APPENDIX E

SUMMARY OF SELECTED VALUED ECOSYSTEM COMPONENTS

Table E-1 Summary of Selected Valued Ecosystem Components for the Maersk Project

Environment	VEC	VEC Sub-components	Reason for Inclusion
Physical	Sediment Quality	-	Accidental events such as hydrocarbon spills may have indirect impacts on biological VEC via direct impacts on sediment quality
	Water Quality	-	Vessel discharges and accidental events such as fuel spills may have indirect impacts on biological VEC via direct impacts on water quality
	Air Quality	-	Air emissions from Project vessels may have indirect impacts on the human receptors via direct impacts on air quality
Biological	Marine Fish	Polar cod	Primary food source for marine mammals and seabirds; potentially occur in License Block area; commercially important species in West Greenland
		Arctic Cod	
		Greenland Halibut	
	Seabirds	Arctic tern	Greenland Red List – Near Threatened
		Atlantic puffin	Greenland Red List – Near Threatened
		Black-legged kittiwake	Greenland Red List – Vulnerable
		Common eider	Greenland Red List – Vulnerable
		Great cormorant	~ 10% of Greenland population occurs in Baffin Bay
		Ivory gull	Greenland Red List – Vulnerable; IUCN listed – Near Threatened (2010)
		King eider	Large flocks assemble in coastal areas and are flightless for a three-week moulting period
		Little auk	> 80% of global population breeds in Greenland with majority of Greenland population in Baffin Bay
		Long-tailed duck	Breed on islets in West Greenland fjords; gather in small flocks in summer for a flightless moulting period; IUCN listed – Least Concern (2010)
		Thick-billed murre	Greenland Red List – Vulnerable; West Greenland population declining; most commonly hunted species in Project area
		Northern fulmar	Eastern Baffin Bay is an important offshore foraging area for the local population
	Marine Mammals	Bearded seal	Greenland Red List – Data Deficient; year-round resident; possible encounter during survey
		Ringed seal	Locally harvested species; year-round resident
		Polar bear	Greenland Red List – Vulnerable; locally harvested species; potential for occurrence in License Block during survey
		Walrus	Greenland Red List – Endangered; locally harvested species; potential for occurrence in License Block during survey
		Bowhead	Greenland Red List – Near Threatened
		Narwhal	Greenland Red List – Critically Endangered; locally harvested species; potential for occurrence in License Block during survey;
		Beluga	Greenland Red List – Critically Endangered; locally harvested species; potential for occurrence in License Block during survey
Land Use / Sea Use	Commercial Fisheries	-	Cultural and economic importance
	Subsistence Hunting / Fishing	-	Cultural and economic importance
	Tourism and Recreation	-	Cultural and economic importance

APPENDIX F

PROJECT-ENVIRONMENT INTERACTION MATRIX

Table F-1 Environment Interaction Matrix

Type of Project Activity	Planned Activities						Unplanned Activities	
	Underwater Sound	Vessel Traffic	Vessel Lighting	Ballast Water Exchange	Vessel Discharge	Airborne Emissions	Minor Spills	Major Spills
VEC								
sediment quality	-	-	-	-	-	-	✓	✓
water quality	-	-	-	-	✓	-	✓	✓
air quality	-	-	-	-	-	✓	-	-
marine invertebrates	✓	-	-	-	-	-	-	-
marine fish	✓	-	-	✓	✓	-	✓	✓
seabirds	✓	-	✓	✓	✓	-	✓	✓
marine mammals	✓	✓	-	✓	✓	-	✓	✓
species of concern/ protected areas	✓	✓	✓	✓	✓	-	✓	✓
commercial fisheries	✓	✓	-	✓	-	-	-	✓
subsistence fishing and hunting	✓	✓	-	✓	-	-	✓	✓
tourism and recreation	-	✓	-	-	-	-	✓	✓

Note: "-" indicates the VEC will not be assessed against the particular project activity.

Note: "✓" indicates the VEC will be assessed against the particular project activity.

APPENDIX G

IMPACT ASSESSMENT TERMINOLOGY

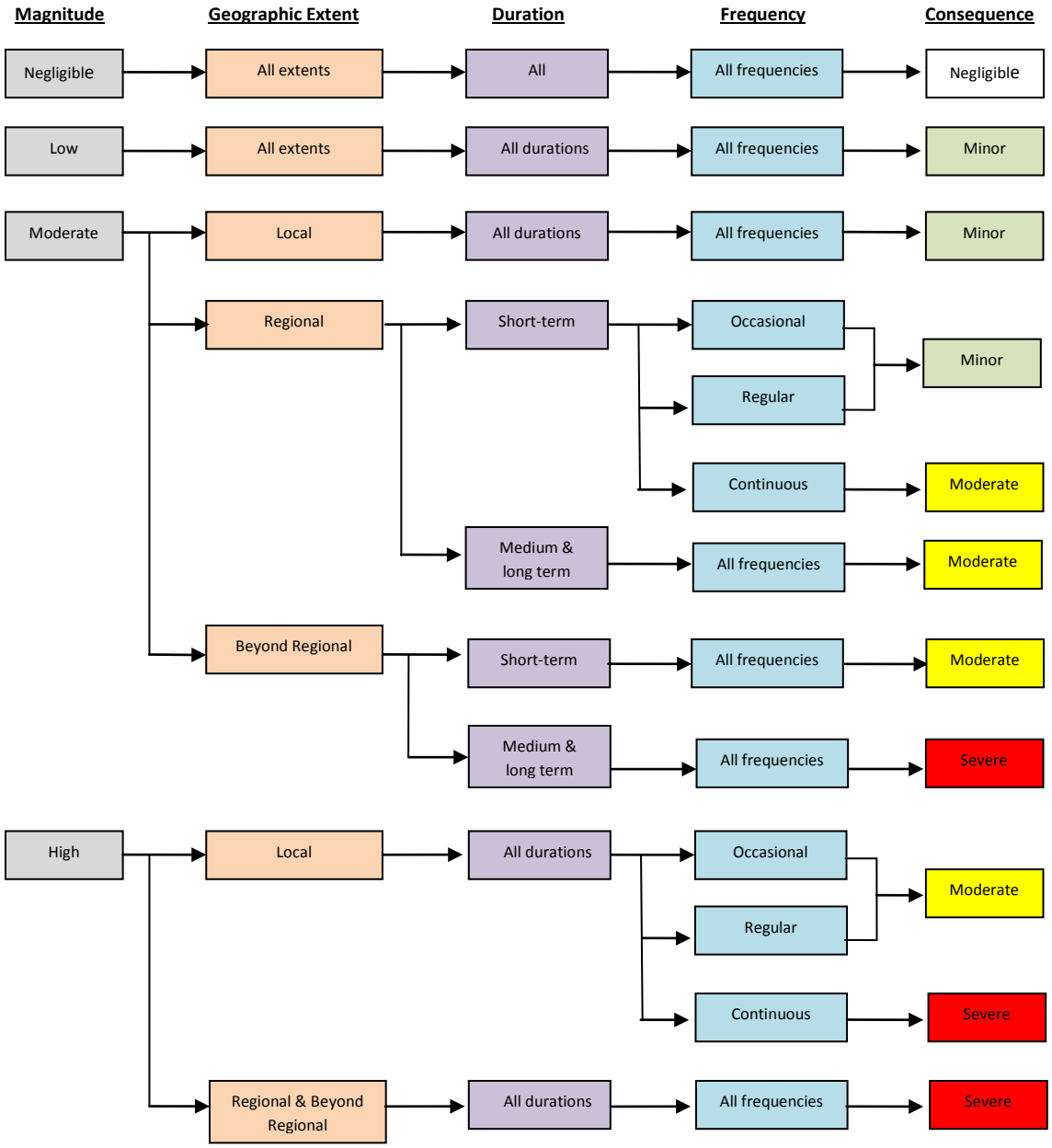
Table G-1 Impact Assessment Terminology

Criteria	Physical	Biological	Land and Sea Use
Magnitude			
Negligible	No changes or small adverse changes unlikely to be measurable against background levels		
Low	Adverse changes that can be monitored and measured above background conditions, but are within the scope of the natural variability, do not exceed established criteria or scientific threshold levels, and do not meet any of the 'moderate' or 'high' magnitude definitions		
Moderate	Likely to result in one or more of the following: 1) localized, occasional violations of air, water, or sediment quality standards or guidelines; or 2) localized contamination of marine environment with hydrocarbons, toxic metals, or other toxic substances	Likely to result in one or more of the following: 1) detectable changes above background conditions, exceed established criteria or scientific threshold levels but effects not expected at population level; 2) ≥1 death or injury of a VEC species; or, 3) occasional or temporary disruption of critical activities (e.g., breeding, nursing); and/or localized damage to sensitive habitats	Likely to result in one or more of the following: 1) localized, temporary displacement from preferred fishing sites and/or other negative interactions with fisheries (e.g., nets or traps damaged); or, 2) localized, short-term decline in fishery harvest
High	Likely to result in one or more of the following: 1) continuous violation of air or water quality standards or guidelines; or, 2) widespread contamination of marine environment with hydrocarbons, toxic metals, or other toxic substances	Likely to result in one or more of the following: 1) detectable changes above background conditions, exceed established criteria or scientific threshold levels with effects potentially occurring at population level; 2) ≥1 death or injury of a Greenland red-listed species; or, 3) extensive disruption of critical activities or damage to sensitive habitats	Likely to result in one or more of the following: 1) extensive, permanent displacement from preferred fishing sites and/or continuous negative interactions with fisheries; 2) extensive, persistent decline in fishery; or, 3) substantial public controversy or social unrest
Geographic extent			
Local	Effect is limited to the local study area (Tooq Block plus 10 km buffer zone (LSA))		
Regional	Effect extends beyond LSA and limited to Greenlandic territorial waters of Baffin Bay (RSA)		
Beyond Regional	Effect extends beyond the regional study area (RSA)		
Duration			
Short-term	Effects only occur during the active seismic program plus two (2) months post-survey		
Medium-term	Effects occur up to one (1) year following completion of survey		
Long-term	Effects occur greater than one (1) year following completion of survey		
Frequency			
Occasional	Conditions causing the effect occur sporadically throughout the Project		
Regular	Conditions causing the effect occur at regular intervals throughout the Project		
Continuous	Conditions causing the effect occur continuously throughout the Project		

APPENDIX H

DECISION TREE FOR ASSESSMENT OF IMPACT CONSEQUENCE

Figure H-1 Decision Tree for Assessment of Impact Consequence



APPENDIX I

SUMMARY OF PROJECT MITIGATION AND ENVIRONMENTAL PROTECTION PLANS

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Physical Presence			
	(1) Consultation and communication with relevant authorities, consultees, and local stakeholders and a dedicated local Greenland phone number will be provided to local stakeholders for any concerns or complaints.	MOKN	BMP Guidelines
	(2) Notification of survey details to BMP and appropriate shipping and harbour authorities prior to the start of the survey.	MOKN	BMP Guidelines
	(3) Obtaining all appropriate environmental permits and associated conditions prior to the start of the program.	MOKN	Industry Best Practice
Environmental Sensitivities			
	(1) All associated subcontractors will be made aware of environmental sensitivities and procedures/mitigation measures to be used; and include any relevant finds and mitigation measure presented in the EIA are incorporated into the operational management of the project.	MOKN	BMP Guidelines
	(2) All associated subcontractors will be provided with details of conditions attached to the environmental authorization and any commitments to the Greenland Government.	MOKN	BMP Guidelines
	(3) Information on all aspects of the environment that may affect the conduct of survey operations (e.g.. Navigation hazards, shipping routes, marine life, etc.) will be provided to the operator of the vessel.	MOKN	BMP Guidelines
	(4) Copies of the NERI and BMP Seismic Guidelines as well as copies of the manual for seabird and marine mammal survey on seismic vessels in Greenland will be provided to contractors to ensure that they understand the role of the MMSO and the measures they will be required to follow in accordance with the guidelines.	MOKN	BMP Guidelines
Operational Phase Measures			
	(1) The vessel operators will maintain contact with the relevant authorities to update on survey progress and vessel position.	Vessel Operator	BMP Guidelines
	(2) The vessel operators will operate in accordance with all applicable laws, standards and conditions while in Greenland waters including: -MARPOL 73/78; SOLAS 1974; any requirement attached to the authorization or any associated conditions required by authorities; E&P Forum Health, Safety and Environmental Schedules for Marine Geophysical Operations (Report No. 6.34/206); IAGC Marine Geophysical Operations Safety Manual (published by the International Association of Geophysical Contractors); IAGC Environmental Guidelines for Worldwide Geophysical Operations; NERI Guidelines to Environmental Impact Assessment of Seismic Activities in Greenland Waters; and OGP Guideline: Managing HSE in a Geophysical Contract (Report No. 432).	Vessel Operator	Industry Best Practice and BMP Guidelines
	(3) A log will be maintained of all sightings and contacts with other vessels.	Vessel Operator	BMP Guidelines
	(4) A log will be kept of any fishing equipment removed from the sea for the purpose of clearing a path for the survey vessel including location, date, type of equipment and any identifying marks.	Vessel Operator	BMP Guidelines

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Emissions and Discharges			
Airborne Emissions			
Primary Sources: exhaust gases from diesel engines on vessels (note: other onboard ancillary equipment i.e., generators not assessed as emissions anticipated to be intermittent and of smaller magnitude).	(1) Estimates of fuel consumption for all Project vessels calculated based on assumption that all vessels will operate on Marine Heavy Fuel Oil. (2) Estimates of total air emissions for the proposed Project provided based on the following parameters: PM; SOx; NOx; VOC; CO. (3) Estimates of total greenhouse gas emissions for the proposed Project provided. (4) Project vessels will comply with local and international pollution prevention requirements including, but not limited to: Act on the Protection of the Marine Environment (1993); International Convention for the Prevention of Pollutions from Ships (1973) as modified by the Protocol of 1978, MARPOL 73/78 (Annex VI); and the BMP Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (Excluding Drilling) in Greenland Waters (2011). (5) Diesel engines, incinerators and equipment will be maintained and operated efficiently. All equipment will be checked on regular basis and maintained in accordance with the manufacturer's guidelines in order to maximise efficiency and minimize discharges to the environment. (6) Ozone depleting substances will not be used except in refrigeration equipment where closed recovery systems are used. (7) Project vessels and equipment will use fuel with a sulphur content <1.5% (weight) - fuel with higher sulphur content will not used.	Golder A/S Vessel Operator and MOKN	Effects of Airborne Emissions from Project Vessels
Vessel Discharges			
Primary Sources: liquid wastes including grey water (domestic wastewater), black water (sewage), drainage and bilge water, and solid wastes including kitchen waste, medical waster, potentially hazardous wastes, and other miscellaneous garbage.	(1) Estimates of grey and black produced and discharged from Project vessels will be provided. (2) Grey water will be discharged directly to sea as treatment of grey water is not required prior to discharge to sea under MARPOL 73/78. (3) All vessels will follow the Project specific Waste Management Plan. (4) Solid wastes will be sorted by type, compacted where practicable, and stored or incinerated onboard until they can be disposed of at a certified waste handling or recycling facility (proposed that disposal occur at the home port of the vessel upon completion of Project. (5) Food waste will be macerated and disposed at sea at least 12 nautical miles from the nearest point of land in accordance with the Act on the Protection of the Marine Environment (Part 7, 22-1, 1993) and under Annex V of MARPOL 73/78. (6) Sewage and kitchen waste will be treated onboard prior to discharge and will meet International Maritime Operation Standards, Annex IV of MARPOL 73/78. (7) Discharge of bilge and drainage water is not planned for the duration of the Project. In the event that discharge is unavoidable, bilge and drainage water will be routed through and oil/water separator and assessed for oil concentration prior to discharge and, where possible, meet the best practices of Annex I of MARPOL. (8) Records will be maintained of all discharges, including estimates of grey and blackwater discharge, dirty oil, bilge and ballast water discharges or quantities held in tanks for onshore disposal.	Golder A/S Vessel Operator and MOKN Vessel Operator	Effects of Discharges from Project Vessels

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Effects of Underwater Noise			
Primary Sources: airgun array pulses, high frequency pulses from acoustic sources associated with hyrdographic survey and seabed sampling, and the Project vessels (propeller cavitation and noise from onboard equipment and machinery). Sound level outputs from the equipment used for the hydrographic survey and seabed sampling program include: multi-beam, single-beam, and side-scan sonar, sub-bottom profilers and an acoustic positioning system. Effects: likely to be limited to short-term behaviour responses (startle, displacement, and schooling behaviour), that will vary by species and hearing group, and will be dependent on the properties of the received sound. Diving birds may suffer damage to their ears if diving occurs very close to the airgun array.	(1) Airguns in the array are configured to project the maximum amount of seismic energy vertically into the seafloor. (2) Use of short duration pulses limiting the total energy an animal would be exposed to, rather than continuous or intermittent pulses. (3) No mitigation is proposed for seismic noise effects on marine invertebrates - "The proposed seismic survey is not expected to result in any measurable physical effects on invertebrates in the survey area because morse invertebrates inhabit the benthic zone where they will be a minimum of 100 meters from the source (minimum water depths in LSA). Furthermore, invertebrates are thought to be resilient to seismic activities because they lack internal gas-filled cavities normally susceptible to sound pressure effects." (4) Use of NMFS interim noise exposure criteria for the onset of direct physical injury in fish exposed to impulsive noise sources. (5) Mitigation for potential effects of underwater noise on fish were accommodated at the design stage by increasing the number of hydrophone receivers required for each survey line which will reduce the total number of seismic lines required and consequently reduce the duration and extent of the potential noise effects. (6) Use of "ramp-up" procedures as recommended in BMP's seismic guidelines (BMP 2011) will be implemented and is considered sufficient to stimulate an "avoidance" behaviour for fish species in the area, providing an opportunity for fish to leave the area before the seismic array reaches full power. (7) Fisheries Liaison Officer will be present onboard the seismic vessel during periods when active seismic surveys have the potential to overlap with active fisheries. (8) Based on a literature review, it is expected that underwater noise generated by seismic activities will not exceed levels know to cause irreversible damage or death to fish (adults and eggs), except at close range. "For all fish VECs in the Tooq Block and surrounding area, the magnitude of the effect of seismic noise was considered to be moderate because sound levels will likely exceed established thresholds for the onset of injury and behavioural changes. However, effects are not anticipated at the population level, as fish and ichthyoplankton are generally widely distributed, and recovery, in terms of both diversity and abundance, occurs rapidly in response to localized impacts. Seismic noise will be restricted to the LSA and will occur over the short-term (survey period) at a continuous frequency (assuming 24-hour shooting)." (9) Presence of the seismic vessel itself will likely result in avoidance behaviour and therefore minimize the potential risk to seabirds. Furthermore, the sensory cells of the inner ear in marine birds can regenerate following incidents of acoustic trauma, even after intense exposure. (10) The proposed survey is not expected to cause any measurable effects on marine birds in the proposed survey area, therefore no mitigation is proposed. (11) Unnecessary shooting will be avoided wherever possible.	Vessel Operator and MOKN Golder A/S, vessel operators, MOKN	Effects of Underwater Sound from Project Activities Effects of Underwater Sound from Project Activities
Effect of Vessel Lighting on Marine Birds			
Primary Source: vessel lights from various Project ships. Effects: increase of risk of bird collisions with vessels and related increase in seabird mortality.	(1) External vessel lights will be shielded and/or reduced during the night and used only when necessary; with exception of navigation and ice searchlights as required by regulations. (2) Birds that land on vessels at night will be left undisturbed, unless they impede operations or risk being harmed by onboard operations. If necessary, an exhausted bird resting on a vessel may be moved to a sheltered location until it is recovered. (3) Project vessels will avoid protected bird areas. (4) Project vessel crews will be instructed on how to handle dead, injured or resting birds and to notify the MMSO on duty of any bird collisions and/or landings on the vessels. (5) The overall distance of the Tooq Block from land and coastal breeding sites will further reduce the likelihood of night-time collisions.	Vessel Operators	Effect of Vessel Lighting on Marine Birds

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Effect of Introduced Species from Ballast Water Exchange			
Primary Source: increased Project vessel traffic. Effects: risk of potential accidental introduction of aquatic alien species during ballast water exchange. Alien species may include bacteria and other microbes, microalgae, aquatic plants and animal species; invasive species can spread rapidly in the absence of natural predators and alter local habitats making them unsuitable for the native species; alien species may also effect the abundance of native marine biota due to predation and/or competition for habitat and food resources.	(1) In order to minimize the potential for release of alien species from Project vessels, all vessels will follow the Project specific Ballast Water Management Plan which will follow mitigation described in the International Convention for the Control and Management of Ship's Ballast Water and Sediments and the IMO (1997) Resolution A.868(20) this includes but is not limited to: - ballast water exchange will be conducted at least 200 nm from land in waters at least 200 m deep; - in cases where the above is not possible, exchange will occur at least 50 nm from land in water at least 200 m deep; - if these requirements cannot be met, other areas may be designated for ballast water exchange; - sediments from the ballast tanks will be removed and properly disposed of; and - maintenance of a ballast water record book (ballast exchanges, treatments and accidental discharges. (2) No ballast water from foreign water sources will be discharged from the Polarcus Asima in Greenlandic waters.	Vessel Operators and MOKN Vessel Operators	Effect of Introduced Species from Ballast Water Exchange
Effects of Accidental Events and Spills			
Primary Source: accidental events and spills have the potential to occur during Project activities. Minor events during routine operations (such as positioning and transiting) have the potential to release small amounts of liquid hydrocarbon, liquid or chemicals, and solid or liquid wastes. Major events could include large hydrocarbon spills due to the vessel sinking, running aground, collisions with icebergs or other vessels, fires and explosions. Effects: environmental conditions during a hydrocarbon spill significantly influences the duration and extent. Currents and tides also play and important role in determine duration and extent. An oil spill in a coastal environment may result in high mortality of adult and juvenile plant and fauna species. Loss of food sources may occur by causing direct mortality or physical injury. Offshore and land feeding areas as well as breeding and moulting habitats can be temporarily or permanently disrupted. Physical injury or death may result from ingestion of contaminated food sources or smothering due to fouling.	(1) The Project strategy to mitigate the potential effects from accidental oil and chemicals spills includes two main components: prevention and response. (2) All operations that involve use, shipping, handling, storage and transfer of fuel, grease and lubricants, and other chemical materials will follow specific procedures and requirements that comply with international safety standards, industry best management practices, and international and local regulations including the following: • Engineering design: fuel tanks, lubricant, and chemical storage containers and components will meet relevant safety standards for preventing uncontrolled release of stored materials during normal operation and during exposure to natural hazards and to prevent fires and explosions; • Personnel training and competence: all activities will be conducted by properly trained personnel; • Documented procedures: all activities will be conducted according to pre-established formal procedures to prevent accidental releases and fire and explosion hazards; all materials will be managed with the use of Material Safety Data Sheets (MSDS) that provide the information necessary to understand the product and to take precautions in case of an accident; • Inspection and maintenance: fuel tanks, lubricant and chemicals storage containers and fuel and lubricant transfer systems and components will be regularly inspected and maintained in proper order to prevent uncontrolled release of substances; and, • Record keeping: fuel, lubricants, and other chemicals transfers, and inspection and maintenance activities will be recorded and records will be kept according to the Project records-keeping procedures. (3) To minimize the potential for vessel accidents, Project vessels will comply with the navigation and safety acts, regulations, and guidelines. The include, but are not limited to: SOLAS 1974, and Acts, Orders, and Regulations established by the Danish Maritime Authority. (4) An Ice Management Plan will be implemented to avoid potential collisions and three chase vessels will be used for	Vessel Operators and MOKN	Unplanned Events and Accidental Spills

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Commercial and substances fisheries may be impacted by oil spills by temporary closures due to concerns due to toxicity levels. Tourism may also suffer from deterioration of the aesthetic value of the affected areas.	spotting and managing glacial ice providing for safe operations. (5) All Project vessels will have an appropriate ice-class rating and be equipped with fixed ice-searchlights. (6) Qualified navigators will be used for navigation through Greenlandic waters. (7) Project vessels will use the Greenland VMS (Vessel Monitoring System) and LRIT (Long Range Identification and Tracking System). Prior to installation of the VMS in Greenland, vessels may use GREENPOS reporting system while navigating to the Greenland EEZ. (8) Each ship will have emergency notification and response equipment, including alarm systems, fire-fighting equipment and spill response kits. (9) All vessels will employ the use of a Shipboard Oil Pollution Emergency Plan as set out in the best practices under MARPOL 73/78, and will be certified to meet the standards of the convention. (10) Regular drills and spill response exercises will be conducted. (11) All accidents, spills, and near-misses will be reported and recorded. A formal investigation will be conducted, if necessary, to determine root cause.		
Effects of Vessel Traffic			
Primary Source: vessel traffic by means of ship strikes - direct mortality and physical injury. Effects: direct mortality and physical injury with baleen whales more probable due to large size and slower travelling and manoeuvring speeds and lower avoidance capabilities. Effects: Project vessel traffic may overlap with other marine traffic in the Tooq Block; only a small portion of the northern shrimp fishery presently occurs within the Tooq Block during the open water season. No commercial fisheries for Greenland halibut, snow crab, or other species presently exist in this area. However, there is potential for Project vessels to interfere with vessels or fishing gear primarily from the northern shrimp fishery. Project vessels may also have an effect on tourism by temporally displacing sightseeing vessels or cruise ships.	(1) Speed restrictions will be imposed on all Project vessels and speeds will not exceed 14 knots which will reduce the likelihood of vessels strikes on marine mammals by providing ample time for avoidance. (2) Marine mammal monitoring will be conducted onboard seismic and hydrographic vessels by trained MMSOs. The MMSO will notify the Survey Party Chief if there is a concern of the vessel striking a marine mammal so that an assessment can be made if action is required to avoid collision. (3) Ramping up of the airguns will also be used to deter marine mammals from the area. (4) When in proximity to marine mammals, the following mitigation will be applied where possible: • Vessels will not approach or be positioned closer than 100 meters to any marine mammal; • If marine mammals approach within 100 meters of a Project vessel, the vessel will reduce speed and cautiously move away; • If it is not possible for support vessels to detour around a stationary marine mammal or group of marine mammals, the support vessel will reduce speed and wait until the animals have departed the area and are at least 100 m from the vessel prior to resuming operational speeds; • As possible, Project vessels will avoid marine protected areas and areas identified as important to marine mammals, specifically, the Melville Bay Reserve and Narwhal Protection Zone (NPZ) IV (summer habitat near Qaanaaq; Project vessels will limit time spent in NPZ - I: (summer habitat area in Melville Bay) and NPZ- II (autumn migratory corridor in Eastern Baffin Bay). (5) It is not anticipated that Project survey vessels will interact with subsistence fishing and hunting, as the survey area does not overlap any traditional fishing and hunting grounds, or special protection areas in Baffin Bay. (6) If deemed necessary by BMP (2011), one or more BMP-approved Fisheries Liaison Officers (FLO) will be onboard the survey and/or support vessels. The FLO will serve as an advisory observer and will facilitate communications for matters related to fisheries. (7) The relevant Greenland authorities (i.e., Island Command Greenland/MRCC Grønnedal) will be notified prior to commencement of operations. This will allow Island Command Greenland, through regular marine radio broadcasts, to alert commercial fishing vessels and other operators to avoid the survey areas where possible. (8) During the seismic operations, a 'notice to mariners' will be regularly broadcast (e.g. every four hours) over local marine radio channel(s) to provide commercial fishing vessels and other marine traffic in the area with details on the proposed survey activities and locations. Where possible, specific notices regarding Project operations and schedule will be provided directly to known operators in the Tooq Block and surrounding area prior to the start of the Project.	Vessel Operators and MOKN	Effect of Vessel Traffic Section 1.4.2.1 Proposed Mitigation and Best Practice

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Effects to Marine Mammals			
Primary Source: man-made underwater sound, particularly for marine mammals that may be sensitive to certain sound levels or frequencies; Effects: potential physical (such as: damage to body tissue, temporary or permanent hearing loss) and/or behaviour impacts from introduced noise sources (varying nature and degree of impact based on animal's distance from the source); avoidance, masking of biologically relevant sounds. Note: potential effects of underwater sound depend on the marine mammal involved and the level and type of ambient noise.	(1) Underwater noise models were used to predict the underwater acoustic field surrounding the seismic array under various Project scenarios. Two complementary acoustic models were used to predict the underwater acoustic field surrounding the seismic airgun array: airgun array pressure signatures and directional source levels were predicted using JASCO's Airgun Array Source Model (AASM) (MacGillivray 2006) and acoustic fields were modelled using JASCO's Marine Operations Noise Model (MONM). (2) The survey will follow mitigation measures outline in the Project specific Marine Mammal Management Plan which combines a vessel-based marine mammal and seabird observer (MMSO) program and a Passive Acoustic Monitoring Program (PAM) with vessel-specific operational procedures to mitigate, minimize, prevent and/or manage effects of noise related to the seismic survey. A brief summary of the proposed mitigation measure is provided below: **Mitigation through Survey Design** • Control at the source: airguns will be operated at lowest practicable power levels; • The source/receiver ratio has been increased to reduce the number of source shots transmitted per survey line, as well as the total number of seismic lines required (provides for a reduction in the duration and extent of potential noise effects); • Where possible, the smallest airgun in terms of energy output (dB) and volume will remain shooting when otherwise the entire array is shut-down (maintaining the mitigation gun in active mode at all times is to acoustically discourage the approach of marine mammals; **Mitigation through Operational Procedures** • The MMSO program will be carried out on the seismic vessel during the full duration of the proposed program providing a minimum of one qualified MMSO continuously monitoring for marine mammals during all periods of daylight, good visibility and sea states; • The MMSO program will adhere to industry standard survey protocols and NERI standards; • MMSOs will be responsible for advising the seismic operator to shutdown the airgun operations if marine mammal(s) are observed within the designated safe zone; • Based on acoustical modelling completed by JASCO the project specific marine mammal safety radii was determined to be 600 m to avoid the potential for injury to marine mammals; • Implementation of "ramp-up" (soft start) procedures allowing power to be built up slowly from a low energy start-up beginning with the smallest airgun in the array providing a constant increase in output that slowly increases over a minimum ramp-up period of 20 minutes, thus providing adequate time for marine mammals to leave the area prior to the airguns operating a full power (where possible ramp-ups will be planned so that they commence during daylight hours); • Implementation of pre-shooting searches to determine that no marine mammals are present with the 600 m safety zone (completed by MMSO or an acoustic scan of the areas by the PAM operator); • Implementation of shutdown procedures - if marine mammals are observed within the 600 m safety zone during the ramp-up procedure, the airguns will be reduced to a single mitigation gun (smallest airgun in array in terms of energy output and volume), and a new revamp-up procedure will be initiated no earlier than 20 minutes after the marine mammals have left the safety zone. Once airguns have achieved full operational power, shut-down procedures will only occur if marine mammals are observed with 200 m of the seismic array, in which case the airguns will be reduced to a single mitigation gun until the marine mammals are outside the 200 m protection zone. A new ramp-up procedure will be initiated no earlier than 20 minutes after the marine mammal is beyond the 600 m safety zone; • If shooting of the airguns has stopped and not restarted for at least 10 minutes, then a pre-shooting search and 20 minute ramp-up will be completed. If the break is less than 10 minutes the MMSO will visually scan within the 600 m safety zone; • Firing of airguns will be terminated at the end of each survey line and a full 20 minute soft-start will be undertaken prior to starting the next survey line, providing that the line chance time is less than 20 minutes. If this is not the case, the smallest airgun will remain shooting;		Effects from Underwater Sound from Project Activities

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
	• A PAM program will be carried out in conjunction with the MMSO program. A certified PAM operator will acoustically monitor for marine mammals during all periods of darkness, limited visibility, and sea states; • Airguns will be operated at the lowest practicable power levels to achieve the geophysical objectives of the proposed seismic survey; • Seismic activities will be avoided in the designated narwhal protection zones (NPZ-I and NPZ-II) during the designated protection periods where practical. If avoidance is not possible, then seismic lines occurring in the protection zones will be limited to more widely spaced lines (>10 km). • If limited seismic surveys are planned within a narwhal protection zone, a detailed shooting program will be provided and subject to approval by BMP. • Support will be provided for a acoustic monitoring field program to be conducted during the during active seismic operations involving in-field verification of sound levels emitted, as well as seismic operations in adjacent License Blocks. In-situ sound levels will be compared to acoustically modeled sound levels and the safety radii may be revised in the field accordingly. Acoustic monitoring will be conducted in critical habitat areas (e.g. NPZ-I) on sufficient temporal and spatial scales to adequately capture pre- and post-seismic events. • Support will be provided for the implementation of a narwhal behavioural study to be conducted during the 2012 open-water season. Behavioural responses of narwhal to active seismic operations will be investigated, using aerial surveys conducted in the Tooq Block and adjacent areas. The study will aid understanding of behavioural reactions of narwhals to seismic noise. Aerial-based visual monitoring of critical habitats will be performed to evaluate potential displacement of narwhal from critical habitat areas and/or disruption of important narwhal behaviours in critical habitat areas as a result of seismic activity. • Support will be provided for a study on the effects of seismic noise on local subsistence harvest activities. Interviews will be conducted with Greenlandic hunters to determine potential effects of the 2012 seismic program on marine mammal catch rates; and • Observation will include all marine wildlife including: cetaceans, pinnipeds, polar bears and avian species. A log will be maintain to record daily sightings, observation locations and data, and a record of operations using the forms associated with the guidelines and all marine mammal observations will be in accordance with the NERI and BMP Seismic Guidelines for seabird and marine mammal surveys in Greenland waters; (3) In order to minimize the potential effects of vessel noise on marine mammals, the following mitigation will be applied: • Project vessels will regularly maintain propellers to minimize propeller cavitations; • Project vessels will be fitted with nozzles/cowlings around propeller blades as this practice significantly reduces propeller noise (especially for ice rated vessels); • Project vessels will avoid rapid acceleration, and will keep speeds as low as practical within specified Project guidelines (speed reduced to less than 14 knots when within 300 m and avoid abrupt course changes); • Project vessels will not approach or position themselves closer than 100 m to any whale and will reduce speed and cautiously move way from whales if they approach within 100 m; • Project vessels will avoid marine protected areas as defined in Section * of the EIA;		Section 1.3.6.4.3.1 Residual Effects and Environmental Significance (Marine Mammals)

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Unplanned Events			
	(1) A log will be maintained of all health, safety and environmental accidents or incidents. (2) BMP will be notified immediately of any significant situation or event, including loss of life, missing person, serious injury to a person, fire onboard, oil spill or threat to the vessel or personnel.	Vessel Operator MOKN	BMP Guidelines
Post Survey Phase			
	(1) MOKN will ensure that any unresolved conditions of the survey authorization, such as reporting requirements or follow-up activities are completed. (2) A report will be provided summarizing all observations and the associated log forms will be provided as appendices.	MOKN MOKN	BMP Guidelines