by the IHA. These include summaries of numbers of marine mammals seen, survey effort by date, maps summarizing sightings, and estimates of numbers of marine mammals that are "taken" according to NMFS criteria. The second level of analyses will be presented in a subsequent comprehensive report. The comprehensive report will provide more detailed analyses of the data to quantify the effect of the exploration drilling program on the distribution and movements of marine mammals. Data will be visualized by plotting sightings relative to the location of the active exploration drill site. We will also overlay the aerial sightings data with acoustic data that indicates the sound levels associated with the drilling activity and with maps of call locations determined by the DASAR recorders. Additionally, aerial survey data will be incorporated into animations of the call locations around the drilling activity as has been done previously during seismic programs conducted in this area.

Estimation of Numbers "Taken"

Shell has used this methodology, which was developed using past studies in the Beaufort and Chukchi sea regions (Miller et al. 1999; Haley and Ireland 2006) and other areas of the world (Lawson et al. 1998; Holst et al. 2005; Ireland et al. 2005), for estimating the numbers of marine mammals that are "taken" (as defined by NMFS). These estimates require estimating the numbers of animals present near or passing the exploration drilling program during periods without exploration drilling activity and assuming that similar numbers would have passed during those activities if the activities were not conducted. The planned approach has been accepted by NMFS as satisfying the requirements for "take" estimates for previous monitoring programs.

The criteria to be used in tabulating and estimating numbers of cetaceans potentially exposed to various sound levels will be consistent with those used during previous related projects in 1996-2010, unless otherwise directed by NMFS. Only cetaceans will be addressed using the aerial survey data because the altitude of the surveys is too high to reliably detect and identify pinnipeds. As in previous studies, Shell anticipates that there will be four components:

1. *Numbers of cetaceans observed within the area ensonified strongly by the exploration drilling operations.* For cetaceans, Shell will estimate the numbers of animals exposed to received rms levels of sounds exceeding 120, 160 dB and 180 dB re 1 μPa, as required by NMFS.

2. *Numbers of cetaceans observed showing apparent reactions to exploration drilling operations, e.g., heading in an "atypical" direction.* Animals exhibiting apparent responses to the activities will be counted as affected by the programs if they were exposed to sounds from those activities.

3. *Numbers of cetaceans estimated to have been subjected to sound levels ≥120, ≥160 and ≥180 dB re 1μ Pa rms when no monitoring observations were possible*. This will involve using the observations from the survey aircraft (Shell and BOEMRE/NMFS), supplemented by relevant vessel-based observations, to estimate how many cetaceans were exposed over the full course of Shell's 2012 exploration drilling season to situations where received sound levels were ≥120, ≥160 and ≥180 dB rms. In the case of the bowhead whale, Shell will estimate the proportions of the observed whales that were close enough to shore to have passed through the area where exposure might occur, and could have passed while exploration drilling operations were underway.

Shell's aerial survey design, together with the complementary aerial surveys to be conducted by BOEMRE/NMFS, will provide the needed data.

4. *The number of bowheads whose migration routes came within 12 mi (20 km) of the drilling activity, or would have done so if they had not been displaced farther offshore, will be estimate*d. This displacement distance has been reported for fall migrating bowhead whales near drilling and seismic operations in the Beaufort Sea (Davis 1987; Davies 1997; Miller *et al.*, 1999). If the 2012 data indicate that the avoidance distance exceeds 12 mi (20 km), the larger avoidance distance will also be used for estimating the numbers of whales potentially responding to the exploration drilling activity. These estimates will be obtained by determining the displacement distance based on the aerial survey results, and then estimating how many bowheads were likely to approach the avoided area during times while the *Kulluk* or *Discoverer* and support vessels were present.

Effects of Exploration Drilling Program on Bowhead Migration

The location of the bowhead migration corridor in 2012 will be determined by examining data from periods with exploration drilling activities and data from east of those operations. The BOEMRE/NMFS aerial survey data will be a useful supplement for areas well east of the drilling locations. Shell will contrast the numbers of bowhead sightings and individuals vs. distance from shore:

- during periods with vs. without exploration drilling operations, and
- near vs. east vs. west of the exploration areas.

The distance categories will be linked to received sound levels based on the results from the acoustic measurement task. Analyses will be done on a sightings-per-unit effort basis to allow meaningful interpretation even though aerial survey effort is inevitably inconsistent at different distances offshore.

To determine how far east, north and west displacement effects (if any) extend, additional analyses will be conducted on bowhead sightings and survey effort in relation to distance and bearing from the exploration drilling operations during times with and without operations. Shell anticipates applying a logistic or Poisson regression approach to assess the effects of distance and direction from the exploration drilling operations on sighting probability of bowhead whales, allowing for the confounding influence of sightability (sea state, ice conditions, etc.) and other covariates. Such an approach has been used extensively in analyses of whale and seal distribution in the Beaufort Sea (Manly et al. 2004; Moulton et al. 2005). Other analyses that may be useful to describe the effects of the exploration drilling operation on the bowhead migration path, including summaries of headings, behavior and swimming speeds, will be included in the technical report.

The data from the current survey may not provide enough sightings to be able to quantify the effects of Shell's 2012 activities on the bowhead whale migration path. That could occur if Shell's operations in the Beaufort Sea during the bowhead whale migration season were limited due to ice or other factors, or if 2012 is a year when weather conditions are poorer than average, which would limit the periods when surveys could be conducted.

The aerial survey data pertaining to other species of marine mammals will also be mapped and analyzed insofar as this is useful. However, the main migration corridor of belugas is far offshore, and generally north of the survey area proposed here. Few gray whales and walrus are likely to be seen because of their rarity in the Beaufort Sea area (although gray whales were seen in the area in 1998 (Miller et al. 1999) and small numbers have been seen during several recent surveys by BOEMRE, formerly as Minerals Management Service (MMS) (Treacy 1998, 2000, 2002) and LGL (Patterson et al. 2007). Therefore, the proposed aerial surveys are expected to document the infrequent use of continental shelf waters of the Beaufort Sea by beluga whales, gray whales and walrus, but detailed analyses for these species probably will not be warranted. Seals cannot be surveyed quantitatively by aerial surveys at altitudes 900-1,500 ft (274- 457 m) over open water. The aerial surveys will provide only incidental data on the occurrence of bearded and especially ringed seals in the area.

ACOUSTIC MONITORING PLAN

Drilling Sound Measurements

Objectives

Drilling sounds are expected to vary significantly with time due to variations in the level of operations and the different types of equipment used at different times onboard the *Kulluk* or *Discoverer*. The objectives of these measurements are:

- to quantify the absolute sound levels produced by drilling, and to monitor their variations with time, distance and direction from the drilling vessel;
- to measure the sound levels produced by vessels operating in support of exploration drilling operations. These vessels will include crew change vessels, tugs, ice-management vessels and spill response vessels; and
- to measure the sound levels produced by an end-of-hole ZVSP survey using a stationary sound source.

Equipment

The *Kulluk* or *Discoverer*, support vessels, and ZVSP sound measurements will be performed using one of two methods, both of which involve real-time monitoring. The first method would involve use of bottom-founded hydrophones cabled back to the *Kulluk* or *Discoverer* (Figure 3). These hydrophones weigh approximately 88 pounds (lb) (40 kilograms) with a footprint of approximately 2.7 ft^2 (0.5 m^2) and would be positioned between 1,640 ft (500 m) and 3,281 ft (1,000 m) from the *Kulluk* or *Discoverer*, depending on the final positions of the anchors used to hold the *Kulluk* or *Discoverer* in place. Hydrophone cables would be fed to real-time digitization systems on board. In addition to the cabled system, a separate set of bottom-founded hydrophones (Figure 4) may be deployed at various distances from the exploration drilling operation for storage of acoustic data to be retrieved and processed at a later date.

As an alternative to the cabled hydrophone system (and possible inclusion of separate bottom-founded hydrophones), the second (or alternative) monitoring method would involve a radio buoy approach deploying four spar buoys 4-5 mi (6-8 km) from the *Kulluk* or *Discoverer*. Additional hydrophones may be deployed closer to the *Kulluk* or *Discoverer*, if necessary, to better determine sound source levels. Monitoring personnel and recording/receiving equipment would be onboard one of the support vessels with 24-hr monitoring capacity. The system would allow for collection and processing of real-time data similar to that provided by the cabled system but from a wider range of locations. Processing would provide real-time localization of sound sources including seals and whales.

Sound level monitoring with either method will occur on a continuous basis throughout all exploration drilling activities. Both types of systems will be set to record digital acoustic data at sample rate 32 kiloHertz (kHz), providing useful acoustic bandwidth to at least 15 kHz. Both the hydrophone systems use Reson TC4032 hydrophones with sensitivity -170 dB re µPa. These systems are capable of measuring absolute broadband sound levels between 90 and 180 dB re µPa. The long duration recordings will capture many different operations performed from the *Kulluk* or *Discoverer*. Retrieval of these systems will occur following completion of the exploration drilling activities.

These recorders will provide a capability to examine sound levels produced by different drilling activities and practices and, possibly to develop real time noise reduction measures. This system will not have the capability to locate calling marine mammals and will indicate only relative proximity. The system will be evaluated during operations for its potential to improve MMO observations through notification of MMOs on vessel and aircraft of high levels of call detections and their general locations.

The deployment of drilling sound monitoring equipment will occur as soon as possible once the *Kulluk* or *Discoverer* is on site. Activity logs of exploration drilling operations and nearby vessel activities will be maintained to correlate with these acoustic measurements.

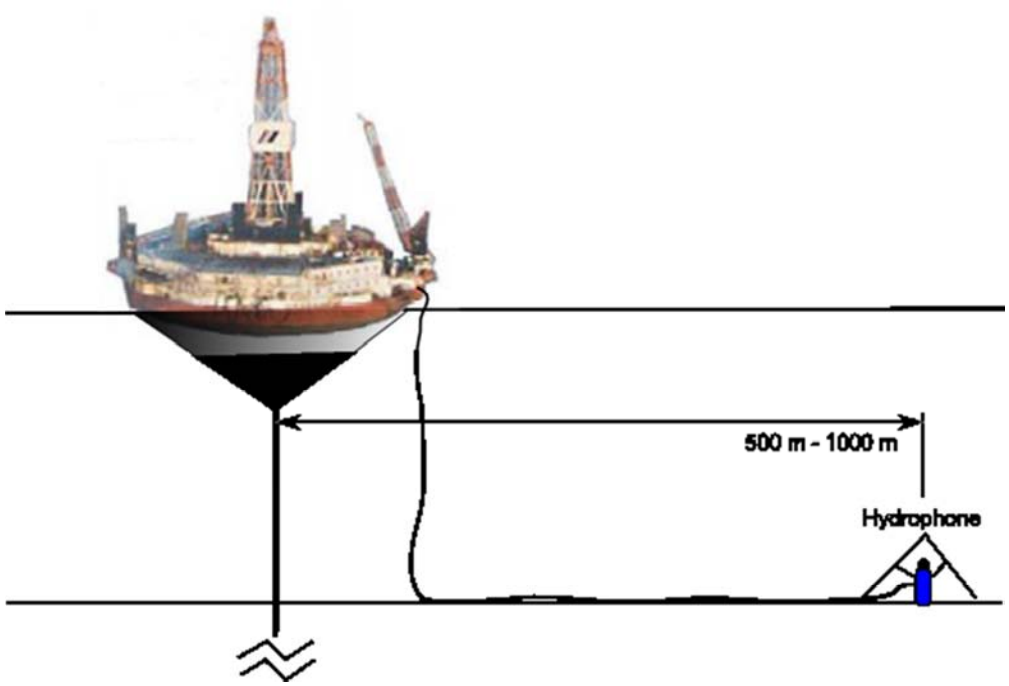

Figure 3. Cabled hydrophone method for real time monitoring of drilling sounds[1].

Note: [1] Drilling vessel *Kulluk* is pictured; however, either it, or the drillship *Discoverer* will be used.

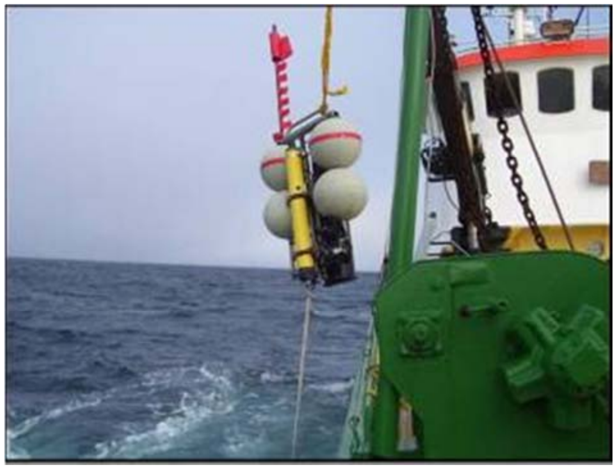

Figure 4. Hydrophone recording system being deployed at sea. The hydrophone system is an autonomous recorder with very high recording resolution. Acoustic data is stored internally on a hard-drive.

Vessel Sounds Monitoring

Sound produced by the vessels supporting exploration drilling operations will be recorded by the drilling-sounds monitoring equipment. Logs of vessel position and activity will be used to determine the time varying contribution of each vessel to the overall sound level measurements. Additional dedicated measurements of vessel source levels will be obtained by having the vessels sail past the monitoring locations. These dedicated measurements will provide sound level versus distance from the respective vessels and will also be processed to compute source levels in 1/3-octave bands referenced to 3ft (1 m) range.

Zero Offset Vertical Seismic Profiling Sounds Monitoring

Sounds produced by the ZVSP survey at, or near the end of each well will be recorded using the drilling sounds monitoring equipment. During ZVSP surveys, an airgun array, which is typically much smaller than those used for routine seismic surveys, is deployed at a location near or adjacent to the *Kulluk* or *Discoverer*, while receivers are placed (temporarily anchored) in the wellbore. The sound source (airgun array) is fired repeatedly, and the reflected sonic waves are recorded by receivers (geophones) located in the wellbore. The geophones, typically in a string, are then raised up to the next interval in the wellbore and the process is repeated until the entire wellbore has been surveyed. The purpose of the ZVSP is to gather geophysical information at various depths, which can then be used to tie-in or ground-truth geophysical information from the previous seismic surveys with geological data collected within the wellbore.

During the ZVSP, the sound source is maintained at a constant location near the wellbore (Figure 5). A typical sound source that likely would be used by Shell in 2012 is the ITAGA eight-airgun array, which consists of four 150 in^3 (2,458 cm^3) airguns and four 40 in^3 (655 cm^3) airguns. These airguns can be activated in any combination and Shell would utilize the minimum airgun volume required to obtain an acceptable signal. Current specifications of the array are provided in Table 3. The airgun array is depicted within its frame or sled, which is approximately 6 ft (2 m) x 5 ft (1.5 m) x 10 ft (3 m), in the photograph below. Typical receivers would consist of a

Schlumberger wireline four level Vertical Seismic Imager (VSI) tool, which has four receivers 50-ft (15.2-m) apart.

Photograph of ITAGA 8-airgun Array in Sled

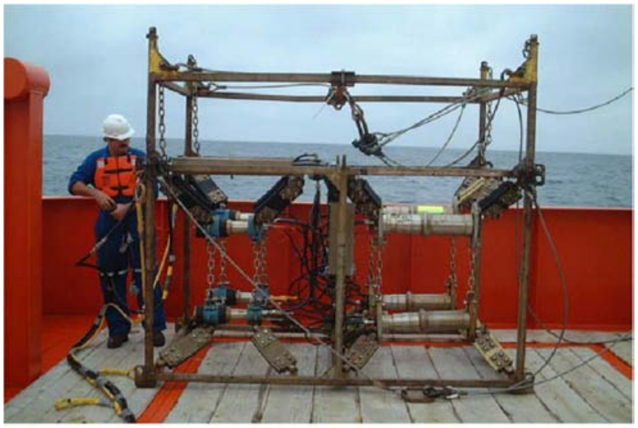

Table 3 Typical Sound Source (Airgun Array) Specifications for ZVSP

Source Type	Number of Sources	Maximum Total Chamber Size	Pressure	Source Depth	Calibrated Peak-Peak Vertical Amplitude	Zero-Peak Sound Pressure Level
SLB, ITAGA Sleeve Array	8 airguns (4) 150 in^3 (2,458 cm^3) (4) 40 in^3 (655 cm^3)	760 in^3 (12,454 cm^3)	2,000 psi 140 bar	9.8 ft / 3.0 m 16.4 ft / 5.0 m	16 bar @1 m 23 bar @1 m	238 dB re1µPa @1 m 241 dB re1µPa @1 m

A ZVSP survey is normally conducted at each well after total depth is reached. For each survey, Shell would deploy the sound source (airgun array) over the side of the *Kulluk* or *Discoverer* with a crane (sound source will be 50-200 ft (15-60 m) from the wellhead depending on crane location), to a depth of approximately 10-23 ft (3-7 m) below the water surface. The VSI with its four receivers will be temporarily anchored in the wellbore at depth. The sound source will be pressured up to 2,000 pounds per square inch (psi) (138 bar), and activated 5-7 times at approximately 20-second intervals. The VSI will then be moved to the next interval of the wellbore and re-anchored, after which the airgun array will again be activated 5-7 times. This process will be repeated until the entire well bore is surveyed in this manner. The interval between anchor points for the VSI usually is between 200-300 ft (60-91 m). A normal ZVSP survey is conducted over a period of about 10-14 hr depending on the depth of the well and the number of anchoring points.

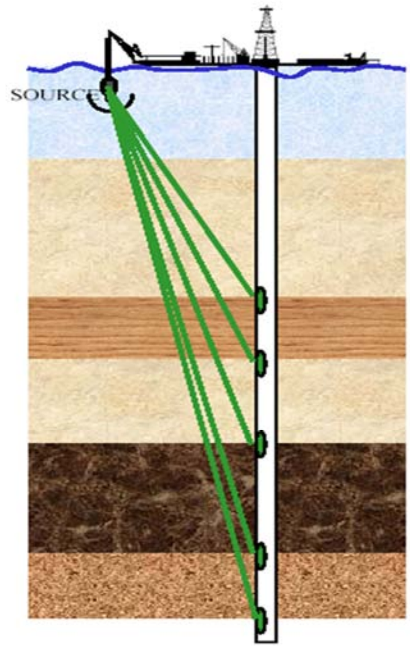

Figure 5. Schematic of ZVSP.[1]

Note: [1]Drillship *Discoverer* is shown; however, either it, or the drill vessel *Kulluk* will be used.

Acoustic Data Analyses

An important purpose of the measurements of sound level variation with time is to provide information that can be correlated with observations of bowhead whale deflections around the exploration drilling operations, should they occur. The calls of bowhead whales will be detected and located by the arrays of directional autonomous seafloor acoustic recorders (DASARs). The goal of that work will be to determine if changes in migration patterns can be correlated with changes in sound level output from the exploration drilling operations.

Drilling sound data will be analyzed to extract a record of the frequency-dependent sound levels as a function of time. Figure 6 shows the results of this type of analysis for a previous deployment of a bottom-founded recorder. These results are useful also for correlating measured noise events with specific exploration drilling operations and also for capturing marine mammal vocalizations. The analysis also provides absolute sound levels in finite frequency bands that can be tailored to match the highest-sensitivity hearing ranges for the various species of interest. For example, bowhead hearing is thought to be most acute in the 100 Hz – 1,000 Hz frequency range which corresponds with the blue dotted line in the upper plot of Figure 6.

The analyses will also consider sound level integrated through 1-hr durations (referred to as noise equivalent level (Leq)[1-hr]). Figure 7 (upper) shows an example of a Leq analysis of hydrophone data. Similar graphs for long time periods will be generated as part of the data analysis performed for indicating drilling sound variation with time in selected frequency bands. These levels will be of particular importance for correlation with bowhead location data obtained from directional acoustic recording arrays deployed for Shell's 2012 bowhead migration study.

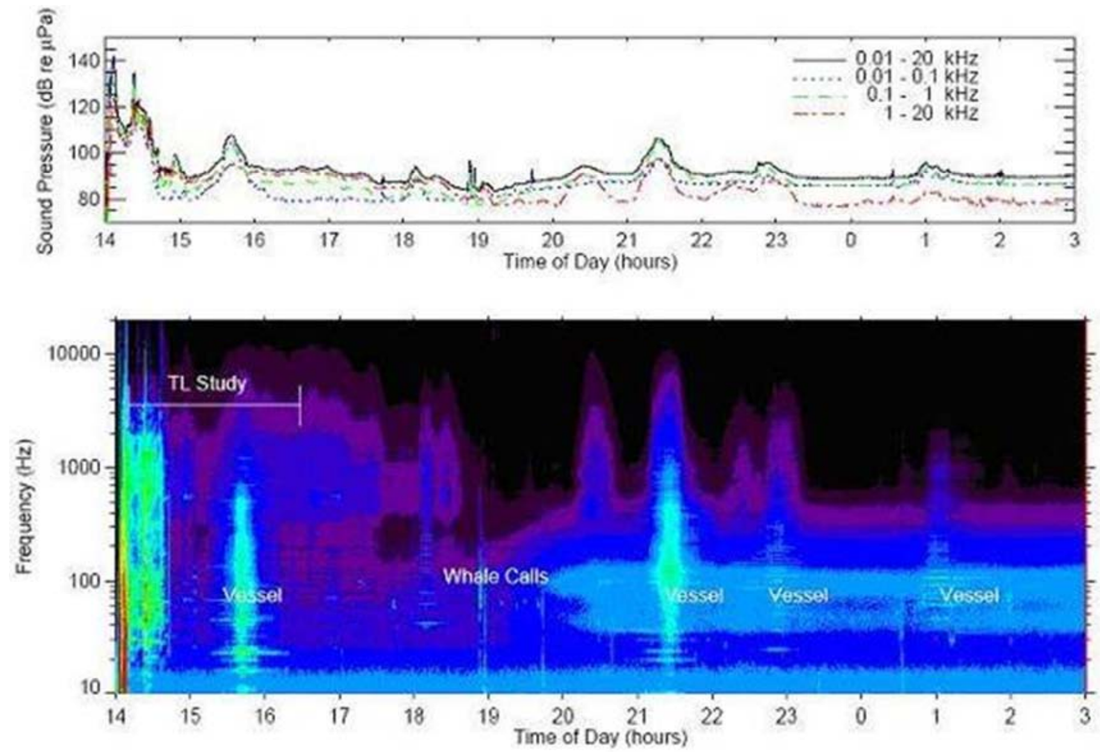

Figure 6. Lower: spectrogram of sound level measurements obtained from a hydrophone recording system. Upper: broadband and selected band level variation with time.

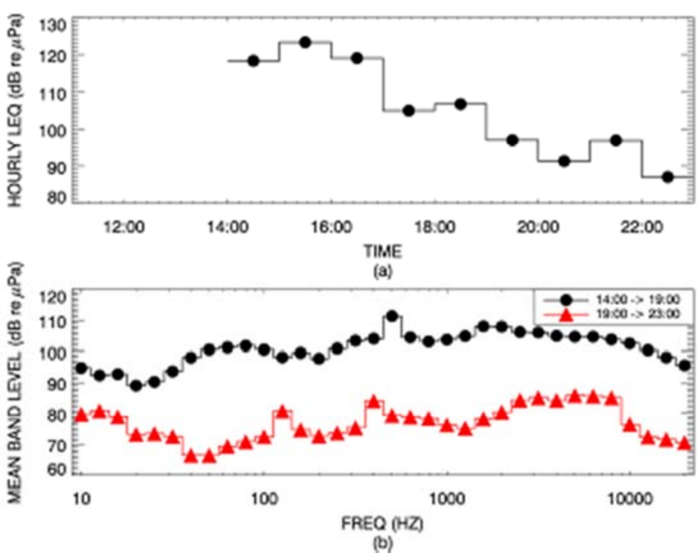

Figure 7. Upper: 1-hr Leq levels that will be calculated from acoustic measurements for use in correlating with bowhead whale deflection data.

Reporting of Results

Sound level results will be reported in the 90-day and comprehensive reports for this program. The results reported will include:

- Sound Source Levels for the *Kulluk* or *Discoverer* and all drilling support vessels;
- Spectrogram and band level versus time plots computed from the continuous recordings obtained from the hydrophone systems;
- Hourly Leq levels at the hydrophone locations. These values will be used to estimate actual sound levels at locations of deflected whales identified in Shell's Beaufort Sea Whale Migration study; and
- Correlation of drilling source levels with the type of exploration drilling operation being performed. These results will be obtained by observing differences in drilling sound associated with differences in the drilling vessel activity as indicated in detailed drilling vessel logs.

Acoustic Study of Bowhead Deflections

Shell plans to deploy arrays of acoustic recorders in the Beaufort Sea in 2012, similar to that which was done in 2007 through 2010, and will be again in 2011 using DASARs supplied by Greeneridge. These directional acoustic systems permit localization of bowhead whale and other marine mammal vocalizations. The purpose of the array will be to further understand, define, and document sound characteristics and propagation resulting from vessel-based exploration drilling operations that may have the potential to cause deflections of bowhead whales from their migratory pathway. Of particular interest will be the east-west extent of deflection, if any (i.e., how far east of a sound source do bowheads begin to deflect and how far to the west beyond the sound source does deflection persist). Of additional interest will be the extent of offshore (or towards shore) deflection that might occur.

In previous work around seismic and drillship operations in the Alaskan Beaufort Sea, the primary method for studying this question has been aerial surveys. Acoustic localization methods will provide supplementary information for addressing the whale deflection question. Compared to aerial surveys, acoustic methods have the advantage of providing a vastly larger number of whale detections, and can operate day or night, independent of visibility, and to some degree independent of ice conditions and sea state—all of which prevent or impair aerial surveys. However, acoustic methods depend on the animals to call, and to some extent assume that calling rate is unaffected by exposure to industrial noise. Bowheads call frequently in fall, but there is some evidence that their calling rate may be reduced upon exposure to industrial sounds, complicating interpretation. The combined use of acoustic and aerial survey methods will provide a suite of information that should be useful in assessing the potential effects of exploration drilling operations on migrating bowhead whales.

Objective

The objective of this study is to provide information on bowhead migration paths along the Alaskan coast, particularly with respect to industrial operations, and whether and to what extent there is deflection due to industrial sound levels. Using passive acoustics with directional autonomous recorders, the locations of calling whales will be observed for a six- to ten-week continuous monitoring period at five coastal sites (subject to favorable ice and weather conditions). Essential to achieving this objective is the continuous measurement of sound levels near the *Kulluk* or *Discoverer*. An example of the whale call locations measured from a similar array of DASARs in 2008 is presented in Figure 8 (Blackwell et al. 2010).

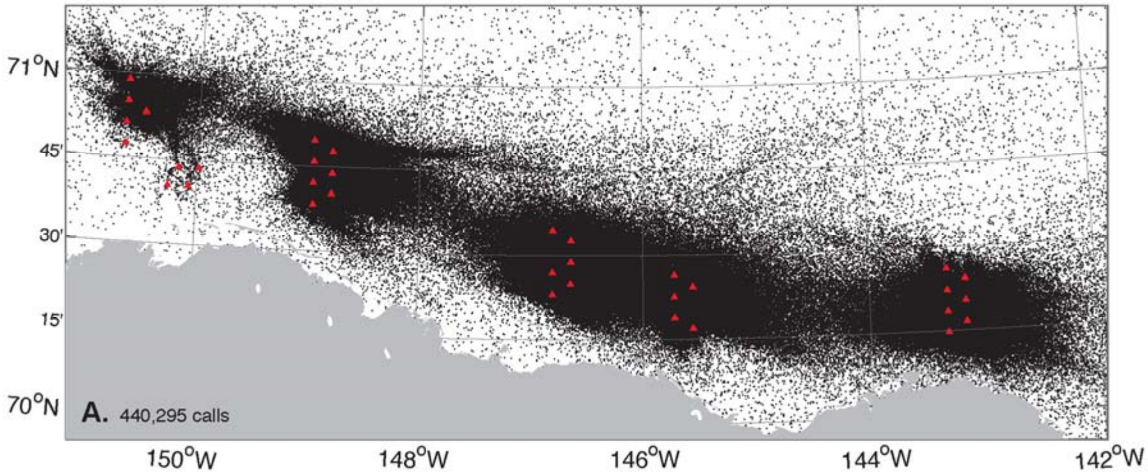

Figure 8. Bowhead whale call locations determined from the received bearings at five arrays of DASARs in the Beaufort Sea in 2008.

Monitoring Plan

Shell plans to conduct the whale migration monitoring using the passive acoustics techniques developed and used successfully since 2001 for monitoring the migration past Northstar production island northwest of Prudhoe Bay and from Kaktovik to Harrison Bay during the 2007 through 2011 migrations. Those techniques involve using DASARs to measure the arrival angles of bowhead calls at known locations, then triangulating to locate the calling whale. Hundreds of thousands, of whale calls were successfully located in 2007 and 2008.

In attempting to assess the responses of bowhead whales to the planned industrial operations, it will be essential to monitor whale locations at sites both near and far from industry activities. Shell plans to monitor at five sites along the Alaskan Beaufort coast, as shown in Figure 9. The eastern-most site (#5 in Figure 9) will be just east of Kaktovik ~62 mi [~100 km] east of the Sivulliq drilling area) and the western-most site (#1) will be in the vicinity of Harrison Bay (~47 mi [~175 km] west of Sivulliq). Site 2 will be located west of Prudhoe Bay (~68 mi [~110 km] west of Sivulliq). Site 4 will be ~6.2 mi (~10 km) east of the Sivulliq drilling area and site 3 will be ~15.5 mi (~25 km) west of Sivulliq. These five sites will provide information on possible migration deflection well in advance of whales encountering an industry operation and on "recovery" after passing such operations should a deflection occur.

The proposed geometry of DASARs at each site is comprised of seven DASARs oriented in a north-south pattern so that five equilateral triangles with 4-mi (7-km) element spacing are achieved. This geometry is illustrated in Figure 9. Three mi (5 km) spacing has been used successfully in the migration studies at Northstar, but whale calls are received reliably at greater spacing and the 4 mi (7 km) spacing will result in greater coverage of whales along the north-south dimension, important in studying possible deflection.

DASARs will be installed at planned locations using a GPS. However, each DASAR's orientation, once it settles on the bottom, is unknown and must be determined to know how to reference the call angles measured to the whales. That is, where is true north relative to the DASAR orientation? Also, the internal clocks used to sample the acoustic data typically drift slightly, but linearly, by an amount up to a few seconds after six weeks of autonomous operation. Knowing the time differences within a second or two between DASARs is essential for identifying identical whale calls received on two or more DASARs. Solving these two problems is accomplished by transmitting known sounds at known times from known locations (by GPS) at six points around each DASAR at the beginning and at the end of the operational period. (Shell also will use a mid-season calibration.) Because of the equilateral triangular geometry, it requires 25 transmission stations for each site. Each set of transmissions requires less than half a minute. For the 3-mi (5-km) spacing, experience has been that it requires an hour to do 4 calibration transmissions, including transit. For our planned 4 mi (7-km) spacing, we estimate three calibration transmissions per hour. With 25 to do at each site, calibration of a site will require ~8 hours.

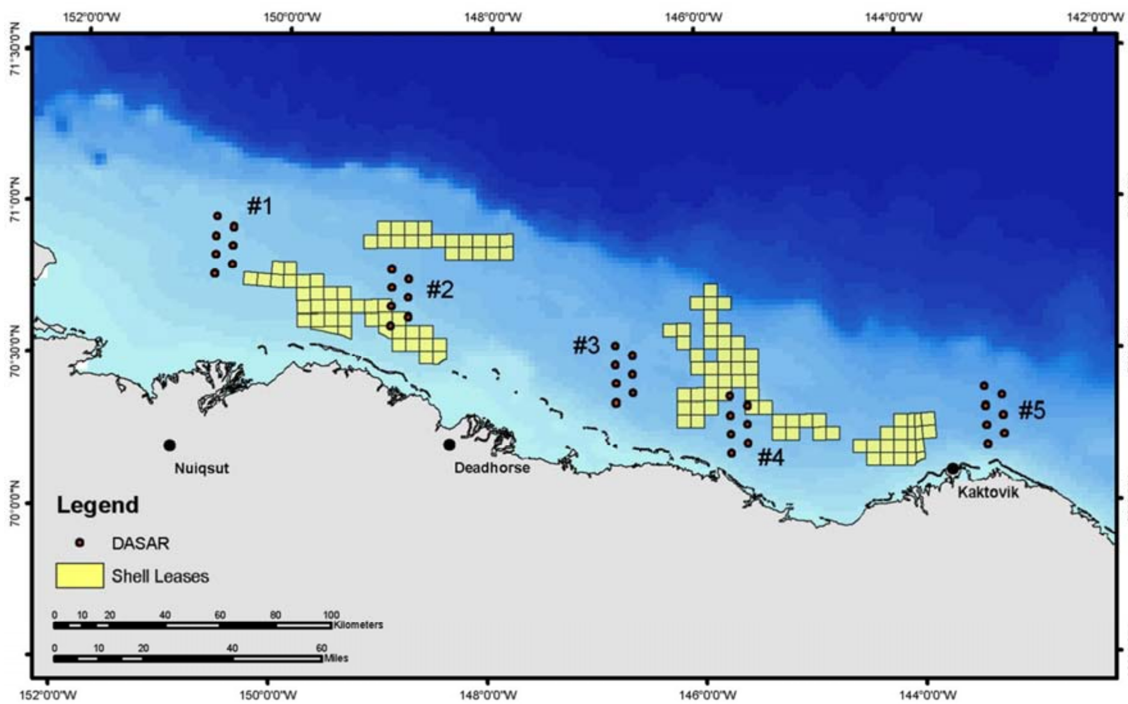

Figure 9. The Alaskan Beaufort Sea coast showing DASAR site locations for whale call location studies. The DASAR array locations at the five sites are shown to scale, with seven DASARs forming five equilateral triangles with a unit spacing of 4 mi (7 km) and a north-south extent of 13 mi (21 km) to aid being able to observe possible offshore deflection.

The calibration transmissions are made using a small projector easily deployed and retrieved over the side of a vessel by a single person. Maximum source level is only 150 dB re 1μPa at 1 m. The received level at a distance of 328 ft (100 m) will be ~110 dB, a level less than any known to cause disturbance to marine life.

Bowhead migration begins in late August with the whales moving westward from their feeding sites in the Canadian Beaufort Sea. It continues through September and well into October. However, because of the exploration drilling schedule, we will attempt to install the 21 DASARs at three sites (#3, #4 and #5 in Figure 9) in early August. The remaining 14 DASARs will be installed at sites #1 and #2 in late August. Thus, we propose to be monitoring for whale calls from before 15 August until sometime before 15 October.

At the end of the season the 4th DASAR in each array will be refurbished, recalibrated, and redeployed to collect data through the winter. The other DASARs in the arrays will be recovered. The redeployed DASARs will be programmed to record 35 minute every three hours with a disk capacity of 10 months at that recording rate. This should be ample space to allow over-wintering from ~mid-October 2012 through mid-July 2013.

Whale call analysis for the Northstar DASARs has been a manual process in which analysts observe acoustic spectrograms in one-minute periods, looking for patterns caused by a whale call. Listening to the sound, the analyst verifies that a sound is or is not a whale call, and when it is, the bearing is calculated and stored for localization if the same call is present at one or more other DASARs in an array. In the proposed 2012 project, machine-aided call detection software will be used to simplify and accelerate the call analysis. Such software was developed with Shell's sponsorship in 2006 and is described in Greene et al. (2007). The software has been tested and refined during data collection efforts in 2008 through 2010, and will be again with 2011 results.

When the call locations have been assessed for accuracy, the locations will be analyzed for evidence of migration deflection. However, one must assess where the migration path would have been in the absence of industrial activities. The migration path is known to vary from year to year as a consequence of various factors. To control for this inter-annual variation, array pairs east and west of industrial activities will be used to compare offshore distances prior to and after whales pass through areas exposed to varying levels of anthropogenic sound. All DASAR arrays, and potentially those deployed for other studies (i.e., those supporting BP's studies of migration past its Northstar development), could be used to quantify density contours of the bowhead whale migration corridor. This estimation of the migration corridor would amount to an unprecedented quantification in terms of the extent of the coastline covered and the amount of data included.

Many interesting analyses will be available from the data collected by the five array sites. Only two analyses are discussed here. One analysis will estimate the location of the migration corridor across the extent of our study area. The migration corridor will be estimated by contours for the distribution of whale locations along the coast from array #1 to array #5. Density contours will be estimated using kernel density estimation (Silverman 1998). To be included in this analysis, call precision must be high, or alternatively, calls will be inversely weighted according to the size of their error ellipse. Because Shell anticipates that calls occurring between arrays will have very low precision, the variance of density estimates in these areas will be high. If the migration corridor is generally close to shore at arrays #5 and #4, but far offshore at the locations of array #3, #2, and #1, an offshore displacement of the corridor near the planned exploration drilling activity might be inferred. Shell plans to use block bootstrapping (Lahiri 2003) of raw data to assess variation in contours, when appropriate. Block bootstrapping accounts for potential autocorrelation among locations collected during short time intervals. This analysis does not depend on quantification of underwater industrial sounds emanating from exploration drilling operations.

A second analysis to assess deflection will relate changes in offshore distribution to changes in industrial sound levels. These analyses are predicated on the assumption that industrial sound levels will vary from below background to substantially above background throughout the season, and that reliable measurements of industrial sound at the source are available. Assuming source levels vary substantially throughout the season, this analysis will use periods of low industrial sound as "reference" periods, and relate shifts in the offshore distribution to increased levels of sound using regression or quantile regression analysis (Koenker and Park 1996; Koenker and Geling 2001; Koenker and Xiao 2002).

To illustrate the second analysis, consider DASAR sites #4 and #3 in Figure 9. Over a standard reporting period, for example 6 hr, calls located by these two arrays will be collected, as well as other environmental covariates such as water depth, ambient sound levels, time of day, etc. From these data, summary statistics for offshore distribution, and all covariates of interest will be calculated. For example, the 25th percentile of offshore distance may be calculated, as well as the average water depth of all call locations in the 6-hour reporting period. Differences in offshore summary statistics among arrays will then be calculated and used in a regression or quantile regression analysis. Using the example above, the difference in 25^{th} percentile of offshore distance between array #4 and array #3 could be related to the average industrial sound level output by the source. Assuming displacement occurs somewhere between arrays #4 and #3, a constant difference in the 25th percentile of offshore distance when sound levels are low, and larger differences in offshore distance when industrial sound levels increase would be expected. A significant slope of the regression relating offshore distance difference to sound levels will indicate a statistically significant displacement between the arrays in question. This type of analysis can be run using any pair of DASAR arrays (e.g., between #5 and #3 or between #4 and #1, etc.).

Analysis Assumptions:

- That changes in the offshore distribution of call locations reflect either changes in whale locations or changes in calling behavior.
- That industrial sound levels will vary substantially throughout the season. "Substantial" means by a level that is both detectable and important to bowhead whales. In other words, extended periods of both low and high sound production need to be present.
- Industrial sound levels surrounding the drilling sources need to be accurately quantified at varying distances in such a way that industrial sound levels and whale locations can be matched. An accurate propagation model for industrial sounds hopefully can be constructed from the collected data.
- A large number of whales will swim through the areas where arrays can reliably locate their calls.

Post-90-day Report Analysis

Analysis of all acoustic data will be prioritized to address the primary questions. The primary data analysis questions are to (a) determine when, where, and what species of animals are acoustically detected on each DASAR, (b) analyze data as a whole to determine offshore bowhead distributions as a function of time, (c) quantify spatial and temporal variability in the ambient noise, and (d) measure received levels of drillship activities. The bowhead detection data will be used to develop spatial and temporal animal distributions. Statistical analyses will be used to test for changes in animal detections and distributions as a function of different variables (e.g., time of day, time of season, environmental conditions, ambient noise, vessel type, operation conditions).

COMPREHENSIVE REPORT ON INDUSTRY ACTIVITIES AND MARINE MAMMAL MONITORING EFFORTS IN THE BEAUFORT AND CHUKCHI SEAS

Following the 2012 exploration drilling season a comprehensive report describing the vessel-based, aerial, and acoustic monitoring programs will be prepared. The comprehensive report will describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the studies into a broad based assessment of industry activities, and other activities that occur in the Beaufort and/or Chukchi seas, and their impacts on marine mammals. The report will help to establish long-term data sets that can assist with the evaluation of changes in the Chukchi and Beaufort Sea ecosystems. The report will attempt to provide a regional synthesis of available data on industry activity in offshore areas of northern Alaska that may influence marine mammal density, distribution and behavior.

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Addendum 1
Aerial Power Analysis

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Shell's proposed 2012 Beaufort aerial survey design around the Sivulliq prospect: Investigation of the power to detect potential differences in densities between two sub-areas

<u>Background</u>:

NMFS has provided feedback on Shell's IHA application and aerial monitoring program for the 2012 open water season. This document serves to address the NMFS suggested power analysis for detecting potential effects of industrial activity. The specific NMFS suggestion is:

> *Given the amount of data Shell's aerial surveys have collected using this aerial survey protocol in this area in the past, once a clear goal of the monitoring has been stated, Shell should use existing data to conduct a priori analyses to investigate the power or probability of detecting effects, should they exist, given the amount of information they expect to collect during the 2012 surveys. If the power or probability of detected effects is low, Shell should state how they will modify their survey protocols or analytical methods, or both, to better address this question.*

<u>Methods</u>:

For the purposes of this exercise, the "probability of detecting effects" is interpreted as the probability of detecting a true difference in underlying densities between two aerial survey sub-areas, i.e. an "impact zone" and an "outer zone".

A simulation exercise was developed using the R package 'WiSP' (Zucchini *et al.*, 2007) to investigate the power associated with different levels of survey effort as well as different underlying densities of bowheads in each sub-area. The power analysis was based on the proposed aerial survey design and parameters (e.g. underlying densities and sighting detection functions) derived from previous aerial surveys in the central Beaufort Sea during the open water season.

The dimensions of the two sub-areas were assumed to be roughly equal to the survey design proposed in the 4MP (Fig. 1) where survey lines are spaced 8 km apart in both the impact and outer zones. The impact zone was assumed to be either 1,250 or 3,000 km^2. This is approximately equal to that which would be expected if bowheads were maintaining a distance of 20 or 30 km from the source of industrial sound, as has been seen for fall migrating bowhead whales near drilling and seismic operations in the Beaufort Sea (Davis 1987; Davies 1997; Miller *et al.*, 1999). The entire proposed aerial survey area is 9,000 km^2, and the outer zone was therefore assumed to encompass the remaining area of either 7,750 or 6,000 km^2

The proposed aerial survey design consists of 14 transect lines total spaced 8 km apart. For the purposes of the base-case simulations (Table 1), the number of transect lines in each sub-area was proportional to the fraction of that sub-area's total area. Hence, in the base case the impact zone was assumed to be surveyed by the equivalent of either two or five full-length transect lines for the 20 and 30 km impact radii, respectively (Table 1). The assumed trackline lengths were 35 (impact zone) and 88 km (outer zone) in the scenario corresponding to a 20 km radius, and 54 (impact zone) and 77 km for the scenario corresponding with a 30 km radius.

The underlying density of bowheads for the outer zone was assumed to be 0.02 individuals per km^2. This corresponds to the average density estimated from previous industry sponsored surveys in this area during the open water season during periods of no detectable industry sound. The underlying density for the impact zone was assumed to be 25%, 50% or 75% of the outer zone.

Bowhead sightings were modeled from a half-normal detection function with an effective half-strip width of 1 km. This value was taken from line transect analyses of recent aerial survey data. The resulting distribution of simulated sighting distances (Figure 2) was compared to available data and mimicked those observations well.

WiSP assumes a g(0) = 1.0, which is unrealistic for aerial surveys of bowheads. Hence, the total number of WiSP sightings in the outer zone was further multiplied by a value of 0.144, which has been estimated for bowheads engaged in all activities during fall migration through the Alaskan Beaufort Sea from previous aerial surveys (Thomas *et al.*, 2002). This added step resulted in the expected number of sightings in the outer zone being equal to that from a detection function with g(0) = 0.144.

The detectability of bowheads in the impact zone is likely to be different than those in the outer zone. Preliminary analyses of surface and dive times for animals exposed to industrial sound suggest a g(0) of 0.10 (Frances Robertson, unpublished data). Hence, the resulting number of WiSP sightings in the impact zone was multiplied by 0.10 to take this difference in detectability into account.

Aerial survey effort in the Beaufort (excluding survey effort prior to August) averaged 18,000 km of effort from 2008 to 2010. The number of surveys in each simulation used this value as the expected total annual effort for the upcoming season. The number of realized completed surveys was then assumed to be 18,000 km divided by the proposed distance of trackline, or 19 complete surveys (all tracklines surveyed in both the outer and impact zone). Figures 3 and 4 show examples of simulated surveys and sightings in the two zones.

The corrected number of sightings and length of survey effort were summed across zones for each simulated survey season to calculate an average sighting rate (individuals per km effort) for the entire survey area. This average rate was used to calculate the expected number of sightings for each zone, based on the length of survey effort in that zone for a given simulated survey. A chi-square goodness of fit test was then used to test if the observed sightings were different than expected.

This process was repeated 10,000 times (i.e. 10,000 simulated survey seasons of 18,000 km of transect effort per season) for each combination of transect effort and differences in underlying densities. The power of the survey design to detect the true underlying difference in density was calculated as the percentage of those 10,000 simulated survey seasons for which the chi-square test correctly detected a significant difference (Tables 1 and 2).

Summary and Results:

1) Given the range of uncertainties taken into account in this analysis, the current survey design has a power of >90% for detecting a difference in densities if the impact zone is assumed to have a radius of 30 km (Table 1).

2) If the impact radius is 20 km, the power of the current survey design to detect differences in densities between the impact and outer zones drops off rapidly with densities in the impact zone which are greater than 25% that in the outer zone (Table 1).

3) Given an impact radius of 20 km, and assuming a doubling of effort in the impact zone (from 1,344 to 2,700 km by reducing the spacing between survey lines to 4 km), there is a 100% probability of detecting a difference if the density in the impact zone is half that of the outer zone (Table 2).

4) In order to achieve a power of 80% for detecting a difference where the impact zone density is 75% that in the outer zone, it would require 4,700 km of effort (~3.5 times the current design) in the impact zone (Table 2).

4a) There is a limit to the amount of effort achievable in the impact zone as dictated by the spacing of transect lines. Under the values for the detection function assumed in this exercise, it is not possible to increase effort in the impact zone (by decreasing spacing) by more than 3.5 times the base case because doing so would create overlapping detection areas and introduce the possibility of double counting.

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TABLES AND FIGURES

Table 1.
The power to detect a given difference in density in the impact zone (expressed as a percentage of the outer zone density), assuming a background density of 0.02 bowheads per km^2 in the outer zone and radius of impact of either 20 or 30 km.

	impact zone density as % of outer zone density		
Radius of impact zone (km)	25%	50%	75%
20	1	0.225	0.001
30	1	1	0.960

Table 2.
The power to detect a given difference in density in the impact zone (expressed as a percentage of the outer zone density), assuming a background density of 0.02 bowheads per km^2 in the outer zone and radius of impact of 20 km is shown as a function of increasing survey effort in the impact zone. Effort of 1,344 km corresponds to the base-case scenario and proposed tracklines. This corresponds to the expected amount of effort that would be achieved over the course of a survey season in the impact zone, given the proposed survey design. Increased effort in the impact zone was modeled by decreasing the spacing between those tracklines and reducing the amount of effort in the outer zone (assuming a constant annual survey effort equal of 18,000 km).

		impact zone density as % of outer zone density		
Impact zone effort multiplier	Effort in impact zone (km)	25%	50%	75%
Base case	1344	1	0.225	0.001
2.0 x	2700	1	1	0.157
2.5 x	3360	1	1	0.431
3.0 x	4000	1	1	0.698
3.5 x	4700	1	1	0.795

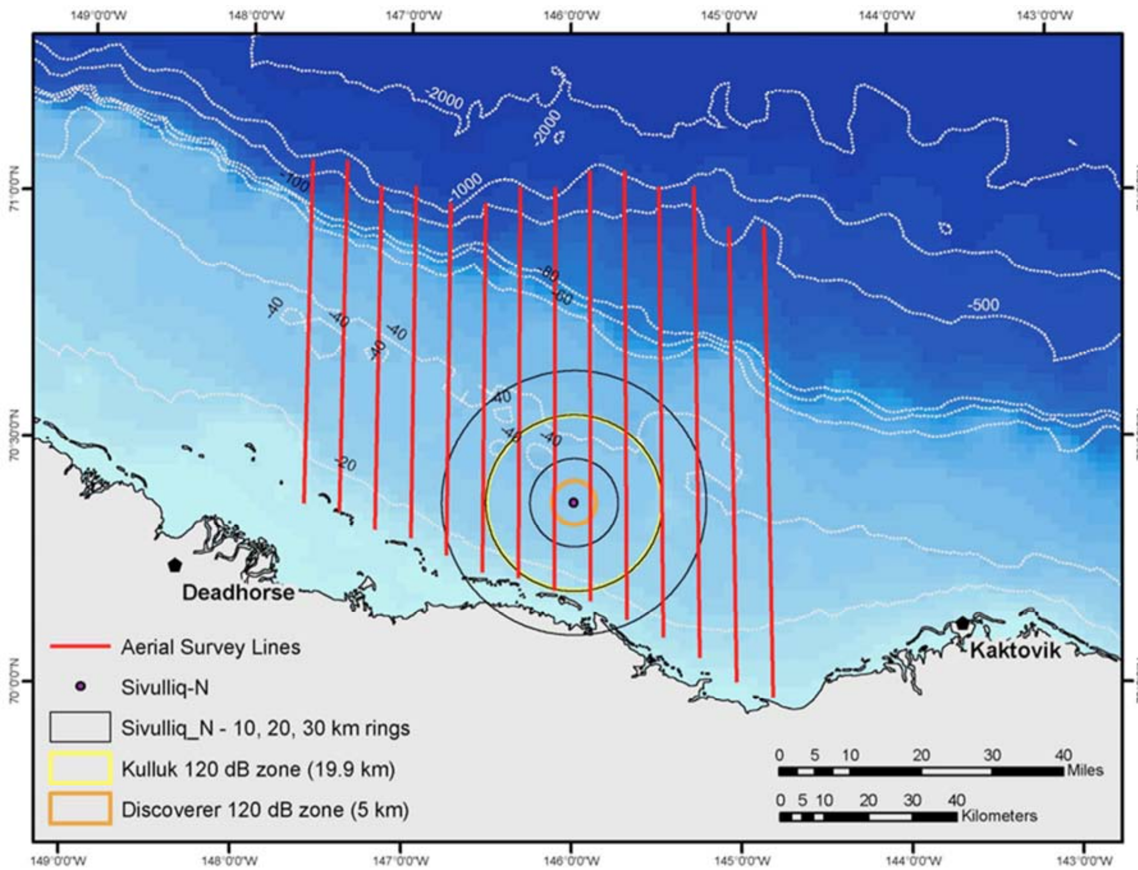

Figure 1. The proposed aerial survey design with transect lines (red) and radii of 10, 20 and 30 km (black circles) around the Sivulliq site. The expected zone of 120dB sound is shown as the tan circle conditional on the *Discoverer* being used as the drill ship, and the yellow circle shows that for the *Kulluk*.

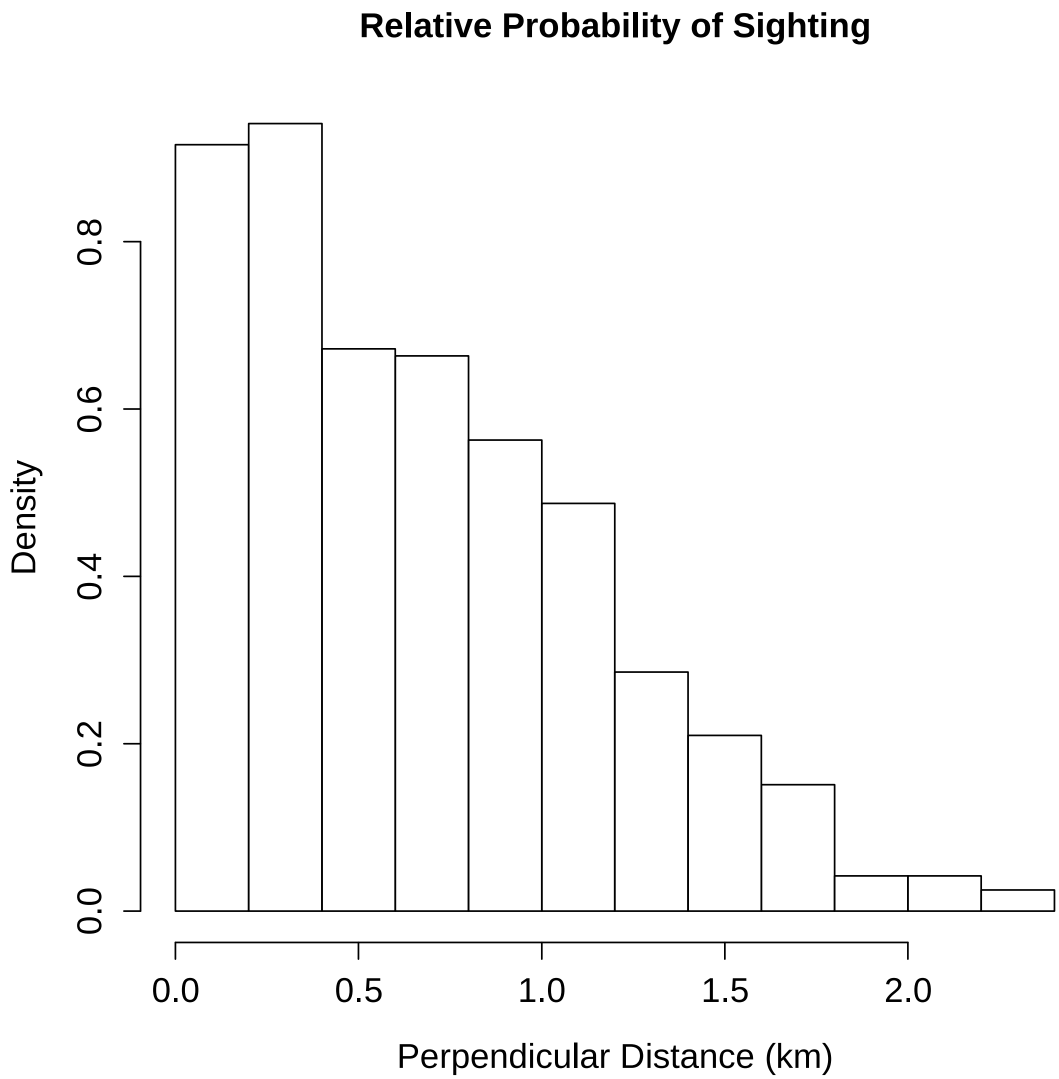

Figure 2. Example of sighting frequencies are shown as a function of perpendicular distance from a simulated survey in the outer zone with a density of 0.02 whales per km^2 and an effective strip half-width of 1km. This sightings curve was compared to existing data and found to mimic available observations well.

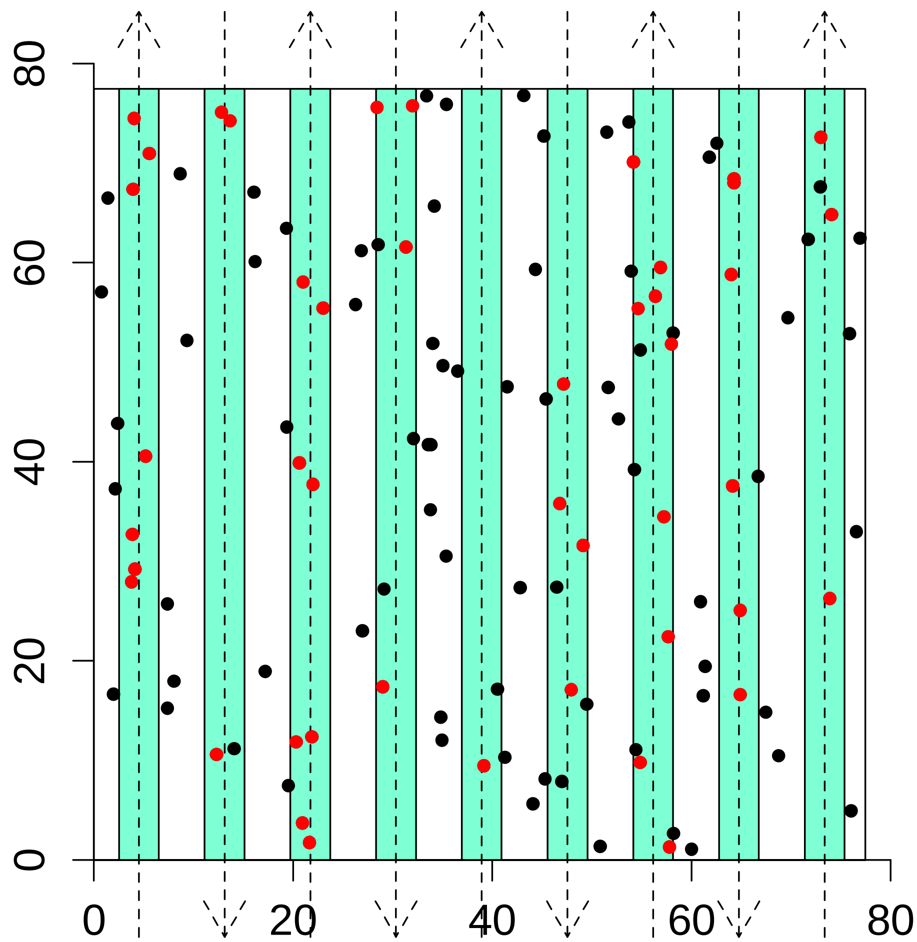

Figure 3. Example of a simulated survey in the 'outer zone'. The underlying density of bowheads is 0.02 individuals per km^2. The right truncation distance (highlighted in green) is assumed to be equal to 2.5 km and the effective strip half-width is assumed to be 1.0 km. The arrows denoted the direction of flight for each transect line (dotted lines). The black dots are undetected animals and the red dots are animals which are detected. In order to take into account the fact that g(0) is less than 1.0 (the value assumed by WiSP in simulating sightings), the number of realized sightings was multiplied by 0.144 for the outer zone. In other words, only 14% of the simulated sightings (rounded to the nearest integer) were used in the power analysis.

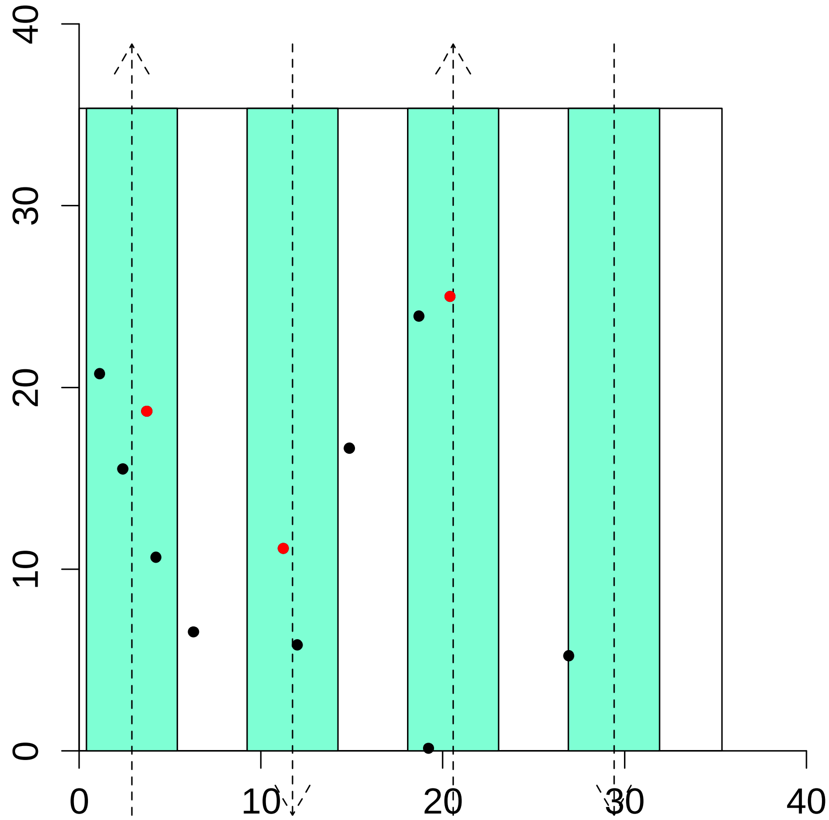

Figure 4. An example of a simulated survey in the impact zone (area equal to a 20 km radius) with an underlying density of 0.01 bowheads per km^2 is shown as per Figure 2. The amount of survey effort shown here is 140 km, which is the survey effort within the impact zone using the current 8 km line spacing. In a full season of ~19 surveys, the total effort in the impact zone would be ~2,700 km in the impact zone.

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Attachment D
Plan of Cooperation Addendum

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Plan of Cooperation Addendum
Revised Outer Continental Shelf Lease Exploration Plan Camden Bay
Beaufort Sea, Alaska

Revised August 2011

Prepared by

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ACRONYMS & ABBREVIATIONS

4MP	Marine Mammal Monitoring and Mitigation Plan
AEWC	Alaska Eskimo Whaling Commission
ASRC	Arctic Slope Regional Corporation
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	Blowout Preventer
CAA	Conflict Avoidance Agreement
CFR	Code of Federal Regulations
COCP	Critical Operations and Curtailment Plan
Com Centers	Communication and Call Centers
Discoverer	drillship M/V *Noble Discoverer*
EA	Environmental Assessment
EP	Exploration Plan
EPA	U.S. Department of Interior, Environmental Protection Agency
FONSI	Finding of No Significant Impact National Environmental Policy Act
ft	foot/feet
ICAS	Inupiat Community of the Arctic Slope
IHA	Incidental Harassment Authorization
IMP	Ice Management Plan
in.	inch/inches
km	kilometer/kilometers
LCMF	LCMF Corporation, a division of Ukpeagvik Iñupiat Corporation
LOA	Letter of Authorization
m	meter/meters
mi	statute mile/miles
min	minutes
MMO	Marine Mammal Observer
MMS	Department of the Interior, Minerals Management Service
M/V	Motor Vessel
NMFS	National Marine Fisheries Service
NSB	North Slope Borough

NWAB	Northwest Arctic Borough
OCS	Outer Continental Shelf
ODPCP	Oil Discharge Prevention and Contingency Plan
OSR	oil spill response
POC	Plan of Cooperation
ROV	remotely operated vehicle
SA	Subsistence Advisor
Shell	Shell Offshore Inc.
UIC	Ukpeagvik Iñupiat Corporation
USFWS	United States Fish and Wildlife Service

1.0 INTRODUCTION

Shell Offshore Inc. (Shell) seeks to revise its initial Camden Bay Exploration Plan (EP). The initial Camden Bay EP was submitted to the former U.S. Department of the Interior, Minerals Management Service (MMS) now Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in May of 2009. In this initial EP, Shell identified two blocks (Flaxman Island 6610 and 6658) of interest in two prospects (Sivulliq and Torpedo), that contained two potential drill sites (Sivulliq N and Torpedo H). The initial Camden Bay EP consisted of an exploration drilling program, which would have been conducted during the 2010 drilling season, using the drillship Motor Vessel (M/V) *Frontier Discoverer* now known as the M/V *Noble Discoverer* (*Discoverer*).

The initial Camden Bay EP was deemed submitted by BOEMRE on 10 August 2009. BOEMRE subsequently prepared and distributed an Environmental Assessment (EA) of the proposed exploration drilling program as detailed in the Camden Bay EP, issued a Finding of No Significant Impact (FONSI), and approved the Camden Bay EP on 19 October 2009. Shell was not able to conduct the exploration drilling program in 2010 or 2011 since the exploration activities were postponed when BOEMRE suspended all exploration drilling activities in the Arctic following the Deepwater Horizon incident in the Gulf of Mexico. Pursuant to a revised Camden Bay EP, Shell plans to conduct an exploration drilling program starting in 2012. This revised Camden Bay EP includes the Sivulliq N and Torpedo H location plus two additional wells, Sivulliq G and Torpedo J, which are located in the same area as Sivulliq N and Torpedo H. Shell is proposing to use either the *Discoverer* or the conical drilling unit *Kulluk* (*Kulluk*) but not both to execute this revised Camden Bay EP. Shell has also committed to collecting select waste streams rather than discharging these waste streams into the ocean. Therefore, Shell has prepared a revised Camden Bay EP and has submitted it to BOEMRE for approval.

BOEMRE Lease Sale Stipulation No. 5 (see Attachment A), requires that all exploration operations be conducted in a manner that prevents unreasonable conflicts between oil and gas exploration activities and subsistence resources and activities. This stipulation also requires adherence to United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) regulations, which require an operator to implement a Plan of Cooperation (POC) to mitigate the potential for conflicts between the proposed activity and traditional subsistence activities (50 Code of Federal Regulations [CFR] § 18.124(c)(4) and 50 CFR § 216.104(a)(12)). A POC was prepared and was submitted with the initial Camden Bay EP. The following POC Addendum updates the POC with information regarding proposed changes in proposed exploration drilling program, and documentation of meetings undertaken to specifically to inform the stakeholders of the revised exploration drilling program and obtain their input. The POC Addendum builds upon the previous POC.

The POC identifies the measures that Shell has developed in consultation with North Slope communities and subsistence user groups and will implement during its planned Camden Bay exploration drilling program to minimize any adverse effects on the availability of marine mammals for subsistence uses. In addition, the POC details Shell's communications and consultations with local communities concerning its proposed exploration drilling program beginning in the summer of 2012, potential conflicts with subsistence resources and hunting activities, and means of resolving any such conflicts (50 CFR § 18.128(d) and 50 CFR § 216.104(a) (12) (i), (ii), (iv)). Shell has documented its contacts with North Slope communities, as well as the substance of its communications with subsistence stakeholder groups. Tables summarizing Shell's communications, and responses thereto, are included in Attachment B. This POC may be supplemented, as appropriate, to reflect additional engagements with local subsistence users and any additional or revised mitigation measures that are adopted as a result of those engagements.

Shell's Camden Bay exploration drilling program, planned for the Sivulliq prospect (two drill sites on one lease block) and Torpedo prospect (two drill sites, one on each lease block) in Camden Bay (Figure 1), is set-out in detail in the *Revised Outer Continental Shelf Lease Exploration Plan Camden Bay, Beaufort Sea, Alaska*, and the impacts of the project, as well as the measures Shell will implement to mitigate those impacts, are analyzed in the *Environmental Impact Analysis, Revised Outer Continental Shelf Lease Exploration Plan Camden Bay, Beaufort Sea, Alaska* (EIA). Shell will implement this POC, and the mitigation measures set-forth herein, for its Camden Bay exploration drilling program.

For additional details regarding the exploration drilling program, the reader is directed toward the revised Camden Bay EP and its appendices.

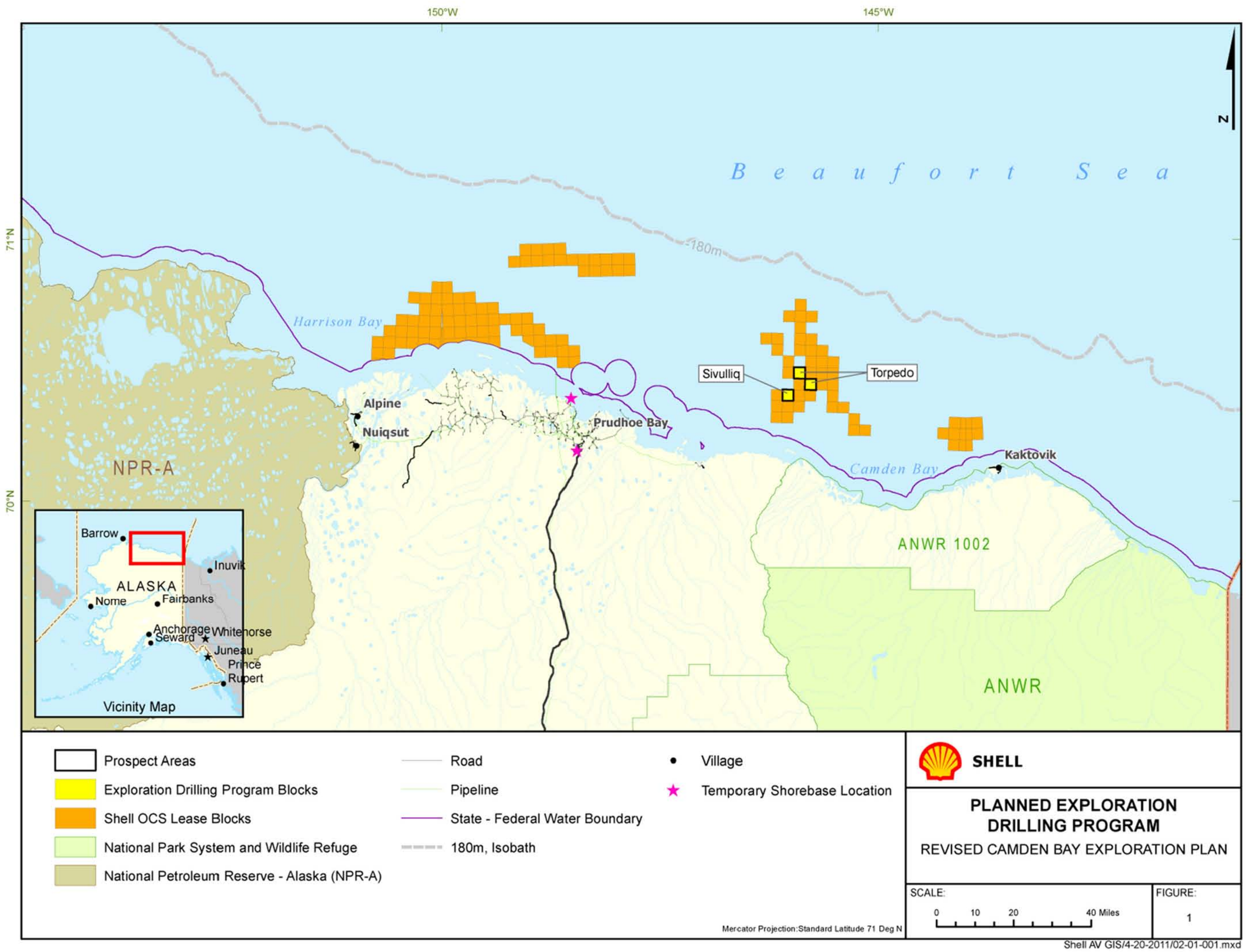
2.0 POC LEASE STIPULATION AND REGULATORY REQUIREMENTS

BOEMRE Lease Sale Stipulation No. 5 (in Attachment A) requires that all exploration operations be conducted in a manner that prevents unreasonable conflicts between oil and gas activities and subsistence resources and subsistence hunting activities of the residents of the North Slope. Specifically, Stipulation No. 5 requires the operator to consult directly with potentially affected North Slope subsistence communities, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC).

Consultation is needed "to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures which could be implemented by the operator to prevent unreasonable conflicts." Stipulation No. 5 also requires the operator to document its contacts and the substance of its communications with subsistence stakeholder groups during the operator's consultation process.

The requirements of Stipulation No. 5 parallel requirements for receipt of a USFWS Letter of Authorization (LOA) and a NMFS Incidental Harassment Authorization (IHA). The LOA and IHA provide authorization for the nonlethal harassment of species protected by the Marine Mammal Protection Act. Both the USFWS and NMFS require an applicant to implement a POC to mitigate the potential for conflicts between the proposed activity and traditional subsistence activities (50 CFR § 18.124(c)(4) and 50 CFR § 216.104(a)(12)). The POC must identify the measures that will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. In addition, both USFWS and NMFS require an applicant to communicate and consult with local subsistence communities concerning the proposed activity, potential conflicts with subsistence activities, and means of resolving any such conflicts (50 CFR § 18.128(d) and 50 CFR § 216.104(a) (12) (i), (ii), (iv)).

Figure 1 Planned Exploration Drilling Program - Revised Camden Bay EP



3.0 MEASURES IN PLACE

The following mitigation measures, plans and programs, are integral to this POC and were developed during consultation with potentially affected subsistence groups, communities, and the NSB. These measures, plans, and programs will be implemented by Shell during its exploration drilling operations in Camden Bay to monitor and mitigate potential impacts to subsistence users and resources. These measures are documented in the following sections:

- Mitigation Measures;
- Exploration Drilling Marine Mammal Monitoring and Mitigation Program (4MP); and
- Interaction and Avoidance Plan for Polar Bear and Pacific Walrus.

3.1 Revised Camden Bay EP Mitigation Measures

The mitigation measures Shell has adopted and will implement during its revised Camden Bay EP exploration drilling operations are listed and discussed below. These mitigation measures reflect Shell's experience conducting exploration activities in Alaska since 2006 and its ongoing consultations with local subsistence communities to better understand their concerns and develop appropriate and effective mitigation measures to address those concerns. Shell's planned mitigation measures have been presented to community leaders and subsistence user groups starting in 2009 and have evolved since in response to comments and concerns expressed during the consultation process. Some mitigation measures appear under more than one sub-heading below, since they are pertinent to more than one "category" of mitigation measures.

3.1.1 Subsistence Mitigation Measures

During each drilling season the *Kulluk* or *Discoverer*, either under tow (*Kulluk*), or by its own propulsion (*Discoverer*) and associated support vessels will transit through the Bering Strait into the Chukchi Sea on or after July 1, arriving on location near Camden Bay approximately July 10. Exploration drilling activities at the drill sites are planned to begin on or about July 10 and run until midnight October 31, with a suspension of all operations beginning August 25 for the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts. During the suspension for the whale hunts the drilling vessel and support fleet will leave the Camden Bay project area and move to an area north of latitude 71^{o} 25'N and west of longitude 146^{o} 4'W. Shell will consult with the Whaling Captain's Associations of Kaktovik and Nuiqsut to ascertain the conclusion of their respective subsistence bowhead whale hunts. Shell will return to resume activities after the subsistence bowhead whale hunts conclude, and depending on ice and weather conditions, continue its exploration activities through 31 October. In addition to the adoption of this project timing restriction, Shell will implement the following additional measures to ensure coordination of its activities with local subsistence users to minimize further the risk of impacting marine mammals and interfering with the subsistence hunt.

Communication, Vessel and Aircraft Travel:

- To minimize impacts on marine mammals and subsistence hunting activities, the drilling vessel and support fleet traversing north through the Bering Strait will transit through the Chukchi Sea along a route that lies offshore of the polynya zone. In the event the transit outside of the polynya zone results in Shell having to break ice (as opposed to managing ice by pushing it out of the way), the drilling vessel and support vessels will enter into the polynya zone far enough so that ice breaking is not necessary. If it is necessary to move into the polynya zone, Shell will notify the local communities of the change in the transit route through the Communication and Call

Centers (Com Centers). As soon as the fleet transits past the ice, it will exit the polynya zone and continue a path in the open sea toward the Camden Bay drill sites.

- Vessels underway will alter course to avoid impacts to marine mammals including possible collisions, stampeding, and exclusion from access to critical resources.
- All vessels must maintain cruising speed not to exceed 9 knots while transiting the Beaufort Sea. This measure would reduce the risk of ship-whale collisions.
- Shell has developed a Communication Plan (See Attachment C) and will implement the plan before initiating exploration drilling operations to coordinate activities with local subsistence users as well as Village Whaling Associations in order to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale migration, as well as the timing and status of other subsistence hunts. The Communication Plan includes procedures for coordination with Com Centers to be located in coastal villages along the Chukchi and Beaufort Seas during Shell's proposed activities.
- Shell will fund the operation of Com Centers in the coastal villages to enable communications between Shell operations and vessels, local subsistence users, and Subsistence Advisors (SAs), thereby notifying the subsistence community of any vessel transit route changes and avoiding conflicts with subsistence activities.
- Shell will employ local SAs from the Beaufort Sea and Chukchi Sea villages to provide consultation and guidance regarding the whale migration and subsistence hunt. The SAs will use local knowledge (Traditional Knowledge) to gather data on subsistence lifestyle within the community and provide advice on ways to minimize and mitigate potential negative impacts to subsistence resources during the drilling season. Responsibilities include reporting any subsistence concerns or conflicts; coordinating with subsistence users; reporting subsistence-related comments, concerns, and information; and advising how to avoid subsistence conflicts. They will work approximately 8-hours per day and 40-hour weeks. SAs must be from a native village located on the North Slope, speak and understand Inupiaq and must have knowledge of subsistence practices for the area. After the initial recruitment and selection of potential candidates, the hiring process will consist of a two-part interview. During the first interview a full description of the job will be given including the schedule, type of work, conditions, and requirements (including drug testing, orientation, and specialized training). The second interview will assess the candidate's previous employment, subsistence hunting experience, communication skills and ensure they have good social skills. Each SA will be based out of their home village and will be given a SA handbook. The SA handbook will give an overview of the program, program objectives, discusses recruitment, hiring, and certification, and details the SA's responsibilities. The handbook will include several forms that the SA will be using along with a Traditional Knowledge Questionnaire and subsistence use maps. The handbook will provide the SA with the information needed to identify situation they are to be alert for, their responsibilities and their authorities.
- Aircraft shall not operate below 1,500 feet (ft) (457 meters [m]) unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or any other emergency situations. Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft (457 m) in areas of active whaling; such areas to be identified through communications with the Com Centers. Except for airplanes engaged in marine mammal monitoring, aircraft shall use a flight path that keeps the aircraft at least 5 miles (mi) (8 kilometers [km]) inland until the aircraft is directly south of its offshore destination, then at that point it shall fly directly north to its destination.

- Shell will also implement non-marine mammal observer (MMO) flight restrictions prohibiting aircraft from flying below 1,500 ft (457 m) altitude (except during takeoffs and landings or in emergency situations) while over land or sea. This flight will also help avoid disturbance of and collisions with birds.

Drilling Operations:

- Shell will collect all drilling mud and cuttings with adhered mud from all well sections below the 26-inch (in.) (20-in. casing) section, as well as treated sanitary waste water, domestic wastes, bilge water and ballast water, and transport them outside the Arctic for proper disposal in an Environmental Protection Agency (EPA) licensed treatment/disposal site. These waste streams will not be discharged to the ocean.
- Drilling mud will be cooled to mitigate any potential permafrost thawing or thermal dissociation of any methane hydrates encountered during exploration drilling if such materials are present at the drill site.
- Drilling mud will be recycled to the extent practicable based on operational considerations (e.g., whether mud properties have deteriorated to the point where they cannot be used further) so that the volume of the mud disposed of at the end of the drilling season is reduced.
- Lighting on the drilling vessel will be shaded and has been replaced with ClearSky lighting. ClearSky lighting is designed to minimize the disorientation and attraction of birds to the lighted drilling vessel to reduce the possibility of a bird collision (*see the Bird Strike Avoidance and Lighting Plan* in Appendix I of the revised Camden Bay EP).

3.1.2 Marine Mammal Mitigation Measures

Marine mammal mitigation measures will utilize MMOs to ensure that drilling and support vessel activities do not disturb marine mammal resources and avoid unreasonable interference with the subsistence hunt of those resources. MMOs will be stationed on all drilling and support vessels to monitor the exclusion zone (areas within isopleths of certain sound levels for different species) for marine mammals. For vessels in transit, if a marine mammal is sighted from a vessel within its respective safety radius, the Shell vessel will reduce activity (e.g., reduce speed and/or change course) and noise level to ensure that the animal is not exposed to sound above their respective safety levels. Full activity will not be resumed until all marine mammals are outside of the exclusion zone and there are no other marine mammals likely to enter the exclusion zone. Regular overflight surveys and support vessel surveys for marine mammals will be conducted to further monitor prospect areas. Shell will also implement flight restrictions prohibiting aircraft from flying below 1,500 ft (457 m) altitude (except during takeoffs and landings or in emergency situations), further reducing the likelihood of impacts.

Anchored vessels will remain at anchor and continue ongoing operations if approached by a marine mammal. The anchored vessel will remain in place and continue ongoing operations to avoid possibly causing avoidance behavior by suddenly changing noise conditions.

For complete MMO protocol refer to the 4MP (Appendix D of the revised Camden Bay EP).

In addition to the use of MMOs, Shell will implement the following measures to avoid disturbances to marine mammals that potentially could rise to the level of incidental take, and ensure coordination of its activities with local subsistence users to minimize further the risk of impacting marine mammals and interfering with the subsistence hunt.

Vessel and Aircraft Travel:

- A 4MP protocol;
- Aircraft will not operate within 1,500 ft (457 m) of whale groups;
- Aircraft and vessels will not operate within 0.5 mi (0.8 km) of walruses or polar bears when observed on land or ice;
- When within 900 ft (274 m) of marine mammals, vessels will reduce speed, avoid separating members from a group and avoid multiple course changes;
- Vessel speed to be reduced during inclement weather conditions in order to avoid collisions with marine mammals;
- Aircraft shall not operate below 1,500 ft (457 m) unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, in poor weather (fog or low ceilings) in an emergency situation. Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft (457 m) in areas of active whaling; such areas to be identified through communications with the Com Centers. Except for airplanes engaged in marine mammal monitoring, aircraft shall use a flight path that keeps the aircraft at least 5 mi (8 km) inland until the aircraft is south of its offshore destination, then at that point it shall fly directly north through the Mary Sachs Entrance to its destination. Shell reserves the option to use an alternative flight route in the event that transit through the Mary Sachs Entrance is unsafe due to weather, other environmental conditions, or in the event of an emergency;
-
- Shell will also implement non-MMO flight restrictions prohibiting aircraft from flying within 1,000 ft (300 m) of marine mammals or below 1,500 ft (457 m) altitude (except during takeoffs and landings or in emergency situations) while over land or sea. This flight will also help avoid disturbance of and collisions with birds;
- The *Kulluk* or *Discoverer* and support vessels will enter the Chukchi Sea through the Bering Strait on or after July 1, minimizing effects on marine mammals and birds that frequent open leads and minimizing effects on spring and early summer bowhead whale hunting. All transit will be coordinated and collaborated with Com Centers as practicable.

Drilling Operations:

- Exploration drilling activities at the Sivulliq or Torpedo drill sites are planned to begin on or about 10 July following transit into the Beaufort Sea and run through 31 October, with a suspension of all operations beginning August 25 for the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts. During the suspension for the whale hunts the drilling vessel and support fleet will leave the Camden Bay project area and move to an area north of latitude 71° 25'N and west of longitude 146° 4'W. Should the drilling vessel or support vessels anchor during the suspension, none will anchor in known environmentally, or archaeologically sensitive areas. Shell will return to resume activities after the subsistence bowhead whale hunts conclude. Exploration drilling activities will be concluded by October 31, depending on ice and weather; and

- During zero-offset vertical seismic profiling (see Section 2.4 of the revised Camden Bay EP Environmental Impact Analysis for details) airguns will be ramped up slowly to warn cetaceans and pinnipeds in the vicinity of the airguns and provide time for them to leave the area and avoid potential injury or impairment of their hearing abilities. A ramp up to the required level will not begin until there has been a minimum of 30 minutes (min) of observation of the safety zone by MMOs to assure that no marine mammals are present. The safety zone is the extent of the 180 decibel (dB) radius for cetaceans and 190 dB for pinnipeds. The entire safety zone must be visible during the 30 min lead-in to an array ramp up. If a marine mammal(s) is sighted within the safety zone during the 30 min watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15-30 min: 15 min for small odontocetes and pinnipeds, or 30 min for baleen whales and large odontocetes.

3.1.3 Mitigation Measures for Operations and Oil Spill Prevention and Response

BOEMRE has concluded that the probability of a large oil spill occurring during an exploration drilling project is extremely remote. Nevertheless, as required by both federal and state regulations, Shell has developed and will implement a comprehensive Oil Discharge Prevention and Contingency Plan (ODPCP) during its exploration drilling operations, in addition to other operations plans including the Ice Management Plan (IMP) and Critical Operations and Curtailment Plan (COCP). The ODPCP will be reviewed and approved by both state and federal regulators to ensure that Shell has the spill response resources necessary to respond to any spill that might occur. While the probability of a spill is very remote, Shell will dedicate all necessary resources to respond to any spill that might occur. In addition to the maintenance and implementation of its ODPCP, Shell will implement the following additional measures to further minimize the risk of a spill that might impact marine mammals and interfere with the subsistence hunt:

- The drilling fleet transit route will avoid known fragile ecosystems, including the Ledyard Bay Critical Habitat Unit, and will include coordination through Com Centers.
- Shell has developed and will implement an IMP to ensure real-time ice and weather forecasting to identify conditions that might put operations at risk and modify its activities accordingly. The IMP also contains ice threat classification levels depending on the time available to suspend exploration drilling operations, secure the well and escape from advancing hazardous ice (see the IMP Appendix K of the revised Camden Bay EP, for details regarding Shell's IMP).
- Ice management will involve preferentially redirecting, rather than breaking, ice floes while the floes are well away from the drill site (see the IMP Appendix K of the revised Camden Bay EP).
- Real time ice and weather forecasting will be from the Shell Ice and Weather Advisory Center.
- Shell has developed and will implement a COCP, which establishes protocols to be followed in the event potential hazards, including ice, are identified in the vicinity of the exploration drilling operations (e.g., ice floes, inclement weather, etc.). Like the IMP, the COCP threat classifications are based on the time available to prepare the well and escape the location. The COCP also contains provisions for not initiating certain critical operations if there is insufficient time available before the arrival of the hazard at the drill site (see the COCP Appendix J of the revised Camden Bay EP).
- Shell has engineered each of its exploration wells (including hole sizing, mud program, casing design, casing cementing depth, hole sizing, and wellhead equipment, etc.) specifically to minimize the risk of uncontrolled flows from the wellbore due to casing or other equipment failures.

- The primary OSR vessel will be on standby at all times when drilling into zones containing oil to ensure that oil spill response capability is available within one hour, if needed.
- Shell will deploy an OSR fleet that is capable of collecting oil on the water up to the calculated Worst Case Discharge flowrate of a blowout in the unlikely event that one should occur. The primary OSR vessel will be on standby when drilling into zones containing oil to ensure that oil spill response capability is available within one hour, if needed. The remainder of the OSR fleet will be fully engaged within 72 hours.
- A polar bear culvert trap has been constructed in anticipation of oil spill response (OSR) needs and will be deployed near Point Thomson or Kaktovik prior to exploration drilling;
- The blowout prevention program will be enhanced through the use of two sets of blind/shear rams, increased frequency of blowout preventor (BOP) performance tests from 14 days to 7 days, a remotely operated vehicle control panel on the seafloor with sufficient pressured water-based fluid to operate the BOP, a containment system that includes treatment and flaring capabilities, capping stack equipment located on one of the ice management vessels and a fully-designed relief well drilling plan and provisions for a second rig (*Kulluk* or *Discoverer*) to be available to drill a relief well if the primary drilling vessel is disabled and not capable of drilling its own relief well.
- In addition to the OSR fleet, oil spill containment equipment will be available for use in the unlikely event of a blowout. The barge will be centrally located in the Beaufort Sea and supported by an Invader Class Tug and possibly an anchor handler. The containment equipment will be designed for conditions found in the Arctic including ice and cold temperatures. This equipment will also be designed for maximum reliability, ease of operation, flexibility and robustness so it could be used for a variety of blowout situations.
- Capping stack equipment will be stored aboard one of the ice management vessels and will be available for immediate deployment in the unlikely event of a blowout. Capping stack equipment consist of subsea devices assembled to provide direct surface intervention capability with the following priorities:
    - Attaching a device or series of devices to the well to affect a seal capable of withstanding the maximum anticipated wellhead pressure and closing the assembly to completely seal the well against further flows (commonly called “capping and killing”)
    - Attaching a device or series of devices to the well and diverting flow to surface vessel(s) equipped for separation and disposal of hydrocarbons (commonly called “capping and diverting”)
- Pre-booming is required for all fuel transfers between vessels (the Fuel Transfer Plan is located in Appendix M of the revised Camden Bay EP).

3.2 Exploration Drilling Marine Mammal Monitoring and Mitigation Program

Under 50 CFR 218.108, NMFS requires any holder of an IHA in Arctic waters to complete monitoring and reporting requirements established in the IHA and published regulations. Additionally, the USFWS requires all applicants for LOAs to conduct monitoring under 50 CFR 18.128. To meet these requirements, a 4MP was developed for the Camden Bay exploration drilling program. The 4MP is designed to avoid, minimize, and mitigate potential adverse impacts to marine mammal subsistence resources that may result from offshore activities. The 4MP for Shell’s exploration drilling activities has been sent to NMFS with the Camden Bay exploration drilling IHA application and is included in Appendix D of the revised Camden Bay EP. The 4MP for the exploration drilling program includes the following provisions:

- MMOs – MMOs will be required to support the transit through the Chukchi Sea and all operations in the Beaufort Sea. The shipboard MMO program is designed to provide real time observations of marine mammals by trained observers from individual vessels to document exposure to industrial activities. MMOs will be present on vessels to monitor for the presence of marine mammals, assist maintenance of marine mammal safety radii around vessels, monitor and record avoidance or exposure behaviors, and communicate with the Com Centers and local subsistence hunters by marine radio. The experience and abilities of the NSB residents in sighting and identifying marine mammals during Shell's exploration programs contributed significantly to the success of Shell's previous monitoring and mitigation program.
- Manned Aerial Program – Aerial surveys to collect information in the vicinity of Camden Bay regarding distribution and abundance of bowhead whales and other marine mammals.
- Acoustic Recorders – A combination of recorder technology, such as pop-up or Directional Autonomous Seafloor Acoustic Recorder buoys, to monitor wide area distribution of marine mammals, specifically bowhead whales, in relation to Shell's proposed activities.
- Sound Modeling – of vessels utilized for exploration drilling activities.
- Sound Source Verification – Field measurement sound propagation profiles of the drilling vessel and support vessels utilized by Shell in the exploration drilling programs in Camden Bay.

3.3 Interaction and Avoidance Plan for Polar Bear and Pacific Walrus

Shell has prepared an interaction and avoidance plan for polar bear and Pacific walrus to meet the requirements of 50 CFR 18.128 for holders of LOAs issued by the USFWS. The plan outlines procedures for mitigating potential impacts to polar bear and Pacific walrus, as well as monitoring program requirements. A copy of the plan for Shell's exploration drilling activities outlined in the revised Camden Bay EP has been sent to the USFWS. Measures in the plan which cover all Shell activities are summarized here.

- New polar bear dens, identified by industry, local residents, and regulatory agencies are reported annually and will be incorporated into project plans to ensure both bear and worker safety. Bear dens discovered during operations will be reported to the designated USFWS representatives.
- Trash will be collected and separated so that all food-associated waste is placed in an appropriate bear-resistant dumpster.
- Hazardous wastes, if generated, would be transported off-site for disposal at an approved facility.
- Employees will be prohibited from directly feeding animals or deliberately leaving food for polar bears and other animals.
- If a polar bear is observed, all on-site personnel will be alerted so that work activities can be altered or stopped to avoid interactions. Personnel will contact the designated USFWS representative whenever a polar bear is sighted. Depending on the distance between the polar bear and the activities this may mean retreating to the safety of vehicles, emergency shelter, temporary buildings, or other safe haven.

- When a polar bear is observed, a designated bear watcher will be assigned to ensure continuous monitoring of the bear's movements. The On-Scene Shell Supervisor will be contacted before any bear hazing activities. Trained polar bear hazers and bear guards will support field operations.
- Exploration Drilling and support vessels will observe a 0.5 mi (0.8 km) exclusion zone around any bear observed on land or ice during transit.
- Aircraft will maintain 1,500 ft (457 m) minimum altitude within, 0.5 mi (0.8 km) of a hauled-out polar bear or Pacific walrus.
- Ice management mitigation measures, such as "ice scouting," will use radar, satellite imagery, observations from support vessels by trained Ice Pilots, and reconnaissance flights to monitor ice movement in areas near the prospect area prior to and during exploration drilling operations. These measures will provide an early warning of bears in the vicinity so appropriate measures can be taken to limit polar bear/human interference.
- Polar bear monitoring, reporting, and survey activities will be conducted in accordance with those outlined in 76 Federal Register 13454.
- Exploration drilling and support vessels will observe a 0.5 mi (0.8 km) exclusion zone around Pacific walrus observed on land or ice during transit.

4.0 AFFECTED SUBSISTENCE COMMUNITY MEETINGS

Affected subsistence communities that were consulted regarding Shell's planned exploration drilling activities in Camden Bay include: Barrow, Nuiqsut, and Kaktovik. Shell conducted POC meetings in the Chukchi Sea communities of Wainwright, Point Lay and Point Hope to discuss a planned Chukchi Sea exploration drilling program, while also describing the mobilization of Camden Bay exploration drilling program vessels through the Chukchi Sea to and from the Beaufort Sea. Additionally, Shell met with subsistence groups including the AEWC, the Nanuuq Commission, the Eskimo Walrus Committee, the Beluga Commission, the Ice Seal Commission, and the Native Village of Barrow, and presented information regarding the proposed activities to the NSB and Northwest Arctic Borough (NWAB) Assemblies, and NSB and NWAB Planning Commissions. Several one-on-one meetings were also held throughout the villages.

4.1 Consultation with Community Leaders

Beginning in early January 2009, Shell held one-on-one meetings with representatives from the NSB, subsistence-user group leadership, the Inupiat Community of the Arctic Slope (ICAS), and Village Whaling Captain Association representatives. These meetings took place at the convenience of the community leaders and in various venues. Meetings were held starting on 12 January 2009 and have continued to date. Shell's primary purpose in holding individual meetings was to inform key leaders, prior to the public meetings, so that they would be prepared to give appropriate feedback on planned activities.

4.2 Community Meeting Summaries

Table 4.2-1 provides a list of public meetings attended by Shell while developing this POC, beginning in 2009 through 2011. Attachment B presents sign-in sheets and presentation materials used at the POC meetings held in 2011 to present the revised Camden Bay EP. Comment analysis tables for numerous meetings held during 2011 summarize feedback from the communities on Shell's planned activities beginning in the summer of 2012. These comments analysis tables, with responses from Shell and corresponding mitigation measures pertinent to the comment are included in Attachment B.

Table 4.2-1 Meeting Dates and Locations

2009	Meeting Location	Meeting Attendees – Position
12-13 January	Barrow	Harry Brower – Whaling Captain, AEWC Chairman and Assistant Director of the NSB Wildlife Department Edward Itta – Whaling Captain and Mayor of the NSB Eugene Brower – Whaling Captain, Arctic Slope Regional Corporation (ASRC) Board Member and President of the NSB Assembly Anthony Edwardsen – Whaling Captain and President of Ukpeagvik Iñupiat Corporation (UIC) Andy Mack – NSB Assistant to the Mayor Harold Curran – NSB Chief Administrative Officer Robert Suydam – NSB Wildlife Department Biologist Cheryl Rosa – NSB Wildlife Department Research Biologist Craig George – NSB Wildlife Department Biologist
21 January	Point Hope	Steve Oommittuk - Mayor of Point Hope
21 January	Barrow	Charlie Hopson – Whaling Captain Representative, LCMF Incorporated employee, and AEWC alternate commissioner in Barrow Adeline Hopson – NSB Assembly Member Deano Oleuman – NSB Assembly Member
21 January	Barrow	Roy Koonuk – AEWC Commissioner and Point Hope Whaling Captain
21 January	Barrow	George Edwardson – Inupiat Community of the Arctic Slope(ICAS) President Juanita Smith – ICAS Natural Resource Director
21 January	Point Hope	Rex Rock Sr.; NSB Assembly Member and Tikiqag Representative
27 January	Kotzebue	Jackie Hill – Maniilaq Association Representative
27 January	Kotzebue	Martha Whiting – Mayor of the NWAB
27 January	Kotzebue	NWAB Assembly Meeting
27 January	Kotzebue	Chuck Greene, EJ Doll Garoutte, Walter Sampson, Gladys Pungowiyi - NANA Representatives
27 January	Kaktovik	Fenton Rexford NSB Assembly Member and Native Village of Kaktovik Executive Director
28 January	Kaktovik	Carla Sims – Kaktovik Vice Mayor
2 February	Barrow	NSB Assembly Workshop
2 February	Barrow	Plan of Cooperation Public Meeting
3 February	Barrow	Janice Meadows – AEWC Executive Director
3 February	Barrow	Vera Williams – Native Village of Barrow Realty Director Joseph Sage – Native Village of Barrow Wildlife Director
5 February	Kaktovik	Plan of Cooperation Public Meeting
4-5 March	Anchorage	AEWC 2009 Conflict Avoidance Agreement (CAA) Negotiations
24 March	Point Hope	Plan of Cooperation Public Meeting
25 March	Kotzebue	Plan of Cooperation Public Meeting
25 March	Kotzebue	NSB/NWAB Joint Planning Commission Meeting
26 March	Wainwright	Plan of Cooperation Public Meeting
2 April	Barrow	ICAS Monthly Meeting
20 April	Barrow	Native Village of Barrow Meeting
22 April	Point Lay	Plan of Cooperation Public Meeting

Table 4.2-1 Meeting Dates and Locations

23 April	Kivalina	Community Meeting
2010	**Meeting Location**	**Meeting Attendees – Position**
14 January	Barrow	ICAS Monthly Meeting
15 January	Anchorage	Eugene Brower – Barrow Whaling Captains Association President
22 January	Anchorage	George Oleuman – Deputy Mayor Eugene Brower – NSB Assembly President Taqulik Hepa – NSB Wildlife Director Bessie O'Rouke – NSB Law Department Marvin Olson – NSB Director Public Works Dan Forster – NSB Planning Director
24 February	Barrow	Plan of Cooperation Public Meeting
25 February	Point Hope	Plan of Cooperation Public Meeting
26 February	Kaktovik	Plan of Cooperation Public Meeting
26 February	Barrow	Edward Itta – Mayor of the NSB
1 March	Wainwright	Plan of Cooperation Public Meeting
2 March	Kotzebue	Community Meeting
5 March	Point Hope	Plan of Cooperation Public Meeting
1 April	Point Lay	Plan of Cooperation Public Meeting
8 April	Barrow	Martha Whiting – Mayor of the NWAB Walter Sampson – NWAB Assembly President
30 April	Barrow	Edward Itta – Mayor of the NSB
1 June	Barrow	NSB Assembly Meeting
1 June	Point Lay	Point Lay Community Meeting
2 June	Barrow	Barrow Community Meeting
3 June	Kaktovik	Kaktovik Community Meeting
8 June	Barrow	Utqiagvik Agviqsiuqtit Aganangich Meeting
8 June	Barrow	Barrow Whaling Captains Association Meeting
24 June	Barrow	NWAB/NSB Joint Planning Commission Meeting
19 July	Barrow	Edward Itta – Mayor of the NSB
3 August	Barrow	NSB Assembly Meeting
7 September	Barrow	NSB Assembly Meeting
23 September	Nuiqsut	Nuiqsut Whaling Captains Association Meeting
23 September	Nuiqsut	Plan of Cooperation Public Meeting
24 September	Barrow	Plan of Cooperation Public Meeting
25 September	Kaktovik	Plan of Cooperation Public Meeting
8 November	Anchorage	Alaska Beluga Whale Committee Meeting
6 December	Anchorage	Alaska Beluga Whale Committee Members Ice Seal Committee Members Alaska Nanuuq Commission Members Eskimo Walrus Commission Members
2011	**Meeting Location**	**Meeting Attendees – Position**
27 January	Barrow	Barrow Whaling Captains Association Meeting
27 February – 2 March	Dutch Harbor	Edith Vorderstrasse – UIC UMIAQ Consulting Division Manager Ray Koonuk, Sr. – Whaling Captain Christopher Oktollik – Whaling Captain John Long, Jr. – Native Village of Point Hope Council Member Joseph Frankson – Whaling Captain Franklin Sage – Native Village of Point Hope Council Member Caroline Cannon – Native Village of Point Hope President Luke Koonook, Sr. – Elder and Whaling Captain Alzred Oomittuk – City of Point Hope Council Member Bessie Kowunna – Shell Point Hope Community Liaison, Tikigaq Board Member, and City Council Member Theodore Frankson – Native Village of Point Hope Staff Aaron Oktollik – AEWC Commissioner for Point Hope and Whaling Captain Carl Brower – Whaling Captain

Table 4.2-1 Meeting Dates and Locations

		Dora Leavitt – City of Nuiqsut Council Member Thomas Napageak – City of Nuiqsut Mayor and Whaling Captain Edgar Kagak – Wainwright Health Board Oliver Peetook – City of Wainwright Vice Mayor Sandra Peetook – City of Wainwright Council Member Joseph Kaleak – AEWC Commissioner for Kaktovik and Whaling Captain George Tagarook – NSB Fire Department Fire Chief and Whaling Captain
28 February – 3 March	Dutch Harbor	William Tracey, Sr. – NSB Planning Commissioner and Point Lay Fire Chief Marie Tracey – NSB Village Liaison Emma Ahvakana – NWAB Assembly Member Enoch Mitchell – Noatak IRA President Ronald Moto, Sr. – Nana Board Member and City of Deering Mayor Cole Schaeffer – Kikiktagruk Inupiat Corporation President & CEO Nellie Wesley – NWAB Planning Commission EPA Assistant Anthony Edwardsen – UIC President/CEO Troy Izat – Tikigaq Corporation COO Susan Harvey – Harvey Consulting, LLC and Consultant to the NSB Thomas Nageak – Barrow Whaling Captain and NSB Cultural Resource Specialist Roy Nageak Jr. – Native Village of Barrow Natural Resource Technician Michael Shults – Barrow City Council Mary Sage –North Slope Borough School District (NSBSD) School Board Member, Ilisagvik College Board Member, and Native Village of Barrow Council Member Robert Suydam – NSB Wildlife Biologist Qaiyaan Opie – ICAS Environmental Director Lloyd Leavitt – City of Barrow Council Member Robert Nageak – City of Barrow Council Member Johnny Aiken – AEWC Executive Director Harry Brower, Jr. – AEWC Chairman
7-8 March	Anchorage	Arctic Open Water Meeting
21 March	Barrow	Plan of Cooperation Public Meeting
22 March	Kaktovik	Plan of Cooperation Public Meeting
23 March	Wainwright	Plan of Cooperation Public Meeting
23 March	Wainwright	Rossman Peetok – AEWC Commissioner for Wainwright Jason Ahmaogak – Wainwright Whaling Captain
24 March	Nuiqsut	Plan of Cooperation Public Meeting
24 March	Nuiqsut	Isaac Nukapigak – AEWC Commissioner for Nuiqsut Herbert Ipalook – President of the Nuiqsut Whaling Captains Association Thomas Napageak – Nuiqsut Whaling Captain Carl Brower – Nuiqsut Whaling Captain Eli Nukapigak – Nuiqsut Whaling Captain
25 March	Point Lay	Plan of Cooperation Public Meeting
28 March	Point Hope	Plan of Cooperation Public Meeting
29 March	Kiana	Community Meeting
30 March	Kotzebue	Community Meeting
31 March	Kivalina	Community Meeting
2 April	Nome	Vera Metcalf – Eskimo Walrus Commission Charlie Johnson – Alaska Nanuuq Commission
5 April	Barrow	NSB Assembly Meeting
7 April	Kotzebue/ Anchorage (Teleconference)	Willie Goodwin – Alaska Beluga Whale Committee
8 April	Anchorage	John Goodwin – Ice Seal Committee
15 April	Anchorage	Vera Metcalf – Eskimo Walrus Commission
25 April	Savoonga	Community Meeting
26 April	Shishmaref	Community Meeting
27 April	Gambell	Community Meeting

4.3 Project Information and Presentation Materials

To present consistent and concise information regarding the planned exploration drilling program, Shell prepared presentation materials (listed below and attached in Attachment B) for meetings with stakeholders across the North Slope.

Camden Bay Exploration Drilling Presentation Summary

- Summary of Shells Science Accomplishments
- Summary and explanation of Shell’s revised Camden Bay EP
- Summary of Shell’s drilling discharge mitigated program
- Summary of Shell’s proposed drill sites for the revised Camden Bay EP

4.4 Meeting Process

Prior to Shell’s public meetings, communities were contacted to determine an optimal meeting date and subsequently notified by public advertising. Meeting notices and flyers were sent to each city council and Native council for public posting well in advance of the meeting dates. Public notices were also published in the *Arctic Sounder*, the local paper that serves most of the North Slope region, and announcements were made on the local radio station KBRW 680 AM and KOTZ 720 AM.

Community meetings are designed to allow the public to voice their concerns and speak one-on-one with project experts. Kiosks manned by subject matter experts were set-up in communities where this form of communication is deemed acceptable to facilitate direct communications, and comment cards supplied for each station. Comment cards with a Shell return address were left with the communities and a toll free phone number and e-mail address were provided in case questions arose after the meeting. Food was provided and door prizes were given out to create a friendly environment and encourage attendance. Every effort was made to ensure the maximum amount of feedback was received and that all questions were addressed and answered to the fullest extent possible.

After each meeting, comment cards were gathered and compiled in a comment analysis table. A separate comment analysis table was completed for each POC meeting, the NSB Assembly Meeting, and each community meeting. These tables are included in Attachment B.

5.0 CONCLUSION

As discussed in Section 4, and detailed in the documents attached here, stakeholders have been provided information relevant to the project and have been invited to offer input on potential environmental, social, and health impacts, as well as and proposed mitigation and conflict avoidance measures. Shell is seeking alignment with stakeholders and, where appropriate and feasible, will incorporate the recommendations of stakeholders into project planning.

As required by applicable lease sale stipulations, as well as anticipated IHA and LOA stipulations, Shell will continue to meet with the affected subsistence communities and users to resolve any conflicts and to notify the communities of any changes in its planned operations. This POC may be supplemented, as appropriate, to reflect additional engagements with local subsistence users and any additional or revised mitigation measures that are adopted as a result of those engagements. Shell respectfully submits that this POC meets its obligations under Stipulation No. 5, as well as the POC requirements established by applicable USFWS and NMFS regulations (50 CFR 216.104, 50 CFR 18.124 and 128).

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Attachment A
OCS Lease Sale 195 and 202 Stipulations

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Leasing Activities Information

MMS

U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

Lease Stipulations
Oil and Gas Lease Sale 195
Beaufort Sea
March 30, 2005

Stipulation No. 1. Protection of Biological Resources
Stipulation No. 2. Orientation Program
Stipulation No. 3. Transportation of Hydrocarbons
Stipulation No. 4. Industry Site-Specific Bowhead Whale-Monitoring Program
Stipulation No. 5. Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities
Stipulation No. 6. Pre-Booming Requirements for Fuel Transfers
Stipulation No. 7. Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eider

Stipulation No. 1. Protection of Biological Resources. If biological populations or habitats that may require additional protection are identified in the lease area by the Regional Supervisor, Field Operations (RS/FO), the RS/FO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RS/FO shall give written notification to the lessee of the RS/FO's decision to require such surveys.

Based on any surveys that the RS/FO may require of the lessee or on other information available to the RS/FO on special biological resources, the RS/FO may require the lessee to:

(1) Relocate the site of operations;
(2) Establish to the satisfaction of the RS/FO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;
(3) Operate during those periods of time, as established by the RS/FO, that do not adversely affect the biological resources; and/or
(4) Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RS/FO and make every reasonable effort to preserve and protect the biological resource from damage until the RS/FO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RS/FO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RS/FO provides written directions to the lessee with regard to permissible actions.

***Stipulation No. 2. Orientation Program*.** The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.203 and 250.204 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the RS/FO. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the sale and adjacent areas. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. This guidance will include the production and distribution of information cards on endangered and/or threatened species in the sale area. The program shall be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee shall maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 5 years. This record shall include the name and date(s) of attendance of each attendee.

***Stipulation No. 3. Transportation of Hydrocarbons*.** Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to recommendations of any advisory groups and Federal, state, and local governments and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of an emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the RS/FO.

***Stipulation No. 4. Industry Site-Specific Bowhead Whale-Monitoring Program*.** Lessees proposing to conduct exploratory drilling operations, including seismic surveys, during the bowhead whale migration will be required to conduct a site-specific monitoring program approved by the RS/FO; unless, based on the size, timing, duration, and scope of the proposed operations, the RS/FO, in consultation with the North Slope Borough (NSB) and the Alaska Eskimo Whaling Commission (AEWC), determine that a monitoring program is not necessary. The RS/FO will provide the NSB, AEWC, and the State of Alaska a minimum of 30 but no longer than 60 calendar days to review and comment on a proposed monitoring program prior to approval. The monitoring program must be approved each year before exploratory drilling operations can be commenced.

The monitoring program will be designed to assess when bowhead whales are present in the vicinity of lease operations and the extent of behavioral effects on bowhead whales due to these operations. In designing the program, lessees must consider the potential scope and extent of effects that the type of operation could have on bowhead whales. Experiences relayed by subsistence hunters indicate that, depending on the type of operations, some whales demonstrate avoidance behavior at distances of up to 35 miles. The program must also provide for the following:

(1) Recording and reporting information on sighting of other marine mammals and the extent of behavioral effects due to operations;
(2) Inviting an AEWC or NSB representative to participate in the monitoring program as an observer;
(3) Coordinating the monitoring logistics beforehand with the MMS Bowhead Whale Aerial Survey Project (BWASP);
(4) Submitting daily monitoring results to the MMS BWASP;
(5) Submitting a draft report on the results of the monitoring program to the RS/FO within 60 days following the completion of the operation (the RS/FO will distribute this draft report to the AEWC, the NSB, the State of Alaska, and the National Oceanic and Atmospheric Administration-Fisheries [NOAA]); and
(6) Submitting a final report on the results of the monitoring program to the RS/FO (the final report will include a discussion of the results of the peer review of the draft report and the RS/FO will distribute this report to the AEWC, the NSB, the State of Alaska, and the NOAA Fisheries).

Lessees will be required to fund an independent peer review of a proposed monitoring plan and the draft report on the results of the monitoring program. This peer review will consist of independent reviewers who have knowledge and experience in statistics, monitoring marine mammal behavior, the type and extent of the proposed operations, and an awareness of traditional knowledge. The peer reviewers will be selected by the RS/FO from experts recommended by the NSB, the AEWC, industry, NOAA Fisheries, and MMS. The results of these peer reviews will be provided to the RS/FO for consideration in final approval of the monitoring program and the final report, with copies to the NSB, AEWC, and the State of Alaska.

In the event the lessee is seeking a Letter of Authorization (LOA) or Incidental Harassment Authorization (IHA) for incidental take from the NOAA Fisheries, the monitoring program and review process required under the LOA or IHA may satisfy the requirements of this stipulation.

Lessees must advise the RS/FO when it is seeking an LOA or IHA in lieu of meeting the requirements of this stipulation and provide the RS/FO with copies of all pertinent submittals and resulting correspondence. The RS/FO will coordinate with the NOAA Fisheries and advise the lessee if the LOA or IHA will meet these requirements.

This stipulation applies to the following blocks for the time periods listed and will remain in effect until termination or modification by the Department of the Interior, after consultation with the NOAA Fisheries and the NSB.

Spring Migration Area: April 1 through June 15

OPD: NR 05-01, Dease Inlet. Blocks included:

6102-6111	6302-6321	6508-6523	6717-6723
6152-6167	6354-6371	6560-6573	
6202-6220	6404-6423	6610-6623	
6252-6270	6455-6473	6659-6673	

OPD: NR 05-02, Harrison Bay North: Blocks included:

6401-6404	6501-6506	6601-6609	6701-6716
6451-6454	6551-6556	6651-6659	

Central Fall Migration Area: September 1 through October 31

OPD: NR 05-01, Dease Inlet. Blocks included:

6102-6111	6354-6371	6610-6623	6856-6873
6152-6167	6404-6423	6659-6673	6908-6923
6202-6220	6455-6473	6706-6723	6960-6973
6252-6270	6508-6523	6756-6773	7011-7023
6302-6321	6560-6573	6806-6823	7062-7073
			7112-7123

OPD: NR 05-02, Harrison Bay North. Blocks included:

6401-6404	6601-6609	6801-6818	7001-7023
6451-6454	6651-6659	6851-6868	7051-7073
6501-6506	6701-6716	6901-6923	7101-7123
6551-6556	6751-6766	6951-6973	

OPD: NR 05-03, Teshekpuk. Blocks included:

6015-6024	6067-6072

OPD: NR 05-04, Harrison Bay. Blocks included:

6001-6023	6157-6173	6309-6324	6461-6471
6052-6073	6208-6223	6360-6374	6513-6519
6106-6123	6258-6274	6410-6424	6565-6566

OPD: NR 06-01, Beechey Point North. Blocks included:

6901-6911	6951-6962	7001-7012	7051-7062
			7101-7113

OPD: NR 06-03, Beechey Point. Blocks included:

6002-6014	6202-6220	6401-6424	6618-6624
6052-6064	6251-6274	6456-6474	6671-6674
6102-6114	6301-6324	6509-6524	6722-6724
6152-6169	6351-6374	6568-6574	6773

OPD: NR 06-04, Flaxman Island. Blocks included:

6301-6303	6451-6459	6601-6609	6751-6759
6351-6359	6501-6509	6651-6659	6802-6809
6401-6409	6551-6559	6701-6709	6856-6859

Eastern Fall Migration: August 1 through October 31

OPD: NR 06-04, Flaxman Island. Blocks included:

6360-6364	6560-6574	6760-6774	6961-6974
6410-6424	6610-6624	6810-6824	7013-7022
6460-6474	6660-6674	6860-6874	7066-7070
6510-6524	6710-6724	6910-6924	7118-7119

OPD: NR 07-03, Barter Island. Blocks included:

6401-6405	6601-6605	6801-6803	7012-7013
6451-6455	6651-6655	6851-6853	7062-7067
6501-6505	6701-6705	6901-6903	7113-7117
6551-6555	6751-6753	6962-6963	

OPD: NR 07-05, Demarcation Point. Blocks included:

6016-6022	6118-6125	6221-6226	6324-6326
6067-6072	6169-6175	6273-6276	

OPD: NR 07-06, Mackenzie Canyon. Blocks included:

6201	6251	6301	6351

***Stipulation No. 5. Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities*.** Exploration and development and production operations shall be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities (including, but not limited to, bowhead whale subsistence hunting).

Prior to submitting an exploration plan or development and production plan (including associated oil-spill contingency plans) to MMS for activities proposed during the bowhead whale migration period, the lessee shall consult with the directly affected subsistence communities, Barrow, Kaktovik, or Nuiqsut, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC) to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures which could be implemented by the operator to prevent unreasonable conflicts. Through this consultation, the lessee shall make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to assure that exploration, development, and production activities are compatible with whaling and other subsistence hunting activities and will not result in unreasonable interference with subsistence harvests.

A discussion of resolutions reached during this consultation process and plans for continued consultation shall be included in the exploration plan or the development and production plan. In particular, the lessee shall show in the plan how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Lessees shall also include a discussion of multiple or simultaneous operations, such as ice management and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for any cumulative affects. Communities, individuals, and other entities who were involved in the consultation shall be identified in the plan. The RS/FO shall send a copy of the exploration plan or development and production plan (including associated oil-spill contingency plans) to the directly affected communities and the AEWC at the time they are submitted to the MMS to allow concurrent review and comment as part of the plan approval process.

In the event no agreement is reached between the parties, the lessee, the AEWC, the NSB, the National Oceanic and Atmospheric Administration - Fisheries (NOAA), or any of the subsistence communities that could be affected directly by the proposed activity may request that the RS/FO assemble a group consisting of representatives from the subsistence communities, AEWC, NSB, NOAA Fisheries, and the lessee(s) to specifically address the conflict and attempt to resolve the issues before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests. Upon request, the RS/FO will assemble this group if the RS/FO determines such a meeting is warranted and relevant before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests.

The lessee shall notify the RS/FO of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns. Lease-related use will be restricted when the RS/FO determines it is necessary to prevent unreasonable conflicts with local subsistence hunting activities.

In enforcing this stipulation, the RS/FO will work with other agencies and the public to assure that potential conflicts are identified and efforts are taken to avoid these conflicts.

Subsistence whaling activities occur generally during the following periods:

August to October: Kaktovik whalers use the area circumscribed from Anderson Point in Camden Bay to a point 30 kilometers north of Barter Island to Humphrey Point east of Barter Island. Nuiqsut whalers use an area extending from a line northward of the Nechelik Channel of the Colville River to Flaxman Island, seaward of the Barrier Islands.

September to October: Barrow hunters use the area circumscribed by a western boundary extending approximately 15 kilometers west of Barrow, a northern boundary 50 kilometers north of Barrow, then southeastward to a point about 50 kilometers off Cooper Island, with an eastern boundary on the east side of Dease Inlet. Occasional use may extend eastward as far as Cape Halkett.

Stipulation No. 6 - Pre-Booming Requirements for Fuel Transfers. Fuel transfers (excluding gasoline transfers) of 100 barrels or more occurring 3 weeks prior to or during the bowhead whale migration will require pre-booming of the fuel barge(s). The fuel barge must be surrounded by an oil-spill-containment boom during the entire transfer operation to help reduce any adverse effects from a fuel spill. This stipulation is applicable to the blocks and migration times listed in the stipulation on Industry Site-Specific Bowhead Whale-Monitoring. The lessee's oil-spill-contingency plans must include procedures for the pre-transfer booming of the fuel barge(s).

Stipulation No. 7. Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eider. In accordance with the Biological Opinion for the Beaufort Sea Lease Sale 186 issued by the U.S. Fish and Wildlife Service (FWS) on October 22, 2002, and FWS's subsequent amendment of the Incidental Take Statement on September 21, 2004, lessees must adhere to lighting requirements for all exploration or delineation structures so as to minimize the likelihood that migrating spectacled or Steller's eiders will strike these structures.

Lessees are required to implement lighting requirements aimed at minimizing the radiation of light outward from exploration/delineation structures to minimize the likelihood that spectacled or Steller's eiders will strike those structures. These requirements establish a coordinated process for a performance based objective rather than pre-determined prescriptive requirements. The performance based objective is to minimize the radiation of light outward from exploration/delineation structures. Measures to be considered include but need not be limited to the following:

- Shading and/or light fixture placement to direct light inward and downward to living and work structures while minimizing light radiating upward and outward;
- Types of lights;
- Adjustment of the number and intensity of lights as needed during specific activities.
- Dark paint colors for selected surfaces;
- Low reflecting finishes or coverings for selected surfaces; and
- Facility or equipment configuration.

Lessees are encouraged to consider other technical, operational and management approaches to reduce outward light radiation that could be applied to their specific facility and operation.

If further information on bird avoidance measures becomes available that suggests modification to this lighting protocol is warranted under the Endangered Species Act to implement the reasonable and prudent measures of the Biological Opinion, MMS will issue further requirements, based on guidance from the FWS. Lessees will be required to adhere to such modifications of this protocol. The MMS will promptly notify lessees of any changes to lighting required under this stipulation.

These requirements apply to all new and existing Outer Continental Shelf oil and gas leases issued between the 156^0 W longitude and 146^0 W longitude for activities conducted between May 1 and October 31. The MMS encourages operators to consider such measures in areas to the east of $146\ ^0$ W longitude because occasional sightings of eiders that are now listed have been made there and because such measures could reduce the potential for collisions of other, non-ESA listed migratory birds that are protected under the Migratory Bird Treaty Act.

Nothing in this protocol is intended to reduce personnel safety or prevent compliance with other regulatory requirements (e.g. U.S. Coast Guard or Department of Occupational Safety and Health) for marking or lighting of equipment and work areas.

Lessees are required to report spectacled and/or Steller's eiders injured or killed through collisions with lease structures to the Fairbanks Fish and Wildlife Field Office, Endangered Species Branch, Fairbanks, Alaska at (907) 456-0499. We recommend that you call that office for instruction on the handling and disposal of the injured or dead bird.

Lessees must provide MMS with a written statement of measures that will be or that have been taken to meet the objective of this stipulation. Lessees must also include a plan for recording and reporting bird strikes that occur during approved activities to the MMS. This information must be included with an Exploration Plan when the EP is submitted for regulatory review and approval pursuant to 30 CFR 250.203. Lessees are encouraged to discuss their proposed measures in a pre-submittal meeting with the MMS and FWS.

Lease Stipulations

Oil and Gas Lease Sale 202
Beaufort Sea
April 18, 2007

Stipulation No. 1. Protection of Biological Resources
Stipulation No. 2. Orientation Program
Stipulation No. 3. Transportation of Hydrocarbons
Stipulation No. 4. Industry Site-Specific Bowhead Whale-Monitoring Program
Stipulation No. 5. Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities
Stipulation No. 6. Pre-Booming Requirements for Fuel Transfers
Stipulation No. 7. Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eider

Stipulation No. 1. Protection of Biological Resources. If biological populations or habitats that may require additional protection are identified in the lease area by the Regional Supervisor, Field Operations (RS/FO), the RS/FO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RS/FO shall give written notification to the lessee of the RS/FO's decision to require such surveys.

Based on any surveys that the RS/FO may require of the lessee or on other information available to the RS/FO on special biological resources, the RS/FO may require the lessee to:

(1) Relocate the site of operations;
(2) Establish to the satisfaction of the RS/FO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;
(3) Operate during those periods of time, as established by the RS/FO, that do not adversely affect the biological resources; and/or
(4) Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RS/FO and make every reasonable effort to preserve and protect the biological resource from damage until the RS/FO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RS/FO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RS/FO provides written directions to the lessee with regard to permissible actions.

Stipulation No. 2. Orientation Program. The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.201 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the RS/FO. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the sale and adjacent areas. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. This guidance will include the production and distribution of information cards on endangered and/or threatened species in the sale area. The program shall be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee shall maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 5 years. This record shall include the name and date(s) of attendance of each attendee.

Stipulation No. 3. Transportation of Hydrocarbons. Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to recommendations of any advisory groups and Federal, state, and local governments and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of an emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the RS/FO.

Stipulation No. 4. Industry Site-Specific Bowhead Whale-Monitoring Program. Lessees proposing to conduct exploratory drilling operations, including seismic surveys, during the bowhead whale migration will be required to conduct a site-specific monitoring program approved by the RS/FO; unless, based on the size, timing, duration, and scope of the proposed operations, the RS/FO, in consultation with the North Slope Borough (NSB) and the Alaska Eskimo Whaling Commission (AEWC), determine that a monitoring program is not necessary. The RS/FO will provide the NSB, AEWC, and the State of Alaska a minimum of 30 but no longer than 60 calendar days to review and comment on a proposed monitoring program prior to approval. The monitoring program must be approved each year before exploratory drilling operations can be commenced.

The monitoring program will be designed to assess when bowhead whales are present in the vicinity of lease operations and the extent of behavioral effects on bowhead whales due to these operations. In designing the program, lessees must consider the potential scope and extent of effects that the type of operation could have on bowhead whales. Experiences relayed by subsistence hunters indicate that, depending on the type of operations, some whales demonstrate avoidance behavior at distances of up to 35 miles. The program must also provide for the following:

(1) Recording and reporting information on sighting of other marine mammals and the extent of behavioral effects due to operations;
(2) Inviting an AEWC or NSB representative to participate in the monitoring program as an observer;
(3) Coordinating the monitoring logistics beforehand with the MMS Bowhead Whale Aerial Survey Project (BWASP);
(4) Submitting daily monitoring results to the MMS BWASP;
(5) Submitting a draft report on the results of the monitoring program to the RS/FO within 60 days following the completion of the operation (the RS/FO will distribute this draft report to the AEWC, the NSB, the State of Alaska, and the National Oceanic and Atmospheric Administration-Fisheries [NOAA]); and
(6) Submitting a final report on the results of the monitoring program to the RS/FO (the final report will include a discussion of the results of the peer review of the draft report and the RS/FO will distribute this report to the AEWC, the NSB, the State of Alaska, and the NOAA Fisheries).

Lessees will be required to fund an independent peer review of a proposed monitoring plan and the draft report on the results of the monitoring program. This peer review will consist of independent reviewers who have knowledge and experience in statistics, monitoring marine mammal behavior, the type and extent of the proposed operations, and an awareness of traditional knowledge. The peer reviewers will be selected by the RS/FO from experts recommended by the NSB, the AEWC, industry, NOAA Fisheries, and MMS. The results of these peer reviews will be provided to the RS/FO for consideration in final approval of the monitoring program and the final report, with copies to the NSB, AEWC, and the State of Alaska.

In the event the lessee is seeking a Letter of Authorization (LOA) or Incidental Harassment Authorization (IHA) for incidental take from the NOAA Fisheries, the monitoring program and review process required under the LOA or IHA may satisfy the requirements of this stipulation. Lessees must advise the RS/FO when it is seeking an LOA or IHA in lieu of meeting the requirements of this stipulation and provide the RS/FO with copies of all pertinent submittals and resulting correspondence. The RS/FO will coordinate with the NOAA Fisheries and advise the lessee if the LOA or IHA will meet these requirements.

This stipulation applies to the following blocks for the time periods listed and will remain in effect until termination or modification by the Department of the Interior, after consultation with the NOAA Fisheries and the NSB.

Spring Migration Area: April 1 through June 15

OPD: NR 05-01, Dease Inlet. Blocks included:

6102-6111	6302-6321	6508-6523	6717-6723
6152-6167	6354-6371	6560-6573	
6202-6220	6404-6423	6610-6623	
6252-6270	6455-6473	6659-6673	

OPD: NR 05-02, Harrison Bay North: Blocks included:

6401-6404	6501-6506	6601-6609	6701-6716
6451-6454	6551-6556	6651-6659	

Central Fall Migration Area: September 1 through October 31

OPD: NR 05-01, Dease Inlet. Blocks included:

6102-6111	6354-6371	6610-6623	6856-6873
6152-6167	6404-6423	6659-6673	6908-6923
6202-6220	6455-6473	6706-6723	6960-6973
6252-6270	6508-6523	6756-6773	7011-7023
6302-6321	6560-6573	6806-6823	7062-7073
			7112-7123

OPD: NR 05-02, Harrison Bay North. Blocks included:

6401-6404	6601-6609	6801-6818	7001-7023
6451-6454	6651-6659	6851-6868	7051-7073
6501-6506	6701-6716	6901-6923	7101-7123
6551-6556	6751-6766	6951-6973	

OPD: NR 05-03, Teshekpuk. Blocks included:

6015-6024	6067-6072

OPD: NR 05-04, Harrison Bay. Blocks included:

6001-6023	6157-6173	6309-6324	6461-6471
6052-6073	6208-6223	6360-6374	6513-6519
6106-6123	6258-6274	6410-6424	6565-6566

OPD: NR 06-01, Beechey Point North. Blocks included:

6901-6911	6951-6962	7001-7012	7051-7062
			7101-7113

OPD: NR 06-03, Beechey Point. Blocks included:

6002-6014	6202-6220	6401-6424	6618-6624
6052-6064	6251-6274	6456-6474	6671-6674
6102-6114	6301-6324	6509-6524	6722-6724
6152-6169	6351-6374	6568-6574	6773

OPD: NR 06-04, Flaxman Island. Blocks included:

6301-6303	6451-6459	6601-6609	6751-6759
6351-6359	6501-6509	6651-6659	6802-6809
6401-6409	6551-6559	6701-6709	6856-6859

Eastern Fall Migration: August 1 through October 31

OPD: NR 06-04, Flaxman Island. Blocks included:

6360-6364	6560-6574	6760-6774	6961-6974
6410-6424	6610-6624	6810-6824	7013-7022
6460-6474	6660-6674	6860-6874	7066-7070
6510-6524	6710-6724	6910-6924	7118-7119

OPD: NR 07-03, Barter Island. Blocks included:

6401-6405	6601-6605	6801-6803	7012-7013
6451-6455	6651-6655	6851-6853	7062-7067
6501-6505	6701-6705	6901-6903	7113-7117
6551-6555	6751-6753	6962-6963	

OPD: NR 07-05, Demarcation Point. Blocks included:

6016-6022	6118-6125	6221-6226	6324-6326
6067-6072	6169-6175	6273-6276	

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Prior to submitting an exploration plan or development and production plan (including associated oil-spill contingency plans) to MMS for activities proposed during the bowhead whale migration period, the lessee shall consult with the directly affected subsistence communities, Barrow, Kaktovik, or Nuiqsut, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC) to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures which could be implemented by the operator to prevent unreasonable conflicts. Through this consultation, the lessee shall make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to assure that exploration, development, and production activities are compatible with whaling and other subsistence hunting activities and will not result in unreasonable interference with subsistence harvests.

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- Low reflecting finishes or coverings for selected surfaces; and
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Lessees must provide MMS with a written statement of measures that will be or that have been taken to meet the objective of this stipulation. Lessees must also include a plan for recording and reporting bird strikes that occur during approved activities to the MMS. This information must be included with an Exploration Plan when the EP is submitted for regulatory review and approval pursuant to 30 CFR 250.201. Lessees are encouraged to discuss their proposed measures in a pre-submittal meeting with the MMS and FWS.

Attachment B
Communication and Consultation with North Slope Subsistence Stakeholders

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TABLE OF CONTENTS

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Issues	Comments	Shell Response	Mitigation Measures*
Credible Science: Baseline Studies	You mentioned the word catastrophe, what's the closest fault line?	There are not active faults in this area but it is a requirement of the BOEMRE that we conduct shallow hazard surveys to ensure that we do not drill through a fault. All of the planned wells are located a good distance away from all faults in the area, and each of those faults is dormant. They have not moved in several million years.	N/A
Baseline Studies	I want to see that-90 foot drop, that hole in the ocean floor. I read a lot of literature of Shell and it's not all exactly what you guys say.	That's why we are having these discussions.	N/A
Biological Environment	What's the polynya zone?	It's an area near the shore where there are open leads along the Chukchi Sea coast with currents where there is a lot of food. The whales follow these currents in the open areas to get their food source.	N/A
Traditional Knowledge	Some large blocks of ice blocked ice from moving from Greenland some time ago.		I
Operational Impacts: Discharge	Can you explain "Cutting after 20" casing"? What is casing?	Casing is the pipe that transmits the cuttings to the surface and keeps the hole from caving in. Cuttings are small chips of rock that the bit grinds up. We capture the cuttings and drilling mud in containers instead of discharging them into the sea. We transport those out of the Arctic for disposal.	K
Drilling	Because of that the amount of drilling, does Shell feel like the expert now because of that?	Shell doesn't just rely on our own internal expertise, we work with people all over the world. We work with all kinds of people even those in communities and with Subsistence Advisors, etc.	E and L
Health & Safety	If one does encounter an emergency will there be Search and Rescue equipment?	Yes. We will have a dedicated helicopter stationed in Barrow to perform search and rescue and evacuation operations.	J

Issues	Comments	Shell Response	Mitigation Measures*
Health & Safety	Can you describe what kind of infrastructure you envision for those programs?	We have a big white hangar in Barrow you may have seen. We will be using this for our air operations for the Chukchi Sea and for search and rescue operations. In Deadhorse, we have a base that is associated with the other infrastructure there for supporting operations in Prudhoe Bay. In the Chukchi Sea we will have a small marine operations station in Wainwright.	J
Health & Safety	What are the minimum guidelines for Shell flying helicopters here? My point is that there were people doing impact contract, due to fog and the minimum safety reason, since you say you're going to have the SAR and with these kinds of deadlines, you will not be able to monitor the ice.	We use the same acronyms for two things. SAR for Synthetic Aperture Radar and for Search and Rescue. We are required to follow the FAA guidelines for aircraft operations including not flying if conditions are below flight minimums. It is no different for our air operations than for anyone else.	J
Ice Management and Monitoring	What is your plan if ice is coming suddenly?	We have a Critical Operations and Curtailment Plan, that includes ice. We have the real time satellite imaging, radar and ice management vessels doing real time ice reconnaissance. The main ice management vessel works from 3-25 miles away from the drill site. The anchor handler works from the drilling vessel to about 5 miles out so we have far and near ice information. If they think we will not be able to manage the ice we will stop drilling, secure the well to make it leak-proof, recover the moorings and move offsite.	I
Ice Management and Monitoring	Has Shell monitored Ellesmere Island ice? It was in the news quite a few years back.	Our ice monitoring is in the area we are operating. We also use the NOAA Ice Center and they are tracking it on a more global basis. Our monitoring is more intensive during our season. The dominant currents in the Arctic tend to move ice toward the ice. If large floes of multi-year ice are entering our area of operation we will be able to track them in a highly detailed manner for several days before they would impact us.	I

Issues	Comments	Shell Response	Mitigation Measures*
Ice Management and Monitoring	BP documented some ice that got stuck in shallow areas a couple years ago.	We are evaluating ice gouging in our lease areas on a yearly basis. This information is really important for development. Our platform must be able to resist the ice and maintain position in the ice all the time we are drilling and producing wells. It is evident that ice frequently grounds on shallow areas like Hanna Shoal and remains there well into the season. These are substantial pieces of ice. We survey the ice by airplane prior to the season and track ice on a daily basis during operations.	I
Ice Management and Monitoring	I have concerns about ice slamming against the platform.	The way we've developed our platforms are conical. They shear the ice and the ice goes around them.	I
Ice Management and Monitoring	The ice that we have up here and the broken pieces that are underneath the water surface will affect you. Your anchor points and your structure underneath. You need to study the glacier ice. There are big pieces of ice that you can't see.	The way we've developed our platforms are conical. They shear the ice and the ice goes around them.	I
Ice Management and Monitoring	I would like to see your plan in place to understand when and how the decisions are made to pack up and move. I want to see on paper who will make the call and it would be very important to get that together. Some days the ice is flat and over night there could be a lot of ridges.	It has to be on paper. We will resubmit our Ice management plan from previous submissions. We are required by the BOEMRE to submit what is called the Critical Operations and Curtailment Plan. Part of this involves hazardous ice that could threaten the drilling vessel. This Ice Management Plan outlines our procedures, and both the state and BOEMRE must approve it before we can drill.	I and L
Ice Management and Monitoring	Do you consider State of Alaska and Federal Government to be experts? If an iceberg came and knocked off the blow out preventer below the seafloor, what would you do? Based on his questions, there is ice that looks invisible and it could come	We must submit our plans to the state and the federal government for approval and issuing permits. They do have expertise in dealing with arctic operations. Shell has also operated in the Arctic for a long time, and we are experts in drilling oil and gas wells in the Arctic. We also need input from the local residents along the coast since you know more about this specific area than anyone. That's one of the reasons we're here: to get your input. The color of the ice is irrelevant to the	I and L

Issues	Comments	Shell Response	Mitigation Measures*
	and cause a problem.	radars that we use for mapping.	
Ice Management and Monitoring	Can you see the thickness of the ice with the satellite? What kind of danger if you can't determine the thickness of the ice?	No, but there are characteristics that tell us when it is multi-year ice and single-year ice. The multi-year ice is constantly tracked. You can tell by the density of it, but we are tracking and we look at subsequent images the direction of the movement.	I
Ice Management and Monitoring	Taking pictures of the water and the currents, if the wells start producing, they will be under the ice seven months out of the year and that's my concern. We need to know which way the currents are going during that time of the season. There is somewhere the currents are going and it will help you track oil, so we can catch it. Especially in the areas where you are.	We have been studying currents for many years, and the trends for oil slick migration (sometimes, toward Russia far offshore in the Chukchi Sea) are important as we plan for response options, anticipate tracking needs, stage shoreline protection equipment, etc.	H and I
Ice Management and Monitoring	There's a different signal that comes back with high-density ice with your ice monitoring methods?	Yes. We can tell from the return radar signals whether it is more dense, meaning multi-year ice, and less dense, meaning first-year ice.	I
Ice Management and Monitoring	On the eastern side of the Beaufort, the ice was all on your tracts. Can you explain that?	There are some heavy ice years, if we can't get out there we can't drill. We have the history of ice accumulations in previous years, and we are aware that there have been years when the ice was very severe. If it is that bad, we simply will not be able to drill that year. That's part of the risk of doing exploration drilling in the Arctic and we accept that risk.	I
Ice Management and Monitoring	Interested in Marine Mammal Observer data from last year. Made point when looking at ice maps that historically there was much more ice than what we are seeing today.	We have the history of ice accumulations in previous years, and we are aware that there have been years when the ice was very severe. If it is that bad, we simply will not be able to drill that year. That's part of the risk of doing exploration well drilling in the Arctic and we accept that risk.	I

Issues	Comments	Shell Response	Mitigation Measures*
Ice Management and Monitoring	I've never seen the ice in the Beaufort Sea that big. I think mother nature was trying to communicate to us. That we have to be very cautious. That ice will keep coming back.	If that is the case we will not get out there to drill. That is a risk we just have to understand and accept.	I
Oil Spill Prevention & Response	At any given time will they have oil spill containment?	We will have an oil spill barge and additional vessel very near the drilling vessel so that we can respond to a spill within 1 hour. There will also be an arctic tanker and a containment vessel that can reach the drilling vessel in a matter of a few days with capping and containment capability.	H and L
Oil Spill Prevention & Response	How often will you be changing your pipes (casing)? Cause that's what caused the GOM spill.	It had to do with a BOP and riser. New regulations require that we have to fully inspect and recertify the entire BOP stack every three to five years.	L
Oil Spill Prevention & Response	What year was your boom manufactured? Are they obsolete? How often do you replace them?	Most of the booms were designed in the last ten to fifteen years. They don't really become obsolete. In the GOM you heard of booms failing. Some of the booms, especially in the shoreline protection mode, were not used properly. The first ones were developed in the early 1970s. They evolved over the last 30-40 years. The life expectancy of a boom depends on how they are being used, and under what kind of conditions. They can get punctured or damaged if used around heavy debris, floating branches, etc.	H
Oil Spill Prevention & Response	That 21-foot Packman boat – is that a standard vessel?	Yes, and it is very reliable for shallow-water transport of equipment, boom handling and anchoring, etc.	H
Oil Spill Prevention & Response	Are those booms made for different types of water, like cold or hot water and ice conditions and so on?	There are different kinds of booms for very specific needs – open ocean, shallow-water, shoreline, river/stream, etc. They are constructed for different purposes, different currents, different degrees	H

Issues	Comments	Shell Response	Mitigation Measures*
		of ice exposure, etc.	
Oil Spill Prevention & Response	Do you have booms that can recover oil under ice? Do boats tow the booms? How will oil be recovered in ice?	It would not be practical to use booms under ice as they could get snagged under the ice, miss oil trapped in the cavities of the under-ice surface, etc. We have other tactics for dealing with oil under ice, including the possible exposure of the oil with vessels, tipping of ice cakes to encourage flow to surrounding water, allowing oil to become entrained within the ice and then accessed later on, etc.	H
Oil Spill Prevention & Response	Do you monitor currents for the boom?	Yes. We are doing a lot of scientific studies on currents right now. There are instruments that are deployed, like upward looking sonar buoys sitting on the sea floor that map the water and currents by sending a sonar signal upward and collecting the reflected data that show currents, temperature differences and salinity. There's a lot of information being gathered in research and traditional knowledge.	H and I
Oil Spill Prevention & Response	Based on the GOM, the boom had water nearshore that went over the top and the waves were not even that big. What is the height of the boom?	Some of the booms in the GOM were used inappropriately in the nearshore/shoreline environment where breaking waves could splash oil over and under the boom. They should be used in relatively quiet water areas - that's what small shoreline protection booms are intended for. All booms have limitations for effective containment when the wind and seas become excessive.	H
Oil Spill Prevention & Response	Will the containment and capping system be ready by 2012?	Yes, it's being developed now and it will be deployed and ready to go for May, 2012.	L
Oil Spill Prevention & Response	The part where the three yellow caps, what kind of suction device will it be using for the containment (containment system slide)?	Our first option would allow for us to latch back onto the wellhead and shut off the flow like what happened on the BP Macondo blowout in the Gulf of Mexico. That's how BP shut off the flow in that well – by capping. The second option, if that connection wasn't available, would be to use one of those domes to collect the oil underwater and pipe it aboard the vessel. Each dome has a pump that will push the oil into separation vessels on the containment vessel where the oil, water and gas will be pulled off. The gas will be flared. The oil will either be collected and offloaded into the tanker or incinerated. The water will be released back into the sea.	L

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	In the 80's when you went out and I wasn't aware and I was actually shocked. We have to tend to those old wells.	Those wells were fully capped.	N/A
Vessel Logistics	Are you constructing a large icebreaker?	Yes, it's a hundred feet longer than the Nanuq. The Nanuq will be in the Chukchi and the new vessel called Hull 247 will be in the Beaufort Sea.	N/A
Vessel Logistics	Between the two drilling locations, will there be traffic between the two locations? Will there be ships going back and forth regularly?	Each drillship will come with its own assets and shouldn't require any transport unless there is an emergency. We will have a shore base in each area with an air operations base between the two seas in Barrow.	A, B, C, D, E, and J
Vessel Logistics	Will there be maritime infrastructure?	No. We will utilize West Dock only. We will have no other marine operations bases in the Beaufort Sea.	N/A
Permits: Process	Offshore development must be done in a way that benefits the local people; in sense of caring for the resources and communities. They are being asked to take the risks but not necessarily getting the benefits. At what point does tribal sovereignty play a role in relation to federal government? How far offshore does this reach? The state is limited to 3 miles, so does sovereignty extend as far as federal?	Thank you for your comment.	N/A
Quality	Based on the fact that there was some secret drilling out there before. How do we trust you people? That drilling that took place.	We have to get permits and we are here. I am not sure what the regulatory regime was at that time in the mid-1980s and early-1990s. We are here in Barrow talking about our plans to be sure you know what we are planning to do. This question was a follow on to a comment that was made that we drilled in the 1980s and 1990s and people in Pt. Hope had no memory of that drilling. This historic drilling	N/A

Issues	Comments	Shell Response	Mitigation Measures*
		was not secret. It was subject to similar permitting and public disclosure and discussion that we have today. The point of the original comment is that the drilling in the 1980s and 1990s did not leave lasting memories of problems or damage.	
Quality of Engagement: Positive/Feedback	Very impressed by Kulluk Visit. 120 photos taken. Copied to CD (got a copy).	Thank you for your comment.	N/A
Positive/Feedback	Just hired on at UMIAQ for spill response, big supporter	Thank you for your comment.	H
Value Proposition: Jobs	I would enjoy joining an oil response team in near future for offshore drilling		N/A

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Credible Science: Air Quality	How is our air quality? Are we going to see more of a Prudhoe Bay or less?	We have new tier-four engines that are very clean. We are replacing the engines on the *Kulluk*. We will have a very clean operation. We will have to monitor the air emissions at a certain level. We will not have a Prudhoe Bay situation.	N/A
Offshore Education: Technology- Containment and Capping	Was that technology available for BP? If it was not and that much technology changes in a year or two, why not wait another five years to drill?	The technology is not new – it has been used for shallow wells since Hurricane Katrina blew over several platforms in the Gulf of Mexico. There is a photograph in the slide presentation showing work using a containment vessel in shallow water in the GOM. There was no similar technology used before the BP Macondo blowout in deep water. The technology that was used was not new, just enhanced for deep water. For shallow water, this technology is not new and it has been used in the past.	L
Operational Impacts: GOM - Macondo	What is the well (reservoir) pressure differences between the deepwater GOM wells and these wells in the Beaufort Sea?	15,000 psi in the GOM versus about 3,000 psi in the Beaufort Sea.	N/A
GOM - Macondo	How many ships did they have in the GOM to response to the Macondo blowout?	There were around 130. It's not about the quantity of ships, but the quality and appropriate use of ships. We have much more storage capacity than is needed based on current understandings of potential recovery. In the Gulf of Mexico there were many vessels that had skimming capability; however, the onboard storage was not always sufficient to handle the volume of oil/emulsion that was available for recovery. Other factors, such as aerial guidance or spotting, oil transfer systems, etc. are important for successful skimming operations.	H and L
GOM - Macondo	Another thing to realize is that they weren't prepared in the GOM, but here they are and they are making every effort to be prepared.	Thank you for your comment.	H and L
GOM - Macondo	Wasn't Shell the cause of the GOM spill?	No. It was BP. And they weren't fully equipped to handle either the blowout or a spill of that magnitude.	H and L
GOM - Macondo	Were any of these vessels used in the GOM oil spill?	None of these ships were used in the GOM.	H and L
Health & Safety	Are we doing any drills to get the people off the rig?	Yes. These drills are part of all marine operations. We will also have dedicated Search and Rescue helicopters available as long as the weather is good to evacuate people. We will also have standby anchor handlers that can house 60-80 people in case of an emergency.	H and J

Issues	Comments	Shell Response	Mitigation Measures*
Health & Safety	How high will the helicopters fly?	1,500 feet, that is the elevation that we were told will not spook the caribou herd. This is a plan and if it doesn't work, we can make adjustments. We can do this with the Subsistence Advisor Program. There is a lot of flexibility. They fly a pattern that will go north, than run 5 miles inside the coast line due east and then fly due south to the drilling vessel. We selected this flight path and the elevation after consultations with the caribou hunters to avoid spooking the herd with our helicopter flights.	G and J
Oil Spill Prevention & Response	We had 95 mile an hour winds here and an iceberg could come at you very fast.	We would not work in severe conditions that put lives at risk. There might have to be a period we wait and track the oil. We look at all response operations and we look at how working in ice and cold water can help us. Cold water does a number of things to oil, it makes oil thicker and the ice can serve as a boom. If you can keep it thick, oil will burn better.	I
Oil Spill Prevention & Response	Do you have skimmers that will work in ice that is 4 feet thick?	We won't be using skimmers in heavy ice. I will show you pictures of what we would do in heavy ice. We are not planning to drill in heavy ice.	H
Oil Spill Prevention & Response	How new are the skimmers? And when were they put on the vessels?	There brand new, some have been in place for the past couple of years.	H
Oil Spill Prevention & Response	Will you use the villages on standby just in case of an oil spill?	Alaska Clean Seas will manage the Village Response Teams and there will be a plan for shoreline cleanup in the highly unlikely event of a spill that will involve the villages.	H
Oil Spill Prevention & Response	I've seen some oil spill boom and they don't work good in rough waters. We get a lot of wind here and you need something that will work here.	Most boom will work effectively in f light to medium waves. You need to work them in a fairly quiet area (if possible), outside of choppy or breaking waves. That's where the challenges are. One tactic is to use the lee side of the ship to create quiet water so the oil can be skimmed from the water's surface, or to tow containment boom with the wind (same direction) to minimize turbulence within the boom.	H
Oil Spill Prevention & Response	Are the booms flexible, will they freeze?	They are very flexible and they have to be durable enough to be able to work in limited ice conditions, and to be able to maneuver between ice cakes with small vessels.	H
Oil Spill Prevention & Response	You said you have ships that will break the waves down?	You operate vessels with the skimmer on the leeward side, if possible, to try to stop breakers from carrying oil over the boom.	H
Oil Spill Prevention & Response	Has this equipment been tested? Where?	A lot of the systems have been tested most recently in extreme northern waters with ice, and in trials with and without ice in large test facilities.	H

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	Has this been tested before in Russia, Iceland or Greenland? Is it theory or are the people here going to be the guinea pigs?	These systems have been tested including booms, skimmers, fire booms and they tested several devices off of Svalbard, Norway, off Canada, and other cold regions. There have been several field tests and tank tests over the past 10 to 15 years.	H and L
Oil Spill Prevention & Response	I saw some pictures where you said you did your Norway recovery tests. You made it sound like you were working in heavy ice. I saw you working with young ice. In your picture it looks like young ice. We need to find equipment that will work in 3-4 feet of ice.	I don't know the pictures you are referring to but the experiments in Norway involved a range of ice concentrations and ice thicknesses. The SINTEF trials, shown in the photos and video at our kiosk help provide insight at to the actual ice conditions in which we have tested equipment for containment, skimming, burning and the use of chemical dispersants.	H
Oil Spill Prevention & Response	Does Shell have any intention to use dispersants? And what are the effects?	We have the capability. We have no intent to use it in the Beaufort Sea where waters could be too shallow. If conditions are right, and their use is approved, dispersants could be used in deeper water where there is good mixing and dilution of the treated oil. If there was a situation where skimmers and booms were not working well because of high wind and sea conditions, the government and industry could make an assessment of the trade-offs of using and not using dispersants, and then approve a limited use of them to test their effectiveness. Right now, mechanical cleanup is preferred, followed by burning, if appropriate.	H
Oil Spill Prevention & Response	Will Alaska Clean Seas continue training sessions with the community to respond to an oil spill?	Yes.	H
Oil Spill Prevention & Response	When you capture the oil can you pump it onto the tankers?	Yes, if we need to store it we can lighter it off the containment barge using other vessels. The tanker has a single-point mooring system meaning that it swings around a bow anchor. We can't tie it to the barge, but we can move the oil from the barge to the tanker using the storage capacity we have in our oil spill response vessels.	H
Vessel Logistics	Are those the same anchors as the ones used on the movie clip that they use on the drillrig?	For the *Kulluk*, we do have some that are a little larger, they are the big anchors, the Sevpris New Generation anchors are 7.5 tons. But, we have 12 anchors instead of 8 like the *Discoverer* in the video clip. We also have some Bruce anchors. They are very large and heavy.	N/A
Vessel Logistics	What are the weights of the anchors?	7.5 tons each and they are about the size of this meeting room, seems like. We pull test all the anchor lines, than we pre-tension each line to keep the drilling vessel right over the well.	N/A
Vessel Logistics	How far offshore are you going to drill?	20 miles.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Threat to Subsistence: Terrestrial Wildlife & Habitat	You're going to be using helicopters in July and August? That's our caribou hunting migration time.	Yes. That is why we have the communication plan and Subsistence Advisors.	A, B, C, D, E, G, and J
Value Proposition: Jobs	I'm the Kaktovik delegate for the North Slope Science Initiative. Will there be Com Centers in Pt. Lay?	Yes.	A and B
North Slope Borough Science Agreement	Of that $5M, will that money be monitored to how it is spent? Who is monitoring the funding? When you give NSB money they tend to only direct it to Barrow.	They will be audited internally on how they spend the funds, and Shell is also auditing too. It has to be high quality science that has to be peer reviewed. Any contract left to doing science is subject to be reviewed by other scientists. The steering committee will be comprised of each coastal committee and the NSB.	N/A

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Credible Science: Baseline Studies	Will the North Slope Science Agreement be affected by the next NSB Mayoral election?	No, it will not. It is separate from politics and is managed by the Wildlife Department. Mayor Itta signed the original document, but the initiative will not be run by the mayor's office. The Wildlife Department will.	N/A
Operational Impacts: Discharge	How will the mitigation (zero discharge) in the Chukchi Sea, will it be comparable to the Beaufort Sea too?	We have chosen zero discharge in the Beaufort because our operations are so much closer to shore. The Chukchi program is many miles from shore unlike the Beaufort Sea well sites.	N/A
Health & Safety	Can we use your boats for whaling?	We will commit our vessels to help anyone who gets into trouble. This is a normal part of marine operations in the open ocean. If you get in trouble during whaling we will be available to help. You can get in touch with our vessels through the Com Centers.	A and B
Oil Spill Prevention & Response	Can you clean oil in broken ice?	Yes, we have had opportunities to clean up oil during small spills and field trials in ice; however, because we have never had a significant spill in the Arctic, we have not tested our large recovery systems under such conditions.	H and K
Oil Spill Prevention & Response	How many times have you cleaned oil on ice?	Numerous times. I have personally cleaned oil in ice 15-18 times over the past 25 to 30 years; but these experiences have, once again, been of relatively small size. Thankfully, we have not had to experience such spill events, and therefore depend upon controlled field trials and tank tests. Generally, efficiencies with some of the latest skimmer designs show efficiencies that are in the 70-80% range. It all comes down to our ability to access the oil when it is mixed with ice.	H and K
Oil Spill Prevention & Response	Will you have a shut-off valve below the surface to stop a flow?	Yes. We have blow out preventers that are located in a mudline cellar below the seafloor. (In a meeting following the presentation, Michael and others were shown a video animation of how the mudline cellar is constructed and how the BOP stack is protected to prevent damage to these valves so they are available to shut off flow from the well if necessary).	K
Oil Spill Prevention & Response	How long will it take to connect the containment system?	It won't be immediate. If you remember the Macando incident, there were damaged risers in the way and had to be removed. It took nearly a month for that debris to be cleared. We will have a crane on site for that purpose so it will probably take 2-3 days maximum to get the	H and K

Issues	Comments	Shell Response	Mitigation Measures*
		capping device in place.	
Oil Spill Prevention & Response	In the meantime will you have equipment to contain the oil in the water?	Yes, we will. We will have skimmers and booms to start gathering to pick it up.	H and K
Oil Spill Prevention & Response	How many oil spill response boats will you have?	We'll have at least six vessels with advanced skimming capability offshore, and many smaller boats that could assist with nearshore and shoreline containment/recovery operations.	H
Oil Spill Prevention & Response	Has this equipment been tested in ice conditions?	Yes, both in actual spills, controlled field trials, and large tank tests with oil.	H and K
Oil Spill Prevention & Response	Are you able to contain the lighter oil that comes up from a spill?	Yes, we have skimmers that can handle a range of oil viscosities from very light low viscosity material to oil and emulsions that could take on the consistency of mayonnaise to something almost as viscous as peanut butter.	H and K
Vessel Logistics	The platform you showed us in ice – does that come in pieces?	Probably 2 pieces with the production and drilling equipment in one piece called "topsides" that sits on top of a base called a "jacket."	N/A
Permits: Process	Obama just announced that he was going to allow drilling in the Arctic. Can that happen without anyone in the communities knowing about it?	We cannot drill without permits and part of those requirements are that we come to the communities and talk about our plans and incorporate those comments into our Exploration Plans.	C
Quality of Engagement: Positive/Feedback	Know that the captain whaler are getting mad not get much whale this year. So that we young elder stand up and let you get the answer. So that why lot's of items pass on. And we take over. So be happy. We young elder take over the oldest Elder, and God bless you all and keep on praying or read bible John 3:16 from: Sister in Christ.	Thank you for your comment.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Positive/Feedback	In favor of oil drilling. Running out of oil and need more.	Thank you for your comment.	N/A
Threat to Subsistence: Marine Mammals	The whales run 60-70 miles offshore there too.	There are some that migrate out there, but for the most part the whale migration expands once the whales pass Barrow. One group goes to the north and ends up in Russian water. Others scatter throughout the Chukchi Sea. In the Beaufort Sea, the entire bowhead whale population travels closer to shore in a corridor that is about 10 miles wide. It turns out that our drilling operations there are very close to the center of that corridor. The whale hunters there have asked that we suspend operations to avoid disruptions to their fall hunts. We will be so far from the shoreline in the Chukchi Sea that we should not impact many whales at all.	A, G, C, D, E, F, and G
Value Proposition: Jobs	Will the money from the Science Program create any temporary jobs?	It is possible – we will get direction from the steering committee and some of the projects may involve local residents participating in field work.	N/A
Jobs	If you have an oil spill will you hire local people?	Yes. Most spills that I've ever worked on have included a heavy reliance upon the expertise and knowledge of the local community.	H
Jobs	Do local oil spill responders need special certification?	Not, necessarily "certification"; however, they do need some training like HAZWOPER. It might be the 40-hour course or it might be as little as 24 hours depending on what the duty of the individual is during the response.	H
Jobs	Do local oil spill responders have to pass a drug test?	Yes.	N/A

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Credible Science: Baseline Studies	Do you have the depth from the surface to the seafloor?	120 feet	N/A
Baseline Studies	The fish come into the river. And they will stop going down the river. When I've flown back and forth between here and Barrow I noticed many rivers. I am trying to understand and I am concerned how it will affect the fish going to the major rivers.	The fish that come up from the rivers for the most part, most of the fish are born in the MacKenzie Delta and they come and move back and forth near the shoreline and they come up the rivers to grow and spend 1-3 years and come back out and go back over to breed in the MacKenzie River. Most of their life cycle is up in the rivers or close to shore. They stay near the ice. Because we will not be discharging any muds, cuttings or sanitary waters, there will not be any pollution. We will not be doing anything onshore, but flying over. There shouldn't be any problem with that, but we are doing scientific evaluations.	J and K
Baseline Studies	Have you studied the currents farther out in the Sivulliq area where the Arctic Cisco migrate to our rivers? There is a lot of fish out there that needs to be studied.	We have been doing fish studies, this year we're working with BOEMRE. There will be another fish study this year. There have been lots of studies close to shore, a total of 30 years on fish. We're doing one farther offshore this year in the Beaufort. We have three years of data in the Chukchi and we will have four years of data after this year. We're looking at currents, ice, plankton, the animals on the seafloor (e.g. clams, coral, fish and mammals). We're looking at many many mammals taking samples and collecting data.	N/A
Offshore Education: Technology	What is the depth from the seafloor to the valve?	It is 8.2 feet for Sivulliq and Torpedo. That's the depth of the deepest ice scour into the seafloor that we've seen in previous year's shallow hazards surveys. The normal ice scour is about three feet deep.	N/A
Technology	If there are large icebergs, can't they scour deeper than 8.2 feet?	It is possible. However, the seafloor north of the Beaufort Sea coast is very flat. So, if a large iceberg that would gouge more than 8.2 feet were to advance toward our drill site, it is likely that it would ground out and stop before it reached us. Also, we have vessels that can divert even a large ice feature so that it would not approach the drill site. Even if the subsea BOP remaining on the wellhead were to be bent or damaged, we will have other plugs	L

Issues	Comments	Shell Response	Mitigation Measures*
		inside the wellbore to keep the well from flowing. The BOP stack is just a safety device; the well is already plugged so it won't flow even if the BOP is sheared completely off. So, the probability of such a large iceberg causing a spill is very, very remote.	
Technology	This looks to be a really good classroom science project. I invite you to the Trapper School. Let's not wait for three years, let's do it this year.	I would like to help out with that. As a follow-up with Dora, it was suggested that basic courses in both drilling and oil spill response might be good topics for discussions with students. Al and Les have taught these classes in schools in other villages in the past. If we are invited, we would be happy to teach these basic classes in Nuiqsut as well.	N/A
Oil Spill Prevention & Response	What is the strength on these booms?	The potential strength on these booms is up to 15,000 pounds or more. When you're towing the booms, the tension on the towlines may only be a few hundred pounds to 1,500 to 2,000 pounds, unless jerked temporarily by a towing vessel. The booms are typically over constructed with robust tension members and fabric to handle occasional high loadings of tension and contact with ice.	H
Operational Impacts: Emissions	There's always a yellow smoke in Prudhoe and it looks like it's going offshore. A yellow haze, does that pollute the ocean?	Yes it does. If it falls in the ocean, it does pollute. This is at very low levels though. We have collected water samples in the Arctic. Though you can certainly detect some of these pollutants, they are at very low levels, below a level that would cause health effects. We are monitoring these levels and will be able to detect if they start going up to levels of concern.	N/A
Emissions	Does the pollution from Prudhoe Bay flares cause harm to the animals in the land and ocean?	There is a possibility that there could be harm but levels are not there yet. But our drilling air emission permits is the strictest standard in the nation. Stricter than any for Prudhoe Bay. Shell Oil has to meet the strictest standards.	N/A
Emissions	Will you catch a disease from the air emissions dissipating on the land and ocean, the Prudhoe Bay yellow haze?	Pollutants can get into the tissues in the fish, if it gets to high levels it could be dangerous. We don't see anything at dangerous levels at this time.	N/A
Emissions	Fish eat other fish and krill. After that yellow haze from Prudhoe Bay dissipates and falls in the ocean and the small krill eat it and the fish eat it.	Thank you for your comment.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Emissions	That yellow haze that we see from Prudhoe and Alpine, she remembers many years ago before there was a haze. She has been to many meetings and expressed her concerns. We have an east and west wind and sometimes we don't have a wind and if there is a southeast wind it will bring the pollution haze to the village.	Thank you for your comment.	N/A
Emissions	I want to thank Shell for coming and answering questions. She realizes that they've already breathed in this pollution from Prudhoe Bay and Alpine. I hope it will be less in the future.	We have really really stringent air permit requirements, the most stringent in the nation. Our air permits are the first ones issued by the EPA since they adopted the new air emissions standards. So our emissions must be control more strictly than anything in the past.	N/A
GOM Macondo	You do your tests in GOM and not here. I don't think you will be able to do it here. They couldn't clean it up in the GOM either.	Keep in mind there is a much higher flow rate in the GOM. If it happens it is only coming up a hundred feet or so and it is coming up at a point or so. In the GOM it could come up at times within a region of 10 by 15 miles, surfacing within existing older slicks. It was hard to know where it would come up, a situation very different from a spill source in only 100 feet of water or less.	H
GOM Macondo	What if you're BOP fails, just like in the GOM? What if your equipment fails and it could be just like the GOM?	In the BP Macondo blowout, the well was drilled to 18,000 ft. We will only be at about 8,000 ft. Reservoir pressure at the Macondo well was nearly 15,000 psi. The wells in the Beaufort Sea will be around 3,000 psi or a little more. We have a 10,000 psi BOP stack with two sets of blind-shear rams instead of one. If the first set of blind-shear rams fail, we have a back-up set to close in the well. We have multiple layers of barriers to prevent flow, and prevention is the key to our planning. We must be responsible and have a plan to respond to any emergency situation, including a spill, but we rely on avoiding all spills through a very thorough prevention program.	H and L
Health & Safety	Other companies say they will stop flying the helicopters, they still fly them.	It will be difficult to sneak out to Camden Bay. A long time ago, we specifically talked to Kaktovik, because they were concerned about the altitude we were flying our helicopters. They requested we fly them at 1,500 feet and not 1,000 feet. We agreed to this and it is in the CAA.	C, G, and J

Issues	Comments	Shell Response	Mitigation Measures*
Ice Management and Monitoring	After you settle your vessel in the Beaufort Sea, if there is any iceberg coming at you, what is the time frame for you to move? We've seen the thick glacier ice. While you're out you might get hit by this.	Typical time is 36 hours to move from the site. We will put cement down the well and plug the well. Then we will disconnect from the well and move offsite. The video shows how we set cement and mechanical plugs in the well, then leave the bottom portion of the BOP stack attached to the well. We can either recover the anchors or use the Rig Anchor Releases to separate the anchor wires from the chain. If we get into a very serious situation, we can suspend the well and move the rig off in six hours or less.	H, I, and L
Ice Management and Monitoring	There is a heavy ice out there in the Beaufort Sea, if there is an oil spill out there and you will not be in control with your vessels.	We have equipment and vessels that are always monitoring the ice. The drilling rig will move offsite if we encounter ice we cannot manage.	H, I, and L
Ice Management and Monitoring	Would there be a phone number for ice updates, so the whalers can find out where the ice is?	Yes, there is a website. We can get something set up to provide that information to the villages. This includes both weather and ice forecasts that are detailed each day and sometimes more often.	I
Ice Management and Monitoring	If you get boxed in from the ice during a spill clean-up, what are you going to do about it?	We have synthetic aperture radar in satellites that look through clouds and fog to help spot approaching ice and keep us from getting boxed in. We also have ice management vessels that work up to 25 miles up-current and upwind to track ice movement. These are also equipped with conventional radar. Further, if we have an emergency situation in progress, we will cease drilling in the other basin and move all of the boats supporting the other drilling vessel. So, instead of just two ice management vessels tracking the ice, we would have four. Instead of two supply vessels assisting in operations, we would have four. We would employ both oil spill fleets. We would be tracking ice with fixed wing and rotary aircraft. If we have a spill we will throw everything we have at it because we want to minimize impacts as much as possible.	I, H and L
Ice Management and Monitoring	So, we can call in for an ice forecast?	Yes, we can put it in the Com Centers. We've thought about putting in a big screen in the Com Centers that reports ice, weather and sea states.	I

Issues	Comments	Shell Response	Mitigation Measures*
Ice Management and Monitoring	Would we be able to see a whale with this synthetic aperture radar. If we lose a whale can they see it in a picture?	We aren't sure if a whale would show up on satellite radar, but it could. It depends on the return signal.	I
Oil Spill Prevention & Response	So the booms will not be ruptured?	I will never say never. It could be torn with bad drivers towing fast in ice. The vessel drivers are trained to know the limitations of the equipment. We have other techniques as well. We have large skimmers that can work within a strong boom, and over-the-side skimmers like rope mops, drum skimmers and weir skimmers that can be placed in pockets of oil trapped by ice.	H
Oil Spill Prevention & Response	How do you get the oil under the ice?	Normally, oil will remain on the water and slide out from below ice cakes. If ice floes are big and trap oil beneath them, vessels can break the ice and expose the oil, they might tip the ice allowing oil to slide and surface next to the ice, or some ice may get trapped and then freeze in quickly, becoming surrounded with ice – we can access that oil later by tracking the oiled ice – skimming it when it surfaces, or burning it in place.	H
Oil Spill Prevention & Response	How about oil in the breathing holes of the bearded seals?	There is such a low likelihood of oil surfacing within those locations; however, we'd monitor for that possibility and work with specialists to take the best course of action to minimize exposure and impact.	A, B, C, E, F, G, H, I, and L
Oil Spill Prevention & Response	Two-percent left could still be a lot of oil, if there is only ninety-eight-percent effectiveness of insitu burning.	The remaining portion, as smoke or floating residue is so very small that such effectiveness is seen as very beneficial. The remaining portions missed are diluted, and dispersed to low levels quickly, and nature continues to work in evaporating and degrading the oil.	H
Oil Spill Prevention & Response	Is there a chemical reaction when you burn the oil, does it get all burned up?	When you burn oil the efficiencies are typically well over 90%, often as high as 98%. We can access the burn residue and recover it if that is the best use of personnel and resources. One weighs the benefits of collecting the residue, taffy-like tar balls with the lighter volatiles burned away, against the time being better used to collect and eliminate other oil slicks in the area.	H

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	So what if the wind changes when you are doing the burns and it is not in your favor?	It takes about a half an hour to eliminate large volumes of oil trapped with a fire boom. The duration of the burn is short, and ignition is always done with careful consideration of where the smoke is likely to go, its direction and duration in light of the proximity of populations that could be nearby. We often insist that burns be at least 3 to 6 miles away.	H
Oil Spill Prevention & Response	Will you be able to recover in a pressure ridge or if it's in a crack with swells? What if there is a blizzard?	Good questions. We look for any barrier, such as ice ridges where oil might be trapped on water along such a ridge – it can sometimes help thicken the oil for recovery with skimmers or with controlled burning. Crack or leads in the ice, if filled with oil also help to enhance the recovery; or, if we can't get to it safely, we'll consider burning it in place. If a blizzard or storm comes up, our first goal is to protect personnel and vessels, and to sometimes simply wait until it is safe to access the oil by tracking the oiled ice and then dealing with it when conditions allow.	H and I
Oil Spill Prevention & Response	You said you would have to wait for the weather, you would have to go another 100 miles with the ice and that would be a lack of time for cleaning up. You can't win against mother nature. While that oil is traveling with the ice, you will have to clean up from end to end.	The ice is keeping it contained and away from shore. You are right, you may have to go 100 miles, but that is just the way it is. We will do whatever needs to be done to track and capture or burn the oil when it is safe to do so.	H and I
Oil Spill Prevention & Response	We will be devastated if that oil is taken in the ice in currents. Especially in the Chukchi Sea, there is heavy ice there.	Equipment had to be built and brought from hundreds of miles away in the GOM. If oil gets away from you, you cannot control the environment. Our first thing is to keep it from ever being released in the ocean.	H and L
Oil Spill Prevention & Response	So you will have a second rig that could be transported to drill a relief well?	Yes. That first rig should be able to drill its own relief well, and we will have two BOPs on each rig so the first rig can start drilling right away. If the rig is disabled, the drilling vessel in the other basin will stop drilling, temporarily abandon the well and mobilize to the drill site and start drilling the relief well in a matter of days. That's the best part about having two drilling vessels available for drilling in the Arctic.	H and L

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	Those blind ram shears will not be activated until the well is plugged right?	Generally, the last thing we do is close the blind shear rams. We have many other means of controlling a flow from a well and multiple barriers in place to avoid a blowout. If we must close the blind shears, cut the pipe and close in the well it means that all of the other measures have already failed. That is a very rare situation.	L
Oil Spill Prevention & Response	When you in-situ burn the oil does it pollute the air and the ocean?	The products of combustion have been studied now for nearly 25 years involving the controlled burning of oil. The duration of a burn is very short, the smoke looks bad, but is only for a brief time and at a high level, reaching very low concentrations within a few hundred meters at ground level, and barely visible concentrations up higher. The fall-out is extremely small, with more than 95% eliminated by combustion during a typical burn. The smoke is part of the trade-off that must be considered when evaluating the net benefit to the environment by burning.	H
Oil Spill Prevention & Response	If you abandon the well you still have a cement plug right?	Yes, we have multiple barriers. We have at least two plugs and we may have a third one. We would also have a cap on the wellhead. With all that, we would have at least five barriers against flow from the well. Again, even without the BOP stack in place, it is unlikely that there would be a spill from a plugged well.	L
Oil Spill Prevention & Response	We live in an area where there are earthquakes. If the earth shakes will it cause a plug to come loose?	It is very unlikely that an earthquake would dislodge a plug. These are very rugged devices. The cement plugs are usually over 100 ft in length and the mechanical plugs, such as a cast iron bridge plug, rarely release due to earthquakes. We have studied this possibility for several years, and I do not know of an earthquake ever causing a properly plugged well to start leaking. We do not locate our wells near faults, if possible. All the faults in the areas where we will be drilling are dormant. If a fault were to cut a well, the well would be effectively sheared off. We have studied wells in California where there are active faults that have cut wells, and there has been no leakage from any of them.	L
Oil Spill Prevention & Response	How do you clean up oil in ice?	We have had opportunities to clean up oil during small spills and field trials in ice; however, because we have never had a significant spill in the Arctic, we have not tested our large recovery systems under such conditions.	H

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	Do these rope mops work?	It is 20 feet across, 20 feet above the water and has 100 feet of mop.	H
Oil Spill Prevention & Response	How do you clean oil? How heavy is the skimmer?		H
Oil Spill Prevention & Response	Is the casing flexible?	Yes. There is a certain amount of flexibility in the pipe. It will bend a certain amount.	N/A
Oil Spill Prevention & Response	What is the length of the booms? How do these booms work?	500 – 1,000 feet is typical for towed U-configurations. When operating with an open-apex system to deflect and release oil at the bottom of the U-configuration, we might use enough boom to achieve up to 750 foot-wide openings to encounter the oil.	H
Oil Spill Prevention & Response	With the currents you will not be able to use your booms.	Currents and ice create enormous forces and challenges so that you don't attempt to control them – you work with them and not fight them. We don't try to drag the ice, you let the boom move with the ice and the ice helps to thicken the oil so you can pick it up better or burn it. With burning you have smoke and that's ugly, but you have to think of the trade-offs. We consider carefully, well in advance, the trade-off of smoke for a few hours in the air, versus not burning that oil, and risking it being in the water or approaching land over a much longer period of time.	H, and I
Quality of Engagement: Insufficient	You talk about this exploration drilling over and over. You might pollute the ocean. You might spill oil and kill the fish. We talk about this over and over.	Thank you for your comment.	H, K and and L
Positive/Feedback	The federal government sold the leases and Shell has to sign a CAA as insurance. They have a policy and money in place, if they spill in the ocean or hurt the ocean. Shell is good they	Thank you for your comment	A, B, C, D, H, I, and L

Issues	Comments	Shell Response	Mitigation Measures*
	sign the CAA, the others do not. They have money to mitigate our hunt. They give money for gas and other things for whaling. Whaling is very expensive. They know this and they are studying the ocean. The federal government gives them the permission to do this in the ocean. The federal government has rules and regulations and they will sign the CAA.		
Threat to Subsistence: Marine Mammals	Vessel traffic adversely impacts the whale hunt. He understands that we will leave on August 24th. Suggest we contact other vessels in the area not associated with our drilling program to request they stay out of the area as well (e.g. Crowley). They do not curtail their operations during whale hunt. May need to be educated and get some encouragement from Shell to stay out of the hunting area for time.	Thank you for your comment.	A, B, C, D, E,and F
Terrestrial Wildlife & Habitat	No wonder we don't have caribou, because of the helicopters.	They signed the CAA and agreed to fly 1,500 feet, they will fly over the land to the east and then go straight out.	A, B, C,and E
Terrestrial Wildlife & Habitat	Can you explain the helicopter route?	Caribou migrates at the coast line, so we agreed to fly.	G and J
Terrestrial Wildlife & Habitat	1,500 feet is loud.	The Federal standard is 500 feet and Shell is going at 1,000 feet more.	G and J
Value Proposition: Jobs	Will you be hiring MMO's from the villages?	Yes. We try to hire the best people we can and the local residents provide the best information available about the areas where we will be working.	E and F
Jobs	We want to have people hired from here. You should come here to train people.	Thank you for your comment.	E and F

Issues	Comments	Shell Response	Mitigation Measures*
Jobs	Give Kuukpik a call, I will get people certified to be MMO's.	If the Nuiqsut Whaling Captains would recommend people from the village to be MMO's that would be very beneficial.	E and F
Jobs	I know there are people that moved to Anchorage and are MMO's, they still have the knowledge and are still qualified for the jobs.	Yes, we agree. Again, if the whaling captains recommend them we would be delighted to talk to them about work regardless of where they live.	E and F
Jobs	These jobs are posted up and because there is a urinary analysis people are not willing to apply for them.	Thank you for your comment.	E and F
Jobs	I agree that most people here in Nuiqsut's biggest problem is that they cannot meet the requirements.	Thank you for your comment.	E and F
Jobs	Would like information about employment and a contact with Shell to discuss this. (erica_k830208@hotmail.com, (907) 590-3830, and (907) 480-2007).	Thank you for your comment.	E and F

Notes:

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"Not applicable" (N/A) is used to designate comments that do not require mitigation measures as a course of action. See Mitigation Measures Index definitions according to assigned letter.

2011 Proposed Mitigation Measures

A-Communication Plan for avoiding conflicts with subsistence users.
B-Collaboration and Communication with Whaling Associations
C-Plan of Cooperation (will work to obtain a CAA)
D-Will honor 2010 Camden blackout dates for Nuiqsut and Kaktovik whaling.
E-Subsistence Advisors based in Chukchi and Beaufort Sea Villages and Kotzebue
F-Marine Mammal Observers
G-Robust Marine Mammal Monitoring Protocol
H-Oil Spill Response Fleet on standby 24/7 near drilling location
I-Real time Ice and Weather Forecasting
J-Crew change by helicopter and collaboration on routes to and from shore base
K-zero discharge of: drilling fluids and cuttings after the 26-in casing; gray and treated black waters; bilge and ballast waters
L-Enhanced blowout prevention and mitigation measures (i.e., second set of blind shear rams, increased frequency of BOP testing, redundant ROV hot stab panel, capping stack and containment system, and relief well plan with designated standby relief well drilling unit).

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Issues	Comments	Shell Response	Mitigation Measures*
Operational Impacts: GOM Macondo	Why did it take so long in the GOM? Won't that happen here?	Our oil spill response fleet will be on site within an hour. BP's had to be mobilized from long distances.	H and K
GOM Macondo	How did those deaths occur and could that have been prevented?	That was a sequence of errors that broke every level of prevention.	H and K
Oil Spill Prevention & Response	Our water is much colder. How do you plan to handle that for oil spill response?	Our technology has to be designed for the service and we have practiced using this equipment in cold weather climates around the world.	H and K
Oil Spill Prevention & Response	What will the containment boom do in our currents?	In 120 feet of water the oil will come to the surface very quickly and we have learned to work with the ice, not against it.	H and I
Oil Spill Prevention & Response	How big is the rope mop skimmer?	It is 20 feet across, 20 feet above the water and has 100 feet of mop.	H
Oil Spill Prevention & Response	What if the oil is trapped under the ice?	New ice will grow and entrap the oil and then we can track it. In the spring, the ice will migrate to the surface of the ice where it can be skimmed or burned.	H and I
Oil Spill Prevention & Response	Were all the oils spills you have worked on Shell's?	No, they weren't Shell's.	H and K
Oil Spill Prevention & Response	Location of domes, quantities, how many response vessels per drilling platform.	It's not about the quantity of ships, but the quality and appropriate use of ships. We have much more storage capacity than is needed based on current understandings of potential recovery.	H and K
Oil Spill Prevention & Response	Where are you planning to drill and how far from this community?	92 miles from Pt. Lay.	NA
Permits: Process	How many companies and agencies are involved?	Coast Guard, BOEMRE, NSB, ADEC, UIC, Alaska Clean Seas.	H
Process	Do you have a permit?	Some activities have yet to happen because there isn't a permit, but many things are already in place because much planning has to be done beforehand.	H and K

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Credible Science: Baseline Studies	There was a question about mitigation and baseline. A seismic program that lasted nine years running from the Canadian border to the Chukchi Sea. Every square inch was analyzed. In 1989, we noticed a lot of seals were sinking from malnutrition. We didn't know what it was from. We accused Red Dog Mine. It wasn't until a couple years ago that we learned about this nine year seismic program that resulted in skinny seals. Now we are going into the third and fourth year of seismic again. There are over 5,000 environmental studies that were done. I would like to see the data and see what the rate of recovery from that data is. Our tomcod has disappeared from our ocean around us. That is what our seals eat. They partially came back last year a little bit. I believed that was mentioned before. Why don't you answer the question before? How do we deal with trying to understand the impact of seismic over the years. NMFS is trying to list them as endangered at the same time they give authorization. I'm confused. How do you take this into consideration? Have you thought about the recovery of these animals from these activities? There's another series of seismic to come. But there was no explanation from NMFS or NOAA when they have questions from years ago. That's part of our food chain, we rely on those seals and they rely on those fish. Is this part of our mitigation?	We do conduct a very large and significant monitoring system of marine mammals and we talk about baseline studies, that benthic, plankton, in the mud on the bottom. We are looking at all of those. For our 4MP, we have recorders that are out there as well, we have airplanes out there, MMO's on every vessel. We've learned a lot over the last three years. The animals tend to move away from activities when there are activities that make noise. They move away for a period of time. Seals react less and bowheads react more. Bowheads get quiet and when the noise stops they will vocalize again. They will move away from noise to protect themselves. They move away and then they go back. I think it's important and it's part of the reason why Shell has entered into this agreement with the NSB, to hear the concerns from the people in the villages and shape science to their concerns. We are getting better and better to reacting and understanding concern. I wasn't here in the 80's and 90's. We have Subsistence Advisors in each of the communities to hear these kinds of things too.	E and G
Baseline Studies	Your studies are done on the areas where you've done seismic after?	We've done seismic at some of these locations. In the Beaufort Sea, we did the studies before the seismic there in some of the locations. Some of the areas we've done studies. For example to answer your question, we did seismic in Burger, we did not do seismic in Hammerhead.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Baseline Studies	That sounds like you are at least looking at it.	Thank you for your comment.	N/A
Baseline Studies	It could mean a case in 15 years?	It would mean a case in 30-50 years. Based on wells that we've drilled here we've seen 3-4 times less pressure than Macondo.	N/A
Baseline Studies	The formation out there is different than Cape Lisburne?	Some of the Lisburne. I don't know much about that and it doesn't seem to be an issue with what we're doing. There is nothing wrong or particularly difficult about where we're drilling.	N/A
Baseline Studies	Can you acknowledge what type of current is there? A whirlpool or	We've been doing several things. We've for the last three years had instruments that have been out all year round. Measuring currents even under the ice. We've deployed a met-ocean buoy that measures the currents. We've worked Oceanic.	N/A
Baseline Studies	Have there been any fluctuations of ice in that area? I've seen publications of the National Science Foundation that we can compare with that data in the past few years.	We're required to do ice gouging studies. We're getting an understanding how frequently ice gouges occur for 15-20 and even100's of years and looking at detail.	N/A
Baseline Studies	And you have that kind of ice gouge data available?	Yes.	N/A
Baseline Studies	How about the NS is known for having fluctuating pressures?	We don't share that opinion. There are other areas that have unknown pressures and fluctuations. Typically when you drill in an area that has been drilled before, and you can run into that. That will not be our case.	N/A
Baseline Studies	Have there been any studies on radioactive plankton?	I don't know. I'm sure there have been oceanographic studies in the 60-70's when they were doing nuclear testing.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Baseline Studies	There are 90 wells in the McKenzie Delta. How many of them were Shell's and what is your experience with them?	Not sure, that would have been operated by our Canadian Group.	N/A
Biological Environment	How deep down at the seafloor will you be drilling?	It's at 120 feet to seafloor.	N/A
Biological Environment	Is this for every hole you drill and how many will that be?	Yes. In the Chukchi Sea drill possibly three and in the Beaufort Sea it's two wells each year.	N/A
Biological Environment	Can you explain how they are the same temperature all year around?	Have you ever gone swimming and it was warm at the surface until you go deeper and you suddenly hit a layer that is cold? Water forms layers called thermoclines that may be warmer or colder and they don't tend to mix unless they are stirred by the wind. So, even if it is very cold on the surface deeper layers may not be that cold because of layering and a lack of mixing.	N/A
Biological Environment	Is there any ice on the ocean bottom?	No, not at those water depths.	N/A
Traditional Knowledge	If you're talking shallow waters in the upper part of the world, there was a lot of land before and it eroded and there is ice coming in. There is erosion along the coast of Alaska.	Thank you for your comment.	C and E
ENGO Opposition: Partnerships	(Question is directed to Earl Kingik) Who brought you here? There's a company here to talk to the community. I haven't seen you for a long time and every time there is industry here you are here. We all don't have jobs and it takes money to travel. You said you were going to follow them around.	I work for Alaska Wilderness League. I work for a Liaison Member to DC to educate our Congress and our House of Representatives to … We cannot let people to push us around anymore. Our aunties and uncles told us to protect our way of life and culture. It was good to see someone from Point Hope go out and do a little tally and say you are invited to tonight's meeting. Maktak or money? Lots of people say maktak. We have a hard time and we want to protect our way of life. Our language is disappearing. Our culture is disappearing. I am here because I love my people.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Offshore Education: Technology	I'm concerned about Santa Barbara. How was that plugged and was that plugged at all? My understanding is that the ground tore.	1969, it was a completely different type of location. I typically know about the seeps that they had and the shallow wells. Natural seeps are found in that area of California. The Santa Barbara event drove changes in the design and hardware that is installed on wells to prevent that type of incident.	K
Technology	How would you cap that Santa Barbara well?	The Santa Barbara well was handled by the operator in coordination with the regulator.	K
Technology	Can you explain what happened to that?	Unocal was the operator, you have land movement and shifting in the area that damaged the subsea of the casing itself. It is also a heavier type oil. It was pretty close to shore. It was in 1969, lots of regulations were changed.	K
Technology	How did they stop the flow at Santa Barbara?	It required well intervention.	K
Technology	What does a formation mean?	More of a solid than a rock.	N/A
Technology	What is a rig?	It's our drilling ship.	N/A
Technology	After that you will be able to develop, for sale?	It will be 10-15 years to development. We're only doing exploration. We drill, look at the results of the wells and look at the project to see if it is supportable. From 7-10 years to develop the project from that. 10 to 15 years. It's a long time away from producing.	N/A
Operational Impacts: Discharge	I understand that the there is no pollution discharge in the Beaufort Sea, is there one in the Chukchi Sea?	Shell has committed to a zero discharge of muds and cuttings and sanitation in the Beaufort Sea. That is our choice; we have not gone to that in the Chukchi Sea. We don't have a zero-discharge policy in the Chukchi Sea today. We have a zero harmful discharge in both seas.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Discharge	Why is there zero discharge in the Beaufort Sea and zero harmful in the Chukchi Sea?	All of the discharge is not harmful. In the Beaufort Sea it is so close to the shore. It is not in the path of the migrating mammals and their food source in the Chukchi Sea.	N/A
Discharge	What is your discharge in three weeks? Zero harmful discharge is million gallons and barrels.	EPA allows 18,000 barrels a day, per well. Our discharge is less than 1% per well.	N/A
Discharge	Each day it will be 2,970 gallons per a day for three wells and it will be 30 days. That will still be a lot. Times three wells. The wells are drilled one at a time. How much discharge will you do per a day per a well? You said 180 barrels a day. It's pretty close to a million.	The way the drillrig works, it will set up in the Chukchi Sea and it will move to another well and drill. At any given time, there will not be more than one well in the Beaufort Sea. If there was more time it would.	N/A
Discharge	Are you including, the sanitation, the oil?	No oil, but treated discharge.	N/A
Discharge	When you flush it where does the drilling muds and cuttings go?	We went back to those wellsites and sampled the mud from those sites and the animals from those sites. You can tell that a well was drilled there. The main reason is because something that's used in this mud called Barite. Barite is a non-toxic agent that comes from the ground and it's put in the mud to make it heavy. Has anyone ever had a digestive tract x-ray? You drink barium, it's used medically, it's non-toxic. We've looked for toxic things in the mud and the animals and . . .	N/A
Discharge	Will you dump your mud off the ships?	There will be some residual chloride, but they will be diluted. Typically we are not dumping whole mud off of the ship. The mud that enters the water is separated on a Shell shaker, the mud gets reused and recycled and it is clinging and goes overboard.	N/A
Discharge	What did you say?	A community member is calculating the discharge total.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
GOM Macondo	Keep in mind, NSB only has 3-5 miles. The ICAS could do the same thing in terms of a science agreement. Work with tribes and work together and it will be easier. Man makes mistakes. Look at Japan. I seen the GOM and how bad it is. We are not ready yet. We will not be ready when time comes. That little boy (pointing at a boy in the audience) might be in charge of oil spill response and my granddaughter might be the president of Shell Oil.	I know you were there. It was very heartbreaking. I'm from the GOM and it was hard to watch. You prevent what happens. It was human error, it could have been prevented. There are no guarantees and there are risks. There are risks to everything. We would like to show you our capping and containment systems.	K
GOM Macondo	Explain how you have ice at the bottom and the temperature is the same as the GOM.	We have instruments that are constantly recording the temperatures. When the air is really cold at the surface, but at the bottom it does not change much. The currents are coming from the Bering Sea and the Pacific Ocean. Even though you get a cold surface temperature. Ice floats, so there would not be ice on the bottom of the ocean. There could be gas hydrates, which are frozen methane because of the high pressure. Since there is no sunlight that penetrates to the deep ocean, there is nothing to warm the water, so it is very cold at deep depths but it doesn't freeze.	N/A
Ice Management and Monitoring	Can you imagine that kind of weather with a couple hundred piles of ice?	It would not happen here.	I
Ice Management and Monitoring	What kind of winds and how fast is that ice traveling (Sakhalin platform in ice video)?	That's real time.	I
Ice Management and Monitoring	What if you have had 90 foot seas?	You won't have that here. It is 15 years away at the soonest. You have to design a structure with engineers that have arctic experience.	I
Ice Management and Monitoring	I want to share a story, where we have a big storm and the ice covered the whole village of Point Hope. You should not underestimate the power of the ice flow.	Thank you for your comment.	I

Issues	Comments	Shell Response	Mitigation Measures*
Ice Management and Monitoring	Have you ever considered using NOAA for ice monitoring?	We do use NOAA resources like the MODIS information. We also use the NOAA Ice Center. But we also do a lot of processing that they don't do because we need more detail than they do. NOAA is very interested in getting the information that we have generated to improve their data set.	I
Ice Management and Monitoring	Where is T-3 it's a large piece of ice that ran ashore five years ago and it broke itself free? It's multiyear ice that has a flow station on it?	There are several ice islands that are in circulation in the Arctic. We are helping to fund drift buoys that are keeping track of where they are.	I
Ice Management and Monitoring	Can we have access to your ice monitoring? It would be very helpful to our whaling.	Yes. There will be a website.	I
Mitigation Measures	What is the meaning of mitigation? I want to know this in Inupiat?	The definition to minimize to lower or decrease any impacts that would occur because we are here.	A, B, C, D, E, F, and G
Oil Spill Prevention & Response	How long will the transit will that take. If you have an accident in the Beaufort Sea and you have to travel from the Chukchi Sea?	Three days. But there will be oil spill response vessels and equipment there with each drillship. We have very big vessels with those drillships. Some of the people in this room went to see one of the drillships and one of the oil spill response vessels.	H and K
Oil Spill Prevention & Response	Are the wells there already?	Yes, they were permanently capped.	H and K
Oil Spill Prevention & Response	You mentioned your BOP will be tested every seven days. Have you started and do you know if they will work in our arctic environment?	When the wells were drilled in the late 80's and 90's they worked fine.	K
Oil Spill Prevention & Response	What is the water temperature difference, and how do the divers dive in the winter?	We are only going to be doing it in open water. We would not be doing it when we have ice or solid ice. At the surface it is much different. In the GOM at 5,000 feet below the sea level it is only 1 degree or so different.	H and K

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	How will you handle divers in the development?	Water temperature is about one degree or so different. The BOPs work in Sakhalin and the North Sea.	K
Oil Spill Prevention & Response	We've heard about many oil spills off Norway.	The recent oil spill in Norway wasn't from drilling. It was from a cargo ship. It was fuel onboard the cargo ship.	H and K
Oil Spill Prevention & Response	That's going to the seafloor at 120 feet for the same water temperature?	Yes.	N/A
Oil Spill Prevention & Response	You are talking about drilling in 2012, how long before you get to the bottom and put out the BOP, will it be twenty days?	To get to where we put in the BOP it will be ten days.	K
Oil Spill Prevention & Response	How long after that will you finally get the oil?	Roughly twenty more days.	K
Oil Spill Prevention & Response	For five years, every time they come they keep bringing different people. Kind of a waste of our time listening to you guys coming here to talk about BOP, prevention taking place, by that time most of us will be gone. If we are a body to give you authority, we will be no less. We wouldn't be thinking about our children and grandchild, they will be observing this after we're gone. Most of us. I would never say, "Hey come and do it now." You say you have safeguards, I cannot say yes to it myself. I am more less going to kill my children and grandchildren. Industry would come and develop and I would be killing my children and grandchildren.	Thank you for your comment.	H and K

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	How do you address the rubber seal in the pipe, that for some reason was to tighten and when they pulled the pipe out it tore the seal. And it came out of the rig? How will you address that? Is there some sort of preventative measure?	They have a diverter that was capturing. The biggest reason that failed, they should have recognized that they had gas above the riser.	K
Oil Spill Prevention & Response	What do you have to detect or monitor that?	To catch that influx get into the riser. That's much easier to do in shallower water. They were in 5,000 feet of water. Shell Layers of Prevention slide. We have instrumentation that would detect that immediately to hold those formation fluids back. The third thing we have is mechanical barriers. On phase four we have a capping and containment system. Our biggest priority is to not let the influx enter the well and happen. We do not plan to get any oil out of these wells.	K
Oil Spill Prevention & Response	If it did leak and it exploded, that oil is going to move fast and it will spread. What type of mitigation or agreement is there to address Pt. Barrow? It's going to hit them before it hits us. Will they come over here to do their whaling?	We have a 25 million dollar good neighbor policy. It is administered by Wells Fargo Bank it is available for immediate use for any kind of verifiable. When you take that money it does not prevent you from taking legal action. You can still participate in a class action suit. You could still take legal action you want.	H and K
Oil Spill Prevention & Response	Where will the Barrow whalers go whaling?	You're presupposing the oil will go to Barrow. I can't do that.	A, B, C, D, E, F, and G
Oil Spill Prevention & Response	Where would the Barrow whalers go?	We don't discuss that in the CAA negotiation. It's never come up with the Barrow Whaling Captains Association.	C
Oil Spill Prevention & Response	What's going to happen to those Barrow whalers? That question was never answered. You're always welcome cousin to come, but we've never really seen it. When was that agreement signed?	We just signed another agreement February of 2011.	C

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	Don't those currents go to Barrow?	Part of it. There's a canyon off of Barrow that is like a bathtub drain. The coastal current will come along the coast and towards Barrow. What's out at Burger, the Hannah Shoal pushes the water to the east and west of it. Jack you mentioned a good point about oil in the Gulf that spread through the water column and did not come to the surface because of the extreme depths. Since our water depths are so shallow in the Chukchi and Beaufort, oil will not spread through the water column and pop in another area. It will all surface near the drilling area where our response fleet will be able to capture it. Our first line of defense is the have spill response vessels.	H and K
Oil Spill Prevention & Response	I would like to thank my Tikigagmiut. It's important for our people, our community, our whaling captains. We have to remember what our elders said. Pete, the majority of us have bad hearing, we don't know what they're really talking about. You heard that elder it has to be in place. I make a recommendation you hire a venue and we would like you to hold your meeting at the Qalgi. Our city government needs money too. I would honor what our elder said. And the meeting was just starting too. I myself, a Tikigagmiut, hunter, Qagmaktuuq. I would say "No development." You show me where those oil spill response crews will come from. They will have two ships. I don't believe it will take three days to get from the Chukchi Sea to the Beaufort Sea. It is less than that. I took a kayak trip. It's good to see you in here, trying to protect our way of life. Pete heard me many times. I speak for these people, our people, the culture that I love the most. We don't know what is going happen with radiation with animals that is contaminated from Japan. The two year Pollock, we got many more. Those adult fish spend time here and go back to Bristol Bay	Thank you for your comment	H and K

Issues	Comments	Shell Response	Mitigation Measures*
	and make more eggs. No activity until you say we can all be protected. I'm a Tikigagmi. We are having problems, we have to be ready for radiation. There might be only three people that come, but they have to make a report. This makes my heart feel. You have an interest in our way of life.		
Oil Spill Prevention & Response	You actually know if the oil is heavier or lighter? What is worse for a blowout?	It's not a function of the type of oil, it's the pressure, the depth. The deeper the water depth the more issues you have access. Working on top of a 500-foot building opposed to a 120 foot building.	H and K
Oil Spill Prevention & Response	How long would it to take to make that decision to cap your well and move offsite?	In the worst case scenario it would take approximately 30 days to drill a relief well, however the capping operation would be much less.	H and K
Oil Spill Prevention & Response	We're talking about the BOP and we're talking about both safety's not working?	Yes, that is correct, but the likelihood of that happening is extremely low.	H and K
Oil Spill Prevention & Response	What's the first safety of the BOP?	We have the levels of prevention.	H and K
Oil Spill Prevention & Response	You said you'll drill three wells in the Chukchi Sea? That's not counting Conoco and the others?	That's correct. We don't know what their plans are.	N/A
Oil Spill Prevention & Response	So will there be companies planning to drill too?	Thank you for your comment.	N/A
Oil Spill Prevention & Response	If they had a spill would your equipment be available to them too?	We are talking to the federal government. We are discussing that they should have their own equipment.	H and K

Issues	Comments	Shell Response	Mitigation Measures*
Oil Spill Prevention & Response	I would like that an oil spill response would be a huge priority. I would think that you would work together.	We've raised the bar pretty high in OSR and the other companies should follow. If they want to go to the same high quality, we would be more than likely to discuss and share with them. I cannot promise anything.	H and K
Oil Spill Prevention & Response	Why can't work with the North Slope Borough? We in other communities when don't even see any of the contracts. Are the wells earthquake resistant? Due to global warming.	Thank you for your comment.	N/A
Oil Spill Prevention & Response	If there is an oil spill would you stop an oil spill by another company?	Let's say Crowley a company delivering fuel runs aground, we would turn around and help them. In regards to stopping our drill, we would have to assess. We do pick up oil as a routine day of business.	H and K
Seismic	I noticed reference to the Sakhalin Island, they were dealing with seismic at that same time. Those animals didn't have a place to go. It's a blanket inventory. We need to see where that seismic went on, to understand. We didn't' know of all the seismic activity. We don't know what the rate of recovery is from this 3-D. There are exemptions from seismic activity. They're exempted from input. There's no recourse. No slowing down or taking another look at a significant impact. There's always a no-finding-of-significant-impact. I don't think Shell was involved, but it was done. And those impacts are there. We have concern of preserving and that our freezers remain at the same level not due to a lack of our knowledge. So that our recovery can take place. We don't want you to have such a big headache. The more that we state info. the less time we have to argue about it. I don't like arguing.	Thank you for your comment.	N/A

Issues	Comments	Shell Response	Mitigation Measures*
Seismic	One question I've been wondering it has to do with the affect on plankton from seismic activity. They are probably disintegrated at impact. Will it change their eating habits or ability to reproduce? You're dragging this machine along the whole ocean, it's been brought up but it is important and we need to find out.	It has been studied in experimental situations where they have an airgun in an enclosed area. Anything within 7 feet can be impacted, but beyond 6-7 feet there is not a noticeable effect. There is a global current that comes into the Chukchi Sea from the Bering. This is one of only a few ways that water enters the Arctic. The plankton that occur in the Chukchi Sea are essentially brought in from the Bering and grow and develop there. So, there is essentially a conveyor belt of plankton constantly moving through the system. If there were impacts they would be very short term as the system replenishes itself.	N/A
Seismic	Will it affect the feeding ground near Greenland?	The waters around Greenland are a mixture of Arctic outflow that mixes with currents coming up from the south. It is very similar, in that the plankton are constantly refreshed and grow rapidly during the open water periods.	N/A
Vessel Logistics	There is going to be a ship in the Beaufort Sea and in the Chukchi Sea and they both will be drilling? And there will be a big storm and they both will get in trouble. What will you have then?	The likelihood is that it will not happen.	I
Vessel Logistics	How far is the drilling rig from shore?	204 miles from Point Hope, 78 from Wainwright and 92 from Point Lay.	N/A
Vessel Logistics	How many icebreakers do you have and will you use? Are they American or are they foreign?	Each drilling vessel has one ice management vessel that is foreign flagged.	N/A

Permits: Process	Do you have all your permits that are required to do offshore activities? Are you sure oil spill response will work? In the past, you just went right in there and started planning without our people. You have to get an IHA, CAA, and Clean Air is a big issue. Do you have all your permits in place? The government might say no, our people might say no. I want to make sure for my people here that you have your permits.	One of the ways we get permits is to come talk to you. There is not a federal agency that would issue a permit, if we didn't come talk to you. We don't have all our permits. We are here because you live on the Chukchi Sea. The federal government and Shell are here to make sure we are acting appropriately.	A, B, C, D, E, F, G, H, I, J, and K
Process	We're having this exploration up here in Alaska, but offshore exploration is not happening on the East or West Coast of the U.S. The eastern states like Rhode Island, the west coast said no. The U.S. Government honored that. Who said yes? We said no. We see this and they honor that and they won't touch. Is it the governor, the senator, the congressman. Those states they say no, they are not drilling over there. Who is saying yes? What's going on now? What did the U.S. Government honor the governor, State of Alaska, Tribes? What's the difference? Do you understand what I'm asking?	First of all, why the Chukchi Sea and Beaufort Sea, the scientist in the industry and government believe there is oil there. Today we discussed onshore, I would love to drill onshore, it would be much easier. We don't want to make things difficult. If we thought it was prospective, but the oil onshore is small quantity. The USGS looked at all the prospective areas. There is no further leasing on the West coast there is oil being produced. When one looks at those areas, the amount of oil is small in comparison to what we see in Alaska. I recognize the people in Point Hope, not all people, in other villages as well. We don't always get the same reception. The people of Wainwright, they're ok with what's been said. When they do polls in Alaska, three of every four people is in favor. That's the way it's worked. It's very important to us. There will never be a time in our lives where all people will agree with us. We can be responsible and drill our wells and work in an exploration process and to development process. We will never be successful, if we don't work with the communities. We will continue to come back and explain until we get a better understanding.	N/A
Process	In 2008, we had a lease sale on the Chukchi Sea. I protested the lease sale cause not even one cent will go to the State of Alaska. We won't even get any money. If you will give money to the State of Alaska and NSB and will you give money to the impacted communities? You gave how many millions to the NSB and State of Alaska? Can I have a big Seattle Seahawks stadium?	The money given to the Borough is meant to be shared with the communities. Concerned residents come to the committee and determine science. Shell is working with congressman Young and Senators Murkowski and Begich. All Borough communities will see significant amounts of revenue through property tax. The pipelines will come onshore and we will continue to pay property tax and put money into the economy that way. We will continue to work with ASRC and Tikigaq to put money in the hands of Alaskans, the Alaskans in this room. That's what we're trying to do.	N/A

Process	NSB can't tax federal waters?	That is correct, but the NSB gets property taxes for pipelines and other facilities onshore.	N/A
Process	Who owns the OCS?	The Federal government.	N/A
Quality	The feds and industry don't have enough scientists and they are not ready.	Thank you for your comment.	N/A
Quality of Engagement: Feedback	To the young people, I want it on the record that we do have experts. I count 5-6 elders here.	Thank you for your comment.	N/A
Insufficient	I want to make sure that you honor the elders request and redo this meeting and because of their hearing issues. Many of them have hearing issues. They don't like to be told to sit here. We respect our elders. If you come into our community you must respect our community. Do an orientation to your staff. You don't disrespect our community. I will always oppose. I say it even now. I would never risk my food I eat.	We will hold another meeting with the proper equipment.	N/A
Insufficient	Is there a recorder? Does Shell have a recorder?	No we don't have one with us, we have staff recording comments and questions.	N/A
Insufficient	I'm an elder here. I tell you all to bring the proper equipment and stuff like that when you are going to hold a meeting. I can't hear nothing. I can't hear good. I just hear mumblings. Get prepared first and talk to us. I would like to postpone this meeting until it's done with a PC system. Nothing wrong with that. You need loud speakers and stuff like that and we want the documents before ahead of time so we can review it. We so move.	We would be happy to come back later and keep going on with the meeting.	N/A
Insufficient	You guys are rich and could come back and forth.	The next time we come we will come with speakers and microphone. Because we have people here right now.	N/A
Insufficient	This is a second meeting that I've heard this complaint. This is what was said in Dutch Harbor.	Thank you for your comment.	N/A

Insufficient	There's no deal. I said it all ready.	We apologize for not having a microphone system. The principal just notified us that their system is down. We will bring a microphone with speakers in the future. There are many people here that have questions and comments and we are going to continue with the meeting.	N/A
Insufficient	Is this part of a POC that is required for your license? What evidence do you have that was asked as questions?	We've never been asked for a recorder and we can bring a recorder. We can send you a copy of the EP that documents all of these questions, our responses and the mitigation measures.	C
Insufficient	A recorder shows what questions have been asked. What is provided to the Feds and the POC is drawn up by your employee. We don't even review what is recorded. It is indisputable. There's something wrong with this. We always hear "We will get back to you." It's time to get beyond this arguing stuff. We need to get beyond this guessing game. I just wonder why you do this time after time without a recorder? It is so simple.	Thank you for your comment.	N/A
Insufficient	Jack has a very good point. You're taking us in circles and we do need answers. I agree with him. Our elders are the ones that need to hear this, we look for guidance from them. We need microphones.	Thank you for your comment.	N/A
Insufficient	All the last meetings that I've attended with industry, we've always had this problem. We have entities with recorders and loud speakers and microphones. If they were offered to be rented, I'm sure they would let you utilize these things. I've been to meetings where people have been able to talk right into a microphone. All you have to do is pay for it and utilize it.	Thank you for your comment.	N/A
Insufficient	Bring microphone system to the next community meeting.	Thank you for your comment.	N/A

Insufficient	Bring a recorder to the next meeting and send a copy of the transcript to the residents.	Thank you for your comment.	N/A
Insufficient	Use simple words in your PowerPoint and oral presentation.	Thank you for your comment.	N/A
Insufficient	I have trouble with the long words. Simple words would give us more understanding. Next time delete it and put simple words.	I will do that.	N/A
Positive/Feedback	Thank you for being here for the community. We've always had someone from the outside protecting our way of life. I have never heard of anyone that has come to explain how you will clean up oil spills in the ocean.	Earl said is it money or is it maktak. The question is do I need to choose? Instead we want people to say "Can I have both?" We want to work with the community for economic justice, where we're supporting people in their current lifestyles. Can I have both and can I take part in this and go forward? This is what we would want you to think about.	N/A
Positive/Feedback	I would like to thank you for continuing the meeting when an elder continued to tell you to stop or end the meeting. I know that this meeting helped inform me. The more meetings to inform our people the closer it will get to begin drilling.	Thank you for your comment	N/A
Positive/Feedback	First all I would like to thank Shell for visiting our community to try and explain your future operating plans and apologize for the few single minded who cannot go beyond their beliefs to even try to understand what is more than likely inevitable for Alaska's future. I worked last summer for ASRC as a Marine Mammal Observer both for Statoil and Shell and from my experience; I believe this can and will be done safely and efficiently as long as the planning is there. I look forward to possibly working again for Shell and will most definitely be a part of the operation for the long run. Thank you.	Thank you for your comment	N/A

Positive/Feedback	We thank you for doing this and helping it come together. There are protocols and guidelines. We need to do it along with Conoco and Statoil, it's better that way. We don't like to work by ourselves either. We don't know how many wells are being done by ConocoPhillips and Statoil. I don't know.	I appreciate you saying you appreciate all the good work that Shell, Conoco and Statoil have done together. We are really proud of our science program. It will have a lot of value in understanding potential impacts and climate change. We are closer now to understanding how this ecosystem works. We have a lot of information that we can provide to you. I need to differentiate between exploration drilling and development. Exploration takes place in three months and number of years and 5,000 studies and ½ billion dollars. Development will require more work. The NSB will be a big help in incorporating the Traditional Knowledge. They will help in knowing what science we need. If we are ever successful.	N/A
Positive/Feedback	That's a good question. That's why we need these meetings to answer our questions.	Thank you for your comment.	N/A
Positive/Feedback	It's not just maktak. It's all the marine mammals in the sea.	Thank you for your comment.	N/A
Protocol	Where there any follow-ups or actions that came up from the last meeting? You should start off each meeting by going through them before with the community.	We document each of the comments and questions and they get put into tables organized in topical order with the comment/question and the response and if there is a mitigation measure that needs to take place it is recorded.	C
Threat to Subsistence: Marine Mammals	How do the animals get Barite in their system?	We've taken very detailed samples. We've gone back and looked and it was done 20 years ago. Today it is even more strict. If we discharge, we discharge much less.	N/A
Value Proposition: Development	Com Centers	Is it your preference that we build our own structure?	A
Development	No. I have no preference.	Our preference would be that we use an existing structure and pay a contract to a local organization.	N/A
Jobs	We want to be included.	Thank you for your comment.	C, E and F

Jobs	What are the Tikigaq contracts?	Waste disposal and compliance.	N/A
Revenue Sharing	When you start drilling, is there any way that Shell can set up shares for the project to the people other than the corporations? Some of the native corporations do not give back to the shareholders. If our people can get shares for the areas that are being drilled, this would be a good way to give back to our people. A lot of times, we don't see any of the money so this would be a good way to give back to the people. For those enrolled in the native village.	Thank you for your comment.	N/A

Notes:
*Mitigation Measures are only assigned to applicable comments.
"Not applicable" (N/A) is used to designate comments that do not require mitigation measures as a course of action. See Mitigation Measures Index definitions according to assigned letter.

2011 Proposed Mitigation Measures
A-Communication Plan for avoiding conflicts with subsistence users.
B-Collaboration and Communication with Whaling Associations
C-Plan of Cooperation (will work to obtain a CAA)
D-Will honor 2010 Camden blackout dates for Nuiqsut and Kaktovik whaling.
E-Subsistence Advisors based in Chukchi and Beaufort Sea Villages and Kotzebue
F-Marine Mammal Observers
G-Robust Marine Mammal Monitoring Protocol
H-Oil Spill Response Fleet on standby 24/7 near drilling location
I-Real time Ice and Weather Forecasting
J-Crew change by helicopter and collaboration on routes to and from shore base
K-Enhanced blowout prevention and mitigation measures (i.e., second set of blind shear rams, increased frequency of BOP testing, redundant ROV hot stab panel, capping stack and containment system, and relief well plan with designated standby relief well drilling unit).

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Issues	Comments	Shell Response	Mitigation Measures*
Cost/Access to Energy: Cost/Access to Energy	Does North Slope oil cost more than other places?	Yes – I can't answer why fuel prices are high in rural Alaska. There have been lots of questions about Native Alaskan populations and we want Native Alaskans to be a significant part of our operations. In Brunei, where I worked before I came here, they had 95% local hire. We call this economic justice. There is a lot of discussion about environmental justice but longer term economic justice is just as important.	N/A
Operational Impacts: GOM Macondo	How did the big spill in Mexico affect everything?	It was a catastrophe for the oil and gas industry. We were very close to drilling last year and had conducted over 450 stakeholder engagements and the more we spoke with communities, the more people felt comfortable with Shell. The president put a moratorium on offshore drilling and the fallout from that accident has continued to follow us. We have to show what we can do not just talk.	H and K
GOM Macondo	The biggest fear people have is a repeat of the GOM accident.	We hear that a lot, people are fearful of oil spill and we have a spill response program to talk about tonight. And one of the most important things is prevention.	H and K
Oil Spill Prevention & Response	Will you have a team ready in case of spill and if you do, do you provide training?	Yes all the personnel have to be trained; We sent some of our personnel from up here to work on the BP spill and they gained experience.	H and K
Oil Spill Prevention & Response	What if you have a spill at the end of the season?	Our equipment can work in a certain amount of ice. We will attempt the capping and containment first and we should be able to control the well before ice becomes too much of a problem.	H and K
Oil Spill Prevention & Response	The ice might help with containment.	Yes the ice can actually help corral the oil.	H and K
Oil Spill Prevention & Response	Are the man made islands safer than the platform?	We really can't use man made islands in water depths higher than 20 feet so when we find production we use what is called concrete gravity based structures.	H and K
Quality of Engagement: Positive/Feedback	This is an excellent presentation very thorough.	Many of the people that helped in the Gulf were from Alaska were from the NANA Region.	N/A
Threat to Subsistence: Marine Mammals	What about whaling season – are you going to stop drilling during the whaling season?	We will have blackout dates in the Beaufort Sea on August 24^{th} and move our drilling rig and boats far offshore and wait until whaling is finished. In the Chukchi, we will continue to work because it is very far offshore.	A, B, C, D, E, F, and G

Issues	Comments	Shell Response	Mitigation Measures*
Value Proposition: Jobs	Do you have any Native people working for you?	We don't have many jobs available because we have not been able to move our program forward, but if we have a drilling program, there will be many jobs and we want Native Alaskans to have most of them.	E and F
Revenue Sharing	Can you give a projection of how Shell's success would affect the NWAB?	There isn't revenue sharing in the OCS but we looked at impacts to the state and nation over 50 years. We found that regionally there would be 4 Billion dollars revenue from taxation and other benefits but the biggest benefit is jobs resulting in $145 billion over that timeframe. It would also impact the whole country.	N/A
Workforce Development	One of the benefits is employment and career opportunities and professional careers. At what time does Shell imagine a project that caters to NWAB and NSB people? There should be a mechanism that kicks in that helps this region because there aren't enough people to fill these jobs. As an Alaskan, I'd like to see this benefit Alaskans first.	Shell has started a program called Avante Guard which certifies teacher's aides with UAA to give them the credentials they need to become professional teachers. We are also working with a group called Polar Pairs which is an exchange program with teachers in Aberdeen. We also support ANSEP. I took a call from Kotzebue about jobs for roustabouts and I also hope there will be jobs in engineering, geologists. We are also trying to attract Native Corporations to build capacity to work offshore. We don't have a large pie now without a drilling program but we want to provide jobs. We have identified that 5th graders are the people that will take advantage of the jobs we will have to offer. The longer we wait, the further out that target moves.	N/A

Notes:

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"Not applicable" (N/A) is used to designate comments that do not require mitigation measures as a course of action. See Mitigation Measures Index definitions according to assigned letter.

2011 Proposed Mitigation Measures

A-Communication Plan for avoiding conflicts with subsistence users.
B-Collaboration and Communication with Whaling Associations
C-Plan of Cooperation (will work to obtain a CAA)
D-Will honor 2010 Camden blackout dates for Nuiqsut and Kaktovik whaling.
E-Subsistence Advisors based in Chukchi and Beaufort Sea Villages and Kotzebue
F-Marine Mammal Observers
G-Robust Marine Mammal Monitoring Protocol
H-Oil Spill Response Fleet on standby 24/7 near drilling location
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K-Enhanced blowout prevention and mitigation measures (i.e., second set of blind shear rams, increased frequency of BOP testing, redundant ROV hot stab panel, capping stack and containment system, and relief well plan with designated standby relief well drilling unit).

Issues	Comments	Shell Response	Mitigation Measures*
Quality of Engagement: Positive/Feedback	A suggestion was made that a good time for Shell to come to Kotzebue would be the Trade Fair on the 8th and 9th of July which is also the Manilaaq annual meeting.	Thank you for your comment.	N/A
Positive/Feedback	Another suggestion was made for Shell to participate in the Spring Clean Up by donating bikes. Sponsors get a lot of publicity.	Thank you for your comment.	N/A

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Issues	Comments	Shell Response	Mitigation Measures*
Operational Impacts: Oil Spill Prevention & Response	Have you used the capping and containment system in the Arctic?	We have used this equipment in many other places but we will fully test the equipment here before it is used.	K
Oil Spill Prevention & Response	Will you test the equipment during bad weather?	Yes we will test the equipment during all conditions we could imagine but if the weather gets too bad, we will suspend operations.	I, H, and K
Oil Spill Prevention & Response	How would you deal with an oil spill in ice?	We have equipment that is designed to operate in ice.	I, H, and K
Permits: Timing	You said there wouldn't be any activities in 2011. Is your decision related to HB 210?	No we made our decision before that bill was introduced.	N/A

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Issues	Comments	Shell Response	Mitigation Measures*
Operational Impacts: Discharge	Will Shell also do the zero harmful discharge in the Chukchi where whales migrate like the Beaufort Sea?	We will not do zero volume discharge, we will be doing a zero harmful discharge of our muds and cuttings. We have looked back at the past wells from the 80's and 90's and have not found any significant change to the ocean flora, etc.	L
Quality of Engagement: Positive/Feedback	When will Shell host more meetings in Wainwright? I've been hearing back from youth there that they see the potential opportunity for careers. I would like to see Shell involved with the schools.	Shell experts would like to come out the village schools and work with youth. We would be able to do that.	N/A
Positive/Feedback	Shell is getting close to developing a partnership with NSB. I have concern about having two rigs working at the same time. There are some challenges there. I continue to see OSPR, discharge, air etc. as issues that will continue to come up in your programs.	Thank you for your comment.	K and L
Value Proposition: Workforce Development	Wants us to expand our job opportunities outside of Marine Mammal Observers and Subsistence Advisor's and Communication and Call Center Operators.	Thank you for your comment.	N/A

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I-Real time Ice and Weather Forecasting

J-Crew change by helicopter and collaboration on routes to and from shore base

K-zero discharge of: drilling fluids and cuttings after the 26-in casing; gray and treated black waters; bilge and ballast waters

L-Enhanced blowout prevention and mitigation measures (i.e., second set of blind shear rams, increased frequency of BOP testing, redundant ROV hot stab panel, capping stack and containment system, and relief well plan with designated standby relief well drilling unit).

Science Accomplishments:

Aspects of the Shell science program that reflect input and requests from the North Slope Borough

Acoustic program in both the Chukchi and Beaufort

- Initiated in 2006 with CPAI & GXT
- Continued since that date with > $10 million expended
- Despite setbacks, this is one of the biggest acoustic monitoring programs globally
- Generated greater understanding of many marine mammal species including walrus and bowhead movements

Chukchi Sea aerial program

- 2006-2010 conducted aerial surveys within 25 miles of the Chukchi coast
- About $10 million expended to date
- The first to document walrus haulouts on the Alaska Chukchi coast
- Documented downcoast (Barrow to Wainwright) movement of migrating bowheads

Chukchi Sea Baseline studies

- 2008- 2010 added an extensive baseline program with CPAI, COMIDA, and others
- Includes – birds, mammals, plankton, benthos, contaminants, fishes, physical parameters
- Initiated following Mayor Itta's letter asking for baseline science
- > $15 million expended to date
- Greater clarity of the ecological drivers of the Chukchi ecosystem

Historic exploration well site evaluation

- Returned to Hammerhead (Beaufort) site in 2008
- Returned to Burger/Klondike (Chukchi) sites in 2009
- Evaluated contaminants issues and biological community structure

Cumulative impacts analysis

- Since 2006 Shell has taken the lead in documenting all industry activities and the results of all industry monitoring efforts in the offshore
- The reports have taken a multi-year/multi-activity approach reporting total ensonification areas and reporting on multiple activities.

Air monitoring stations

- 2008-2010 air monitoring stations at Reindeer Island and Wainwright

EXPLORATION PLAN

SHELL'S GOALS

To demonstrate that Shell does not cause undue or serious damage to the human, marine, or coastal environment, conforms to sound conservation practices, and is prepared to conduct exploration that is safe.

WHY PREPARE AN EXPLORATION PLAN?

To discuss and explain the various operative activities associated with drilling.

WHO REVIEWS THE EXPLORATION PLAN?

The North Slope Borough, potentially impacted communities, AEWC, marine mammal management groups, tribes, State of Alaska, and the federal government.

WHAT IS INCLUDED IN THE EXPLORATION PLAN?

- Description of drilling vessels, and associated vessels and equipment
- Location and timing of operations
- Proposed type and amount of discharges
- Oil spill prevention and response measures
- Analysis of direct and indirect environmental impacts
- Mitigation measures
- Health and safety measures
- Geologic information assessment of any hazards to drilling
- Permit applications

Exploration Plan Details

- Two EPs – Camden Bay EP in the Beaufort Sea and a Chukchi Sea EP
- Both are two year plans – starting in 2012
- Up to 2 wells per year in the Beaufort Sea
- Up to 3 wells per year in the Chukchi Sea, plus future well site work
- Noble Discoverer drillship and Conical Drilling Unit Kulluk
- Oil Spill Response capabilities on standby 24/7
- Crew change by helicopter – routes determined through coordination and communication
- Real time ice and weather forecasting
- Shorebase in Deadhorse, Barrow and Wainwright
- Robust marine mammal monitoring protocol
- Communications Plan to avoid conflicts with subsistence users
- Subsistence Advisors

SHELL'S GOALS IN ALASKA'S BEAUFORT & CHUKCHI SEAS OUTER CONTINENTAL SHELF

ENGAGEMENT PHILOSOPHY

Engage local residents and regulatory bodies to understand issues and concerns before design work is initiated

Utilize knowledge gained in design and operational feasibility studies, for example minimizing or mitigating the impact of a development.

Being a "good neighbor" to the residents of the North Slope, and all areas we operate within the state of Alaska.

COMMITMENT TO NORTH SLOPE RESIDENTS

Integrate cultural and environmental protection considerations into the planning, design, construction and operational phases of our potential oil and gas activities.

Improve communication to ensure full and meaningful dialogue with residents.

Consult with NSB and NWAB staff and village residents during the planning and design stages in order to blend traditional and contemporary local knowledge with exploration technology in an appropriate manner.

SHELL'S GOALS IN ALASKA'S NORTH SLOPE

To find and develop commercial hydrocarbon resources in the Beaufort and Chukchi OCS.

To support the community in benefiting from any potential offshore development both economically and socially.

To respect and enhance the way of life of the residents of the North Slope Borough and Northwest Arctic Borough.

OBJECTIVES

Discuss the possible infrastructure needed to make Beaufort and Chukchi OCS development a reality, should it occur.

Review the potential social and economic benefits associated with increased infrastructure and development of Shell leases in the Beaufort and Chukchi OCS.

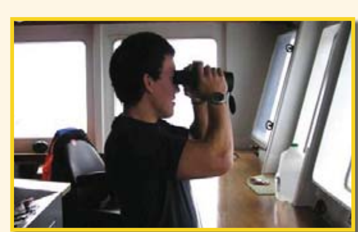
Discuss future engagement with the residents of the North Slope Borough and Northwest Arctic Borough.

EXPERIENCE & COMMITMENT

Shell has experience in Arctic and other ice-covered offshore regions. Traditional knowledge and assistance goes a long way in helping to ensure success.

POTENTIAL BENEFITS: JOBS & CAREERS

- Direct and indirect
- Local business contracting opportunities
- Workforce development and training



POSSIBLE INFRASTRUCTURE NEEDS

Sakhalin

WHY IS OFFSHORE INFRASTRUCTURE REQUIRED?

Many leases are more than 15 miles from shore

Longest land based reach to offshore sites is approximately 8 miles

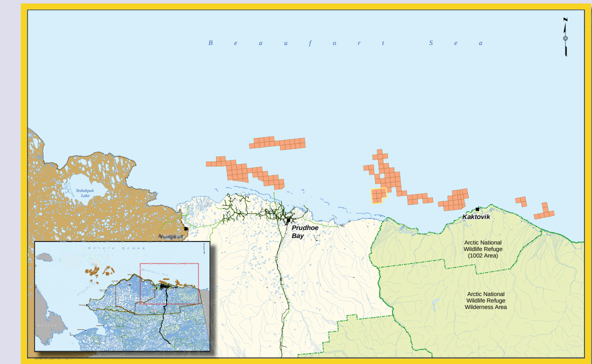
POTENTIAL BENEFITS: REVENUE

- Tax base from pipelines & support bases to address declining revenues
- Extending the life of TAPS and the pipeline tax base
- Additional infrastructure which could make other onshore fields economic and increase revenue

SOCIAL & CULTURAL INVESTMENTS

- Socio-economic studies
- Marine mammal studies
- Environmental studies
- Additional social and cultural investments

BEAUFORT SEA INFRASTRUCTURE: INITIAL DEVELOPMENT FOCUS



Camden Bay:
Initial focus is the 1985 discovery of Hammerhead/Sivulliq.

- 14 to 18 miles offshore
- Water depth 100 feet

Development of Sivulliq is dependent upon factors including:

- Seismic results
- Appraisal drilling results

CHUKCHI SEA INFRASTRUCTURE: INITIAL EXPLORATION FOCUS

The first public sale of leases in the Chukchi Sea since 1991 took place on February 6, 2008.

The Chukchi Sea Shelf is believed to hold up to 30 billion barrels ($4.8x10^9 m^3$) of oil and gas reserves.

- Lease blocks are more than 50 miles offshore
- Water depth 130-200 feet

ADDRESSING CHALLENGES THROUGH RESEARCH & DEVELOPMENT

Platform & vessel noise reduction to minimize impact to marine mammals

Production platform structure design to withstand ice loading

Oil spill prevention and response for development infrastructure

Vessel and platform re-supply

Offshore pipeline installation beyond landfast ice

Evacuation and rescue

FUTURE ENGAGEMENT: THE WAY FORWARD

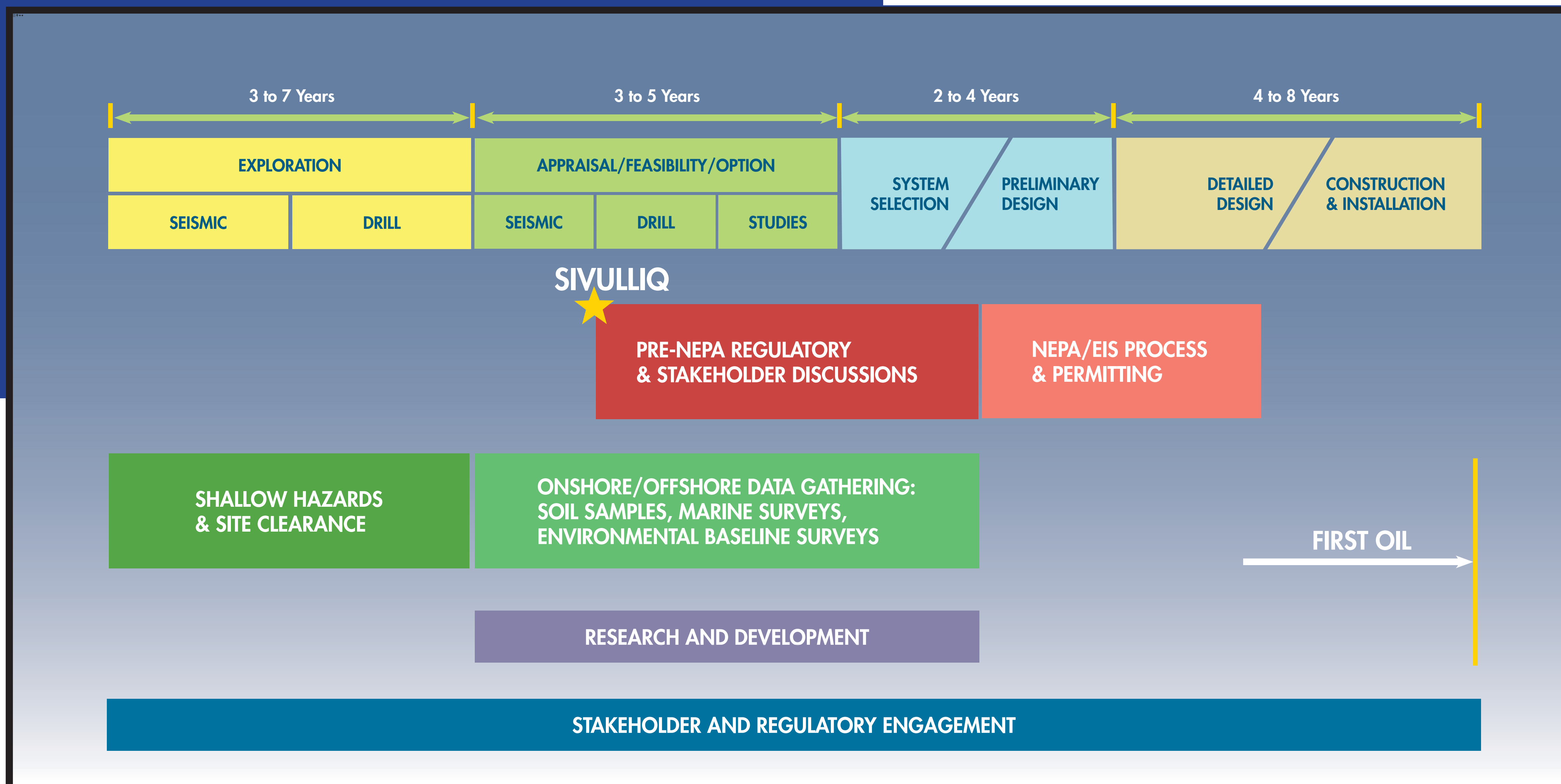
To succeed in meeting mutual goals, we must move forward together based on mutual respect and open dialogue:

- Discuss ideas on ways to engage, consult and work together;
- Validate our understanding of your concerns;
- Discuss issues, potential impacts and potential solutions & mitigation measures;
- Share ideas and feedback on economic development.

"It is clear, that substantial involvement of all potentially affected parties including Alaska Natives is a prerequisite for a successful approach to the development of Arctic OCS Oil and Gas."

–Environmental Information for Outer Continental Shelf Oil and Gas Decisions In Alaska by the National Research Council

Typical Offshore Development Timeline



Shell Camden Bay and Chukchi Sea Program Update

March 2011

Shell In Alaska

- 2011 Program
- 2012-2013 Proposed Exploration Plans

2011 Program

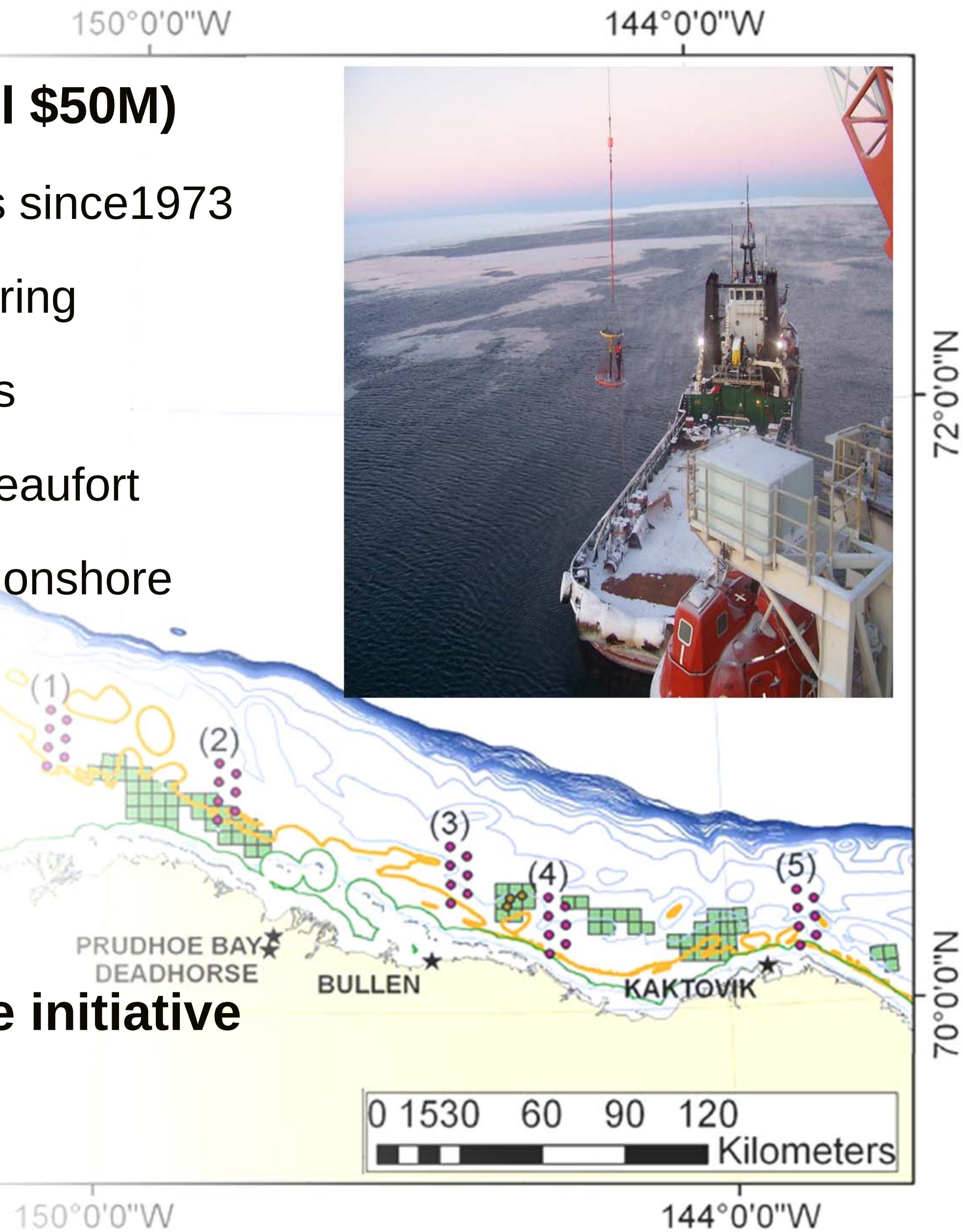
2011 Shell Proposed Operations

- **Shell 2011 program**:
  - Marine mammal monitoring to support operations
  - Non Shell operated Ecological science data gathering (offshore and onshore)
  - Com Centers and Subsistence
  - Advisors in Coastal Villages of North Slope:
    - Point Lay, Point Hope, Wainwright, Barrow, Deadhorse, Kaktovik, Nuiqsut

Science

Baseline Science Supports Exploration In Alaska

- **$500 Million and growing (Shell $50M)**
  - 5000 independent scientific studies since1973
  - 6 years of marine mammal monitoring
  - Tagging studies – walrus and seals
  - First air quality station in OCS – Beaufort
  - Ongoing offshore, nearshore, and onshore ecological characterization studies
  - Traditional knowledge studies
  - Health impact assessments



- **Up to $5 million annual science initiative with North Slope Borough**

Offshore, nearshore, onshore studies

- Marine Mammal
- Acoustic Recorders
- Ice & Metocean Buoys
- UAV Monitoring
- Stereo Photography
- Upward Looking Sonar
- Benthic Studies
- Sediment chemistry
- Current Meter
- Hydrology & Habitat Assessment
- Coastal Stability Studies
- Traditional Knowledge
- Bird Observations
- Fisheries Sampling
- Zooplankton
- Physical Oceanography

NSB Collaborative Science Agreement

- Objective: To enable community members in coastal villages of the Chukchi and Beaufort Seas to participate and prioritize science being conducted related to the potential effects and impacts of oil and gas exploration and development in the outer continental shelf (OCS).
- Signed Sept. 24, 2010
- Funded annually by Shell for an initial term of five years, and administered by the NSB Mayor’s Office
- 14-Member Steering Committee
  - Coastal Villages
  - NSB Wildlife Department and Mayor’s Office
  - Independent Scientists
  - Shell

2012-13 Proposed Exploration Plans

Chukchi and Beaufort Seas

2012-13 Proposed Operations

- Drill up to three wells per year in Chukchi Seas during open water drilling season (July-October)
- Drill up to two wells per year in Beaufort Sea during open water drilling season (July-October)

- Continuation of Shell's long-term ecological characterization offshore and onshore

Mitigation

Mitigation Shell has committed to

- Communication Plan for avoiding conflicts with subsistence users
- Collaboration and Communication with Whaling Associations, Walrus, Nanuq and Seal Commissions
- Capping and Containment system
- Commitment to hire Subsistence Advisors
- Marine Mammal Observers on all vessels
- Robust Marine Mammal Monitoring Protocol
- Real time Ice and Weather Forecasting
- Crew change by helicopter and collaboration on routes to and from operations
- Deadhorse, Wainwright and Barrow shore bases
- No transiting, including within polynya zone, without communicating
- Relief rig capabilities

Prevention and Response

Commitments

- **Prevention Is the First Priority and Can Be Accomplished**
- **BOP – testing and enhancements**
  - **Testing every 7 days instead of every 14 days**
  - **Use of second set of shear rams**
  - **Sub-sea remote operating panel relocation**
  - **ROV/Diver options on and near site**
- **Arctic Cap and Containment System**
- **Full OSR capabilities for each sea**
- **Second rig relief well capability**

Alaska Arctic Cap and Containment System

New and Traditional Oil Spill Contingency Planning

Shell Oil Spill Response Goals

- Immediate Onsite Response
- Latest Technology
- Flexible Environmental Response Capability
- Sustained Response

Arctic Response Options

Offshore:

Mechanical

In-situ Burning

Dispersants
(under select conditions)

Nearshore:

Mechanical

In-situ Burning

Onshore:

Mechanical

In-situ Burning

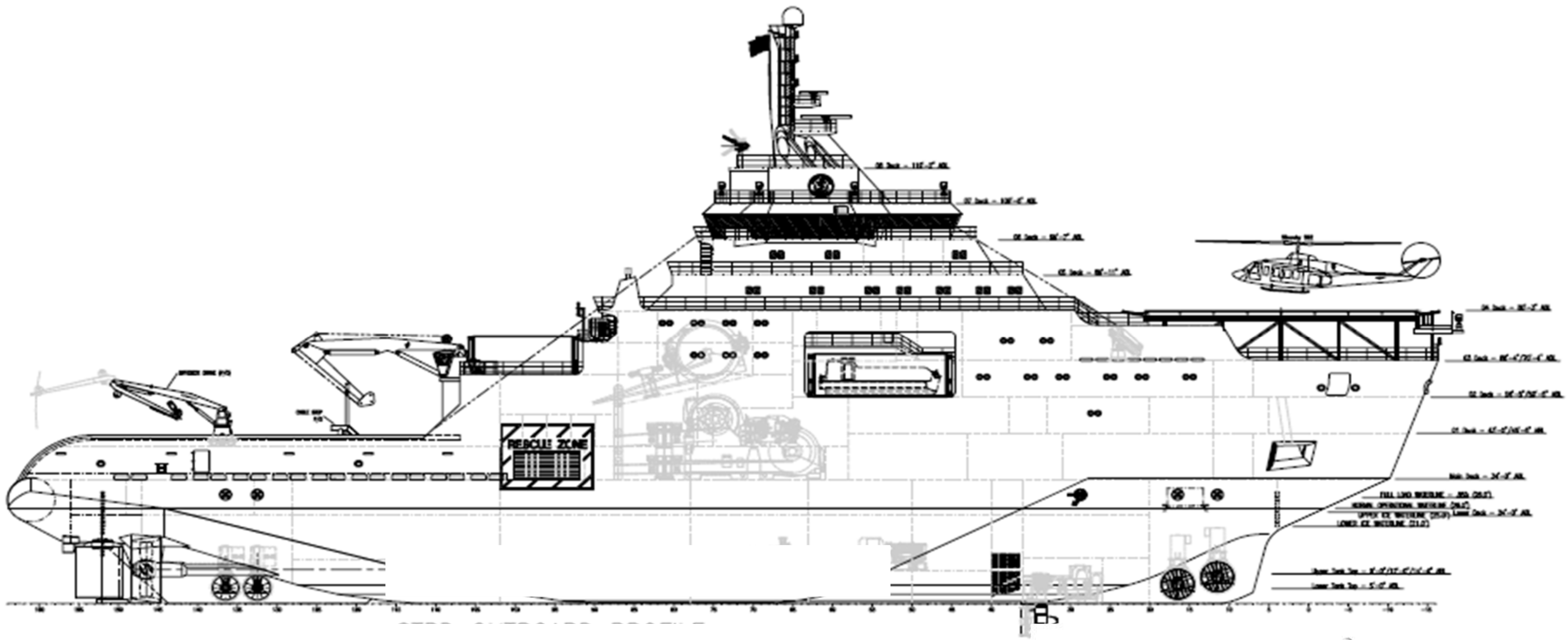
Nanuq

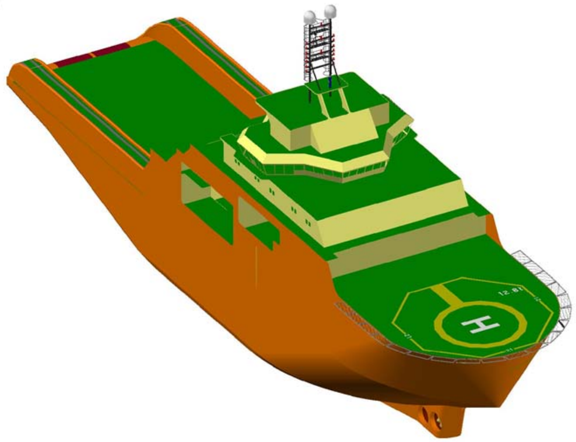
- Multi-Purpose Vessel
  - Spill Response;
  - Onsite Command Center;
  - Anchor Handling;
  - Ice Management; and
  - Supply
- Ice Class A1 Vessel
- Dynamic Positioning Capability
- Full support for up to 41 crew and responders
- 2 Lamor LSC-5 Brush Skimmers & Power Packs
- Staging and Deployment of Boom-tending Work Boats
- Onboard storage: >12,000 bbl
- Rapid Transit for lightering recovered oil
- High Volume, Viscous Oil Lightering capability

Arctic Endeavor

- Dedicated Oil Spill Response Barge with Tug Assist
- Ice Strengthened
- Onboard Field Command and Communications Center
- 2 Lamor LSC-5 Brush Skimmers & Power Packs
- Staging and Deployment of Boom-tending Work Boats and 249-bbl barges
- Staging and Deployment of 47' Skimmer with built-in Brush Skimmers
- Onboard storage: >18,000 bbl
- High Volume, Viscous Oil Lightering capability

Hull 247





- Length Overall – 360’ (110m)
- Beam – 80’ (24.4m)
- Draft – 26’ (normal)
- Anchor Handling Backup
- Polar Ice Classed
- High POB for contingency response
- Storage Capacity: 8,000 bbl

Mechanical Recovery

Lamor Brush

TransRec 150

Ocean Buster

47’ Kvichak w/ brush skimmer

Small Over-the-Side Skimmers

Rope Mop skimmer

Harsh Weather Operations

Brent 'B' production platform photographed in stormy weather.

The photograph shows the ferocity of the wind and waves during a storm in the North Sea. Winds of more than 100 mph produced waves reaching up to the **underside of the deck which is 75 ft above sea level**. Platform on calm day shown at bottom.

Ice Against Platform Legs - video

Thank You

END OF PRESENTATION

Attachment C
Communication Plan

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COMMUNICATION PLAN
EXPLORATION DRILLING PROGRAM
CAMDEN BAY, ALASKA

The following Communication Plan will be used during each exploration drilling season to coordinate activities with local subsistence users, including the Alaska Eskimo Whaling Commission (AEWC), Alaska Eskimo Walrus Commission (AWC), Alaska Nanuuq Commission (ANC), Alaska Beluga Whale Committee (ABWC), Ice Seal Committee (ISC), and village Whaling Captains Associations (WCAs). During each drilling season the drilling vessel *Kulluk* or *Discoverer*, either under tow (*Kulluk*), or by its own propulsion (*Discoverer*) and associated support vessels will transit through the Bering Strait into the Chukchi Sea on or after July 1, arriving on location near Camden Bay approximately July 10. Exploration drilling activities at the drill sites are planned to begin on or about July 10 and end on or before October 31, with a suspension of all operations beginning August 25 for the Nuiqsut (Cross Island) and Kaktovik subsistence bowhead whale hunts. During the suspension for the whale hunts the drilling vessel and support fleet will leave the Camden Bay project area and move to an area north of latitude 71^{o} 25'N and west of longitude 146^{o} 4'W. Shell will return to resume activities after the subsistence whale hunts conclude.

The Communications Plan will be implemented in two phases. Phase I describes the guidelines already in place to ensure proper communication during the drilling season. Phase II describes what to do in the event Shell Offshore Inc. (Shell) activities potentially affect subsistence activities and how to keep subsistence user groups informed of Shell activities. Phase I and II are designed to minimize the potential for interference of Shell activities with subsistence activities and resources and to keep operators up-to-date regarding the timing and status of the bowhead whale migration in Camden Bay as well as the timing and status of other subsistence hunts.

Drilling program operations will be performed in compliance with all applicable permits and authorizations, including the Plan of Cooperation, Letter of Authorization per U.S. Fish & Wildlife Service, Incidental Harassment Authorization per National Marine Fisheries Service and Lease Stipulation 5 from lease sales 195 and 202 per Bureau of Ocean Energy Management, Regulation and Enforcement.

PHASE I

- Shell will fund the operation of Communication and Call Centers (Com Centers) in the coastal villages to enable communications between Shell operations and vessels, local subsistence users, and Subsistence Advisors (SA), thereby notifying the subsistence community of any vessel transit route changes and avoiding conflicts with subsistence activities.

- Marine Mammal Observers (MMOs) will be onboard exploration drilling-related vessels with responsibilities to: monitor for the presence of marine mammals, assist with the maintenance of marine mammal safety radii around vessels, monitor and record avoidance or exposure behaviors, and communicate with the Com Centers and local subsistence hunters by marine radio.
- If a conflict arises with offshore activities, the MMO will immediately contact the vessel captain and the Com Centers. The Com Centers will then contact Shell's simultaneous operations emergency response team. If avoidance is not possible, the next phase will include communication between a Shell representative and a representative from the impacted subsistence hunter group(s) to resolve the issue and plan an alternative course of action by either industry or the subsistence groups.
- Shell will employ local SAs from the Camden Bay villages to provide consultation and guidance regarding the affected species migration, the subsistence hunt, and other subsistence activities. The SAs will work approximately 8 hours per day and 40-hour weeks each drilling season. Responsibilities of the SAs will include: reporting any subsistence concerns or conflicts, within 4 hours if the conflict appears imminent, to the Com Centers (who will then contact Shell's simultaneous operations emergency response team); coordinating with subsistence users to advise on location and timing of Shell's activities; reporting subsistence-related comments, concerns, and information to Shell staff; and, advising Shell how to avoid subsistence conflicts and subsistence users. A SA handbook will be developed and provided to each SA. The handbook will outline contact numbers, communication procedures, and communication timelines for reporting and communicating potential conflict situations.
- Helicopter traffic flight restrictions will be in place to prohibit aircraft from flying below 1,500 ft (457 m) altitude, (except during takeoffs and landings, in emergency situations or for MMO overflights), while over land or sea. If flights need to deviate from this path due to emergency landings or other unavoidable reasons, the new flight information will be immediately shared, as outlined by Shell Health, Safety, Security, and Environment requirements, with Com Centers so area subsistence users can be notified.
- Regular overflight surveys and support vessel surveys for marine mammals will be conducted to further monitor prospect areas and identify areas currently being used for subsistence activities to avoid potential conflicts with users.
- To minimize impacts on marine mammals and subsistence hunting activities, the drilling vessel and support vessels traversing north through the Bering Strait will transit through the Chukchi Sea along a route that lies offshore of the polynya zone. In the event the transit outside of the polynya zone results in Shell having to break ice, as opposed to managing ice by pushing it out of the way), the drilling vessel and support vessels will move into the polynya zone far enough so that ice breaking is not necessary. If it is necessary for any vessel to move into the polynya zone, Shell will notify the local communities of the change in the transit route through the Com Centers.

PHASE II

All guidelines in Phase I will be adhered to in addition to the following:

- If potential conflicts are identified between Shell activities and subsistence activities; the Com Center Action Plan will be used to manage the issue.
- Shell will continue with engagements and regular communications with the AEWC, AWC, ANC, ABWC, ISC, and the WCAs of Barrow, Wainwright, Point Lay, Point Hope, Kaktovik and Nuiqsut once transiting of vessels begins through Chukchi Sea on the way to Camden Bay, during drilling activities, and during mobilization from Camden Bay and through the Chukchi Sea.

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Attachment E
Analysis of the Probability of an "Unspecified Activity" and Its Impacts: Oil Spill

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Analysis of the Probability of an "Unspecified Activity" and Its Impacts: Oil Spill

Shell analyzed the likelihood of an accidental oil spill and its possible impacts in its revised Camden Bay Exploration Plan (EP) and Environmental Impact Assessment (EIA). The following analysis is excerpted from that document.

Probability Analysis of an Oil Spill

While a well blowout (loss of well control) is potentially the most significant concern for generating a large hydrocarbon spill because of the associated spill volume, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) has estimated the risk that a blowout event would impact the Beaufort Sea as a result of exploration drilling is low. A total of thirty-five (35) exploration wells have been drilled between 1982 to 2003 in the Chukchi and Beaufort Seas and there have been no blowouts. In addition, none have occurred from the approximately 98 exploration wells drilled within the Alaskan Outer Continental Shelf (OCS) (MMS 2007a).

The BOEMRE Environmental Assessment (EA) prepared for the Beaufort Sea (MMS 2007b) reported that from 1971 through 2005 approximately 13,463 exploration wells were drilled (172 in the Pacific OCS, 51 in the Atlantic OCS, and 98 in the Alaska OCS). Sixty-six blowouts were identified for all exploration drilling from 1971 to 2005. No large spills (greater than 1,000 barrels [bbl; greater than or equal to 159 m^3]) occurred during exploration drilling well blowouts from 1971 to 2005. Of the approximately 13,000 wells that were drilled, four spills resulted in crude reaching the environment from blowouts with volumes of 200, 100, 11, and 0.8 bbl (31.8 m^3, 16 m^3, 1.8 m^3, and 0.13 m^3), respectively. Another BOEMRE study affirmed that no crude oil spills greater than 100 bbl (16 m^3) resulting from blowouts occurred from 1985 to 1999 (Hart Crowser, Inc. 2000). A 2007 report by BOEMRE (Izon et al. 2007) reviewed blowout statistics for the U.S. from 1992 through 2006. This paper did not distinguish between exploration and development wells but reported that the overall frequency of blowouts has diminished since their previous review for the period of 1971 through 1972.

Holand (1997) reported the U.S. Gulf of Mexico OCS exploration blowout frequencies as 0.0059 per well drilled, based on worldwide historical data available from the SINTEF Offshore Blowout Database. As Holand's exploration blowout frequencies included blowouts of all types, the frequencies for a blowout resulting in oil reaching the environment are significantly less. Of the total blowouts reported by Holand (1997), gas releases accounted for 77 percent of the total blowouts, gas/liquid mixtures 14 percent, and uncontrolled liquid flows involved only three percent.

BOEMRE recently analyzed how the *Deepwater Horizon* event affected prior analysis about the likelihood of an oil spill.[2] It explained that, when preparing such predictive analyses, it used data from past OCS spills. However, from 1985-1999 (the time period used when preparing the Gulf of Mexico analysis), there were no platform or blowout spills greater than 1,000 barrels. Thus, "to allow for conservative future predictions of spill occurrence, a spill number of one was 'assigned' to provide a non-zero spill rate for blowouts. Therefore, this spill rate already included the occurrence of the Macondo Event."[3]

Scandpower (2001) used statistical blowout frequencies modified to reflect specific field conditions and operative systems at the Northstar Development in the Beaufort. The report concluded that the predicted frequency of blowouts when drilling into the oil-bearing zone is 0.000015 per well drilled. This same report estimates that the frequency of oil quantities per well drilled for Northstar for a spill greater than 130,000 bbl (20,668 m^3) is 0.00000094 per well. This compares to a statistical blowout frequency of 0.000074 per well for an average development well.

Bercha (2006, 2008) developed a fault tree model to estimate oil spill occurrence rates associated with Arctic OCS locations. Since limited historical spill data for the Arctic exists, Bercha modified the existing base data using fault trees to arrive at oil spill frequencies for future development and production scenarios. For offshore exploration drilling, Bercha (2008) used statistics derived from Holand (1997) for non-Arctic drilling operations and Scandpower's (2001) blowout frequency assessment for Northstar to estimate the anticipated size and frequency of spills. Based on this historical data, Bercha reported the spill frequency for non-Arctic exploration well drilling as 0.000342 per well for a blowout equal to or in excess of 150,000 bbl (23,848 m^3).

In order to model the data variability for Arctic exploration, Bercha applied a numerical simulation approach to develop the probability distribution of 150,000 bbl (23,848 m^3) or greater, and arrived at a frequency ranging from a low of 0.00015 per well to a high of 0.000697 per well. The expected value for a blowout of this size was computed to be 0.000394 per well (Bercha 2008). To address causal factors associated with blowouts, Bercha applied adjustments for improvements to logistics support and drilling contractor qualifications that resulted in lower

[2] BOEMRE, Site Specific Environmental Assessment of Exploration Plan No. S-7445 for Shell Offshore Inc. (March 21, 2011), Appendix A: Accidental Oil Spill Discussion, at A-4. This technical analysis builds on and is consistent with BOEMRE's findings related to the Deepwater Horizon incident. *See* BOEMRE, Modifications to Suspension of Deepwater Drilling Operations Environmental Assessment and Finding of No Significant Impact (October 12, 2010) at 35 ("The probability of a catastrophic spill from drilling deepwater exploration and development well[s] remains very low, even remote. The knowledge gained and proactive steps taken since the Macondo well blowout further reduces that probability, the degree to which is still unknown."); BOEMRE ESA Section 7(d) Determination Relating to Gulf of Mexico Leasing, Drilling and Production Activities (October 7, 2010) at 5 ("The potential impact of these activities on listed species and their designated critical habitat remains low because it is very unlikely that another high impact oil spill would occur in the [Gulf of Mexico] and because BOEMRE is taking steps to reduce the likelihood of such a spill and to protect listed species and their habitat, including new measures devised in light of the [Deepwater Horizon] incident.").

[3] *Id.*

predicted frequencies for Arctic drilling operations. No fault tree analyses or unique Arctic effects were applied as a modification to existing spill causes for exploration, development, or production drilling frequency distributions. For exploration wells drilled in analogous water depths to planned Beaufort Sea wells at 98-197 ft (30-60 m), Bercha (2008), the predicted, adjusted frequency is 0.000612 per well for a blowout sized between 10,000 bbl (1,590 m^3) to 149,000 bbl (23,689 m^3) and 0.000354 per well for a blowout greater than 150,000 bbl (23,848 m^3).

The best available information on blowouts associated with oil and gas operations on Alaska's North Slope identifies 11 blowouts between 1977 and 2001. These blowouts released either dry gas or gas condensate only; resulting in minimum environmental impact (NRC 2003).

Impact Analysis of an Oil Spill

Oil and gas exploration activities, such as those proposed in Shell's Revised Outer Continental Shelf Lease Exploration Plan, Camden Bay, Beaufort Sea, Alaska for Flaxman Island Blocks 6559, 6610 and 6658 and Beaufort Sea Lease Sales 195 and 202 ("revised Camden Bay EP") carry a risk of an oil spill. Various events could cause a spill, ranging from a hose rupture to the extreme example of a loss of well control (blowout). However, the most likely spill to occur during the activities in the revised Camden Bay EP would be a spill of approximately 48 bbl resulting from a refueling operation.[4] This conclusion is consistent with BOEMRE's prior findings when analyzing the likelihood of various kinds of spill impacts.[5] Accordingly, this EIA evaluates the impacts of a 48 bbl spill on existing environmental resources.[6] These impacts will not be significant. As discussed *infra*, the impacts of a 48 bbl spill resulting from a refueling operation are expected to be localized and fleeting.

While not a reasonably expected impact of this exploration project, BOEMRE has analyzed the impacts of a very large oil spill ("VLOS") in the Beaufort Sea, defined by BOEMRE as a spill of 150,000 or more bbl. BOEMRE analyzed the impacts of a 180,000 bbl spill in the 2003 Final Environmental Impact Statement for the Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202 ("2003 Multi-Sale Environmental Impact Statement (EIS)"). As discussed below, BOEMRE concluded that such a spill would be rare, but that, if it occurred, it could have significant impacts on certain environmental resources. As part of that analysis, BOEMRE analyzed potential trajectories of a spill and considered the impacts of a spill in various ice conditions.

[4] *See* infra (EIA) at [*Environmental Impact Analysis, Revised Outer Continental Shelf Exploration Plan, Camden Bay, Beaufort Sea, Alaska*]

[5] 2010 Camden Bay EP/EA at Appendix A.

[6] This approach is consistent with the approach approved by the Ninth Circuit in *Edwardsen v. U.S. Dep't of the Interior*, in which the agency did not include a worst case scenario analysis regarding oil spill trajectories. 268 F.3d 781, 785 (9th Cir. 2001) ("Moreover, an EIS need not include a worst-case scenario. *See Robertson v. Methow Valley Citizen's Council*, 490 U.S. 332, 354 (1989). *See also* Mandelker, *NEPA Law and Litigation* § 10.07[3] at 10-39.").

The VLOS analysis in the 2003 Multi-Sale EIS properly informs the analysis of the revised Camden Bay EP. The Ninth Circuit has approved of the use of existing NEPA analyses on spill impacts when the analysis covers the area at issue.[7] Applying the impacts analysis in the 2003 Multi-Sale EIS to the activities in the revised Camden Bay EP provides a site-specific analysis of the potential impacts of a VLOS resulting from the revised Camden Bay EP. Although the oil spill resulting from the *Deepwater Horizon* incident has brought heightened attention to oil spill – and especially VLOS – issues, there is no new information related to the site-specific impacts of this project that requires additional analysis. The existing analysis of VLOS impacts in the Beaufort Sea in the 2003 Multi-Sea EIS, as properly applied to the revised Camden Bay EP, evaluates the reasonably foreseeable impacts from a VLOS resulting from this operation.

Impacts Of A Very Large Oil Spill

In its 2003 Multi-Sale EIS, BOEMRE analyzed the likelihood of a spill, the fate of spilled oil without cleanup and the most likely trajectories of spills of various sizes that could result from oil exploration and development on the proposed leased areas.[8] This analysis included an evaluation of the impacts of a VLOS, which BOEMRE defined as greater than 150,000 barrels of oil.[9] For the purposes of the analysis, the agency evaluated the impacts of a hypothetical 180,000 barrel spill in a nearshore area on areas identified by the agency as sensitive resources.[10] BOEMRE analyzed the behavior of spilled crude oil in open water, solid ice, and broken ice. For each scenario, BOEMRE evaluated the impacts of the spill on environmental resources.[11] The agency concluded that impacts to some resources were likely to be significant in the unlikely event of a very large oil spill. However, the agency also noted the mitigating role that oil spill response activities could have on these potential impacts.

In its 2003 Multi-Sale EIS BOEMRE noted the following impacts resulting from a very large 180,000 barrel oil spill. BOEMRE considered the impact of a VLOS on threatened and endangered species, including bowhead whales. BOEMRE estimated a VLOS during summer had a 35 percent chance of contacting important bowhead whale habitat within 30 days. The probability of oil contacting whales, however, is likely to be considerably less than the probability of it contacting bowhead whale habitat. If bowhead whales were contacted, available data shows baleen whales are unlikely to experience serious direct effects from oil exposure. While lethal effects for some individuals are possible, most individuals exposed to spilled oil are expected to experience temporary nonlethal effects from, for example, oiling of the skin and inhalation of hydrocarbon vapors.[12]

[7] *Id.* at 785-86 (upholding the approval of the BP Northstar project which relied on analysis of oil spill impacts in the NEPA documents related to Lease Sale 170, which covered the same area as the project).

[8] 2003 Multi-Sale EIS at Section IV-1.

[9] *Id.* at IV-227.

[10] *Id.* at IV-228.

[11] *See id.* at IV-230 to IV-247.

[12] *Id.* at IV-233 to IV-234. BOEMRE's analysis also considered the impacts of a VLOS on spectacled and Steller's eiders, which are potentially significant for these small populations. *See id.* at IV-234 to IV-236. BOEMRE also analyzed the potential impacts on other marine and coastal birds. Depending on season and distribution, a VLOS could cause the loss of potentially thousands of waterfowl. *Id.* at IV-236 to IV-238.

A VLOS could have potentially lethal impacts on marine mammals, including pinnipeds, polar bears and beluga whales, because of absorption, inhalation or ingestion of toxic hydrocarbons. About 67 percent of the oil likely would contact offshore seal and polar bear ice-front habitat. Several thousand walrus and seals and as many as 128 polar bears (assuming a high population density) could be exposed to oil. Assuming all contacted individuals died, this loss could take these marine mammal populations more than one or two generations to recover (up to approximately 15 years). Beluga whales might encounter spilled oil during the spring migration and summer, but few if any whales are likely to be adversely affected, with fewer than 20 individuals lost (population recovery in 1 year).[13]

BOEMRE found that a VLOS would impact water quality by increasing the concentration of hydrocarbons in the water column in a large area greatly above background levels. For example, a very large spill to open water during summer could increase concentrations above the 1.5 parts/million acute toxic criterion during the first several days in an area of a hundred square miles (mi^2). Oil could exceed the 0.015 parts/million chronic criterion for several months or more in an area of approximately 5,000 mi^2, before dispersion and dilution reduced oil concentrations below the chronic criterion.[14] BOEMRE estimated only limited affects on lower trophic-level organisms given their distribution and seasonal factors. For example, BOEMRE estimated there would be no impacts on subtidal marine plants because they live below the zone where toxic concentrations of oil are expected to occur. Lethal and sublethal effects are expected on marine invertebrates in the intertidal and subtidal zones. Plankton species would also be impacted by a spill, but because of their wide distribution, large numbers and rapid rate of regeneration, there would be only a temporary, local effect on the plankton community resulting from a very large oil spill.[15] BOEMRE estimated a very large oil spill would have no measurable effects on fishes in winter, due to their low numbers and wide distribution. A VLOS during summer could affect fishes in nearshore waters, although BOEMRE estimated the likelihood of a VLOS occurring and contacting nearshore areas as very low (< 0.5%). If such a spill did occur, some marine and migratory fishes could be harmed or killed, but mortality due to oil exposure is seldom observed outside the laboratory because the zone of lethal toxicity is very small and short lived, and fishes in the immediate area typically avoid that zone.[16]

Finally, BOEMRE analyzed the impact of a VLOS on air quality. BOEMRE concluded a spill's effects on air quality would be low. A VLOS could cause an increase in gaseous hydrocarbon concentrations, which could affect onshore air quality. Any effects would be localized and temporary, and concentrations of criteria pollutants would likely remain well within Federal air-quality standards.[17]

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[13] *Id.* at IV-238 to IV-239.

[14] *Id.* at IV-230 to IV-231.

[15] *Id.* at IV-231 to IV-232.

[16] *Id.* at IV-232.

[17] *Id.* at IV-245. The 2003 Multi-Sale EIS also analyzed the impacts of a VLOS on terrestrial mammals, vegetation and wetland habitats as well as socio-economic impacts, particularly the impacts on subsistence activities and resources. *See id.* at IV-239 to IV-245.

BOEMRE continued to refine its impacts analysis in subsequent EAs it prepared in advance of lease sales held pursuant to the 2003 Multi-Sale EIS. For example, by the time it prepared its EA of Proposed OCS Lease Sale 202 Beaufort Sea Planning Area ("Lease Sale 202 EA") in 2006, BOEMRE had updated its analysis with refined information to estimate that the likelihood of one or more large spills (defined by BOEMRE to mean > 1,000 bbl) had increased from the 8-10 percent likelihood estimated in the 2003 Multi-Sale EIS to 20 percent in the Lease Sale 202 EA.[18] The EA further stated that in the absence of any clean-up activities, it assumed that after 30 days in open water or broken ice, 27-29 percent of oil evaporates, 4-32 percent disperses, and 28-65 percent remained. After 30 days under landfast ice, the EA assumed that nearly 100 percent of oil remains in place and unweathered.[19]

<u>The VLOS Impacts Analysis Of The 2003 Multi-Sale EIS Is Applicable To Shell's Current EP</u>.

The detailed impacts analysis of the 2003 Multi-Sale EIS provides decision-makers with useful information on the anticipated impacts of a VLOS from a given project. For example, when BOEMRE prepared its EA of the Shell Offshore Inc. 2010 Outer Continental Shelf Lease Exploration Plan for Camden Bay, Alaska ("2010 Camden EA"), the agency referred back to the overall analysis prepared in the 2003 Multi-Sale EIS and determined that the potential impacts from a very large spill in the vicinity of Shell's proposed operations were "statistically similar" to the impacts and contacts modeled in the 2003 Multi-Sale EIS.[20] BOEMRE then applied the previous analysis to determine the likelihood of spilled oil reaching various key environmental areas from the proposed activity site in various time windows, both in the summer and winter.[21] In this way, BOEMRE was able to narrow the range of possible impacts from those identified in the 2003 Multi-Sale EIS to the more likely impacts if a spill were to occur from the proposed activities.

This analysis remains applicable for the revised Camden Bay EP. OCSLA anticipates and instructs that BOEMRE evaluate exploration and development in the OCS in a staged manner, building its analysis over the course of the lease sale, exploration, and development. The statute's limited time period in which to approve or deny EPs indicates Congress's intent that the agency use the environmental analysis underlying the lease sale to the extent appropriate. There is no reason not to use this approach here. The revised Camden Bay EP proposes activities that will take place within the area analyzed in the 2003 Multi-Sale EIS. Thus, any analysis of potential VLOS impacts arising from the revised Camden Bay EP properly should look to the analysis in the 2003 Multi-Sale EIS. Further, the revised Camden Bay EP proposes drill sites in the vicinity as those proposed in the 2010 Camden Bay EP approved by BOEMRE and upheld by the Ninth Circuit. Having once analyzed the VLOS impacts related to wells in these locations by using the 2003 Multi-Sale EIS framework, it is reasonable to take the same approach for the revised Camden Bay EP. There is no new information indicating that this approach, and the analytical framework created by the 2003 Multi-Sale EIS, is incomplete, dated or otherwise insufficient. To the contrary, additional information regarding the potential size of a "worst

[18] Lease Sale 202 EA at 15.

[19] *Id.* at 14-15.

[20] Camden EA at A-2.

[21] Camden EA at A11 through A-12.

case" spill arising from the proposed activities, developed using new guidance from the agency in response to the *Deepwater Horizon* incident, indicate that such a spill would be well within the range of spills analyzed by the agency in the 2003 Multi-Sale EIS.

The drill sites proposed have worst case discharge scenarios comparable to, albeit notably lower than, the scenarios used in the 2003 Multi-Sale EIS. For example, using BOEMRE's revised "Worst Case Scenario" guidelines, Shell calculated and reported in response to NTL-06 that, if a well control event occurred at the Sivulliq N exploration well, the most oil that would be released in a single day would be 860 bbl, on the first day.[22] Modeling indicates that oil released from the well would decrease steadily to 556 bbl/day on the 38th day (when the relief well, if necessary, would be completed). This modeling assumes no bridging over of the well, although the wet sands formations above the oil-bearing zone and prior experiments with Hammerhead wells in the area indicate that bridging over would likely occur.[23] If the well did bridge over the worst case discharge would fall to approximately 20 percent of the modeled amounts.[24]

Shell has continued to refine its analysis since that submission and has determined that the worst case discharge scenarios for the proposed drill sites are as follows: Sivulliq G (594 bbl/day), Sivulliq N (918 bbl/day), Torpedo H (9,648 bbl/day), Torpedo J (5,824 bbl/day).

<u>Shell's Oil Spill Response Strategies Will Mitigate The Impacts Of A Spill</u>.

Shell has an extensive response system in place that would minimize the amount of oil reaching the environment.[25] Shell will deploy state-of-the art subsea blow-out preventer devices to stop all flow from the well immediately upon a well control event occurring. If that system fails, Shell will have a secondary system which will be capable of either (i) stopping the flow from the well, or (ii) capturing the flow from the well and diverting it to the surface for proper disposal. Shell anticipates that it can stop the flow from the well within 15 days of deploying this secondary system. Shell is also ready to intervene with containment devices as necessary to capture the oil below the surface to prevent interference with sea ice. If subsurface efforts are not successful at capturing and containing all oil, Shell has surface response vessels that will conduct clean-up operations. Shell also is prepared to drill a relief well, if necessary, with its primary drilling vessel (whether that be the *Kulluk* or *Discoverer),* but if the primary drilling vessel is disabled, Shell will have the other drilling vessel on standby to complete the relief well. In the event the primary drilling vessel is not available to complete the relief well, Shell anticipates that it would take a maximum of 43 days from the time the secondary drilling vessel is mobilized for it to complete a relief well at the Torpedo Prospect where the wells will be drilled slightly deeper than Sivulliq where the maximum number of days for a relief well is 38. The time to drill a relief well would be substantially shorter if the primary drilling vessel is able to complete it. Thus, even if a large spill were to occur, the impacts identified in the 2003 Multi-

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[22] *Id.* at 1, 21. A bridge over refers to the collapse of a well bore during a loss of well control, in which rock, sand, clay and other materials obstruct the well and stop the blow out.

[23] *Id.* at 2, 23-24.

[24] *Id.* at 23.

[25] *See* Shell's [*Beaufort Sea Regional Oil Discharge Prevention and Contingency Plan*] for a full description and timeline of Shell's response capabilities.

Sale EIS would not necessarily follow because Shell's spill response capabilities would minimize the amount of oil reaching the environment.

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