UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

AUG 17 2009

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE: Environmental Assessment on the Issuance of an Incidental Harassment Authorization to Shell to Take Marine Mammals by Harassment Incidental to Conducting an Open-water Marine Survey Program in the Chukchi Sea, Alaska, During 2009-2010

LOCATION: Chukchi Sea, Alaska

SUMMARY: On December 15, 2008, the National Marine Fisheries Service (NMFS) received an application from Shell for the taking, by Level B harassment only, of small numbers of several species of marine mammals incidental to conducting an open-water marine survey program during the 2009/2010 Arctic open-water season in the Chukchi Sea. Pursuant to the Marine Mammal Protection Act, NMFS has determined that Shell's activity will have a negligible impact on marine mammal species or stocks, will not have an unmitigable adverse impact on the availability of such marine mammal species or stocks for taking for subsistence uses, and will result in the taking of only small numbers of marine mammals of a species or population stock. In addition, pursuant to NEPA, NMFS has determined that Shell's activities will not result in a significant impact on the human environment.

RESPONSIBLE OFFICIAL: James H. Lecky
Director
Office of Protected Resources
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1315 East-West Highway, Room 13821
Silver Spring, MD 20910
(301) 713-2332

The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI), including the supporting environmental assessment (EA), is enclosed for your information.

Although NOAA is not soliciting comments on this EA/FONSI, we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the responsible official named above.

Sincerely,

for Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator

Enclosure

Environmental Assessment on the Issuance of an Incidental Harassment Authorization to Shell to Take Marine Mammals by Harassment Incidental to Conducting an Open-water Marine Survey Program in the Chukchi Sea, Alaska, During 2009-2010

Prepared by
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

August 2009

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
2D	Two-dimensional
3D	Three-dimensional
4MP	Marine Mammal Monitoring and Mitigation Plan
AAM	Active Acoustic Monitoring
AES	ASRC Energy Services
AEWC	Alaska Eskimo Whaling Commission
ARBO	Arctic Regional Biological Opinion
BCB	Bering-Chukchi-Beaufort
BP	BP Exploration (Alaska) Inc.
CAA	Conflict Avoidance Agreement
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Commission	Marine Mammal Commission
CPAI	ConocoPhillips Alaska Inc.
dB	Decibel
DO&G	Division of Oil and Gas
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FR	Federal Register
FONSI	Finding of No Significant Impact
ft	Foot (feet)
G&G	Geological and Geophysical
Hz	Hertz
IHA	Incidental Harassment Authorization
in^3	Cubic Inch
ITA	Incidental Take Authorization
ITS	Incidental Take Statement
kHZ	Kilohertz
km	Kilometer(s)
Lat.	Latitude
LOA	Letter of Authorization
Long.	Longitude
m	meter(s)
mi	Mile(s)
MMPA	Marine Mammal Protection Act
MMOs	Marine Mammal Observers
MMS	Minerals Management Service
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act

Acronym	Definition
NEPA	National Environmental Policy Act
nm	Nautical Mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NSB	North Slope Borough
OBHs	Ocean Bottom Hydrophones
OCS	Outer Continental Shelf
OPR	Office of Protected Resources
PAM	Passive Acoustic Monitoring
PEA	Programmatic Environmental Assessment
PEIS	Programmatic Environmental Impact Statement
PGS	PGS Onshore Inc.
POC	Plan of Cooperation
rms	Root-Mean-Squared
SBP	Sub-bottom Profiler
SEA	Supplemental Environmental Assessment
SPL	Sound Pressure Level
TTS	Temporary Threshold Shift
µPa	microPascal
UASs	Unmanned Aircraft Systems
U.S.	United States
USC	United States Code
USFWS	United States Fish and Wildlife Service
WNPS	Western North Pacific Stock

Chapter 1 PURPOSE AND NEED FOR ACTION

1.1 Proposed Action

Pursuant to the National Environmental Policy Act (NEPA), the National Marine Fisheries Service (NMFS), through this Environmental Assessment (EA), has analyzed the potential impacts to the human environment that may result from the issuance of an Incidental Harassment Authorization (IHA) pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 USC 1361 *et seq.*) to Shell Offshore Inc. and Shell Gulf of Mexico Inc., collectively known as Shell, for the harassment of marine mammals incidental to an open-water marine survey program, which includes shallow hazards and site clearance work and strudel scour surveys, in the Chukchi Sea, Alaska.

On December 15, 2008, NMFS received an application from Shell requesting authorization for the take[1], by Level B harassment only, of small numbers of several species of marine mammals incidental to conducting an open-water marine survey program during the 2009/2010 Arctic open-water season in the Chukchi Sea. These surveys are a continuation of those conducted by Shell in the Chukchi Sea in 2008. After reviewing Shell's application for completeness and requirements under the MMPA, NMFS published a proposed IHA notice in the *Federal Register* on June 1, 2009 (74 FR 26217), which included a request for comments from the public for 30 days. NMFS' proposed action is to issue an IHA to Shell to take 12 species of marine mammals, by harassment, incidental to an open-water marine survey program. The species of marine mammals that would be authorized for taking are: beluga whale (*Delphinapterus leucas*); killer whale (*Orcinus orca*); harbor porpoise (*Phocoena phocoena*); bowhead whale (*Balaena mysticetus*); gray whale (*Eschrichtius robustus*); minke whale (*Balaenoptera acutorostrata*); fin whale (*Balaenoptera physalus*); humpback whale (*Megaptera novaeangliae*); bearded seal (*Erignathus barbatus*); spotted seal (*Phoca largha*); ringed seal (*Phoca hispida*); and ribbon seal (*Histriophoca fasciata*).

1.2 Purpose and Need

The purpose and need of the proposed action is to ensure compliance with the MMPA and its implementing regulations in association with Shell's proposed open-water marine survey program in the Chukchi Sea. The MMPA prohibits takes of all marine mammals with certain exceptions.

Sections 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review. See 16 U.S.C. 1371(a)(5)(A), (D).

[1] Take under the MMPA means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. 16 U.S.C. 1362(13).

Permission may be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not (where relevant) have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as "...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) of the MMPA established an expedited process by which U.S. citizens can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as:

> Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

Shell determined that conducting an open-water marine survey program in the Chukchi Sea might potentially disturb marine mammals and, accordingly, submitted an application for an IHA under the MMPA. The primary concern related to potential take of marine mammals incidental to Shell's activities relates to noise generated by the use of airguns on the source vessel during shallow hazards and site clearance surveys and associated activities. If the actions proposed in the application will have no more than a negligible impact on the species or stocks, will not have an unmitigable adverse impact on the availability of the species or stock for subsistence uses, and the permissible methods of taking and required monitoring are set forth, then NMFS shall issue an IHA pursuant to the MMPA. Shell has conducted previous open-water marine survey programs, including seismic surveys and site clearance and shallow hazards surveys in the Chukchi and Beaufort seas, in accordance with the MMPA under IHAs issued in 2006, 2007, and 2008. Shell's 2008 IHA is valid through August 19, 2009, or until a new IHA is issued. The current action is needed to achieve MMPA compliance for Shell's activities for the 2009/2010 Arctic open-water season.

1.3 Description of the Specified Activity

As described above, section 101(a)(5)(D) of the MMPA requires that an applicant identify the specified activity sought for which take authorization is sought. The applicant's activity is evaluated by NMFS and informs NMFS' development of a proposed action and range of alternatives to be considered by NMFS in accordance with NEPA. The specified activity (i.e., site clearance and shallow hazards surveys and a strudel scour survey in the Chukchi Sea) is summarized in this subsection and is also

described in more detail in Shell's application, as well as two addenda to the application submitted by Shell. These documents are available on the NMFS Office of Protected Resources (OPR) website at: http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.

1.3.1 Site Clearance and Shallow Hazards Surveys

Applicant's conducting site clearance and shallow hazards surveys evaluate the seafloor and shallow sub-seafloor at prospective exploration drilling locations, focusing on the depth to seafloor, topography, the potential for shallow faults or gas zones, and the presence of archaeological features. The equipment used to conduct these surveys use involves low-level energy sources focused on limited areas in order to characterize the footprint of the seafloor and shallow sub-seafloor at prospective drilling locations.

Site clearance and shallow hazards surveys of potential proposed locations for exploration drilling will be executed as required by the Minerals Management Service's (MMS) regulations. These surveys gather data on: (1) bathymetry; (2) seabed topography and other seabed characteristics (e.g., boulder patches); (3) potential geohazards (e.g., shallow faults and shallow gas zones); and (4) the presence of any archeological features (e.g., shipwrecks). Site clearance and shallow hazards surveys can be accomplished by one vessel with acoustic sources. No other vessels are necessary to accomplish the proposed work.

The Chukchi Sea site clearance and shallow hazards surveys will be conducted on leases that were acquired in Outer Continental Shelf (OCS) Lease Sale 193. Site clearance surveys are confined to small specific areas within OCS blocks. Shell has indicated that it will conduct site clearance and shallow hazards surveys at the prospects named Burger and Crackerjack (see Figure 1) and possibly SW Shoebill (which is not depicted in Figure 1 but is west of Crackerjack within the Chukchi Sea marine survey area of OCS lease blocks shown in Figure 1). These surveys will occur more than 113 km (70 mi) or more offshore of the Alaska coast. Before the commencement of operations, survey location information will be supplied to MMS as ancillary activities authorizations and provided to other interested agencies as it becomes available.

Shell anticipates shooting approximately 480 km (298 mi) of survey lines (plus approximately 120 km (74.6 mi) of mitigation gun activity between survey lines) from August through October, 2009, exposing approximately 900 km^2 (347.5 mi^2) of water to sounds of 160 dB (rms) or greater. The operation will be active 24 hours per day and use a single vessel to collect the geophysical data.

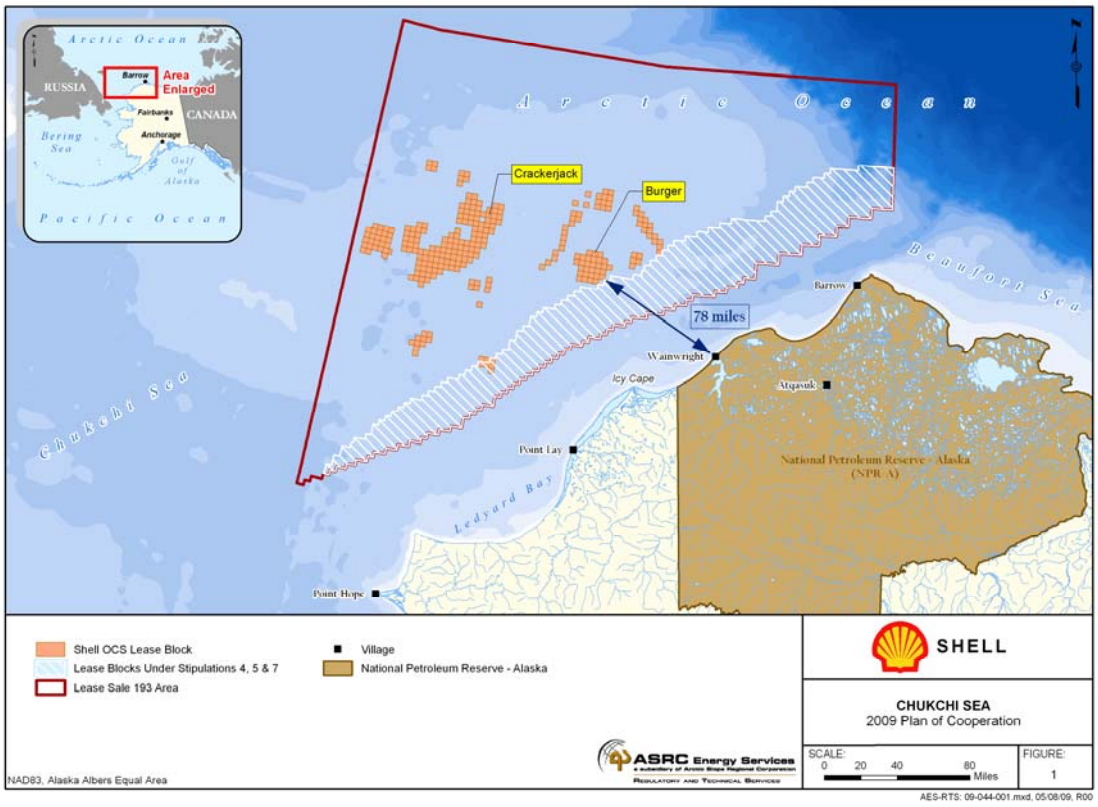

Figure 1. Chukchi Sea proposed site clearance and shallow hazards survey location map.

The vessel that will be conducting the site clearance and shallow hazards surveys may also be used in the deployment and retrieval of underwater Ocean Bottom Hydrophones (OBHs) as described in the Marine Mammal Monitoring and Mitigation Plan (4MP) in Attachment A of Shell's application and also later in this EA. These OBHs are anchored underwater buoys that record marine mammal vocalizations and other underwater sounds.

The site clearance and shallow hazards surveys are confined to small specific areas within OCS blocks. At this time, Shell has indicated that the *R/V Mt. Mitchell* will be used to conduct the activity. The *R/V Mt. Mitchell* is a diesel powered vessel, 70 m (231 ft) long, 12.7 m (42 ft) wide, with a 4.5 m (15 ft) draft. In the event the *R/V Mt. Mitchell* becomes unavailable, Shell would utilize a similar vessel to conduct the activities.

Shell plans to use the following acoustic instrumentation, or something similar, to conduct the site clearance and shallow hazards surveys: (1) dual-frequency side scan sonar (2-7 kHz or 8-23 kHz), or similar; (2) single beam Echo Sounder (33-210 kHz), or similar; (3) multibeam Echo Sounder (200 kHz), or similar; (4) high resolution multi-channel two-dimensional (2D) system, 40 in^3 (4 x 10) airgun array (0-150 Hz), or similar; (5) shallow sub-bottom profiler (SBP; 1-12 kHz), or similar; and (6) medium penetration SBP (400-800 Hz), or similar.

This activity is proposed to occur during August-October 2009, and, as proposed, the total program will last a maximum of 50 days of active data acquisition, excluding downtime due to weather and other unforeseen delays. The *R/V Mt. Mitchell* may also be used to perform other activities, such as deploying and retrieving the OBHs. The time for deploying and retrieving the OBHs is not included in the 50-day estimate.

1.3.2 Strudel Scour Survey

During the early melt, the rivers begin to flow and discharge water over the coastal sea ice near the river deltas. That water rushes down holes in the ice ("strudels") and scours the seafloor. These erosional areas are called "strudel scours". Information on these features is required for prospective pipeline planning. Two proposed activities are required to gather this information: an aerial survey via helicopter overflights during the melt to locate the strudels and strudel scour marine surveys to gather bathymetric data. The overflights investigate possible sources of overflood water and will survey local streams that discharge in the vicinity of potential pipeline shore crossings. The helicopter overflights are proposed to occur during mid-May/early June 2010 and, weather permitting, should take no more than four days. There are no planned landings during the overflights other than at local airports. Areas that have strudel scour identified during the aerial survey would be verified and surveyed with a marine vessel after the breakup of nearshore ice. This proposed activity, i.e., marine surveys to gather bathymetric data, is not anticipated to take more than 10 days to conduct, excluding downtime due to weather and other unforeseen delays. It is anticipated to occur sometime in July through mid-August 2010. This is a daylight only operation. The specific locations for pipeline shore crossings have not yet been identified. The vessel for the strudel scour survey would use the following equipment: multi-beam bathymetric sonar, or similar; side-scan sonar system, or similar; and single beam bathymetric sonar, or similar.

As of the development of this EA, Shell had not contracted a vessel to conduct these activities; however, it is anticipated that it will be the diesel-powered *R/V Annika Marie* which has been utilized from 2006-2008 and measures 13.1 m (43 ft) long or similar vessel. Only one vessel is needed to complete the survey, and the acoustic sources will be deployed from that vessel.

1.4 Other EA/EIS that Influence the Scope of this EA

In 2006, MMS prepared Draft and Final Programmatic Environmental Assessments (PEAs) on the *Arctic Ocean Outer Continental Shelf Seismic Surveys - 2006* (MMS, 2006, or PEA) for permitting up to four seismic surveys to be conducted in the open-water season in both the Beaufort and Chukchi Seas, for a total of up to eight annual surveys. NMFS was a cooperating agency in the preparation of the MMS PEA. A Final PEA was released by MMS on June 22, 2006 and adopted by NMFS.

On November 17, 2006, NMFS and MMS issued a notice of intent to jointly prepare a Programmatic Environmental Impact Statement (PEIS) to assess the impacts of MMS'

annual authorizations under the OCS Lands Act to the U.S. oil and gas industry to conduct a higher level of offshore geophysical seismic surveys in the Chukchi and Beaufort Seas off Alaska over a longer time frame than evaluated in the PEA and to assess the impacts of NMFS' authorizations under the MMPA to incidentally harass marine mammals while conducting those surveys. The Draft PEIS assumes that up to six offshore geophysical seismic surveys would be conducted annually in both the Chukchi and Beaufort Seas off Alaska (for a total of up to 12 annual surveys) and evaluates the environmental effects of the increased level of seismic effort (which represents a 50 percent increase in activity compared to the level of seismic effort analyzed in the MMS 2006 PEA). On March 30, 2007, the Environmental Protection Agency noticed the availability for comment of the MMS/NMFS Draft PEIS (MMS, 2007a).

In August 2007, NMFS prepared a Supplemental EA (SEA; NMFS, 2007) and issued a new Finding of No Significant Impact (FONSI) to update the 2006 Final PEA for analysis of an arctic seismic survey incidental take authorization, including NMFS' issuance of an IHA to Shell for the 2007 season. The 2007 SEA analyzed the effects on the human environment of issuing an IHA to Shell to conduct deep three-dimensional (3D) seismic surveys in both the Beaufort and Chukchi seas and marine surveys, including site clearance and shallow hazards surveys, in the Beaufort Sea during the 2007 Arctic open-water season. Where appropriate, sections of the 2006 Final PEA and 2007 Draft PEIS were incorporated into the 2007 SEA by reference.

For the 2008 Arctic open-water season, NMFS received applications from five companies (i.e., Shell, BP Exploration (Alaska) Inc. (BP), PGS Onshore Inc. (PGS), ASRC Energy Services (AES), and ConocoPhillips Alaska Inc. (CPAI)), requesting IHAs to conduct various types of seismic and site clearance and shallow hazards surveys in the Arctic Ocean. In July 2008, NMFS prepared a new SEA (2008 SEA; NMFS, 2008) to update analyses contained in the 2006 Final PEA since it was determined that the 2008 surveys would have environmental impacts similar to the activities analyzed in the 2006 Final PEA. Where appropriate, sections of the 2006 Final PEA and 2007 Draft PEIS, as well as NMFS' 2007 SEA, Arctic Regional Biological Opinion, MMS' 2007 *Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea - Final Environmental Impact Statement* (MMS, 2007b), and MMS' 2003 *Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, 202 Final Environmental Impact Statement* (MMS, 2003), were incorporated into the 2008 SEA by reference. After completion of the 2008 SEA, NMFS issued five FONSIs in July and August 2008 for each of the five IHAs issued by NMFS.

Portions of these NEPA documents are appropriately incorporated by reference, as directed by 40 CFR 1502.21 of the Council on Environmental Quality's regulations. This EA updates information contained in the above mentioned NEPA documents to include Shell's proposed activities described in Section 1.3 of this document and new information on potential impacts to marine mammals based on previous years of monitoring (including results from 2008) that has taken place since Shell began these activities.

1.5 Public Involvement

On June 1, 2009, NMFS published a notice of a proposed IHA in the *Federal Register* (74 FR 26217) and requested comments from the public for 30 days. NMFS received six comment letters from the following organizations: the Marine Mammal Commission (Commission); Ocean Conservancy and Oceana; the Alaska Eskimo Whaling Commission (AEWC); the Inupiat Community of the Arctic Slope; North Slope Borough (NSB) Office of the Mayor and NSB Department of Wildlife Management; and Alaska Wilderness League, Center for Biological Diversity, Defenders of Wildlife, Earthjustice, Natural Resources Defense Council, Northern Alaska Environmental Center, Pacific Environment, Sierra Club, The Wilderness Society, and World Wildlife Fund, which also included an attached letter from David E. Bain, Ph.D.

Three of the comment letters addressed (among other issues) issues related specifically to the NEPA process for this action. The letters expressed three specific issues regarding the NEPA process. First, the commenters believed that NMFS was excluding the public from the NEPA process since NMFS did not release a draft EA for the public to review and to provide comments prior to NMFS taking its final action. However, neither NEPA nor the CEQ's regulations explicitly require circulation of a draft EA for public comment prior to finalizing the EA. The Federal courts have upheld this conclusion, and in one recent case, the Ninth Circuit squarely addressed the question of public involvement in the development of an EA. In *Bering Strait Citizens for Responsible Resource Development* v. *U.S. Army Corps of Engineers* (9th Cir. 2008), the court held that the circulation of a draft EA is not required in every case; rather, Federal agencies should strive to involve the public in the decision-making process by providing as much environmental information as is practicable prior to completion of the EA so that the public has a sufficient opportunity to weigh in on issues pertinent to the agency's decision-making process. In the case of Shell's 2009 MMPA IHA request, NMFS involved the public in the decision-making process by distributing Shell's IHA application and addenda for a 30-day notice and comment period. However, at that time, a draft EA was not available to provide to the public for comment. The IHA application and NMFS' *Federal Register* notice of the proposed IHA (74 FR 26217, June 1, 2009) contained information relating to the project. For example, the application includes a project description, its location, environmental matters such as species and habitat to be affected, and measures designed to minimize adverse impacts to the environment and the availability of affected species or stocks for subsistence uses.

Second, the letter from the AEWC notes that Shell's IHA application warrants review in an EIS given the potential for significant impacts. This EA was prepared to evaluate whether significant environmental impacts may result from the proposed action (issuing an IHA to Shell), which is an appropriate application of NEPA.

Finally, all three letters note the release of the MMS/NMFS Draft PEIS (MMS, 2007a) in the summer of 2007. To date, a Final PEIS has not been completed. The commenters believe that all public comments submitted on the Draft PEIS must be answered and the Final PEIS released before NMFS can issue new IHAs for seismic activities in the

Chukchi and Beaufort Seas. While the Final PEIS will analyze the affected environment and environmental consequences from seismic surveys in the Arctic, the analysis contained in the Final PEIS will apply more broadly to Arctic seismic operations. NMFS' proposed action to issue an IHA to Shell for the taking of several species of marine mammals incidental to conducting its open-water marine survey program in the Chukchi Sea, as analyzed in this EA, is not expected to significantly affect the quality of the human environment. NMFS' proposed action to issue an IHA to Shell for the taking of several species of marine mammals, by harassment, incidental to conducting its open-water marine survey program in the Chukchi Sea, as analyzed in this EA, is not expected to significantly affect the quality of the human environment because of the limited duration and scope of Shell's operations.

All of the comments received on the proposed IHA notice (74 FR 26217, June 1, 2009) will be addressed in the final IHA *Federal Register* notice.

1.6 Statutory and Regulatory Framework

In addition to the regulatory framework described in section I.A.1. of the 2006 Final PEA, more detailed information on NMFS' mandates is presented here. Pursuant to 30 CFR § 251.4, a Geological and Geophysical (G&G) permit must be obtained from MMS to conduct geophysical exploration for oil, gas, and sulphur resources. The MMS authority is discussed in the 2006 PEA (section I.A.1.), which is incorporated herein by reference. However, MMS considers site clearance and shallow hazards surveys to be ancillary activities that do not require a G&G permit. On May 18, 2009, Shell submitted an *Ancillary Activity Authorization Request for Site Clearance and Shallow Hazards Surveys and Scientific Data Device Deployment in the Chukchi Sea, Alaska During 2009* application to MMS. On July 10, 2009, MMS issued a letter to Shell indicating that after evaluation of Shell's request, MMS determined that the proposed ancillary activity complies with the performance standards listed in 30 CFR § 250.202(a), (b), (d), and (e) and therefore may proceed with the proposed activities in accordance with 30 CFR § 250.209.

1.6.1 Marine Mammal Protection Act

Under the MMPA, the taking of marine mammals without an authorization from NMFS is prohibited. 16 U.S.C. § 1371. The term "take" under the MMPA means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill." 16 U.S.C. § 1362(13). Except with respect to certain activities not relevant here, the MMPA defines "harassment" as:

> "...any act of pursuit, torment, or annoyance which (a) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (b) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to

injure a marine mammal or marine mammal stock in the wild [Level B harassment]."

To date, NMFS' practice has been to use the 180-decibel (dB) re 1 µPa root-mean-squared (rms) received level for cetaceans and 190-dB re 1 µPa rms received level for pinnipeds to indicate where temporary threshold shift (TTS, or temporary loss of portion of hearing sensitivity) of these animals from acoustic exposure begins. Since TTS does not result in a permanent loss of hearing sensitivity, and the animal is expected to fully recover from TTS after a certain period of time (see review in Southall *et al.*, 2007), NMFS considers TTS to be Level B harassment. In addition, NMFS uses the 160-dB re 1 µPa rms isopleth for cetaceans and pinnipeds to indicate where Level B behavioral harassment begins for acoustic sources, including impulse sounds, such as those used for seismic surveys.

In order to obtain an exemption from the MMPA's prohibition on taking marine mammals, a citizen of the U.S. who engages in a specified activity (other than commercial fishing) within a specified geographic region must obtain an incidental take authorization (ITA) under section 101(a)(5)(A) or (D) of the MMPA. An ITA shall be granted if NMFS finds that the taking of small numbers of marine mammals of a species or stock by such citizen will have a negligible impact on the affected species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses. NMFS shall also prescribe, where applicable, the permissible methods of taking and other means of effecting the least practicable adverse impact on the species or stock and its habitat (i.e., mitigation, monitoring, and reporting of such takings). ITAs may be issued as either (1) regulations and associated Letters of Authorization (LOAs) where there is a potential for serious injury or mortality; or (2) IHAs, when there is no potential for serious injury or mortality or where any such potential can be negated through required mitigation measures.

As part of the MMPA authorization process, applicants are required to provide detailed mitigation plans that outline what efforts will be taken to reduce negative impacts to marine mammals and their availability for subsistence use to the lowest level practicable. In addition, ITAs require that operators conduct monitoring, which should be designed to result in an increased knowledge of the species and an understanding of the level and type of takings that result from the authorized activities. Under the MMPA, NMFS further requires that monitoring be designed to provide data verifying (or disputing) that the taking of marine mammals is, in fact, negligible and there are no unmitigable adverse impacts on the availability of marine mammals for subsistence uses.

In making a determination of no unmitigable adverse impacts to subsistence uses of marine mammals, NMFS considers whether a Plan of Cooperation (POC) has been negotiated between the affected Alaskan Native communities and the applicant.

1.6.2 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) states:

> "Each Federal agency shall, in consultation with and with the assistance of the Secretary [of the Interior/Commerce "Secretary"], insure that any action authorized, funded, or carried out by such agency…is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of habitat of such species, which is determined by the Secretary…to be critical…"

16 U.S.C. § 1536(a)(2).

A summary of NMFS' and MMS' ESA consultation with the NMFS Alaska Region Anchorage Field Office and the U.S. Fish and Wildlife Service (USFWS) in regards to the seismic survey activities conducted in 2006 is provided in Section VI of the 2006 Final PEA, which is incorporated herein by reference. The prior consultation concluded with issuance of the Arctic Regional Biological Opinion (ARBO) on June 16, 2006. The 2006 ARBO concluded that the issuance of seismic survey permits by MMS and the issuance of the associated IHAs by NMFS for seismic surveys are not likely to jeopardize the continued existence of threatened or endangered species (specifically the bowhead whale) under the jurisdiction of NMFS or destroy or adversely modify any designated critical habitat. NMFS issued Incidental Take Statements (ITSs), which contained reasonable and prudent measures with implementing terms and conditions to minimize the effects of take of listed species.

In 2007, NMFS issued only one IHA (to Shell) to harass marine mammals incidental to seismic survey activities in the Arctic. NMFS determined that the findings in the 2006 ARBO were still relevant to the 2007 open-water seismic survey season. Therefore, a new Biological Opinion was not issued. However, NMFS did issue a new ITS in 2007.

For the 2008 activities, a new consultation under section 7 of the ESA concerning the impact on humpback and fin whales in the Chukchi Sea was conducted between the MMS and NMFS' Anchorage Field Office. NMFS Office of Protected Resources also consulted under section 7 of the ESA on the issuance of IHAs pursuant to section 101(a)(5)(D) of the MMPA for the 2008 open-water season. In a Biological Opinion issued on July 17, 2008, NMFS concluded that the issuance of seismic survey permits by MMS and the issuance of the associated IHAs for seismic surveys are not likely to jeopardize the continued existence of threatened or endangered species (specifically the bowhead, humpback, and fin whales) under the jurisdiction of NMFS or destroy or adversely modify any designated critical habitat. The 2008 Biological Opinion takes into consideration all oil and gas related activities that are reasonably likely to occur, including exploratory (but not production) oil drilling activities. In addition, NMFS issued new ITSs under the 2008 Biological Opinion for each issued IHA, which contained reasonable and prudent measures with implementing terms and conditions to minimize the effects of take of listed species.

On May 15, 2008, the USFWS listed the polar bear (*Ursus maritimus*) as a threatened species under the ESA. Therefore, MMS conducted a new consultation under section 7 of the ESA with USFWS to cover incidental harassment of polar bears during seismic survey activities during the 2008 open-water season. Since the polar bear is under the jurisdiction of the USFWS, under the MMPA, incidental take of this species cannot be authorized unless the FWS finds that any take that is reasonably likely to occur will have no more than a negligible impact on the species. For information on previous consultations between MMS and USFWS under section 7 of the ESA, refer to Section VI of the 2006 Final PEA.

NMFS has determined that Shell's proposed activities described and analyzed in this EA and NMFS' proposed IHA (74 FR 26217, June 1, 2009) for the 2009/2010 open-water season have been adequately analyzed in the 2008 Biological Opinion issued on July 17, 2008. Therefore, NMFS does not plan to prepare a new Biological Opinion under section 7 of the ESA. A new ITS will be issued if an IHA is issued to Shell for the proposed activities described in Shell's application and this EA.

1.6.3 Magnuson-Stevens Fishery Conservation and Management Act

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), Federal agencies are required to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency which may adversely affect essential fish habitat (EFH) identified under the MSFCMA.

A summary of NMFS' and MMS' EFH consultation with the NMFS Office of Habitat Conservation regarding the conduct of seismic surveys in the Arctic is provided in Section VI of the 2006 Final PEA. In a June 6, 2006, response, the NMFS Office of Habitat Conservation stated that further EFH consultation is not necessary unless implementation of the plan or operational conditions change. NMFS has reviewed the scope of the project descriptions for Shell's 2009 activities. Based on that review, the project falls within the scope of the consultation. Therefore, additional consultation for EFH is not necessary.

1.7 Scope of the Analysis

This EA addresses the proposal of NMFS to issue an IHA under section 101(a)(5)(D) of the MMPA and the alternatives to the proposed action. The IHA, if issued, would authorize the harassment of 12 species of marine mammals incidental to an open-water marine survey program, which includes shallow hazards and site clearance work and strudel scour surveys in the Chukchi Sea, Alaska. The IHA, if issued, would be valid from August 2009 through expiration of the IHA (approximately July 2010) and would not exceed one year. Shell's current IHA is valid through August 19, 2009 or until the issuance of a new IHA.

Chapter 2 ALTERNATIVES

In light of NMFS' stated purpose and need, NMFS considered the following three alternatives for the issuance of an IHA to Shell to conduct its open-water marine survey program during the 2009/2010 Arctic open-water season.

2.1 Alternative 1—No Action Alternative

Under the No Action Alternative, NMFS would not issue an IHA to Shell for the harassment of marine mammals incidental to conducting an open-water marine survey program in the Chukchi Sea. The MMPA prohibits all takings of marine mammals unless authorized by a permit or exemption under the MMPA. The consequences of not authorizing incidental take is (1) the entity conducting the activity may be in violation of the MMPA if take occurs, (2) mitigation and monitoring measures cannot be required by NMFS, and (3) mitigation measures might not be performed voluntarily by the applicant. By undertaking measures to further protect marine mammals from incidental take through the authorization program, the impacts of these activities on the marine environment can potentially be lessened. While NMFS does not authorize the geophysical activity itself (that authority falls to MMS), NMFS does authorize the incidental harassment of marine mammals in connection with these activities and prescribes the methods of taking and other means of effecting the least practicable adverse impact on the species and stocks and their habitats. If an IHA is not issued, Shell could decide either to cancel its open-water marine survey program or to continue the activities described in Section 1.3 of this EA. If the latter decision is made, Shell could independently implement (presently unidentified) mitigation measures; however, they would be proceeding without authorization from NMFS pursuant to the MMPA. If Shell did not implement mitigation measures during survey activities, takes of marine mammals by harassment (and potentially by injury or mortality) could occur if the activities were conducted when marine mammals were present. Although the No Action Alternative would not meet the purpose and need to allow incidental takings of marine mammals under certain conditions, CEQ regulations require consideration and analysis of a No Action Alternative for the purposes of presenting a comparative analysis to the action alternatives.

2.2 Alternative 2—Issuance of an IHA with Required Mitigation, Monitoring, and Reporting Measures (Preferred Alternative)

Under this alternative, NMFS would issue an IHA under section 101(a)(5)(D) of the MMPA to Shell, allowing the take by Level B harassment of 12 marine mammal species incidental to conducting an open-water marine survey program (which would include site clearance and shallow hazards and strudel scour surveys) in the Chukchi Sea during the 2009/2010 Arctic open-water season. In order to reduce the incidental harassment of marine mammals to the lowest level practicable, Shell would be required to implement the mitigation, monitoring, and reporting measures described in Chapters 5 and 6 of this EA. For authorizations in Arctic waters, NMFS must also prescribe measures to ensure no unmitigable adverse impact on the availability of the affected species or stock for

taking for subsistence uses. The impacts to marine mammals and subsistence hunters that could be anticipated from implementing this alternative are addressed in Chapter 4 of this EA. Since the MMPA requires holders of IHAs to reduce impacts on marine mammals to the lowest level practicable, implementation of this alternative would meet NMFS' purpose and need as described in this EA.

2.3 Alternative 3—Issuance of an IHA with Additional Mitigation and Monitoring Measures

Under Alternative 3, NMFS would issue an IHA under section 101(a)(5)(D) of the MMPA to Shell, allowing the incidental take by Level B harassment only of 12 marine mammal species incidental to conducting an open-water marine survey program (which would include site clearance and shallow hazards and strudel scour surveys) in the Chukchi Sea during the 2009/2010 Arctic open-water season. While all of the mitigation, monitoring, and reporting measures that would be required under Alternative 2 would also be required under Alternative 3, the difference under this alternative is that additional mitigation and monitoring measures would be required. Additional measures that would be required by NMFS under this alternative include: a 120-dB monitoring (safety) zone for bowhead whale cow/calf pairs, near real-time passive acoustic monitoring (PAM), active acoustic monitoring (AAM), and the use of unmanned aerial vehicles to conduct aerial monitoring. At this time, these technologies are still being developed or refined. For example, while there has been some testing of unmanned aerial vehicles conducted recently, the technology has not yet been proven effective for monitoring or mitigation as would be required under an IHA. Additionally, the existing PAM devices have not been proven effective for implementing mitigation measures that would be required in an IHA. However, once the monitoring technologies are either developed or refined, requiring the implementation of these measures (e.g., PAM) would allow for increased effectiveness in implementing mitigation measures (e.g., shutdown), which would reduce potential impacts to marine mammals even further. The effects of implementing Alternative 3 are addressed in Chapter 4 of this EA.

2.4 Alternatives Considered but Eliminated from Further Consideration

NMFS considered whether other alternatives could meet the purpose and need and support Shell's proposed activities. An alternative that would allow for the issuance of an IHA with no required mitigation or monitoring was considered but eliminated from consideration, as it would not be in compliance with the MMPA and therefore would not meet the purpose and need. For that reason, this alternative is not analyzed further in this document.

Chapter 3 AFFECTED ENVIRONMENT

The purpose of this chapter is to provide baseline information for consideration of the alternatives and to describe the environment that might be affected by the proposed action and alternatives. The physical, acoustic, biological, and socioeconomic environment of the Chukchi and Beaufort Seas, including its physical oceanography, air quality, ambient noise levels from natural and anthropogenic sounds, underwater sound propagation, seismic sound and its impacts to marine life, marine seismic surveys in the Beaufort and Chukchi Seas, vessel and air traffic, oil and gas development, fish/fishery resources and EFH, marine birds, marine mammals, community setting and regional economy, subsistence use of natural resources, culture and traditional knowledge, archaeological resources, land use plans and coastal zone management, and environmental justice, are described in MMS' 2006 Final PEA (MMS, 2006). Since completion of the 2006 PEA (MMS, 2006), updated information on several marine mammal species expected to be present in the action area has become available. Section III.A. of NMFS' 2008 SEA (NMFS, 2008) provided updated information on the polar bear and ringed, spotted, ribbon, and bearded seals. The area where Shell's activities would occur does not contain any park land, prime farmlands, wetlands, wild and scenic rivers, or critical habitat, or districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places.

The proposed action area for Shell's 2009/2010 shallow hazard and site clearance and strudel scour surveys is similar to that described in the MMS 2006 PEA (MMS, 2006). This conclusion is based on NMFS' review of the most recent scientific literature concerning the affected environment of the proposed action area and the MMS 2006 PEA. That document described which resources were carried forward for analysis and which resources were not considered for further analysis. A matrix was prepared listing the categories of seismic survey impact agents and the list of resource categories of concern. The level of impact associated with each interaction was ascertained as either: (1) potentially adverse; (2) likely negligible; (3) not likely; or (4) not applicable. Those resources having any potential to be adversely affected were carried forward for further analysis. The 2006 PEA identified the following resources that could potentially be affected by marine seismic surveys and therefore mainly focused the impact analysis on these resources: archaeological sites; marine invertebrates; coastal and marine birds; EFH; marine fish; commercial fisheries; marine mammals; the sociocultural environment; and subsistence harvest activities. The marine mammal species that were analyzed in the 2006 PEA, which may occur near Shell's 2009 activities and may be taken by harassment include: beluga whale; killer whale; harbor porpoise; bowhead whale; gray whale; minke whale; fin whale; humpback whale; bearded seal; spotted seal; ringed seal; and ribbon seal. The bowhead, fin, and humpback whales are listed as endangered under the ESA. The affected physical, acoustic, biological, and socioeconomic environment of the proposed action areas described in the MMS 2006 PEA (MMS, 2006) is incorporated herein by reference.

Additionally, NMFS has reviewed the updated information provided in the 2008 SEA (NMFS, 2008) on the four ice seal species (ribbon, ringed, spotted, and bearded seals)

likely to occur in the proposed action area and the polar bear. This information is incorporated herein by reference. However, newer information is available regarding the ribbon seal since completion of the 2008 SEA (NMFS, 2008). Some newer information on the distribution and occurrence of fin and humpback whales in the proposed action area (eastern Chukchi Sea) is now available. The updated information on these three species is provided below.

The updated information regarding ice seals in NMFS' 2008 SEA (NMFS, 2008) described the December 2007 petition submitted by the San Francisco-based Center for Biological Diversity to list ribbon seals as either threatened or endangered under the ESA. In addition to reviewing the ribbon seal, NMFS determined that it should also prepare status reviews on bearded, ringed, and spotted seals for possible listing, since these four species of ice seals in Alaska all utilize various types of sea ice habitats. On March 28, 2008, NMFS published a *Federal Register* notice (73 FR 16617) and opened a 90-day public comment period to solicit scientific and commercial information regarding all of these ice seal species to ensure a comprehensive status review. Since completion of the 2008 SEA, NMFS has issued a notice of finding regarding whether or not to list ribbon seals under the ESA. On December 30, 2008, NMFS announced its 12-month finding on a petition to list the ribbon seal as a threatened or endangered species under the ESA (73 FR 79822). After a formal review of the best available scientific and commercial information, NMFS found that listing of the ribbon seal was not warranted. A final determination on whether or not to list the other three ice seal species has not yet been made. Nevertheless, should new scientific information become available and should NMFS decide to list any of the ice seal species under the ESA, NMFS would, pursuant to the ESA, act accordingly.

While sections III.F.3(d)(6)(a) and III.F.3(e)(6)(b) of MMS' 2006 PEA (MMS, 2006) described the use of the Chukchi and Beaufort Seas by fin and humpback whales, respectively, some newer information on the potential occurrence of these species in both seas has become available since completion of that document. Below is some updated information on fin and humpback whale occurrences in the Chukchi Sea near Shell's proposed activities.

The distribution of fin whales can be understood only in light of their feeding ecology (Mizroch et al., 2001). Fin whales are known to migrate between high latitude summer feeding grounds and lower-latitude wintering areas, although some individuals and even local populations do not. Rice (1974) reported that the summer distribution of fin whales included immediate offshore waters throughout the North Pacific from central Baja California to Japan, and as far north as the Chukchi Sea. They occurred in high densities in the northern Gulf of Alaska and southeastern Bering Sea from May to October, with some movement through the Aleutian passes into and out of the Bering Sea (NMFS, 2006). Fin whales were observed and taken by Japanese and Soviet whalers off eastern Kamchatka and Cape Navarin, both north and south of the eastern Aleutians, and in the northern Bering and southern Chukchi Seas (NMFS, 2006). They were also taken by whalers off central California throughout the year.

NMFS (2006) reports that fin whales have been observed year-round off central and southern California, with peak numbers in summer and fall, in summer off Oregon, and in summer and fall in the Gulf of Alaska (including Shelikof Strait), and the southeastern Bering Sea. Their regular summer occurrence has also been noted in recent years around the Pribilof Islands in the northern Bering Sea. Data suggest that, as in the North Atlantic, the migratory behavior of fin whales in the eastern North Pacific is complex: whales can occur in any one season at many different latitudes, perhaps depending on their age or reproductive state as well as their stock affinity. Movements can be either inshore/offshore or north/south. Some individuals remain at high latitudes through the winter. Fin whale concentrations in the northern North Pacific and Bering Sea generally form along frontal boundaries, or mixing zones between coastal and oceanic waters, which themselves correspond roughly to the 200-m (656-ft) isobath (shelf edge) (NMFS, 2006).

Fin whales may occur seasonally in the southwestern Chukchi Sea, north of the Bering Strait along the coast of the Russian Chukotka (also referenced as the Chukchi) Peninsula. Their known current summer feeding habitat includes the southern portion, especially the southwestern portion, of the Chukchi Sea along the Asian coast. This species' current use of parts of its historic range probably is modified due to serious population reduction during commercial hunting. However, there is no indication that fin whales typically occur within the Chukchi Sea Planning Areas or in areas directly adjacent. There have been only rare observations of fin whales into the eastern half of the Chukchi Sea. In the southeast Chukchi Sea on September 23, 2006, three adult fin whales were seen from a vessel by marine mammal observers (MMOs; Patterson et al., 2007). In 1981, three fin whales (two adults, one calf) were observed (Ljungblad et al., 1982) in the extreme southern Chukchi Sea associated with the aerial surveys of endangered whales in the Beaufort Sea, Chukchi Sea, and northern Bering Sea. These represent the only confirmed observations since 1979 in or near the planning areas (neither of these occurrences occurred within the planning areas). No other sightings of fin whales were reported during aerial surveys of endangered whales in summer (July) and autumn (August, September, and October) of 1979-1987 in the northern Bering Sea (from north of St. Lawrence Island), the Chukchi Sea north of lat. 66º N. and east of the International Date Line, and the Alaskan Beaufort Sea from long. 157º01' W. east to long. 140º W. and offshore to lat. 72º N. (Ljungblad et al., 1988a). During a research cruise in the Chukchi and Beaufort seas (from July 5-August 18, 2003), in which all marine mammals observed were recorded, no fin whales were observed (Bengtson and Cameron, 2003).

Based on this information, it appears that fin whales are uncommon to the eastern Chukchi Sea and the Chukchi OCS Planning Area in which lease sales are held. Fin whales do occur south and west of the Chukchi Sea Planning Areas, and may expand northward in the future. It is possible that continued Arctic warming could result in changes in oceanographic conditions favorable to the distribution and abundance of fin whale prey species, and the extended distribution into waters of the Chukchi Sea. Therefore, while it is unlikely that fin whales will occur near Shell's proposed surveys, it is possible that one or two individuals could be observed near the site of operations.

Humpback whales are found primarily in coastal and continental shelf waters, but are known to migrate through deep waters between tropical/sub-tropical breeding and calving habitats during the winter and temperate/polar feeding habitats during the summer. Known breeding areas in the Pacific Ocean include Japan, the Hawaiian Islands, coastal Central America and Mexico, and Revillagigedo Archipelago. Humpback whales summer throughout the central and western portions of the Gulf of Alaska, including Prince William Sound, around Kodiak Island (including Shelikof Strait and the Barren Islands), and along the southern coastline of the Alaska Peninsula, as well as the coast of California. It is believed that minimal feeding occurs in wintering grounds (Salden, 1987).

NMFS (1991) (citing Nikulin, 1946 and Berzin and Rovnin, both in Russian), summarized that the northern Bering Sea, Bering Strait, and southern Chukchi Sea along the Chukchi Peninsula are the northern extreme of the range of the humpback. Figure 38 of the most recent (Angliss and Outlaw, 2008) stock assessment for the Western North Pacific Stock (WNPS) depicts the southwestern Chukchi Sea as part of the "approximate distribution" of humpback whales in the North Pacific. Other references indicate that both the historical and current summer feeding habitat of the humpback included, and at least sometimes includes, the southern portion, especially the southwestern portion, of the Chukchi Sea. Mel'nikov (2000) wrote:

> In the fall, humpback whales formed aggregations in the most southern part of the Chukchi Sea, in the Senyavin Strait, and in the northern part of the Gulf of Anadyr. The whales left the area of the survey prior to the start of ice formation. Both in the past and at present, these waters are the summer feeding ground of humpback whales. The regular character of the encounters with the humpback whales points to signs of the restoration in their numbers in the waters off Chukchi Peninsula.

Until 2007, historic and recent information did not indicate humpback whales inhabit northern portions of the Chukchi Sea or enter the Beaufort Sea. No sightings of humpback whales were reported during aerial surveys of endangered whales in summer (July) and autumn (August, September, and October) of 1979-1987 in the Northern Bering Sea (from north of St. Lawrence Island), the Chukchi Sea north of lat. 66º N. and east of the International Date Line, and the Alaskan Beaufort Sea from long. 157º01' W. east to long. 140º W. and offshore to lat. 72º N. (Ljungblad et al., 1988a). During a 2003 research cruise in which all marine mammals observed were recorded from July 5 to August 18 in the Chukchi and Beaufort seas, no humpback whales were observed (Bengtson and Cameron, 2003). One observation of one humpback whale was recorded in 2006 by MMOs aboard a vessel in the southern Chukchi Sea outside of the Chukchi Sea Planning Area (Patterson et al., 2007; unpublished MMS MMO reports, 2006). During summer 2007 between August 1 and October 16, humpback whales were observed during seven observation sequence events in the western Alaska Beaufort Sea (1) and eastern and southeastern Chukchi Sea (6) (unpublished MMS MMO reports, 2007) and one other observation in the southern Chukchi Sea in 2007 (Sekiguchi, In prep.).

Based on this information, it appears that the southern and eastern Chukchi Sea may be a portion of a potentially expanding summer distribution or summer feeding ground for humpback whales. It is most likely that these individuals belong to the WNPS and not the Central North Pacific Stock of humpback whales, but individual photo-identification and genetic data are needed to confirm stock origin. Continued arctic warming could result in changes in oceanographic conditions favorable to the distribution and abundance of humpback whale prey species and the seasonal distribution and movements of humpback whales further north. Therefore, while sightings of humpbacks in the eastern Chukchi Sea have been rare in the past, recent sightings in 2006 and 2007 indicate that it is possible that a few humpback whales could occur near Shell's proposed open-water marine surveys.

Chapter 4 ENVIRONMENTAL CONSEQUENCES

This chapter outlines the effects or impacts to the aforementioned resources in the Chukchi Sea from the proposed action and alternatives. Significance of those effects is determined by considering the context in which the action will occur and the intensity of the action. The context in which the action will occur includes the specific resources, ecosystem, and the human environment affected. The intensity of the action includes the type of impact (beneficial versus adverse), duration of impact (short versus long term), magnitude of impact (minor versus major), and degree of risk (high versus low level of probability of an impact occurring).

The terms "effects" and "impacts" are used interchangeably in preparing these analyses. The CEQ's regulations for implementing the procedural provisions of NEPA, also state, "Effects and impacts as used in these regulations are synonymous" (40 CFR §1508.8). The terms "positive" and "beneficial", or "negative" and "adverse" are likewise used interchangeably in this analysis to indicate direction of intensity in significance determination.

4.1 Effects of Alternative 1 (No Action)

Under the No Action Alternative, NMFS would not issue an IHA to Shell for the proposed activities. In this case, Shell would decide whether or not it would want to continue with the surveying activities. If Shell chooses not to conduct the activities, then there would be no effects to marine mammals. It should be noted, though, conducting these activities, where takes of marine mammals are likely, without an MMPA authorization (i.e., an IHA) is a violation of Federal law. However, if Shell decides to conduct some or all of the activities without implementing any mitigation measures, and if activities occur when marine mammals are present in the action area, there is the potential for unauthorized harassment of marine mammals. The sounds produced by the airgun array could cause behavioral harassment of marine mammals in the action area. Some marine mammals may avoid the area of ensonification. Additionally, masking of natural sounds may occur. Auditory impacts (i.e., temporary and permanent threshold shifts) could also occur if no mitigation or monitoring measures are implemented. As explained later in this document, monitoring of safety zones for the presence of marine mammals allows for the implementation of mitigation measures, such as power-downs and shutdowns of the airguns when marine mammals occur within these zones. These measures are required to avoid the onset of shifts in hearing thresholds. However, if a marine mammal occurs within these higher ensonified zones, it is possible that TTS could occur. Additionally, although unlikely, based on its proximity to the airgun array, permanent threshold shift (PTS) could also possibly occur. If Shell were to decide to implement mitigation measures similar to those described in Chapter 5 of this EA, then the impacts would most likely be similar to those described for Alternative 2 below.

4.2 Effects of Alternative 2 (Preferred)

Under this alternative, NMFS would issue an IHA to Shell for its proposed open-water marine survey program in the Chukchi Sea during the 2009/2010 Arctic open-water season with required mitigation, monitoring, and reporting requirements as discussed in Chapters 5 and 6 of this EA. As part of NMFS' action, the mitigation and monitoring described later in this EA would be undertaken as required by the MMPA, and, as a result, no serious injury or mortality of marine mammals is expected and correspondingly no impact on the reproductive or survival ability of affected species would occur. Potentially affected species would be: beluga whale; killer whale; harbor porpoise; bowhead whale; gray whale; minke whale; fin whale; humpback whale; bearded seal; spotted seal; ringed seal; and ribbon seal. Three of these species (i.e., bowhead, humpback, and fin whales) are listed as endangered under the ESA.

4.2.1 Effects on the Physical Environment

Effects to the physical environment are expected to be minor. The proposed activities are not expected to result in any permanent impact on habitats used by marine mammals or to their prey sources. The proposed activities are not expected to have any habitat-related effects that would produce long-term impacts to marine mammals or their habitat due to the limited extent of the acquisition areas and timing of the activities. Sections III.A. and III.D. of the MMS 2006 PEA (MMS, 2006) contain information regarding the physical environment of the Chukchi Sea and potential effects of seismic activities. That information is incorporated herein by reference. In summary, resources within the physical environment that were described in the PEA include air quality, geology and sediments, and water quality. The effects to these resources were considered briefly, as it was determined that the effects to these resources would be negligible or unlikely. Regarding air quality, marine seismic operations would cause only a short-term, local increase in the concentration of criteria pollutants, and emissions would be within national ambient air quality standards. In addition, because emissions would be from mobile sources, they would be spread over a substantially larger area and are expected to be rapidly dispersed by prevailing offshore winds. Therefore, the potential impacts to air quality from marine seismic operations in the action area are considered negligible. Additionally, Shell's activities would occur in limited areas of the Chukchi Sea, and shallow hazard and site clearance surveys *per se* only emit a very small quantity of greenhouse gases by operating seismic and assistant vessels and survey related equipment and do not appreciably contribute to climate warming.

The activities associated with Shell's marine survey program are not expected to disturb or resuspend any sediment. Therefore, there are no anticipated impacts to geology and sediments in the area. Water quality could be affected by accidentally spilled lubricating oil or diesel fuel from vessels and equipment associated with marine seismic surveys. However, impacts to water quality are unlikely because vessel collisions are not likely to occur. Moreover, should there be any incidents involving the release of oil and fuel from vessels during refueling, impacts from those incidents will likely be small (i.e., less than five gallons per refueling event with only about one refueling event anticipated during

Shell's activities in 2009). Additional information can also be found in the MMS 2007 FEIS on the Chukchi Sea Lease Sale 193 (MMS, 2007b) and the MMS 2007 draft PEIS (MMS, 2007a).

4.2.2 Effects on the Biological Environment

4.2.2.1 Effects on Fish/Fishery Resources and Essential Fish Habitat

Mortality to fish, fish eggs, and larvae from energy sources would be expected within a few meters (0.5 to 3 m (1.6 to 10 ft)) from the sound source. Direct mortality has been observed in cod and plaice within 48 hours that were subjected to pulses 2 m (6.6 ft) from the source (Matishov, 1992); however, other studies did not report any fish kills from sound source exposure (La Bella *et al.*, 1996; Hassel *et al.*, 2003). To date, fish mortalities associated with normal operations are thought to be slight. Saetre and Ona (1996) modeled a worst-case mathematical approach on the effects of energy on fish eggs and larvae, and concluded that mortality rates caused by exposure to sounds are so low compared to natural mortality that issues relating to stock recruitment should be regarded as insignificant.

Limited studies on physiological effects on marine fish and invertebrates to acoustic stress have been conducted. No significant increases in physiological stress from sound energy were detected for various fish, squid, and cuttlefish (McCauley *et al.*, 2000) or in male snow crabs (Christian *et al.*, 2003). Behavioral changes in fish associated with sound exposures are expected to be minor (e.g., temporary abandonment of the ensonified area). Because only a small portion of the available foraging habitat (i.e., airguns will be used in less than 0.2 percent of the Chukchi Sea during Shell's site clearance and shallow hazards surveys) would be subjected to sound pulses at a given time, fish would be expected to return to the area of disturbance within anywhere from 15 to 30 min (McCauley *et al.*, 2000) to several days (Engas *et al.*, 1996).

Available data indicate that mortality and behavioral changes of various fish or invertebrates do occur within very close range (less than 2 m (6.6 ft)) to the energy source. Shell's proposed data acquisition activities in distinct areas in the Chukchi Sea would impact less than 0.1 percent of available food resources, which would have little, if any, effect on a marine mammal's ability to forage successfully. EFH for five species of Pacific salmon (pink [humpback], chum [dog], sockeye [red], chinook [king], and coho [silver]) has been identified in the action area. Section 1.6.3 of this EA described the outcome of the EFH consultation conducted in 2006 and that Shell's 2009 activities are not anticipated to have any significant effects on EFH in the action area. Section III.F.1 of the MMS 2006 PEA (MMS, 2006) provides a full analysis of the impacts from seismic surveying activities to fish/fishery resources and EFH. However, impacts to these resources under Alternative 2 in this EA are expected to be less than those described in the 2006 PEA (MMS, 2006), as that document analyzed the effects of permitting up to four seismic surveys in the Chukchi and four seismic surveys in the Beaufort Sea in a single season, utilizing a range of airgun arrays some of which could potentially have discharge volumes of 6,000 in^3. Here, the proposed action is to issue only one IHA for one open-water marine survey program in the Chukchi Sea only, utilizing a small airgun

array (i.e., total of 40 in^3). Additionally, information can also be found in the MMS 2007 FEIS on the Chukchi Sea Lease Sale 193 (MMS, 2007b) and the MMS/NMFS 2007 Draft PEIS (MMS, 2007a).

4.2.2.2 Effects on Marine Birds

It is not expected that NMFS' proposed action of issuing an IHA to Shell will have any significant impact on marine birds in the proposed action area. Section III.F.2 of the MMS 2006 PEA (MMS, 2006) provides a full analysis of the impacts from seismic surveying activities to marine birds. That information is incorporated herein by reference. To summarize, the PEA noted that seismic surveys could have a variety of potential impacts on marine birds from the physical presence and noise produced by vessels, sound produced by the airguns, and the physical presence and noise produced by support aircraft. Effects from the physical presence of vessels and the noise produced by the vessels and airguns are expected to be minimal, as the surveys will not occur for longer than the duration of the open-water season (approximately mid-July to early or mid-November). Birds are expected to move away from the slow-moving seismic vessels, thus making collisions less likely as well. Additionally, marine birds could be exposed to petroleum products in the event of an accidental spill. However, the risk is quite low because the activities will occur farther from shore in the open-water environment (i.e., ice-free). Impacts are anticipated to be even lower than those analyzed in the 2006 PEA (MMS, 2006), as the level of activity being analyzed in this EA is far less than that analyzed in 2006, and no support aircraft will be used by Shell during the site clearance and shallow hazards surveys. Additional information can also be found in the MMS 2007 FEIS on the Chukchi Sea Lease Sale 193 (MMS, 2007b) and the MMS/NMFS 2007 Draft PEIS (MMS, 2007a).

4.2.2.3 Effects on Marine Mammals

Available information indicates that marine mammals are responsive, in some cases highly responsive, to anthropogenic noise in their environment. Sections III.F.3.f. and III.F.4.b. of the 2006 Final PEA (MMS, 2006) provide detailed descriptions of potential effects of both 2D and 3D seismic surveys on ESA-listed marine mammals (i.e., bowhead, fin, and humpback whales) and non-ESA-listed marine mammals (i.e., pinnipeds and other cetaceans), respectively, that occur in the Arctic. That information is incorporated herein by reference and summarized next. At present, the primary documented response has been avoidance, sometimes, at least in the case of bowhead whales at a considerable distance (Richardson and Malme, 1993; Richardson *et al.*, 1999). Additional responses by marine mammals may include: tolerance (that is the capacity of the individuals to endure or become less responsive to the repeated exposure); masking of natural sounds; behavioral disturbance; auditory impacts (e.g., temporary and permanent threshold shifts); and other physiological effects. In addition, seismic surveys, either alone or in combination with other factors, can also have subtle, chronic effects such as: excluding marine mammals from important habitat and engaging in important behavioral activities (e.g., feeding and resting) at significant times; interfering with their migration and movement; contributing to habitat degradation, disrupting biologically significant behaviors; and increasing levels of stress. Responses to noise and disturbance

are also likely to vary with time of year, sex, age, and reproductive status of individuals exposed, location (because of differences in noise propagation and use by marine mammals), activity levels and the exact characteristics of that activity (e.g., airgun source levels, array configuration and placement in the water column), context (e.g., feeding versus migrating whales), the animal's motivation to be in an area, and options for alternative routes or places to feed. A more detailed discussion of seismic surveys and the impacts to marine mammals is described by Richardson *et al.* (1995). While the types of potential impacts described in the PEA are similar to the types of impacts possible during the use of airguns for site clearance and shallow hazards surveys similar to that described in Section 1.3 of this EA, the level of impact is expected to be less for Shell's activities analyzed in this EA than the level of impacts analyzed in the 2006 PEA since that document analyzed the effects of multiple surveys (which could potentially use airgun arrays of much higher discharge volumes, up to 6,000 in^3) occurring in both the Beaufort and Chukchi Seas during a single open-water season. Here, only one, small scale survey (approximately 50 days of active data acquisition, utilizing an airgun array with a total discharge volume of 40 in^3) will occur in the Chukchi Sea, and no industry surveys will occur in the U.S. Beaufort Sea.

Southall *et al.* (2007) provides the most up-to-date literature reviews of impacts to marine mammals from anthropogenic noise. Those reviews indicate that onset of TTS for cetaceans and pinnipeds are likely to be much higher than the standards currently used by NMFS. As a matter of past practice and based on the best available information at the time regarding effects of sound in the marine environment compiled over the past decade, NMFS used conservative numerical estimates to approximate where Level A harassment (onset of injury) from acoustic sources could begin (e.g., 180 dB re 1 µPa rms level for cetaceans and 190 dB re 1 µPa rms level for pinnipeds). NMFS has determined that TTS (non-injurious, Level B harassment), the first adverse hearing effect, may occur at these levels. Lab controlled experiments using a seismic watergun to induce TTS in one beluga whale and one bottlenose dolphin (Finneran *et al.*, 2002) showed measured TTS_2 (TTS level 2 minutes after exposure) was 7 and 6 dB in the beluga at 0.4 and 30 kHz, respectively, after exposure to intense single pulses (226 dB re: 1 µPa p-p). Threshold returned to within 2 dB of the pre-exposure value within 4 minutes of exposure. No TTS was observed in the bottlenose dolphin at the highest exposure condition (228 dB re 1 µPa p-p). Lab controlled studies on three species of pinnipeds (harbor seal, California sea lion, and northern elephant seal) also point to the direction that TTS onset for these animals is higher than NMFS' standard of 190 dB re 1 µPa rms (Southall *et al.*, 2007).

A detailed overall description of the potential impacts of Arctic open water seismic surveys to bowhead whales is provided in the MMS 2006 PEA, the MMS/NMFS 2007 Draft PEIS, and the MMS 2003 EIS on Chukchi Sea Lease Sale 193 (MMS, 2003; 2006; MMS, 2007a). NMFS' 2008 SEA (NMFS, 2008) updated some of that information and analysis, specifically for the bowhead whale. Some of that information is provided here as well. One of the greatest concerns associated with the impacts of seismic surveys on marine mammals has to do with potential impacts of noise on their ability to engage in normal behavioral activities and whether noise could have adverse effects on their health. During seismic surveys, noise is transmitted through the water and air from a variety of

sources including, but not limited to, the acoustic sound source, support-vessel traffic, and helicopter and fixed-winged aircraft traffic. Southall *et al.* (2007) provides a thorough review of the scientific literature on the potential impacts from these anthropogenic sounds.

The levels of potential impacts are mainly dictated by the intensity (or sound pressure level (SPL)) of the acoustic sound source (airgun arrays and other acoustic sources), the duration, location, and season of the surveys. The intensity or SPL from the airgun arrays is related to the total displacement volume of the airguns. The larger the displacement volume of an airgun array, the louder the source level and the larger the ensonified area becomes. Therefore, with larger airgun arrays, more bowhead whales (and marine mammals in general) could be affected (assuming that whales are evenly distributed in the area). Shell's 2009 proposed shallow hazard and site clearance survey in the Chukchi Sea will use a small array with a total displacement volume of 40 in^3, thus creating a much smaller ensonified zone than surveys that utilize large airgun arrays. For example, larger airguns, such as those used to conduct 3D deep seismic surveys, would ensonify a larger area, thereby resulting in the potential to expose larger numbers of marine mammals. In contrast, the area expected to be ensonfied by the use of smaller airguns would be substantially smaller because of the lower level of energy output, thereby reducing the number of marine mammals potentially exposed to seismic energy. For example, in its October 2007 application, Shell noted that the measured 160-dB radius for the its 3,147 in^3 airgun array for 3D deep seismic surveys was 8,100 m (5 mi) in the Chukchi Sea (Shell, 2007) compared to the 1,400 m (0.87 mi; more than five times less) for the 40 in^3 array Shell proposes to use for its 2009 site clearance and shallow hazards surveys.

In addition, the potential acoustic impact to marine mammals also depends on the location, such as bathymetry, ocean bottom topography, and sediment types, and the behavior of the animals. Generally speaking, in deeper water, acoustic energy propagates in a spherical spreading model, thus there is more propagation loss of its energy when reaching a given distance when compared in shallow water, where the acoustic energy propagates in a cylindrical spreading model as is confined between the surface and ocean bottom (Urick, 1983). Therefore, using the same size airgun arrays, seismic surveys conducted in shallow water are expected to have a larger ensonified area as compared in deep water. One exception is that when the seismic surveys are conducted in extremely shallow water (1 to 6 m, or 3 to 18 ft), there is a "low frequency cutoff" of the airgun acoustic signals at the horizontal plane, making the ensonified zone much smaller (Greene, 1998).

Also, the degree of reaction an animal shows when exposed to anthropogenic sounds varies among individuals, life stage (young vs. old), prior experience of the animals (naïve vs. previously exposed); habituation or sensitization of the sound by the animals; and behavior context (whether the animal perceives the sound as predatory or simply annoyance) (Southall *et al.*, 2007). In the case of bowhead whales, some research has indicated that migrating animals respond to seismic airgun received levels around 120 dB re 1 μPa (Richardson *et al.*, 1999), while for non-migrating bowheads, the behavioral

disturbance starts at received levels around 140 to 160 dB re 1 μPa (Malme *et al.*, 1983; 1984; Richardson *et al.*, 1986; Ljungblad *et al.*, 1988b).

While Shell is actively collecting data through use of the airgun array, marine mammals that may be present in the area are likely to exhibit some form of behavioral response to the disturbance. Behavioral effects are expected to be non-lethal and non-injurious. For cetaceans, behavioral changes may be subtle alterations in surface, respiration, and dive cycles. More conspicuous responses include changes in activity or aerial displays, movement away from the sound source, or complete avoidance of the area. If animals avoid the ensonified area, especially in zones where injury might occur, then the impact of conducting the survey would result in Level B harassment (e.g., short-term displacement from the area, which is not expected to exceed the time of ensonification for an area). The reaction threshold and degree of response also are related to the activity of the animal at the time of the disturbance. Whales engaged in active behaviors, such as feeding, socializing, or mating, appear less likely than resting animals to exhibit overt behavioral reactions, unless the disturbance is perceived as directly threatening.

In addition to the small airgun array proposed to be used by Shell for its site clearance and shallow hazards survey work, other acoustical devices, as described in Section 1.3 of this EA, are proposed for use. While the sonar equipment proposed to be used for this project generates high sound energy, the equipment operates at frequencies (>100 kHz) beyond the effective hearing range of most marine mammals likely to be encountered during the proposed activities (Richardson *et al.*, 1995). The equipment proposed for the seismic profiling operate at a frequency range and sound level that could affect marine mammal behavior if they occur within a relatively close distance to the sound source (Richardson *et al.*, 1995). However, given the direct downward beam pattern of these sonar systems coupled with the high-frequency characteristics of the signals, the horizontal received levels of 180 and 190 dB re 1 μPa (rms) would be much smaller when compared to those from the low-frequency airguns with similar source levels. Therefore, NMFS believes that effects of signals from sonar equipment to marine mammals will be inconsequential.

Based on the discussion of impacts contained in MMS' 2006 PEA (MMS, 2006), MMS' 2007 FEIS on the Chukchi Sea Lease Sale 193 (MMS, 2007b), the MMS/NMFS 2007 Draft PEIS (MMS, 2007a), NMFS' 2008 SEA (NMFS, 2008), and the updated information provided in this EA, NMFS anticipates that marine mammals present in the proposed action area will incur only short-term Level B harassment in the form of behavioral changes and displacement from certain habitat areas. In addition, no take by death or serious injury is anticipated as a result of Shell's proposed activities or NMFS' proposed action of issuing an IHA to Shell. Moreover, the potential for temporary or permanent hearing impairment, as well as death or serious injury, will be avoided through the incorporation of the mitigation and monitoring measures described in Chapters 5 and 6 of this EA.

4.2.3 Effects on the Socioeconomic Environment

Subsistence remains the basis for Alaska Native culture and community. Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives. In rural Alaska, subsistence activities are often central to many aspects of human existence, including patterns of family life, artistic expression, and community religious and celebratory activities. The main species that are hunted include bowhead and beluga whales, ringed, spotted, and bearded seals, walruses, and polar bears. The importance of each of these species varies among the communities and is largely based on availability. For the most part, the MMS 2006 PEA (MMS, 2006), the MMS/NMFS 2007 DPEIS (MMS, 2007a), the MMS 2007 FEIS on the Chukchi Sea Lease Sale 193 (MMS, 2007b), and the MMS 2003 multi-sale EIS (MMS, 2003) provided a thorough analysis of the effects to the Arctic native communities by seismic survey activities.

The disturbance and potential displacement of marine mammals by sounds from seismic activities are the principal concerns related to subsistence use within the proposed action area. If whales are permanently deflected away from their migration path, there could be adverse repercussions, such as unavailability of whales in nearshore waters, to the subsistence use villages. However, mitigation measures will be implemented to minimize or avoid completely any adverse affects on all marine mammals to ensure no unmitigable adverse impact to the subsistence uses.

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a POC or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes. The POC specifies measures the applicant would take to minimize adverse effects on marine mammals where proposed activities may affect the availability of a species or stock of marine mammals for Arctic subsistence uses or near a traditional subsistence hunting area. Shell conducted community POC meetings between February and April 2009 with the following villages: Barrow, Wainwright, Point Hope, Point Lay, and Kotzebue. During 2009, Shell will continue to meet with the marine mammal commissions and committees including the AEWC, Eskimo Walrus Commission, Alaska Beluga Whale Committee, Alaska Ice Seal Committee, and the Alaska Nanuuq Commission. On May 15, 2009, Shell submitted its draft POC to NMFS, other government agencies, and affected stakeholder groups.

In addition, since the 1980s, some oil and gas industry companies conducting seismic or drilling operations in the Arctic have negotiated agreements with affected Alaska Native organizations, now known as the Conflict Avoidance Agreement (CAA). Currently, the CAA is negotiated between the industry applicants and the AEWC and the affected villages' Whaling Captain Associations to avoid impacts to the bowhead hunts in the Beaufort and Chukchi Seas. Shell signed the 2009 CAA on June 24, 2009. The 2009 CAA, among other things, includes a dispute-resolution process, communications strategy between industry and whaling vessels, and provisions for emergency assistance to whalers at sea. However, it should be noted that while the signing of a CAA by Shell or any other IHA applicant assists NMFS in making its determination of no unmitigable

adverse impact to marine mammal species or stocks for subsistence uses, the submission of a signed CAA is not a requirement for the issuance of an IHA.

NMFS has determined that the Preferred Alternative will not have a significant impact on the socioeconomic environment and that there will not be an unmitigable adverse impact on affected marine mammal species or stocks for subsistence uses. This determination is based on the following factors: (1) Survey activities will not begin prior to the close of the spring bowhead hunt in Chukchi coastal villages; (2) Shell will closely coordinate with and avoid impacts to beluga whale hunts through subsistence advisors; (3) seismic activities are scheduled to avoid the traditional subsistence beluga hunt, which annually occurs in July in the community of Point Lay; (4) Barrow is east of the proposed project area, so the animals will reach Barrow before entering the project area on their fall westward migration through the Beaufort and Chukchi Seas; (5) survey activities will occur more than 113 km (70 mi) or more from shore, and most cetaceans and pinnipeds are hunted much closer to the shore; and (6) that several of the mitigation and monitoring conditions proposed for the IHA (described in Chapters 5 and 6 in this document) are designed to ensure that there will not be an unmitigable adverse impact on subsistence uses of marine mammals.

4.3 Effects of Alternative 3

4.3.1 Effects on the Physical Environment

Effects to the physical environment would be the same under Alternative 3 as those described above for Alternative 2. No additional effects beyond those already described would be expected.

4.3.2 Effects on the Biological Environment

4.3.2.1 Effects on Fish/Fishery Resources and Essential Fish Habitat

No additional effects beyond those described in Section 4.2.2.1 above would be expected under Alternative 3 on fish/fishery resources and EFH in the Chukchi Sea.

4.3.2.2 Effects on Marine Birds

Although the implementation of Alternative 3 would require that Shell conduct additional mitigation and monitoring during its activities, those measures are designed to reduce impacts to marine mammals. Therefore, no additional effects beyond those described in Section 4.2.2.2 above would be expected for marine birds if Alternative 3 were selected.

4.3.2.3 Effects on Marine Mammals

Marine mammals would still be expected to be harassed by the proposed site clearance and shallow hazards survey. As described in Alternative 2, anticipated impacts to marine mammals associated with Shell's proposed activities (primarily resulting from noise

propagation) are from vessel movements and airgun operations. Potential impacts to marine mammals might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects. These are the same types of reactions that would be anticipated under the Preferred Alternative (Alternative 2).

The primary difference under Alternative 3 is that additional mitigation and monitoring measures for detecting marine mammals would be required. These additional measures include a 120-dB monitoring (safety) zone for bowhead whale cow/calf pairs, near real-time PAM, active acoustic monitoring, and the use of unmanned aerial vehicles to conduct aerial monitoring. While the technologies for these monitoring methods are still being developed and refined, it is expected that they would allow for additional detection of marine mammals beyond visual observations from shipboard observers. These additional monitoring measures could allow for necessary mitigation measures (i.e., power-downs and shutdowns) to be implemented more quickly and more frequently, thereby potentially reducing further the number of marine mammal takes.

4.3.3 Effects on the Socioeconomic Environment

Under Alternative 3, impacts to the socioeconomic environment are anticipated to be the same as those described for Alternative 2 in Section 4.2.3 above.

4.4 Estimation of Take

The marine mammal species NMFS believes likely to be taken by harassment incidental to Shell's proposed open-water marine survey program in the Chukchi Sea during the 2009/2010 Arctic open-water season are: beluga whale; killer whale; harbor porpoise; bowhead whale; gray whale; minke whale; fin whale; humpback whale; bearded seal; spotted seal; ringed seal; and ribbon seal. Any takes are most likely to result from noise propagation during the use of airguns or other acoustic sources. All anticipated takes would be by Level B harassment, involving temporary changes in behavior or brief TTS. The required mitigation and monitoring measures described in Chapters 5 and 6 of this EA are expected to prevent the possibility of injurious takes.

For purposes of evaluating the potential significance of the takes by harassment, an estimation of the number of potential takes is discussed in terms of the populations present. The specific number of takes considered for this authorization is developed via the MMPA process, and the analysis in this EA provides a summary of the anticipated numbers that would be authorized to give a relative sense of the nature of impact of the proposed action. The methods to estimate take by harassment and present estimates of the numbers of marine mammals that might be affected during Shell's proposed activities are described in detail in Shell's IHA application. Specifically, the average estimate of "take" for each species was calculated by multiplying the expected average species densities by the area of ensonification for the 160 dB re 1 μPa (rms) in the survey region, time period, and habitat zone to which that density applies.

It is estimated that approximately 10 beluga whales, six harbor porpoise, one bowhead whale, 19 gray whales, 31 bearded seals, 692 ringed seals, and six spotted seals would be taken by Level B harassment incidental to proposed site clearance and shallow hazards survey to be conducted by Shell. These take numbers represent 0.27 percent of the eastern Chukchi Sea population of beluga whales, 0.01 percent of the Bering Sea stock of harbor porpoise, 0.01 percent of the Bering-Chukchi-Beaufort population of bowhead whales, 0.11 percent of the Eastern North Pacific stock of gray whales, and 0.6 percent, 0.3 percent, and 0.01 percent of the Bering-Chukchi-Beaufort populations of bearded, ringed, and spotted seals, respectively.

In addition, killer, fin, humpback, and minke whales and ribbon seals could also be taken by Level B harassment as a result of the proposed survey. However, the possibility is low. The numbers of "average" estimated take of these species are not available because they are rare in the project area and little density data exist for these species in the proposed project area. Since the Chukchi Sea represents only a small fraction of the North Pacific and Arctic basins where these animals occur, and these animals do not regularly congregate in the vicinity of the project area, NMFS believes that only relatively small numbers, if any, of these marine mammal species would be potentially affected by the proposed open-water marine survey program.

With the incorporation of mitigation measures described later in this document, both Shell and NMFS expect that only Level B harassment may occur as a result of the proposed activities and that these events will result in no detectable impact on marine mammal species or stocks or on their habitats.

4.5 Cumulative Impacts

Cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions" (40 CFR §1508.7). Cumulative impacts may occur when there is a relationship between a proposed action and other actions expected to occur in a similar location or during a similar time period, or when past or future actions may result in impacts that would additively or synergistically affect a resource of concern. These relationships may or may not be obvious. Actions overlapping within close proximity to the proposed action can reasonably be expected to have more potential for cumulative effects on "shared resources" than actions that may be geographically separated. Similarly, actions that coincide temporally will tend to offer a higher potential for cumulative effects.

Actions that might permanently remove a resource would be expected to have a potential to act additively or synergistically if they affected the same population, even if the effects were separated geographically or temporally. Note that the proposed action considered here would not be expected to result in the removal of individual cetaceans or pinnipeds from the population or to result in harassment levels that might cause animals to permanently abandon preferred feeding areas or other habitat locations, so concerns

related to removal of viable members of the populations are not implicated by the proposed action. This cumulative effects analysis considers these potential impacts, but more appropriately focuses on those activities that may temporally or geographically overlap with the proposed activity such that repeat harassment effects warrant consideration for potential cumulative impacts to the affected 12 marine mammal species and their habitats.

Cumulative impacts on affected resources may result from the following activities—seismic survey activities, vessel and air traffic, oil and gas exploration and development in Federal and state waters, subsistence harvest activities, military activities, industrial development, community development, and climate change—within the proposed action area and were analyzed in detail in the MMS 2006 PEA (MMS, 2006). The action area where Shell's proposed 2009 open-water marine survey program would be conducted is within those that were analyzed in the MMS 2006 PEA (MMS, 2006). Therefore, the cumulative impact analysis from the MMS 2006 PEA (MMS, 2006) is incorporated by reference herein. That analysis concluded that seismic surveys, especially as mitigated under the Proposed Action alternatives contained in the PEA, were not expected to add significantly to the impacts from past, present, and reasonably foreseeable future activities for the following resources: fish/fishery resources and EFH; marine birds; marine mammals; and sociocultural systems, including subsistence harvest resources.

NMFS' 2008 SEA (NMFS, 2008) updated the cumulative impacts analysis to account for more recent activities in the Arctic Ocean. These more recent activities include Shell's proposed offshore exploratory drilling operations in the Beaufort Sea in 2007; the State of Alaska lease sale in 2006 and 2007; and the MMS Lease Sales 202 and 193 in the Beaufort Sea in 2007 and the Chukchi Sea in 2008, and seismic survey activities by several oil and gas companies during the 2006 and 2007 Arctic open-water season. That information is contained in Section III.D.1. of the 2008 SEA (NMFS, 2008) and is incorporated herein by reference. In addition, the 2008 SEA (NMFS, 2008) also updated the analysis of cumulative impacts as the result of the ongoing climate change within the proposed action area, especially in terms of global warming and its potential impacts to the Arctic region, based on the availability of new information after the publication of MMS' 2006 PEA (MMS, 2006). This updated cumulative impact analysis of climate is presented in Section III.D.2. of NMFS' 2008 SEA (NMFS, 2008) and is incorporated herein by reference. In summary, scientific evidence indicates that average air, land, and sea temperatures are increasing at an accelerating rate. Arctic regions have experienced some of the largest changes, with major implications for the marine environment as well as for coastal communities. Bowhead and other Arctic whales are associated with and well adapted to ice-covered seas with leads, polynyas, open-water areas, or thin ice that the whales can break through to breathe. Climate change associated with Arctic warming may also result in regime change of the Arctic Ocean ecosystem: subarctic species may begin to increase their ranges into the Chukchi and Beaufort Seas; and, Arctic species, such as ice seals, which depend on the ice for their life functions, could become vulnerable; however, there are insufficient data to make reliable predictions of the effects of Arctic climate change on ice seals in the Arctic. With the large uncertainty of the degree of impact of climate change to Arctic marine mammals, NMFS recognizes that

warming of this region which results in the diminishing of ice could be a concern to ice dependent seals and polar bears. Nonetheless, the effects of seismic and shallow hazard and site clearance surveys on climate change are too remote and speculative at this time to conclude definitively that they would contribute to climate change and therefore a reduction in Arctic sea ice coverage.

4.6.1 Additional Activities in the Beaufort and Chukchi Seas (Since July 2008)

In order to update the cumulative impacts analysis, the following paragraphs provide more recent information on past, present, and reasonably foreseeable future actions in the Arctic Ocean since NMFS finalized its 2008 SEA (NMFS, 2008).

NMFS' 2008 SEA (NMFS, 2008) notes that NMFS was reviewing and considering issuing an IHA to Shell for its exploratory drilling program in 2008. NMFS did not issue an IHA to Shell for its exploratory drilling program in the Beaufort Sea in 2008, as Shell withdrew that application (74 FR 29678, June 23, 2009). Shell has submitted IHA applications to NMFS for the taking of marine mammals incidental to exploration drilling programs in both the Beaufort and Chukchi Seas during the 2010 Arctic open-water season. Shell plans to utilize one drill ship to drill up to two exploration wells in the Beaufort Sea and up to three exploration wells in the Chukchi Sea in 2010. The highest priority exploratory drilling targets identified for the 2010 season in the Beaufort Sea are located near Camden Bay, on the leaseholds referred to as Torpedo and Sivulliq. The highest priority exploratory drilling targets identified for the 2010 season in the Chukchi Sea are on the leaseholds referred to as Burger, SW Shoebill, and Crackerjack. Since Shell is proposing to use the same drill ship for both the Beaufort and Chukchi exploratory drilling programs, Shell would be unable to conduct exploratory drilling in both seas at the same exact time. Additionally, while NMFS does not know of any specific oil and gas companies planning to conduct exploratory drilling beyond the 2010 season, it is likely that at least one or two companies will submit Exploration Plans to MMS and subsequent IHA applications to NMFS for activities in either the Beaufort or Chukchi Seas in 2011 and 2012.

In 2008, the State of Alaska, Division of Oil and Gas (DO&G) conducted two lease sales in state waters of the Beaufort Sea. The Beaufort Sea Area-wide 2008 sale, conducted on October 22, 2008, sold 32 tracts totaling 74,552 acres (116 mi^2 or 301 km^2). The Beaufort Sea Area-wide 2009 sale is scheduled for October 2009 (ADNR DO&G, 2009). No State of Alaska lease sales are scheduled to occur in the Chukchi Sea in 2009, nor are any State deep seismic survey permits scheduled to be issued for the Beaufort or Chukchi seas. State mitigation measures and lessee advisories for the Beaufort Sea can be found at: http://www.dog.dnr.state.ak.us/oil/products/publications/previous_sales.htm.

The MMS did not conduct any lease sales in the Beaufort or Chukchi Seas in 2008 beyond those mentioned in NMFS' 2008 SEA (NMFS, 2008). The MMS does not have any lease sales in the Beaufort or Chukchi Seas scheduled for 2009. Lease sales are

scheduled to occur in both the Beaufort and Chukchi Seas in 2010, one in the Beaufort Sea in 2011, and one in the Chukchi Sea in 2012.[2]

BP has planned seismic survey for leases it holds in the Canadian Beaufort Sea during the 2009 open-water season (July through October). The survey would occur northeast of Mackenzie Bay, approximately 180 km north of Tuktoyaktuk, Northwest Territories, Canada. The survey will be either a 2D or 3D seismic survey, utilizing two source arrays, containing 24 active airguns each (48 total). The airgun volumes would range from 70 in^3 to 330 in^3, with each array having a total discharge volume of 4,450 in^3. Individuals from the Bering-Chukchi-Beaufort (BCB) stock of bowhead whales may potentially be harassed during BP's seismic survey. BCB bowhead whales that have been summering in the Canadian Beaufort Sea typically begin their westward migration into the U.S. Beaufort Sea and Chukchi Sea in late August or early September. It is expected that members of this stock may reach Shell's proposed project area towards the end of Shell's surveying activities. Therefore, these animals would be exposed to airguns from a second survey. However, the exposure these animals would encounter would differ both temporally and spatially. While in Canadian waters, these animals would be exposed in July and August. Should these same individuals occur in Shell's proposed project area, they would not be exposed until sometime most likely after mid-September. Additionally, the two project locations are many hundreds of miles apart; therefore, there will be no overlap of ensonified zones.[3]

NOAA's Office of Ocean Exploration and Research is embarking on an international expedition in cooperation with Canada and the U.S. Geological Survey to collect data on the seaward limits of the U.S. and Canadian extended continental shelves in portions of the western Arctic Ocean north of Barrow, Alaska, and offshore of the western Canadian Arctic Islands. All the activities will be conducted in the high seas/international waters beyond the 200 nm (370.4 km, 230 mi) Exclusive Economic Zone (EEZ) limit of the U.S. The seismic survey is expected to occur between August 7 and September 16, 2009. The U.S. Coast Guard Cutter *Healy* will be the lead vessel with the Canadian Coast Guard Ship *Louis S. St. Laurent*. The *Healy* will be breaking up the ice for the *Louis* and collecting multi-beam data. The Canadian vessel, *Louis*, will be collecting seismic data. The airgun array onboard the *Louis* will have a total discharge volume of 1,820 in^3. This survey will occur hundreds of miles away from Shell's operations, therefore, there will be no overlap of ensonified zones. Additionally, because the NOAA seismic survey will occur very far offshore, it is unlikely that the same marine mammals will be affected by both surveys. NOAA has indicated that a similar survey will occur in the summer of 2010. While the location will be close to that for 2009, in 2010, the seismic vessel may need to collect some data inside the EEZ but would still remain far offshore (most likely beyond 150 nm, if not farther, [278 km, 176.6 mi]) (M. Bohan, 2009, NOAA, pers. comm.).

[2] Information obtained from the MMS Alaska website: http://www.mms.gov/ld/AKsales.htm**.**
[3] Information regarding BP's Canadian Beaufort seismic survey was obtained from the following website: http://www.neb-one.gc.ca/clfnsi/rthnb/pblcrgstr/bpxplrtnpkk/drftnvrnmntlscrnngrprt20090603.pdf.

4.6.2 Conclusion

After considering the additional information and activities described above, NMFS considers the potential 2009 level of open-water marine survey and other oil and gas-related activities in the Chukchi Sea (i.e., one site clearance and shallow hazards survey with a small airgun array measuring 40 in^3 and other bathymetric acoustic devices and zero exploration activities) to be lower than what was cumulatively analyzed in the MMS 2006 PEA (i.e., four seismic surveys operating simultaneously in the Chukchi Sea; MMS, 2006) and updated in the 2008 SEA (NMFS, 2008). Given the small scale (small airgun array) and relatively short duration (approximately 50 days of active data acquisition) of the proposed activity, and its anticipated minimal environmental effects, the proposed survey activities, as described in the application, application addenda, and Section 1.3 of this EA, would not contribute significantly or measurably to the overall environmental effects of other human activities along the Arctic Slope. While other seismic activities will occur in the Canadian Arctic during the 2009 open-water season in the general time frame of Shell's proposed activities, it is not expected that animals would experience more than short-term disturbance or displacement (animals would be able to return to the area at the conclusion of the data acquisition) as a result of any of the activities described above. Additionally, none of the activities are anticipated to result in injury or mortality of marine mammals. Therefore, NMFS has determined that its proposed action would not produce any significant cumulative impacts to the human environment.

Chapter 5 MITIGATION MEASURES

As required under the MMPA, NMFS considered mitigation to effect the least practicable impact on marine mammals and has developed a series of mitigation measures, as well as monitoring and reporting procedures (Chapter 6), that would be required under an IHA issued for the proposed activities described earlier in this EA. Mitigation measures have been proposed by Shell for their 2009 open-water marine survey program activities. Additional measures have also been considered by NMFS pursuant to its authority under the MMPA to ensure that the proposed activities will result in the least practicable impact on marine mammal species or stocks in the Chukchi Sea. The mitigation requirements contained in the MMPA IHA will ensure that takings are of small numbers, potential impacts to marine mammals will be negligible, and that there will be no unmitigable adverse impacts to subsistence uses of the affected species or stocks. If issued, all mitigation measures contained in the IHA, especially those related to avoiding impacts to subsistence hunting, must be followed.

Shell's proposed survey program incorporates both design features and operational procedures for minimizing potential impacts on cetaceans and pinnipeds and on subsistence hunts. Survey design features include the following: (1) timing and locating survey activities to avoid interference with the annual fall bowhead whale and other marine mammal hunts; (2) selecting and configuring the energy source array in such a way that it minimize the amount of energy introduced into the marine environment and, specifically, so that it minimizes horizontal propagation; (3) limiting the size of the acoustic energy source to only that required to meet the technical objectives of the survey; and (4) early season field assessment to establish and refine (as necessary) the appropriate 180 dB and 190 dB safety zones, and other radii relevant to behavioral disturbance.

The potential disturbance of cetaceans and pinnipeds during survey operations will be minimized further through the implementation of several ship-based mitigation measures, which include establishing and monitoring safety and disturbance zones, speed and course alterations, ramp-up (or soft start), power-down, and shutdown procedures, and provisions for poor visibility conditions.

The following discussion provides details of the mitigation measures associated with the Preferred Alternative:

Exclusion Zone - A marine mammal exclusion zone of 180 dB (cetaceans) and 190 dB (pinnipeds) from the seismic-survey sound source shall be free of marine mammals before the survey can begin and must remain free of marine mammals during the survey. The purpose of the exclusion zone is to protect marine mammals from Level A harassment (e.g., potential for injury). These safety criteria are based on an assumption that seismic pulses at lower received levels will not injure these animals or impair their hearing abilities but that higher received levels might have such effects. It should be understood that marine mammals inside these safety zones will not necessarily be seriously injured or killed as these zones were established prior to the current

understanding that significantly higher levels of impulse sounds would be required before injury or mortality could occur (see Southall et al., 2007). The modeled radii of the 180-dB and 190-dB isopleths for the 4 x 10 in^3 array are 160 m (525 ft) and 50 m (164 ft), respectively.

A 160-dB vessel exclusion zone for bowhead and gray whales will be established and monitored. Whenever an aggregation of bowhead whales or gray whales (12 or more whales of any age/sex class that appear to be engaged in a non-migratory, biological behavior (e.g., feeding, socializing)) are observed during a vessel monitoring program within the 160-dB safety zone around the survey activity, the operation will not commence or will shut down, until the MMOs confirm they are no longer present within the 160-dB safety radius of surveying operations. The radius of the 160-dB isopleth based on modeling for the array proposed to be used by Shell is 1,400 m (0.87 mi).

Monitoring of the Exclusion Zone - Trained MMOs shall monitor the area around the survey for the presence of marine mammals to maintain a marine mammal-free exclusion zone and monitor for avoidance or take behaviors. Visual observers monitor the exclusion zone to ensure that marine mammals do not enter the exclusion zone for at least 30 minutes prior to ramp up, during active data acquisition, or before resuming use of the airguns after a shutdown. During nighttime or poor visibility conditions, MMOs will be provided with infra-red or night-vision binoculars.[4] The purpose of this mitigation measure is to ensure that no marine mammal is present within the exclusion zone during the seismic activities, thus preventing the onset of TTS.

Although a power-down or shutdown of the airguns is not required if a marine mammal is sighted with the 160-dB radius (except for aggregations of 12 or more bowhead or gray whales), MMOs will also monitor this radius to note how many animals are taken by Level B harassment and to record any observed behaviors of the animals during airgun operations.

Power-down and Shutdown - A power-down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shutdown is the immediate cessation of firing of all energy sources. The survey shall be powered down or suspended until the exclusion zone is free of marine mammals. All observers shall have the authority to, and will, instruct the vessel operators to immediately stop or de-energize the airgun array whenever a marine mammal is seen within the applicable exclusion zone. If the airgun array is completely powered down for any reason during nighttime or poor sighting conditions, it shall not be re-energized until daylight or whenever sighting conditions allow for the exclusion zone to be effectively monitored from the source vessel for at least 30 minutes prior to the start of operations. The purpose of this mitigation measure is to mitigate impacts of intense noise to marine mammals in case an animal is sighted within the safety zone.

[4] Shell plans to conduct the site clearance and shallow hazards survey 24 hours per day. However, regarding nighttime operations, note that there will be no periods of total darkness until mid- to late August.

Emergency Shutdown - In the unanticipated event that an injured or dead marine mammal is sighted within an area where the airguns were deployed and utilized within the past 24 hours, the array must be shutdown immediately. Activities may resume after the lead MMO (to the best of his or her abilities) determine how long the animal has been dead and in the case of an injury if that injury resulted from something other than airgun operations (e.g., gunshot wound, polar bear attack). After written certification and supporting documentation (e.g., photographs or other evidence to support the certification) by the lead MMO, operations may resume. Within 24 hours after the event specified herein, Shell must notify NMFS and provide NMFS with the written certification and supporting documents.

However, in the event that the cause of the injury or death cannot be immediately determined by the lead MMO, the incident must be reported immediately to either the NMFS Office of Protected Resources or the NMFS Alaska Regional Office. The seismic airgun array shall not be restarted until NMFS is able to review the circumstances of the take, make determinations as to whether modifications to the activities are appropriate and necessary, and has notified Shell that activities may be resumed.

In all cases, Shell must call the Alaska Region Marine Mammal Stranding Hotline no later than 24 hours after sighting a stranded marine mammal.

Ramp-up – Ramp-up is the gradual introduction of sound to deter marine mammals from potentially damaging sound intensities and from approaching the exclusion zone. This technique involves the gradual increase (usually 5 - 6 dB per 5-minute increment) in emitted sound levels, beginning with firing a single airgun and gradually adding airguns over a period of at least 20 - 40 minutes, until the desired operating level of the full array is obtained. Ramp-up procedures may begin after observers ensure the absence of marine mammals in the exclusion zone for at least 30 minutes. Ramp-up procedures shall not be initiated at night or when monitoring the exclusion zone is not possible. A single airgun operating at a minimum source level can be maintained for routine activities, such as making a turn between line transects, for maintenance needs, or during periods of impaired visibility (e.g., darkness, fog, high sea states) and does not require a 30-minute clearance of the exclusion zone before the airgun array is again ramped up to full output. Following a power-down or shutdown, operation of the airgun array will not resume until the marine mammal has cleared the applicable safety zone. The animal will be considered to have cleared the safety zone if it: (1) Is visually observed to have left the safety zone; (2) Has not been seen within the zone for 15 min in the case of small odontocetes and pinnipeds; or (3) Has not been seen within the zone for 30 min in the case of mysticetes. This mitigation measure serves as a warning to any marine mammal that is not detected during the pre-survey observation period, so the animal has the opportunity to leave the exclusion zone before the airguns operate at full power.

Field Verification - Before conducting the survey, the operator shall verify the radii of the exclusion and monitoring zones within real-time conditions in the field. This provides for more accurate radii rather than relying on modeling techniques before entering the field. Field-verification techniques must be consistent with NMFS-approved

guidelines and procedures. When moving a seismic-survey operation into a new area, the operator shall re-verify the new radii of the exclusion zones. The purpose of this mitigation measure is to establish and monitor more accurate safety zones, as compared to the zones based on empirical calculations and modeling.

Speed and Course Alterations - If a marine mammal (in water) is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct course would be changed in a manner that does not compromise safety requirements. The animal's activities and movements relative to the source vessel will be closely monitored to ensure that the individual does not approach within the safety radius. If the mammal is sighted approaching near or close to the applicable safety radius, further mitigative actions will be taken, i.e., either further course alterations or power-down or shutdown of the airgun(s). The purpose of this mitigation measure is to prevent marine mammals from entering the applicable safety zones.

Temporal/Spatial/Operational Restrictions - Dynamic management approaches to avoid or minimize exposure, such as temporal or spatial limitations are based on marine mammals being present in a particular place or time, or being engaged in a particularly sensitive behavior (such as feeding). Vessel transits must not occur prior to July 1 in the spring leads to ensure that there will be no conflict with the spring bowhead whale migration and subsistence hunts conducted by Barrow, Point Hope, or Wainwright or the beluga subsistence hunt conducted by the village of Point Lay in July. Additionally, surveys must not occur prior to July 15 in the Chukchi Sea spring lead system, unless authorized by NMFS, to provide bowhead cow/calf pairs additional protection. In the Chukchi Sea, seismic activities may not occur within 96.6 km (60 mi) of the coast.

The following discussion provides details of additional mitigation that would only be required under Alternative 3:

In previous IHAs for seismic and site clearance and shallow hazards surveys in the Arctic, NMFS has required that a 120-dB (rms) monitoring (safety) zone for bowhead whales be established and monitored if four or more bowhead whale cow/calf pairs are observed at the surface during an aerial monitoring program within the area where an ensonified 120-dB zone around the vessel's track as projected for the next 24 hours would occur. Under this measure, no seismic surveying was permitted to occur within the 120-dB safety zone around the area where these whale cow/calf pairs were observed, until two consecutive surveys (aerial or vessel) indicated they were no longer present within the 120-dB safety zone of seismic-surveying operations. Surveying activities were authorized to resume when there were three or fewer bowhead cow/calf pairs inside the 120-dB isopleth or that projected zone over the next 24 hours. In recent years, and as described in previous IHAs for seismic surveys in the Arctic (e.g., 2008 IHA to CPAI, 73 FR 49421, August 21, 2008; 2008 IHA to Shell, 73 FR 66106, November 6, 2008), this condition has only been included for surveys conducted in the Beaufort Sea after August 25 (i.e., the start of the bowhead migration westward through the Beaufort Sea). However, this condition has not been included in IHAs for activities occurring in the

Chukchi Sea (such as Shell's 2009/2010 open-water marine survey program) due to safety and practical reasons (e.g., fewer airports can be utilized to support a survey aircraft for its survey activities and the prevalence of fog and other inclement weather in the area).

Chapter 6 MONITORING AND REPORTING REQUIREMENTS

Under both the Preferred Alternative (Alternative 2) and Alternative 3, NMFS would require Shell to undertake the monitoring activities described in Section 6.1. The monitoring measures described in that section are standard measures that have been required of IHA holders in Arctic waters in recent years. Section 6.2 describes "emerging" monitoring technologies that would be required by Shell if Alternative 3 were the selected alternative. However, as will be described in further detail below, many of these monitoring technologies are infeasible at this time. The reporting requirements outlined in Section 6.3 would be implemented under the two action alternatives.

As part of its IHA application, Shell submitted a 4MP, which consists of monitoring and mitigation for their open-water site clearance and shallow hazards data acquisition activities in the Chukchi Sea during the 2009/2010 Arctic open-water season. The program consists of monitoring and mitigation during Shell's various activities related to survey data acquisition, including transit and data acquisition. This program will provide information on the numbers of marine mammals potentially affected by the survey program and real-time mitigation to prevent possible injury or mortality of marine mammals by sources of sound and other vessel related activities. Monitoring efforts will be initiated to collect data to address the following specific objectives: (1) improve the understanding of the distribution and abundance of marine mammals in the Chukchi Sea project areas; and (2) assess the effects of sound and vessel activities on marine mammals inhabiting the project areas and their distribution relative to the local people that depend on them for subsistence hunting. These objectives and the monitoring and mitigation goals will be addressed through the utilization of vessel-based MMOs on the survey source vessels. Additional information can be found in Shell's application.

The MMPA requires that monitoring plans be independently peer reviewed "where the proposed activity may affect the availability of a species or stock for taking for subsistence uses" (16 U.S.C. 1371(a)(5)(D)(ii)(III)). Regarding this requirement, NMFS' implementing regulations state, "Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan" (50 CFR 216.108(d)). Reviewers are selected by NMFS, in consultation with the Commission, AEWC and/or other Alaskan native organizations as appropriate, and the applicant. Selected panelists are experts who are not currently employed or contracted by either the affected Alaskan native organization or the applicant. An independent peer review of Shell's 2009 Chukchi Sea 4MP occurred during the public comment period for the proposed IHA. NMFS consider all recommendations made by the reviewers, and based on discussions with Shell will incorporate appropriate changes into the monitoring requirements of the IHA. The reviewers' findings and recommendations will be published in the final IHA *Federal Register* notice of issuance or denial.

6.1 Monitoring Requirements

Vessel-based monitoring for marine mammals will be conducted throughout the period of survey operations. The 4MP will be implemented by a team of experienced MMOs, including both biologists and Inupiat personnel. Biologist-observers to be assigned will have previous marine mammal observation experience and field crew leaders will be highly experienced with previous vessel-based monitoring projects. All MMOs will be approved by NMFS prior to the start of operations. At least one observer on the survey vessel will be an Inupiat who will have the responsibility of communicating with the Inupiat community and (during the whaling season) directly with the Subsistence Advisors in coastal villages. Inupiat observers will be experienced in the region and familiar with the marine mammals of the area.

The MMOs will be stationed aboard the survey source vessel throughout the active field season. The duties of the MMOs will include watching for and identifying cetaceans and pinnipeds; recording their numbers, distances, and reactions to the survey operations; initiating mitigation measures when appropriate; and reporting the results. MMOs aboard the survey source vessel will be on watch during all daylight periods when the energy sources are in operation and when energy source operations are to start up at night. Each MMO shift will not exceed more than 4 consecutive hours, and no MMO will work more than three shifts in a 24 hour period (i.e., 12 hours total per day) in order to avoid fatigue. Shell will have five MMOs on-board the site clearance and shallow hazards source vessel, which will allow for two MMOs to be on-watch at all times when observers are required.

6.1.1 Monitoring Methodology

The observer(s) will watch for marine mammals from the best available vantage point on the operating source vessel, which is usually the bridge or flying bridge. The observer(s) will scan systematically with the naked eye and 7 x 50 reticle binoculars, supplemented with 20 x 50 image stabilized binoculars, and night-vision equipment when needed. Personnel on the bridge will assist the MMOs in watching for pinnipeds and cetaceans.

The observer(s) will pay particular attention to the areas within the "safety zone" around the source vessel. These zones are the maximum distances within which received levels may exceed 180 dB re 1 µPa (rms) for cetaceans or 190 dB re 1 µPa (rms) for pinnipeds. MMOs will also be able to monitor the 160 dB re 1 µPa (rms) radius for Level B harassment takes, as this radius is expected to be a maximum of 1,400 m (0.87 mi). The 160-dB isopleth will also be monitored for the presence of aggregations of 12 or more bowhead or gray whales.

Information to be recorded by MMOs will include the same types of information that were recorded during previous monitoring programs (1998-2008) in the Chukchi and Beaufort seas (Moulton and Lawson, 2002; Patterson *et al.*, 2007). When a mammal sighting is made, the following information about the sighting will be recorded:

(1) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the source vessel, apparent reaction to the source vessel (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;

(2) Time, location, heading, speed, activity of the vessel, and operational state (e.g., operating airguns, ramp-up, etc.), sea state, ice cover, visibility, and sun glare; and

(3) The positions of other vessel(s) in the vicinity of the source vessel. This information will be recorded by the MMOs at times of whale (but not seal) sightings.

The ship's position, heading, and speed, the operational state (e.g., number and size of operating energy sources), and water temperature (if available), water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch and, during a watch, every 30 minutes and whenever there is a change in one or more of those variables. Additional information on the monitoring methodology is described in Shell's 4MP and the proposed IHA *Federal Register* notice (74 FR 26217, June 1, 2009).

6.1.2 Field Data-recording and Verification

The observers 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 the start-of-season training session, subsequent supervision by the onboard field crew leader, and ongoing data checks during the field season.

6.1.3 Acoustic Monitoring

Shell and ConocoPhillips are jointly funding an extensive acoustic monitoring program in the Chukchi Sea in 2009. This program incorporates the acoustic programs of 2006-2008 with a total of 44 recorders distributed both broadly across the Chukchi lease area and the nearshore environment and intensively on the Burger and Klondike lease areas. The broad area arrays are designed to capture both general background soundscape data and marine mammal call data across the lease area. From these recordings, it is anticipated that Shell (and others) may be able to gain insights into large-scale distribution of marine mammals, identification of marine mammal species present, movement and migration patters, and general abundance data.

While all sites where site clearance and shallow hazards surveys will be conducted by Shell in 2009 will have acoustic recorders, the intense area arrays (e.g., Burger and Klondike) are designed to support localization of marine mammal calls on and around the leasehold areas. In the case of the Burger prospect, where Shell intends to conduct

shallow hazards data acquisition, localized calls will enable investigators to understand response of marine mammals to survey operations both in terms of distribution around the operation and behavior (i.e., calling behavior).

6.2 "Emerging" Monitoring Technologies

The information provided in this section outlines monitoring technologies and techniques that are not currently considered viable by NMFS; however, these methods may become viable, effective, and feasible in future seasons. The monitoring requirements described in this section would only be required under Alternative 3.

6.2.1 Passive Acoustic Monitoring

PAM, or listening devices, can occur either from a vessel-based system, from a directional or non-directional hydrophone or sonobuoy array placed on the seafloor or allowed to drift in the water column, or both (Burks *et al.*, 2001; Swartz *et al.*, 2001; MMS, 2004c). These passive acoustic methods generate data that may provide species-specific signature calls (i.e., presence-absence data) and directional information (i.e., magnetic bearing angles from the survey vessel to the signal[s]). However, PAM is effective only when an animal or group of animals is actively vocalizing. The absence of vocalizations does not necessarily mean that animals are not present. Furthermore, there are limitations in assessing an accurate enumeration of individuals present in larger groups.

PAM has been used for several years to detect marine mammals with varying degrees of success. Continuing development of both hardware and software for PAM has resulted in a choice of systems. The oil and gas industry has specifically invested time and resources into further developing the capabilities of PAM for use in monitoring marine mammal activities during noise-producing oil and gas operations. This has included the development of PAMGUARD, a standard software infrastructure for acoustic detection, localization, and classification of marine mammals.[5] Other types of PAM hardware and software systems also occur, many of which still needed to be detected for effectiveness in the Arctic offshore environment. Along with the fact that marine mammals may not always vocalize while near the PAM device, another shortcoming is that it requires a quiet vessel so that vessel noise does not hinder the ability to hear marine mammals.

MMS will be sponsoring a workshop in November 2009 which will review available acoustic monitoring technology (passive and active), its feasibility and applicability for use in MMS-authorized activities, and what additional developments need to take place to improve its effectiveness. NMFS may consider requirements for PAM in the future depending on information received as the technology develops further.

[5] See http://www.pamguard.org/background.shtml for additional information.

6.2.2 Active Acoustic Monitoring

AAM is another method of determining the presence of marine mammals and other animals. In AAM, sonar is actively used to locate animals and, unlike PAM, non-vocalizing marine mammals are detectable. Different species can require multiple frequency bands, and species identification has been a hurdle when using AAM. The requirement to add sound to the ocean with AAM has presented environmental and regulatory concerns. However, systems are becoming more accurate with less noise output. Units similar to the very ubiquitous fish finders found on many vessels are proving useful in some cases for marine mammal monitoring.

Both MMS and NMFS are currently exploring the use and implications of AAM in order to better understand the capabilities, applicability, and availability of current acoustic monitoring systems, the potential developments and improvements in future acoustic monitoring systems, and ways in which industry, MMS, and NMFS could use acoustic monitoring as a monitoring tool. In the interim, NMFS will not approve individual use of active acoustics as a marine mammal mitigation tool until the proposed device has been independently tested by a company approved in advance by NMFS.

At this time, AAM systems generally emit high frequency sound, similar to the power level, signal type and frequency as high-frequency "fish finder" type sonars used worldwide by both commercial and recreational fishermen. The systems are used for 30 minutes prior and during seismic operations to detect, locate and track marine mammals, mainly within the 180/190-dB exclusion zones. Detection of a marine mammal within this zone by AAM will result in the power-down or shutdown of the airguns in the same way as visual monitoring. At this time, it is not known if AAM would be effective at detecting marine mammals outside of the 180/190-dB exclusion zones.

MMS will be sponsoring a workshop in November 2009 which will review available acoustic monitoring technology (passive and active), its feasibility and applicability for use in MMS-authorized activities, and what additional developments need to take place to improve its effectiveness. NMFS may eventually consider requirements for AAM depending on information received as it develops further.

6.2.3 Unmanned Aerial Surveys

Unmanned Aircraft Systems (UASs) have been emerging as a potential monitoring resource for detecting the presence of marine mammals during research, as well as to meet monitoring requirements during human activities, such as military sonar, seismic surveys, and geophysical research. A number of organizations, such as members of the offshore oil and gas industry, NOAA, MMS and the U.S. Navy, have been investigating the use of these surveys for a number of reasons, including but not limited to: (1) unmanned surveys address safety concerns of putting human pilots and observers in potentially dangerous offshore areas; (2) unmanned aircraft can generally fly up to 20 hours which is longer than manned surveys; (3) unmanned surveys can provide video data, even with high definition video cameras, which can be carefully reviewed post-

flight rather than relying simply on visual observations during the flight; (4) unmanned surveys may provide for more frequent survey effort since securing personnel for flights is not necessary; and (5) aircraft can be launched from seismic ships.

At this time, NMFS is unable to determine the effectiveness and feasibility of UASs. However, NMFS does note that UASs may offer a possible solution for detecting marine mammals during periods of low visibility and a variety of weather situations. Development and testing of UASs is already occurring, with information on their applicability expected to increase each year. For this reason, NMFS will continue to follow the development of this monitoring tool, and, if evidence supports their effectiveness and feasibility for use in the Arctic, will consider the implementation of these technologies after first vetting through the annual MMPA permit review processes.

6.3 Reporting Requirements

A report on the preliminary results of the acoustic verification measurements, including as a minimum the measured 190-, 180-, and 160-dB (rms) radii of the airgun sources, will be submitted within 120 hr after collection and analysis of those measurements at the start of the field season. This report will specify the distances of the safety zones that were adopted for the survey.

The results of the 2009 Shell vessel-based monitoring, including estimates of "take" by harassment, will be presented in the "90-day" and Final Technical reports, as required by NMFS under IHAs. Shell proposes that the Technical Reports will include: (1) summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through study period versus operational state, sea state, and other factors affecting visibility and detectability of marine mammals); (2) summaries of the occurrence of power-downs, shutdowns, ramp-ups, and ramp-up delays; (3) analyses of the effects of various factors, influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare); (4) species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover; (5) sighting rates of marine mammals versus operational state (and other variables that could affect detectability); (6) initial sighting distances versus operational state; (7) closest point of approach versus operational state; (8) observed behaviors and types of movements versus operational state; (9) numbers of sightings/individuals seen versus operational state; (10) distribution around the acoustic source vessel versus operational state; and (11) estimates of take by harassment. This report will be due 90 days after termination of the 2009 open-water season and will include the results from any seismic work conducted in the Chukchi/Beaufort Seas in 2009 under the previous IHA, which expires on August 19, 2009, or upon issuance of this proposed IHA. The draft reports will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final reports prior to acceptance by NMFS. The draft reports will be considered the final reports if NFMS has not provided comments and recommendations within 90 days of receipt of the draft reports.

Following the 2009 open-water season, a comprehensive report describing the acoustic and vessel-based 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 program into an assessment of 2009 industry activities and their impacts on marine mammals. The report will help to establish long term data sets that can assist with the evaluation of changes, if any, in the Chukchi Sea ecosystem. 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.

This report will consider data from many different sources including differing types of acoustic systems for data collection (net array and OBH systems) and vessel based observations. Collection of comparable data across the wide array of programs will help with the synthesis of information and allow integration of the data sets over a period of years. Data protocols for the acoustic operations will be similar to those used in 2006-2008 to facilitate this integration. The comprehensive report must be submitted within 240 days after issuance of the IHA. Before the comprehensive report will be considered final by NMFS, Shell must incorporate comments and recommendations from NMFS and participants of the annual Open-water Meeting held each year in Anchorage, Alaska.

6.4 Review of the 2008 Open-water Seismic Survey Marine Mammal Monitoring and Mitigation Reports

NMFS' 2008 SEA (NMFS, 2008) provided a review of the 90-day technical reports submitted by IHA holders who conducted seismic and site clearance and shallow hazards surveys during the 2006 and 2007 Arctic open-water seasons. In 2008, NMFS issued five IHAs for the harassment of marine mammals incidental to conducting seismic and/or site clearance and shallow hazards surveys in the Beaufort and Chukchi seas to Shell, CPAI, BP, PGS, and AES. NMFS has reviewed the reports submitted by these companies (Aerts *et al.*, 2008; Hauser *et al.*, 2008; Brueggeman, 2009; Ireland *et al.*, 2009) (The work conducted by AES was on behalf of Shell, so information that would be contained in a 90-day for their survey operations were contained in Shell's report for the 2008 season.) Based on the results of these studies collectively, NMFS concludes that the previous monitoring and mitigation measures prescribed in these marine mammal take authorizations were effective. In addition, actual take of marine mammals by Level B harassment was generally lower than expected due to the implementation of monitoring and mitigation measures. No Level A harassment (injuries included) or mortality was observed or suspected as a result of the operations.

6.5 Conclusion

The inclusion of the mitigation and monitoring requirements in the IHA, as described in the Preferred Alternative, will ensure that Shell's activities will have the least practicable impact on affected marine mammal species and stocks, will have a negligible impact on the affected species or stocks, and will not have an unmitigable adverse impact on the affected species or stocks for subsistence uses. With the inclusion of the required

mitigation and monitoring requirements, NMFS has determined that Shell's proposed activities (described in Section 1.3 of this EA) and NMFS' proposed issuance of an IHA to Shell will result at worst in a temporary modification of behavior (Level B harassment) of 12 species of marine mammals in the Chukchi Sea. In addition, no take by death and/or serious injury is anticipated, and the potential for temporary or permanent hearing impairment will be avoided through the incorporation of the mitigation and monitoring measures described earlier in this document.

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