COMPREHENSIVE
STUDY REPORT
DEVON BEAUFORT SEA EXPLORATION
DRILLING PROGRAM

Submitted to:
National Energy Board

Submitted by:
Devon Canada Corporation
Calgary, Alberta

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Abbreviations

ADW ..... authority to drill a well
AWK ..... alternative well kill
BCB ..... Bering-Chukchi-Beaufort Sea population of beluga whales
BOD ..... biochemical oxygen demand
BOP ..... blowout prevention
CCBA ..... Comprehensive Cooperation and Benefits Agreement
CCP ..... Community Conservation Plan
CEAA ..... *Canadian Environmental Assessment Act*
CEA Agency ..... Canadian Environmental Assessment Agency
CO_2 ..... carbon dioxide
COSEWIC ..... Committee on the Status of Endangered Wildlife in Canada
CS Report ..... Comprehensive Study Report
CS Team ..... Comprehensive Study Team
dBA ..... A-weighted sound level
Devon ..... Devon Canada Corporation
DLP ..... defence of life and property
DFO ..... Fisheries and Oceans Canada
DPA ..... drilling program authorization
EC ..... Environment Canada
EIRB ..... Environmental Impact Review Board
EISC ..... Environmental Impact Screening Committee
EL 420 ..... Exploration Licence
EMS ..... environmental management system
EPP ..... environmental protection plan
ERDS ..... End of Risk Drilling Season
EUB ..... Energy and Utilities Board (Province of Alberta)
FEMP ..... Frontier Emergency Management Plan
FICON ..... Federal Interagency Committee on Noise
FJMC ..... Fisheries Joint Management Committee
GHG ..... greenhouse gas
GNWT ..... Government of the Northwest Territories
GSA ..... Gwich'in Settlement Area
GTC ..... Gwich'in Tribal Council
H_2S ..... hydrogen sulphide
HTC ..... hunters and trappers committee
IFA ..... Inuvialuit Final Agreement
IGC ..... Inuvialuit Game Council
INAC ..... Indian and Northern Affairs Canada
IRC ..... Inuvialuit Regional Corporation
ISR ..... Inuvialuit Settlement Region
KCl ..... potassium chloride
Leq ..... energy-averaged A-weighted sound level
LC50 ..... the lethal concentration of a substance that causes mortality in 50% of an exposed population
LRTAP ..... long-range transboundary air pollution
LSA ..... local study area
LTD ..... landfast tender-assist drill
MAT ..... a large metal base that sits on the seafloor and is fitted to the SDC

MPA ..... Marine Protected Area
N_2 ..... nitrogen
NEB ..... National Energy Board
NO_X ..... oxides of nitrogen
PCB ..... polychlorinated biphenyls
POP ..... persistent organic pollutant
RA ..... responsible authority
RSA ..... regional study area
RWED ..... Resources, Wildlife and Economic Development (Government of the Northwest Territories)
SARA ..... Species At Risk Act
SDC ..... steel drilling caisson
SHARE ..... Safety, Health and Respect for the Environment
SO_2 ..... sulphur dioxide
TA Report ..... Technical Assessment Report
VEC ..... valued ecosystem component
VOC ..... volatile organic compound
VSC ..... valued social component
WMAC ..... Wildlife Management Advisory Council

1 Introduction

This Comprehensive Study Report (CS Report) presents a summary of the potential biophysical and socio-economic effects of Devon Canada Corporation's (Devon) proposed Beaufort Sea Exploration Drilling Program (the Program). More detailed information is provided in a series of biophysical and socio-economic baseline reports (KAVIK-AXYS Inc. 2004a), as well as in the discipline-specific assessments in the supporting Technical Assessment Report (TA Report) (KAVIK-AXYS Inc. 2004b). The TA Report includes details on assessment methods, findings of the assessment, proposed environmental management and mitigation programs, the determination of significance, and recommended monitoring and follow-up programs.

1.1 Program Overview

The Program entails exploration drilling on Devon's offshore Exploration Licence (EL) 420 in the southern Beaufort Sea, north of the Mackenzie River Delta, to evaluate potential hydrocarbon reservoirs. EL 420 comprises 338,469 ha in two blocks, the Eastern Block (Areas A and B) and the Western Block (Areas C and D), located in relatively shallow water (Figure 1-1). Devon has identified ten potential drilling targets within EL 420, nine of which are located offshore within the landfast ice zone. The exploration drilling will be conducted during the winter, within the landfast ice zone, from one of three potential drilling platform systems: a steel drilling caisson (SDC), a landfast tender-assist drill unit (LTD) or an ice island platform.

The drilling Program will fulfill the terms of EL 420. Devon is required to commence drilling a well in any one of the four areas (A, B, C or D) by August 15, 2006. It could drill one well per year until the end of the licence period in August 2009. To meet these requirements, Devon is currently planning to drill the first well during the winter of 2005–2006 and one well per winter season for each of three subsequent seasons, completing the Program in the winter of 2008-2009. Failure to complete a well in each of the four areas of EL 420 by the end of the licence period will result in the termination of the licence for that specific area, with the rights reverting back to the federal government.

1.2 Regulatory Context

The National Energy Board (NEB) is responsible for regulation of offshore oil and gas activities in the Beaufort Sea under the *Canada Oil and Gas Operations Act*. Development of offshore oil and gas is subject to environmental assessment under the *Canadian Environmental Assessment Act* (*CEAA)*: Bill C-13, June 23, 1992. Federal regulations under *CEAA* require that the first offshore oil and gas exploration project in an area be subject to a Comprehensive Study. While 85 offshore exploration programs were completed in the Canadian Beaufort Sea during the 1970s and 1980s (Beaufort Sea Steering Committee 1991), the Program is the first exploration well in the Beaufort Sea region to be considered under *CEAA* and, therefore, is subject to a Comprehensive Study. The federal responsible authorities (RAs) under *CEAA* are:

- the NEB (lead RA)

- Fisheries and Oceans Canada (DFO)
- Indian and Northern Affairs Canada (INAC)
- Transport Canada (via the Canadian Coast Guard)

Other federal agencies such as the Canadian Environmental Assessment Agency (CEA Agency), Environment Canada, Health Canada, Natural Resources Canada and Parks Canada will also provide comment on the CS Report.

Because EL 420 is located within the Inuvialuit Settlement Region (ISR), the Program is subject to an environmental review under the *Western Arctic (Inuvialuit) Land Claims Settlement Act*: Bill C-49, 1983-84 (i.e., the federal Act that put the Inuvialuit Final Agreement [IFA] into law – a land claim agreement pursuant to Section 35 (3) of the *Constitution Act* of 1982). Specifically, the Program requires review by the Environmental Impact Screening Committee (EISC) and, subject to its decisions, the Environmental Impact Review Board (EIRB).

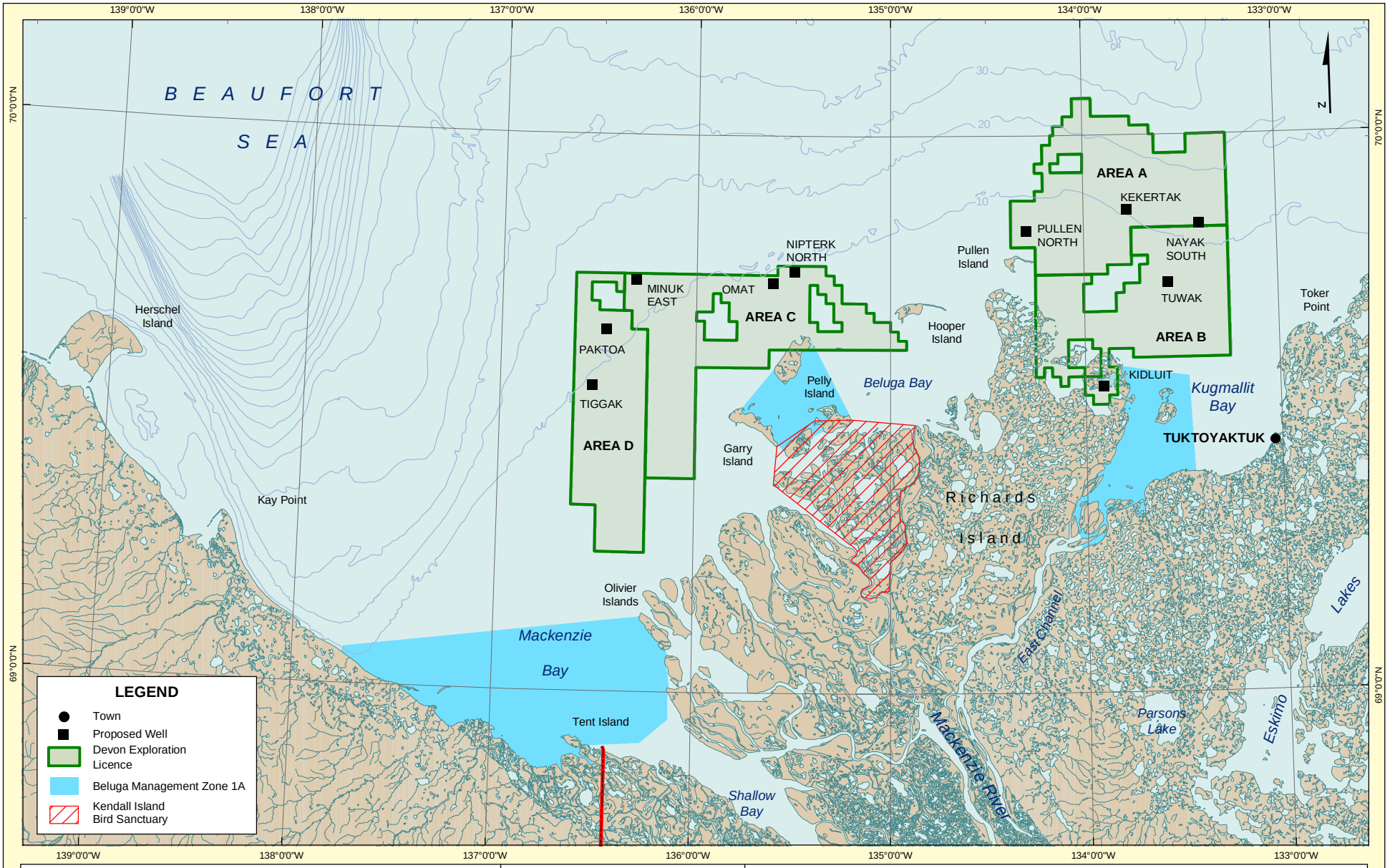
To avoid duplication, the RAs under *CEAA*; the CEA Agency, on behalf of the Minister of the Environment; and the Inuvialuit joint implementing bodies are undertaking a Coordinated Review of the Program to address their full range of responsibilities. The Inuvialuit joint implementing bodies include the Inuvialuit Game Council (IGC) and the three Joint Secretariat co-management agencies (the Wildlife Management Advisory Council [WMAC] for the Northwest Territories and the North Slope and the Fisheries Joint Management Committee [FJMC]), the EISC and the EIRB.

A Comprehensive Study Team (CS Team) is guiding the coordinated review process. The team is composed of representatives from:

- the NEB
- CEA Agency
- the federal RAs
- the Inuvialuit joint implementing bodies

The required scope of the environmental assessment of the Program is described in the document entitled: *Scope of the Environmental Assessment and Environmental Impact Screening and Review* (see Appendix A). While the focus of the assessment is the first exploration well to be drilled in EL 420, it also identifies any additional or different effects that could occur because of drilling other locations in the EL area in the subsequent three-year period. The assessment also examines the effects of all three drilling platform systems currently under consideration by Devon.

In accordance with guidance from the NEB, Devon submitted a draft of the CS Report to the CS Team for review and comment. The draft CS Report was made available to the public through the NEB public registry and Devon's website and public repositories. Comments from the RAs and the other federal agencies were used by Devon in completing the CS Report and the accompanying TA Report.



devon

KA036 Devon - Licence Areas
August 11, 2004

Data Sources:
Devon Canada
National Energy Board
National Topographic Series
Projection: Universal Transverse Mercator Zone 8 (NAD 27)

Figure 1-1
Licence Areas

When the RAs have determined that the CS Report and TA Report are complete, the CEA Agency will release the CS Report for a formal public comment period as required under *CEAA*. The completed CS Report and other appropriate documentation will be submitted to the EISC, who will determine if the Program will be subject to an environmental screening or will be referred to the EIRB for a public hearing. At the completion of either the EISC or EIRB process, the EISC or EIRB will provide their findings to the Minister of Indian and Northern Affairs and the NEB. The Minister of Indian and Northern Affairs and the NEB will forward the EISC or EIRB findings to the federal Environment Minister.

Following the public comment period, the federal Environment Minister will decide, based on a determination of the likelihood of significant adverse environmental effects, whether the Program can be referred back to the RAs for regulatory action. To conduct a drilling program in the Beaufort Sea, a Drilling Program Authorization (DPA) is required from the NEB. The DPA allows an operator to drill in a particular area for a specified amount of time. After a DPA is issued, each well within the drilling program must be approved by obtaining an Authority to Drill a Well (ADW).

Approvals obtained under this process will only apply to the offshore exploration program. If Devon decides to develop the natural gas reserves in EL 420, the production program will be subject to a separate regulatory review process, including an environmental assessment, under both the federal and Inuvialuit processes.

1.3 Devon's Northern Commitment

Devon has been active in hydrocarbon exploration within the ISR as an operator since 2000 and has demonstrated a commitment to sustaining northern values and lifestyles. This is exemplified by Devon's respect for the specific concerns of Aboriginal peoples, participation in community initiatives, optimization of employment benefits, and proactive pollution prevention and risk management pertaining to health, safety and the environment.

Devon is committed to conducting all of its activities in a manner that will safeguard the health and safety of its employees and the public, and will preserve the quality of the environment for future generations, consistent with its corporate, social and environmental policies. As part of that commitment, Devon has systematically engaged the input and advice of public stakeholders and regulators throughout the Program planning and assessment process (Section 4: Public Engagement and Consultation).

2 Project Description

Devon recently conducted 3D seismic programs (2002–2003) that identified potential hydrocarbon deposits in Exploration Licence (EL) 420. Its proposed Program will permit further evaluation of these potential reservoirs, as well as meeting the requirements of the licence.

In designing the Program, Devon systematically considered optional approaches to achieving the Program objectives as follows:

- alternatives to the Program
- drilling season alternatives
- drilling platform alternatives
- wellsite location alternatives
- waste management alternatives
- well control alternatives
- logistical support alternatives

The rationale for selected options and resulting Program design are described below.

2.1 Alternatives to the Program

Devon is planning to commence the drilling program during the winter season of 2005–2006. Under the terms of the exploration license for EL 420, failure to complete a well in an area (A, B, C or D) will result in the termination of the licence for that specific area, with the rights reverting back to the federal government. While there are alternative means to carry out the drilling program (Sections 2.2 to 2.8), there are no alternatives to the Program that would fulfill the requirements of the exploration licence.

2.2 Drilling Season Alternatives

The Program is based on drilling exploration wells during the winter within the landfast ice zone. The winter drilling season typically lasts from 120 to 150 days and operations are relatively independent of weather conditions during this period. By drilling in the landfast ice zone, Devon will be operating in a stable, well understood setting. The longer, more dependable winter drilling season should permit Devon to effectively drill and evaluate any of its potential drill targets.

Direct environmental benefits of drilling during the winter in the landfast ice zone include:

- minimal overlap with the migratory fish, bird and mammal populations that normally use the area during summer
- minimal overlap with Inuvialuit hunting activities
- in the unlikely event of an accidental spill, more efficient and effective containment and recovery of potential accidental spills on the ice surface is possible compared to an open-water environment or broken/moving ice

Drilling will only be conducted within the landfast ice zone. If the landfast ice does not develop sufficiently at a proposed wellsite during any one year, drilling at the site would be postponed to another year.

2.3 Drilling Platform System Alternatives

Because the water depths are relatively shallow within EL 420, bottom-founded drilling platforms will need to be used. These fall into two categories:

- dredge-supported – platforms requiring dredging for seabed preparation and the construction of the drilling platform
- self-supported – platforms that are set directly on the seabed and require minimal or no dredging

Platform alternatives were compared based on technical suitability, use of existing infrastructure, reduction of environmental impact and cost effectiveness. In general terms, dredge-supported systems were found to be less suitable than self-supported platforms, specifically:

- the disturbance footprint of dredge-supported platforms is significantly larger than equivalent self-supported system alternatives because the footprint includes the platform base as well as the source area for the dredged materials
- the dredge-supported structures require additional time and cost to install and dismantle, thereby increasing the potential for conflicts with environmentally sensitive periods or delays due to inclement weather and summer ice incursions
- requirements for ocean-going dredging equipment and ice-reinforced support vessels can add significant costs to the drilling Program
- existing dredge supported platforms available for use in the Beaufort Sea require repair and have design problems that increase costs and reduce their technical suitability

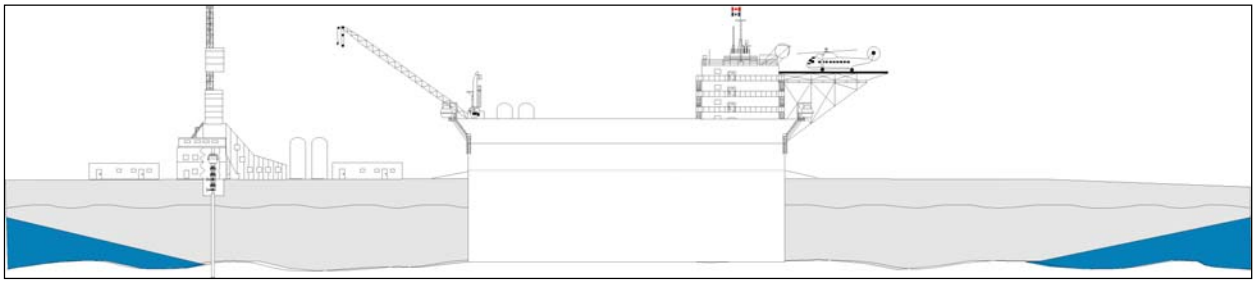
As a result, Devon will use a self-supporting drilling platform system and is considering three optional drilling platforms (Figure 2-1) for use on EL 420:

1. **Steel Drilling Caisson** (SDC) – a former crude oil tanker that has been converted into a certified mobile arctic drilling platform and has previously been used successfully to drill exploration wells in the Beaufort Sea. The SDC has room for consumables storage and is fitted with personnel accommodations. It has a special steel base, referred to as the MAT, which allows it to be set directly on the sea floor. A grounded ice pad would be constructed adjacent to the platform to increase sliding resistance and to provide a platform for a relief well rig, if necessary. The SDC is presently stored in Herschel Basin.
2. **Landfast Tender-assist Drill Unit** (LTD) – an ice-strengthened steel caisson with a crane, consumables storage and personnel accommodations. The LTD would be set directly on the sea floor and would be used as an operating base from which to construct a grounded ice pad. Once the ice pad is complete, a ‘land rig’, stored on the LTD, would then be lowered to the ice to drill the well. The LTD would be a custom-built structure that would be towed into the Beaufort Sea.

3. **Ice Island** – a constructed, grounded ice pad used as a drilling platform. Equipment and materials required for constructing the ice island and for drilling and testing activities would be transported by barge during the open-water season to an intermediate sheltered staging area and then transported to the drill site during the winter by ice road after the landfast ice has formed. Alternatively, Hercules air support or heavy-lift helicopters might be used to transport equipment and consumables from either the barge staging site or an existing staging facility (e.g., Swimming Point, Inuvik), as well as to transport equipment back to either of these sites at the end of each winter drilling season.

Steel Drilling Caisson

Ice Island



Landfast Tender-Assist Drilling Platform

Figure 2-1 Drilling Platform Types for the Devon Beaufort Sea Exploration Drilling Program

The general characteristics of the drilling platform options under consideration are summarized in Table 2-1. Because all three platform system options are under active consideration by Devon, all are assessed in this report. The SDC is assessed as the base-case option and any different effects associated with the other options are identified.

Table 2-1 Summary of Platform System Characteristics

Characteristics	SDC	LTD	Ice Island
Caisson footprint	162 m x 110 m	48 m x 64 m	None
Grounded ice pad footprint[1]	260 m x 320 m	~350 m in diameter	~316 m in diameter
Operating depth	7. 6–24 m	6–13 m	0–8+ m
Ice road footprint	0	0	43 km x 10 m (on landfast ice)
Substrate preparation	None	None	None
Potential length of drilling season (approx.)	Four months	Three months	Two months
Bulk resupply requirements	• Annual barge shipment	• Infrequent – Years 1 and 2 • Barge supply – Years 3 and 4	• Annual barge shipments to staging area
Air support	• Regular helicopter and/or fixed wing flights and 6 Hercules flights2	• Regular helicopter and/or fixed wing flights and 6 Hercules flights[2]	• Regular helicopter and/or fixed wing flights and up to 150 Hercules or heavy-lift helicopter flights[2]
Support vessels	• One 16,000–24,000 hp vessel; two 7000–8000 hp vessels	• Two 5000 hp vessels	• None
Ancillary onshore facilities	• Supply storage • Accommodation for crew changes	• Supply storage – Years 3 and 4 • Accommodation for crew changes	• Supply storage • Staging area • Accommodation for crew changes
Limitations	• Upgrading required	• Lead time for construction and transport of LTD to the Program area • Lead time required for construction of ice pad shortens drilling season	• Lead time for construction of ice road and ice island results in shortest potential drilling season; use of Hercules or heavy-lift helicopters would extend the season

Notes: 1 All dimensions are nominal
2 Cat trains may be used to reduce some Hercules flights

2.4 Wellsite Location Alternatives

Devon has identified nine potential offshore drilling locations within the landfast ice zone of EL 420 (Figure 1-1). A tenth drilling location that may be considered is located on an island in Mason Bay (Kidluit site). This CS Report addresses only the nine potential offshore drilling locations.

Water depths at the nine offshore locations range from 6.8 m to 12.2 m and the average drilling depth is approximately 3500 m. For geological reasons, the current preferred location for the first wellsite is in the Western Block.

The primary targets identified in the Western Block are:

- Paktoa/Tiggak (Area D)
- Nipterk North (Area C)

Because Devon is continually refining its subsurface geological interpretation, refinements and changes on exact drilling locations and drilling methods will continue to occur until the time that the well is drilled. Devon will continue to update regulatory and Inuvialuit stakeholders with respect to changes to the Program.

To ensure that the CS Report addresses the full range of potential environmental effects associated with exploration drilling in EL 420 and adjacent areas, all nine potential offshore drill sites have been considered in the impact assessment. Drilling at the Paktoa drill site was used as the focus for Year 1 of the Program (i.e., the base project case). For the remaining three years of the Program, differences in the effects between the drilling Program at Paktoa and the other eight potential offshore sites are assessed. This approach provides Devon with flexibility in selecting the final specific location of offshore drill sites, based on detailed seismic data and geotechnical analyses, while ensuring appropriate environmental effects management at all sites.

Although Devon has discussed the tenth drilling location at Kidluit (on land) in the community consultations, it is not within the scope of the Comprehensive Study. If Devon decides to conduct exploration drilling at this site, Devon will submit an environmental assessment and supplemental information to the EISC and the NEB. Devon also would inform communities about the Kidluit program and would implement appropriate opportunities for community engagement and consultation.

2.5 Drilling Waste Management Alternatives

Devon proposes to use a water-based potassium chloride (KCl) drilling mud system instead of either synthetic or oil-based muds. The final selection of drill muds and mud additives will be based on the well depth, profile and location. Where any drilling mud additives are required, they will be selected in accordance with the *Guidelines Respecting the Selection of Chemicals Intended to be Used in Conjunction With Offshore Drilling and Production Activities on Frontier Lands* (NEB et al. 1999).

Devon compared five potential drilling waste disposal methods that are suitable for water-based KCl drilling muds: onshore sump, landfill, downhole re-injection, on-ice disposal and under-ice disposal. The alternatives were compared on the basis of technical feasibility, safety considerations, regulatory certainty, operational and logistical considerations, cost and potential environmental and socio-economic impacts (For further details refer to the TA Report (KAVIK-AXYS Inc. 2004b). Under-ice disposal was selected as the preferred method for the following reasons:

- regulatory certainty - this method has been accepted by regulatory authorities (NEB et al. 2002) as a suitable method for offshore drilling operations
- minimal handling of drilling wastes
- reduced associated costs and management risks
- ability to complete the disposal of drilling wastes during the winter drilling season, thereby limiting the time frame for potential effects
- biophysical effects can be closely controlled as part of operational procedures, such as dilution of wastes with sea water prior to discharge and under-ice dispersion

Under-ice disposal consists of discharging inert drill cuttings and spent drilling mud below the ice, using an insulated pipeline. Devon will develop a drilling mud testing program, which will include testing mud constituents prior to use, in accordance with Environment Canada test parameters identified in the *Offshore Waste Treatment Guidelines* (NEB et al. 2002). Devon will also test representative samples of the drilling waste stream (mud and cuttings). The testing and sampling protocol will be developed in consultation with the NEB and Environment Canada.

The drilling waste will be mixed with other liquid wastes from operational activities (i.e., treated sewage, grey water, desalination brine from the drinking water treatment system and miscellaneous wash water). Sea water will be used to dilute the waste stream by a minimum of 15:1 before being discharged. The pipe location, diameter, angle under the ice and discharge rate will be designed to ensure a minimum of a further 100-fold dilution of the waste discharge stream within 10 metres of the point of discharge. Natural sedimentation and ice scouring will help to combine, cover and mix the drill cuttings and drilling muds with natural sediments.

The drill rig will be equipped with a solids control system that will allow recycling of the drilling mud, minimize water consumption during drilling and reduce the final volume of drill mud requiring disposal. All disposals of fluids will comply with the *Offshore Waste Treatment Guidelines* (NEB et al. 2002) and the *Canada Oil and Gas Drilling Regulations* (Government of Canada 2003a, Internet site). Section 11: Chemical Oceanography provides further details on waste management and its effects on the receiving environment.

As part of the DPA process, Devon will develop a Waste Management Plan for drilling that will describe:

- specific waste streams
- specific waste disposal techniques
- waste minimization methods
- methods of minimizing potential impacts from waste production
- waste manifest recording

Devon will engage relevant stakeholders in the development of the Waste Management Plan and will design the plan to comply with pertinent guidelines and legislation. Opportunities for reduction, recycling and reuse of products will be identified during the planning process, and any new waste treatment technologies that are proven to be technically and economically feasible will be considered as they become available (e.g., advanced sewage treatment processes).

2.6 Well Control Alternatives

It is the policy of the Government of Canada that an offshore operator not drill into a potentially hydrocarbon-bearing zone (the risk threshold) without the ability to drill a relief well in the same season, as a means to respond to a possible blowout. The *End of Risk Drilling Season Guidelines* (ERDS Guidelines) (Beaufort Sea Steering Committee 1991) provides a protocol for determining the latest date that drilling can occur while still providing relief well capability. Devon will follow these guidelines in determining its drilling schedule.

Devon's current strategy is to build an ice pad adjacent to the drill platform. If required, the ice pad would be used to drill a conventional relief well with a

separate drilling rig. The Program schedule incorporates the latest drilling date that would allow time to mobilize a relief well rig to the drill site, erect the drill rig, complete the relief well, bring the well under control and complete a site cleanup prior to the end of the ice season, in keeping with the ERDS Guidelines.

Depending on the specific conditions of the well, the ERDS date for completion of drilling generally would range from mid- to late April. Well testing activities and site demobilization activities can continue beyond the ERDS completion date.

Project-specific emergency response procedures and a spill contingency plan will be developed for the Program as part of the DPA process.

Devon is also developing new technology, known as the Alternative Well Kill (AWK) system, which consists of a super shear and seal blowout prevention (BOP) system. Once the AWK system has been constructed and tested to the satisfaction of NEB, Devon intends to use this new technology as a replacement for a conventional relief well. The AWK system would also allow Devon to extend the active drilling period compared to that available under a relief well scenario. This new system would provide the same capabilities as a standard BOP, but also allows any obstruction in the hole to be cut while simultaneously achieving a seal. Once the AWK system has been activated, heavy fluids are pumped down the hole to 'kill' the well.

For the purpose of this Comprehensive Study, the drilling Program does not include the use of the AWK system. The proposed drilling Program is based on the use of conventional well control alternatives, including the use of a relief well on the ice pad adjacent to the main drilling platform. However, if the AWK system were to be used, it would not substantially alter any of the impact predictions in the assessment for routine operations.

2.7 Logistical Support Alternatives

2.7.1 Onshore Logistical Support

Limited shore-based transportation infrastructure and services will be required to meet staging and support requirements for the Program. The two potential centres for onshore logistical support are Inuvik and Tuktoyaktuk.

Requirements for onshore support logistics include:

- air shipment and temporary storage of bulk supplies (e.g., drilling supplies, fuel, camp provisions) and supplies for a relief well, if needed
- helicopter and Twin Otter support for crew changes and small supply shipments during mobilization and operation
- marine shipping and barging facilities
- large supply aircraft such as Hercules transport aircraft or heavy-lift helicopters
- regular commercial flights for personnel
- short-term accommodations (i.e., overnight in the event of bad weather) for personnel prior to flying to the drill site or to southern destinations
- waste handling, storage and disposal

In the event of inclement weather, temporary personnel accommodation will be required onshore. A variety of commercial accommodations is available in Inuvik and Tuktoyaktuk that can meet the needs of the Program. It is not necessary to maintain a camp for intermittent use because appropriate camp accommodations will be provided at the drilling location.

While Inuvik and Tuktoyaktuk would be suitable for limited logistical support facilities, the choice of these two sites will depend on the drill location. Inuvik is strategically located with respect to the Western Block. Most of the required goods will have to be shipped through Inuvik (i.e., using the Dempster Highway or on barges from Hay River). Inuvik also has regular scheduled commercial flights from Edmonton and Calgary, making it more adaptable to Program activities. During drilling in the Eastern Block, Tuktoyaktuk could be a more suitable location for many staging activities, particularly if an ice island platform is used. Staging construction materials and supplies at Tuktoyaktuk could reduce the length of the new ice road that would need to be constructed, and the distance for barge transport of supplies and equipment would be reduced.

The choice of Inuvik or Tuktoyaktuk for onshore logistical support for each year of the Program will be made after the final drilling locations are confirmed. The decision to stage equipment and personnel at either or both locations would be based on the type of facilities available and proximity to the drill site.

For this assessment, it is assumed that onshore support facilities will be based in Inuvik, with some logistical support provided from Tuktoyaktuk for drilling in the Eastern Block. The assessment of effects indicates different effects associated with use of Inuvik and Tuktoyaktuk as staging areas, where relevant.

2.7.2 Equipment Staging

If an ice island platform is used, equipment and supplies for the drilling season could be moved by barge from Inuvik to a barge staging area near one of the natural islands close to the drill site. All the barge staging activities would remain offshore; no onshore activities will be required. Alternatively, it may be feasible to transport the ice construction equipment by winter road directly from Tuktoyaktuk or by airlift between Inuvik or an alternate staging area (e.g., Swimming Point) using Hercules or heavy-lift helicopters, thereby foregoing the summer barge support.

If a barge staging area is required, Devon will conduct an assessment of possible locations, taking into account a range of operational, economic, environmental and social factors prior to the summer mobilization of the barges. Devon would inform communities about the barge staging options and would implement appropriate opportunities for community engagement and consultation. Reconnaissance surveys of the preferred site(s) would be conducted prior to their use to ensure that coastal conditions (e.g., shoreline processes and erosion, bathymetry, currents) are suitable for a staging area.

2.8 Other Program Facilities and Infrastructure

2.8.1 Fuel and Chemical Storage

Diesel is the primary fuel for all three platform systems, although storage of limited quantities of gasoline, propane and aviation fuel will also be required. Fuel storage tanks on all platform systems will be equipped with fuel transfer fittings to prevent spillage and secondary containment capable of containing 110 percent of the capacity of each tank. For all platform options, fuel barges will likely be used for fuel resupply. Fuel would be transferred directly from the fuel barge to the onboard storage facilities for the SDC and LTD options or trucked from the barge staging area to the drill site for the ice island option. Devon has a comprehensive Frontier Emergency Management Plan (FEMP) and spill prevention and response procedures pertaining to fuel storage and handling.

Bulk consumables and products, which will be used during the Program and stored at the platform, include KCl drilling muds and well treatment fluids. All liquid hazardous products, similar to fuel, will be stored with drainage secondary containment to prevent any uncontrolled releases.

2.8.2 Water Supply

Water is required for ice pad and ice road construction, potable supplies for the camp, drilling mud and well testing and completion. Untreated sea water will be used for most construction and drilling applications and will be pumped from under the sea ice. A reverse osmosis water system will be used at all platform systems for the production of potable water from sea water. The brine by-product will be disposed under the ice using the insulated pipeline.

2.8.3 Other Waste Management

Solid waste includes combustible materials as well as inert waste that cannot be burned or re-used on-site. Combustible wastes will be incinerated on-site and the ash removed to an appropriate onshore landfill facility (e.g., Inuvik landfill) along with any other inert wastes. The incinerator ash will be analyzed to ensure that it is below the criteria for hazardous waste.

Black water and grey water will be handled and treated to comply with the *Offshore Waste Treatment Guidelines* (NEB et al. 2002). The macerated sewage and grey water will be discharged into the ocean under the ice. Biodegradable and environmentally safe products will be used where possible.

The SDC and LTD platforms are equipped with oil/water separators for treatment of water. Devon will ensure that discharged ballast water does not contain any detrimental waste substances that exceed guidelines and that discharge will comply with the *Arctic Waters Pollution Prevention Act* and the *Offshore Waste Treatment Guidelines*.

Used oil, oil filters and other oily waste (e.g., rags) will be handled according to the *Used Oil and Waste Fuel Management Regulations* (GNWT 2003) and other applicable guidelines and legislation (e.g., NEB et al. 2002). All of these products will be brought to shore for approved disposal or incinerated on-site, as applicable.

2.9 Program Activities

Program activities have been categorized into three main phases:

1. **Pre-operations** – This phase includes supplying and mobilizing the SDC or LTD platform to EL 420. Three towing vessels, including one 16,000 to 24,000 hp vessel, would be required to move the SDC from the current storage site at Herschel Island to EL 420. The LTD, which is lighter, could be towed with fewer or lower powered vessels, with the exception of the first year when it would be towed into the Beaufort Sea from the fabrication site. Pre-operations activities for the ice island potentially involve barge staging of construction materials and supplies at a sheltered moorage near the drill site.

   All platforms will be supplied by barge. The ice island platform would require the most supply barge support (up to 15 barges). Requirements for the SDC and LTD (three to six barges) would vary from year to year, based on requirements for resupply.

   The pre-operations phase extends into the winter period with the construction of ice pads, which are required for each of the three platform systems under consideration.

   All platforms will require air support during the pre-operations phase, including periodic helicopter flights and smaller fixed-wing support for personnel and small supplies. In addition, Hercules transport aircraft or heavy-lift helicopter may be used to transport rental equipment to the site after an airstrip is constructed. In the case of the ice island platform, a Hercules transport aircraft or heavy-lift helicopter may also be used to move drilling equipment, camp facilities and consumables to and from the drill site.

   Factors that could affect the environment during the pre-operations phase include:

   - noise and air emissions from marine vessels, aircraft and platform generators
   - disposal of desalination brine, treated sewage and grey water from marine vessels to the sea
   - noise and air emissions from vehicles and construction equipment during ice pad and drill site construction

2. **Operations** – This phase includes drilling and testing and subsequent platform shutdown and standby prior to mobilization to the next drilling location during the following open-water season. Drilling could commence in late December in the case of the SDC or as late as early March in the case of the ice island platform. The testing period could extend into May or June.

   Drilling operations will be similar regardless of the platform type adopted. These operations generally involve the drilling of the initial surface hole and installation of a blowout prevention (BOP) device, drilling of well sections and the final well profile. Cuttings are continuously monitored to characterize the rock formations and look for indicators of hydrocarbons. If hydrocarbons are detected during drilling, flow testing may be conducted to provide data to estimate the size of the reservoir and determine whether additional delineation wells will be needed in the future. Upon completion of drilling and testing, the

well will be permanently plugged and abandoned, using a combination of cement plugs and mechanical 'bridge' plugs.

Factors that could affect the environment during the operations phase include:

- noise and air emissions from generators, drilling equipment, vehicles and, if gas is discovered, flaring
- disposal of drilling cuttings and fluids and desalination brine under the ice
- disposal of treated sewage and grey water under the ice
- incineration and storage of solid wastes for later disposal at an approved landfill
- periodic aircraft support

Once the well has been tested and evaluated, equipment will be removed from the ice surface and stored on board the SDC or LTD. In the case of the ice island, the equipment will be transported (by truck or cat train) back to the barge staging site, Inuvik, or airlifted using Hercules transport aircraft or heavy-lift helicopters to the barge site, Inuvik or an alternate staging area (e.g., Swimming Point). The cat train would travel over the ice to the existing ice road between Tuktoyaktuk and Inuvik. After all equipment is stored or removed from the sites, the platform or barge staging site would be secured for cold shutdown until remobilization to the next drilling location the following August.

3. **Closure** - At the end of the Program, there will be no further activities or Program infrastructure remaining in the Program area. If either the SDC or LTD platform systems is used, there are several options at closure:

   - continued use on EL 420
   - deployment to other exploration licences or other offshore areas (e.g., Alaska)
   - storage in an appropriate harbour location within the Beaufort Sea region

   If storage is required, Devon will select a preferred location by taking into account operational requirements for the storage area, as well as biophysical and social factors. An assessment of possible storage sites within the Beaufort Sea region will be conducted and appropriate government agencies and the communities will be consulted. A federal permit would be required for storage of the SDC or LTD; therefore, Devon would file an application and an environmental impact assessment for the preferred location to the EISC.

2.10 Program Schedule

The Program schedule varies with the drilling platform system used. Timing of activities is also influenced by constraints imposed by ice and weather conditions, sensitive biological periods and traditional use activities. The overall window for Program activities is similar for all platforms, commencing with mobilization to EL 420 in late August and shut down prior to breakup in June. Table 2-2 provides a summary of the timing for the key phases of program activities. The main difference in platform systems is the lead time required to construct ice pads, the start date for drilling and the resulting time window for drilling and testing.

Table 2-2 Timing of Key Phases of Program Activities

Activity	Timing
Platform/equipment mobilization	August[1]
Ice pad construction	November to February[2]
Drilling (below risk threshold)	Late December to March[3]
Testing	April to June[4]
Shutdown	June

Notes:
1 Towing of the SDC would occur in late August. The LTD would be towed from the Pacific Ocean and through the western portion of the Beaufort Sea in early August, arriving at EL 420 in late August.
2 Ice pad construction could commence in November for the SDC and LTD. Ice pad construction for the ice island will depend on the drill site location and time required to build the ice road to the drill site or an aircraft landing area, prior to the commencement of ice pad construction. Ice island construction at Paktoa would probably commence in mid-January and take about 40 days.
3 Drilling could commence by late December with the SDC, February with the LTD or early March with the ice island. In all cases, drilling would be complete by mid-April to address ERDS requirements for relief well contingencies.
4 Timing of testing will depend on the duration and findings of the drilling Program, but could extend into June, particularly with the ice island.

The SDC requires the smallest ice pad (for sliding resistance and relief well deployment only) and affords the earliest potential start date for drilling and the longest potential drilling and testing window. The LTD requires a more extensive ice pad (for deployment of both the exploration rig and a relief well) and a slightly longer period for ice pad construction. The ice island requires construction of an ice road from the equipment staging area to the drill site or a landing area for Hercules transport aircraft or heavy-lift helicopters, followed by construction of the ice pad and exploration wellsite and camp. It has the longest lead time prior to the start of drilling. Therefore, it has the shortest window for drilling and testing.

2.11 Program Costs

Devon's budgeted annual expenditures for the Program will depend on the drilling platform system selected and other factors, but the costs could be C$80 million per year (SDC option). Devon's current estimates of expenditures for Year 1 of the Program, along with estimates of the expenditures that may be made in the Northwest Territories, are provided in Table 2-3.

2.12 Environmental Management System

2.12.1 Corporate Commitment

Devon's environmental management system will ensure that commitments to environmental protection and management documented in this report are carried out. In addition to its social, economic, and environmental policies and associated responsibility and implementation procedures—which are applicable to all company projects—Devon will implement project and site-specific policies and procedures that address the unique circumstances of the Program.

Table 2-3 Approximate Drilling Program Expenditures in Year 1[a]

Expenditure Category	Total Expenditures (C$ million)	Expenditures within the Northwest Territories (C$ million [rough estimates])
Labour	12.1	2.5
Major equipment	41.7	5.0
Consumables/Supplies	10.9	2.0
Transportation and other services	14.1	4.0
Other including program management, fees and permits	1.2	0.2
Total	80.0	13.7

Notes: Dollar amounts are given in 2004 Canadian dollars
a = Assuming steel drilling caisson platform system

Source: Devon

2.12.2 Regulatory Compliance

Devon will meet the requirements of all applicable environmental acts, regulations and licensing and permitting conditions, and will strive to improve its performance in the area of environmental protection and management. Devon is familiar with the northern regulatory environment through management of its arctic onshore and offshore seismic programs and onshore drilling programs. In the course of this work, the company has developed an excellent record of regulatory compliance, incident reporting and responsiveness to regulatory and community concerns.

2.12.3 Safety and Environmental Plans

For Devon's Program, a number of plans are required to comply with existing legislation and guidelines: a safety plan, an emergency response plan, a relief well plan and the spill response plan. In general, these plans outline a systematic approach to safety and environmental management and define procedures for responding to emergency situations.

In addition, Devon has committed to developing a series of voluntary environmental protection plans (EPP): wildlife protection plans, a waste management plan, a communication plan and an environmental effects monitoring plan. Developing these plans with stakeholder involvement (i.e., Inuvialuit organizations, federal and territorial agencies, federal responsible authorities) will provide stakeholders with an improved understanding of the project, as well as providing Devon with suggestions that may improve its environmental performance.

2.12.4 Management Structure and Responsibilities

Key roles and responsibilities for implementation of the Environmental Management System (EMS) are described below.

- **Project Manager** - Devon's Project Manager is ultimately responsible for Program implementation in accordance with the commitments of this report. The Project Manager will ensure that staff and contractors are aware of, and agree to carry out, the environmental protection and management commitments of this report.

- **Environmental, Regulatory and Community Relations Manager** - Devon's Project Environmental Manager will report to the Project Manager and ensure that appropriate mechanisms are in place to address environmental protection and management commitments on-site (e.g., EPP orientation, reporting, communications protocols).
- **Drilling Program Supervisor** - Devon's on-site Drilling Program Supervisor will hold regular site meetings to review activities and performance, including environmental performance. The Drilling Program Supervisor will communicate regularly with the environmental monitor to review the status of operations and ensure that the environmental and wildlife monitors are aware of all upcoming activities in advance.
- **Environmental Monitor** - To ensure the Program is implemented in accordance with Devon's policies and standards and program-specific commitments as documented in the EPP, there will be a full-time, qualified Inuvialuit environmental monitor on-site. The environmental monitor will report to the on-site Drilling Program Supervisor and will work closely with the wildlife monitor.
- **Wildlife Monitor** – An Inuvialuit wildlife monitor, with knowledge of the local area, will be on-site to monitor wildlife near the platform and ensure implementation of mitigation measures to reduce interactions between wildlife and crews or equipment, consistent with EPP commitments and agreements with the HTCs and co-management agencies. The wildlife monitor will report directly to the Drilling Program Supervisor and work closely with the environmental monitor.

2.12.5 Training, Awareness and Competence

Prior to commencement of Program activities, Devon will ensure that environmental issues and associated management and mitigation measures are effectively communicated to all individuals with responsibilities for environmental performance. Mechanisms for communicating these issues and measures will include:

- provision of the EPP as part of contract specifications
- pre-job orientation to the contents of the EPP
- on-site orientation meetings prior to commencement of key phases of Program activities and specific high-risk activities, including a review of environmental protection and management measures

In keeping with its Aboriginal Relations Policy, Devon will provide all employees and contractors' representatives with a cross-cultural awareness session prior to commencement of job activities, to support cross-cultural respect among workers.

2.12.6 Monitoring and Corrective Action

During the Program, Devon will check and report on compliance of Program activities with all requirements in the EPP and assess the effectiveness of mitigation measures. Non-compliance will be reported immediately to the Drilling Program Supervisor, the Environmental Manager and regulatory and co-management agencies as required, and steps taken to resolve the issue.

3 Project Setting

EL 420 is located in the shallow waters of the continental shelf in the Beaufort Sea, north of the Mackenzie River Delta. The western portion of EL 420 lies off Beluga Bay to the west of Richards Island and overlaps part of Pelly Island (Section 1: Introduction, Figure 1-1). The eastern portion is at the mouth of Kugmallit Bay and overlaps part of the northeast coast of Richards Island. The surrounding terrain is flat. High sediment loads from the Mackenzie River, slow current speeds, small tidal variations, discontinuous permafrost, variable sea ice cover and seabed ice scouring characterize the aquatic environment.

The weather in the southern Beaufort Sea can be extreme and is an important factor in Program planning. Winters are characterized by extremely low temperatures, landfast sea ice cover and short daylight hours. Summers are milder with open-water conditions and long hours of daylight. However, periods of poor visibility, storm waves and pack ice intrusions can occur. Freeze-up begins in early to mid-October, and the outer edge of the landfast ice stabilizes beyond the location of Devon's nine potential offshore drill sites by mid-December to mid-January. Spring breakup occurs from mid-June to early July. By late July, EL 420 is generally clear of ice. The open-water season extends from mid-July to mid-October, although strong northerly winds can move pack ice into nearshore waters during this time.

The diversity and abundance of aquatic life in EL 420 are affected by variations in salinity and water temperature associated with the Mackenzie River outflow. The relatively warm, brackish water of the nearshore area of the coast provides excellent feeding habitat for freshwater, anadromous1, and marine fish species. Freshwater and anadromous fish overwinter in coastal rivers and estuaries from January to June, while marine species typically move into deeper offshore waters during this period.

The Mackenzie River Delta Key Migratory Bird Habitat Site encompasses the Kendall Island Migratory Bird Sanctuary, Pelly Island and parts of Richards Island, and overlaps with EL 420 at Pelly Island. An International Biological Program site, recognized as important habitat for nesting waterfowl and small mammals, encompasses both Garry and Pelly Islands. Important marine mammals that are frequently present in the licence area at specific times of the year include beluga and bowhead whales, ringed seals, bearded seals and polar bears.

EL 420 falls within the Aklavik, Inuvik and Tuktoyaktuk Conservation Planning Areas. Tuktoyaktuk, located 20 km from the southeast corner of EL 420, is the closest settlement. Inuvik and Aklavik are approximately 120 to 140 km to the southeast of the western portion of EL 420. The community of Inuvik includes many Inuvialuit and Gwich'in, as well as non-Aboriginal residents. Aklavik's population is primarily Gwich'in and Inuvialuit. Tuktoyaktuk's population is mainly Inuvialuit. Almost half the population in the general area of the Program lives in Inuvik. Winter ice roads connect Tuktoyaktuk and Aklavik with Inuvik, and Tuktoyaktuk has a port facility.

1 Dwelling in marine and fresh water at different times during its life cycle

Hunting of beluga whales, polar bears, ringed seals, Arctic fox, fish and waterfowl are important traditional activities in the Program area. Small, isolated hunting and fishing camps are scattered throughout the Mackenzie Delta. The eastern portion of EL 420 overlaps Beluga Management Zone 1A, and the remainder of the exploration licence area is located within Beluga Management Zone 2. The Beaufort Sea Integrated Management Planning Initiative (BSIMPI) has proposed a marine protected area (MPA), referred to as the Tarium Niryutait Marine Protected Area, comprising the Beluga 1A zone in the Mackenzie Delta (Fisheries and Oceans Canada 2002). Portions of this proposed MPA are located directly to the south of Areas B and C of EL 420.

Commercial development in the area is limited to tourism, sports hunting and fishing and marine, air and road transportation service. There are several local tourism companies that operate in the Mackenzie Delta area, and a few run tours near EL 420. Sport fishing occurs more commonly to the south and along river channels than near EL 420. Target species for guided hunters in the region include polar bear, muskox, grizzly bear and barren-ground caribou. Of these, polar bears are most likely to be hunted within and around EL 420. Eight privately owned companies provide air transportation services near EL 420, including basic supply or charter services for government, industry and locals.

During the 1970s and 1980s there was substantial onshore and offshore oil and gas exploration in the Mackenzie River Delta and Canadian Beaufort Sea. At present, the only current industrial production in the region is the Ikhil project, a single gas well that supplies natural gas to the town of Inuvik. The largest potential future development in the region is the Mackenzie Gas Project. In conjunction with the proposed gas pipeline, a number of other operators have initiated exploration programs for natural gas in the Mackenzie Delta and parts of the Tuktoyaktuk Peninsula.

4 Public Engagement and Consultation

Devon is committed to being a responsible member of the communities in which it operates. Devon recognizes the importance of consistent and transparent communications with local communities, federal and territorial agencies, Inuvialuit organizations and a full spectrum of other stakeholders. Devon is committed to:

- provide the public with information on the nature of the Program, the planning and approvals process, baseline studies and conditions, potential effects on communities and the natural environment, community involvement activities and mechanisms for community members to participate in the planning process
- understand the views of local people on Program activities, specific concerns they would like to have addressed, information relevant to the Program planning and impact assessment processes, and their opinions of the impact assessment findings and proposed mitigation measures
- improve Program planning and environmental assessment by integrating local and traditional knowledge and ideas in the Program decision-making process
- improve Program planning and environmental assessment by integrating the knowledge and advice of federal and territorial agencies and Inuvialuit organizations and members of the scientific community

Devon has developed a phased public engagement and consultation approach linked to the progressive planning and assessment of the Program:

- **Phase I: Preliminary Contacts and Stakeholder Communications –** Commencing in mid-2002, this phase comprised initial meetings or telephone conferences in the ISR, Gwich'in Settlement Area, Yellowknife and Yukon to introduce preliminary Program plans and obtain advice and information on appropriate formats, methods and timing of subsequent consultation. These preliminary meetings and discussions continued through to September 2003.
- **Phase II: Issues Identification and Scoping –** An Issues Identification Workshop was held in Inuvik, September 15–16, 2003 to formally involve 45 community members, resource managers and other stakeholders in identifying and refining socio-economic and environmental issues to be considered in the Comprehensive Study. The impact assessment methods were also reviewed. Issues identification continues until the completion of the Comprehensive Study.
- **Phase III: Environmental and Socio-economic Impact Assessments –** An Impact Assessment Workshop was held in Inuvik, February 10–11, 2004. Seventy community and agency representatives reviewed the preliminary findings of the impact assessment, including predicted impacts and mitigation. The participants provided input to Devon on the findings and adequacy of the proposed mitigation measures.
- **Phase IV: Impact Management –** This phase began in early 2004 and will continue throughout the regulatory review and approvals process for the Program, including the application for a DPA and an ADW. During this phase, local communities, federal and territorial agencies, Inuvialuit organizations and other appropriate stakeholders will be involved in the review and development

of specific approaches and recommendations for managing environmental and socio-economic impacts. Where appropriate, key stakeholders will be consulted in the development of the following aspects:

- a safety plan
- a relief well plan
- an emergency response plan
- a waste management plan
- an oil spill contingency plan
- environmental protection plans
- wildlife monitoring protocols
- monitoring programs

Information from this process will be used to support the DPA and ADW applications and the Benefit Plan required by Indian and Northern Affairs Canada. Activities during this phase will be closely coordinated with the development of a wildlife compensation plan.

- **Traditional Knowledge Studies** - In addition to discussions held during the community workshops, studies engaging local elders in the impact assessment were conducted in Inuvik, Tuktoyaktuk and Aklavik (Section 18: Traditional Knowledge and Land Use). Twenty-five to 30 elders, hunters and trappers and community members from each of the communities were engaged to provide information on traditional use values, resources, sites and activities and provide input to the impact assessment and mitigation planning process. Relevant information was provided to the discipline specialists for inclusion in the current impact assessment. A stand-alone report on the traditional knowledge studies for each community will be completed during the summer 2004 (KAVIK-AXYS Inc. 2004c, d, e [in prep]). Following review and comment by each community, copies will be provided to the communities, the federal RAs and agencies and the Inuvialuit organizations.

- **Ongoing Communication –** During the Program operations from 2005 to 2009 and the associated monitoring activities, Devon will continue to communicate and consult with stakeholders in a manner consistent with its corporate policy. Mechanisms will include additional meetings and presentations, continued participation in established regional resource development working groups, media advertising and news releases, newsletters (i.e., *Devon Dispatch*), a toll-free phone number and an e-mail address. In April 2004, public repositories containing hard copies of all Program documents that are on the NEB public registry (e.g., Project Description, TA Report, baseline reports) were established in Inuvik, Tuktoyaktuk and Yellowknife. These documents were also posted on the NEB and the Devon websites.

Based on the consultation activities for the Program during mid-2002 through to 2004, local residents identified a number of key concerns related to the Program, including:

- disturbance of wildlife such as marine mammals and birds during summer operations
- increased potential for polar bear mortality resulting from defence of life and property, which may affect the polar bear quota and sport hunts

- effects of waste management activities and spills on the health of the environment
- access by local people to training and job opportunities, as well as access by local businesses to contracts for the Program

Information from these consultation activities was used in the selection of valued ecosystem components (VECs) and valued social components (VSCs), the identification of the issues to be addressed in the assessment and the conduct of the comprehensive review and impact assessment. Section 5: Impact Assessment Methodology fully discusses VECs and VSCs.

5 Impact Assessment Methodology

5.1 Environmental Effects Assessment

The impact assessment methodology was developed to meet the requirements of a Comprehensive Study under *CEAA*. While it is consistent with federal guidelines for preparation of a Comprehensive Study Report (CEA Agency 1997) and a cumulative effects assessment (CEA Agency 1999), it also meets the requirements of the Inuvialuit Final Agreement (IFA) and associated guidelines for preparation of an environmental impact statement (EISC 2002; EIRB 1994, 2001; Hegmann et al. 2002). Of note, while the *CEAA* only requires a consideration of socio-economic effects that may occur because of a change in the environment, the Inuvialuit process requires a broader consideration of socio-economic effects. Hence, the scope of the socio-economic assessment (Section 17: Socio-economic Conditions) includes aspects required under the *CEAA*, as well as aspects required under the IFA.

The assessment considers all potential effects, but focuses in particular on representative valued ecosystem and social components (VECs and VSCs) that serve as sensitive indicators of Program effects on the ecological and social environment in the Program area. The assessment methodology comprises the following steps:

- **Step 1: Identifying Assessment Scope –** Federal RAs, the CEA Agency, the Inuvialuit Game Council (IGC) and the Joint Secretariat co-management agencies provided initial guidance on the assessment scope. This was refined through reviews of existing information, baseline surveys, traditional knowledge surveys, and interaction with regulators, planning and resource management agencies and community members in the Program area (Section 4: Public Engagement and Consultation; Section 18: Traditional Knowledge and Land Use).

  Baseline studies conducted by Devon in the Program area include:

  - ice and physical oceanography (Wright and KAVIK-AXYS Inc. 2004)
  - coastal processes (AMEC Earth & Environmental Ltd. and KAVIK-AXYS Inc. 2004a)
  - chemical oceanography (KAVIK-AXYS Inc. 2004f)
  - fish, benthos and plankton (North/South Consultants Inc. and KAVIK-AXYS Inc. 2004)
  - birds (LGL Limited environmental research associates and KAVIK-AXYS Inc. 2004a)
  - marine mammals (LGL Limited environmental research associates and KAVIK-AXYS Inc. 2004b)
  - socio-economics (AMEC Earth & Environmental Ltd. and KAVIK-AXYS Inc. 2004b)

VECs and VSCs were selected based on:

- sensitivity to program effects
- importance to local communities and resource users
- national or international importance (including status under the *Species at Risk Act [SARA]*)
- value as an indicator of effects on related resources and broader systems
- importance as an ecological link

The assessment of Program effects on VECs and VSCs provides an indication of Program effects on broader environmental and social conditions. Similarly, mitigation measures for Program effects on VECs and VSCs provide protection for the broader environmental and social systems they represent.

The scope of the Program for impact assessment purposes is defined as follows:

- three potential drilling platform systems:
  - steel drilling caisson (SDC)
  - landfast tender-assist drilling unit (LTD)
  - ice island
- nine potential offshore drilling sites in the Western and Eastern Blocks of EL 420
- up to four winter drilling seasons, beginning in 2005–2006

For the purpose of this report, a base case involving the use of the SDC at the Paktoa site in winter 2005-2006 is assessed in detail, and any differences associated with the other variables (platform systems, drilling locations and years of the Program) are also identified.

- **Step 2: Establishing Assessment Boundaries** – Temporal and spatial assessment boundaries are established and encompassed those periods and areas during, and within which, the VECs or VSCs are likely to interact with, or be influenced by, the Program. Local and regional study areas are defined for each VEC and VSC and are described generally as follows:
  - The local study area (LSA), where Program effects can be predicted with a reasonable degree of accuracy and confidence and impacts are likely to be most concentrated, is generally defined as EL 420 and the area between the Eastern and Western Blocks of the licence area.
  - The regional study area (RSA), where—depending on conditions (e.g., wind and current directions, ice cover, seasonal activities and habitat use)—Program effects may be dispersed more widely. It is generally defined as the landfast ice zone of the Mackenzie Delta, from Herschel Island to the Tuktoyaktuk Peninsula (i.e., McKinley Bay area) and the immediate coastline of the islands and mainland of the Mackenzie Delta. The definition of the RSA may take into consideration factors such as habitat for sensitive life stages, wildlife migration routes and ranges, harvesting areas, areas where there is potential for cumulative effects with other projects and the potential extent of effects resulting from an unlikely

accident such as a blowout. Routes for marine vessel support along the Mackenzie River to Inuvik (Figure 5-1) and east to Davis Strait and west to the Chukchi Sea (Figure 5-2) are also considered.

Temporal boundaries for program-related effects are defined as follows:

- baseline – existing, pre-program conditions
- pre-operations – mobilization and supply of platform systems, construction of ice pads, ice roads and ice airstrips (as applicable) and rig assembly (Section 2: Project Description)
- operations – drilling and testing activities and platform shutdown/standby (Section 2: Project Description)
- closure – post-Program, following completion of the four-year Program

- **Step 3: Evaluating Program-Related Environmental Effects –** Potential effects of routine Program operations, on each VEC or VSC, are evaluated for each Program phase, starting with a base case of the SDC drilling platform at the Paktoa site in Year 1 of the Program. Any different or additional effects associated with the use of the other two platform system options, the eight remaining potential drill sites and the three remaining years of the Program are also identified. Effects of accidents and malfunctions are assessed separately (Section 22: Accidents and Malfunctions), based on defined scenarios. Mitigation measures to avoid or minimize impacts of these interactions on each component are identified, including design standards, environmental protection measures, site-specific measures and contingency measures.

  Residual effects, those that are predicted to persist after recommended mitigation measures, are identified. The residual effects are characterized as fully as possible, based on the direction, magnitude, geographic extent and duration of the effect.

- **Step 4: Identifying the Scope of the Cumulative Effects Assessment –** After the residual program effects are characterized, the potential for these effects to act cumulatively with similar effects from other projects and human activities are assessed. This involves determining whether there were other projects in the vicinity of the Program, including past, present and reasonably foreseeable future projects that may have effects that could combine with the residual Program effects to change the level of effect on the VECs and VSCs. Foreseeable future projects are identified as existing activities known to be ongoing in future years, or new projects that have embarked on a formal approval process.

  If the residual effects of the Program are not found to overlap with similar effects from past, present and reasonably foreseeable future projects, then it is concluded that the Program would not contribute to cumulative effects, and no further analysis of cumulative effects is conducted. The determination of impact significance is then based only on the Program's residual effects (Step 6). If residual effects of the Program are found to overlap with similar effects from other projects, a cumulative effects assessment is completed as described in Step 5.

- **Step 5: Evaluating Cumulative Environmental Effects –** The cumulative effects assessment addresses the question "Will the project contributions to regional cumulative environmental effects have the potential to measurably change the health or sustainability of the resource in question?" In general, because there are currently no offshore projects in an approvals process and few industrial or other human activities occur in the offshore area, no significant cumulative effects on biophysical components of the offshore environment are anticipated. The proposed Mackenzie Gas Project, which has recently commenced a public review process, may overlap in time with the Program and could result in cumulative socio-economic effects with the Program (Section 17: Socio-economic Conditions).
- **Step 6: Determining Significance of Impacts –** The significance of residual impacts and cumulative effects of routine operations on the VECs and VSCs, and their sustainability over time, are characterized using criteria based on the predicted level of effect, documented quantitative thresholds, compatibility with resource management objectives and priorities, and the professional judgment and experience of assessors. While the Program is the first offshore well in the Beaufort to be reviewed under *CEAA*, it is small in scope (i.e., one exploration well per year over four years) with a very small footprint in space and time.
- **Step 7: Monitoring –** Based on the findings of the assessments, requirements for monitoring programs to evaluate the effectiveness of mitigation measures and guide subsequent management actions, are identified as appropriate. As part of the Comprehensive Study process and the subsequent DPA process, Devon will continue to consult with the RAs and the Inuvialuit organizations regarding the need for monitoring programs.

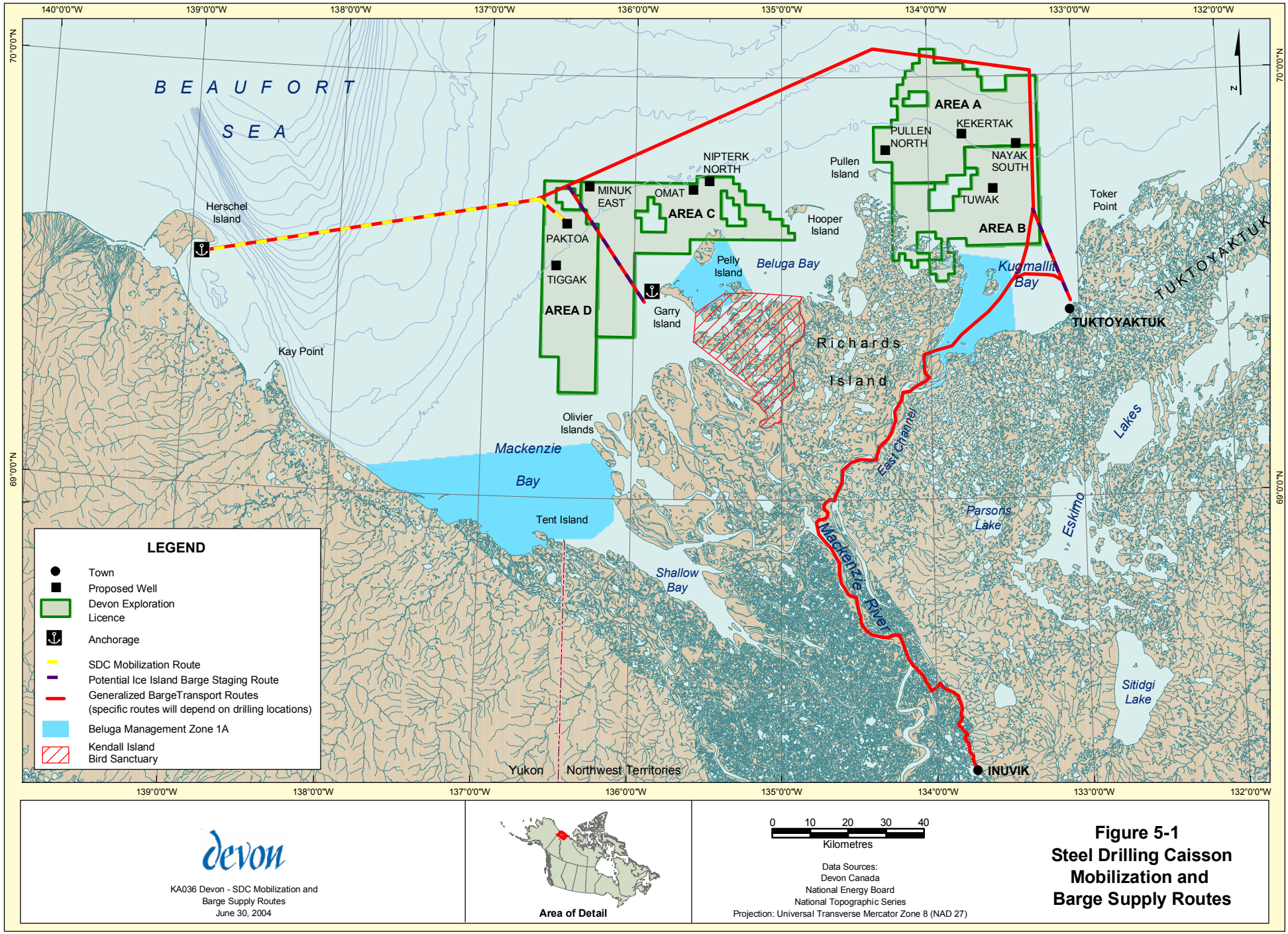
5.2 Species at Risk Act

On June 5, 2004, the federal *Species At Risk Act* (*SARA*) came into force. The National Energy Board has included SARA-related requirements in the recently released NEB Filing Manual (NEB 2004).

All species that are classified as being at risk (i.e., Extirpated, Endangered, Threatened, Special Concern) by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) are addressed under the *SARA*. Species are listed under three different schedules based on the certainty of their status relative to the types of protection afforded under the *SARA*.

At present, only Endangered, Threatened, and Extirpated species (and their residences) listed on Schedule 1 are protected. The status of Schedule 2 and 3 species must be reassessed to attain federal protection (Schedule 1). In essence, Schedules 2 and 3 contain candidate species for protection based on their past status.

SARA species that may potentially be found in the local study area are listed in Table 5-1.



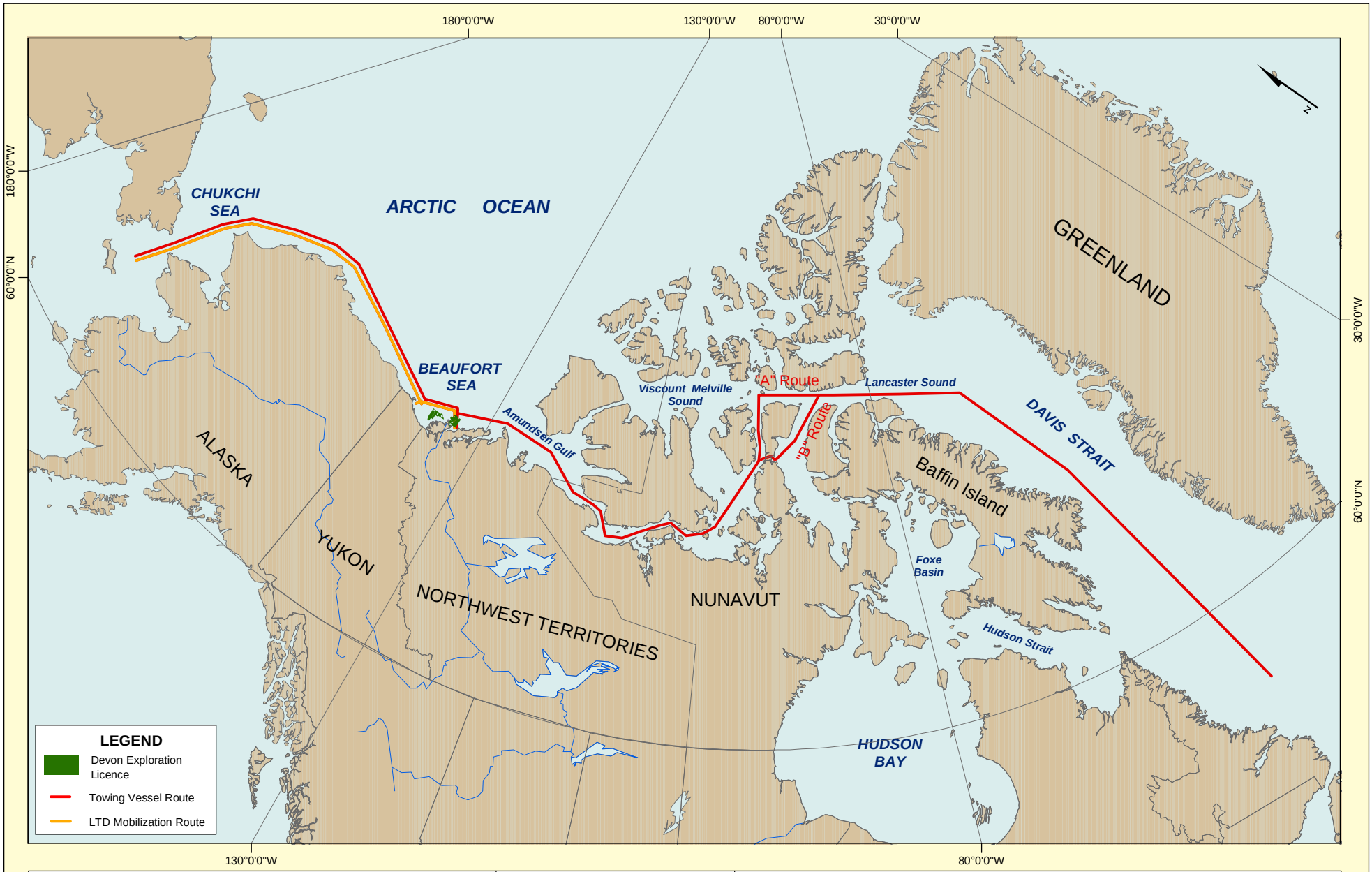
devon

KA036 Devon - SDC Mobilization and Barge Supply Routes
June 30, 2004

Area of Detail

Data Sources:
Devon Canada
National Energy Board
National Topographic Series
Projection: Universal Transverse Mercator Zone 8 (NAD 27)

Figure 5-1
Steel Drilling Caisson Mobilization and Barge Supply Routes



devon

KA036 Devon - Towing Vessel and
Landfast Tender-Assist Drilling Platform
Mobilization Routes to EL 420
August 11, 2004

0 200 400 600 800
Kilometres

Data Sources:
Devon Canada
ESRI
National Topographic Series
Projection: Canada Lambert Conformal Conic

Figure 5-2
Towing Vessel and Landfast Tender-Assist Drilling Platform Mobilization Routes to EL 420

Table 5-1 *SARA*-listed species that may be found in the Regional Study Area[1]

Species	*SARA* Schedule	*SARA* Status
Bowhead whale (Western Arctic population)	2	Endangered
Polar Bear	3[2]	Special Concern
Peregrine Falcon (ssp. tundrius)	3	Special Concern

Note:
1 Based on comparison of species occurrences to the species lists by Environment Canada
2 The polar bear is listed as Special Concern on Schedule 3, however it is currently undergoing reassessment and may be added to Schedule 1 as a Species of Special Concern as early as January 2005.

At this time, there are no species in the study area that are protected under *SARA* (Schedule 1). If polar bear are added to Schedule 1 as a Species of Special Concern, protection of individuals and residences and Critical Habitat on Federal Lands would not apply (*SARA* prohibitions only apply to Schedule 1 Extirpated, Endangered, and Threatened species). However, a management plan would be drafted by the federal government for polar bear within three years of listing on Schedule 1, at which time mitigative measures for individuals and habitat may be determined.

6 Air Quality

6.1 Baseline Conditions

Very little information is available to define background ambient air quality conditions in the Beaufort Sea area. Several environmental impact assessments have previously been conducted for offshore drilling programs in the region (e.g., the Isserk I-15 and Kulluk programs); however, they did not consider air quality issues in detail.

Air quality measurements in pristine Arctic environments have indicated background levels of oxides of nitrogen (NO_X) in the range of 0.04 to 0.08 µg/m^3 (Finlayson-Pitts and Pitts 2000). It is expected that the background levels for sulphur dioxide (SO_2) and NO_X near EL 420 would be similar because there is a relative lack of current development and industrial activity in the region. There are currently no industrial emission sources in this area and baseline ambient air quality conditions are virtually pristine.

6.2 Impact Assessment

Ambient air quality was selected as the VEC for this assessment because it has links to human and general ecological health and the aesthetic quality of the Program area.

The Program activity with the greatest potential for significant effects on ambient air quality is flaring during well testing, which will occur only if hydrocarbons are found. Other sources include diesel fuel emissions from vehicles, construction equipment, marine vessels and generators and periodic emissions from aircraft flying to and from the drill site during pre-operations and operations.

The primary emissions from these various sources include carbon dioxide (CO_2), water vapour (H_2O) and nitrogen (N_2). In addition, trace amounts of other compounds might be released, depending on the fuel composition and the combustion source (the specific type of equipment, flare gas composition). These compounds could include sulphur dioxide (SO_2), oxides of nitrogen (NO_X), fine particulate matter, volatile organic compounds, air toxics (e.g., benzene, polynuclear aromatic hydrocarbons, naphthalene, acetaldehyde, acrolein, ethyl benzene, hexane, toluene and xylene) and greenhouse gases (carbon dioxide, methane, nitrous oxide).

Potential flaring emissions were modeled as the most likely major emission source associated with the Program. If natural gas is discovered, flaring could occur on an intermittent basis (i.e., hours to several days per test) over a period of up to 30 days, depending on the amount of gas found and other operating conditions. A 14-day period of continual flaring at the maximum potential flaring rate (708×10^3 m^3/d) was modelled to illustrate the probable maximum effects on air quality that could be associated with routine operations.

The gas composition for modeling was based on gas analysis from the five previous successful exploration wells near the Western Block of EL 420. These samples contained very little or no measurable H_2S (i.e., only found in one well;

less than 0.0001 molar fraction). For the modeling exercise, H_2S was included in the gas composition; again to illustrate a greatest effect on ambient air quality that would likely be expected.

The US EPA SCREEN3 dispersion model was used to evaluate the effect of flare stack emissions on ambient air quality. The use of SCREEN3 addresses the requirements laid out in the Resources, Wildlife and Economic Development (RWED 2002, Internet site).

The results of the dispersion modeling for the flaring activities were compared with both the known baseline levels for arctic regions (Finlayson-Pitts and Pitts 2000) and various ambient air quality objectives, guidelines and standards:

- NO_2 Air Quality Objectives – Health Canada (2000, Internet site), World Health Organization (2000)
- SO_2 Air Quality Objectives – Health Canada (2000, Internet site), RWED (2002), World Health Organization (2000)
- Ambient Air Quality Criteria for Air Pollutants – Alberta Environment (2000), Ontario Ministry of Environment (2001).

The impact significance for flaring activities was determined by comparing the magnitude of the maximum predicted effects with these values. If predicted air contaminant concentrations from the Program were found to exceed relevant criteria, effects are considered significant.

The maximum predicted concentrations in the immediate vicinity of the drill sites, as one-hour averages due to flaring, are much lower than the relevant air quality criteria (less than one to two percent of ambient air quality objectives) (Table 6-1).

Flaring emissions for all three platform alternatives will be of short-term duration (e.g., typically up to 14 days during each of the four years of the drilling program) and will return to baseline ambient conditions shortly after the cessation of annual well testing activities. Because ambient air quality will remain well within the levels specified in the applicable objectives, guidelines and standards, and the effects of flaring emissions will be transient, localized, short term and low, they are expected to be not significant (Table 6-2).

The effects of emissions from mobile and stationary sources during the pre-operations and closure phases of the Program are expected to be similar but significantly lower in magnitude than the impacts associated with flaring during the operations phase. Emissions from mobile sources will be transient, short term and very low compared to the flaring emissions. Stationary source emissions (i.e., wellsite and platform electrical generators) will be longer in duration than the flaring (i.e., several months during drilling or warm shutdown), but they will still be temporary in nature and emission rates will be much lower. Because the effects of emissions from mobile and stationary sources during drilling will be highly localized and many of the sources will be transient, they are also expected to be not significant (Table 6-2).

Table 6-1 Maximum Predicted Contaminant Concentrations due to Flaring

Contaminant	Maximum Hourly Concentration[1] (μg/m^3)			Ambient Air Criteria (μg/m^3)
	SDC[2]	LTD[3]	Ice Island	
NO_2	3.51	3.53	3.52	400
SO_2	0.86	0.86	0.85	450
$PM_{2.5}$	1.93	1.94	1.94	30[a]
Benzene	0.0081	0.0081	0.0081	30[b]
Formaldehyde	0.0595	0.0598	0.0596	65[b]
Total PAHs	0.0002	0.0002	0.0002	36[c]
Naphthalene	0.0006	0.0006	0.0006	500[c]
Acetaldehyde	0.0022	0.0022	0.0022	90[b]
Acrolein	0.0005	0.0005	0.0005	28[c]
Ethyl Benzene	0.0735	0.0739	0.0736	–
Hexane	0.0015	0.0015	0.0015	35,000[c]
Toluene	0.0030	0.0030	0.0030	2000[c]
Xylene	0.0015	0.0015	0.0015	2300[c]

Notes: – No criteria
a As a 24-h average
b Alberta criteria
c Ontario criteria
1 Distance from flare to point of maximum hourly concentrations is 1.4 km
2 steel drilling caisson platform
3 landfast tender-assist drilling platform

Table 6-2 Program Effects on Air Quality

Potential Effect	Interaction with VEC	Level of Effect	Effect Significance[1]	
			Program-related Effect	Cumulative Effect
Pre-operations				
Emissions from mobile and stationary sources during platform mobilization and supply	Increased concentrations of air contaminants and greenhouse gases	Emissions transitory, short term and localized. Magnitude much lower than those modeled for flaring (see below)	Not significant	Not significant
Operations				
Emissions from mobile and stationary sources during drilling operations, demobilization and warm platform shut-down (generators operating after drilling and before breakup)	Increased concentrations of air contaminants and greenhouse gases	Emissions short term and localized. Magnitude much lower than those modeled for flaring (see below)	Not significant	Not significant

Table 6-2 Program Effects on Air Quality (cont'd)

Potential Effect	Interaction with VEC	Level of Effect	Effect Significance[1]	
			Program-related Effect	Cumulative Effect
Operations (cont'd)				
Flaring emissions if hydrocarbons are found	Increased concentrations of air contaminants and greenhouse gases	Maximum modelled concentrations using conservative assumptions are well within ambient air quality objectives used to determine significance; emissions will be transitory, short term and localized	Not significant	Not significant
Closure				
No effect	N/A	N/A	N/A	N/A

Note: 1 Based on ambient air quality objectives

The effects of other air quality-related issues are:

- local and regional visibility – the flame during flaring will be visible, particularly in the dark winter sky. The flare will be operated to prevent a visible smoke plume (i.e., from visible soot particles), but in very cold conditions, water vapour emissions may condense, forming a visible plume. The considerable distance of the potential drill sites from any settled area will minimize effects (Section 20.2: Impact Assessment), because the effects will be highly localized, and many of the sources will be transient.
- odour – odour is primarily associated with hydrogen sulphide (H_2S) in the fugitive gas emissions. Because projected H_2S content of gas in EL 420 is low and all gas produced will be flared (thereby converting H_2S to odourless SO_2), there will be no H_2S odours.
- acid deposition – deposition of acidic compounds (originating from SO_2 and NO_x in air emissions) is not expected to be an issue because:
  - the maximum NO_x and SO_2 emission rates are very low (0.78 and 0.19 t/d, respectively)
  - the maximum potential duration of flaring is limited to a maximum of 14 days during the winter
  - precipitation is low during the winter, limiting the occurrence of wet deposition
  - the offshore location of potential drill sites limits the amount of dry deposition on land
  - any deposition will be on snow and ice, which will dilute any potential effects of acid deposition on land or in the marine environment
- particulate deposition – as noted above, the flare will be operated in such a way as to limit soot formation and fallout

- bioaccumulation of toxics – long-range transport of air toxics, from the south and northern Eurasia to the Canadian Arctic, is an issue (Wilson 1998). The toxics of primary concern are persistent organic pollutants (POPs), which accumulate in the environment. They include:
  - polychlorinated biphenyls (PCBs)
  - dioxins
  - the pesticide chlordane
  - mercury

  None of these toxins are constituents of program-related air emissions.
- greenhouse gas (GHG) emissions – a maximum of 76 kt of GHG emissions are projected assuming 14 days of flaring at all four of the exploratory wells over a four-year period. Actual flaring rates are likely to be lower. It is important to note that flaring is a necessary activity for well testing, and there is no feasible alternative to flaring for disposing of the test gas. While these emissions do contribute to total GHG emissions, they are a very small contribution to total national and global emissions.

In summary, these issues are not significant for air quality concerns.

At closure, there will be no further emission sources and no effects on ambient air quality.

6.3 Mitigation Measures

Because the flaring activity is remotely located, there are no feasible mitigation options for reducing emissions from this source. Apart from standard mitigation measures (e.g., flaring guidelines, vehicle maintenance, standard emissions controls) (Table 6-3), no further mitigation measures are required for mobile or stationary emissions sources.

Table 6-3 Mitigation Measures for Effects on Air Quality

Potential Effect	Mitigation Measures
Air emissions from stationary and mobile sources (generators, drilling motors, vehicles.) during pre-operations and operations.	• Use of equipment and vehicles with current emission control technologies • Regular maintenance to ensure maximum operational efficiency
Air emission due to flaring during operations (if hydrocarbons are discovered).	• Industry standards for flaring (e.g., EUB 1999, Guide 60)

6.4 Residual Program Effects and Significance

There will be localized, low magnitude, short-term emissions during pre-operations and operations; however, concentrations of air contaminants near the wellsites will remain well within ambient air quality objectives. Ambient air quality conditions will return immediately to baseline conditions when transient and short-term emissions cease. Therefore, residual effects from Program-related air emissions are expected to be not significant.

6.5 Cumulative Effects and Significance

No significant residual Program effects are predicted and no other activities with significant emission sources are planned that would overlap in space or time with Program-related emissions. Non-significant Program-related emissions may overlap periodically in space and time with emissions from other sources (e.g., other aircraft, marine vessels or vehicles). Because other potential emission sources are also localized, transient and of low magnitude, cumulative effects on air quality are expected to be not significant.

6.6 Monitoring

Because the effects of the Program on ambient air quality are expected to be minimal and no residual effects are predicted, no Program-specific monitoring is recommended.

A regional program, which could be conducted jointly by the government and industry proponents working in the region, is suggested to address the current lack of baseline air quality data for the Beaufort Sea region. This program, which would require the participation of relevant government agencies and project proponents in the region, would comprise several air quality monitoring stations located throughout the region. These air quality monitoring stations would allow for the collection of baseline air quality data for the region, as well as providing information on changes in ambient air quality as oil and gas development progresses in the region.

Table 6-4 Monitoring Programs for Air Quality

Potential Effects	Program Objectives	General Methods	Reporting	Implementation
No significant Program or cumulative effects	Improve baseline air quality data for the Beaufort Sea region	Regional ambient air quality monitoring stations located in several locations in the region that would collect ambient air quality and meteorological information	Annually	Voluntary joint government and industry program

7 Noise

This section examines the effects of Program-related noise on human receptors. Effects of noise on wildlife are assessed in Section 16: Marine Mammals.

7.1 Baseline Conditions

The only offshore exploration activity in the Canadian Beaufort since the early 1990s has been Devon's offshore seismic program. As a result, there are very few existing noise sources near EL 420, particularly during the winter.

During the open-water period, the natural ambient sound level at EL 420 is affected by wind speed and wave height. Other intermittent noise sources include various marine vessels (e.g., tug boats, barges, ice breakers, research vessels) and small watercraft (e.g., outboards), as well as noise that may be associated with seismic exploration. Aircraft operations for exploration, research and tours may contribute periodically to the noise level in the Program area.

During the winter period, the ambient sound levels would be affected by high winds and blowing snow. Due to the remote nature of the proposed drilling locations, the average daytime and nighttime ambient sound level is conservatively assumed to be similar to the average ambient sound level established by the Alberta Energy and Utility Board (EUB) for remote rural Alberta specified in EUB *Guide 38 Noise Control Directive* (EUB 1996). Accordingly, the daytime and nighttime ambient sound level within the surroundings of each drilling location is assumed to be 45 dBA L_{eq} and 35 dBA L_{eq}, respectively.

7.2 Impact Assessment

The VEC for the noise assessment is the ambient sound level as experienced by human receptors. The measurable parameter for the VEC is the average ambient sound pressure level measured in A-weighted sound level (dBA). The degree of change in measurable parameters is used to characterize the level of effect.

The local study area (LSA) is the zone where potential impacts from the Program are expected to occur. Noise from drilling rigs generally decreases to natural background levels at distances of approximately 1.5 km from the rig. Therefore, the LSA is defined as a 1.5-km radius from each potential drill site because the activities at the drill site would most likely have a measurable effect on the ambient sound levels within this zone. For aircraft and marine operations, the LSA is the surroundings of the aircraft flight path and marine transport routes. Devon will establish standard flight paths and altitudes and marine transport routes in consultation with the hunters and trappers committees (HTCs) and appropriate Inuvialuit co-management agencies before air or marine transport activities commence.

To evaluate the geographic extent of anticipated noise impact, the regional study area (RSA) is defined to be a 20-km radius from the proposed drilling platform and any other associated activities (i.e., transportation routes).

Noise impact was assessed by identifying the contributing noise sources, characterizing these sources in terms of acoustical power, and modeling the

propagation of sound from the sources to the receptor locations of concern. Once the sum of all the contributing sources had been calculated, the predicted sound at each receptor location is compared to the Permissible Sound Level (PSL), as defined by applicable guidelines. If the predicted sound level exceeds guideline levels, mitigation is identified, where feasible, to reduce the Comprehensive Sound Level (CSL). Residual effects on receptors are determined by the predicted sound levels after mitigation.

The Environmental Protection Services of the Government of the Northwest Territories, Department of Resources, Wildlife and Economic Development, the territorial regulatory authority for the upstream oil and gas industry, endorses the use of the Alberta Energy and Utilities Board *Guide 38 – Noise Control Directive User Guide* (EUB 1999b).

The Alberta Energy and Utilities Board (EUB) *Guide 38 – Noise Control Directive User Guide* (EUB 1996) defines a fixed limit on the amount of noise, measured at a receptor location, that may be generated by energy-related facilities. For remote rural areas where no sensitive human dwelling exists within a distance of 1.5 km from the facility, EUB Guide 38 recommends that new facilities planned for such areas should be designed to meet a target sound level of 40 dBA L_{eq} at a distance of 1.5 km, although this is not a mandatory requirement (EUB 1996). While this is a guideline specifically for Alberta, in absence of a similar guideline for the NWT, this recommended sound level is used for this assessment. The L_{eq} value is the energy-averaged A-weighted sound level, which is one of the most reliable predictors of human response to noise.

The US Department of Defense Federal Interagency Committee on Noise guideline (FICON 1992) addresses community reactions to aircraft noise, including the degree to which noise interferes with the performance of routine, daily tasks, as well as the degree to which noise interferes with normal sleep patterns. This method was used to assess the impact of aircraft noise during the Program (Finegold and Elias 2002).

Noise propagation modeling was conducted using the International Standards Organization Standard 9613. The modeling approach accounts for distance and atmospheric attenuations, surrounding terrain (flat, reflective) and meteorology (winter, inversion, downwind conditions).

Criteria for effects characterization are provided in Table 7-1.

The significance of the residual and cumulative effects was determined, based upon a combination of the quantitative analysis and professional judgement that takes into account the various rankings of each of the individual attributes discussed above, comparison of predicted noise levels to applicable guidelines and the likelihood of interaction with human receptors (Table 7-2).

In general, noise emanating from the drill sites (construction-related noise during pre-operations and drilling and flaring activities during operations) will have a high magnitude near the drill sites (Table 7-3). However, because the location is remote, there is a low likelihood of effects on human receptors other than Program employees. Mitigation measures, which include consultation with and notification of HTCs and Inuvialuit co-management agencies to minimize potential conflicts with human activities in the vicinity of drill sites (e.g., guided hunting), will further reduce the potential for effects on human receptors (Table 7-4).

Noise associated with air, marine and winter road transport activities during pre-operations mobilization and cat train or air transport during the demobilization phase of operations will be of high magnitude within 140 m of the source. Similarly, noise associated with marine and winter road transport activities during mobilization and demobilization will be of high magnitude within 140 m and 1.5 km of the source, respectively. HTCs and co-management agencies will be consulted to confirm transport routes and mitigation measures to minimize potential effects. To minimize noise impacts of air transport activities during pre-operations and operations, HTCs and co-management agencies will be consulted to determine appropriate flight paths and altitudes.

Table 7-1 Effect Attributes for Noise

Direction	
Positive	Beneficial if there is a decrease in ambient noise levels
Negative	Detrimental if there is an increase in ambient noise levels
Neutral	If there is no change in ambient noise levels
Magnitude	
Negligible	• 3 dB or less • change is imperceptible
Low	• 4 to 5 dB • change is just a noticeable increase
Moderate	• 6 to 9 dB • change is a marginally significant increase
High	• 10 dB or more • change is perceived as a doubling of sound level
Geographic Extent	
Local	Impact will be restricted to within 1.5 km from the platform or associated activities
Subregional	Impact will extend beyond 1.5 km, but is restricted to within 10 km from the platform or associated activities
Regional	Impacts will extend beyond 10 km, but are restricted to 20 km from the platform or associated activities
Duration	
Immediate	Impact duration is limited to two days or less
Short term	Impact duration is longer than two days but shorter than one year
Medium term	Impact duration is more than one year but less than five years
Long term	Impact duration is more than five years
Frequency	
Isolated	Impact occurs once
Occasional	Impact occurs intermittently and sporadically over assessment period
Periodic	Impact occurs intermittently but repeatedly over assessment period
Continuous	Impact occurs continuously over assessment period

Table 7-2 Program Effects on Ambient Noise Levels

Potential Effect	Interaction with VEC	Level of Effect[1]					Effect Significance[2]	
		Direction	Magnitude	Extent	Duration	Frequency	Program-related Effect	Cumulative Effect
Pre-operations								
Noise from marine transport activities	No overlap of increased ambient noise with land-based receptors. Would only affect people in boats within 220 m of marine transport vessels	Negative within 220 m of source; neutral beyond	Low (beyond 220 m from source) to high (within 140 m of source)	Local	Immediate	Occasional	Not significant	Not significant
Construction noise (ice pad and ice road construction)	Very low probability of overlap with human receptors during winter. May affect hunters within 5.5 km of source	Negative within 5.5 km of source.	Low (beyond 5.5 km from source to high (within 3.4 km from source)	Sub-regional	Short term	Occasional	Not significant	Not significant
Noise from air transport:								
• Takeoffs and landings	Very low probability of overlap with human receptors (residents) in vicinity of airports or at drill sites	Negative within 10 km of the source; neutral beyond.	Low (beyond 10 km from source) to high (within 6 km of source)	Sub-regional	Immediate	Periodic	Not significant	Not significant
• Flyovers	Low probability of overlap with human receptors due to flight paths to avoid concentrated settlement	Negative within 11 km of the source; neutral beyond	Low (beyond 11 km from source) to high (within 6 km of source)	Regional	Immediate	Periodic	Not significant	Not significant
Noise from ice road transport	Very low probability of overlap with human receptors during winter. May affect hunters within 2.8 km of source	Negative within 2.8 km of source; neutral beyond	Low (beyond 2.8 km from source) to high (within 1.5 km of source)	Sub-regional	Short term	Periodic	Not significant	Not significant

Table 7-2 Program Effects on Ambient Noise Levels (cont'd)

Potential Effect	Interaction with VEC	Level of Effect					Effect Significance	
		Direction	Magnitude	Extent	Duration	Frequency	Program-related Effect	Cumulative Effect
Operations								
Drilling noise	Very low probability of overlap with human receptors during winter. May affect hunters within 600 m of source	Negative within 1.5 km; neutral beyond.	Negligible (beyond 600 m from source) to high (within 200 m of source)	Local	Short term	Continuous	Not significant	Not significant
Noise from flaring (if gas is discovered)	Very low probability of overlap with human receptors during winter. May affect hunters within 1.5 km of source	Negative within 1.5 km; neutral beyond	Low to high within 1.5 km; negligible beyond	Local	Immediate	Occasional	Not significant	Not significant
Closure								
No remaining noise sources at closure	NA	NA	NA	NA	NA	NA	NA	NA

Notes: 1 Based on criteria in Table 7-1
2 Based on criteria in Section 7.1

Table 7-3 Predicted Comprehensive Sound Level Due to Drilling Operations

Distance From Drilling Platform (m)	Ambient Sound Level Leq (dBA)		Modeled Sound Level[2] Leq (dBA)		Comprehensive Sound Level[3] Leq (dBA)		Impact Magnitude[4]	
	Day[1]	Night[1]	Day	Night	Day	Night	Day	Night
50	45	35	70	70	70	70	High	High
100	45	35	63	63	63	63	High	High
200	45	35	57	57	57	57	High	High
300	45	35	54	54	54	54	Moderate	High
400	45	35	51	51	52	51	Moderate	High
500	45	35	49	49	50	49	Low	High
600	45	35	47	47	49	47	Low	High
700	45	35	45	45	48	46	Negligible	High
800	45	35	44	44	48	45	Negligible	Moderate
900	45	35	43	43	47	43	Negligible	Moderate
1000	45	35	41	41	47	42	Negligible	Moderate
1100	45	35	40	40	46	41	Negligible	Low
1200	45	35	39	39	46	41	Negligible	Low
1300	45	35	38	38	46	40	Negligible	Low
1400	45	35	37	37	46	39	Negligible	Low
1500	45	35	37	37	46	39	Negligible	Low
1600	45	35	36	36	45	38	Negligible	Negligible

Notes:
1 Daytime period is from 07:00 to 22:00 and nighttime period is from 22:00 to 07:00. The day and night ambient sound levels specified above reflect the fact that nighttime periods are quieter than daytime periods
2 Modeled sound level is the contribution from drilling operations
3 Comprehensive sound levels include the modeled sound level and the ambient sound level
4 Based on definitions for effect magnitude in Table 7-1

Table 7-4 Mitigation Measures for Effects on Ambient Noise Levels

Potential Effect	Mitigation Measures
• Noise from marine transport activities during pre-operations	• Activity scheduled to minimize potential effects on whale hunt • Notification of HTCs and Inuvialuit co-management agencies as to the locations and schedule of activities and anticipated noise levels • In the event towing activities might overlap with hunting activities, Devon will have an Inuvialuit wildlife monitor on board during platform transport to check for whale movements and implement impact avoidance mitigation measures, maintaining acceptable buffer distances as required
• Construction noise (ice pad and ice road construction) during pre-operations	• Notification of potential receptors regarding location and schedule of activities • Avoidance of peak whale hunting season
• Noise from air transport during pre-operations and operations	• Consultation with HTCs and community stakeholders to identify preferred aircraft flight corridors and altitudes
• Noise from ice road transport during pre-operations	• Notification of HTCs and Inuvialuit co-management agencies as to the locations and schedule of activities and anticipated noise levels • Routing of the ice road, if feasible, to avoid potential hunting areas
• Drilling noise during operations	• Notification of potential receptors regarding location and schedule of activities
• Noise from flaring during operations (if gas is discovered)	• Notice to HTCs prior to flaring

At closure, there will be no noise sources associated with the Program and no further effects.

Because there is a very low likelihood of noise effects on human receptors at the remote location of Program activities, particularly during the winter, and the generally localized and short-term nature of these effects, noise effects due to the Program are expected to be not significant.

7.3 Mitigation Measures

Mitigation measures to address Program effects on ambient noise levels are summarized in Table 7-4.

7.4 Residual Program Effects and Significance

The residual effects from noise associated with the Program are expected to be not significant.

7.5 Cumulative Effects and Significance

No other activities with major noise sources are planned near EL 420 during the operations phase of Program. However, transport-related noise sources during pre-operations and operations will overlap with existing and ongoing sporadic transportation-related noise sources in the Program area. The dispersed and sporadic nature of transportation activities in the RSA makes quantification of cumulative effects impossible. However, cumulative effects on ambient noise levels experienced by human receptors are expected to be immediate, localized to subregional and occasional. On this

basis, Program-related contributions to cumulative effects on ambient noise levels are expected to be not significant.

7.6 Monitoring

As noted, Devon will meet with local HTCs, guides and appropriate Inuvialuit co-management agencies to discuss activities and avoid potential conflicts with other activities as much as possible. To check the effectiveness of the mitigation measures, Devon will maintain a liaison with these groups and, should any conflicts or complaints arise, they will work closely with these groups to address concerns in an appropriate manner (e.g., improving or adding impact mitigation measures) (Table 7-5).

Table 7-5 Monitoring Programs for Noise

Potential Effect	Program Objectives	General Methods	Reporting	Implementation
No significant Program or cumulative effects	Check effectiveness of mitigation measures	Liaison with local co-management agencies and address any conflicts or complaints	Annually	Devon