REPORT

Port au Port Seismic Program Screening and Registration

TEKOIL AND GAS CORPORATION

REPORT NO. 1008389

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REPORT TO	**Tekoil & Gas Corporation** **25025 Interstate 45 North** **Suite 525** **The Woodlands, Texas** **77380**
ON	**Tekoil and Gas Corporation** **Port au Port Seismic Program** **Screening and Registration**

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EXECUTIVE SUMMARY

This Screening and Registration presents information on the proposed three-dimensional (3D) seismic exploration program on the Port au Port Peninsula, Newfoundland and Labrador, as proposed by Tekoil & Gas Corporation, and the results of the environmental assessment. The proposed program would be conducted onshore Port au Port Peninsula, to the offshore transition area along the western shore. A description of the proposed program and the existing physical, biological and socio-economic environments is included. Project information was provided to government and interested public groups to scope the issues and the environmental assessment. Valued Environmental Components (VECs) were identified to focus the environmental effects analysis. The VECs selected for this assessment were:

- Marine Birds;
- Marine Fish, Shellfish, and Habitat;
- Marine Mammals and Sea Turtles;
- Commercial Fisheries;
- Terrestrial Environment;
- Freshwater Environment; and,
- Land Use.

This Screening and Registration includes consideration of the environmental effects of the proposed 3D seismic program on each of the VECs, including the potential effects of each of the planned activities and potential unplanned (i.e., accidental) events. It also considers species at risk and potential cumulative effects. Mitigation measures that are technically and economically feasible have been incorporated into the program design and planning. Monitoring programs are considered where appropriate. Provisions of relevant legislation and guidelines (e.g., *Guidelines for Conducting Petroleum Exploration Surveys in the Newfoundland and Labrador Onshore Area*, 2005, and the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines*, 2004) have been identified and incorporated into the proposed seismic program.

Significant adverse environmental effects, including cumulative effects, are not predicted as a result of planned activities. The proposed 3D seismic program is not likely to result in significant adverse environmental effects.

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1.0 INTRODUCTION

Tekoil & Gas Corporation (Tekoil) is proposing to conduct a three-dimensional (3D) seismic survey over part of, and adjacent to the Port au Port Peninsula, western Newfoundland for a six-week period between May and October 2006, with offshore seismic activities occurring between mid-August and October (the "Project"). This Screening/Registration is submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) as part of the application for a Geophysical/Geological Work Authorization, and pursuant to requirements of the *Canadian Environmental Assessment Act* (CEAA), and to the Newfoundland and Labrador Department of Environment and Conservation (NLDOEC) pursuant to requirements of the *Environmental Assessment Regulations* (Section 26).

1.1 Project Overview

The proposed program covers an area of approximately 270 km^2. The Project Area includes a portion of the Port au Port Peninsula and the onshore to offshore transition area along the western shore, to a maximum water depth of 50 m (Figure 1.1). The total length of the offshore source lines is approximately 200 km. The onshore portion of the survey will be acquired using conventional dynamite shot hole sources and conventional surface geophone detectors. In order to extend the onshore 3D seismic coverage in a continuous fashion across the coastline and into the near offshore environment (the transition zone), submersible geophones will be used to extend the recording array from onshore to offshore, to a maximum water depth of 50 m. Both the onshore and offshore geophone receiver arrays will tie into an onshore recording truck.

1.2 The Proponent

Tekoil is a Houston-based oil and gas exploration and production company that uses advanced production technologies. The company is focused on the development, acquisition, stimulation, rehabilitation, and asset improvement of oil and gas fields throughout North America. Fekete Associates Inc. (Fekete) has been retained by Tekoil to manage the technical and operational aspects of the project. Fekete is a consulting company based in Calgary, Alberta, Canada, providing engineering and geological services and software to the oil and gas industry world wide. Founded in 1973, Fekete currently has a full-time staff of over 100 engineers, geologists, technologists, programmers and support personnel. The contact for the purpose of this environmental assessment is:

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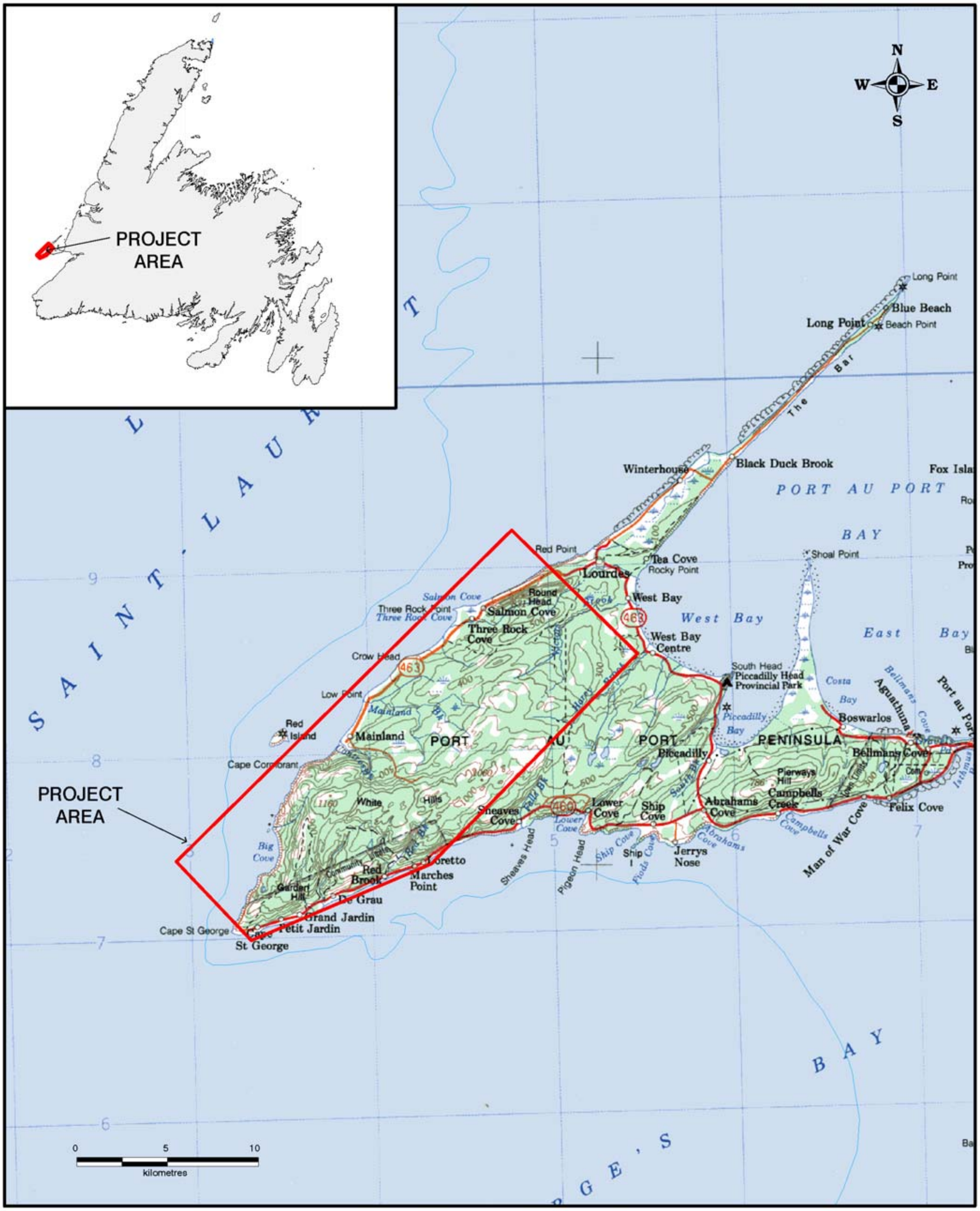
Figure 1.1 Port au Port Seismic Project Location



1.3 Regulatory Context

The C-NLOPB regulates oil and gas activities in the Newfoundland and Labrador offshore area pursuant to the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (Accord Acts). The Petroleum Resource Development Division of the Newfoundland and Labrador Department of Natural Resources (NLDNR) regulates petroleum exploration activities in Newfoundland and Labrador.

The C-NLOPB's regulatory role includes the issuing of Exploration Licenses and approvals and authorizations pertaining to offshore exploration activities. The C-NLOPB is also designated a Federal Authority under CEAA. Seismic surveys are included in the list of activities requiring federal assessment under CEAA (Government of Canada 2004). Several other federal agencies have an advisory role in the environmental assessment of the proposed seismic exploration program. Fisheries and Oceans Canada (DFO) is responsible for the protection of fish and fish habitat. Environment Canada is responsible for the protection of migratory birds under the *Migratory Birds Convention Act*, as well as discharges to the marine environment under Section 36 of the *Fisheries Act*. Transport Canada is responsible for provision of safe navigation (under the *Navigable Waters Protection Act*) and discharge of pollutants at sea (under the *Canada Shipping Act* and *Regulations* such as the *Pollutant Discharge Reporting Regulations, 1995*) and Guidelines (such as the *Guidelines for the Control of Ballast Water Discharge from Ships in Waters Under Canadian Jurisdiction*).

The Newfoundland and Labrador Petroleum Resource Development Division's regulatory role includes the issuance of Exploration Licenses for onshore exploration programs.

NLDOEC administers several statutes and regulations, including the *Environmental Protection Act* and *Environmental Assessment Regulations*. It has been determined that the proposed program is subject to the *Environmental Assessment Regulations.*

The C-NLOPB is the designated Federal Environmental Assessment Coordinator for this environmental assessment. A Scoping Document was issued by the C-NLOBP on December 21, 2005. This Screening/Registration has been submitted to fulfill the requirement of CEAA, the Newfoundland and Labrador *Environmental Assessment Regulations*, and the Scoping Document.

1.4 Document Organization

The Screening/Registration is organized as follows:

Section 1 identifies the Proponent, outlines the purpose and need for the seismic exploration program, the Project Area, the regulatory approvals processes to which the project is subject, and outlines the organization of the document.

Section 2 provides an overview of the proposed program. This is followed by a detailed discussion of each of the components and activities associated with the seismic exploration program, as well as information on its schedule. Program-related emissions and discharges and the potential for accidental events are also discussed.

Section 3 describes stakeholder consultation.

Section 4 describes the scoping exercise and selection of Valued Environmental Components (VECs), potential interactions between project activities and VECs and the approach and methods used in conducting the environmental assessment.

Section 5 provides a description of the existing physical, biological, and socio-economic (land-use) environments.

Section 6 provides the environmental effects analyses for each of the VECs under consideration. Each VEC is discussed in a separate section, which includes a discussion of: assessment boundaries; potential interactions and existing knowledge; mitigation measures; potential environmental effects and their significance; cumulative environmental effects; and any proposed follow-up initiatives.

Section 7 provides a description of the effects of the environment on the project.

Section 8 presents a summary of the environmental management procedures that will be in place for the project.

Environmental monitoring requirements for the project are described in Section 9.

Permits and approvals that must be obtained prior to project initiation are described in Section 10.

Funding requirements for the project are described in Section 11.

Section 12 presents a summary of the assessment and its main conclusions.

References, including personal communications and the literature cited in the report, are provided in Section 13.

Supporting materials are provided as Appendices.

2.0 DESCRIPTION OF THE PROPOSED SEISMIC PROGRAM

2.1 Purpose/Need for the Project

The 3D seismic survey will be used to map hydrothermal porosity development within the Ordovician carbonate platform reservoir system. Oil was first discovered in 1984 on the Port au Port Peninsula by Hunt Oil Company. Past attempts at development of this valuable resource have been frustrated by a complex geological history and non-uniform porosity development. Mapping of the existing 2D seismic data indicates that a 3D survey is necessary to properly develop the oil field discovered by Hunt's original Port au Port #1 well. Based on technical analysis of over $50 million USD of investment made by previous exploration efforts, the proposed Port au Port 3D survey represents the next step in technology to improve the chance of success for full development of an important energy resource for Western Newfoundland in the 21st century.

2.2 Equipment and Methods

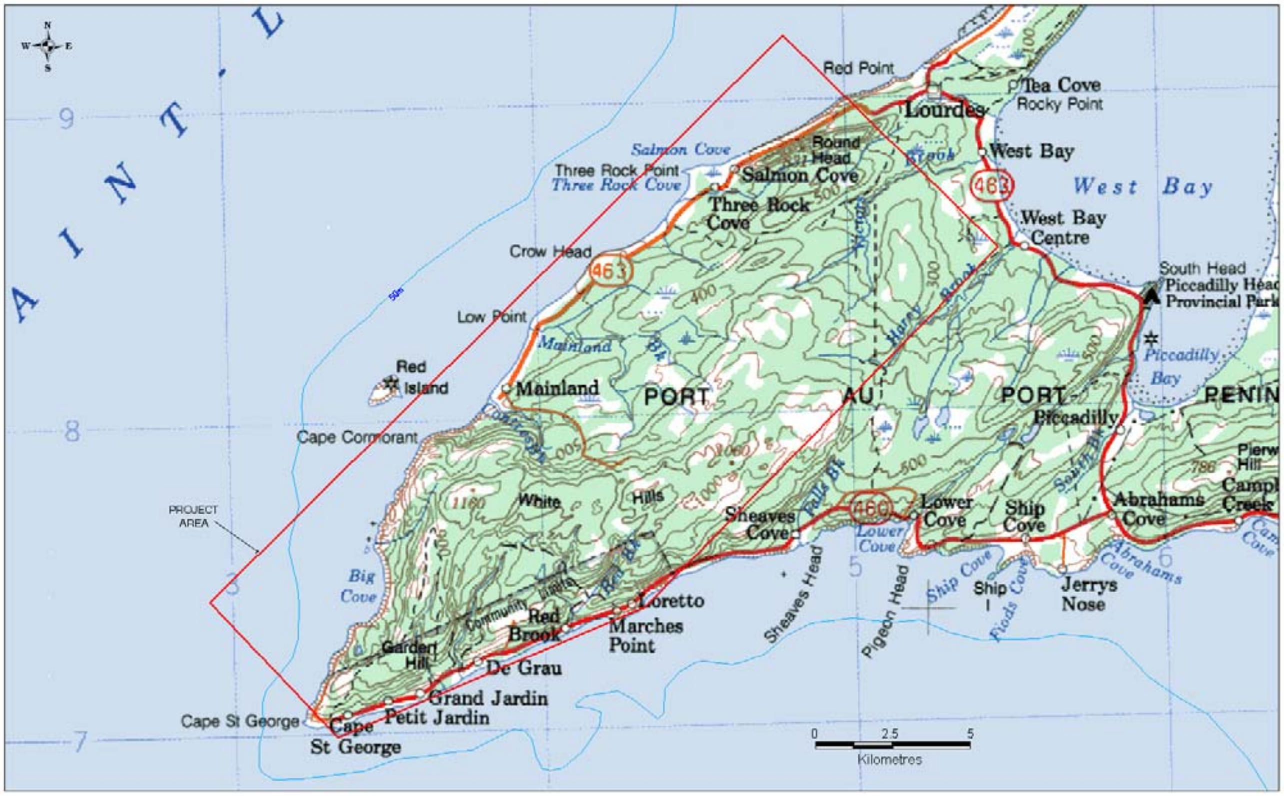
Three-dimensional (3D) seismic surveys enable a greater resolution of potential and existing oil and gas fields. These seismic surveys provide a detailed picture of the area under investigation, allowing for a more detailed analysis of the quantity and distribution of hydrocarbons (Davis et al. 1998). These can result in a reduced number of wells required to define a field and allow for optimal oil and gas recovery.

The proposed Port au Port 3D survey is classified as a transition zone ("TZ") survey. This means that seismic recording will be conducted across the surf zone on the western coast of Port au Port Peninsula and will provide a seamless, high quality 3D subsurface image tying geology from the onshore into the offshore environment. The complex geological history of the Port au Port Peninsula can only be understood with an image that crosses these physical boundaries. The TZ survey combines elements of conventional onshore and offshore survey systems and requires both special equipment and expertise not generally available in the seismic industry. All applicable legislation will be adhered to, including the *Guidelines for Conducting Petroleum Exploration Surveys in the Newfoundland and Labrador Onshore Area* (NLDNR 2005) and the *Geophysical, Geological, Environmental, and Geotechnical Program Guidelines* (C-NLOPB 2004).

Preparations for the survey onshore will begin several months prior to the arrival of the recording crew. Preparation includes line surveying, clearing (if required), drilling shot holes, and pre-loading the shot holes. Setting out the receiver lines and recording the seismic source points will take approximately one week for each recording patch. There will be a total of eight recording patches. Approximately 7,000 point seismic sources will be activated.

In the onshore portion of the survey (Figure 2.1), a variety of conventional equipment and methods will be used.

Figure 2.1 Port au Port Seismic Project Area



2.2.1 Receiver Array

Receiver lines will run southeast-northwest for a length of approximately 12 km each, beginning onshore and ultimately crossing the western coastline of Port au Port Peninsula and continuing into water depths up to 50 m. In order to obtain efficiency of operation, the 3D seismic recording method requires that multiple receiver lines be laid parallel, approximately 400 m apart; the Project Area is approximately 22.5 km long and 12 km wide. The survey will be accomplished by dividing the Project Area into 8 manageable "patches" with dimensions of approximately 12 km wide and 2.8 km long.

Along the length of each receiver line, small listening devices ("geophones") will be placed at regular intervals approximately every 50 m. Onshore, these geophones will be coupled to the ground using a short (10 cm) spike pushed into the soil which is attached to each phone element. Offshore, the geophones will be incorporated into an ocean bottom cable system that is similar in size to a normal heavy duty extension cord, approximately 1.5 mm in diameter. The ocean bottom phones will sink to the ocean floor and neither the cable nor the geophone will be floating in the water. There is no fluid in the offshore cable or the offshore geophone system. The cable and housing are designed to sink to the ocean bottom and are deployed and retrieved (depending on sea state) using a shallow draft vessel similar to a fishing boat or zodiac type recovery vessel. Each individual receiver station (both onshore and offshore) is then connected via fiber optic cable to a central recording unit that is mounted on a truck located onshore.

Once a recording patch has been laid out on the ground and in the water on the ocean bottom, seismic sources will be activated which create a highly directional (focused downward) acoustic pulse into the subsurface geology. As this sound wave travels through the layered geology, small reflections are created at each rock boundary. It is these weak reflections that then travel back to the surface and are amplified and recorded by the seismic recording system. Due to the very regular geometry of the recording patch and the fact that the same subsurface point will be observed from many different angles and surface positions, sophisticated computer processing can use these reflections to create a three-dimensional image of the subsurface geology that is similar in many respects to a CAT Scan in the medical field. Ideally, recording will start on the northeastern boundary of the Project Area and will progress sequentially to the other end of the Project Area. However, environmental or other considerations may necessitate some deviation from this plan.

2.2.2 Land-based Seismic Source Points

Seismic energy sources that will be used onshore will be comprised of conventional shot holes containing dynamite.

The proposed seismic survey uses similar sized dynamite charges as have been used in previous surveys on the Port au Port Peninsula. There are no known adverse impacts from the previous surveys.

When and where necessary, in areas where there is a concern with the conventional method, surface Vibroseis methods will be considered. These seismic sources can be optimally configured to minimize surface impact and are readily adaptable to the wide variety of surface conditions that will be encountered on the Port au Port Peninsula.

In those areas that are heavily forested and which represent steep topographic relief, the seismic energy will be created by firing a small dynamite charge (2.5 to 5.0 kg) buried in a shot hole between 10 and 30 m deep. The small diameter holes (<10 cm diameter) will be drilled by air hammer drill systems supported by trucks, helicopter or all-terrain vehicles (ATV). In areas of loose fill, conventional truck-mounted water well drill rigs may have to be used to drill stable shot holes.

In order to maintain the regular geometry for the 3D recording technique, source lines will be surveyed perpendicular to the receiver lines with a spacing of approximately 400 m between each source line. Along the length of each source line, at regularly spaced intervals of approximately 50 m, a small diameter hole approximately 10 to 30 m deep will be drilled. The dynamite charge will be loaded into the hole, which will then be backfilled and tamped.

During the recording phase, one of these small charges will be discharged to create the acoustic sound wave that travels though the geological layers. The time interval between activating each onshore source point can be as much as 5 to 10 minutes as the crew works through the recording process pertaining to each onshore source event. Only those source points pertaining to the active recording patch will be detonated for a given recording setup. It will take one week on average to lay out the geophone cables, record and dismantle the onshore equipment for each patch array.

At the time the onshore source is activated, a discernable thump can be felt near the source point, but no effects will be observed at the surface. The charges are small and will not result in fissures or cracks on the surface. After the charge has been fired, the de-activated source point drill hole will be capped with a metal cap that is buried, preventing any accidental re-entry of this hole by humans or animals. The area around the source point is then returned to its original condition. The reflections from each onshore source point will be recorded using both the onshore and offshore receiver lines for a particular recording patch resulting in a seamless subsurface 3D image.

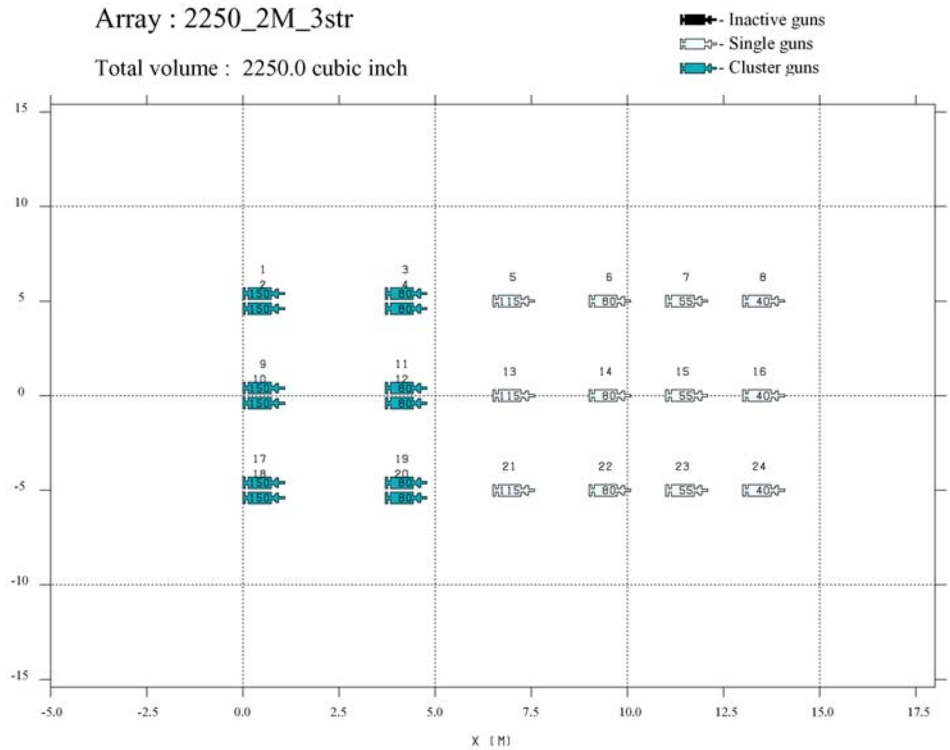
In certain areas of the survey, where topographic relief is less extreme and where surface vegetation is minimal, and along Route 405 (parallel to the west coastline of the peninsula) the Vibroseis source method will be incorporated. The Vibroseis source is comprised of a hydraulic ram that presses a steel plate against the ground. This equipment is mounted on a large four wheeled articulated truck that can be driven at low speeds similar to a farm tractor. Once the plate is pressed against the ground, the hydraulic system vibrates the plate (also known as the sweep) through a range of seismic frequencies (10 to 100 Hertz (Hz)) for a duration of 8 to 10 seconds. Once this sweep is complete, the plate is lifted and the Vibroseis truck moves a short distance forward and repeats the process. Typically, the Vibroseis system is deployed using up to four separate trucks operating in concert to provide adequate energy into the ground. The Vibroseis system can be effectively tuned to enhance or diminish the power of each sweep and has been successfully used to acquire seismic data in highly urbanized areas such as downtown Los Angeles without damage to roadways, buildings or any buried facilities such as pipelines or utility lines. It is anticipated that Vibroseis will be used in areas where conventional shot hole contained dynamite source points are not feasible.

2.2.3 Marine-based Seismic Source Points

The shooting sequence will be extended offshore using a shallow draft marine source vessel equipped with an air compressor system that charges an array of air sleeves. This source vessel will travel along a given source line and will be continually moving during the survey (Figure 2.2). Therefore, the seismic energy emitted from the array will not remain focused on any one location. The energy emitted from the source array will occur for approximately 150 milliseconds (ms) every 8 seconds, rather than occurring continuously. Upon arrival at the Project Area, the source vessel will implement a 30-minute ramp-up procedure by gradually increasing the number of sleeves fired simultaneously within an array. This ramping up will give marine mammals and fish an opportunity to move away from the immediate zone of influence.

The vessel employed for the proposed program will be a shallow draft (minimum draft of 3 m) marine source vessel. It will be approximately the same size as a fishing boat and will likely be hired (with captain and crew) from the local fishing fleet based in Port au Port bay and equipped with the required specialized equipment by the seismic contractor. The maximum speed of the vessel will be 10 to 12 knots. Operating speed will generally be 5 to 6 knots while towing the air sleeve array. The crew size on the source vessel will range between 4 and 10 persons. Shooting operations will only be conducted during daylight hours and the source vessel will return to port each evening. It is estimated that the source vessel will require a turning radius of 2 km on the northeast and southwest ends of the Project Area.

Figure 2.2 Source Array for Offshore Component



The air sleeves are towed behind the vessel at a depth between 4 and 8 m with a typical array incorporating up to 24 separate air sleeves. The source array for the offshore component of the seismic survey can be comprised of three lines of air sleeves (Figure 2.2). The overall dimensions of this array are approximately 10 m wide by 15 m long. The total displacement of the 24-sleeve array is 2,250 cu. inches. The sleeves are operated at a pressure of 2,000 psi. The air sleeves are sequenced together and fired in such a way that the acoustic energy thus generated is highly directional (focused downward). Similar to the onshore shot, the air sleeves direct their energy downward into the water and ultimately through the sea floor into the subsurface geology, thereby allowing the reflections generated at depth to be recorded on the onshore and offshore receiver lines simultaneously. The air sleeves will be fired at intervals of approximately every 6 to 8 seconds as the vessel moves at a constant rate along a given source line (parallel to the coastline). Once a particular offshore source line is completed, the vessel will then turn around and reposition itself to begin acquisition on the next sequential source line in the pattern until the complete pattern for that particular recording patch is completed. Each offshore patch is approximately 3.6 km wide (southeast-northwest) and 2.8 km long (northeast-southwest).

Once all source points, both onshore and offshore are recorded and cleared for any given recording patch, the equipment is picked up and moved over to set up the next recording patch. When the new recording patch is fully laid out both onshore and offshore, the next sequence of onshore and offshore source points are acquired to record the reflections arriving from the deep subsurface for that specific recording patch. Each onshore recording patch will take approximately one week to lay out, record and pickup. The corresponding offshore recording patch will take approximately 3 days to lay out, record and pickup.

2.3 Onshore Preparation

Preparations for the survey onshore will begin several months prior to the arrival of the recording crew. Work included in the site preparation phase includes finalization of access permits on private lands, surveying of the receiver and source line positions, line clearance (as required) and drilling and pre-loading of the shot holes at each source position. During this time, the crew will be comprised of a Global Positioning System (GPS)-supported survey crew, various drilling crews and a project manager as well as a permit agent.

2.3.1 Onshore Permits and Program Information

While the majority of the lands in the Project Area are controlled by the Crown, in some instances, land is controlled by individual private land owners. Permits to access these privately held lands with the seismic crew will be negotiated and reasonable access fees will be paid to the landowner of record. These negotiations will be conducted by a trained permit agent working for the seismic contractor as an agent on behalf of Tekoil.

Prior to Project start-up, information will be provided to local town councils, residents and FFAW. Project information will include: planned methods, local jobs related to the Project and the results of this environmental assessment.

2.3.2 Land Surveying and Line Clearance

After the snow has disappeared and when surface conditions permit, the survey crew will begin to survey the source and receiver line locations onshore. Standard survey stakes and small pin flags will be set by the survey crew who will also accurately record the coordinates and elevation of each position. State-of-the-art GPS receivers for rapid and efficient movement across the Project Area will be used. The typical survey crew will be supported by pickup truck and/or SUV type vehicles with ATV support in areas that are not accessible to larger vehicular traffic. Vehicular traffic will use existing roads and paths.

Working in conjunction with the survey crew, a line clearance crew will begin to clear underbrush and trees as necessary to allow the drilling and recording crews access to the source and receiver lines. Existing cleared trails used by recreational ATV traffic, logging roads and cleared lines for previously acquired 2D seismic lines in the area will all be used for access to the Project Area. Source and receiver lines will be laid out primarily by walking. Pick-up trucks, ATVs or helicopter support will be used to transport equipment and crews to the jobsite. Due to the cost of brush and tree clearance, these activities will be held to a minimum; however some vegetation clearance will be unavoidable. Footpaths will be cleared with machetes; hand-held chainsaws will be used only where necessary in more heavily forested areas. In some instances, lines may have to be cleared to a width of approximately 3 m to allow vehicular access.

2.3.3 Source Line Drilling and Pre-Loading

Once the survey crew has positioned a sufficient number of source lines and marked individual source positions with pin flags, the drilling crews will begin to drill the holes necessary to load the small dynamite charges into the ground. The soil profile over the Port au Port Peninsula is generally very thin. Approximately 60 percent of the Project Area is comprised of very hard, dense carbonate rock exposed on the surface. Due to this wide variation in surface conditions, a variety of drilling options will be required. In the areas of carbonate rock exposure, holes will be drilled using air hammer drills supported by a diesel powered air compressor. A conventional truck mounted water well rig will be used in those areas where loose fill precludes the use of air hammers. In areas of dense vegetation and tree coverage, the drilling equipment will be transported by ATVs, by hand, or assisted to the location by helicopter support. The shot holes will be small (<10 cm diameter) and will be drilled to a depth between 10 and 30 m, depending on soil and drilling conditions. Multiple drilling crews working simultaneously will be required to drill and pre-load a sufficient number of holes before the recording crew arrives on location. Noise levels associated with these activities will be typical of industrial equipment. The noise will be of short duration and intermittent. While drilling can and will continue once the recording starts, crew efficiency requires that a sufficient lead of drilled and pre-loaded shot holes always be maintained prior to the arrival of the recording crew. Once the hole is drilled, it will be loaded with a small charge of dynamite (2.5 to 5.0 kg), which will be equipped with an electrical blasting cap. The hole will then be backfilled with the drill cuttings and tamped. The cap wires will be secured inside the hole which is then capped using a temporary metal cap buried under the surface. A marker is left behind so that the hole can be reoccupied by the recording crew in the future.

It is estimated that each drilling crew will drill and pre-load between four and six holes per day and use a crew of two to four people each. Dynamite and electrical blasting caps will be handled only by trained personnel on the seismic crew. Shot holes will not be drilled within 180 m of any identified surface features such as residential developments or designated environmentally sensitive areas. Trucks will be used to transport crews to and from site. Vehicles and ATVs will be re-fuelled at local gas stations on a daily basis. If gasoline is required to be carried with the ATVs, Transport Canada-approved 10 to 15 L gasoline containers will be used. Fuel will not be stored on-site.

2.4 Onshore Execution

There will be eight recording patches. When a patch is ready to be recorded, the small charges located onshore within that particular recording patch will be detonated. The time interval between activating each individual onshore source point can be as much as 5 to 10 minutes as the crew works through the recording process pertaining to each onshore source event. Only those source points pertaining to the active recording patch will be detonated for a given recording setup.

At the time the onshore source is activated, a discernable thump can be felt near the source point, but no effects will be observed at the surface as a result of the detonations. The charges are small and will not result in fissures or cracks on the surface. As the charge is fully contained in the ground and there is no surface blowout, noise generated by the onshore source point is negligible. After the charge has been fired, the de-activated source point drill hole will be capped with a metal cap that is buried, preventing any accidental re-entry of this hole by humans or animals. The area around the source point is then returned to its original condition. The reflections from each onshore source point will be recorded using both the onshore and offshore receiver lines for a particular recording patch resulting in a seamless subsurface 3D image.

In certain areas of the survey, where topographic relief is less extreme and where surface vegetation is minimal, and along Route 405 (parallel to the west coastline of the peninsula) the Vibroseis source method will be incorporated. The Vibroseis system can be effectively tuned to enhance or diminish the power of each sweep and has been successfully used to acquire seismic data in highly urbanized areas such as downtown Los Angeles without damage to roadways, buildings or any buried facilities such as pipelines or utility lines. Vibroseis will be used in areas where conventional shot hole contained dynamite source points are not feasible.

The typical recording crew consists of approximately 30 to 40 people and includes highly trained technical individuals to run the recording instruments and maintain the various electronic and mechanical systems, and surveying personnel. A number of local laborers will be required to move the receiver elements and cable systems. The recording instrument is typically housed in a recording unit housed on a three- ton truck. This truck is usually positioned in a central location within the patch to maximize recording efficiency.

2.5 Seismic Signals (underwater)

The onshore recording arrays will extend into the offshore environment through the temporary installations of ocean bottom geophones. The offshore recording array will record reflected signals generated by both onshore and offshore seismic source points. The offshore seismic source points will be generated by using an array of air sleeves towed behind a shallow draft vessel (typical fishing boat) which has been specially equipped by the seismic contractor with compressors, navigation equipment and the air sleeve array. The total length of nine offshore source lines is approximately 200 km. This is relatively small compared to a typical (1,000 – 5,000 km) deepwater marine survey. The offshore source vessel activity will be coordinated with the onshore source activity and will be controlled by the onshore recording truck. This will insure that the proper signals are recorded at the proper time across the entire recording patch under consideration.

In operation, the air sleeves will be fired at approximately six- to eight-second intervals as the source vessel moves along the specific source line track (parallel to the coastline) through the water at approximately 5 knots. The release of energy from the air sleeves is of short duration, 150 to 200 ms on average. Although peak energy levels reached within a specific source event may be high, the short signal duration reduces the total energy transmitted into the water column. Most of the sound energy produced by an air sleeve array is in the range of 10 to 300 Hz, with highest power at frequencies of less than 100 Hz (Turnpenny and Nedwell 1994). Seismic air sleeves are designed to produce low frequency noise, but research has shown that high frequency sound may also be produced, up to several kilohertz (kHz) (Goold 1996; JNCC 1998). Other factors (e.g., rise times, etc.) also influence the characteristics of a seismic signal, and thus its potential environmental effects.

The proposed offshore source for this Project may use up to 24 air sleeves in a towed array. This is done to increase the available acoustic output for greater penetration into the sea floor, to obtain greater source efficiency, and to shape the acoustic signature so that the vertical resolution needed for this survey is obtained. The layout of the array and the sequence of firing are carefully designed to optimize the data. The total air sleeve volume in the array, and their operating pressure, determine the amplitude of the acoustic signal, measured as the output Sound Pressure Level (SPL).

Large air sleeve arrays used in deep marine environments normally have a combined chamber volume ranging up to 4,000 cubic inches (cu. in.) and operate at approximately 2,000 pounds per square inch (psi). Peak SPLs for typical deepwater marine arrays are between 240 to 260 dB 1µPa @ 1 m. A considerably smaller array is proposed for the transition survey. The maximum capacity is 2,250 cu. in. The peak SPL for the proposed array is less than 210 dB re 1µPa @ 1 m.

2.5.1 Air Source Design Parameters

Design work is currently under way by Tekoil to customize the air source array necessary to achieve good technical results as balanced against potential environmental effects of an air source array working the shallow water depths of the transition zone. This design may depart from the “off the shelf” standardized air source arrays.

2.5.2 Source Array

A source array with a maximum capability of 2,250 cu. in. is typical for this type of seismic survey. It is composed of three sub-arrays, operating at 2,000 psi air pressure. There are eight sleeves per sub-array, for a total of 24 sleeves. The larger sleeves are at the front of the source array and are clustered. The clusters will have their component sleeves arranged in a fixed side-by-side fashion, with the distance between the sleeve ports set to maximize the bubble suppression effects of clustered sleeves. The survey parameters are summarized in Table 2.1.

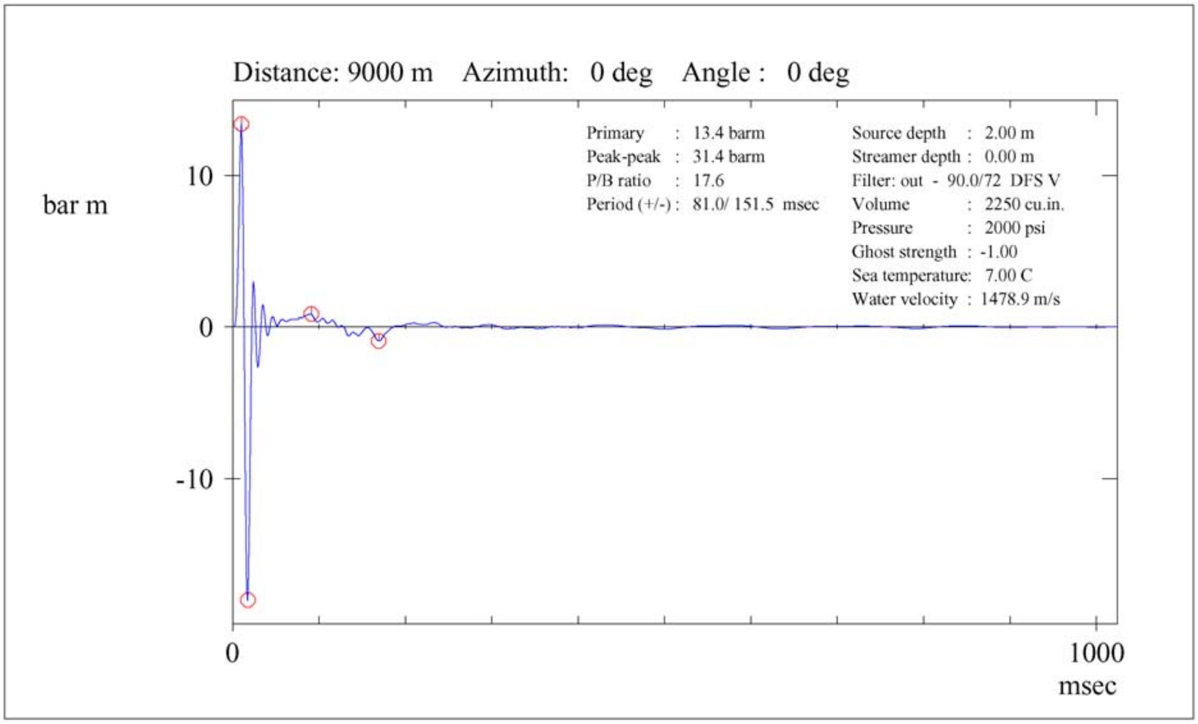
Table 2.1 Offshore Seismic Survey Parameters

Parameter	Dimensions
Number of Source Lines	9
Total Length of Lines (km)	203
Shot Interval	Approximately 50 m; 8 seconds/air sleeve pop
Recording Time	5 seconds
Peak SPL	Less than 210 dB re 1µPa @ 1 m
Source Array Tow Depth	4 m
Vessel Speed	5 to 6 knots
Firing Pressure	2,000 psi (air pressure in sleeves)
Number of Sub-Arrays	3
Width of Array	10 m
Length of Array	15 m
Number of Sleeves	24
Volume of Air Sleeve Array	Maximum of 2,250 cu. in.

2.5.3 Array Signature and Acoustic Radiation Patterns

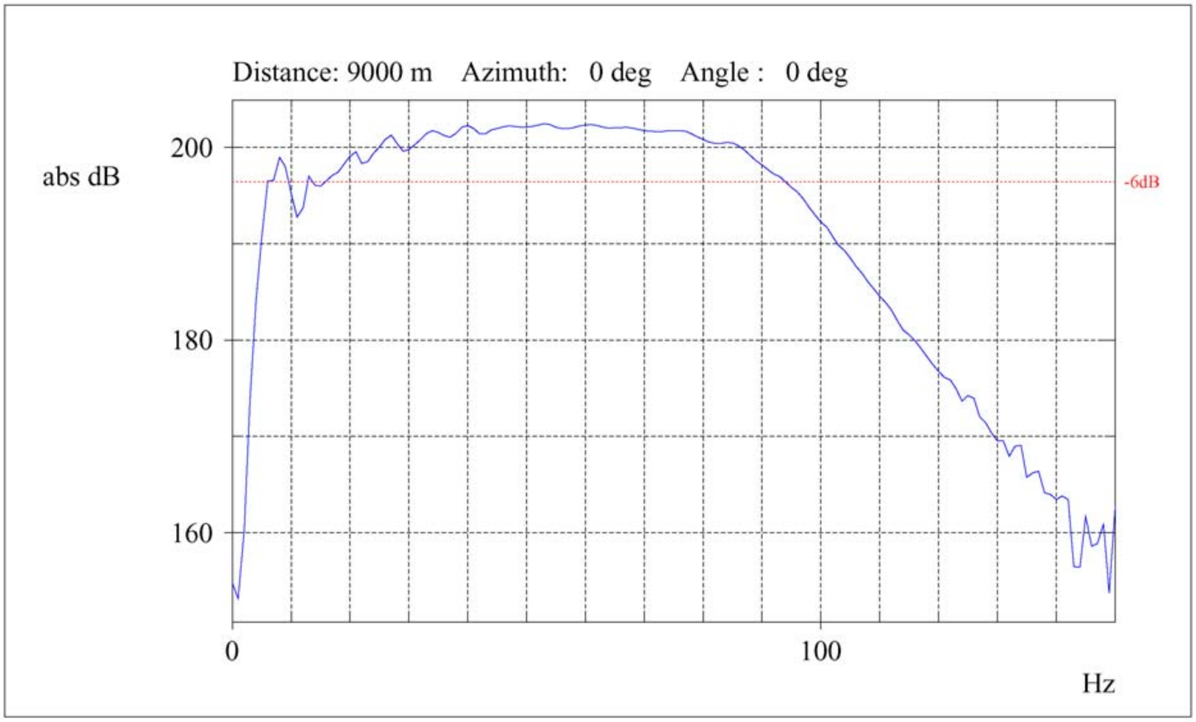
For evaluating the environmental impact of an air sleeve source, the signature is reported at the widest practical bandwidth. The far-field signature and amplitude spectrum for a typical 2,250 cu. in. array in the 0 to 150 Hz frequency band are shown in Figures 2.3 and 2.4, respectively. The seismic source energy in this survey will be concentrated between 15 and 95 Hz (-6 dB points representing the one-half power intercepts as shown on Figure 2.4) with almost no energy at frequencies higher than 110 Hz (-12 dB points representing the one-fourth power intercepts as shown on Figure 2.4).

Figure 2.3 Far-field Signature of Array: 2250_2M_3str



Source: Typical Air Sleeve Array Design Specifications provided by Global Geophysical

Figure 2.4 Amplitude Spectrum of Far-field Signature Array: 2205_2M_3str



Source: Typical Air Sleeve Array Design Specifications provided by Global Geophysical

The acoustic energy radiation pattern for a 2,250 cu. in. array in the vertical plane along the inline axis of the array is shown in the top diagram of Figure 2.5. The outer semi-circle represents a frequency at 150 Hz. The next inner arc is at 125 Hz, the next at 100 Hz to a minimum of 0 Hz. Emission angle is measured along the lines emanating from the 0 value in the center of the display. The line connecting 0-0 represents the vertical axis of the air sleeve source array; the colors along this axis represent the amplitude power spectrum of the vertical signature and are shown progressively in -6 dB increments as defined by the color bar associated with the plot. Amplitude power is defined in increments of -6 dB as the logarithmic scale thus represented translates to each -6 dB being one-half the power of the previous color. Therefore -6 dB represents ½ power, -12 db is ½ of ½ or ¼ power and so forth. Emission angle is incremented in 30-degree increments up to the horizontal directions indicated at azimuths of +90 B (behind the array) and -90 A (in front of the array). The cross array direction is depicted in a similar manner on the lower display of Figure 2.5.

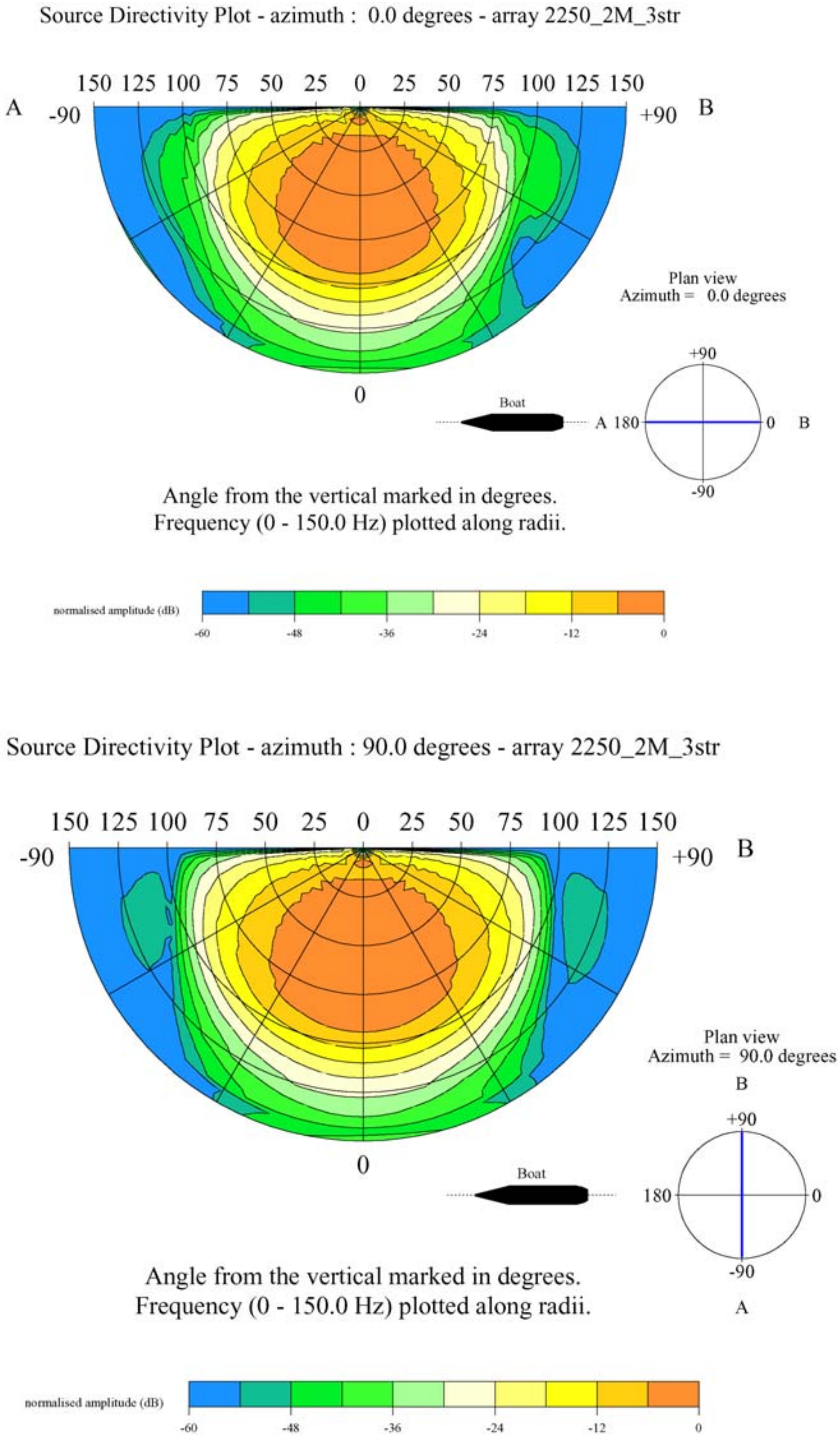
Most of the broadband energy is concentrated close to the vertical (orange to yellow colors). Emissions at frequencies above 100 Hz are highly attenuated (green to blue colors) along radiation paths away from the vertical and there is slightly more high frequency energy emitted side-ways from the array rather than from front-to-back (IAGC 2002). In general, direct air sleeve pressure pulses propagating through the water column result in:

- most of the broadband energy emitted from the air sleeve array being concentrated close to the vertical emission angle resulting in maximum power being directed directly below the array and straight into the seafloor;
- pressure amplitudes being significantly less than predicted from point source extrapolation (by as much as -20 dB (i.e., 1/10th reference), in the array's near-field;
- rapidly diminishing pressure amplitude at emission angles greater than 45 degrees; and
- coherent high frequency energy generated by air sleeve arrays generally is less than 100 Hz.

2.5.4 Transmission Loss and Sound Attenuation

Sound output from a seismic air sleeve source array diminishes with distance from the source point. In general, transmission loss occurs more rapidly near the source and becomes more gradual at longer distances. The chief factors contributing to transmission loss are spreading loss and attenuation (Canning and Pitt 2003). Spreading loss occurs as the sound energy is dispersed from the source. The power or density of the sound then diminishes as the sound spreads out over a progressively larger area. The spreading loss is spherical in the ocean until the sound reaches the sea floor, the air/sea interface or some other discontinuity such as thermal layers (Canning and Pitt 2003). At this point the sound wave becomes more cylindrical and spreading loss slows.

Figure 2.5 2,250 cubic inch Array Source Directivity Plots for Azimuth 0 Degrees and 90 Degrees at Frequencies 0 to 150.0 Hertz



Source: Global Geophysical.

Sound attenuation occurs through other means including absorption loss into the sea floor or other features or loss due to viscosity of water, suspended particles, and air bubbles. In shallow water, scattering may also occur when sound energy is reflected and refracted by various boundaries (Canning and Pitt 2003). Differences in absorption and scattering will result depending on the shape of the sea bottom and whether it is composed of sand, rock or silt. Water pressure, salinity and temperature will also affect the speed and behaviour of sound waves (Canning and Pitt 2003). For example, sound propagation in shallow, shelf areas, is more strongly attenuated, especially at low frequencies, while sound is likely to propagate further in deeper waters, especially where acoustic channels exist.

2.6 Schedule

Onshore preparation and charging of the shot holes will begin after snowmelt in May, with a target completion date of July 30. Laying out of the receiver lines onshore and offshore will commence August 15 through to October 31.

A total of eight patch areas of approximately 2.8 by 12 km each are required to cover the complete Project Area. With an inter-line spacing of approximately 400 m, it will take approximately one week to lay out an onshore patch, record the seismic and pick up the cables and geophones to relocate them to the next patch area. The corresponding offshore cables can be laid out and picked up more quickly. On average, it will take approximately three days total to lay out the underwater cables, tie them into the patch array, record seismic and pick the cables up again.

Both preparation and recording work will be done in daylight hours. As the vessel returns to port every evening, the morning weather forecast will help to determine if the vessel goes out on a particular day.

2.7 Routine Discharges

Discharges and emissions from this program will be similar to those of any standard marine fishing vessel. These routine discharges are minor and will not cause significant environmental effects:

- Atmospheric Emissions - emissions from ship engines and onboard equipment will comply with the *Air Pollution Control Regulations* (Newfoundland and Labrador *Environmental Protection Act*) and the Ambient Air Quality Objectives (*Canadian Environmental Protection Act*).
- Ballast Water – ballast water is stored in dedicated ballast tanks to improve vessel stability. No oil should be present in these tanks or in any discharged ballast/preload water (*Guidelines for the Control of Ballast Water Discharge from Ships in Waters Under Canadian Jurisdiction* (Transport Canada 2001)).
- Grey and Black Water - It is anticipated that the seismic source vessel will carry a crew of 4 to 10 people. The seismic source vessel will be operated only during daylight hours and will return to port each evening. Therefore, there will be no personnel living on the vessel and no discharge of grey or black water is anticipated.
- Solid Waste - Solid waste will be transferred to shore and disposed of at an approved landfill facility. Any hazardous materials (e.g., oily rags) will be handled separately in hazardous materials containers.

2.8 Labour Force Requirements

The number of persons employed, and goods and services required for the survey will be determined once contracts are let. First priority will be given to qualified local residents, goods and services where such are competitive in terms of price, quality and delivery. Approximate employment levels are:

Shot Hole Preparation	80
Field Biologist	1
Recording Crew	25
Source Vessel	6
Fisheries Liaison Officer (FLO)	1
Single Point of Contact (SPOC)	1
Environmental Observer	1
Archaeologist	1

2.9 Accidental Events

The survey will be conducted using either a specialized vessel or a local fishing vessel equipped with specialized air compressors and a towed air sleeve array. Either vessel will be equipped with the proper equipment, systems, and protocols in place for prevention of pollution in accordance with the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2004). Vessel pre-survey audits by regulatory agencies, the seismic contractor and Project operator will be conducted prior to survey commencement.

Any accidental spill of diesel fuel or lube oil from the seismic source vessel will be reported to the C-NLOPB and Canadian Coast Guard Emergency Response immediately. Fish and fish habitat may be affected if there is direct contact with the fuel. Mortality of eggs and larvae could be expected. Depending on the timing, location, and environmental conditions of such an event, there could be oiling of seabirds. Fishing gear fouling and potential loss of income through reduced catch value or suspended fishing could also result. However, the likelihood of such an event is extremely low and the nature of diesel fuel is such that it evaporates from the surface relatively quickly and does not persist in the environment for any length of time. Other accidental events that may occur include damage or loss of seismic gear, entanglement of seismic gear with fishing gear, and vessel collisions. Best management practices will be used on the source vessel to avoid gear loss or damage. Seismic recording gear (including cables and ocean bottom geophones) is designed to remain on the ocean bottom with a very low profile. In the event of a temporary increase in sea state (summer storm), the seismic source vessel will not be allowed to work in the Project Area and the recording equipment will remain safely sequestered on the ocean bottom. Deployment and recovery of the ocean bottom cables will only be undertaken during times of moderate to low sea state, when conditions allow safe operations.

In order to ensure effective communication with fishers and to avoid gear damage and vessel collisions, a FLO will be onboard when the seismic source vessel is working. Entanglement of marine mammals or sea turtles in seismic gear is not likely as no lengthy recording streamers are being towed behind the vessel. The source vessel will travel at an average speed of 5 to 6 knots when the towed air sleeve array is deployed and will increase to approximately 10 to 12 knots while in transit from the Project Area to port. Although the potential for collisions with marine mammals exists, the likelihood of this happening is extremely low as marine mammals will avoid the vessel. A trained on-board Environmental Observer will keep watch for marine mammals and sea turtles during the program.

3.0 STAKEHOLDER COMMUNICATIONS

3.1 Stakeholders Contacted and Issues Identified

Stakeholders were contacted by telephone to provide an opportunity for information exchange regarding the proposed project and potential issues. Tekoil recognizes that these contacts with local fishers were preliminary only and will be meeting with interested fishers and Fish, Food and Allied Workers (FFAW) as required. The proceedings of these meetings will be provided to the C-NLOPB. Tekoil will continue to work with area fishers and other stakeholders to effectively respond to identified concerns.

A complete list of stakeholders contacted during the preparation of this environmental assessment is provided in Table 3.1. The list includes federal and provincial government departments, municipal councils, economic development boards, local fishers, conservation groups, francophone organizations, union representatives, One Ocean and the C-NLOPB. The various organizations and a description of the information exchanged is identified.

Table 3.1 Stakeholders Contacted and Information Exchanged

Organization	Information Exchanged
Department of Fisheries and Oceans (Stephenville)	Contacted for information on local fisheries, no issues raised.
Department of Fisheries and Oceans (St. John's) Habitat Evaluation Section	Contacted for information on timing and location of DFO fisheries assessment surveys in the Gulf of St. Lawrence in 2006, no issues raised.
Department of Fisheries and Oceans (St. John's) Salmonid Section	Contacted for information on run timing of Atlantic Salmon to west coast rivers.
Department of Fisheries and Oceans (St. John's) Salmonid Section	Contacted for information on run timing of Atlantic Salmon to west coast rivers.
Department of Fisheries and Oceans (St. John's) Habitat Evaluation Section	Concern expressed regarding the timing of the project in relation to fishing and spawning times and lack of detail in project description on the freshwater component.
Canadian Wildlife Service (St. John's)	Contacted regarding seabirds on the Port au Port Peninsula.
Newfoundland and Labrador Department of Fisheries and Aquaculture	No fisheries development or emerging fisheries projects ongoing or planned for the project area in 2006.
Newfoundland and Labrador Department of Environment and Conservation	Contacted Environmental Assessment Division regarding environmental assessment process clarification
Newfoundland and Labrador Department of Environment and Conservation (Inland Fish and Wildlife Division)	Contacted regarding rare plants on the Port au Port Peninsula.
Newfoundland and Labrador Department of Environment and Conservation (Inland Fish and Wildlife Division)	Contacted regarding caribou and other wildlife on the Port au Port Peninsula.
Department of Natural Resources (Agrifoods)	Contacted regarding agriculture on the Port au Port Peninsula.
Department of Natural Resources (Forestry Branch)	Contacted regarding forest inventory on the Port au Port Peninsula.
Department of Tourism and Culture (Parks and Natural Areas Division)	Contacted regarding rare plants and special areas on the Port au Port Peninsula.
Department of Natural Resources	Contacted regarding other onshore seismic activity in the area.
Atlantic Canada Conservation Data Center (ACCDC)	Contacted regarding records of rare flora or fauna on the Port au Port Peninsula.
Fish Food and Allied Workers Union (FFAW)	Suggested seismic survey could not take place prior to mid August due to conflicts with fishing activity and critical spawning times. Provided fisheries information and contact names for fishers.

Organization	Information Exchanged
Federation of Newfoundland Indians (FNI)	Suggested project description be sent to Kitpu first nation and Port au Port Indian Band. No concerns raised.
Kitpu First Nation	Sent project description by electronic mail. No concerns raised.
Port au Port Indian Band	Sent project description by electronic mail. No concerns raised.
Stephenville Town Council	Described project by phone and sent project description by electronic mail. No comments received.
Cape St. George Town Government	Described project by phone and sent project description by fax. No comments received.
Port au Port West Municipal Government	Described project by phone and sent project description by electronic mail. No comments received.
Port au Port East Town Government	Described project by phone and sent project description by fax. No comments received.
Lourdes Municipal Government	Described project by phone and sent project description by electronic mail. No comments received.
Long Range Regional Economic Development Board	Described project by phone and sent project description by electronic mail. No comments received.
Atlantic Coastal Action Program (ACAP)	Left telephone message providing brief project description, no reply received, no project description sent.
ARCO Francophone Association	Asked if Cape St. George Park would be disturbed by the project, informed of a suspected increase in the number of Gannets in the area.
Salmonid Council of Newfoundland and Labrador	Concern expressed regarding possible impacts to salmon migrating to west coast rivers, especially MSW salmon returning to Bay St. George area. Suggested in-depth analysis of potential impacts to salmon and that work be completed well before or after the annual migration of salmon.
Salmon Preservation Association for the Waters of Western Newfoundland (SPAWN)	Described project by phone and sent project description by electronic mail. No comments received.
Atlantic Salmon Federation (ASF)	Concern expressed regarding adult salmon, juvenile salmon (smolts) and sea trout that may be abundant in the project area during migration/emigration times. Outlined need for greater scientific understanding of seismic impacts on salmonids in the marine environment. In the absence of science the precautionary approach would be to not conduct seismic operations prior to July 15.
Fisher (Bay St. George)	Provided information on inshore fishery. Project description provided by electronic mail.
Fisher (Benoits Cove)	Provided information on fishery in the project area mainly related to seining activity for capelin, herring and mackerel. Suggested a project conducted in August would offer the least opportunity for conflict. Project description sent by mail.
Fisher (Black Duck Cove)	Provided information on inshore fishery in the project area. Asked about the effects of seismic on fish species. Project description provided by electronicmail.
One Ocean	Provided project description by electronic mail. Requested that FFAW and fishers be consulted.
C-NLOPB	Contacted regarding other offshore seismic activity in the area

One Ocean was contacted to exchange information regarding the proposed Project and fishery-related issues. The Project Description (Appendix A) was provided to One Ocean and a request was made for fisher-related contacts. One Ocean distributed the Project information to FFAW in Corner Brook. FFAW provided preliminary information to One Ocean on the lobster, crab, cod, halibut, herring and mackerel seasons in the vicinity of the Project Area. FFAW requested mapping information on migration routes and spawning areas for cod, crab, shrimp, lobster, mackerel, and herring. One Ocean advised that oil and gas activity should not proceed until after August, and that consultation is required. One Ocean also indicated they would be available to assist.

Following discussions with One Ocean a representative of FFAW in Corner Brook was contacted by telephone. The FFAW representative provided an overview of fisheries-related activity occurring within the Project Area and provided a list of four local fishers who could be consulted. Contact was made with three of the four local fishers; the fourth could not be contacted. A subsequent informal meeting was held with the FFAW representative at the Jacques Whitford office in St. John's to obtain further information on fisheries within the Project Area.

3.2 Concern and Issue Summary

Concerns and issues raised during the consultation process relate mainly to the timing of the proposed survey and its potential conflict with fishing activities and fish spawning times. This issue was raised by fishers, union representatives and DFO.

A closely related concern is the potential effects of seismic operations on fish. This issue was raised by fishers, FFAW, DFO and conservation organizations. Conservation organizations were concerned with the potential effect of seismic on the salmonid resource.

Other comments made in relation to the project include concern over the lack of information contained in the project description regarding the freshwater environment and concern over possible seismic activity in Cape St. George Park.

4.0 ENVIRONMENTAL ASSESSMENT METHODS

4.1 Overview

The approach and methods used for the environmental assessment are based largely on the work of Beanlands and Duinker (1983), the CEA Agency (1994; 1999), and Barnes et al. (2000), as well as the study team's experience in conducting environmental assessments. The approach and methods used have proven very effective for assessments conducted under federal, provincial, joint federal-provincial and multi-party processes, as well as for environmental assessments in various jurisdictions throughout the world. The environmental assessment focuses on the VECs identified through issues scoping as described below.

The specific steps involved in the assessment for each VEC are as follows:

- determining boundaries;
- identifying potential interactions between VECs and the project's components/activities and outlining existing knowledge regarding these potential interactions;
- significance criteria for residual environmental effects;
- assessing environmental effects and mitigations;
- cumulative effects assessment; and
- identifying the need, if any, for follow-up requirements.

Each of these is described in more detail in the following sections.

4.2 Issues Scoping and Selection of Valued Environmental Components

Project scope encompasses those components and activities considered for the purpose of environmental assessment (CEA Agency 1996). The scope of the proposed seismic exploration program includes all of the components and activities, including accidental events, described in Section 2 of this report.

Assessing all of the potential environmental issues associated with a proposed undertaking is impractical, if not impossible (Beanlands and Duinker 1983). It is therefore generally acknowledged that an environmental assessment should focus on those components of the environment that are valued by society and/or which can serve as indicators of environmental change. These components are known as Valued Environmental Components (VECs), and may include both biophysical and socio-economic features.

The issues scoping exercise conducted in relation to this environmental assessment included:

- review of the Scoping Document issued by C-NLOPB in December 2005;
- consultation with relevant regulatory agencies and other stakeholders;
- a review of available information on the existing biophysical and socio-economic environments of the region in which the program will occur, and of other environmental assessments undertaken in relation to similar projects;

- a review of relevant regulations and guidelines related to offshore exploration drilling; and
- the professional judgment of the study team.

Representatives of key government agencies, industry representatives and other stakeholders were contacted as part of the issues scoping process, in order to discuss the proposed seismic exploration program, obtain information on the existing environment, and to identify any potential environmental issues that may be associated with the proposed program.

As discussed previously, it is generally acknowledged that an environmental assessment must focus on those components of the environment that are valued by society and/or that can serve as indicators of environmental change and have the most relevance to the final decision regarding the environmental acceptability of a proposed undertaking.

Based on the results of the issues scoping exercise described above, the following VECs are considered in this Screening/Registration:

- marine birds;
- marine fish, shellfish and habitat;
- marine mammals;
- sea turtles;
- commercial fisheries;
- freshwater environment;
- terrestrial environment; and
- land use.

The rationale for the selection of these VECs is provided below.

- **Marine Fish, Shellfish and Habitat**: The commercial fishery is an important element in Newfoundland and Labrador's history, as well as its current socio-cultural and economic environment. The fish and fish habitat upon which the fishery depends is therefore an important consideration in the environmental assessment of activities which may influence the marine environment. It should be noted that this rather broad VEC includes coverage of such components of fish habitat as plankton and benthos. Fish and their habitat are assessed as a single VEC because they are clearly interrelated. The consideration of fish and fish habitat as one VEC is in keeping with current practice in environmental assessment, and provides for a more comprehensive, ecosystem-based approach while at the same time minimizing repetition and enhancing brevity.
- **Marine Mammals and Sea Turtles**: Whales and seals are key elements in the biological and social environments of Newfoundland and Labrador. Historically, seals have played an important economic and cultural role due to the large annual seal hunt. At present, a significant portion of the province's tourism industry is based on tour boats that feature whale watching. Although sea turtles are generally uncommon in the northern Gulf of St. Lawrence, they are considered a VEC because of some species' endangered and threatened status.
- **Marine Birds**: Newfoundland's offshore environment hosts a range of seabirds throughout the year. Seabirds are a key component near the top of the food chain and are an important

resource for tourism and recreational activities, and for scientific study. They are therefore important socially, culturally, economically, aesthetically, ecologically and scientifically.

- **Fisheries**: Commercial fisheries were also selected as a VEC because historically, the fishery has played an important role in Newfoundland and Labrador's economy and has helped to define much of the province's character. The fishery remains an integral component of the economy of Newfoundland and Labrador.
- **Freshwater Environment**: Although there are no scheduled salmon rivers in the Project Area, there may be an interaction between the proposed project and the freshwater environment.
- **Terrestrial Environment**: The Port au Port Peninsula falls within the Western Newfoundland Forest Ecoregion and the Port au Port Subregion. The area is geologically diverse with limestone, serpentine and acidic rock types covering extensive areas (Meades 1990). A number of rare vascular plant species have been identified on the Port au Port Peninsula.
- **Land Use**: The proposed Project Area is used by local residents for recreational activities and for the relative undeveloped nature of the area, which attracts tourists to the area. The Port au Port Peninsula is also a Moose Management Area (MMA 43) and is open to hunters in the autumn of each year.

These seven VECs represent the key environmental components that are assessed in this document. This environmental assessment provides detailed effects analyses for each of these VECs. Species at risk, as defined by the *Species at Risk Act* (SARA) are addressed within each relevant VEC.

4.3 Environmental Effects Assessment Organization

4.3.1 Boundaries

Boundaries provide a meaningful and manageable focus for an environmental assessment. They also aid in determining the most effective use of available study resources. Boundaries are described generally below and in further detail as part of the effects analysis sections for each of the VECs. Establishing the spatial and temporal scope of the environmental assessment for each VEC included consideration of project, ecological/socio-economic and administrative boundaries.

The boundaries have been categorized as follows:

- Project Area: the area in which seismic activities will occur and the "buffer zone" required for line changes.
- Affected Area: the area that could potentially be affected by project activities beyond the Project Area.
- Region: The area extending beyond the "affected area" boundary. The "region" boundary will also vary with the component being considered (e.g., boundaries suggested by bathymetric and/or oceanographic considerations).
- Provincial: The area extending beyond the "region" boundary but confined to the Province of Newfoundland and Labrador, the area of jurisdiction of the C-NLOPB, or both.
- Assessment Area: the area within which the baseline conditions are described for each VEC.

4.3.1.1 Project Boundaries

Project boundaries are defined by the spatial and temporal extent of project components and activities and are determined primarily by project-specific characteristics. Spatial project boundaries are defined by project "footprints" and may vary between project components and activities. Temporal project boundaries are defined by the timing and duration of project activities, as described in Section 2.

4.3.1.2 Ecological and Socio-economic Boundaries

Ecological boundaries are determined by the spatial and temporal distributions of the biophysical VECs under consideration. Spatial ecological boundaries may be limited to the immediate Project Area or may extend well beyond the immediate footprints as the distribution and/or movement of an environmental component can be local, regional, national or international in extent. Such factors as population characteristics and migration patterns are important considerations in determining ecological boundaries and may influence the extent and distribution of an environmental effect.

Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects, and any sensitive or critical periods of a VEC's life cycle (e.g., spawning, migration).

Spatial and temporal socio-economic boundaries are determined by the nature of the VECs under consideration. For Fisheries, spatial boundaries include North Atlantic Fisheries Organization (NAFO) region 4Rc. Temporal boundaries include historical fisheries to 1986 and projected fisheries to 2006.

4.3.1.3 Administrative Boundaries

Administrative boundaries refer to the spatial and temporal dimensions imposed on the environmental assessment for political, socio-cultural or economic reasons. Spatial administrative boundaries can include such elements as the manner in which natural and/or socio-economic systems are managed.

4.3.2 Potential Interactions and Existing Knowledge

The assessment focuses on identifying and evaluating potential interactions between program components and activities and each of the VECs under consideration. As a first step in the effects analysis, potential program-VEC interactions are identified and discussed. Existing knowledge concerning these potential interactions is also reviewed and summarized.

4.3.3 Mitigation

Based on the potential interactions identified above and existing knowledge regarding these interactions, technically and economically feasible mitigation measures to reduce or eliminate potential adverse effects are identified.

Where possible, a proactive approach to mitigating potential environmental effects has been taken by incorporating environmental considerations directly into program design and planning (Section 2). Where required and feasible, additional measures are identified in the environmental assessment to further mitigate potential negative effects and optimize benefits for certain VECs. These mitigation measures are identified and discussed within the appropriate effects analysis section(s). Residual environmental effects predictions were made, taking into consideration these identified mitigation measures.

4.3.4 Residual Environmental Effects Significance Criteria

Evaluating the significance of predicted residual environmental effects is one of the critical stages in an environmental assessment. Significant environmental effects are those adverse effects that will cause a change that will alter the status or integrity of a VEC beyond an acceptable level. In this assessment, environmental effects are evaluated as either significant, not significant or positive, based on definitions of significance which will be developed and used for each VEC (provided in Section 6).

The definitions for significant adverse environmental effects integrate key factors such as magnitude (i.e., the portion of the VEC population affected), potential changes in VEC distribution and abundance, effect duration (i.e., the time required for the VEC to return to pre-project levels), frequency, and geographic extent. They also include other important considerations such as interrelationships between populations and species, as well as any potential for changes in the overall integrity of affected populations. For each VEC, an adverse environmental effect that does not meet the criteria for a significant environmental effect is evaluated as not significant. A positive effect is one that may enhance a population or resource use activity.

4.3.5 Environmental Effects Assessment

This stage entails the assessment of the potential effects associated with each project's components/ activities and potential accidental events for each of the VECs under consideration. Effects were analyzed qualitatively and, where possible, quantitatively using existing knowledge, professional judgment and appropriate analytical tools.

The evaluation of environmental effects, including cumulative environmental effects, takes into consideration:

- the potential interaction between Project activities for each of the Project phases and their environmental effects in combination with those of other past, present and likely future projects;
- the mitigation strategies applicable to each of the interactions; and
- the Agency's evaluation criteria for determining significance (CEAA 1994) and any other evaluation criteria established by the study team to further characterize the nature and extent of the environmental effects, where required.

Environmental effects are classified by determining whether they are adverse or positive. This is indicated in Table 4.1 by the use of a bracketed ("A") or ("P"). The following includes some of the key factors that can be considered for determining adverse environmental effects, as per the Agency guidelines (CEAA 1994):

- negative environmental effects on the health of biota;
- loss of rare or endangered species;
- reductions in biological diversity;
- loss or avoidance of critical/productive habitat;

- fragmentation of habitat or interruption of movement corridors and migration routes;
- transformation of natural landscapes;
- discharge of persistent and/or toxic chemicals;
- toxicity effects on human health;
- loss of, or detrimental change in, current use of lands and resources for traditional purposes;
- foreclosure of future resource use or production; and
- negative effects on human health or well-being.

The environmental effects assessment also includes summary tables for each VEC that summarize the potential effect of each project activity/component using the following criteria (see Table 4.1 as an example):

- magnitude;
- geographic extent;
- frequency;
- duration;
- reversibility; and
- ecological and socio-economic context.

Magnitude describes the nature and degree of the predicted environmental effect. For the biophysical VECs (fish and fish habitat, marine mammals and sea turtles, marine birds, freshwater environment, terrestrial environment and land use), ratings for magnitude were defined as follows (effects include mortality, sub-lethal effects or exclusion due to disturbance):

- Low Affects 0 to 10 percent of individuals in the affected area;
- Medium Affects 10 to 25 percent of individuals in the affected area; and
- High Affects greater than 25 percent of individuals in the affected area.

For the fishery, the magnitude of potential adverse effects is defined as follows:

- Low Affects 0 to 5 percent of fishers in the affected area;
- Medium Affects 6 to 25 percent of fishers in the affected area; and
- High Affects greater than 25 percent of fishers in the affected area.

Geographic extent refers to the area where the particular effect in question will occur. Frequency and duration describe how often and for how long a disturbance will occur. Quantitative values are provided for geographic extent, frequency and duration (see Table 4.1).

Reversibility refers to the ability of a VEC to return to an equal or improved condition once the disturbance has ended (for example, reclaiming habitat area equal or superior to that lost). Predicted effects are rated as reversible or irreversible based on previous research and/or experience. Finally, ecological, socio-cultural and economic context describes the current status of the VEC in the area affected by the projects due to past and/or existing human activities or natural factors.

Table 4.1 Potential Environmental Effects Assessment Summary

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting								
Vessel Traffic								
Safety Zone								
Routine Discharges								
Vessel Emissions (exhaust)								
Onshore Vegetation Clearing								
Drilling of Shot Holes								
Vehicular/ATV Traffic								
Unplanned Events								
Marine Fuel Spills (on-surface)								
Onshore Fuel Spills								

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
2 = Evidence of existing adverse effects
3 = High level of existing adverse effects

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

These criteria are used to provide a common basis for summarizing the potential effects of each project activity for each VEC.

The project is anticipated to take less than two months to complete (Duration rating of 2), and occurs within a geographic area of approximately 270 km^2. The nature of seismic activity is transient or reversible.

4.3.6 Follow-up

Consideration of a follow-up program is required for a screening-level environmental assessment. The purpose of the follow-up program is to:

- verify the accuracy of the environmental assessment;
- determine the effectiveness of mitigation measures.

As part of the environmental effects analysis, appropriate follow-up is described where warranted. Follow-up will be considered where there are important Project-VEC interactions, where there is a high level of uncertainty, where significant environmental effects are predicted, or in areas of particular sensitivity.

Follow-up programs should be well-defined and focused to allow for efficient use of time and resources. Follow-up programs are typically associated with longer-term projects, but are considered for discussion purposes in this assessment.

4.3.7 Cumulative Environmental Effects

Individual environmental effects are not necessarily mutually exclusive of each other but can accumulate and interact to result in cumulative environmental effects. This environmental assessment includes consideration of cumulative environmental effects for each VEC.

Within-project cumulative effects (i.e., those due to the accumulation and/or interaction of each project's own environmental effects) are considered as part of the project-specific environmental effects analyses described above (i.e., the overall effect of each project on a VEC). This section focuses on the cumulative effects of the seismic exploration program in combination with other relevant projects and activities.

The region's natural and human environments have been affected by past and on-going human activities. The description of the existing (baseline) environment reflects the effects of these other actions. The evaluation of cumulative environmental effects considers the nature and degree of change from these baseline environmental conditions as a result of the proposed program in combination with other ongoing and planned projects and activities.

An important step in undertaking a cumulative effects assessment is the identification of other actions whose effects will likely act in combination with those of the project under review to bring about cumulative effects. CEAA requires that only projects and activities that have been or will be conducted be considered. The degree of certainty that the project will proceed must therefore be considered (CEA Agency 1999). The other projects and activities considered in this assessment therefore included those that are ongoing or likely to proceed and have been issued permits, licenses, leases or other forms of approval (as specified by CEA Agency 1994). The cumulative effects assessment considers the cumulative effects of the proposed seismic exploration program in combination with:

- marine transportation;
- commercial fishery;
- oil and gas exploration;

- other seismic activity; and,
- onshore resource use.

4.3.8 Summary of Residual Environmental Effects Assessment

Significance ratings for the predicted residual environmental effects of each project component/activity and for each project as a whole are provided in summary tables for each VEC (see Table 4.2 as an example).

Table 4.2 Environmental Effects Significance

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting			
Vessel Traffic			
Safety Zone			
Routine Discharges (deck drainage)			
Vessel Emissions (exhaust)			
Onshore Vegetation Clearing			
Drilling Shot Holes			
Vehicular/ATV Traffic			
Unplanned Events			
Marine Fuel Spills (on-surface)			
Onshore Fuel Spills			
Project Overall			

KEY:

Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

The evaluation of the significance of the predicted residual environmental effects is based on a review of relevant literature and professional judgment. In some instances, assessing and evaluating potential environmental effects is difficult due to limitations of available information. Ratings are therefore provided to indicate the level of confidence in each prediction. The level of confidence ratings provide a general indication of the confidence with which each environmental effects prediction was made based on professional judgment and the effects recorded from similar existing projects. The likelihood of the occurrence of any predicted significant adverse effects is also indicated, based on previous scientific research and experience. As also specified in CEAA, the capacity of any significantly affected renewable resources to meet present and future needs was also considered, if required.

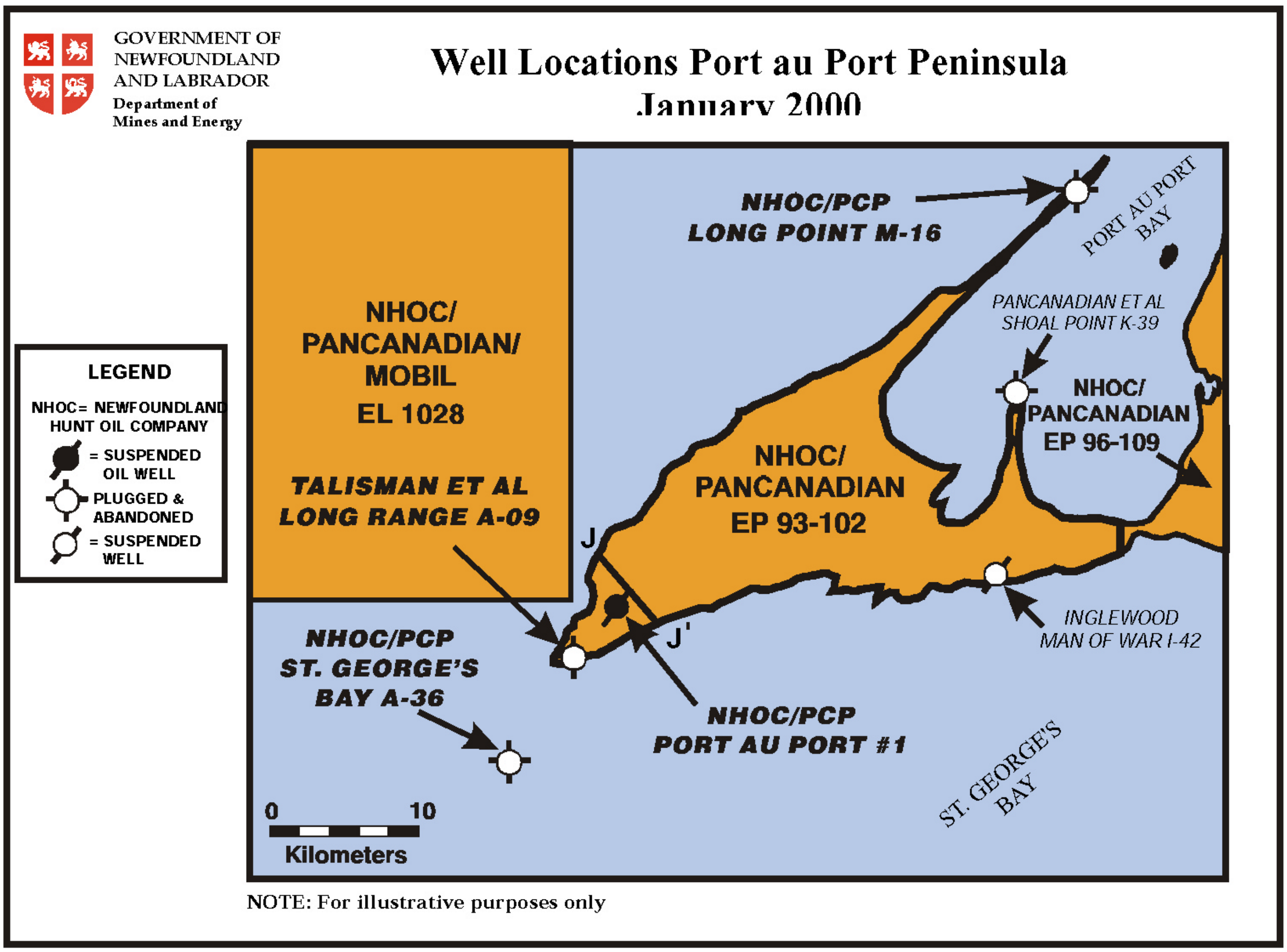
5.0 EXISTING ENVIRONMENT

5.1 Physical Environment

5.1.1 Geology

The Port au Port Peninsula is within the Magdalen Basin (a Carboniferous Basin) and adjacent to the Anticosti Basin (a Paleozoic Basin) (NLDME 2000). Wells previously drilled in the area (Figure 5.1) indicate that hydrocarbon in the Port au Port area is high quality, sweet oil, which is consistent with a Cambrio-Ordovician source rock (which is shale within the Green Point Formation in Western Newfoundland) (NLDME 2000).

Figure 5.1 Previously Drilled Wells in the Port au Port Peninsula Area



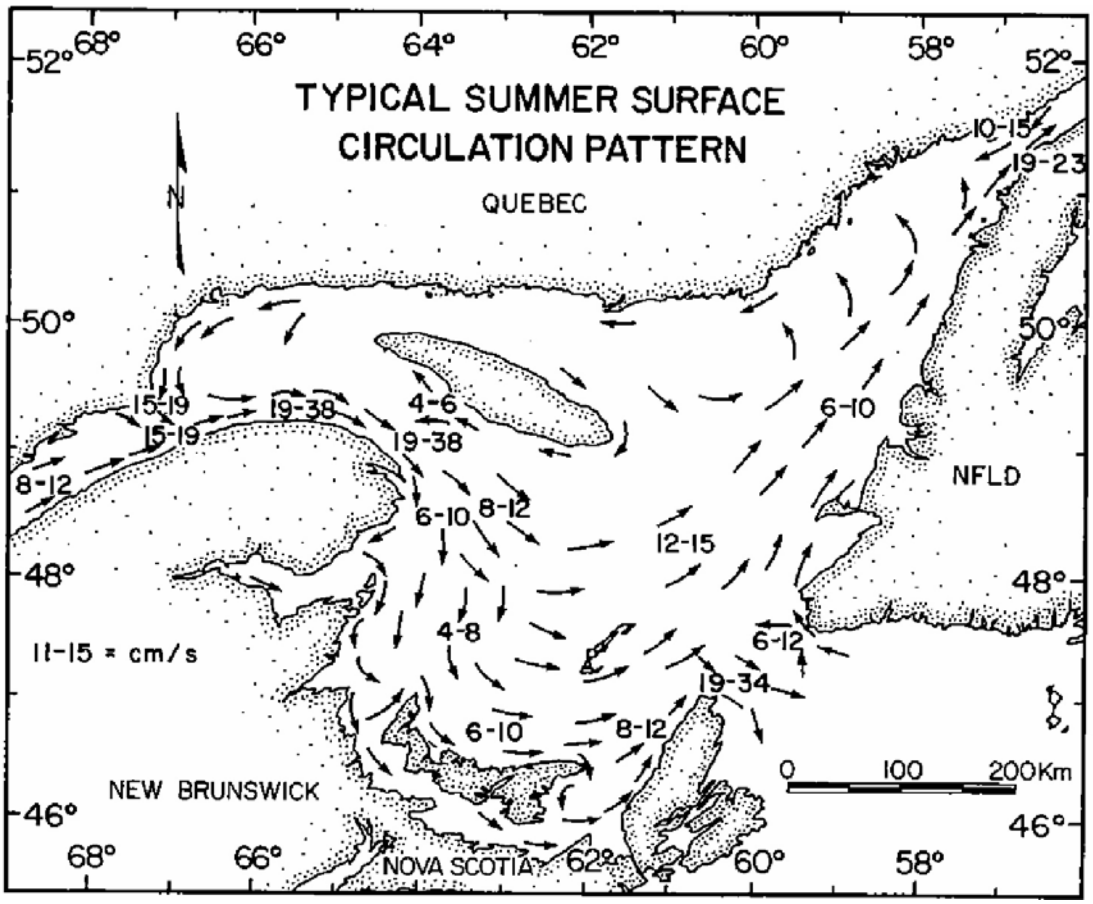
Source: NLDME (2000).

Shoal Point, a prominent, bedrock-cored point of land, separates the southern part of Port au Port Bay, an area of relatively flat saltwater marshes (C-NLOPB 2005). The remaining coastal geomorphology of the Port au Port Peninsula is characterized by raised terraces and marine deltas, paleocliffs and beaches (C-NLOPB 2005).

5.1.2 Currents

The mean monthly current speed in the Project Area ranges from 0.021 m/s in January to 0.080 m/s in October, with maximum current speeds recorded at from 0.110 m/s in October to 0.375 m/s in March (Bedford Institute of Oceanography 2003a). Surface circulation is counter-clockwise (cyclonic) (Figure 5.2) (Trites 1972, in C-NLOPB 2005), with water circulated out the Gulf of St. Lawrence from the Strait of Belle Isle along the island side and into the Gulf along the Labrador side of the province (C-NLOPB 2005).

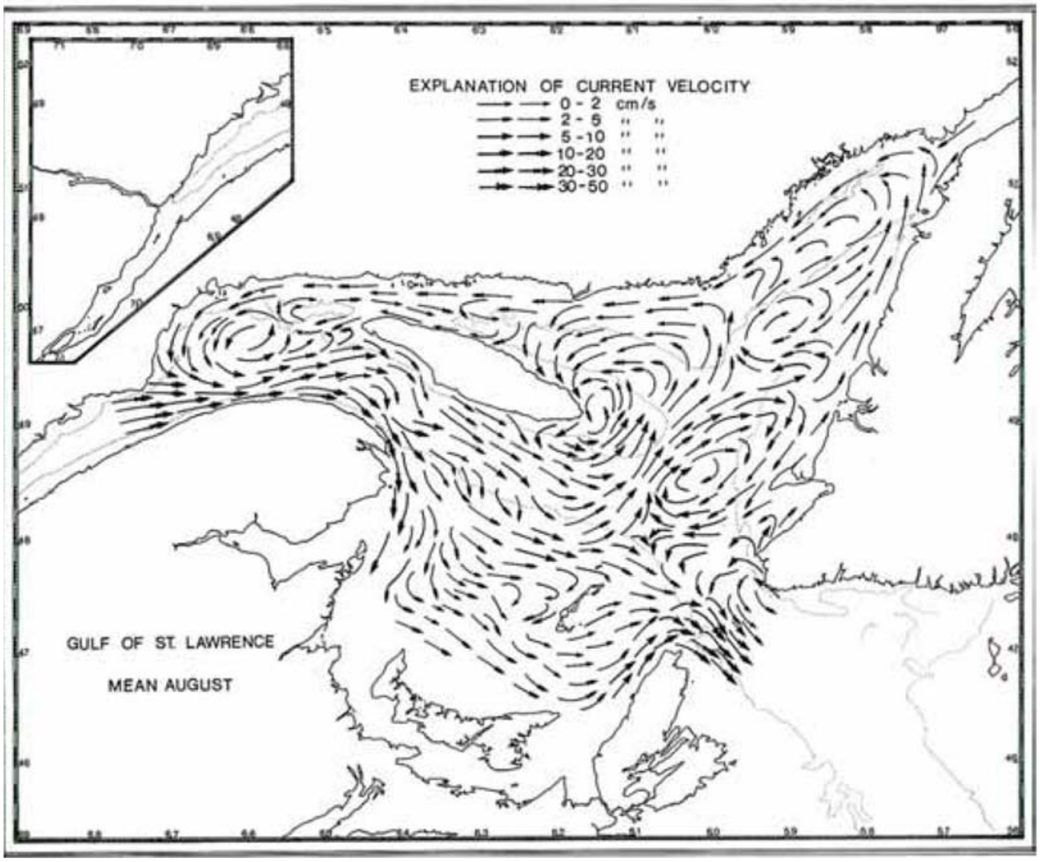
Figure 5.2 Surface Circulation (Summer)



Source: Trites 1972, in C-NLOPB 2005.

Although currents usually flow directly northeastward along the Island's west coast (El-Sabh 1976, in C-NLOPB 2005), permanent clockwise and counter-clockwise gyres do exist and sometimes move with the general flow, indicating a complex ocean circulation pattern in the Project Area (Figure 5.3) (C-NLOPB 2005).

Figure 5.3 Geostrophic Surface Currents in the Gulf of St. Lawrence in August



Source: C-NLOPB 2005.

5.1.3 Waves

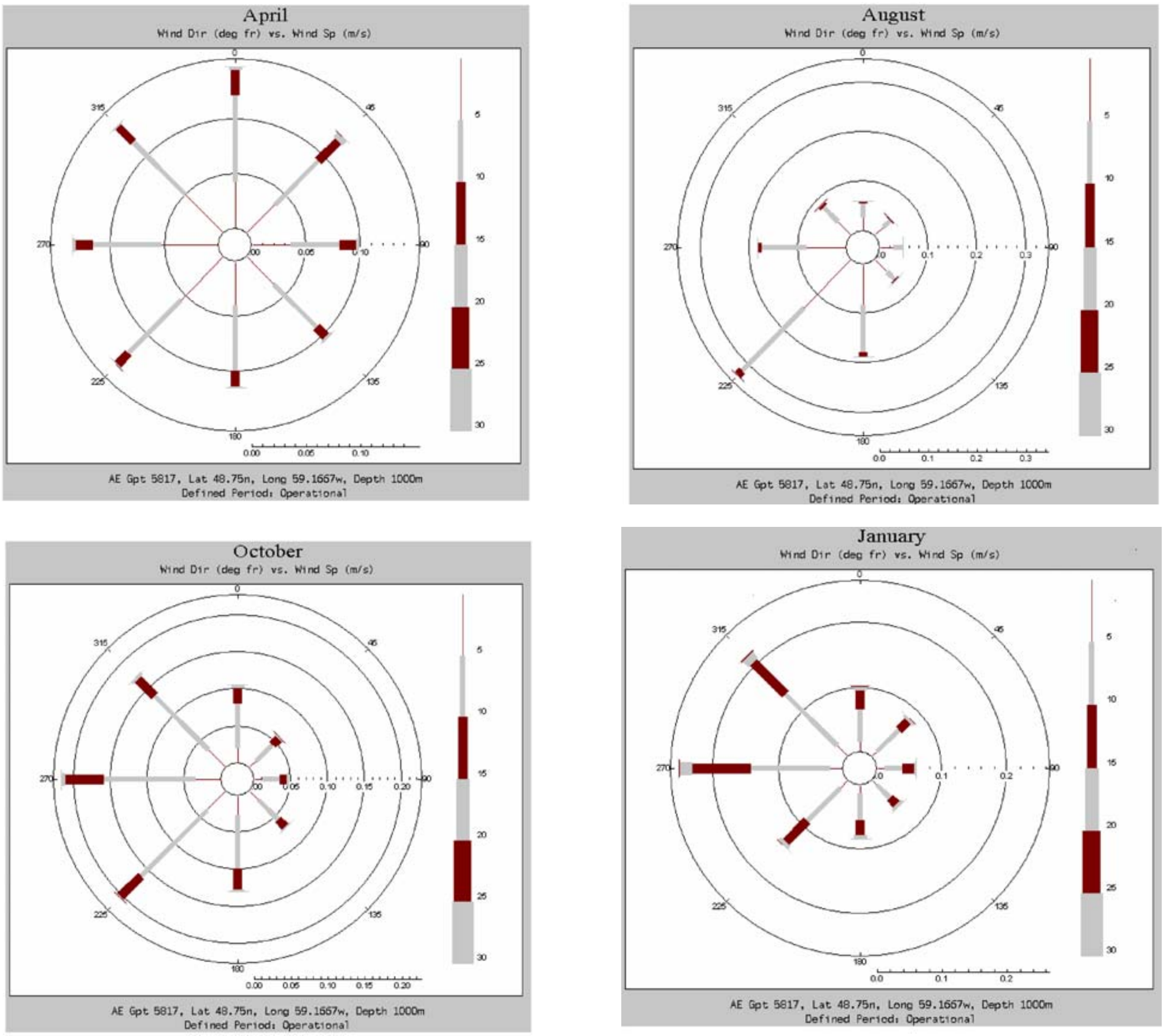
Extra-tropical storms, occurring primarily from October to March, dominate the Gulf of St. Lawrence wave climate. Tropical origin storms most often occur between late August and October. Hurricanes are rare but sometimes the tropical/extra-tropical storms do retain hurricane-force winds that result in high waves (C-NLOPB 2005). The highest waves have been recorded between October and January, with a 9.43-m significant wave height recorded in January. Significant wave heights have been recorded for all months except June to August (C-NLOPB 2005).

Wave statistics for the Gulf Port-au-Port area (1958 to 1999) (Atlantic Climate Centre 2003) and from the AES40 dataset (Atlantic Climate Centre 2003) include mean monthly wave heights, which range from 0.5 m (February and March) to 2.2 m (December). Maximum wave heights range from 4.6 m (July) to 10.5 m (January);

5.1.4 Wind

Data from the nearest Atmospheric Environment Service Grid Point 5817 (48.75°N; 59.17°W) just northwest of the Project Area indicated that wind direction shows a strong annual cycle. Winds from the southwest to northwest predominant in April. Predominant winds from May to August are from the south to southwest. Winds from the southwest to west were predominant in September and October, while west to northwest winds predominated from November to March (Figure 5.4) (C-NLOPB 2005).

Figure 5.4 Wind Roses for Four Seasons at Grid Point 5817



Source: C-NLOPB 2005.

All months except July and August recorded gale force (17.2 to 24.4 m/s) winds at AES Grid Point 5817, with storm force winds (24.5 to 32.6 m/s) recorded in December and January. No hurricane force (≥ 32.7 m/s) winds have been recorded at this AES Grid Point (C-NLOPB 2005). The highest wind speeds occur most frequently between November to January. However, the passage of tropical systems can result in high wind in late summer and fall (C-NLOPB 2005).

5.1.5 Water Temperature and Salinity

Due to the summer influx of the Labrador Current through the Strait of Belle Isle, there is a cold intermediate layer between approximately 50 and 200 m of water. Below 200 m, the water temperature ranges between 4°C to 6°C (C-NLOPB 2005). Average monthly surface water temperatures range from -0.77°C in March to 14.6°C in August. Temperatures at 100 m range from 0.19°C in March to 1.11°C in January, while temperatures at 300 m range from 0.62°C in November to 5.90°C in December (Bedford Institute of Oceanography 2003b). The nearshore (<12 m water depth) water temperatures range from -1.2°C in February to 14.8°C in August (DFO n.d.).

Average surface water salinities range from 30.50 ppt (July) to 32.05 ppt (March); salinity at 100 m ranges from 32.53 ppt (March) to 33.10 ppt (January), while salinities at 300 m are fairly constant (34.39 to 34.72 ppt) (Bedford Institute of Oceanography 2003b).

5.1.6 Ice

The Strait of Belle Isle is susceptible to seasonal incursions of ice, with sea ice formed in the Project Area. Icebergs are generally found in the northern part of the Strait. The Project Area is ice free from May to December, with pack ice the key determining factor (C-CORE 2005 in C-NLOPB 2005). The potential for ice is generally greatest in March. However, ice conditions can vary considerably from year to year. Warmer than normal temperatures in recent years resulted in less ice than usual off Newfoundland and Labrador and in the Gulf of St. Lawrence. In 2000 for example, sea ice disappeared much earlier than normal, with little or no ice reaching the Scotian Shelf (DFO 2000a; 2001a; Drinkwater et al. 2001). But in 2003, sea ice extended further south and persisted longer than has been the case in recent years (Canadian Ice Service 2003).

5.1.7 Noise/Acoustic Environment

Natural sources of sound in the marine environment include both natural and anthropogenic sources. Natural sources include wind, rain, waves and marine life. Anthropogenic sources include vessel traffic, fishing and sonar (navigation, fishing). Approximate source levels and frequency ranges are presented in Table 5.1.

Natural and anthropogenic sound sources will all contribute to the ambient sound level at any location. There are no measurements of ambient sound level in the Project Area. Sound levels that are typical of a marine environment are reported to be in the range of 80 to 120 dB re 1 $\mu Pa^2/Hz$ over a wide frequency range, with much of the energy in the 2 to 200 Hz frequency band. This varies with location, season, meteorological and oceanographic conditions and time of day (OGP/IAGC 2004). The sound level of the marine environment is naturally noisy. Natural sounds on their own (i.e., no anthropogenic sources) can mask weak sound signals from distant sources (C-NLOPB 2005).

The dispersion or propagation of the sound as it spreads outward from the source will change as a result of divergence, attenuation and interaction with the seabed. In deeper water, sound will diverge spherically, whereas in shallower water it will generally spread cylindrically. The nature of divergence (spherical or cylindrical) also depends on the nature of the seabed (OGP/IAGC 2004), bottom absorption and sound speed gradients (with depths) (C-NLOPB 2005). Although air sleeve arrays used in offshore seismic surveys produce very high peak levels of sound, the sound energy often attenuates quickly (C-NLOPB 2005).

Table 5.1 Approximate Source Pressure Levels and Frequency Ranges of Marine Sounds

Sound Sources	Source level (dB re 1 uPa –m, as provided in original reference)	Frequency Band of Major Amplitude	Normal Duration	Directionality	Reference
Naturally Occurring Sounds					
Sperm Whale Click	236 rms	5-40 kHz	10's of microseconds	Focused	Møhl et al. 2003
Male sperm whale	232 dB re 1 uPa at 1 m (rms)				
Bottlenosed Dolphin	225 P-to-P	Very broad band in kHz range	70 us	Focused	Nachtigall et al. 2003
Killer Whale	224 P-to-P	12-80 kHz	80-120 us	Focused	Au et al. 2004
Mysticete Moans	190 rms	10-25 Hz	10's of seconds	Omni-directional	NRC 2003
Individual Snaps of Snapping Shrimps	189 P-to-P	Broad band including up to 200 kHz		Omni-directional	NRC 2003
Snapping shrimp	185-188 dB re 1 uPa at 1 m				Au and Banks 1998
Anthropogenic Sounds					
10 lbs of TNT	279 peak	Very broad band	ms	Omni-directional	Urik 1975
7900 Cubic-inch Air Sleeve Array	259 Peak	5-500 Hz	30 ms	Vertically focused	Richardson et al. 1995
M/V Ewing Multibeam Sonar	237 rms	15.5 kHz	50 ms	Vertically focused	USA Federal Register 2003
US Navy 53C Mid-range Sonar	235 rms	Centre Freq. of 2.6 & 3.3 kHz	Variable, 0.5 s over 2 s period	Horizontally focused	NOAA and US Dept. Navy 2001
Echosounders	235 Peak	Variable 1.5-36 kHz	A few ms	Strongly vertically focused	Cay and Medwin 1977
SURTASS LFA	235 Peak	100-500 Hz	6-100 s	Horizontally focused	SURTASS website
GLORIA-type Sidescan Sonar	28 Peak	6-7 kHz	Continuous	Vertically focused	SCAR 2002
Heard Island Test	221 rms	57 Hz		Omni-directional	Baggeroer and Munk 1990
Single 30 Cubic-inch Air Sleeve	221 Peak	10-600 Hz	60 ms	Omni-directional	Bolt Assoc., n.d.
Acoustic Deterrence/ Harassment Devices	205 rms	8-30 kHz	Variable 1.5-500 ms	Omni-directional	Gordon and Northridge 2002
M/V Ewing Sub-bottom Profiler	204 rms	3.5 kHz	1, 2 or 4 ms	Vertically focused	USA Federal Register 2003
ATOC Source	195 Peak	-55-95 Hz	20 min.	Omni-directional	NRC 2000
Supertanker	190 Peak @ 6.8 Hz	6.8 Hz	Weeks	Omni-directional in vertical plane	Richardson et al. 1995
Pile Driving	135 Peak @ 1 km	30-40 Hz & 100 Hz	Days	Omni-directional	Richardson et al. 1995
Source: OGP/IAGC, 2004; C-NLOPB 2005.					

5.2 Climate

Winter climate in the Port au Port Peninsula and surrounding area is primarily the result of snow forming by cold Arctic air from the Quebec North Shore crossing the warmer Gulf of St. Lawrence waters. The late spring-early summer climate is often characterized by advection fog that can persist for many days as a result of warmer air flowing from the south to southwest crossing the cooler Gulf of St. Lawrence waters. The prevailing south to southwest air flow in the summer results in a lower wind speed (C-NLOPB 2005).

5.3 Species at Risk

Endangered, threatened and special concern wildlife species are protected federally under SARA, as listed in Schedule 1 of the Act. As defined in SARA, "wildlife species" means a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and (a) is native to Canada; or (b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. The purpose of this act is to protect wildlife species at risk and their critical habitat. SARA is administered by Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada.

Endangered species are protected provincially under the Newfoundland and Labrador *Endangered Species Act*. The purpose of this Act is to provide protection to endangered species and their habitats. The Newfoundland and Labrador *Endangered Species Act* is administered by NLDOEC. The *Endangered Species Regulations* list those species considered endangered in the province.

Information used in support of the assessment of wildlife was obtained from the Atlantic Canada Conservation Data Centre (ACCDC 2005). The relationship between rarity rankings and significance criteria is illustrated in Table 5.2.

Table 5.2 Relationship Between Rarity Rankings and Significance Criterion

Atlantic Canada Conservation Data Centre (ACCDC 2006)	
S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations. (21 to 100 occurrences).
S4	Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the species is of long-term concern (*e.g*. watch list). (100 + occurrences).
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species (*e.g*., S1S2)
Secure	Species that are not believed to be At Risk, May Be At Risk, or Sensitive. These were generally species that were widespread and/or abundant. Although some Secure species may be declining, their level of decline was not felt to be a threat to their status in the province.
Species at Risk Act **(SARA) and Committee on the Status of Endangered Wildlife in Canada (COSEWIC)**	
Extirpated	Wildlife species that no longer exist in the wild in Canada, but exists elsewhere in the wild.
Endangered	Wildlife species that is facing imminent extirpation or extinction.
Threatened	Wildlife species that is likely to become an endangered species if nothing else is done to reverse the factors leading to its extirpation or extinction.
Species of Special Concern	Wildlife species that may become a threatened or endangered species because of a combination of biological characteristics and identified threats.

Newfoundland and Labrador *Endangered Species Act*	
Extirpated	Wildlife species that no longer exist in the wild in the province, but exists elsewhere in the wild.
Endangered Species	Wildlife species that faces imminent extirpation or extinction.
Threatened	Wildlife species that is likely to become an endangered species if nothing else is done to reverse the factors limiting its survival.
Vulnerable	Wildlife species that has characteristics which make it particularly sensitive to human activities or natural events.
Protected Species **Listed Species** **Non-Listed and Secure Species**	

Species at risk are described within each of the VEC sections (e.g., marine bird species at risk are discussed in Marine Birds, Section, 5.4).

5.4 Marine Birds

General distributions, seasonal abundances and demographic parameters of marine birds off western Newfoundland were summarized in the *Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment* (C-NLOPB 2005). The following discussion on marine birds draws largely on the information provided in this document, and in consultation with CWS focusing on the Project Area, specifically the Port au Port Peninsula and nearshore waters.

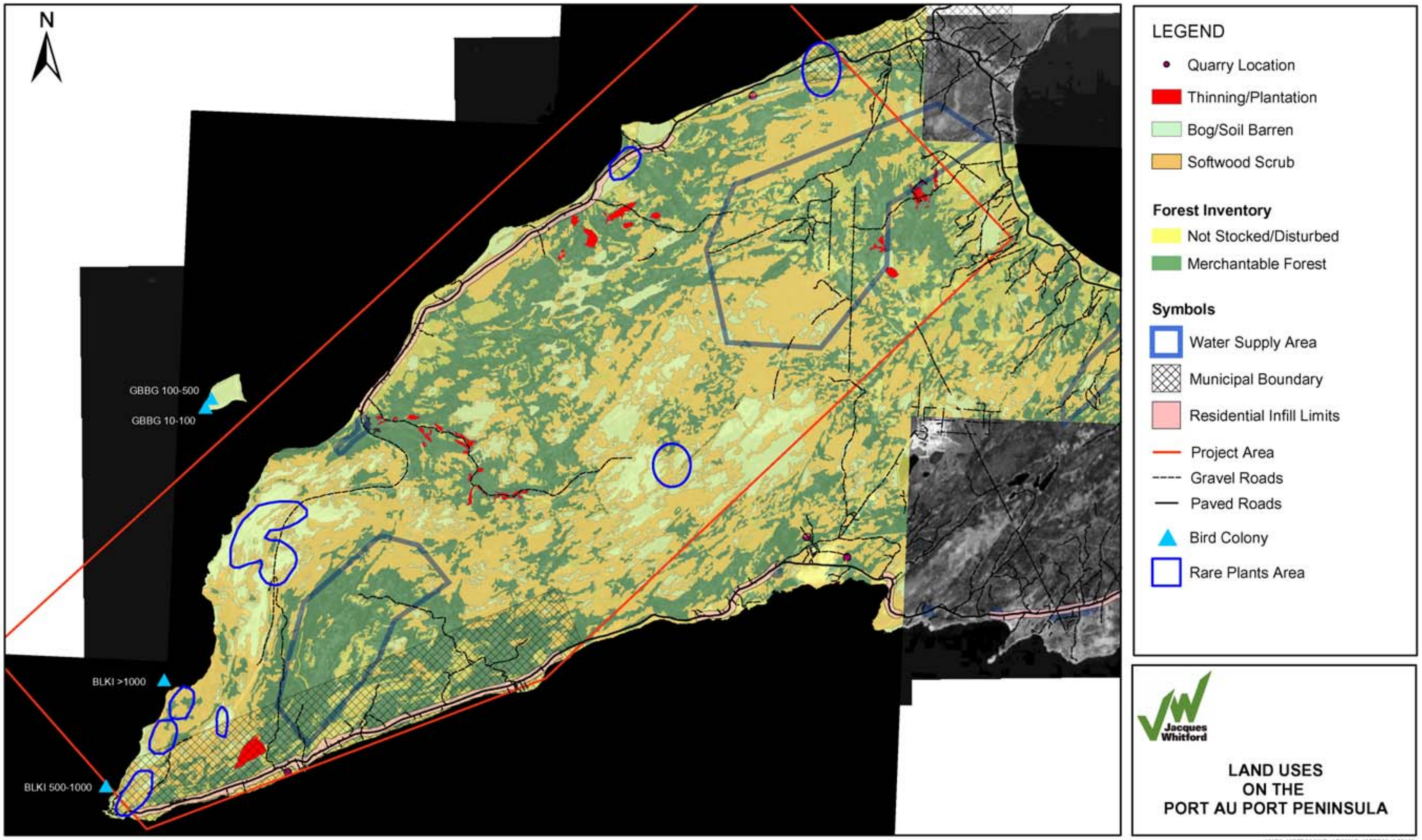
5.4.1 Pelagics

The marine coast and waters of western Newfoundland have lower abundances of seabirds than other coastal areas of Newfoundland, possibly due to limited breeding habitat and lower productivity of the adjacent waters compared to the east coast (Lock et al.1994). Pelagic seabirds include shearwaters, fulmars, petrels, jaegars, skuas, phalaropes, gannets, cormorants, alcids, kittiwakes and gulls. However, only the large gulls, terns and gannets are reported to be common along the west coast of the island (C-NLOPB 2005).

The period of peak concentrations) of pelagic seabirds along the west coast of Newfoundland is between January and March (Lock et al. 1994) with highest abundances during this period occurring from the Bay of Islands south to the Codroy estuary. Pelagic seabirds are least abundant along the west coast during the period from October to December.

The Port au Port Peninsula is not recognized as an important area for pelagic seabirds (C-NLOPB 2005). However, two Black-legged Kittiwake (*Rissa tridactyla*) colonies with numbers ranging from 500 to >1,000 individuals were identified in 2002 during aerial surveys by the CWS (Robertson, pers. comm.). These colonies are located on the western tip of the Port au Port Peninsula (Figure 5.5). In addition, during the aerial survey by CWS, northern gannets (*Sula bassanus*) were observed on the water in the vicinity of, but not at, the colonies on the Port au Port Peninsula. It is suspected that these birds are from the Gaspé Peninsula colonies, although it could not be determined for certain that no gannets were nesting in this area (M. Robertson, pers. comm.).

Figure 5.5 Land Uses on the Port au Port Peninsula



SOURCE: FORESTRY BRANCH, NLDNR; LANDS BRANCH, NLDOEC

The Port au Port Peninsula is not recognized as an important area for pelagic seabirds and no colonies are identified in this area (C-NLOPB 2005). Common terns (*Sterna hirundo*), Arctic terns (*S. paradisaea*), great black-backed gulls (*Larus marinus*), herring gulls (*L. argentatus*) and ring-billed gulls (*L. delawarensis*) nest at Flat Bay Island, south of the Project Area. North of the Port au Port Peninsula, the nearest pelagic seabird colonies occur in the vicinity of the Bay of Islands (Figure 5.5). These colonies support a small number of great cormorants (*Phalacrocorax carbo*) and double-crested cormorants (*P. auritus*), as well as black-legged kittiwakes (*Rissa tridactyla*), herring gulls and great black-backed gulls (C-NLOPB 2005).

During the nesting season the greatest abundance of pelagic seabirds occurs in the immediate vicinity of nesting colonies. Millions of seabirds such as shearwaters (particularly greater shearwaters (*Puffinus gravis*) and Wilson's storm petrels (*Oceanites oceanicus*) nest in the South Atlantic and spend the austral winter in the northern hemisphere. While most of these birds congregate on the Grand Bank off eastern Newfoundland, a small proportion occurs off the west coast of Newfoundland (C-NLOPB 2005). Similarly during winter, Arctic nesting species including thick-billed murres (*Uria lomvia*), dovekies (*Alle alle*), northern fulmars (*Fulmarus glacialis*), glaucous gulls (*Larus hyperboreus*) and black-legged kittiwakes spend the winter in waters offshore Newfoundland. A small proportion of these birds may be found off the west coast.

5.4.2 Coastal Waterfowl

Although the west coast of Newfoundland has not been systematically surveyed for coastal waterfowl, it is known that a small wintering population of common eiders (*Somateria mollissima*) and scoters (*Melanitta* sp.) aggregates in Port au Port Bay (Figure 5.5). A small number of eiders also nest on Stearin Island in the Bay of Islands, to the north of the Project Area. South of the Project Area, the Codroy River estuary supports relatively large concentrations of breeding and staging waterfowl including large aggregations of Canada geese (*Branta canadensis*) (C-NLOPB 2005). Canada geese and American black ducks (*Anas rubripes*) also occur at Sandy Point during migration.

5.4.3 Shorebirds

Migrating shorebirds concentrate at beaches and tidal flats along the west coast of Newfoundland. The area just north of Port au Port Bay was identified by Lock et al. (1994) as having large concentrations of migrating shorebirds. Lock et al. (1994) also identified Piccadilly Bay, within Port au Port Bay, as an area where lesser concentrations of shorebirds occur. Specific areas identified within Port au Port Bay as being important shorebird areas include Point au Mal, Piccadilly Lagoon, West Bay and Black Duck Brook (C-NLOPB 2005).

The common shorebird species that occur along the west coast of Newfoundland include common snipe (*Gallinago gallinago*), white-rumped sandpiper (*Calidris fuscicollis*), semipalmated sandpiper (*C. pusilla*), least sandpiper (*C. minutilla*), greater yellowlegs (*Tringa melanoleuca*), ruddy turnstone (*Arenaria interpres*), semipalmated plover (*Charadrius semipalmatus*), black-bellied plover (*Pluvialis squatarola*) and sanderling (*Calidris alba*) (Lock et al. 1994).

5.4.4 Species at Risk

Marine bird species at risk in the west coast area of Newfoundland include piping plover (*Charadrius melodus*), harlequin duck (*Histrionicus histrionicus*) and Eskimo curlew (*Numenius borealis*). Piping plover and Eskimo curlew are listed as Endangered by COSEWIC and on Schedule 1 of SARA*;* harlequin duck are listed as Special Concern. These species also have comparable listings under the Newfoundland and Labrador *Endangered Species Act.*

Piping plovers nest on sandy beaches south of the Project Area, including Flat Bay Island, Codroy Valley estuary and Grand Bay West. Harlequin ducks breed along rivers to the north of the Project Area and may be found in coastal waters at the mouths of these streams during spring and fall staging (C-NLOPB 2005). A search of the ACCDC database for the Project Area indicated sightings of harlequin duck off of Cape St. George as far back as 1922 and as recently as 2003 (ACCDC 2006). There is no information on time of year of sightings, although it is likely that these observations were of migrating or wintering birds. The Eskimo curlew once migrated in large numbers down the eastern seaboard from nesting grounds in the Arctic. It is probable that the Eskimo curlew is extinct although there are continued occasional reports of sightings (18 from 1975 to 1998) (Environment Canada 2005). None of these species at risk has been documented in the Project Area.

The ivory gull (*Paqophila eburnean*) is listed as a species of special concern by COSEWIC and on Schedule 1 of SARA and under the Newfoundland and Labrador *Endangered Species Act*. This species nests in the high Arctic but may winter along the Atlantic coast as far south as New York and inland to the Great Lakes. The ivory gull is unlikely be present in the Project Area.

5.4.5 Sensitive Areas

There are no Important Bird Areas identified in the Project Area (N. Lights, pers. comm.) and no important habitat for waterfowl or shorebirds have been identified in the Project Area. However, there are black-legged kittiwake and gull colonies identified on the western side of the Port au Port Peninsula and on Red Island. These colonies would be sensitive to human disturbance during the nesting season, particularly from mid May through early August.

5.5 Marine Fish, Shellfish and Habitat

5.5.1 Plankton

The northeastern Gulf of St. Lawrence is a highly productive marine ecosystem. Oxygen and nutrient rich waters from the Strait of Belle Isle and the Cabot Strait support a large phytoplankton bloom in the spring and a smaller bloom in the fall that are the basis for the entire marine food web. Phytoplankton are primary producers and prey for zooplankton, which in turn are a very important food item for many species of fish, birds and marine mammals. Large copepods of the genus *Calanus*, krill and shrimp dominate the zooplankton community (White and Johns 1997). Zooplankton are most abundant after the phytoplankton bloom that will vary year to year and spatially within the Gulf, but can be expected between mid-April and Mid-June. The lowest zooplankton concentration can be expected in February (DFO 2000a). In the Gulf, zooplankton concentration is highest along the Laurentian Channel (Harvey et al. 2002). Aggregations of krill occur on average at depths between 60 and 110 m (Doniol-Valcroze 2001). Krill are a major food source of baleen whales and pelagic fish.

Plankton of the Gulf also include up to 50 species of fish eggs and larvae (Table 5.3). Dominant in the ichthyoplankton are the larva of herring, capelin, snailfish, shanny and sculpin (White and Johns 1997) all of which are benthic spawners, whose pelagic larvae hatch from eggs deposited on the seafloor. In more inshore areas, species such as lobster, herring, scallop, cunner, radiated shanny, winter flounder and capelin dominate the ichthyoplankton. In early May, the most common fish larvae in the northeast Gulf is the sandlance (*Ammodytes* sp.) and by late June, redfish (*Sebastes* sp.) and capelin (*Mallotus villosus*) are prominent (de Lafontaine et al. 1991). Redfish and Greenland halibut are most prominent in waters over the Laurentian Channel.

Table 5.3 Common Ichthyoplankton in the Gulf of St. Lawrence and St. Lawrence Estuary

Pelagic Spawning Species		**Benthic Spawning Species**	
Atlantic Mackerel	*Scomber scombrus*	Atlantic Herring	*Clupea harengus*
Atlantic Cod	*Gadus morhua*	Rainbow Smelt	*Osmerus mordax*
American Plaice	*Hippoglossoides platessoides*	Tomcod	*Microgadus tomcod*
Fourbeard Rockling	*Enchelyopus cimbrius*	Winter Flounder	*Pseudopleuronectes americanus*
Hake	*Urophycis* sp.	Capelin	*Mallotis villosus*
Cunner	*Tautogolabrus adspersus*	Snailfish	*Liparis* sp.
Yellowtail Flounder	*Limanda ferruginea*	Shanny	*Lumpenus* sp.
Redfish	*Sebastes* sp.		*Stichaeus* sp.
Give birth to live young			*Ulvaria* sp.
Crustaceans		Sculpins	*Myoxocephalus sp.*
Snow Crab	*Chionoecetes opilio*		*Icelus* sp.
Rock Crab	*Cancer irroratus*		*Hemitripterus* sp.
American Lobster	*Homarus americanus*		*Artediellus* sp.
Boreal Shrimp	*Pandalus borealis*	Sandlance	*Ammodytes* sp.
Eggs attach to the underside of female abdomen until the following year; larvae drift in surface waters			
From: White and Johns 1997. Sources: de Lafontaine 1990; de Lafontaine et al. 1991.			

5.5.2 Invertebrates

Benthic habitat in the Project Area will vary by depth. The nearshore shallow areas are low salinity, rocky habitats, with seaweeds being the dominant vegetation. Ice scour can have a significant effect on the diversity of plants and animals in the intertidal areas. In the nearshore subtidal area, a benthic community of whelks, sea urchins, seastars, bivalves, polychaete worms, sand dollars, lobster and crab can be expected. In deeper habitats of unconsolidated sediments, marine worms and brittle stars would dominate. The environmental assessment will focus on the invertebrates for which there is a commercial fishery in the Affected Area.

5.5.2.1 Lobster

Lobster are common within the Project Area and within the region generally. The area between the outer portion of Port au Port Bay and northward to Shag Island has been identified by fishers as a lobster spawning ground, yielding large females (C-NLOPB 2005). This area is outside the Project Area. The lobster fishery occurs during the spring. Lobsters mate during the summer after the female molts (Aiken and Waddy 1980). Eggs are not fertilized until the following summer and pre-hatch larvae are released during the next summer. Larvae remain planktonic in near surface waters for 3 to 10 weeks before they settle out to the bottom (Ouellet et al. 2001). Lobster larvae can be present in waters near the coast between June and mid-October. Some variation can be expected, depending on the area and the annual variation in water temperatures. Early benthic phase lobsters have been found nearshore in 2 to 8 m of water (Wahle and Steneck 1992) and at 5 and 10 m of water but not at 20 m (Palma et al. 1999). During recent consultations, fishers identified two lobster nursery areas north of the Bay of Islands (C-NLOPB 2005). These areas are outside the Project Area.

5.5.2.2 Icelandic Scallop

Icelandic scallop (*Chlamys islandicus*) may be found in the Gulf in water depths between 20 and 60 m, primarily on substrates of gravel, shell or rocky substrate (DFO 2001b; 2001c). Spawning occurs in August and scallop larvae are in water column for about 5 weeks before they settle onto the seabed (Langton and Robinson 1990). Larvae are concentrated in the upper 10 m of water, moving near the surface at night and down to the thermocline during the day (Gallager et al. 1996).

5.5.2.3 Snow Crab

Adult snow crab (*Chionoecetes opilio*) occur in the Gulf at water depths primarily between 70 and 100 m on relatively soft bottoms (White and Johns 1997). They feed on bivalves, polychaetes, brittle stars, small crustaceans, fish and detritus. Moulting usually occurs between March and July (Mousseau et al. 1997). Male and female snow crab pair up and prepare for mating in late April and early May on the west coast of Newfoundland (Ennis et al. 1990). Eggs are carried by the female for up to 2 years and are hatched in late spring or early summer. The newly hatched larvae spend 12 to 15 weeks in the water column before settling to the bottom between late August and late October (DFO 2002a). Juvenile snow crab prefer hard substrates in relatively shallow water, compared to adults (Comeau et al. 1998; DFO 2005a).

5.5.2.4 Northern Shrimp

Northern shrimp (*Pandalus borealis*) are found on mud or silty bottoms with high organic content at depths between 150 and 350 m (DFO 2004a). They are most common in water temperatures between 1 and 8°C (DFO 2002b). Shrimp feed on polychaetes and echinoderms while near the bottom, and on protozoa and planktonic crustaceans while in the water column (Scarratt 1982). Shrimp migrate from the bottom through the water column at night and return to the bottom during the day.

Mating occurs in the fall and shrimp carry fertilized eggs until the next spring. Shrimp females gather in relatively shallow water (150 to 180 m) in April and May to release their larvae into the water column. Larvae are pelagic for three or four months and settle to the bottom from July to September (DFO 2002b).

5.5.3 Marine Fish

5.5.3.1 Capelin

Capelin (*Mallotus villosis*) generally occur in water between 30 and 100 m during the winter until they migrate in late spring or early summer to spawn on beaches or in deeper waters of up to 125 m. Spawning may occur in particular areas each year or appear sporadic. The exact time of spawning may be a function of annual water temperature fluctuations. Spawning lasts four to six weeks. On the west coast of Newfoundland spawning occurs between May and July (DFO 2004b). After an incubation period between 9 and 24 days, the capelin larvae remain in the sediment for another three to eight days before entering the water column (Scott and Scott 1988). Capelin larvae are passive drifters nearshore during the summer months but become more active swimmers and make their way to deeper water offshore by autumn (see Scott and Scott 1988).

5.5.3.2 Mackerel

Mackerel (*Scomber scombrus*) is a pelagic migratory fish whose distribution seems to be determined by a preference of water temperatures between 9°C and 12°C. Mackerel over-winter off the Scotian Shelf and usually enter the Gulf in late May or early June and spawn through out the southern Gulf during June and July (Ringuette et al. 2002). The largest concentration of eggs is always found south of the Laurentian Channel, west of the Magdalen Islands (DFO 2003a). Eggs and larvae are likely contained to this area by currents that recirculate throughout the Gulf (White and Johns 1997). Eggs will hatch in about 7 days at 11°C to 14°C and are concentrated in the upper 10 m of the water column (Scott and Scott 1988). Larvae are approximately 3 mm upon hatching and are planktonic and perform diurnal vertical migration to the thermocline between 10 and 20 m (see Fritzsche 1978). When larvae reach the juvenile stage (>50 mm) they form schools and some schools migrate towards the coast. The purpose of this migration is unknown. Juveniles feed on plankton. Adults may feed on small and large zooplankton near the surface at night but return to deeper depths during the day (DFO 2005b).

5.5.3.3 Herring

Gulf of St. Lawrence herring (*Clupea harengus harengus* L.) overwinter in the Esquiman Channel and often migrate in schools from the deep water to specific inshore locations to spawn during April and May. Spring spawning herring in the Gulf are likely a different stock than the fall spawners (DFO 2003b), but the two stocks mix between April and December (DFO 2005c). Herring have spawned historically in the spring within St. Georges Bay and more recently have been discovered spawning in Port au Port Bay (DFO 2004c). Fall spawning occurs mainly north of Point Riche on the Northern Peninsula (DFO 2003b). St. Georges Bay is also a known as a spring feeding area for herring, as are the major bays on the west coast in the fall. Herring primarily feed on small and large euphausiids (DFO 2005c).

Masses of herring eggs attach to the hard bottom substrate nearshore or to kelp leaves. Larvae hatch after about 30 days at 5°C and after 10 days at 15°C (Scott and Scott 1988). Duration of the pelagic larval stage is temperature dependent and therefore depends on the time of spawning. Spring recruits will remain in the water column during spring and summer but the fall recruits may be pelagic until the following spring. Eggs and larvae can be contained near the spawning grounds by tidally induced retention areas or may passively drift with the dominant currents (DFO 1984).

5.5.3.4 Lumpfish

Lumpfish (*Cyclopterus lumpus*) is a shallow water benthic species, preferring rocky substrates as adults. Mature fish migrate inshore in the spring or early summer to spawn and return to deeper waters in the fall (Scott and Scott 1988). Fertilized egg masses are laid on rocks in shallow water throughout the spring. The eggs are guarded by the male until hatching occurs after six to eight weeks. Juveniles are pelagic for the first year and are often found among kelp leaves in shallow water. The lumpfish diet consists of amphipods, euphausiids, copepods, jellyfish, comb jellies and small fish such as herring and sandlance (Scott and Scott 1988).

5.5.3.5 Halibut

Young halibut are most common between 37 and 55 m whereas mature fish are found between 165 and 229 m (Scott and Scott 1988). Larger fish migrate to shallower waters in the summer (DFO 2005d) to feed and do so within the Project Area during July and August (J. Spingle, pers. com).

The spawning grounds of the halibut are not clearly defined (C-NLOPB 2005), but in the Gulf of St. Lawrence spawning is believed to occur in the Esquiman Channel in January and May. Halibut eggs are near neutrally buoyant; they float in the water column at depths greater that 54 m and are most common between 300 and 400 m, as eggs move deeper during development (DFO 1991). Eggs hatch within 16 days at 6°C. Larvae are pelagic for 10 to 12 weeks, before taking up a benthic habitat. There they feed on polychaetes, shrimp, euphausiids and small crab and supplement with fish as they become larger. Adult halibut feed entirely on fish (Scott and Scott 1988).

5.5.3.6 American Plaice

American plaice (*Hippoglossoides platessoides*) inhabits a wide range of water depths, from 36 to 713 m. The largest commercial catches are made between 125 and 200 m (see Scott and Scott 1988). American plaice prefer fine sand or mud substrates. Long migrations are not known to occur, just a seasonal movement into deeper water in the winter. American plaice are spring spawners in water less than 90 m deep, with fertilized eggs rising to near the surface. Eggs will hatch in 11 to 14 days at 5°C but the duration of the pelagic stage is not known. Larvae and juvenile plaice are common in shallow nearshore areas.

5.5.3.7 Atlantic Salmon

The salmon (*Salmo salar*) life cycle begins in freshwater when the eggs hatch in spring. The newly hatched alevins remain in the gravel for a number of weeks and emerge as fry. The fry develop into parr, which can feed and grow in the freshwater environment from two to five years. Before entering the marine environment, parr go through a process of smoltification in preparation for life at sea. These silvery-coloured smolt emigrate to sea, mainly during May and June and migrate along the coast on their journey to the Labrador Sea and west Greenland, where they feed and grow into adult salmon.

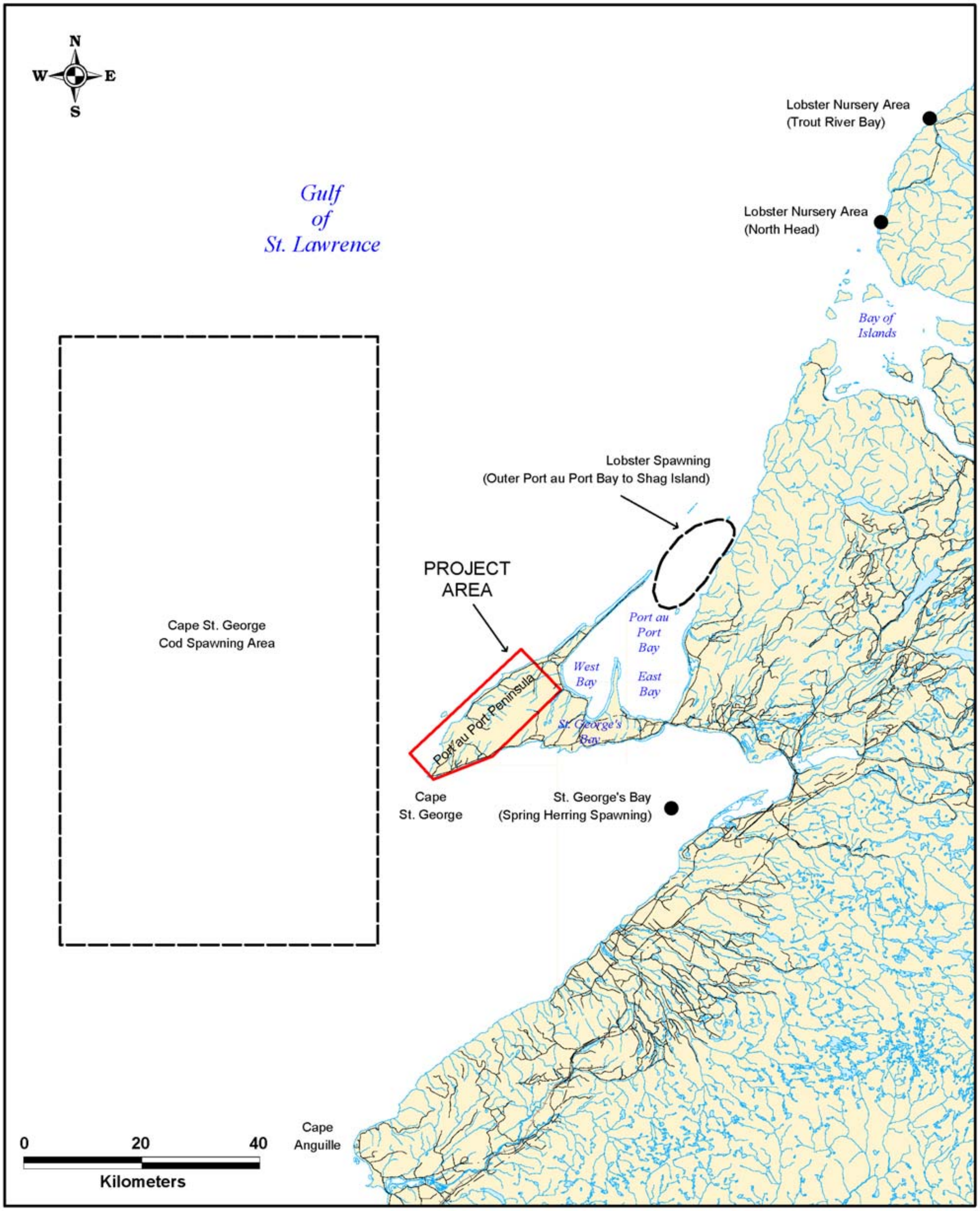
Most salmon return to Newfoundland rivers after one year at sea and are termed one Sea Winter (1SW) small salmon or “grilse”. Others remain at sea for two (2SW) or three years (3SW) and return as large maiden (never spawned before) salmon. The return of adult salmon to their natal rivers can occur from May to October but the peak run often occurs between mid-June and mid-July. Upon entering the freshwater environment the salmon migrate upstream to occupy their spawning grounds. Spawning occurs between late October and December. Eggs are deposited in gravel nests or redds and incubate over winter until they hatch in the spring.

5.5.4 Species at Risk

5.5.4.1 Atlantic Cod

The majority of the Northern Gulf of St. Lawrence cod (*Gadus morhua*) stock (3Pn4RS) migrate along western Newfoundland in the fall and spend the winter in the area of the Cabot Strait, off southern and southwestern Newfoundland, at depths of more than 400 m (DFO 2005e; Yvelin et al. 2005). The stock returns to the Gulf in the spring to spawn during April and May. Spawning is concentrated in an area named Cape St. George Cod Spawning Area (Figure 5.6) which is closed to all groundfish fishing between April 1st and June 15th each year. Cod move further into the Gulf during the summer along the west coast of Newfoundland towards Quebec’s Middle and Lower North Shore, to feed on capelin and herring (see Yvelin et al. 2005). Cod move inshore and may occur within the Project Area in July (J. Spingle, pers. com.).

Figure 5.6 Sensitive Fish and Fish Habitat Areas



Source: C-NLOPB 2005.

Fertilized eggs will rise through the water column and can be concentrated at water depths between 50 and 100 m (Ouellet et al. 1997). The incubation period is temperature dependent but given spring water temperatures in the Gulf, would be on the order of 14 to 40 days (Scott and Scott 1998). Egg densities outside the spawning area are reported to be between 0 and 25 eggs/m^2. Newly hatched larvae remain pelagic and settle out to substrates in shallow nearshore areas when they reach 25 to 50 mm in length or within three months (Pinsent and Methven 1997).

There is considerable mixing between the Northern Gulf of St. Lawrence (3Pn4RS) cod stock and the southern Newfoundland cod stock (3Ps), so COSEWIC has grouped the two for status assessment. The combined stocks are called the Laurentian North population, which has been declared as threatened by COSEWIC (COSEWIC 2003a). The Laurentian North population is listed on Schedule 3 of SARA as being of Special Concern and is under consideration for listing on Schedule 1. A final decision is expected in April 2006 (SARA website 2005).

5.5.4.2 Northern Wolffish

Northern wolffish (*Anarhichas denticulatus*) in the northwest Atlantic are treated as a single population. It is listed as threatened on Schedule 1 of SARA due to the rapid decline along the Northeast Newfoundland/Labrador Shelf and the Grand Banks (Environment Canada website 2005). The abundance of northern wolffish in the Gulf of St. Lawrence has been more stable in recent years with no evidence of a decline (DFO 2004d). However, northern wolffish in the Gulf are much less common than in other areas. It is a deep water species, preferring depths from 151 to 600 m (Scott and Scott 1988). There is little known about the reproductive biology of this species but spawning is believed to occur late in the year (DFO 2004d). Fertilized eggs are deposited on the bottom but larvae are pelagic (see Simpson and Kulka 2002). Northern wolffish are expected to be infrequent in the nearshore waters of western Newfoundland.

5.5.4.3 Spotted Wolffish

Spotted wolffish (*Anarhichas minor*) are also treated as a single population in the northwest Atlantic and listed as threatened on Schedule 1 of SARA, due to the rapid decline along the Northeast Newfoundland/Labrador Shelf and the Grand Banks. As is the case for the northern wolffish, the abundance of spotted wolffish in the Gulf of St. Lawrence has been stable in recent years, with no evidence of a decline (DFO 2004d). Spotted wolffish in the Gulf are much less common than on the Northeast Newfoundland Shelf. It is a deepwater species, inhabiting waters of 457 m or more (Scott and Scott 1988). As with the other wolffish species, larvae are pelagic. A seasonal inshore migration is not known. Spawning is thought to occur late in the year (DFO 2004d). Spotted wolffish are expected to be infrequent in nearshore waters of western Newfoundland.

5.5.4.4 Atlantic Wolffish

Atlantic or striped wolffish (*Anarhichas lupus*) are more widely distributed throughout the Gulf of St. Lawrence and on the Scotian Shelf than the other wolffish species. As a single population, Atlantic wolffish in the northwest Atlantic are listed on Schedule 1 of SARA as a “species of special concern”. They are common in the deeper parts of the Gulf of St. Lawrence. (McRuer et al. 2000) Atlantic wolfish are found over hard clay bottoms at depths from 101 to 350 m around Newfoundland (Scott and Scott 1988). Mature wolfish migrate to shallow, inshore waters in the spring and spawn in September (see Simpson and Kulka 2002). Eggs are laid in a mass that adheres to the bottom and the eggs are guarded by the male. Eggs hatch by mid-December. The larvae are pelagic but they seldom swim near surface waters and the entire larval stage is spent close to where the eggs were deposited (see Simpson and Kulka 2002).

5.5.4.5 Porbeagle Shark

The porbeagle shark (*Lamna nasus*) is believed to constitute a single population in the Northwest Atlantic. The population is considered endangered by COSEWIC and is currently under consideration for a Schedule 1 listing by SARA.

Adults undertake annual migrations between the Gulf of Maine and Georges Bank, to the waters off Newfoundland and the Gulf of St. Lawrence at a preferred temperature between 5°C and 10°C (Campana et al. 2001, as cited in COSEWIC 2004a). Porbeagles are found in the Gulf of St. Lawrence during the summer and fall (Campana et al. 1999, as cited in COSEWIC 2004a). They may be found singly or in schools and are occasionally found closer to shore in shallow water during the summer (Compagno 2001, as cited in COSEWIC 2004a). They are primarily a mid-water species and feed opportunistically on benthic, pelagic and epipelagic fish species (Joyce et al. 2002, as cited in COSEWIC 2004a).

Mating is believed to occur from August to November in the Cabot Strait off southern Newfoundland and on the Grand Bank. Gestation is approximately eight to nine months and self-reliant young are born from early April to early June (Jensen et al. 2002, as cited in COSEWIC 2004a). Juveniles are not known to migrate and are most common on the Scotian Shelf.

5.5.5 Sensitive Areas

There are sensitive areas for Marine Fish, Shellfish and Habitat near the Project Area but not within it (see Figure 5.6). The Cape St. George Spawning Area is known to be a regular spawning area for the Northern Gulf cod stock during April and May each year. The area is closed to all groundfish fishing between April 1st and June 15th each year. Depths within the spawning area range from just under 100 to over 300 m. The Cape St. George Spawning Area is delineated by:

- 48° 00' N, 59° 20' W
- 49° 10' N, 59° 20' W
- 49° 10' N, 60° 00' W
- 48° 00' N, 60° 00' W

There are several sensitive areas with respect to herring near the Project Area. Each year herring spawn near the bottom of St. Georges Bay between April and May or June. More recently herring have also been discovered spawning in Port au Port Bay (DFO 2004c). St. Georges Bay is also known as a spring feeding area for herring.

Outer Port au Port Bay is known for lobster spawning. The area between the outer portion of Port au Port Bay and northward to Shag Island has been identified by fishers as a lobster spawning ground, yielding large females (C-NLOPB 2005). This area is also outside the Project Area. During recent consultations, fishers identified two lobster nursery areas north of the Bay of Islands (C-NLOPB 2005).

5.6 Marine Mammals and Sea Turtles

5.6.1 Marine Mammals

5.6.1.1 Humpback

The North Atlantic population of humpbacks (*Megaptera novaeangliae*) are estimated to exceed 11,500 animals and are considered “not at risk” by COSEWIC (COSEWIC 2003b). Humpbacks are common in the Gulf of St. Lawrence during the summer (Katona and Beard 1990). In the mid 1990s, estimates were that approximately 100 humpbacks occupied the Gulf during the summer, mostly in the northeast portion of the Gulf (Kingsley and Reeves 1998). These humpbacks are not genetically distinct from whales off Greenland, Newfoundland and Labrador, those in the Gulf of Maine or on the Scotian Shelf during the summer months (Palsbøll et al. 1995).

Humpbacks migrate to the North Atlantic each year to feed and may form small groups while feeding. Their preferred food is capelin but they also feed on herring, krill and shrimp.

5.6.1.2 Minke

Minke whales (*Balaenoptera acutorostrata*) are common nearshore and generally sighted in waters less than 200 m deep (Hooker et al. 1999). They are most commonly observed singly. Minkes are common throughout the Gulf of St. Lawrence in the summer, particularly along the northern portions of the Gulf (Kingsley and Reeves 1998). Along the northern Gulf, minkes were associated with sand dunes which may indicate they were foraging for capelin and sand lance (Naud et al. 2003). In a single survey during late summer, 1,000 minkes were estimated to be present throughout the Gulf of St. Lawrence.

The north Atlantic population of minke whales can be divided into four genetically distinct groups. They are west Greenland, central North Atlantic-east Greenland-Jan Mayen, northeast Atlantic and the North Sea (Andersen et al. 2003). Minke whales have not been evaluated by COSEWIC and are not listed by SARA. Populations are therefore considered strong.

5.6.1.3 Long-finned Pilot Whale

Long-finned pilot whales (*Globicephala melas*) or potheads are distributed throughout the North Atlantic with some evidence of segregation between the west and east North Atlantic populations (Bloch and Lastein 1993). They usually travel in pods of 10 or more related individuals (Amos et al 1993; Whitehead et al. 1998). An accurate population estimate is not available but there are several thousand in the western North Atlantic Ocean. The long-finned pilot whale has not been assessed by COSEWIC and is not listed under SARA, which indicates that the population is stable.

Within the Gulf of St. Lawrence area in late summer, pilot whales were most common in the southern Gulf and off southern Newfoundland in deep water with steep topography (Kingsley and Reeves 1998). They commonly come close to shore, especially if squid are abundant in the area. Squid is a primary prey item along with pelagic schooling fish species.

5.6.1.4 Atlantic White-sided Dolphin

The Atlantic white-sided dolphin (*Lagenorhynchus acutus*) are quite common in the Northwest Atlantic with a total population of several hundred thousand in the North Atlantic (Reeves et al. 1999). Those in the western North Atlantic may be comprised of three distinct populations; Gulf of Maine, Gulf of St. Lawrence and the Labrador Sea population (Palka et al. 1997). They usually travel in groups numbering between 50 and 60 but groups sometimes number in the hundreds (Reeves et al. 1999).

Atlantic white-sided dolphins are common throughout the Gulf of St. Lawrence and most common over areas of step topography along the margins of the Gulf (Kingsley and Reeves 1998). During one survey in late summer, 12,000 white-sided dolphins were estimated to occur throughout the Gulf of St. Lawrence but the estimate is considered highly variable from year to year (Kingsley and Reeves 1998). Their primary foods are squid and herring. The Atlantic white-sided dolphin has not been assessed by COSEWIC and is not listed under SARA.

5.6.1.5 White-beaked dolphin

White-beaked dolphins *(Larenorhynchus albirostris)* occur on both sides of the North Atlantic but the west and east populations are genetically distinct (Kinze 2002). The largest population is off Labrador and south western Greenland. White-beaked dolphins commonly travel in groups of approximately 30 but groups may number in the hundreds or thousands (Kinze 2002).

Within the Gulf of St. Lawrence, approximately 2500 white-beaked dolphins were estimated to occur during the summer (Kingsley and Reeves 1998). However, during these surveys they almost exclusively occurred in the northeast corner of the Gulf, near the Strait of Belle Isle. White-beaked dolphins are likely to be uncommon in the western Newfoundland offshore region (C-NLOPB 2005).

5.6.1.6 Harbour Seal

The harbour seal (*Phoca vitulina*) has been divided into five different subspecies (Burns 2002). Western North Atlantic harbour seals are of the subspecies *P. vitulina concolor* and number between 15,000 and 24,000 on the east coast of Canada, excluding the east coast of Newfoundland (Hammill et al 2001); 4,000 to 5,000 of which are estimated to occur in the Estuary and Gulf of St. Lawrence (Robillard et al. 2005). They are year-round residents of the Gulf of St. Lawrence, the St. Lawrence Estuary and coastal Newfoundland (Burns 2002). Their population status was last examined in 1999 by COSEWIC, which declared there was insufficient information available to make a determination on the risk of extinction to the subspecies. The status of the subpopulation remains data deficient.

The primary prey of harbour seals in Newfoundland waters are winter flounder, Arctic cod, shorthorn sculpin and Atlantic cod, with some regional variability (Sjare et al. 2005). Harbour seals are common in nearshore shallow waters near river mouths or at particular haul-out sites. Pupping is expected to occur in May or June and pups are nursed for approximately 24 days (Bowen et al. 2001). The pups spend time in the water with the mother following weaning.

Within the area of the Port au Port Peninsula and St. Georges Bay, there may be 200 to 300 resident harbour seals (B. Sjare, pers. com.). The northern tip of the Peninsula known as The Bar, is a favourite haul-out site for harbour seals, with 40 to 60 seals observed there during a survey in August and September (J. Lawson, pers com.). The major haul-out area and biggest colony (at least 50 seals) of harbour seals is at Cape Anguille and along that shore, which is at the very end of St. George Bay. In the Bay, the major concentration during April, May and June is around Flat Island inside St. George's Harbour. Harbour seals will also haul out around the Stephenville Crossing bridge. The seals will hang out at the mouths of all of the Bay rivers (Highlands, Crabbes, Middle Barachois, Fishcells and Robinsons), but there are no major haul-out sites at any of them (B. Sjare, pers. comm.).

5.6.1.7 Harp Seals

The harp seal (*Phoca groenlandica*) population in the northwest Atlantic was estimated to be between 4 and 6.4 million in 2000 (Healey and Stenson 2000). This population has been stable since 1996. This northwest Atlantic population is genetically distinct from those that whelp in the northeast Atlantic (Perry et al. 2000).

Harp seals are abundant in the Gulf of St. Lawrence during the winter, specifically north of the Magdalen Islands during late winter when they haul out on the ice and give birth in late February and March (DFO 2000b). Harp seal pups are nursed for about 12 to 14 days on the ice. Harp seals then disburse throughout the northern-most Gulf, northeastern Newfoundland and southern Labrador. Moulting aggregations may form in April and May, followed by a migration to Greenland and the eastern Arctic where they spend the summer (DFO 2000b). Harp seals are likely to be common off western Newfoundland in late fall to early spring and rare at other times of the year (C-NLOPB 2005).

5.6.1.8 Hooded Seal

The southern Gulf of St. Lawrence is also one of several whelping habitats for the hooded seal (*Cystophora cristata*). Congregations occur in March and April near Prince Edward Island and the Magdalen Islands for pupping and breeding. Hooded seal pups are weaned in four days, which is followed by mating. The moulting migration to the waters off Greenland begins soon after but hooded seals are more widely distributed throughout the summer and fall (Kovacs 2002).

Population estimates are on the order of half a million seals (Kovacs 2002), a small portion of which whelp in the southern Gulf (Hammill 1993). Hooded seals feed on benthic invertebrates, Greenland halibut, redfish, Arctic cod and squid.

5.6.1.9 Grey Seals

Grey seals (*Halichoerus grypus)* occur on both sides of the north Atlantic but the stocks are genetically distinct (NAMMCO 1997). The northwest Atlantic stock occurs in the Gulf of St. Lawrence, off Nova Scotia and Newfoundland and Labrador. The largest colony occurs on Sable Island with 85,000 individuals. The Gulf of St. Lawrence population is estimated at 69,000 (Hall 2002).

The Sable Island population will move north during July to September, returning to Sable Island in October to December (Stobo et al. 1990). Grey seals may be born from September to March but peak pupping occurs in January (Hall 2002). Grey seals also congregate in the Gulf of St. Lawrence, between the eastern end of Prince Edward Island and Cape Breton Island and on the ice in St. George's Bay for pupping and breeding from mid-December to late February (Stobo et al. 1990). Pups are weaned in approximately three weeks and soon after, grey seals disperse throughout the Gulf, the Scotian Shelf, and along southern Newfoundland. Grey seals are benthic and pelagic predators of herring, cod, flounder, skate, squid, and mackerel.

Grey seals have been observed hauled out on the northern tip of the Port au Port Peninsula in an area known as The Bar, during a survey in August and September (J. Lawson, pers. com.).

5.6.2 Sea Turtles

Leatherback turtles (*Dermochelys coriacea*) are frequent visitors to the Gulf of St. Lawrence. Adults are regularly recorded feeding on jellyfish on the Scotian Shelf between June and October (Breeze et al.

2002) and may occur within the Gulf of St. Lawrence during the summer and fall (Goff and Lien 1988; James 2001). There are no estimates of the number of leatherback turtles occurring within the Gulf of St. Lawrence or the Northern Atlantic. The leatherback turtle is listed as endangered on Schedule 1 of SARA.

Atlantic loggerhead turtles (*Caretta caretta*) are not as common as leatherbacks on the Scotian Shelf (Breeze et al. 2002) and are therefore expected to be less common in the Gulf of St. Lawrence.

Kemp's Ridley (*Lepidochelys kempii*) turtles are thought to be rare visitors to eastern Canada.

5.6.3 Species at Risk

5.6.3.1 Fin Whale

Fin whales (*Balaenoptera physalus*) are common in the Gulf of St. Lawrence during the summer, ranging into the St. Lawrence estuary (COSEWIC 2005a). One aerial survey of the Gulf of St. Lawrence during the summer estimated a few hundred fin whales in the Gulf at that time and they were most common along the margins of the Laurentian Channel (Kingsley and Reeves 1998). During the summer they feed primarily on euphausiids and capelin and sometimes herring. They may form small groups while feeding but are usually seen singly or in pairs.

Recent estimates are that approximately 43,700 fin whales come to the east and west North Atlantic each summer to feed (IWC 2005). There are genetically distinct populations between the fin whales of the Gulf of St. Lawrence and Gulf of Maine and those whales sampled near Iceland and eastern North Atlantic (Berubé et al. 1998). Also, there is debate as to whether the fin whales of the eastern North Atlantic may comprise two or more stocks (see COSEWIC 2005a). The fin whale is listed on Schedule 3 of SARA as a species of special concern.

5.6.3.2 Blue Whales

Blue whales (*Balaenoptera musculus*) occur throughout the world but in low numbers. Estimates are of a few hundred in the western North Atlantic (Sears and Calambokidis 2002) and approximately 1,400 in the entire North Atlantic population. The Atlantic population of blue whales is listed as endangered under Schedule 1 of SARA.

Blue whales can occur in the Gulf of St. Lawrence at any time of year. Although they are more likely to occur there in spring, summer or fall, in years of low ice cover they may remain in the Gulf for much of the winter (Species at Risk website 2005). They are most common in the Gulf between August and November (Sears et al. 2002). Blue whales enter the Gulf through the Cabot Strait during ice breakup from late March to early April, after wintering in southern latitudes. Ice-related standings and entrapments have occurred during the winter and early spring on the southwest coast of Newfoundland (COSEWIC 2002).

Between 20 and 105 blue whales have been sighted in the Gulf of St. Lawrence in any one year and sightings are most frequent along the north shore of the Gulf (COSEWIC 2002). They are regularly sighted off the eastern tip of the Gaspé Peninsula in late April, with peak sightings in June. During the summer they are more common further in the estuary (COSEWIC 2002). It is estimated that 40 percent of the whales that occur within the Gulf return each year. The remainder are occasional visitors that typically range outside the Gulf (Species at Risk Website 2005). Blue whale feed almost exclusively on krill, so are attracted to areas of upwelling and oceanographic fronts.

5.6.3.3 Harbour Porpoise

There are three genetically distinct subpopulations of Harbour porpoise in the western North Atlantic: Gulf of St. Lawrence, Newfoundland, and Bay of Fundy-Gulf of Maine (Wang et al. 1996). Within the Gulf of St. Lawrence during the summer, annual estimates of harbour porpoise in two consecutive years in the mid 1990's were 12,000 and 21, 000 (Kingsley and Reeves 1998). Harbour porpoise were found throughout the Gulf but were most common along the North Shore of Quebec. In the northwest Atlantic, the population is estimated to be more than 50,000 (COSEWIC 2003c). The harbour porpoise is currently listed on Schedule 2 of SARA as a threatened species and is being considered for listing to Schedule 1 (Environment Canada website 2005). Harbour porpoise (*Phocoena phocoena*) are often seen in small groups but may form very large groups occasionally (Bjørge and Tolley 2002). Unlike other marine mammals, groups of harbour porpoise are not formed to increase feeding efficiency, since they feed individually on small schooling fish like capelin, herring and squid (Read 1999).

5.6.3.4 Leatherback Turtle

There are no estimates of the number of leatherback turtles occurring within the Gulf of St. Lawrence or the Northern Atlantic. The leatherback turtle is listed as endangered on Schedule 1 of SARA.

5.6.4 Sensitive Areas

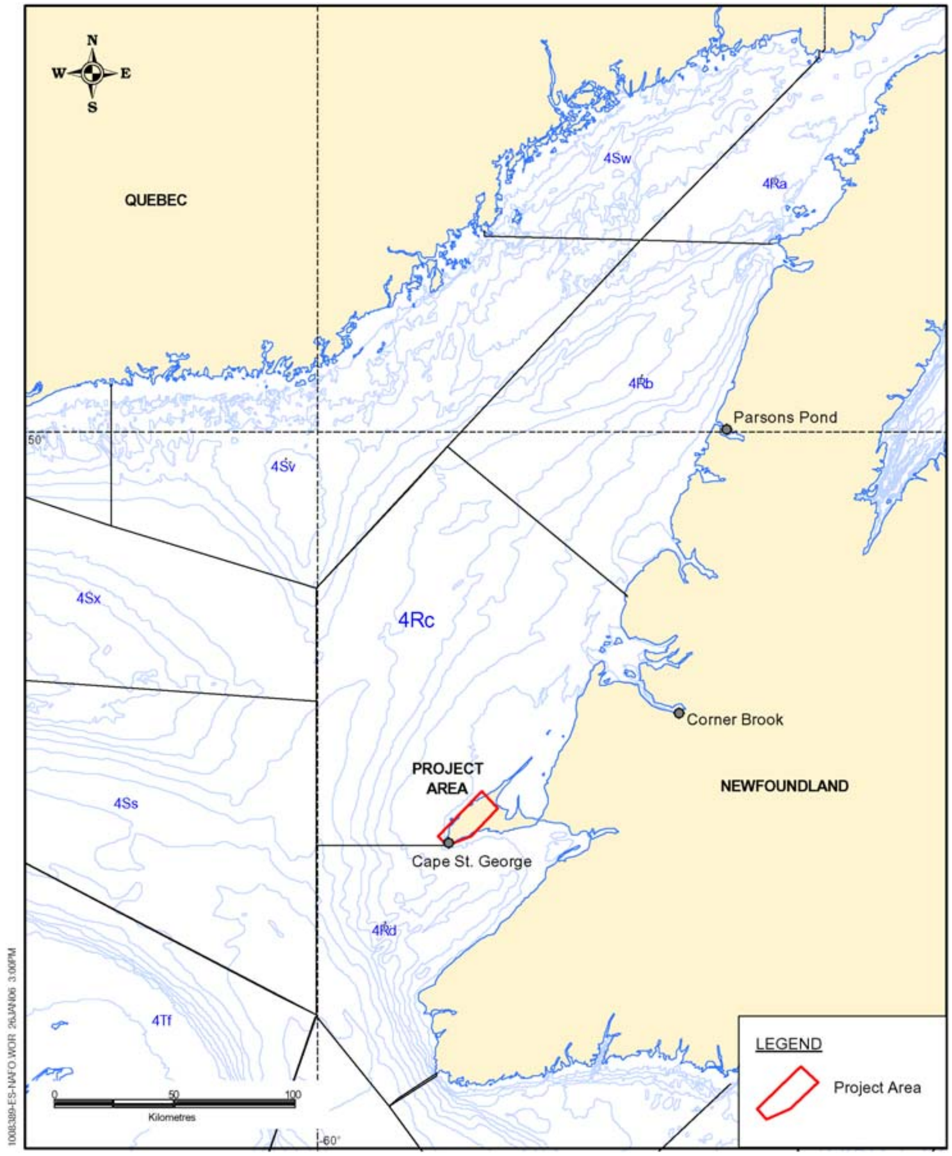
There are no known sensitive areas for marine mammals or sea turtles within the Project Area (C-NLOPB 2005).

5.7 Commercial Fisheries

Commercial Fisheries includes commercial fishing activity and DFO assessment surveys conducted in or near the Project Area. The commercial fisheries in the Project Area are included within North Atlantic Fisheries Organization (NAFO) Unit Area 4Rc (Figure 5.7). The following overview of commercial fishing activity is based on fisheries catch data available from DFO, DFO Stock Assessment documents, and telephone interviews/electronic mail exchange. Fisheries from 1986 to 2006 are discussed. Fisheries data for NAFO Unit Area 4R were sourced from the *Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment* (C-NLOPB 2005). At the time of writing, the most recent year for which DFO-validated fisheries data for NAFO Unit Area 4Rc are available is 2003 (landed weight value). But because the 2003 data lack reliable cash value estimates, 2002 landed value data are also referenced. Various DFO Stock Assessment documents, which are used to predict fisheries trends for 2006, were also referenced in the preparation of this report

For the purposes of this environmental assessment, fishing activity within NAFO Division 4R is described in general terms (total landings and value); fishing activity within Unit 4Rc is described in more detail. Local fishery information was then used to further delineate fishing activity that occurs specifically within the Project Area.

Figure 5.7 Northwest Atlantic Fisheries Organization Unit Areas and Project Area



5.7.1 Fisheries in Northwest Atlantic Fisheries Organization Division 4R Unit Area (b,c,d)

The NAFO Division 4R (unit areas b, c, and d combined) unit covers an area substantively more expansive that the Project Area. However, general information on trends associated with the fishery for NAFO Division 4R provide insight and knowledge for the Project Area, as well as a general overview.

Since 1985, the fisheries within NAFO Division 4R have undergone many changes, largely due to the collapse of the groundfish fisheries after 1991 and the subsequent moratoria and catch reductions that were initiated after 1993. The current scientific advice and knowledge indicate that increases in the groundfish fisheries are highly unlikely for the foreseeable future. Groundfish harvest since 1993 for NAFO Division 4R has been consistently below 8,000 Tonnes (C-NLOPB 2005). In 1985, groundfish harvests accounted for 73 percent of total landings. These landings were dominated by cod (61 percent) with redfish (11 percent) and plaice (1 percent) rounding out the remainder of the harvest (C-

NLOPB 2005). In 2004, groundfish harvest accounted for 4 percent of the landings (cod 3 percent and turbot 1 percent).

The changes in fish harvests in NAFO Division 4R are illustrated by examining the harvest patterns in 1985 and 2004. In 1985, the NAFO Division 4R harvest was comprised of 73 percent groundfish, 6 percent pelagic, 7 percent shellfish and 4 percent other species. In 2004, the NAFO Division 4R harvest was comprised of 77 percent pelagic, 16 percent shellfish, 4 percent groundfish and 3 percent other species. In terms of quantity of landings recorded within NAFO division 4R, two pelagic species (herring and mackerel) have made up nearly 72 percent of the harvest by quantity from 2002 to 2004 (C-NLOPB 2005). Other principle species during these years with regard to landed weight include northern shrimp, capelin, cod and snow crab. Lobster fisheries, although comparatively lower in landed weight, have high economic and social value (C-NLOPB 2005). In 2004, northern shrimp, lobster, snow crab, mackerel, herring and cod are estimated to have the highest landed value in 4R, respectively (C-NLOPB 2005).

The landed value ($/kg) of the 2004 NAFO Division 4R harvest, based on average prices from DFO statistical reports (2004), indicates that although pelagic species account for the highest quantities landed (kg), shellfish species account for the highest landed value with lobster and snow crab having the highest landed values (C-NLOPB 2005)) (Table 5.4). Shellfish species (lobster, crab and shrimp) account for 66.3 percent of landed values, followed by pelagic species (22.9 percent), groundfish (9.8 percent), and others (1 percent). The importance of shellfish species harvest to NAFO Division 4R is clearly demonstrated given that the shellfish harvest accounts for 7 percent of the landed weight, and for 66.3 percent of the overall landed value.

Table 5.4 2004 Landed Value of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit 4R (b,c,d)

Species	Weight (kg)	Price Per Weight ($/kg)	Landed Value ($)
Atlantic Cod	1,230,100	1.25	1,532,211
Haddock	2,800	1.01	2,827
Redfish (Sp.)	484,800	0.49	236,203
Halibut	123,900	6.61	818,904
Plaice	74,900	0.77	57,628
Greysole/witch flounder	407,000	0.87	354,423
Turbot/Greenland halibut	834,000	1.32	1,097,666
Skate (sp.)	14,400	0.24	3,429
White hake	28,300	0.53	14,974
Wolffish (sp.)/catfish	6,300	0.28	1,736
Herring	14,258,300	0.16	2,263,237
Mackerel	23,300,700	0.27	6,215,616
Capelin	2,873,900	0.27	779,303
Mako shark	2,400	1.03	2,471
American Lobster	756,800	11.03	8,347,212
Northern Shrimp	7,993,100	1.39	11,083,979
Snow Crab	1,427,200	5.40	7,708,693
Seal parts (1)	62,800	0.26	16,328
Lumpfish roe	26,700	5.36	143,112
All other (2)	3,300	1.80	5,940
Total	53,911,700		40,685,890

Source: C-NLOPB 2005.
Notes: 1. The value for seal parts is based on parts reported by weight (meat, fat);
2. The value for “all other” species is based on the average 2004 price for all Newfoundland region species reported by weight.

Fish harvesting practices are dictated by weather, ice conditions, resource availability, resource management plans, commercial considerations and the fishers' harvesting plans. NAFO Division 4R has limited fish harvesting activity from January to May due primarily to ice conditions in the Gulf. The impact of ice conditions for any particular region often will dictate the commencement of certain fisheries (C-NLOPB 2005). Additional information on fish harvest is provided in subsequent sections.

5.7.2 Fisheries in Northwest Atlantic Fisheries Organization Unit Area 4Rc

Canadian commercial fisheries catches and value for all species caught in NAFO Unit Area 4Rc from 2000 to 2003 is illustrated in Appendix B. The total catch in 4Rc ranged from approximately 12,500,000 kg to approximately 17,400,000 kg from 2000 to 2003. The total landed value from 2000 to 2002 was approximately $28,000,000. In 2002, Unit 4Rc had landings valued at over $10,000,000. Lobster, crab, cod, herring, and mackerel represented the greatest value (JWL 2005).

Important commercial species in terms of landed value from 2000 to 2002 have included lobster, snow crab, herring, mackerel and cod:

- lobster – 30 percent of total fishing revenue;
- snow crab – 32 percent;
- herring – 1 percent;
- mackerel – 10 percent; and,
- cod – 9.5 percent.

Capelin also constituted a substantial portion of landings in 2000. Remaining fisheries in 4Rc each accounted for less than 5 percent of the total fisheries revenue from 2000 to 2002.

The amount of fishing effort expended on a monthly basis ranged from 0 sets (December to March) to over 2,500 sets (May) in 4Rc in 2002. A total of 7,541 fishing sets were recorded in NAFO Unit Area 4Rc and a total of 19 species were fished (JWL 2005). The fishing season extended from April to November with no fishing activity being reported from December to March. May, June, and July were the months with the most fishing activity with the majority of effort directed towards lobster, crab and cod fisheries. Remaining fisheries each accounted for less than 5 percent of the fishing sets. Lobster and crab pots were the most frequent gear type. Gill nets, long line and hand line were also common for cod and other finfish. Mobile gear types, including bottom otter trawl, shrimp trawl, Danish seine, purse seine and scallop dredge were used for redfish, herring, mackerel, capelin, squid, shrimp and scallop.

5.7.3 Summary of 2000 to 2003 Fisheries in Northwest Atlantic Fisheries Organization Unit Area 4Rc

Fishing activity in 4Rc takes place from April to November, with little or no fishing activity from December to March. The most intense fishing months are May through July. The lobster and snow crab fisheries are mainly pursued in spring (April to July). Cod and other finfish fisheries are more common in summer months (July through September). Fixed gear is more common than mobile gear and includes gill nets, longline and hand line (for cod and other finfish) and pots (for crab and lobster). Mobile gear types, including bottom otter trawl, shrimp trawl, Danish seine, purse seine and scallop dredge are used for redfish, herring, mackerel, capelin, squid, shrimp and scallop.

The most lucrative fisheries (more than 5 percent of annual revenue in any year) in 4Rc from 2000 to 2003 were lobster, snow crab, herring, mackerel and cod. Revenue for capelin accounted for greater than 5% of cash landings in 2000 only.

5.7.4 Main Fisheries Occurring in the Project Area

Information on the fisheries that occur specifically within the Project Area was obtained on a preliminary basis through telephone consultations with a representative from FFAW, fishers, and DFO personnel in January 2006 (see Section 3). Fisheries that occur within the Project Area (less than 50 m water depth) as identified through these discussions are described.

Stakeholders were contacted by telephone to provide an opportunity for information exchange regarding the proposed Project and potential issues. Tekoil recognizes that these contacts with local fishers were preliminary only and will be meeting with interested fishers and FFAW as required. The proceedings of these meetings will be provided to the C-NLOPB. Tekoil will continue to work with area fishers to effectively respond to identified concerns.

5.7.4.1 Lobster

The lobster fishery accounts for less than 2 percent of the NAFO Division 4R harvest by quantity (C-NLOPB 2005). Nevertheless, lobster is a high value fishery that is relatively stable as compared to other fisheries over the same time frame (1985 to 2004). Declines were noted in the late 1990s and early this decade; however, harvest levels are at or near historic levels over the past few years (C-NLOPB 2005).

The information collected during the preliminary contact with FFAW, fishers and DFO indicates the lobster fishery in 4Rc is conducted from April to June and occurs exclusively in the nearshore environment (<50 m depth). The lobster fishery is pursued by the use of baited pots, a type of fixed gear that sits on the ocean floor attached to surface buoys via ropes. A very active lobster fishery occurs within the Project Area with as many as 40 lobster fishers using this area, each fishing a maximum of 250 pots per fisher. The lobster fishery is the most economically valuable fishery that occurs within the Project Area and is described by fishers as constituting the economic survival of most fishers. Concurrent with the lobster fishery is a “bait fishery”; a fixed gear, gillnet fishery usually for herring or flounder. This fishery is conducted by lobster fishers to provide bait for their lobster traps and takes place in the nearshore environment.

5.7.4.2 Cod

The local cod fishery (4Rc) is conducted from June to October, with a peak effort in July. The cod fishery in particular and the groundfish fishery in general is still important socially and economically. However, the harvest is approximately 5 percent of what it was previous to the fishery collapse and moratoria (C-NLOPB 2005). In past years, cod quotas have been set on a monthly basis and a competitive fishery is conducted until the monthly quota is taken. This has resulted in a fishery that employs a substantial effort for a few days each month Following a moratorium on cod fishing in 2003, a more restrictive boat quota of 3,000 pounds per boat was introduced, increasing the time required to catch the monthly quota to about one week. Further regulation changes are possible for the 2006 fishing season, including an individual quota system (J.Spingle, pers. comm.).

The cod fishery is pursued with fixed gear (gillnets, long line and baited hand line) and occurs mainly at depths between 20 and 55 m. Gillnets and long lines are deployed as bottom sets that are left to fish for extended periods and are attached to surface buoys via ropes. Baited hand lines are manually operated by fishers at areas of known/suspected fish concentrations. A very active cod fishery takes place within the Project Area.

5.7.4.3 Lumpfish

The lumpfish fishery in 4Rc occurs from May 14 to May 29 as the fish move to shallow water areas to spawn. The fishery is pursued with gillnets and occurs exclusively at water depths less than 50 m. There has been limited effort directed toward this fishery in recent years mainly due to resource scarcity. Fishers describe the lumpfish fishery as being cyclic. If resource numbers improve as many as 35 fishers could be expected to fish within the Project Area.

5.7.4.4 Crab (snow, toad and rock)

Snow crab fisheries take place almost exclusively outside the Project Area at depths greater than 50 m. Small boat fishers are known to fish snow crab off Cape St. George near the southwest portion of the Project Area. This constitutes the only potential area of overlap with snow crab fishers and the Project Area. The snow crab season normally extends from April 1 to June 30. None of the persons contacted were aware of any directed fishery for rock crab or toad crab within the Project Area.

The crab fishery (snow crab) within NAFO Division 4R has increased dramatically over the past twenty years (C-NLOPB 2005). However, the crab industry has experienced a decline since 2000 with reduced quotas for Area 12 in which the Project Area is located. Closure dates vary and depend upon resource conditions including species quality (soft shell states) and quotas.

5.7.4.5 Skate and Flounder

Fisheries for these species are conducted within the Project Area and occur within the month of July. This fishery is conducted by use of gillnets, is of short duration (two to three weeks) and involves only a minimal amount of effort (few fishers are involved).

5.7.4.6 Herring

Herring harvests have been relatively stable for NAFO Division 4R at approximately 15,000 tonnes annually (C-NLOPB 2005). A harvest fishery and unrecorded bait fishery are conducted.

The herring season extends from April to December but is mainly conducted from May to July (spring fishery) and then from October to November (fall fishery). The main method of fishing is with mobile gear (seine). A limited gillnet bait fishery also occurs in spring. Fishing within the Project Area is primarily limited to the spring fishery. A fall fishery is conducted mainly in St. Georges Bay. This fishery often occurs at water depths less than 50 m. As many as 25 vessels have been known to operate within the Project Area.

5.7.4.7 Mackerel

No formal season exists for mackerel but it is mainly fished from mid-August to October. The August fishery occurs mainly to the north of the Project Area and that fishing in the Project Area usually commences in September. The main method of fishing is with mobile gear (seine). This fishery occurs at water depths less than 50 m and is often conducted at night. As many as 25 vessels have been known to fish within the Project Area.

5.7.4.8 Capelin

The capelin fishery occurs from June to July and is conducted mainly by use of mobile gear (seine). No inshore trap fishery occurs in the Project Area. Seining activities for capelin occur within the Project Area. As many as 25 vessels have been known to operate in the Project Area.

5.7.4.9 Shrimp

The shrimp fishery does not occur within the Project Area, but a limited fishery occurs within NAFO Unit Area 4Rc. The bulk of shrimp landings are attributable to NAFO Unit Areas 4Ra and 4Rb (JWL 2005).

In terms of quantities and landed values, the shrimp industry is substantive within NAFO Division 4R (C-NLOPB 2005). The shrimp harvest has assumed the position that the groundfish harvest historically occupied. A steady increase since the early 1980s has been observed in shrimp harvests. However, recent years have exhibited some degree of variability with fluctuating quotas and catches. The shrimp harvest is focused on areas with depths greater than 200 m and therefore would not occur in the Project Area.

5.7.4.10 Halibut

The halibut fishery occurs for a few days during July and is mainly comprised of an offshore fishery that occurs at depths greater than 250 m or not less than approximately 19 km offshore. A limited inshore fishery does occur within the Project Area at water depths between 16 and 40 m. The inshore fishery is pursued by small boat fishermen (<35 ft) by use of fixed gear (baited trawls).

5.7.4.11 Eels

A limited commercial eel fishery exists within the Project Area. There are two commercial licenses for Harry’s Brook, Lourdes Brook and Victor’s Brook (DF0 2005). The season extends from August 15 to November 30. Fish are captured in the freshwater environment with traps.

5.7.4.12 Atlantic Salmon

The commercial fishery for Atlantic salmon (*Salmo salar*) has been under moratorium since 1992 but the fish has remained an important recreational species in Newfoundland and Labrador. Atlantic salmon are anadromous, spending time in both saltwater (feeding and growing) and freshwater (spawning). It is during the time of migration to and from the saltwater environment that Atlantic salmon may occur in the vicinity of the Project Area and potentially be affected by seismic activity.

The Project Area is contained within Salmon Fishing Area 13 (SFA 13), which extends from Cape Ray to Cape St. Gregory. A total of 18 scheduled salmon rivers occur within SFA 13 (although none occur within the Project Area).

DFO (2005f) reports a decrease in the total catch of both large and small salmon (SFA 12 and 13 combined) in 2004 as compared to 2003, and from the mean catch that occurred from 1994 to 2003. Effort expenditure in 2004 increased over 2002 but remained about average. Catch per unit of effort in 2004 was one of the lowest on record (DFO 2005f).

Information on total returns of small and large salmon is available for seven rivers within SFA 13 and is reported in Table 5.5. All rivers had increases in returns of small salmon in 2004 relative to 2003 and the reported means. Returns of large salmon to Highland's River and Harry's River increased over 2003 and were greater than the multi-year means. Returns to the remaining rivers were similar to 2003, with Crabbes River and Fishells River increasing in relation to the mean and Middle Barachois River, Robinsons River and Flat Bay Brook decreasing relative to the mean.

Adult Run Timing

There are "early" and "late" run rivers within SFA 13. The run timing on the Highlands River can extend from May to October. Highlands River also lacks the characteristic "run pulse" (peak run occurring in a narrow time frame) associated with most rivers (B. Dempson, pers. comm.). Data available from 1980 to 1982 and from 1993 to 2004 indicate that on average, 75 percent of small salmon enter Highlands River by August 16, while 75 percent of large salmon enter by September 5 (B. Dempson, pers. comm).

Other rivers in SFA 13 are mostly composed of 2SW and 1SW stocks. The 2SW stocks generally enter freshwater in June and the 1SW in late June or early July. Assuming normal run timing, 75 percent of returning adult salmon could be expected to be in the rivers by late July, with the exception of Highland's River. (C. Bourgeois, pers. comm.).

Smolt Run Timing

The seaward migration of smolt in SFA 13 occurs during May and June. Smolt may be present in the Project Area during this time as they migrate along the coast on their journey to the Labrador Sea and west Greenland. While the exact migration route is not known, it is known that some smolt from Western Newfoundland rivers migrate along the south coast of Newfoundland, while others exit the Gulf of St. Lawrence via the Strait of Belle Isle.

5.7.5 Fisheries in 2005-2006

A review of the most recent DFO stock status reports and stock assessment reports indicates potentially decreasing catches for lobster and cod and potentially stable catches for herring, mackerel and capelin.

The lobster fishery in Newfoundland is less stable and future landings are expected to be lower, on average, than in previous years (DFO 2003c). Northern Gulf cod (NAFO areas 3Pn4RS) was under moratorium in 2003 but a limited fishery with Total Allowable Catch (TAC) of 3,500 tonnes was opened for 2004 and 2005. As of January 2005, 3,112 tonnes of the quota was taken (DFO 2005e). The 2005 spawning stock biomass is well below the conservation limit and DFO has recommended that landing levels remain low to promote the increase of the stocks' biomass (DFO 2005e). The abundance index for spring spawning herring rose in the period from 1998 to 2002 but it has been dropping since 2003. A significant drop in age has been observed in west coast herring over the last 30 years (DFO 2005c). DFO recommended continued TACs of 20,000 tonnes for west coast herring in 2005. Mackerel spawning biomass remains low compared to levels noted before 1992 (DFO 2004e). The dispersion index (presence/absence of capelin per tow) for 4R capelin shows a clear upward trend since 1990 but a decrease was observed for 2004. DFO has recommended a system of progressive increases in TAC if any increases are approved (DFO 2005g).

Table 5.5 Total Returns of Small and Large Salmon for Seven Rivers within Salmon Fishing Area 13

Year	Highlands River			Crabbes River			Middle Barachois River			Robinson's River			Fischelles River			Flat Bay Brook			Harry's River		
	Sm	Lg	Tot	Sm	Lg	Tot	Sm	Lg	Tot	Sm	Lg	Tot	Sm	Lg	Tot	Sm	Lg	Tot	Sm	Lg	Tot
1992																			888	16	904
1993	137	78	215																1808	115	1923
1994	145	148	293																1791	128	1919
1995	172	120	292																2213	80	2293
1996	199	142	341	870	249	1119	818	38	856	882	138	1020				1233	132	1365	1798	126	1924
1997	398	157	555	1168	361	1529	1056	189	1245	1107	195	1302	863	89	952	1320	174	1494	1747	201	1948
1998	96	117	213	494	239	733			0			0	205	72	277			0	1659	191	1850
1999	146	82	228	717	265	982	563	66	629	1452	204	1656	1264	246	1510	2276	235	2511	1713	176	1889
2000	58	67	125	1027	156	1183	1142	155	1297	1501	320	1821	1800	276	2076	2397	494	2891	1271	49	1320
2001	75	65	140	688	180	868	937	142	1079	1909	232	2141	248	45	293	1150	176	1326	1028	132	1160
2002	169	87	256	630	136	766	548	165	713	998	206	1204	414	42	456	1560	202	1762	1640	285	1925
2003	294	166	460	1107	264	1371	735	101	836	1260	182	1442	1071	180	1251	1641	200	1841	2334	422	2756
2004	507	252	759	2135	272	2407	1082	98	1180	1993	167	2160	1254	190	1444	2122	192	2314	2828	498	3326
Mean 92-96	163	122																	1700	93	
Mean 97-03	177	106		832	229		835	137		1363	222		838	136		1715	244		1627	208	

Source: DFO 2005f.

5.7.6 Historical Fisheries

Cash landings in 4Rc have been predominantly made up of lobster, redfish, cod, and herring landings from 1986 to 1994. The most important species in terms of cash landings since 1994 have been lobster, snow crab, herring and cod (JWL 2005).

5.7.7 Aquaculture, Fish Plants, Emerging and Developing Fisheries

The Newfoundland and Labrador Department of Fisheries and Aquaculture reports there are no fish plants or aquaculture operations within the Project Area. The closest aquaculture operations are two blue mussel sites and one giant scallop site that are located in Piccadilly Bay (Figure 5.8 from www.aquagis.com). No fisheries development or emerging fisheries projects are ongoing or planned for the Project Area this year (W. Goosney, pers. comm).

5.7.8 Fisheries and Oceans Canada Surveys

DFO assessment surveys for 2006 are summarized in Table 5.6, along with the scheduled date, area in which the survey is to be conducted and the region responsible for the survey. Offshore seismic activities have been planned to avoid conflicts.

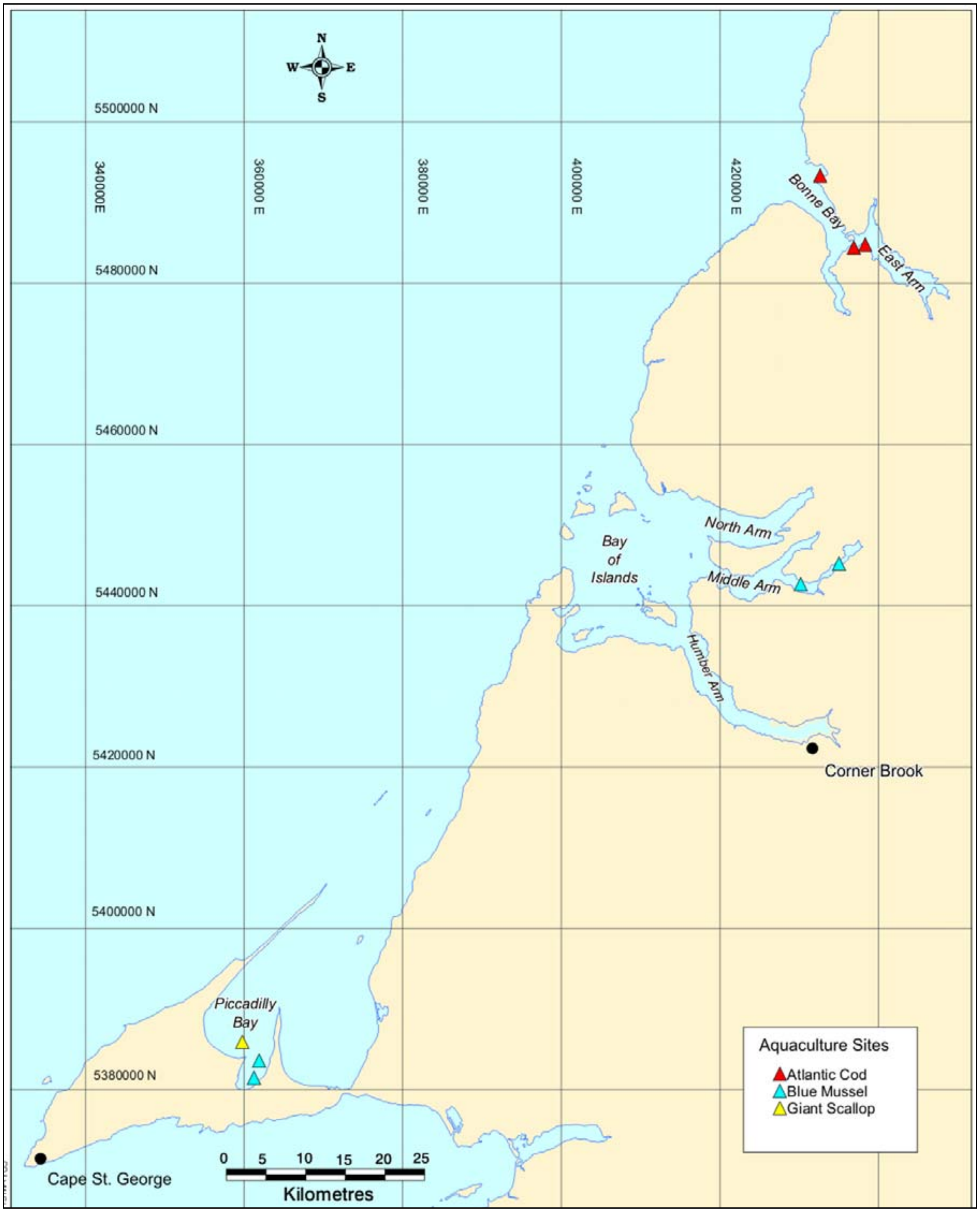
Table 5.6 Fisheries and Oceans Canada Assessment or Research Surveys in Vicinity of Project Area

DFO Region	Area	Survey	Scheduled Date
Quebec Region	4RST	Sentinel Survey	Mid June - Mid July
Quebec Region	4RST and 4Vn	*PZMA Survey	June 20 – July 8
Gulf Region	Southern Gulf	Snow Crab	Jul 1 – Oct 1
Gulf Region	4T	Sentinel Survey	Jul 1 – Oct 31
Quebec region	4RST, 3PN	Ground fish RV Survey	Aug 1 – Aug 30
Gulf Region	Southern Gulf	Ground fish RV Survey	Aug 31 – Sept 28
Gulf Region	4T	Herring Survey	Sept 25 – Oct 13
Quebec Region	4RST and 4Vn	*PZMA Survey	Nov 01 - Nov 14
* Atlantic Zone Monitoring Program.			

5.7.9 Special Areas

The Project Area is approximately 5 km away from the eastern-most boundary of the cod spawning area as identified in the Western Newfoundland and Labrador SEA (C-NLOPB 2005). This area is closed to commercial fishing activities from April 1 to June 23 each year.

Figure 5.8 Aquaculture Sites in the Vicinity of the Project Area



Source: www.aquaqgis.com

5.8 Terrestrial Environment

5.8.1 Vegetation

The Port au Port Peninsula falls within the Western Newfoundland Forest Ecoregion and the Port au Port Subregion. The area is geologically diverse with limestone, serpentine and acidic rock types covering extensive areas (Meades 1990). The Port au Port Subregion, in particular, has wind-exposed limestone barrens and large area of exposed bedrock. As a result, the herbaceous flora is diverse and the Subregion supports many calcareous Arctic-alpine species, Gulf endemics and Cordilleran disjunct populations (Meades 1990). A series of limestone barrens extends inland from the shoreline of the Peninsula. The lower terraces are dominated by dwarf willow and swamp birch. The upper terraces become more exposed further inland resulting in open bedrock with little soil cover. These areas are dominated by mountain avens (*Dryas integrafolia*) and as a result, are often called Dryas Rock Gardens (PAA 2000).

Forest cover is limited and generally unproductive (Meades and Moores 1994) consisting mostly of balsam fir underlain with wood ferns and feathermoss. Black spruce occurs on poorly drained sites or in areas of exposed bedrock (PAA 2000). Forest inventory data for the Port au Port Peninsula indicates that much of the area is forested and is classified as scrub or merchantable timber. Scrub forest is generally more open and the trees tend to be stunted compared to trees on merchantable sites. Some areas of merchantable timber have been pre-commercially thinned (Figure 5.5). Bogs or soil barrens cover the interior plateau and are dominant in an area on the northwest corner of the Peninsula (Figure 5.5) (NLDNR 2006).

A number of rare vascular plant species have been identified on the Port au Port Peninsula, including two species that have not been found anywhere else (Bouchard et al. 1991). The vascular plant species that have been found on the Port au Port Peninsula are classified as S1 or S2 (Bouchard et al. 1991; ACCDC 2006), as indicated in Table 5.7.

Table 5.7 Rare Vascular Plant Species Identified on the Port au Port Peninsula

Species	Habitat Affiliation	Nfld Rarity Rank[1]	Notes
Woolly arnica (*Arnica angustifolia)*	Turfy limestone barrens	S1	Type locality is Table Mountain, Port au Port
Laurentian fragile fern (*Cystopteris laurentiana)*	Crevices and ledges of calcareous escarpments	S1	-
Teaberry (*Gaultheria procumbens)*	Dry coniferous forest, peaty slopes with ericaceous shrubs	S1	Found at De Grat Bay, Port au Port
Mackenzie's sweetvetch (*Hedysarum boreale (ssp. Mackenzii))*	Exposed gravelly and turfy limestone barrens	S1	Found only at Cape St. George, Port au Port
Potamogeton friesii	Alkaline pools and ponds	S1	Such aquatic species may be undercollected
Western threadleaf pondweed *(Stuckenia filiformis subsp occidentalis)*	Slow moving brook through fen	S1	
Senecio cymbalaria	Dry exposed ledges and gravels on limestone barrens	S1	Type locality is Table Mountain, Port au Port. Known only from this locality
Sphenopholis intermedia	Limestone cliffs and talus	S1	-
Fairyslipper (*Calypso bulbosa var. americana*)	Limestone barren, low heath	S1	

Species	Habitat Affiliation	Nfld Rarity Rank[1]	Notes
Rock dwelling sedge (*Carex petricosa var. misandroides)*	Limestone cliffs, talus and barrens	S1	Type locality is Table Mountain, Port au Port
Alpine fescu *(Festuca brachyphylla)*	Gravelly limestone barren	S2	
Crantz's cinquefoil *(Potentilla neumanniana)*	Heath, grassy areas	S2	
Dwarf tansy *(Tanacetum bipinnatum subsp huronense)*	Turfy limestone barren	S2	
Antennaria gaspensis	Cliffs, talus, and barrens on limestone	S2	-
Antennaria straminea	Dry gravelly limestone and exposed basic rock barrens	S2	-
Handsome pussytoes (*Antennaria pulcherrima)*	Dry gravelly limestone and exposed basic rock barrens	S2	
Low northern sedge (*Carex concinna)*	Shaded limestone ledges and escarpments; limestone barrens	S2	-
Carex glacialis	Gravelly limestone barrens	S2	
Hooker's orchid (*Platanthera hookeri*)	Limestone barren	S2	
Knotted rush (*Juncus nodosus)*	Wet margins of pools, fens, sandy-gravelly beach	S2	
Northern rough fescue *(Festuca altaica)*	Heath, limestone barrens	S2	
Slenderleaf sundew *(Drosera linearis)*	Fen, pond edges	S2	
Cerastium beeringianum	Limestone barrens	S2	-
Cypripedium calceolus	Turfy limestone barrens and talus slopes	S2	Can be locally abundant
Showy ladyslipper (*Cypripedium reginae)*	Fens and eutrophic larch scrub	S2	-
Cystopteris bulbifera	Limestone crevices, ledges and talus; openings in coniferous forest on limestone	S2	-
Gymnocarpium robertianum	Talus and ledges of limestone cliffs	S2	-
Lesquerella arctica	Limestone cliffs, talus and gravelly barrens	S2	-
Limonium carolinianum	Upper limit of tidal flats	S2	Salt marsh habitat limited in Nfld
Malaxis monophyllos	Fens and moist limestone barrens, talus and ledges	S2	-
Dawson sandwort (*Minuartia dawsonensis)*	Limestone cliffs, talus and barrens	S2	-
Polygonum raii	Brackish sandy or gravelly beaches	S2	-
Macoun's buttercup (*Ranunculus macounii)*	Alluvial shores and swales	S2	-
Ranunculus recurvatus	Shady woods along river banks	SH	-
Salix arctica	Stream margins and peaty depressions in limestone barrens	S2	-
Scirpus maritimus	Tidal flats and salt marshes	S2	Salt marsh habitat limited in Nfld
Smilacina racemosa	Salt marshes and brackish shores	S2	Salt marsh habitat limited in Nfld
Spartina alterniflora	Tidal marshes and sea-shores	S2	Salt marsh habitat limited in Nfld
Broadlobed dandelion (*Taraxacum latiolbum)*	Turfy limestone sea-shore	S1/S2	-
Trisetum melicoides	Rocky, gravelly or sandy banks of rivers; moist thickets	S2	-
Northern valerian (*Valeriana dioica)*	Bogs, mossy woods and brook shorelines on limestone	S2	_
Selkirk's viola (*Viola selkirkii)*	Moist thickets and coniferous forests in ravines, barrens and talus; on	S2	-

Species	Habitat Affiliation	Nfld Rarity Rank[1]	Notes
	limestone		
Viola septentrionalis	Moist thickets along rivers and in ravines	S2	-
Smooth cliffbrake (*Woodsia glabella)*	Crevices of limestone cliffs	S2	-

Source: Bouchard et al. 1991; ACCDC 2006.
[1] Nfld Rarity Ranks are based on the scale used by The Nature Conservancy and Argus and Pryor (1990):
S1 – extremely rare (5 or fewer occurrences or very few surviving individuals or hectares), or because of some factor(s) making the taxon particularly vulnerable to extirpation on the Island.
S2 – rare (6 to 20 occurrences or very few surviving individuals or hectares) or because of some factor(s) making the taxon particularly vulnerable to extirpation on the Island.
SH – historically known but presence unverified in last 20 years; suspected to be still present.

5.8.2 Terrestrial Birds

Birds inhabiting the Port au Port Peninsula would be typical of boreal species found elsewhere in Newfoundland. Various species of raptors, songbirds, and waterfowl use the forests, shrubs, barrens, and wetlands within the Project Area. The Port au Port Peninsula is an important stopover area for shorebirds and songbirds during fall migration (PAA 2000).

Willow ptarmigan (*Lagopus lagopus*) are also likely present in suitable habitat. Species observed and general trends from Breeding Bird Surveys (BBS) at Trout River (approximately 75 km north of the Port au Port Peninsula) and general habitat affiliations for each species are indicated in Table 5.8 (Sauer et al. 2005). Trout River is the closest BBS location to the Port au Port Peninsula. It is likely that these species would also be found in suitable habitats on the Port au Port Peninsula.

Table 5.8 Species Observed During Breeding Bird Surveys at Trout River, 1966 to 2003

Species	Average Birds/Trout River route (1989-1998)	Population Trend 1966-2003 (% change/year in Nfld)[1]	General Habitat Affiliations
Spotted Sandpiper (*Actitis macularia*)	1	-22.3	Riparian zone
Common Snipe (*Callinago gallinago*)	5	1.3	Open habitats/ wetlands
Herring Gull (*Larus argentatus*)	10	-3.7	Ponds/coastal
Great Black-backed Gull (*Larus marinus*)	3	-0.1	Ponds/coastal
Belted Kingfisher (*Ceryle alcyon*)	1	5.8	Riparian zone
Downy Woodpecker (*Picoides pubescens*)*	1	-23.7	Coniferous forest
Hairy Woodpecker (*Picoides villosus*)	1	16.4	Coniferous forest
Blue-headed Vireo (*Vireo solitarius*)	3	-24.7	Mixed open deciduous and coniferous forest
American Crow (*Corvus brachyrhynchos*)	23	2.8	Forested/open habitats
Common Raven (*Corvus corax*)	9	-6.0	Forested/open habitats/coastal
Black-capped Chickadee (*Poecile atricapillus*)	8	-0.2	Coniferous forest
Boreal Chickadee (*Poecile hudsonicus*)	3	-12.9	Coniferous forest
Winter Wren (*Troglodytes troglodytes*)*	2	23.4	Coniferous forest

Species	Average Birds/Trout River route (1989-1998)	Population Trend 1966-2003 (% change/year in Nfld)[1]	General Habitat Affiliations
Golden-crowned Kinglet (*Regulus satrapa*)	1	28.5	Coniferous forest
Ruby-crowned Kinglet (*Regulus calendula*)*	19	2.1	Coniferous forest
American Robin (*Turdus migratorius*)*	52	-2.2	Open habitats, bushes/thickets, edges
Nashville Warbler (*Vermivora ruficapilla*)	1	Not available	Deciduous forest/ mixed wood/shrub
Yellow Warbler (*Dendroica petechia*)	3	0.8	Alder/willow thickets near water
Magnolia Warbler (*Dendroica magnolia*)	5	0.7	Coniferous forest
Cape May Warbler (*Dendroica tigrina*)*	1	30.4	Coniferous forest/ mixed wood/edges
Yellow-rumped Warbler (*Dendroica coronata*)*	13	3.6	Coniferous forest/ mixed wood
Black-throated Green Warbler (*Dendroica virens*)*	7	-8.9	Coniferous forest/ mixed wood
Blackpoll Warbler (*Dendroica striata*)*	6	-7.1	Coniferous forest
Black and White Warbler (*Mniotilta varia*)*	2	-3.2	Deciduous forest
American Redstart (*Septophaga ruticilla*)*	2	8.2	Deciduous forest
Ovenbird (*Seiurus aurocapillus*)*	1	-16.6	Deciduous forest
Northern Waterthrush (*Seiurus noveboracensis*)'	33	-5.5	Coniferous forest
Mourning Warbler (*Oporonis Philadelphia*)	4	0.4	Bushes/thickets/ immature forest/ edges
Common Yellowthroat (*Geothlypis trichas*)	2	4.4	Bushes/thickets along water/edges
Wilson's Warbler (*Wilsonia pusilla*)*	7	-8.0	Bushes/thickets along water
Savannah Sparrow (*Passerculus sandwichensis*)*	6	-11.0	Open habitats/bogs
Fox Sparrow (*Passerella iliaca*)*	13	1.2	Bushes/thickets/ edges/scrubby forest
Song Sparrow (*Melospiza melodia*)	1	7.8	Bushes/thickets/ edges
Lincoln's Sparrow (*Melospiza lincolnii*)*	35	3.1	Bushes/thickets/ scrubby forest/bogs
Swamp Sparrow (*Melospiza georgiana*)	12	-3.2	Wetlands, riparian bushes/thickets
White-throated Sparrow (*Zonotrichia albicollis*)*	52	-0.1	Bushes/thickets/ edges of coniferous/ mixed wood forest
Purple Finch (*Carpodacus purpureus*)	1	-6.1	Coniferous forest
Pine Siskin (*Carduelis pinus*)	4	-3.7	Coniferous forest

[1]Trend data for species with asterisks are considered to have "important deficiencies": regional abundance is less than 0.1 birds/route (very low abundance), the sample is based on less than five routes for the long term, or is based on less than 3 routes for either subinterval (very small samples), or the results are so imprecise that a 5%/year change would not be detected over the long-term (very imprecise).
For all other species, data is considered "deficient": regional abundance is less than 1.0 birds/route (low abundance), the sample is based on less than 14 routes for the long term (small sample size), the results are so imprecise that a 3%/year change would not be detected over the long-term (quite imprecise), or the sub-interval trends are significantly different from each other (P less than 0.05, based on a z-test). This suggests inconsistency in trend over time).
Source: Sauer et al. 2005.

Raptors such as osprey (*Pandion haiaetus*), bald eagle (*Haliaeetus leucocephalus*), boreal owl (*Aegolius funereus*), merlin (*Falco columbarius*) and sharp-shinned hawk (*Accipter striatus*) would also be expected in the Project Area. Waterfowl including American black duck, ring-necked duck (*Aythya collaris*), northern pintail (*Anas acuta*) and Canada geese likely use wetland habitats.

5.8.3 Wildlife

Wildlife typical of boreal habitats inhabit the Port au Port Peninsula including moose (*Alces alces*), mink (*Mustela vison*), ermine (*M. erminea*), snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), black bear (*Ursus americanus*), meadow vole (*Microtus pennsylvanicus*), masked shrew (*Sorex cinereus*), little brown bat (*Myotis lucifugus*), eastern long-eared bat (*M. keenii septentrionalis*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*) and river otter (*Lontra canadensis*).

The Port au Port Peninsula represents Moose Management Area (MMA) 43. The hunting season for moose extends from September 10 through December 10 each year. In 2005/2006, 400 either-sex moose licenses were issued for MMA 43 (NLDOEC 2005). The Port au Port Peninsula is currently closed to black bear hunting (NLDOEC 2005).

Twenty caribou (*Rangifer tarandus*) were introduced to the Port au Port Peninsula in 1964-65, with the population growing to a maximum estimate of 83 in 1971. While the area has not been surveyed since 1982 (estimated population of 44 animals), caribou observations are still reported on the Port au Port Peninsula. However, these animals may be migrants from other west coast herds or remnants of the original introduction (W. Barney, pers. comm.). There is no caribou hunting on the Port au Port Peninsula (NLDOEC 2005).

No reptiles have been recorded on the Port au Port Peninsula. However, the green frog (*Rana clamitans*), an introduced species, inhabits small ponds and marshes and the American toad (*Bufo americanus*), also introduced, inhabits moist terrestrial areas (PAA 2000).

5.8.4 Species at Risk

5.8.4.1 Vegetation

There are four vascular plant species found in Newfoundland that are currently listed on Schedule 1 of SARA (Environment Canada 2005) and under the Newfoundland and Labrador *Endangered Species Act* (COSEWIC 2005b):

- barrens willow (*Salix jejuna*), Endangered;
- Long's braya (*Braya longii*), Endangered;
- Fernald's braya (*B.aya fernaldii*), Threatened; and
- Fernald's milk-vetch (*Astragalus robbinsii* var. *fernaldii*), Special Concern.

All four plants are limited to limestone barrens or calcareous substrates and, to date, populations have only been identified on the Northern Peninsula (Environment Canada 2005). Surveys conducted on the Port au Port Peninsula in the late 1990s by the Inland Fish and Wildlife Division did not identify any of these species (B. Keeping, pers. comm.). However, it is possible that these species are present on the

Port au Port Peninsula, since limestone barrens and calcareous substrates are found throughout the peninsula.

Porsild's bryum (*Bryum porsildii*) is a moss that grows in cracks and cliffs of calcareous conglomerate rock, limestone, basalt, sandstone and shale (Environment Canada 2005). This species is listed as Threatened on Schedule 1 of SARA and under the Newfoundland and Labrador *Endangered Species Act*. The moss is known from only six sites on the tip of the Northern Peninsula. The majority of the Canadian population occurs in this province. It is unlikely that this species occurs on the Port au Port Peninsula due to the lack of suitable cliff habitat.

The low northern rockcress (*Neotorularia humilis*) is listed as Endangered under the Newfoundland and Labrador *Endangered Species Act* but is not currently protected under SARA (Environment Canada 2005). This species has been identified only on Table Mountain near the Port au Port Peninsula (Government of Newfoundland and Labrador 2004).

5.8.4.2 Birds

The red crossbill subspecies percna (*Loxia curvirostra percna*) is listed as Endangered on Schedule 1 of SARA and under the Newfoundland and Labrador *Endangered Species Act*. Breeding of this subspecies is likely confined only to Newfoundland, where it generally occurs in coniferous forest habitat (Environment Canada 2005). The presence or absence of crossbills is usually dictated by the abundance or scarcity of cone crops on which they predominantly feed. The species is currently rare in Newfoundland with an estimated population of 500 to 1,500 individuals (COSEWIC 2004b). It is possible that redc are using coniferous habitat on the Port au Port Peninsula.

Both subspecies of peregrine falcon are listed on SARA. Peregrine falcon anatum subspecies (*Falco peregrinus anatum*) is considered Threatened on Schedule 1, whereas peregrine falcon tundrius subspecies (*F. peregrinus tundrius*) is considered Special Concern on Schedule 3. Both subspecies are listed as Threatened under the Newfoundland and Labrador *Endangered Species Act*. Individuals of either subspecies may occur along the west coast of Newfoundland during migration. However, such occurrences would likely be infrequent.

The short-eared owl (*Asio flammeus*) is an open-ground hunter and nester that may occur in open habitats on the Port au Port Peninsula. This species is listed as Special Concern on Schedule 3 of SARA and under the Newfoundland and Labrador *Endangered Species Act*. Populations of this owl are considered stable in Atlantic Canada and concern for this species results primarily from habitat loss on the Prairies, Ontario and Quebec (Environment Canada 2005). The areas of bog and soil barren on the Port au Port Peninsula may support short-eared owls.

5.8.4.3 Mammals

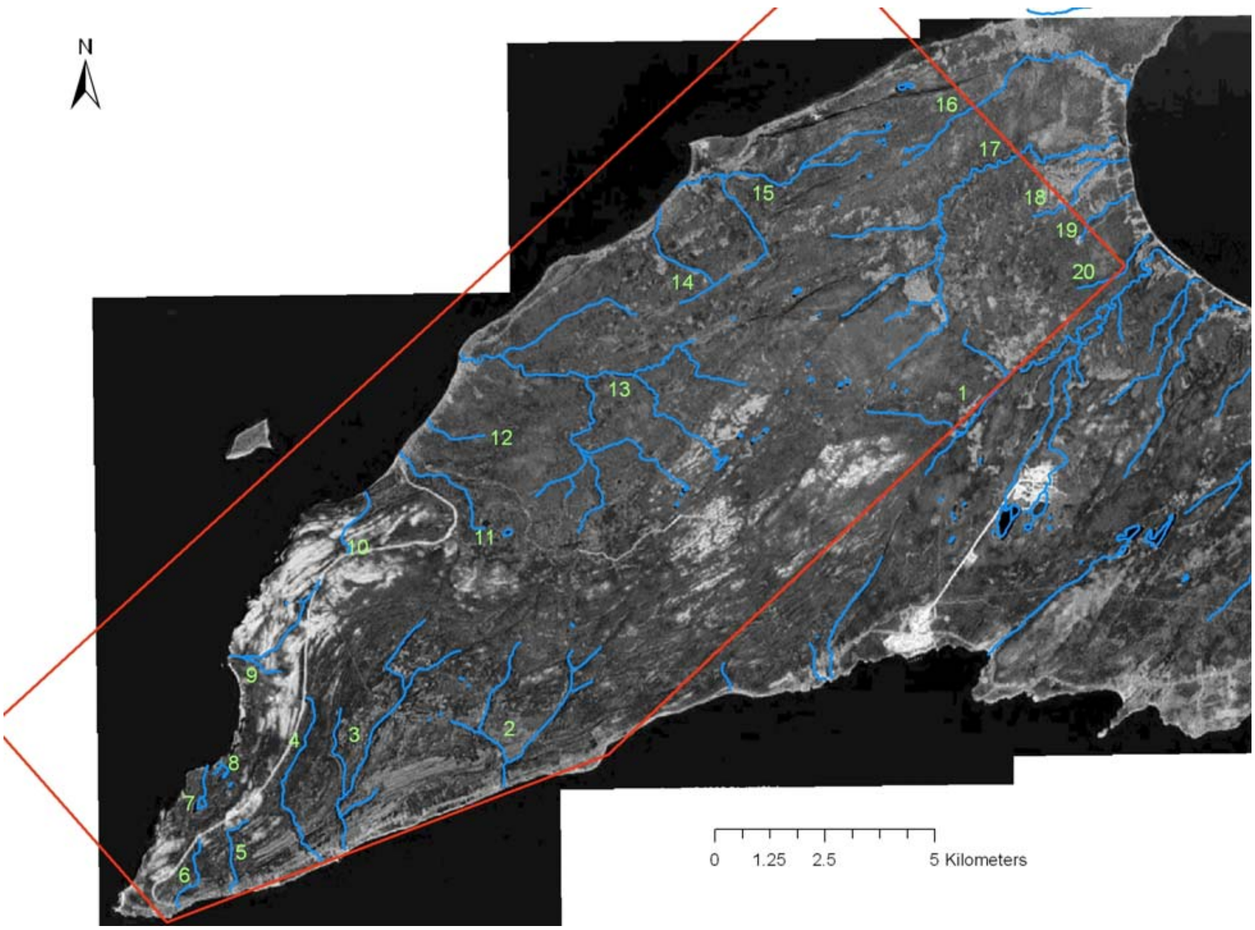
Newfoundland marten (*Martes americana*) are listed as Endangered on Schedule 1 of SARA and under the Newfoundland and Labrador *Endangered Species Act*. Marten inhabit mature coniferous forest, predominantly in western Newfoundland. An introduced population is also found in Terra Nova National Park in central-east Newfoundland. Although there is coniferous forest on the Port au Port Peninsula, there is no evidence that the distribution of Newfoundland marten extends to the Peninsula. It is likely that human induced and natural fragmentation of habitat has prevented marten from using the Port au Port Peninsula, at least in recent times.

5.9 Freshwater Environment

5.9.1 Streams

A total of 20 watersheds are wholly or partially located within the Project Area as shown on 1:50,000 topographic maps (refer to Figure 5.9). Most of the watersheds in the Project Area are relatively small. Ten (10) are first order streams (i.e., have no tributaries) and can be termed springs when headwater ponds are absent. These springs are usually fed by bog or hillside runoff and the potential to be fish habitat is often limited by steep gradients or seasonally intermittent flows. Seven second order streams and three third order streams have first and second order tributaries, respectively.

Figure 5.9 Port au Port Peninsula Drainage



Source : Land Use Atlas, Government of Newfoundland and Labrador.

A listing of watersheds/streams in the Project Area is provided in Table 5.9, as well as a number of discernible features derived from 1:50,000 mapping (i.e., maximum length, stream order and whether ponds are present within the watershed). Seven of the twenty streams are named, so for ease of reference, streams are numbered sequentially starting at the southeast corner of the study block (Harry Brook) and moving in a clockwise direction. In cases where stream names exist, both the number identifier and stream name are listed in Table 5.9. The longest streams in the Project Area are Harry Brook (approximately 8 km), Victor's Brook (approximately 8 km) and Mainland Brook (approximately 7 km).

Table 5.9 Characteristics of Watershed Within the Project Area

Watershed/Stream Name	Maximum Length of stream (km)	Stream Order At Main Stem	Pond area (Ha) Present in Watershed
1. Harry Brook	8	3	Yes (but occur outside Project Area)
2. Red Brook	4	3	None
3. No Name	6	2	None
4. No Name	4	1	None
5. No Name	2	1	None
6. No Name	2	1	None
7. No Name	1.5	1	3.453
8. No Name	0.5	2	0.556
9. No Name	3	2	None
10. No Name	1.5	1	None
11. Cointres Brook	3	1	None
12. No Name	1.5	1	None
13.Mainland Brook	7	3	3.177
14. No Name	2	2	None
15. Three Rock Cove Brook	5	2	0.898
16. Lourdes Brook	5	1	0.784
17. Victor's Brook	8	2	No
18. No Name	2.5	2	No
19. No Name	1.5	1	No
20. No Name	2	1	No

5.9.2 Pond Habitat

As outlined in Table 5.9, 20 watersheds exist within the Project Area. However, only six of these watersheds contain ponds (ponds associated with Harry Brook occur outside and upstream of the Project Area). Only two watersheds contain ponds with a surface area that exceeds 1 ha, namely watershed #7 (3.453 ha) and Mainland Brook (3.177 ha). The total pond area within the Project Area (that has an inflowing or outflowing stream) is 8.92 ha. The topographic maps show a further 11.2 ha of standing water, which have no associated streams.

5.9.3 Fish Species Present

Brook trout (*Salvelinus fontinalis*) are reported in some of the streams within the Project Area (J. Spingle, pers. comm.) with the possible exception of springs, as noted above. Eels (*Anguilla rostrata*) are also reported in the area and two commercial eel licenses are issued for use in Harry Brook, Lourdes Brook and Victor's Brook. Limited sampling conducted by Jacques Whitford at the head waters of Harry Brook confirmed the presence of threespine sticklebacks (*Gasterosteus aculeatus*) in that watershed (JWEL 1998).

5.9.4 Species at Risk

There are no species of conservation concern within the Project Area as identified by SARA. One species of freshwater fish in Newfoundland and Labrador is listed as a species of special concern on Schedule 1 of SARA. But the banded killifish (*Fundulus diaphanous*) has not been reported within the Project Area. The Newfoundland and Labrador *Endangered Species Act* also lists the banded killifish as a vulnerable species. The habitat of killifish is usually coastal brackish water and salt marshes but killifish are also known to have made incursions into freshwater habitats. There are seven reported sites for the Newfoundland population of banded killifish but none have been reported on the Port au Port Peninsula. The closest reported site is near Stephenville, NL.

5.10 Land Use

Port au Port residents make use of land and water resources for subsistence, recreation and commercial ventures. A variety of resource use activities are carried out in the Project Area including hunting, trapping, fishing, forestry, agriculture and mineral exploration. Resource users include local residents, other residents of Newfoundland and Labrador and tourists to the area.

5.10.1 Residential

Some communities on the Port au Port Peninsula have drilled wells that supply water to individual residences. However, the majority of these wells fall within municipal boundaries or residential infilling boundaries (see Figure 5.5). Areas within both types of boundaries will be avoided by the seismic survey activity. There are three protected water supply areas in the Port au Port Peninsula (Figure 5.5).

5.10.2 Agriculture

Agricultural activity occurs on the Port au Port Peninsula but there is little activity within the Project Area. There is an alpaca and llama farm at Felix Cove and a vegetable farm at Black Duck Brook that are both outside the Project Area. The closest area designated as community pasture occurs adjacent to the northeast boundary of the Project Area. Smaller pastures occur within municipal boundaries or within community infilling area, where no surveys will take place. Some sheep and cattle farming also occurs (M. Fleming, pers. comm.).

5.10.3 Timber Harvesting

There are numerous forest resource roads, particularly on the eastern portion of the Port au Port Peninsula. There are also several registered ATV trails that provide access from the coast to inland areas (Figure 5.5) (GSC 2006). Most of the forest harvesting activities took place on the Port au Peninsula during the 1990s, although there has been limited harvesting in the area since 2000 (NLDNR 2006). There are pre-commercially thinned areas and plantations located in the Project Area (Figure 5.5).

5.10.4 Mining

There are several quarries on the Port au Port Peninsula (Figure 5.5). At Lower Cove, Atlantic Minerals Ltd operates a limestone-dolostone quarry. Port au Port Quarries is currently developing a dolostone-limestone quarry near Aquathuna (NLDNR 2004) and a third quarry operates at De Grau near Cape St. George (Figure 5.5).

5.10.5 Recreational

The Port au Port Peninsula represents Moose Management Area (MMA) 43. The hunting season for moose extends from September 10 through December 10 each year. In 2005/2006, 400 either-sex moose licenses were issued for MMA 43 (NLDOEC 2005). The Port au Port Peninsula is currently closed to black bear hunting and there is no caribou management area on the Port au Port Peninsula (NLDOEC 2005). Small game, including snowshoe hare, willow ptarmigan and migratory waterfowl are hunted in season. There are no commercial outfitting operations on the Port au Port Peninsula (GSC 2006). There is limited fishing in the ponds and rivers for trout and eel and there are no scheduled salmon rivers on the Peninsula. There are no wildlife or wilderness reserves on the Port au Port Peninsula (NLDOEC 2006).

5.10.6 Historic Resources

There is one site on the Port au Port Peninsula registered with the Provincial Archaeology Office (PAO). It is located within the community of Mainland. The site appears to be historic, containing ceramic and glass artifacts dating to the eighteenth and nineteenth centuries (PAO Archaeological Site Record Inventory). These areas will be avoided by the seismic survey. As well, there is reported to be (but not confirmed) airplane wreckage in the south of the Project Area. Activities associated with the seismic survey will be located a minimum of 50 m from any confirmed sites.

The requirements for a historic resources assessment/survey will be determined in consultation with the PAO.

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 Marine Birds

Marine birds are considered a VEC due to regulatory concern and in recognition of their protected status under the *Migratory Birds Convention Act*, *1994.*

6.1.1 Boundaries

The spatial boundaries for the assessment of Marine Birds include the marine and coastal portion of the Project Area indicated on Figure 2.1. However, it is recognized that marine birds have widespread distribution patterns with ranges that vary between individual species and the ecological boundaries will vary accordingly. Temporal boundaries are defined by the Project schedule, covering May through October 2006, with offshore seismic activities occurring between mid-August and October.

6.1.2 Potential Interactions and Existing Knowledge

Potential interactions, issues and concerns related to Marine Birds and the Project include:

- oiling of marine birds as a result of discharges from the vessel; and
- direct and indirect effects associated with seismic noise.

The source vessel will be returning to port every evening so vessel lighting will not be required.

There is little information available on the effects of seismic surveys on seabirds. The lack of data regarding seabirds and seismic activity may be a reflection of the fact that there is little evidence that problems occur (Davis et al. 1998). The sound created by air sleeves is focused downward below the surface of the water and sound levels at and immediately below the surface are likely greatly reduced compared to levels deeper in the water (LGL Limited 2002).

A study of the effects of seismic surveys on moulting long-tailed ducks in the Beaufort Sea found no effects on movement or diving behaviour, although the authors cautioned that they had limited ability to detect subtle disturbance effects (Lacroix et al. 2003).

Observations made during a seismic program in the Davis Strait area showed no evidence of mortality or distributional effects on marine birds (Stemp 1985). Parsons (in Stemp 1985) reported that shearwaters with their heads under water were observed within 30 m of seismic sources (explosives) and did not respond. Similarly, trained observers reported no ill effects on guillemot, fulmar and kittiwake species that were monitored during air sleeve seismic surveys in the North Sea (Turnpenny and Nedwell 1994). Evans et al. (1993) noted that there was no evidence to suggest that seabirds were either attracted to or repelled by seismic testing in the Irish Sea.

The sound created by air sleeves is focused downward below the surface of the water. Above the water, the sound is reduced to a muffled shot that should have little or no effect on birds that have their heads above water or are in flight. It is possible that birds on the water at close range would be startled by the sound. However, the presence of the ship and associated gear dragging in the water should have already warned the bird of unnatural visual and auditory stimuli (C-NLOPB 2005).

6.1.3 Residual Environmental Effects Significance Criteria

6.1.3.1 Non-listed Species

A **significant adverse environmental effect** affects a population or portion thereof in such a way as to cause a decline or change in abundance and/or distribution of the population over one or more generations. Natural recruitment may not re-establish the population, or any populations or species dependent upon it, to its original level within several generations (i.e., the integrity of the population would be threatened) or avoidance of the area becomes permanent.

A **non-significant adverse environmental effect** is defined as an adverse effect that does not meet the above criteria.

6.1.3.2 Listed Species

A *significant adverse residual environmental effect* on all species listed in Schedule 1 of SARA or under the Newfoundland and Labrador *Endangered Species Act* as "Extirpated", "Endangered" or "Threatened" is:

- one that results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA or in contravention of any of the prohibitions stated in Section 16 of the Newfoundland and Labrador *Endangered Species Act*.

6.1.4 Environmental Effects Assessment and Mitigation

6.1.4.1 Seismic Noise

Birds occupying the Project Area are not expected to be significantly affected by vessel traffic due to the transitory nature of the survey vessel. Most species of seabirds that may be present in the Project Area spend only a few seconds underwater during a foraging dive, so there would be minimal opportunity for exposure to noise associated with seismic shooting. Only the Alcidae (dovekie, common murre, thick-billed murre, razorbill, black guillemot and puffin) spend longer time underwater during forage dives and thus have the potential to be exposed to the sounds produced by seismic activity. However, the nature of this survey will result in only temporary incremental increases in ambient noise and disturbance from the vessel in any one area. Most of the species of seabirds expected to be found in the Project Area feed at or less than 1 m from the surface. These include gulls, terns and kittiwakes of which kittiwakes and gulls are known to nest in the Project Area. While it is possible that diving birds within close range of the seismic activity could be startled by the sound, the presence of the ship and the associated seismic equipment in the water will have already indicated unnatural stimuli to any birds in the vicinity. As well, the ramping up process will allow birds to move away from the noise source before it reaches maximum volume. It is unlikely that non-diving birds would be affected by air sleeves.

6.1.4.2 Routine Discharges

Limited amounts of hydrocarbons may enter the marine environment as a result of routine discharges (e.g., deck drainage) from the source vessel. Hydrocarbon concentrations associated with ship discharges are not generally associated with formation of a surface slick. They are therefore not likely to have a measurable effect on Marine Birds.

6.1.4.3 Accidental Events

The survey will be conducted with a source vessel having equipment, systems and protocols in place for prevention of pollution in accordance with the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2004).

Any accidental spill of diesel fuel or lube oil from the source vessel will be reported to the C-NLOPB and Canadian Coast Guard Emergency Response immediately. Depending on the timing, location and environmental conditions of such an event, there could be oiling of Marine Birds. However, the likelihood of such an event is extremely low and the nature of diesel fuel is such that it evaporates from the surface relatively quickly and does not persist in the environment for any length of time.

6.1.4.4 Listed Species

None of the identified marine bird species at risk are known to nest in the Project Area either because suitable habitat is not available (i.e., piping plover, harlequin duck) or because the area is outside of the current known breeding range (i.e., ivory gull, Eskimo curlew). It is not anticipated that ivory gull or Eskimo curlew would occur in the Project Area at any time. Occurrences of piping plover or harlequin duck in the Project Area would be infrequent and should they occur, it would likely be during spring or fall migration periods or during over-wintering off the coast, in the case of harlequin duck. Since the Project will not occur during the winter months, interaction in the marine environment with harlequin duck is unlikely. Similarly, it is unlikely that the Project will interact with piping plovers. Therefore, the potential environmental effects of the Project on marine bird species at risk are rated not significant (negligible).

6.1.4.5 Summary of Potential Environmental Effects

A summary of the potential environmental effects of seismic activity on Marine Birds is provided in Table 6.1.

6.1.5 Cumulative Environmental Effects

Marine bird distribution and abundance may be influenced by natural processes such as weather, food availability and oceanographic variation, as well as by human activities such as fishing, vessel traffic, large offshore structures and pollution (Wiese and Montevecchi 2000).

Other seismic programs, oil and gas exploration, commercial fishing and commercial shipping could result in cumulative effects on seabirds. Seabirds may also be affected by projects and activities that occur outside the Project Area but within their migratory ranges. As well, changes in prey and predator populations may affect marine bird populations.

During the seismic survey, it is expected that some commercial fishing vessels and commercial shipping will be operating within the Project Area. There are no current plans or proposals for other seismic surveys to be conducted in the Project Area. Vessel traffic may affect marine birds through vessel lighting, oily discharges and noise. Chronic routine discharges, such as deck drainage and ballast and accidental releases of hydrocarbons, can expose birds to oil. Chronic releases may be equally or more important to long-term population dynamics of seabirds.

Table 6.1 Potential Environmental Effects Assessment Summary – Marine Birds

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Noise disturbance (A) • Decline in prey availability (A)	• Ramping up procedures • On-board Environmental Observers	1	2	5	2	R	1
Vessel Traffic	• Noise disturbance (A)	• Transitory nature of survey	1	1	6	2	R	1
Safety Zone	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Routine Discharges (deck drainage)	• Oiling of birds (A)		0	2	2	2	R	1
Vessel Emissions (exhaust)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Drilling of Shot Holes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Unplanned Events								
Marine Fuel Spills (on surface)	• Oiling of birds	• Spill Prevention Planning • Spill Response Plan	0	2	1	2	R	1
Onshore Fuel Spills	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
2 = Evidence of existing adverse effects
3 = High level of existing adverse effects

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

The incremental amount of vessel traffic as a result of this Project will be negligible compared to existing vessel traffic in the area. Cumulative environmental effects resulting from any of the Project activities will not be additive or cumulative because the Project activities are transitory. Furthermore, the Project is predicted to have minor to negligible effects on Marine Birds in the Project Area. Therefore, in consideration of the mitigation measures to be applied for the Project, the cumulative environmental effects of Project activities on Marine Birds within the Project Area are rated not significant.

6.1.6 Monitoring and Follow-up

An Environmental Observer will be on board during the seismic survey program. The observer will record marine bird sightings. This will provide additional distributional data for marine birds off the west coast of Newfoundland and may also help verify whether distribution patterns are affected by seismic activity. An outline of a seabird monitoring protocol is provided in Appendix C.

6.1.7 Summary of Residual Environmental Effects Assessment

Effects associated with vessel traffic and routine discharges are predicted to be negligible. Effects associated with seismic noise are predicted to be very localized and likely to affect only deep diving birds that may be in the immediate vicinity of the air sleeve array during operation. Should birds be so exposed, it is likely these effects would be non-lethal and temporary. Therefore, the residual adverse environmental effects, including cumulative effects, of the Project on Marine Birds are rated not significant. The significance of planned activities on Marine Birds is summarized in Table 6.2.

Table 6.2 Environmental Effects Significance – Marine Birds

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	3	n/a
Vessel Traffic	NS	3	n/a
Safety Zone	n/a	n/a	n/a
Routine Discharges (deck drainage)	NS	3	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a
Drilling Shot Holes	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a
Unplanned Events			
Marine Fuel Spills	NS	2	n/a
Onshore Fuel Spills	n/a	n/a	n/a
Project Overall	**NS**	**3/2**	**n/a**

KEY:

Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

6.2 Marine Fish, Shellfish and Habitat

Marine Fish, Shellfish and Habitat is considered a VEC in this assessment because of the biological and commercial significance of several fish species and associated spawning, feeding and nursery habitats within the Project Area. Several fish species or stocks that may occur in the Project Area have been declared to be of special status by COSEWIC and are listed under SARA. Fish and fish habitat are also protected by the federal *Fisheries Act*. Marine Fish, Shellfish and Habitat includes finfish, shellfish, invertebrates, plankton, the water column and benthic habitats where relevant in the assessment.

6.2.1 Boundaries

Temporal and spatial boundaries encompass those periods during, and areas within which, the VECs are likely to interact with or be influenced by the Project. While the spatial and temporal extents of the Project are known, in most cases the spatial and temporal distribution of the fish and shellfish species within the Project Area is not precisely known. Therefore, as a precautionary approach for the purposes of this assessment, it is assumed that species known to occur regularly in the nearshore areas of the northern Gulf of St. Lawrence may occur in the Affected Area and be potentially affected by Project activities. This includes migratory species (e.g., herring) as well as sessile invertebrates. Ecological boundaries for fish vary among species due to differences in home ranges, migration patterns and life histories. Temporal boundaries for this analysis are for the period of proposed offshore Project activities (between mid-August and October).

6.2.2 Potential Interactions and Existing Knowledge

The environmental effects of seismic activity on marine biota were summarized in the *Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment* (C-NLOPB 2005) and *Seismic Exploration Program Environmental Assessment for EL 1069* (JWL 2005). The following discussion draws largely on the information provided in these documents.

There are over 50 families of fish with sound-producing species (Myrberg 1980). Fish sounds are normally generated in the range of 50 to 3,000 Hz. Fish use sound for communication, navigation and sensing of prey and predators. Sound transmission is thought to play an important role in cod and haddock mating. (Engen and Folstad 1999; Hawkins and Amorin 2000). Seismic signals are typically in the range of 10 to 200 Hz (Turnpenny and Nedwell 1994) and will therefore overlap slightly with signals produced by fish. However, detecting a signal does not mean the fish will have any measurable reaction to the noise. The hearing ability of fish varies considerably by species as will the effects of seismic exploration. Variability in effect may also vary within a species because seismic signals have a more pronounced effect on larger fish than of smaller fish of the same species (Engås et al. 1996).

Potential effects are divided into behavioural and physical responses and are discussed below. Potential effects of seismic signals on fisheries and fishing are discussed separately in Section 6.6.

6.2.2.1 Behavioural Effects

Fish with swim bladders and specialized auditory couplings to the inner ear (e.g. herring) are highly sensitive to sound pressure. Fish with a swim bladder but without a specialized auditory coupling (e.g. cod and redfish) are moderately sensitive, while fish with a reduced or absent swim bladder (e.g.

mackerel and flounder) have low sensitivity (Fay 1988). Fay (1988) has developed an approximate threshold for each of these three classifications of hearing sensitivity. The highly sensitive group has a hearing threshold of less than 80 dB re 1µPa[1]. The moderately sensitive threshold is between 80 and 100 dB re 1µPa and those fish with a low threshold have a sensitivity of greater than 100 dB re 1µPa. These sensitivity thresholds were derived under quiet laboratory conditions, so thresholds to seismic sound pressure in the ocean are thought to be 40 dB higher due to ambient noise and the start and stop nature of the seismic signal. A comparison of moderately sensitive species such as cod, haddock, pollock and redfish determined a measurable behavioural response in the range of 160 to 188 dB re 1µPa (Turnpenny and Nedwell 1994). Source levels during seismic surveys are usually in excess of the noise levels that elicit a response in fish, so the area in which fish react to the noise may extend several kilometres in the open ocean. By comparison, underwater ambient noise in bad weather is in the range of 90 to 100 dB re 1 µPa. As an example, large tankers may have a source noise level of 170 dB re 1 µPa at 1 m.

There are well documented observations of fish and invertebrates exhibiting behaviours that appeared to be in response to exposure to seismic activity like a startle response, a change in swimming direction and speed, or a change in vertical distribution (Hassel et al. 2003; Wardle et al. 2001; McCauley et al. 2000a; 2000b; Pearson et al. 1992; Schwarz and Greer 1984; Blaxter et al. 1981) although the significance of these behaviours is unclear. Some studies indicate that such behavioural changes are very temporary while others imply that marine animals might not resume pre-seismic behaviours/ distributions for a number of days (Engås et al. 1996; Løkkeborg 1991; Skalski et al. 1992).

The expected distance for fish to react to a typical peak source level of 250 to 255 dB re 1 µPa is from 3 to 10 km (Engås et al. 1996). A reaction may simply mean a change in swimming direction. The spatial range of response in fish will vary greatly with changes in the physical environment in which the sounds are emitted. In one environment, fish distribution has been shown to change in an area of 40 x 40 nautical miles and 250 to 280 m deep for more than five days after shooting ended, with fish larger than 60 cm being affected to a greater extent than smaller fish (Engås et al. 1996).

Due to the dampening effects of shallow areas, especially with soft substrates, behavioural responses in shallow waters are less obvious. Two studies in the shallow coastal areas concluded limited changes in fish behaviour in response to seismic noise. In one area with water depths less than 20 m, a seismic signal of 225 dB re 1 µPa at 1 m was emitted and the response of sea bass (*Dicentrarchus labrax*) observed. The study concluded that the bass were not displaced and that they continued to feed (Pickett et al. 1994). In another study, pollock (*Pollachius pollachius*) on a shallow coastal reef were observed during a signal of 230 dB re1 µPa (Wardle et al. 2001). Direct visual observations determined that only minor changes in fish behaviour patterns were detectable around the reef. When smaller pollock passed within a few metres of the array and were exposed to approximately 229 dB, they showed a typical “c-start” response and moved away only a few metres.

McCauley et al. (2000a or b) describes a more intense “generic” fish alarm startle response of seeking shelter in tight schools and moving near the bottom. The level that will induce this response varies with fish species and the physical environment at the time but was observed at 156 to 168 dB re 1 µPa. Behavioural changes in squid were observed at levels of 156 to 166 dB re 1 µPa. The typical squid response was to school to the surface of the testing tank. The effects of nearby air sleeve operations on fish as determined from several studies, are summarized in Table 6.3.

[1] Unless otherwise indicated, all sound level measurements are reported at 1 m.

Table 6.3 Summary of Behavioural Effects of Fish and Invertebrates from Nearby Air Sleeve Operations

Source	Level (dB re 1 mPa rms)	Species	Effects
McCauley et al. 2000a; 2000b	156-161	various fishes	common 'alarm' behaviour of forming 'huddle' on cage bottom centre, noticeable increase in alarm behaviours begins at lower level
Pearson et al. (1992)	[a]149	rockfish (*Sebastes* spp.)	subtle behavioural changes commence
Pearson et al. (1992)	[a]168	rockfish	alarm response significant
McCauley et al. 2000a; 2000b	>171	fish ear model	rapid increase in hearing stimulus begins
McCauley et al. 2000a; 2000b	182-195	fish (*P. sexlineatus*)	persistent C-turn startle
Pearson et al. (1992)	100-205	selected rockfish species	C-turn startle response elicited
Wardle et al. (2001)	[b]183-207	various wild finfish	C-turn startle responses
McCauley et al. 2000a; 2000b	146-195	various finfish	no significant physiological stress increase
McCauley et al. 2000a; 2000b	[c]	fish (*Chrysophrys auratus*) and others	preliminary evidence of pathological damage to hearing systems of constrained fish
McCauley et al. 2000a; 2000b	174	Squid *(Sepioteuthis australis)*	startle (ink sac fire) and avoidance to startup nearby
McCauley et al. 2000a; 2000b	156-161	squid	noticeable increase in alarm behaviours
McCauley et al. 2000a; 2000b	166	squid	significant alteration in swimming speed patterns, possible use of sound shadow near water surface

Source: adapted from McCauley et al. 2000a; 2000b.
a - converted from mean peak to rms using -12 dB correction from 7,712 records from Bolt 600B air-sleeve.
b - correction of -12dB applied (peak to rms).
c - exposure precisely known but because of ramped nature did not allow level for damage to be determined.

The potential effect that seismic activities may have on masking communications by fishes is not well documented. There is overlap in the frequency of seismic signals and the sounds emitted by fish, so there is potential for sound reception and production in fish to be reduced (Myrberg 1980). Recent experiments on goldfish indicate that fish are capable of "auditory scene analysis", meaning that a sound stream of interest can be "heard out" and analyzed for its informational content independently of simultaneous, potentially interfering sounds (Fay 1998, in MMS 2004). These studies were carried out using repetitive impulses or clicks as signals and as potentially interfering sounds. These results suggest that the presence of intermittent, audible air sleeve shots would not necessarily impair fishes in receiving and appropriately interpreting other biologically relevant sounds from the environment (MMS 2004).

Behavioural effects on planktonic and benthic species are also not well documented but are of minor concern and little consequence because the behavioural changes of such species would be at a relatively small scale. Christian et al. (2003) observed snow crab at 50 m from a seismic signal of 233 dB at 1m and reported no startle response or movement away from the source.

6.2.2.2 Physical Effects

Planktonic species and life stages of fish and invertebrates in the immediate vicinity of seismic air sleeves are probably the most vulnerable to seismic activities simply because they can not move away. Several studies have concluded that direct physical damage of eggs and larvae is caused by air sleeve levels exceeding 220 dB re 1 µ Pa (see Table 6.4). From existing evidence, physical damage is therefore restricted to within a few metres of the air sleeve (Gausland 1992). Studies on the effects of seismic exposure on fish eggs and larvae (i.e., Kostyuchenko 1973; Dalen and Knutsen 1987; Holliday et al. 1987; Matishov 1992; Booman et al. 1996; Dalen et al. 1996) have found that effects appeared to be minimal and any mortality effect was generally not significantly different from experimental controls. Generally, any observed larval mortality occurred after exposures within 0.5 to 3 m of the air sleeve source. For example, some retinal tissue damage was observed in cod larvae exposed at 1 m from an air sleeve source (Matishov 1992). One study concluded potential pathological effects on eggs and larvae at 5 m from source (Kostyuchenko 1973). Application of a 'worst-case scenario' mathematical model to investigate the effects of seismic energy on fish eggs and larvae, concluded that mortality rates caused by exposure to seismic are so low compared to natural mortality, the impact of seismic activity on recruitment to a fish stock would be insignificant (Saetre and Ona 1996).

Table 6.4 Observations from Exposures of Marine Plankton Life Stages to Air Sleeves at Close Range

Organism	Life Stage	Exposure Distance from Air Sleeve (m)	Estimated Exposure Level (dB re 1 µ pA)	Observed Response	Reference
Pollock (*Pollachus virens*)	Egg	0.75	242	Some delayed mortality	Booman et al. 1996
Cod (*Gadus morhua*)	Larvae	5	220	Immediate mortality	Booman et al. 1996
	Fry	1.3	234	Immediate mortality	
	5-day-old larvae	1	250	Delamination of retina	Matishov 1992
	Eggs	1 to 10	202 to 220	No signs of injury	Dalen and Knutsen 1987
Plaice (*Pleuronectes platessa*)	Eggs & larvae	1	220	High mortality (unspecified0	Kosheleva 1992
		2	214	No effect	
Anchovy (*Engraulis mordax*)	Eggs	unknown	223	8.2% mortality	Holiday et al., in Turnpenny and Nedwell 1994
	2-day-old larvae	3	238	Swimbladder rupture	
Red Mullet (*Mullus surmuletus*)	Eggs	1	230	7.8% of eggs injured	Kostyuchenko 1973
		10	210	No injuries	
Fish (various spp.)	Eggs	0.5	236	17% dead in 24 hr	Kostyuchenko 1973
		10	210	2.1% dead in 24 hr	
Dungeness Crab (*Cancer magister*)	Larvae	1	231	No observed effect on time to molt or long-term survival	Pearson et al. 1994

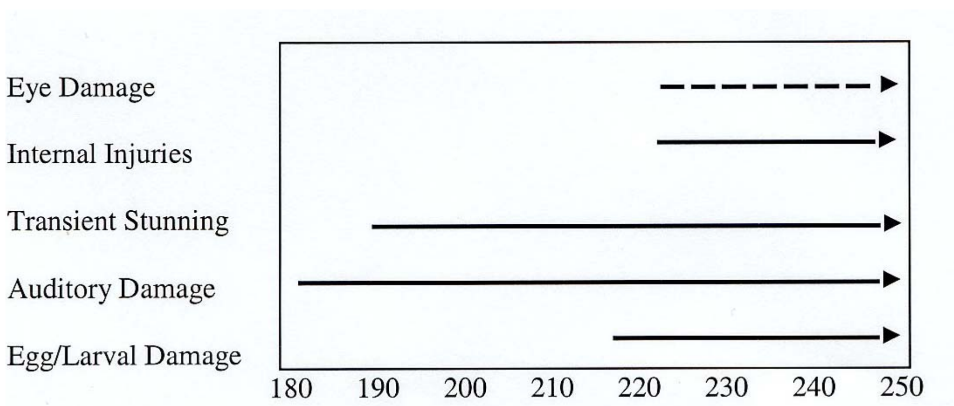
Numerous studies have been conducted on fish mortality as a result of exposure to seismic sources (i.e., Falk and Lawrence 1973; Holliday et al. 1987; La Bella et al. 1996; Santulli et al. 1999; McCauley et al. 2000a, 2000b; 2003; Thomsen 2002; IMG 2002; Hassel et al. 2003). Mortality of fish did not occur in any of these studies. In another study, Atlantic salmon within 1.5 m of underwater explosions did not die immediately after the event or during a seven-day monitoring period following exposure (Sverdrup et al. 1994). Explosive detonations are characterized by higher peak pressures and more rapid rise and decay times compared to seismic air sleeve sources and therefore are considered to have greater potential to cause damage to marine organisms (C-NLOPB 2005).

There is very little information on the sublethal effects of fish and invertebrate exposure to seismic noise (Payne 2004). Potential effects may include damage to hearing, eyesight or internal organs but the distance at which these or other physiological effects occur is unknown and may extend beyond 5 m (Payne 2004).

In adult fish, pressure differentials can cause damage to the swimbladder within several metres of an air sleeve (Turnpenny and Nedwell 1994). Evidence of damage to the inner ear was apparent in cod and goldfish (*Carassius auratus*) at exposures of 180 dB and 182 to 204 dB of pure tones, respectively. Damage to fish ear structures from exposure to seismic air sleeves has been documented (McCauley et al. 2000a; 2000b, 2003; Enger 1981). However, the experimental fish were caged and exposed to high cumulative levels of seismic energy that would not likely occur under normal seismic operations due to avoidance behaviour of uncaged fish. Studies have shown that exposure to intense sound can affect the auditory thresholds of fish resulting in temporary threshold shifts (TTS) under certain conditions (i.e. Amoser and Ladich 2003; Smith et al. 2004). However, these studies focused on captive fish that were exposed to loud (158 dB re 1 µPa) noise for periods of 10 minutes for 12 or 24 hours. TTS may seldom (or never) occur in the wild unless fish are prevented from fleeing the irritant (C-NLOPB 2005). Threshold shifts affect the fish's ability to hear its natural full range of sound.

Kosheleva (1992) reports no obvious physiological effects beyond 1 m from a source of 220 to 240 dB re 1 µPa. Hastings (1990) reports the lethal threshold for fish beginning at 229 dB and a stunning effect in the 192 to 198 dB range. Turnpenny and Nedwell (1994) deduce that blindness can be caused in fish exposed to air sleeve blasts on the order of 214 dB. A summary of fish injuries caused by exposure to sound pressure is given in Figure 6.1. Auditory damage starts at 180 dB, transient stunning at 192 dB and internal injuries at 220 dB.

Figure 6.1 Sound Pressure Threshold for the Onset of Fish Injuries



Source: adapted from Turnpenny and Nedwell 1994.
Note: Dotted line indicates an assumed sound level rather than an estimated one.

Benthic macroinvertebrates are less likely to be impacted by seismic activity because few invertebrates have gas-filled spaces and benthic species are usually more than 20 m away from the seismic source. The resilience of various macroinvertebrates has been tested by exposing them at a short distance to an active air sleeve (Table 6.5). The rate of injury experienced by macroinvertebrates due to the passage of a seismic survey should be less than indicated for planktonic organisms and fish. A laboratory study of the effects of seismic on snow crab concluded that there was no difference between exposed and control groups in terms of physical damage to the statocyst, hepatopancreas or heart and that there was no acute or chronic mortality of snow crab (Christian et al. 2003). Male snow crab were exposed to 227 and 233 dB at 1m at distances ranging from 2 to 85 m. These exposed crab also showed no significant difference in stress levels as indicated by hormone and enzyme levels (Christian et al. 2003). However, snow crab egg masses exposed at 2 m to intense seismic energy had a higher proportion of less-developed eggs than the unexposed mass (Christian et al. 2003). Lobsters are similar to crab in that they are thought to be resilient to seismic activity because decapods lack the gas-filled voids that would make them sensitive to changes in pressure. Mortality and development rates of Stage II Dungeness crab larvae exposed to single discharges from a seismic array were compared with those of unexposed larvae. No statistically significant differences between the exposed and unexposed larvae were observed with respect to immediate and long-term survival and time to molt, even for those exposed larvae within 1 m of the seismic source (Pearson et al. 1994).

Table 6.5 Observation from Exposures of Marine Macroinvertebrates to Air Sleeves at Close Range

Organism	Exposure Distance from Air Sleeve (m)	Estimated Exposure Level (dB re 1 µ Pa)	Observed Response	Reference
Iceland Scallop (*Acequipecten irradians*)	2	217	Shell split in 14 of 3 tested	Matishov 1992
Sea Urchin (*Strongylocentrotus droebachiensis*)	2	217	15% of spines fell off	Matishov 1992
Mussel (*Mytilus edulis*)	0.5	229	No detectable effect within 30 days	Kosheleva 1992
Periwinkle (*Littorina* spp.)	0.5	229	No detectable effect within 30 days	Kosheleva 1992
Crustacean (*Gammarus locusta*)	0.5	229	No detectable effect within 30 days	Kosheleva1992
Brown Shrimp (*Cragnon cragnon*)	1	190	No mortality	Webb and Kempf 1992

6.2.3 Residual Environmental Effects Significance Criteria

6.2.3.1 Non-Listed Species

A **significant adverse environmental effect** is defined as one that affects a fish or shellfish population or portion thereof or their associated habitat in such a way as to cause a decline or change in abundance and/or distribution of the population over one or more generations and natural recruitment (reproduction and in-migration from unaffected areas) may not re-establish the population to its original (i.e., pre-Project) level within several generations or avoidance of the area becomes permanent.

A **non-significant adverse environmental effect** is defined as an adverse effect that does not meet the above criteria.

A **positive effect** is defined as one that results in a measurable population increase and/or enhances the quality of habitat for marine fish.

6.2.3.2 Listed Species

A *significant adverse residual environmental effect* on all species listed in Schedule 1 of SARA as “Extirpated”, “endangered” or “Threatened” is:

- one that results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA.

6.2.4 Environmental Effects Assessment and Mitigations

6.2.4.1 Behavioural Effects

Behavioural effects of seismic activity on marine fish may include avoidance behaviour, increased swimming speeds, disruption of migration patterns and disruption of reproductive behaviour. Noise generated by seismic activity may cause some species to avoid the zone of influence around the source vessel.

Collins et al. (2002) looked at potential effects on fish catches during and after two independent inshore and nearshore seismic surveys undertaken in the Bay St. George and Port au Port areas of western Newfoundland. While not statistically conclusive, their analyses suggested no observable effects on overall fish catches including snow crab, during or in the years following the seismic surveys. This indicates that fish behaviour was not measurably affected. Turnpenny and Nedwell’s (1994) general conclusion is that seismic activity has a reduced affect on fish behaviour inshore, in shallow water because attenuation of the sound is more rapid. An assessment of the effects of the Project on fisheries can be found in Section 6.6. This section will assess the affects of the Project on fish behavior and how a change in behavior may affect individual populations.

McCauley et al. (2000 a or b) summarized that many finfish species and squid display an alarm response of increased swimming speed, tightening schools and moving towards the sea floor at levels between 156-168 dB re 1m. A level of 156 dB re 1m can be expected between 3 and 5 km from a 3D array (2678 cu in 100 to 120 m of water) and therefore the distance at which swimming speed may begin to increase. Active avoidance behavior may begin at distances of 1 to 2 km from a source of this level. In water less than 50 m in depth, the affected area is 0.01 percent of the area affected by seismic activity in deep water (Turnpenny and Nedwell 1994).

Davis et al. (1998) summarized that most schools of fish will not show avoidance if they are not in the path of the approaching vessel. Schools that the vessel passes over may show lateral avoidance or compress towards the bottom. Observed responses indicate that the fish schools are quite variable and depend on species, life history stage, current behaviour, time of day, whether the fish have fed and how the sound propagates in a particular setting. Fish moving to the bottom appears to be a common response to seismic activity, especially for demersal or benthic species (see Davis et al. 1998). Seismic activity has also been demonstrated to reduce the density of demersal species several kilometres from the source, in up to 250 m of water (Engås et al. 1996).

It is reasonable to assume that fish would move from an area, if possible, before sound pressure levels reached a level that would cause hearing damage (McCauley et al. 2000 a or b). The vessel will travel along a track line in a prescribed grid and will be continually moving during the survey. Therefore, the sound from the array will not remain focused on any one location and continue to affect fish in one area. The sound emitted from the source array will occur for approximately 150 milliseconds every 8 seconds, rather than occurring continuously.

Fish species migrating through the Project Area such as capelin, herring, cod, and salmon may be affected by the seismic program in that startle responses and temporary changes in swimming direction and speed can be expected if the seismic survey overlaps with their presence. But schooling behavior is not expected to be affected (Blaxter et al. 1981) so given the natural instinct of the fish to migrate to a spawning or feeding area, the temporary change in behavior is not expected to interrupt fish migration.

Seismic activity can have a greater spatial affect on the behaviour of fish than on the physiology of fish. However, most available literature indicates that the effects of noise on fish are transitory and if short-lived and outside a critical period, are expected not to translate into biological or physical effects. In most cases, it appears that behavioural effects on fish as a result of seismic operation should result in negligible effects on individuals and populations. The issue of primary concern is the potential for interactions during particularly sensitive periods, such as spawning. The Science Review Working Group (C-NSOPB 2002), which evaluated two proposed seismic surveys near Cape Breton, agreed that although the duration of behavioural effects of seismic activity on marine fish are uncertain, indications exist, as described in Section 6.2.2.1, that displacement of marine fish is short-term. The adverse environmental effect of the Project on fish and invertebrate behavior and their habitats is rated not significant.

6.2.4.2 Physical Effects

A source array of 2,250 cu. in., with a generated peak SPL of less than 210 dB re 1μPa @ 1 m (see Section 2.3) is being assessed for the purpose of this environmental assessment. There are no records of mass fish kills associated with the operation of air sleeve arrays (Payne 2004). Mortality of adult fish is not expected because fish are likely to be driven away by the approaching noise source (Turnpenny and Nedwell 1994). Rise times are too slow and peak pressures too low to cause serious injury, except perhaps to fish that are within a few metres of an air sleeve at the time of discharge (Turnpenny and Nedwell 1994). At further distances, fish may suffer hearing loss, hemorrhaging of the eyes, swim bladder rupture or stunning. Depending on water depth, source noise level and distance of the fish relative to the source, injuries to eyes and internal organs would only occur within a few tens of metres, with lesser symptoms such as hearing damage possible out to several hundred metres (Turnpenny and Nedwell 1994).

A more recent study on the effects of seismic activity on adult snow crab determined that there are no indications of acute or mid-term mortality, that the survival of embryos being carried by the female and locomotion of the resulting larvae after hatch were unaffected by seismic activity (DFO 2004f). In another snow crab study, eggs were exposed to 221 dB at 2 m and possibly showed signs of retarded development (Christian et al. 2003). However, eggs are not likely to be exposed at this range or intensity in nature because the eggs are not pelagic, but instead are carried by the female on the seafloor. The same is true for shrimp. A study with Dungeness crab found that no significant effects were detected on crab larvae exposed to peak levels of 230 dB re 1 μ Pa at a distance of 1 m (Pearson et al. 1994). This suggests that crab larvae and perhaps other invertebrates (e.g., shrimp) without air pockets are more resistant to the effect of air sleeves than are fish eggs and larvae.

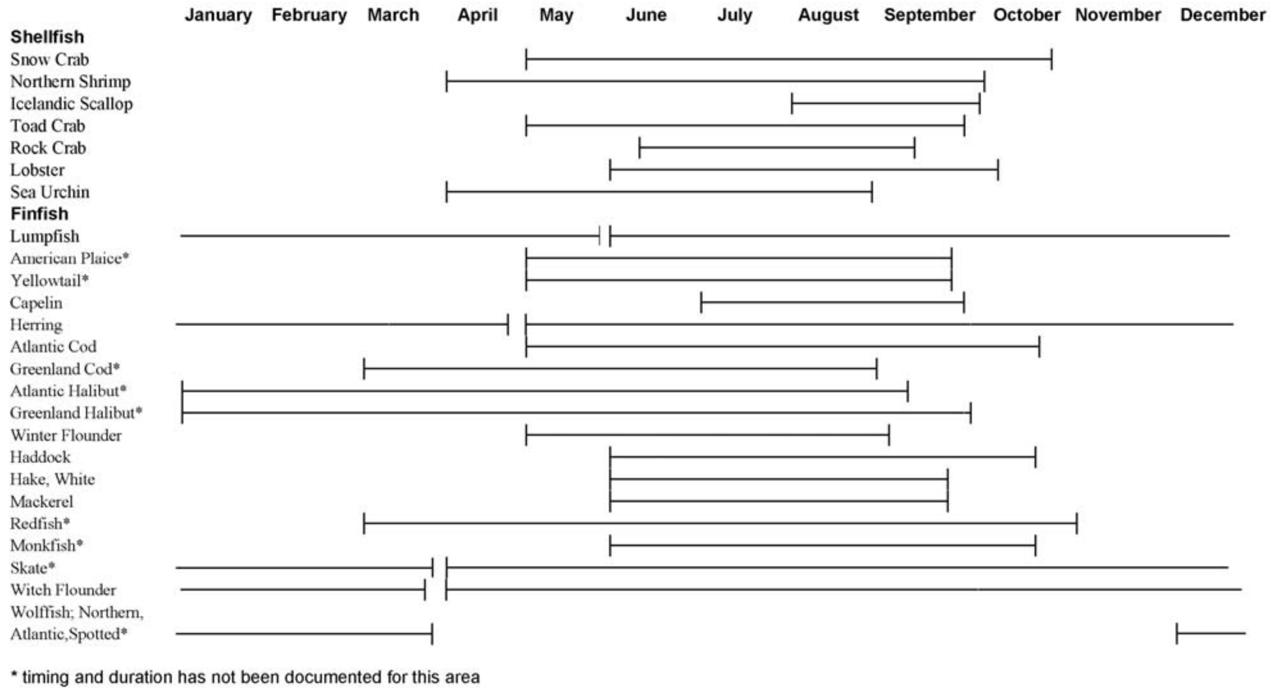
Several studies have estimated the mortality rate of planktonic organisms during seismic surveys. Davis et al. (1998) estimated that up to 1 percent of the plankton in the top 50 m of the water column would be killed during a 3D seismic survey off Nova Scotia. Saetre and Ona (1996) estimated 0.45 percent of planktonic organisms in the survey area would be killed in the upper 10 m of water off Norway. The highest estimate reported is that 6 percent mortality would result in the survey area if plankton were concentrated in the upper 10 m (Kenchington 2001). These estimates are considered conservative and may apply more to phytoplankton and zooplankton than to planktonic life stages of fish and shellfish, given that seismic-related mortality in fish has not been reported beyond 5 m during field and laboratory studies. This is supported by Kostyuchenko (1973) who reported more than 75 percent survival of fish eggs at 0.5 m from source (233 db at 1 m) and more than 90 percent survival at 10 m from source.

Because sound attenuation is much more rapid in shallow water, the potential affected area may be reduced by as much as 10,000 times compared to a similar sized seismic program offshore (Turnpenny and Nedwell 1994). Shallower, nearshore communities may be comprised of more benthic species that have no swim bladder and therefore are impacted less than pelagic species. Also, shallow inshore communities have a higher proportion of juvenile and small fish than in deep regions, which seem to be less affected by seismic exploration (Engås et al. 1996). The range and magnitude of physical effects on fish and shellfish will therefore be reduced, compared to those reported from offshore studies.

Seismic activity inshore can have its greatest effect if the program overlaps spatially and temporally with the occurrence of concentrations of fish eggs or larvae. Temporal overlap will occur because there are eggs or larvae in the water column year-round and all of the fish and shellfish assessed can have pelagic eggs and larvae in the water column during August and September (Figure 6.2). However, peak abundance in the water column for each species will be of much shorter duration and likely occur during the middle 50 percent of the duration illustrated. July, August and September are when most species are expected to have eggs or larvae present in the water column. In order for an interaction to occur between fish eggs and larvae and seismic activity, there must be spatial as well as temporal overlap with the Project. Spatial overlap will occur only with those species expected to have eggs and larvae near inshore areas since most of the seismic activity will take place within 2 to 5 km of the shoreline and in less than 50 m of water. The Project therefore has the potential to interact mostly with the pelagic life stages of herring, lumpfish, yellowtail flounder, winter flounder, mackerel, lobster, scallop, sea urchin, rock crab and toad crab. With the exception of herring larvae, the eggs and larvae of these species are dispersed soon after release to such low densities that mass mortality of a population's year class is unlikely. Mackerel larvae can form schools in coastal areas but they would be infrequent within the Affected Area because the main mackerel spawning grounds are west of the Magdalen Islands (Scott and Scott 1998).

If the seismic survey overlaps spatially and temporally with the occurrence of herring larvae, mortality can be expected within a few metres of the array. However, herring spawning is concentrated in St. Georges Bay, so herring larvae are not expected to drift into the Project Area. Herring larvae are passive drifters during their pelagic stage and therefore will be retained onshore by predominant southwest winds and along shore circulation patterns (see Section 5.1.2). Herring eggs are not expected to be affected by seismic activity because of the separation between the Project Area and spawning area in St. Georges Bay. Herring deposit eggs directly on substrate or vegetation in very shallow water close to shore and they remain adhered until hatching.

Figure 6.2 Fish and Shellfish Duration and Timing of Pelagic Stages



Source: JWL 2005.

From the results of the studies summarized in Table 6.4, it is assumed that a sound pressure level of 220 dB re 1 µPa0-P is required for egg/larval damage. Sound levels are not expected to reach 220 dB @ 1 m during this Project, so physical or lethal effects on fish and shellfish eggs and larvae are minimized. Mortality of phytoplankton and zooplankton near the seismic array will be sufficiently localized as to negligibly affect food availability for fish, shellfish, birds and mammals.

As a mitigative measure, the source vessel will implement a 30-minute ramp-up procedure by gradually increasing the number of sleeves fired simultaneously within an array. This ramping up will give motile fish an opportunity to move away from the immediate zone of influence before decibel levels reach maximum volume.

Potential effects of seismic activity from this Project on larvae and eggs will not affect the abundance or distribution of any population, including those species of concern such as cod, for more than one generation. Oil exploration generally is considered to have a negligible effect on the survival and recovery of the northern and spotted wolfish populations in the Gulf of St. Lawrence (DFO 2004d). Critical habitats of species listed under COSEWIC and SARA legislation (see Section 5.2) are not expected to be affected. Egg and larval mortality is possible only within a few metres of the seismic array, physical injury of adult fish is possible only within a few tens of metres and auditory damage is possible only within a few hundreds of metres. Project activities are therefore not predicted to result in a significant adverse effect, given the attenuation of the energy in shallow water and the avoidance of peak egg and larval densities in the spring and summer. Any effect from the Project will not cause a decline or change in abundance or distribution that will last more than one generation.

6.2.4.3 Accidental Events

The effects of a fuel spill on Marine Fish, Shellfish and Habitat will be determined by factors such as weather, time of year, type of habitat, species and life history stage. Hydrocarbons will be longest lasting in nearshore sheltered habitats of fine-grained substrates if the spill reaches the shoreline. Concentrations of hydrocarbons can be detectable for several years in the sediments if they are not physically or biologically disturbed (Sanders et al. 1990). Low levels of hydrocarbons in the substrate can have sub-lethal effects on nearby invertebrates.

A hydrocarbon spill can affect local abundance and availability of phytoplankton and zooplankton to fish but fish are not expected to remain within the area affected by the spill. If zooplankton survives exposure, accumulated hydrocarbons would be depurated within a few days after exposure has ended (Trudel 1985). If fish eat contaminated zooplankton they will accumulate hydrocarbons themselves, but fish are also able to metabolize hydrocarbons and there is no potential for biomagnification (C-NLOPB 2005).

All fish and shellfish past the egg and larval stage will likely actively avoid a hydrocarbon spill by swimming away (Irwin et al. 1997). Effects of an oil spill resulting from an accidental release associated with this Project are therefore expected to be negligible on juvenile and adult fish. If the spill reaches the shallow subtidal and intertidal environments, sessile invertebrates may be lost or suffer sub-lethal effects. Eggs and larvae are more subject to harmful physiological effects from a fuel spill because they cannot actively avoid the spill and they have not developed any detoxification mechanisms. Effects can include morphological malfunctions, genetic damage, reduced growth or localized mortality of eggs and larvae (C-NLOPB 2005).

The effect of a localized spill on egg and larval survival would be undetectable from the high rate of natural mortality. Recruitment to a population would not be affected unless more than 50 percent of the larvae in a large portion of the spawning area were lost (Rice 1985). When the survival of herring larvae was reduced by 58 percent as a result of the *Exxon Valdez* spill, no effect was detected at the population level (Hose et al. 1996). Likewise the effects of the *Exxon Valdez* spill were not significant on the larval distribution and settlement, fecundity, recruitment and growth of juveniles and sub-adult crab, pandalid shrimp, clams and scallops (Armstrong et al. 1995, in C-NLOPB 2005).

6.2.5 Listed Species

Cod eggs and larvae from the Laurentian North cod population may be present with the Project Area during the survey. However, the effect of the Project will not be distinguishable from the high rate of natural mortality normally experienced by cod eggs and larvae. The Project Area is outside the Cape George Cod Spawning Area, so this Project is not expected to affect cod spawning behaviour. The Project will survey an area less than 50 m deep and cod are not expected to spawn in water of these depths. There are no known critical habitats for the Laurentian North cod population within the Project Area.

Northern, spotted, and Atlantic wolffish are not known to occur within the Project Area. They are all deep water species, so the chance of interaction with the current Project is minimal. There are no known critical habitats for northern, spotted, or Atlantic wolffish within the Project Area.

The porbeagle shark is primarily a mid water species and therefore is expected to be a rare visitor within the Project Area, so the chance of interaction with the current Project is minimal. There are no known critical habitats for the porbeagle shark within the Project Area.

6.2.5.1 Summary of Potential Environmental Effects

A summary of the potential environmental effects of the Project on Marine Fish, Shellfish and Habitat is provided in Table 6.6.

Table 6.6 Potential Environmental Effects Assessment Summary – Fish and Fish Habitat

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Egg and larval mortality (A) • Avoidance (A)	• Scheduling of offshore seismic activity • Ramp-up procedures	2	3	5	2	R	2
Vessel Traffic	• Avoidance (A)	• Scheduling of offshore seismic activity • Ramp-up procedures	0	1	6	2	R	2
Safety Zone	• n/a		n/a	n/a	n/a	n/a	n/a	n/a
Routine Discharges	• n/a		n/a	n/a	n/a	n/a	n/a	n/a
Vessel Emissions (exhaust)	• n/a		n/a	n/a	n/a	n/a	n/a	n/a
Onshore Vegetation Clearing	• n/a		n/a	n/a	n/a	n/a	n/a	n/a
Drilling of Shot Holes	• n/a		n/a	n/a	n/a	n/a	n/a	n/a
Vehicular/ATV Traffic	• n/a		n/a	n/a	n/a	n/a	n/a	n/a
Unplanned Events								
Marine Fuel Spills (on-surface)	• Egg and larval mortality	• Spill prevention plan • Spill response plan	2	2	1	3	R	2
Onshore Fuel Spills	• n/a	•	n/a	n/a	n/a	n/a	n/a	n/a

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
2 = Evidence of existing adverse effects
3 = High level of existing adverse effects

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.2.6 Cumulative Effects Assessment

Cumulative effects within the Project Area such as vessel noise and traffic (e.g., seismic vessels) have been considered within the environmental effects assessment of the Project. Potential cumulative effects external to the Project include marine transportation, commercial fishing, oil and gas exploration and other seismic activity. During the seismic survey, it is expected that some commercial traffic will be passing in the vicinity of the Project Area and entering the Bay of Islands en route to Corner Brook. As well, commercial fishing vessels will be operating within the Project Area. There are no current plans or proposals for other seismic surveys to be conducted in the Project Area. Negligible cumulative effect is expected with noise and traffic external to the Project, given the restricted access of non-project vessels near the source vessel during the seismic survey. The incremental amount of vessel traffic as a result of this Project will be negligible compared to existing vessel traffic in the area. Cumulative effects resulting from any of the Project activities will not be additive or cumulative because the Project activities are transitory. Therefore, the cumulative environmental effects of the Project in combination with other projects and activities are rated not significant.

6.2.7 Monitoring and Follow-up

There is no follow-up and monitoring recommended for Marine Fish, Shellfish and Habitat. The vessel will have a FLO onboard during operations to monitor interactions with fishing vessels and serve as a liaison between the source vessel and fishing operations (see Section 6.6).

6.2.8 Summary of Residual Environmental Effects Assessment

The residual environmental effects, including cumulative effects, of the Project on Marine Fish, Shellfish and Habitat are rated not significant. Studies indicate that a conservative safe range of no effects to fish from seismic surveys is likely 50 m. The effect of this Project on eggs and larvae is not likely discernible from natural mortality. The significance of environmental effects is summarized in Table 6.7.

Table 6.7 Environmental Effects Significance – Fish and Fish Habitat

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	3	n/a
Vessel Traffic	NS	3	n/a
Safety Zone	n/a	n/a	n/a
Routine Discharges	NS	2	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a
Drilling Shot Holes	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a
Unplanned Events			
Marine Fuel Spills (on-surface)	NS	2	n/a
Onshore Fuel Spills	n/a	n/a	n/a
Project Overall	**NS**	**3/2**	**n/a**

KEY:
Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

6.3 Marine Mammals and Sea Turtles

Marine mammals play a significant role in the offshore ecosystem. This importance is manifested in regulatory protection and scientific and public concern. As well, the whale-watching industry and the annual seal harvest are important economic considerations in Newfoundland and Labrador, as are interactions of marine mammals with the commercial fishery. Sea turtles are occasional visitors to the west coast of Newfoundland and could potentially be affected by Project activities. For these reasons, Marine Mammals and Sea Turtles are considered a VEC. The environmental assessment focuses on whale and seal species that may live and/or migrate through the Project Area.

6.3.1 Boundaries

Temporal and spatial boundaries encompass those periods during and areas within which the VECs are likely to interact with or be influenced by the Project. For the purposes of this environmental assessment, it is assumed that species known to occur regularly in the northern Gulf of St. Lawrence may occur in the Affected Area and be potentially affected by Project activities. Temporal boundaries for this analysis are the period of proposed offshore Project activity (between mid-August and October).

6.3.2 Potential Interactions and Existing Knowledge

Potential interactions between the Project and marine mammals relate primarily to noise disturbance and direct physical effects associated with the vessel and air sleeve operations. These disturbances may lead to communication masking (e.g. interception of vocalizations), behavioural effects (e.g. avoidance, changes in migration, reproductive or feeding behaviours) and direct physical effects (e.g. auditory damage and mortality). Potential collisions between the source vessel and individual animals may also occur.

6.3.2.1 Communication Masking

Marine mammals are highly dependent on sound for communicating, detecting predators, locating prey, and in toothed whales, echolocation (Lawson et al. 2000). Natural ambient noise created by wind, waves, ice and precipitation alone can cause masking or interfere with an animal's ability to detect a sound. Marine animals themselves also contribute to the level of natural ambient noise. The calls of a blue whale have been recorded for 600 km (Stafford et al. 1998). A sperm whale call can be as loud as 232 dB re 1µPa at 1 m (rms) (Møhl et al. 2003) and a species of shrimp has been recorded at 185 to 188 dB re 1µPa at 1 m (Au and Banks 1998). When anthropomorphic noise from ships, drill rigs, seismic and sonar are layered on natural ambient sounds, the level of noise underwater can be quite loud in some areas. In areas where natural background noise is relatively high, such as near a shelf break or high surf, anthropomorphic noise itself can be masked and reduce the area in which it is detectable. The anthropomorphic noise is undetectable for marine mammals once it falls below ambient noise level or the hearing threshold of the animal. Given this and the fact that mammal response will vary by species and between individuals, the zone of potential influence of noise on marine mammals is highly variable.

Some degree of masking can be expected when high levels of broadband sounds are emitted underwater but because it occurs naturally, marine mammals have evolved systems and behaviour to reduce the impacts of masking (C-NLOPB 2005). Since little is known about the significance of how a temporary interruption in sound detection affects mammals (Richardson et al. 1995), it is very difficult to assess the impact. In general, the impact of both natural and man-made noise is less severe when it is intermittent rather than continuous (C-NLOPB 2005). The introduction of man-made sounds at frequencies relevant to marine mammals will increase the likelihood of masking. But because the Project Area is close to shore, there will be a directional effect for the vast majority of marine mammals, since they will be seaward of the source vessel. The level of masking may be significantly reduced if the anthropogenic noise originates from a different direction than the mammal vocalization (see C-NLOPB 2005).

The low frequency spectrum of industrial noise will not overlap with the high frequency echolocation of belugas, dolphins, or pilot whales, for example. The frequencies do overlap with the sounds of baleen whales and will reduce the area of auditable sound for the whale. The impact of such a reduction is unknown (C-NLOPB 2005). Toothed whales and presumably other species have demonstrated the ability to alter the frequencies and increase the level of transmission when competing with ambient noise (see C-NLOPB 2005).

The masking effect from the seismic survey is expected to be limited. C-NLOPB (2005) reports that some marine mammals continue calling in the presence of seismic operations, which typically emit an impulse every 11 seconds. An increase in interval time will enable mammals to receive communications that persist through the survey operation, as reported during other surveys (Richardson et al. 1986; McDonald et al. 1995; Greene and McLennan 2000; Madsen et al. 2002; Jochens and Briggs 2003).

6.3.2.2 Hearing Impairment

Extended periods of moderate noise levels under water can cause a reduction in hearing sensitivity in some marine mammals (Kastack et al. 2005), referred to as temporary threshold shift (TTS). At TTS exposure levels, hearing sensitivity is generally restored quickly after the sound dissipates. Pinnipeds exposed to 2500 Hz at 80 and 95 dB for 22, 25 and 50 minutes experienced TTS ranging from 2.9 to 12.2 minutes, but recovered fully with 24 hours of noise exposure (Kastack et al. 2005). A beluga whale exposed to a single peak to peak pressure of 226 dB re 1 μPa experienced TTS to within 2 dB for 4 minutes after exposure (Finneran et al. 2002). A bottlenose dolphin exposed to a single 228 dB re 1 μPa sound did not experience TTS (Finneran et al. 2002). Exposure to several seismic pulses at received levels near 200 to 205 dB (rms), which may be experienced within 100 m of a source vessel, may result in slight TTS in small toothed marine mammals (C-NLOPB 2005). There are no data on the level or properties of sound that are required to induce a TTS in any baleen whale (C-NLOPB 2005).

A permanent threshold shift may be a symptom of physical damage and may alter the functional sensitivity at some or all frequencies. Although there are no data to quantify sound levels required to cause a permanent threshold shift, it is believed that a source level would have to far exceed the level required for a TTS, the exposure would have to be prolonged, or the rise level would be extremely short (C-NSOPB 2005). Richardson et al. (1995) hypothesized that permanent hearing impairment of marine mammals would not likely occur with prolonged exposure to continuous man-made sound of up to about 200 dB re 1 μPa-m.

Policy in the United States regarding exposure of cetaceans and pinnipeds to sound restricts impulses exceeding 180 and 190 dB re 1 μPa (rms) (NMFS 2000). A source level of 234 dB re 1 μPa (rms) with spherical spreading would create sound pressure levels of 180 and 190 dB re 1 μPa (rms) at distances of 170 and 512 m from the source (C-NLOPB 2005).

Very little is known about the non-auditory effects of seismic surveys on marine mammals. If such effects exist they would only be expected within a short distance from the vessel. Given that most mammals demonstrate short range avoidance of seismic vessels, non-auditory effects are unlikely to occur (C-NLOPB 2005).

There are fewer studies pertaining to effects on sea turtles of seismic activities. Twenty-four hours after exposure to a few hundred pulses from an air sleeve, 5 of the 11 caged loggerhead turtles experienced TTS but normal hearing had resumed when the turtles were tested two weeks post-exposure (Moein et al. 1994). The level of sound exposure was not reported for his study but the source is presumed to range from 175 to 179 dB. These results are consistent with the occurrence of TTS in turtles exposed to air sleeves (C-NLOPB 2005). It is not clear how this study would translate to turtles subject to seismic noise in the open ocean, other than to allow us to presume that less exposure would have less effect. Turtles would not be exposed to more than a few air sleeve discharges before they moved away or before the vessel passed by them, thus reducing the risk of TTS.

6.3.2.3 Disturbance

Behavioural changes in marine mammals resulting from seismic surveys will vary by species and even by individuals of the same species. There are reports of humpbacks approaching the seismic source to within 100 to 400 m, where the maximum received levels were 179 dB re 1 µPa rms (McCauley et al. 1998). Some baleen whales have avoided areas receiving an impulse noise in the 160 to 170 dB re 1 µPa (rms) range or lower (C-NLOPB 2005 and references therein). Depending on the survey area's physical environment (e.g., water depth), this area may extend 4.5 to 14.5 km from source. The observed behavioural reaction included moving away from feeding areas or changing migration routes. A change in migration route is believed to have little biological significance since the whales course can be corrected once it is outside the area of influence (C-NLOPB 2005). The impact of a loss of feeding opportunity will depend on factors like the availability of alternate feeding locations and species, time since previous feed, age and species. Marine mammals are opportunistic feeders and have adapted to the annual variability in prey abundance, so presumably are not reliant on any single location for food. If whales are deterred from an area in one year, it is not known whether it will affect their use of that area in subsequent years (C-NLOPB 2005). However, studies of grey and bowhead whales have demonstrated continuous use of areas of seismic activities (C-NLOPB 2005 and references therein). Few studies have been conducted on the reaction of toothed whales to seismic activity but there are numerous observations of dolphins and porpoises bow riding active seismic vessels (C-NLOPB 2005). Several observations during seismic activity on sperm whales have concluded little detectable effect (see C-NLOPB 2005). Pinnipeds have shown only slight (if any) avoidance of air sleeves and only slight (if any) changes in behaviour, avoiding the active array by a few hundred metres. Individual variation within seal species has been indicted by telemetry studies (C-NLOPB 2005).

There is very little data on the effects of seismic activity on sea turtles. In a caged study, sea turtles increased their swimming speed when exposed to a 166 re 1 µPa (rms) sound from an air sleeve, firing every 10 seconds (McCauley et al. 2000 a or b). The turtles behaviour became more erratic when the received level was increased to 175 dB re 1 µPa (rms). The authors suggested that the erratic behaviour would translate into avoidance behaviour in nature. They suggest that behaviour changes may be observed at approximately 2 km and avoidance behaviour at approximately 1 km from a typical sleeve array (2,678 in^3, 12-elements) operating in 100 to 120 m of water. This scale of avoidance is not expected to affect the migration of sea turtles but if the seismic activity prevented them from entering a preferred feeding area for a prolonged period, there could be negative impacts (C-NLOPB 2005). There are no known feeding areas for sea turtles within the Project Area.

6.3.2.4 Accidental Events

Fuel Spills

Significant long-term and lethal effects from external exposure, ingestion or bioaccumulation of oil have not been demonstrated in whales (C-NLOPB 2005). Even on the scale of the *Exxon Valdez* oil spill, the only effect detected on humpback whales was temporary displacement, for which there was no clear cause (von Ziegesar et al. 1994).

Whales can detect oil in the water but still may swim through it (C-NLOPB 2005). If direct exposure occurs, effects may include eye irritation and ingestion while feeding or breathing within the slick. Oil may be expelled through vomit or feces but if enough is adsorbed it may create a toxic effect, or cause internal damage if large quantities are ingested (see C-NLOPB 2005). Oiling of the baleen may reduce its filtering efficiency but the effects are minimal and quickly reversible (C-NLOPB 2005).

There is more evidence that seals are adversely affected by oil spills than are whales. There have been several occurrences of dead seals in the vicinity of an oil spill (see C-NLOPB 2005). The cause of death may have been ingestion or drowning caused by a heavy coating of heavy bunker oil. During the *Exxon Valdez* spill, several harbour seal haul-out sites were oiled and resulted in seals moving from some of the oiled haul-out sites (Hoover-Miller et al. 2001, in C-NLOPB 2005). There was no significant quantities of oil in the tissues of harbour seals exposed during the *Exxon Valdez* spill (Bence and Burns 1995).

Within the Affected Area, the most vulnerable marine mammal group are newly born seal pups. If their fur is oiled before they have established a fat layer, they are subject to hypothermia. Juveniles and adults of harp, hooded, grey and harbour seals are well protected from the cold by a layer of blubber. It is not clear whether seals will avoid oil in the water, so if they move through the spill they become exposed to coating and vapours. If oil is ingested, seals are able to metabolize most of the oil and recuperate quickly if exposure is not prolonged. Seals exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage (see C-NLOPB 2005).

It is not known whether sea turtles can detect an oil spill but limited observations indicate they do not avoid spills (see C-NLOPB 2005). Exposure to oil has caused temporary lesions, reduced lung diffusion capacity, decreased oxygen consumption, decreased digestion efficiency and damaged nasal and eyelid tissue (Lutz et al. 1989, in C-NLOPB 2005). Sea turtles appear to be more sensitive to the effects of an oil spill than seals or whales.

Collisions

Large vessels traveling at more than 14 knots are the principal source of ship strike mortalities in whales (Laist et al. 2001). High speed container ships are considered to be potentially one of the greatest threats to blue whales. Given that the source vessel will be traveling between 5 and 6 knots and emitting seismic energy during operation, the potential for a collision with marine mammals and sea turtles is minimal.

6.3.2.5 Listed Species

Species of special concern that may occur within the Project Area are the fin whale, blue whale, harbour porpoise and the leatherback turtle. These whales are not common within shallow, nearshore areas, which will reduce the chance of interaction with the Project. An Environmental Observer and ramp-up procedures will be implemented to further reduce the chance of an interaction.

6.3.3 Residual Environmental Effects Significance Criteria

6.3.3.1 Non-Listed Species

A **significant adverse environmental effect** is defined as one that affects a marine mammal or sea turtle population or portion thereof or their associated habitat in such a way as to cause a decline or change in abundance and/or distribution of the population over one or more generations. Natural recruitment (reproduction and in-migration from unaffected areas) may not re-establish the population to its original (i.e., pre-Project) level within several generations or avoidance of the area becomes permanent.

A **non-significant adverse environmental effect** is defined as an adverse effect that does not meet the above criteria.

A **positive effect** is defined as one that results in a measurable population increase and/or enhances the quality of habitat for marine fish.

6.3.3.2 Listed Species

A *significant adverse residual environmental effect* on all species listed in Schedule 1 of SARA as "Extirpated", "endangered" or "Threatened" is:

- one that results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA.

6.3.4 Environmental Effects Assessment and Mitigation

The proposed Project may result in short-term behavioural effects on marine mammals. However, most studies indicate that such behavioural disturbances are likely to be transitory with normal behaviour resuming within an hour or two after vessel passage (Davis et al. 1998). During the weeks of seismic survey, the western nearshore area of the Port au Port Peninsula may be avoided by marine mammals but it is not expected to alter established migration routes since these routes would be further offshore. The Project is not expected to restrict access to St. Georges Bay if marine mammals use the area for feeding during herring spawning. The colony of resident harbour seals on The Bar may exhibit some avoidance of the Project Area during seismic activity. However, the haul-out area is more than 10 km away, so the Project is not expected to cause seals to abandon this haul-out site. They may avoid the Project Area while in the water but the Project Area is not known to be important habitat for harbour seals.

Masking results primarily from continuous noise (e.g., shipping) rather than short pulses associated with seismic exploration (Richardson et al. 1995). The interval between pulses ranges from 6 to 8 seconds with a masking effect occurring for less than one second during the pulse (Davis et al. 1998). Species using echolocation or sounds for communication are likely still effective between the pulses.

Therefore, the seismic pulses will not have an appreciable masking effect during approximately 96 percent of the survey time. It is reasonable to assume that mammal species have been able to overcome most, if not all, of the masking sounds to which they have been exposed in the last decade (Lawson et al. 2000). Therefore, communication masking is not considered to be a significant Project-related issue.

Marine mammals often exhibit strong behavioural reactions, sometimes including avoidance, when received levels of anthropogenic sounds are well below the anticipated TTS thresholds. Therefore, it is likely that most marine mammals will avoid the direct area of influence during the ramp up to peak energy levels and thus will be outside the predicted area of TTS (i.e., further than four kilometres from the source). As a result, marine mammals are likely to avoid exposure to physiologically harmful levels of sound. Auditory damage and mortality is not a major concern with respect to the proposed Project.

Collisions between the seismic survey vessel and marine mammals are not expected to result from the Project given the slow survey speed of the vessel, the avoidance caused by seismic activity and the familiarity of these marine mammals to vessels.

Based on existing knowledge of the effects of seismic activity on marine mammals, the timing of the survey and the mitigations that will be implemented, the project is predicted to have only minor effects on marine mammals. A summary of the potential environmental effects of the Project on Marine Mammals and Sea Turtles is provided in Table 6.8.

6.3.5 Cumulative Environmental Effects

Cumulative effects within the Project Area such as vessel noise and traffic (e.g., seismic and supply vessels) have been considered within the environmental effects assessment of the Project. Potential cumulative effects external to the Project include marine transportation, commercial fishing, oil and gas exploration and other seismic activity. During the seismic survey, it is expected that some commercial traffic will be passing near the Project Area. As well, commercial fishing vessels will be operating within the Project Area. There are no current plans or proposals for other seismic surveys to be conducted in the Project Area. Minimal cumulative effect is expected with noise and traffic external to the Project given the restricted access of non-project vessels near the source vessel during the seismic survey. The incremental amount of vessel traffic as a result of this Project will be negligible compared to existing vessel traffic in the area. Cumulative effects resulting from any of the Project activities will not be additive or cumulative because the Project activities are transitory. Therefore, the cumulative environmental effects of Project activities are rated not significant.

Table 6.8 Potential Environmental Effects Assessment Summary – Marine Mammals and Sea Turtles

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Communication masking (A) • Behavioural effects (avoidance, change in migration patterns, reproductive and feeding behaviours) • Physical effects (auditory damage, mortality)	• Environmental Observer for marine mammals • Ramp-up procedure	1	4	5	2	R	2
Vessel Traffic	• Collision (A)	• Environmental Observer for marine mammals • Slow vessel speed	2	4	1	2	R	2
Safety Zone	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Routine Discharges	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Drilling of Shot Holes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Unplanned Events								
Marine Fuel Spills (on-surface)	• Oiling/avoidance of habitat	• Spill prevention kits • Spill response plan	1	3	1	1	R	1
Onshore Fuel Spills	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
2 = Evidence of existing adverse effects
3 = High level of existing adverse effects

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.3.6 Monitoring and Follow-up

An Environmental Observer, trained for marine mammal observations, will watch for marine mammals from the bridge of the source vessel throughout the survey. The observer will record sightings of marine mammals on a daily basis throughout the seismic program, weather permitting. The C-NLOPB's Environmental Mitigative Measures for ramp-up and shut down of the air sleeves will be closely followed (http://www.cnlopb.nl.ca/).

Specifically, the ramp-up of the air sleeve to seismic survey capacity will occur over a 20- to 40-minute period to initiate a behavioural avoidance response in marine mammals whereby they will leave the Project Area prior to experiencing hearing damage. The Environmental Observer will conduct continuous monitoring for marine mammals for 30 minutes prior to start-up of the seismic array. Should a marine mammal be observed in a 500-m zone from the centre of the seismic source array, start-up will be delayed until the marine mammal has not been observed for 30 minutes or has been observed leaving the 500-m zone. The survey will also shut down should the observer detect a marine mammal other than a dolphin or porpoise within 500 m from the centre of the seismic source array. A 1-km protection zone monitoring program for the endangered blue whale during survey data acquisition will be conducted. The air sleeves will be shut down every time a blue whale enters the defined protection zone.

6.3.7 Summary of Residual Environmental Effects Assessment

The residual environmental effects, including cumulative effects, of the Project on Marine Mammals and Sea Turtles are rated not significant (Table 6.9). The proposed Project may result in short-term behavioural effects on marine mammals. However, most studies indicate that such behavioural disturbances are likely to be transitory with normal behaviour resuming within an hour or two after vessel passage (Davis et al. 1998). Auditory damage and mortality as a result of seismic activities and/or vessel traffic is not a major concern with respect to the proposed Project. Any potential residual environmental effects will be minimized through implementation of protection measures such as ramping up procedures and an Environmental Observer to identify marine mammals in the area as specified in the C-NLOPB guidelines. Therefore, the residual adverse environmental effects, including cumulative effects, of the Project on marine mammals are rated not significant. The residual environmental effects of the Project on listed marine mammal and sea turtle species are rated not significant.

Table 6.9 Environmental Effects Significance – Marine Mammals and Sea Turtles

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	3	n/a
Vessel Traffic	NS	3	n/a
Safety Zone	n/a	n/a	n/a
Routine Discharges	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a
Drilling Shot Holes	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a
Unplanned Events			
Marine Fuel Spills (on-surface)	NS	2	n/a
Onshore Fuel Spills	n/a	n/a	n/a
Project Overall	**NS**	**3**	**n/a**

KEY:

Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

6.4 Commercial Fisheries

Historically, the fishery has played an important role in Newfoundland and Labrador's economy, and has helped to define much of the province's character. The fishery remains an integral component of the economy of Newfoundland and Labrador.

6.4.1 Boundaries

The spatial boundary for commercial fisheries is designated as NAFO Unit Area 4Rc. Area 4Rc represents the potential affected area. It is anticipated most effects will be limited to the Project Area. The temporal boundary for commercial fisheries is limited to the period in which the offshore component of the Project is to occur (mid-August to October).

Fisheries data for NAFO Unit Area 4R were sourced from the *Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment* (C-NLOPB 2005). At the time of writing, the most recent year for which DFO-validated fisheries data for NAFO Unit Area 4Rc are available is 2003 (landed weight value). But because the 2003 data lack reliable cash value estimates, 2002 landed value data are also referenced. Various DFO Stock Assessment documents, which are used to predict fisheries trends for 2006, were also referenced in the preparation of this report

6.4.2 Potential Interactions and Existing Knowledge

Most of the information available on potential interactions between the fishing industry and the offshore oil and gas industry has been gathered through stakeholder consultations undertaken as part of recent environmental assessments for petroleum exploration and development projects in Atlantic Canada and elsewhere. Studies include the Terra Nova EIS (Petro-Canada 1995), the White Rose EIS (Husky Oil 2000), the Laurentian Sub-Basin SEA (Jacques Whitford 2003b), the Orphan Basin SEA (LGL 2004) the Seismic Exploration EA on Scotian Shelf (Jacques Whitford 2003a) and the Western Newfoundland and Labrador Offshore Area SEA (CNLOPB, 2005). These consultations and those undertaken as part of this assessment (Section 3), have identified the primary issues as being potential interference with harvesting activities and fishing gear, potential impacts on fish catchability, potential interference with DFO research surveys and potential biophysical effects on fish and subsequent reductions in fish landings.

Fishers elsewhere in the world have expressed concerns with respect to offshore oil exploration and development. Lam (2001) provides a good review of fisheries-related issues in the United Kingdom over more than three decades of offshore oil and gas development. Issues and concerns relevant to this environmental assessment include loss of access, damage to gear and compensation for damage, and communication between the two industries. Similarly, issues identified off California (MMS 2001) have included space use conflicts and reduced catch due to seismic activity. Peterson (2004) draws on Canada east coast experience to describe potential interaction between seismic testing activities and fisheries on the west coast of Canada. Issues identified in that report include reduced fish catch and space use conflict. Numerous other such reports exist, all of which highlight the importance of communication between the fishing and oil industry, often through the establishment of formal liaison mechanisms to deal with specific issues.

Based on the information presented above, the following potential interactions are addressed in this analysis:

- conflict with harvesting activities and fishing gear,
- impacts on fish catchability, and
- interference with DFO surveys.

Biophysical effects on fish are dealt with in Section 6.2.

6.4.3 Residual Environmental Effects Significance Criteria

For fisheries, residual environmental effects significance criteria are defined as follows:

A **significant adverse effect** is defined as one where the Project results in an unmitigated or non-compensated net loss of Commercial Fisheries.

A **non-significant adverse effect** is defined as one where the Project does not result in an unmitigated or non-compensated net loss of Commercial Fisheries.

A **positive effect** is defined as one that results in a measurable increase in fisher income.

6.4.4 Environmental Effects Assessment and Mitigation

6.4.4.1 Conflict with Harvesting and Fishing Gear

Loss of access to fishing grounds could occur during seismic programs. Damage to fishing gear or vessels could result from physical contact with the source vessel or equipment. In addition to fishing vessel damage or loss of gear, further economic loss might result from reduced catch following damage.

Since Project activities in the marine environment will be limited to depths of less than 50 m the Project has the greatest potential to conflict with harvesting activities that take place in the nearshore environment. No conflict is anticipated with harvesting activities or fishing gear that occur at water depths exceeding 50 m (e.g., snow crab, shrimp and most halibut fisheries).

Greater potential for conflict exists for fixed gear fisheries (pots, gillnets and long line) than for more mobile gear types (various types of seines). Thus, fixed gear fisheries that occur at water depths shallower than 50 m pose the greatest potential for conflict. These fisheries include lobster, cod, lumpfish, halibut, flounder, skate and bait fisheries (herring, mackerel and flounder).

The period of highest fishing activity within the Project Area is May to July. All fixed gear inshore fisheries outlined above will be partially or entirely conducted within this timeframe. Of greatest economic importance is the lobster fishery which will be conducted from April to June. Peak effort employed during the cod fishery also occurs during this period (July). In addition to fixed gear fisheries, mobile gear fisheries for herring and capelin will occur within this timeframe. Therefore, the Project would have greatest potential impacts with harvesting and fishing gear and the economics of the fishing industry during the May to July time period.

Fishing activity within the Project Area beyond July will be mainly targeted toward the fixed gear cod fishery and the mobile gear herring and mackerel fisheries. The cod fishery is likely to be limited to a few days of fairly intense effort until the quota allocation is caught. Fixed gear effort within the Project Area should be minimal after the cod quota is taken. Mobile gear (seine) fishers have indicated that mackerel and herring fisheries occur in the Project Area mainly in September and October and that the August fishery occurs mainly to the north of the Project Area. The potential for harvesting and gear conflicts is reduced for mobile fishery gear as compared to fixed gear. These circumstances suggest that a seismic program conducted in early August (immediately following the closing of the August cod fishery) and extending to mid-September (prior to peak seining effort in the Project Area) would offer the least potential for conflict with harvesting and fishing gear.

6.4.4.2 Effects on Fish Catchability

Recent studies using a number of methods to estimate fish distribution in open sea fisheries showed a decrease in gadoid abundance during seismic surveys (Løkkeborg and Soldal 1993; Engås et al. 1996). The areas apparently affected extended up to 33 km from the survey centre but the most pronounced reduction in catch occurred within the seismic shooting area (Engås et al. 1996). Dalen and Raknes (1985, in Engås et al. 1996) suggested that cod may swim toward the bottom and remain immobile during disturbance by sound and Løkkeborg and Soldal (1993) have suggested that this change in behaviour could explain increases in catch rates of cod in saithe trawls during seismic activity. Chapman and Hawkins (1969) illustrated how whiting in mid-water schools moved deeper below air sleeves. Pearson et al. (1992) showed rock fish catches declined, mainly due to changes in fish depth rather than to dispersal of the shoals.

Other studies have shown no effect of seismic surveys on the distribution of tagged bass (Pickett et al. 1994) or reef fish (Wardle et al. 2001). Turnpenny and Nedwell (1994) have speculated that inshore species, such as those in the latter two studies may be less affected by sound due to faster sound attenuation in shallow water and because inshore species comprise a large proportion of benthic species that have no swimbladder and are therefore less sensitive to sound. Turnpenny and Nedwell (1994) concluded that the impacts of seismic testing are therefore likely substantially less in inshore waters.

The lack of swimbladder in shrimp, crab and lobster should also make these species less sensitive to sound. Large displacements of macroinvertebrates through avoidance behaviour are very unlikely (Turnpenny and Nedwell 1994). Christian et al. (2003) reported no drastic decrease in catch rate for snow crab during an experimental commercial fishery conducted before and after an area was exposed to seismic shooting. However, study limitations were noted including variability in set durations and a relatively low number of sets conducted.

Based on the above (and Section 6.2), seismic activities are unlikely to significantly affect macroinvertebrates (e.g. lobster).

6.4.4.3 Fisheries and Oceans Canada Surveys

The timing of DFO surveys in and around the Project Area is provided in Section 5.6. Offshore seismic activities have been planned to avoid conflicts.

6.4.4.4 Accidental Effects

An accidental spill of diesel fuel or lube oil from the source vessel could potentially affect Commercial Fisheries. Accidental spills could result in fishing gear fouling and potential loss of income through reduced catch value or suspended fishing. However, the likelihood of such an event is extremely low and the nature of diesel fuel is such that it evaporates from the surface relatively quickly and does not persist in the environment for any length of time. Other accidental events that may occur include damage or loss of seismic gear, entanglement of seismic gear with fishing gear and vessel collisions. Although it is unlikely to occur, the residual environmental effect of an accidental event to Commercial Fisheries is rated significant.

6.4.4.5 Summary of Potential Environmental Effects

A summary of the potential environmental effects of seismic activity on Commercial Fisheries is provided in Table 6.10.

6.4.4.6 Mitigation

Environmental effects related to interference with fishing vessels or gear, or through interference with DFO survey activities can be minimized through consultation and effective communication between operators, regulators and the fishing industry in the planning phase and in the execution of seismic surveys (Jacques Whitford 2003b).

The seismic survey is being planned and coordinated with the fishing industry and with DFO to reduce potential conflict with commercial fishing activities, sensitive life cycle stages of fish and DFO assessment surveys. Thus, offshore seismic activities will not be conducted during the period May 1 to August 15 to avoid peak fishing activity and the critical time associated with cod spawning that occurs to the west of the Project Area.

A SPOC will be established between the survey operations and the fishing industry. The SPOC will be responsible for identifying the most effective means of communicating information to the fishing industry. The SPOC will also develop protocols for recording and reporting gear or vessel damage (including damage resulting from an accidental fuel spill) and for providing gear locations to the survey vessel. The SPOC will also file Notices to Shipping with contact information in the event of gear damage and to deal with compensation claims.

In order to further facilitate communication between the source vessel and fishing vessels, a FLO will be on duty onboard the source vessel during the survey. The use of FLOs involves the hiring of fishers by seismic operators to help coordinate seismic surveys and fishing activities in test areas. FLO responsibilities can include communicating with fishing vessels to warn of potential dangers and proposing alternative routes to the source vessel crew, away from larger fishing aggregations.

The survey will be conducted with a source vessel having equipment, systems and protocols in place for prevention of pollution in accordance with the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2004). Any accidental spills will be reported to the C-NLOPB and Canadian Coast Guard Emergency Response immediately. Best management practices will be used on the source vessel to avoid gear loss or damage.

Table 6.10 Potential Environmental Effects Assessment Summary – Commercial Fisheries

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Loss of access (A) • Damage to gear or vessel (A) • Decreased fish catch • Interference with DFO surveys	• Avoidance of peak fishing time • Coordination and communication with fishing industry and DFO • SPOC • FLO • Notice to Mariners • Compensation for damage	3	3	5	2	R	2
Vessel Traffic	• Loss of access • Damage to gear or vessel • Decreased fish catch	• Avoidance of peak fishing times • Coordination and communication with fishing industry and DFO • SPOC • FLO • Notice to Mariners • Compensation for damage	2	1	6	2	R	2
Safety Zone	• Temporary localized loss of access	• Avoidance of peak fishing times • Coordination and communication with fishing industry and DFO • Notice to Mariners • Compensation for damage	1	1	6	1	R	2
Routine Discharges (deck drainage)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Drilling of Shot Holes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Unplanned Events								
Marine Fuel Spills (on-surface)	• Tainting of fisheries resources	• Spill prevention planning • Best management practices to avoid accidental events	3	3	1	1	R	2
Onshore Fuel Spills	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
(Refers to population)
2 = High level of existing adverse effects
3 = Evidence of existing adverse effects

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.4.5 Cumulative Effects Assessment

The potential effects of the Project on the fishing industry relate primarily to effects of noise on fish catches. In general, the Gulf of St. Lawrence underwater environment is noisier since the introduction of engine-powered shipping. The noise resulting from the proposed Project will be temporary, of short duration and will add only incrementally to the underwater ambient noise levels. Cumulative environmental effects resulting from any of the Project activities will not be additive or cumulative, because the Project activities are transitory.

There are no current plans or proposals for other offshore seismic surveys to be conducted in the Project Area. Therefore, there will be no temporal overlaps with the proposed Project. The cumulative effects of the project in combination with other projects and activities are rated not significant.

6.4.6 Monitoring and Follow-up

A land-based SPOC and an on-board FLO will be retained to monitor fishing activity and coordinate activities between the source vessel and fishing and/or DFO vessels.

6.4.7 Summary of Residual Environmental Effects Assessment

Residual environmental effects are anticipated effects after implementation of mitigation measures. Overall and after implementation of mitigations listed in Section 6.4.4.6, the significance of residual environmental effects of the Project on Commercial Fisheries is rated not significant (Table 6.11).

Table 6.11 Environmental Effects Significance – Commercial Fisheries

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	2	n/a
Vessel Traffic	NS	2	n/a
Safety Zone	NS	3	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	n/a	n/a	n/a
Drilling Shot Holes	n/a	n/a	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a
Unplanned Events			
Marine Fuel Spills (on-surface)	S	2	1
Onshore Fuel Spills	n/a	n/a	n/a
Project Overall	**NS**	**2**	**n/a**

KEY:

Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

6.5 Terrestrial Environment

The Terrestrial Environment is considered a VEC due to regulatory concern and the potential for the Project to interact with habitat for terrestrial flora and fauna. For this assessment the terrestrial environment includes vegetation, birds and wildlife.

6.5.1 Boundaries

The spatial boundaries for the assessment of the terrestrial environment include the terrestrial portion of the Project Area indicated on Figure 2.1. Temporal boundaries are defined by the Project schedule, covering May through October 2006, with offshore and onshore seismic activities occurring between mid-August and October.

6.5.2 Potential Interactions and Existing Knowledge

Potential interactions, issues and concerns related to the terrestrial environment and the Project include:

- disturbance to birds and wildlife from vehicular noise and noise from seismic shooting;
- removal and/or disturbance of vegetation during placement of source lines; and
- accidental spills of fuel or other hazardous materials.

6.5.2.1 Disturbance

Disturbance to birds and wildlife during Project activities could result in increased physiological stress, displacement or permanent avoidance of habitat. Bird and wildlife species tend to be most sensitive to disturbance during the breeding season, which generally begins in early May for many boreal species in Newfoundland. While waterfowl may not avoid areas of human activity during breeding, they have been noted to avoid these areas during early brood-rearing (Kuchel 1977). Reduced reproductive success has been reported in the vicinity of human activity with the greatest disturbance occurring during nesting, incubation and brood rearing (Bengston 1972; Dzubin 1984; Cassirer and Groves 1990).

Similarly, caribou tend to be most sensitive to noise disturbance during the calving period (Davis and Valkenburg 1985; Harrington and Veitch 1992), which is early May on the Port au Port Peninsula. Use of industrial equipment, blasting and human presence also have the potential to cause disturbance to moose with cow-calf pairs which are particularly sensitive. But Sopuck et al. (1979) reported that among ungulates, moose are relatively tolerant of disturbance although they avoid areas of intense activity.

Generally, noise levels under 90 dBA or of a continuous or predictable nature have little environmental effect and lead to habituation in wildlife (Gladwin et al. 1988; Larkin 1994). Loud, unpredictable noises will not likely lead to habituation over time and such sudden noises can be stimulus for flight movements in birds and wildlife.

6.5.2.2 Removal of Habitat

Removal of habitat may affect wildlife species if the removal occurs in the core area of a home range or if the species has a small home range such a red squirrel. Similarly, removal of riparian habitat along a river or waterbody may affect resident beaver or muskrat that tend to be tied to a specific waterbody or group of connected waterbodies.

Fragmentation of habitat is a concern with respect to declining neotropical bird populations (Simberloff 1993). Migrant bird species that nest on or near the ground are most vulnerable to increased predation that occurs when forested areas are broken up into small patches (Perry 1994). In general, when a corridor is cut through a forested area, birds that are considered habitat generalists become more common along the corridor (Hanowski and Niemi 1995; Ferris 1979). Miller et al. (1998) also found a similar pattern when looking at trails. Habitat edge species such as American robin and blue jay were more abundant at sites with trails than on sites without trails. At a landscape scale, the presence of narrow forest-dividing disturbance corridors (as narrow as 8 m) may have a cumulatively measurable effect on the abundance of forest-interior bird species (Rich et al. 1994). But other bird species, particularly mixed habitat and early successional species, tend to increase in numbers (Askins 1994).

Although fragmentation is a concern, it is important to understand the ecology of local ecosystems and landscapes and evaluate disturbances in terms of their “foreignness” within a given system (Freemark 1989). The Project Area is characterized by a naturally fragmented landscape of forest interspersed with bogs and barrens and the species living within this system are adapted to this natural fragmentation. The maximum width of trails (if required) will be 3 m.

6.5.2.3 Accidental Events

Raptors such as bald eagles and osprey and waterfowl may be affected by a fuel or other hazardous material spill in a waterbody, due to their dependence on waterbodies for foraging opportunities and the shoreline for nesting sites. Individual waterfowl are vulnerable to oiling, but a single accidental fuel or other hazardous material spill at an interior location is unlikely to seriously affect populations due to their wide distribution (Lock et al. 1994). Fuel spills or spills of other hazardous materials may also have negative effects on vegetation and species that depend on the vegetation for nesting or foraging.

6.5.3 Residual Environmental Effects Significance Criteria

6.5.3.1 Non-listed Species

A **significant adverse environmental effect** affects a population or portion thereof in such a way as to cause a decline or change in abundance and/or distribution of the population over one or more generations. Natural recruitment may not re-establish the population, or any populations or species dependent upon it, to its original level within several generations (i.e., the integrity of the population would be threatened) or avoidance of the area becomes permanent.

A **non-significant adverse environmental effect** is defined as an adverse effect that does not meet the above criteria.

6.5.3.2 Listed Species

A *significant adverse residual environmental effect* on all species listed in Schedule 1 of SARA or under the Newfoundland and Labrador *Endangered Species Act* as “Extirpated”, “Endangered” or “Threatened” is:

- one that results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA or in contravention of any of the prohibitions stated in Section 16 of the NL *Endangered Species Act*.

6.5.4 Environmental Effects Assessment and Mitigation

6.5.4.1 Disturbance

Noise and human disturbance may cause birds and wildlife to avoid habitat in the vicinity of the activity. Birds and wildlife may be particularly sensitive during the early breeding period in May and June. Activities that may result in disturbance during May and June include surveying, clearing and shot hole drilling. Once shot holes have been placed, the activity in any particular area will cease until the seismic is shot (mid-August to October). Activities after August 15 that may result in disturbance effects include stringing of geophone cable, shooting the seismic and collection of cables and flagging. The level of noise and human disturbance in any one area will be localized and of short duration. Eight recording patches of approximately 8.4 by 2.8 km (onshore dimensions) will be required. Each recording patch will take approximately one week to lay out, shoot and pick up. The shot holes will be approximately 50 m apart along each source line. The sources will be activated or shot in a consecutive manner to create multiple sound waves. The time interval between activating each onshore source point can be as much as 5 to 10 minutes. When the seismic charge is fired, there will be a discernable “thump” that can be felt on the surface but there will be no observable effects to the ground surface. Birds and wildlife in the area will likely have moved away from the vicinity of the seismic charge due to the presence of human activity. Therefore, individual animals will either not be aware of the firing of the seismic charge or they will experience a mild startle effect that will likely have negligible effects on the animal. As noted above, the nature of the seismic activity is such that it is localized and of short duration in any particular area. After the seismic charge has been fired, the hole will be capped below the surface to prevent animals from falling into the hole and the surface area around the hole will be returned to the original contour. There will be no feeding, hunting or harassment of birds or wildlife by Project personnel and any active migratory bird nests that are identified along the seismic lines will be avoided.

6.5.4.2 Habitat Removal

Removal of vegetation will only be required in areas that are forested. Areas of bog, barren, shrub and tuckamore will be traversed and surveyed without any vegetation removal required. In areas where vegetation is removed, the right-of-way will be limited to 3 m and the cutting of standing trees will be avoided wherever possible. Since much of the Port au Port Peninsula is forested with either scrub forest or merchantable timber, it is likely that some cutting of trees will be required. However, the amount of cutting that will be required will be relatively small. Most access will be with ATV or on foot and effort will be made to use existing trails, access roads and seismic lines from previous surveys to minimize cutting. Where cutting must occur, vegetation will be cut at a height of 10 cm to accommodate natural regeneration. Hand cutting with machete will be used wherever possible. Chainsaws will only be used when necessary. There will be no ground disturbance other than that required for the 10 cm diameter hole drilled to accept the small explosive charge.

Because of the presence of calcareous barrens and limestone outcrops, there is a potential for rare plants to be encountered during Project activities in these areas. Areas of high potential for rare plants will be avoided wherever possible (refer to Figure 5.5). A trained botanist will accompany the crew placing the shot lines to provide guidance on placement of the lines in order to avoid sensitive plant areas.

6.5.4.3 Accidental Events

An accidental spill of fuel or other hazardous material during placement of shot holes or firing of charges could have negative effects on vegetation or aquatic wildlife if it enters waterbodies. However, for this Project the only potential source for fuel or other hazardous materials is a leak from vehicles or the drilling equipment. The likelihood of such an event occurring is low and should it occur it would be relatively small and localized. Crews will not fuel portable equipment within 30 m of any waterbody.

6.5.4.4 Listed Species

The Project could have adverse environmental effects on plant species at risk if vehicles travel over areas where these plants are located or drilling of shot holes occurs in this areas. However, in areas with high potential for plant species at risk, a trained botanist will accompany the crew placing the shot lines to provide guidance on placement of the lines.

The Project is not likely to interact with Newfoundland marten as there is no evidence that this species inhabits the Port au Port Peninsula at this time. Similarly, it is unlikely that the Project will interact with either subspecies of peregrine falcon. There are no known nesting sites on the Port au Port Peninsula. The migration periods for peregrine falcon does not coincide with the Project schedule, and therefore Project activities are unlikely to disturb them. Nesting and foraging habitat for red crossbills could be removed if cutting of mature forest is required. However, cutting of mature forest will be kept to a minimum so any adverse effects to habitat for red crossbills on the Port au Peninsula will likely be minor. Short-eared owls are open ground nesters that could be adversely affected by vehicular travel over bogs and barrens in the Project Area, particularly since the Project will occur during the breeding season. However, should a short-eared owl nest or a nest of any other migratory bird be detected, the seismic shooting line will be adjusted to avoid destruction or disturbance of the nest. Therefore, the potential adverse environmental effects on terrestrial species at risk are rated not significant.

6.5.4.5 Summary of Potential Environmental Effects

A summary of the potential environmental effects of seismic activity on the terrestrial environment is provided in Table 6.12.

Table 6.12 Potential Environmental Effects Assessment Summary – Terrestrial Environment

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Noise Disturbance (A)	• Transitory nature of survey • Noise levels low at ground surface	0	2	5	2	R	1
Vessel Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Safety Zone	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a	n/a	n/a	n/a 2	n/a	n/a
Onshore Vegetation Clearing	• Noise disturbance (A) • Loss or alteration of habitat(A)	• Transitory nature of survey • Avoid sensitive habitats • Minimize removal of vegetation	1	2	6	2	R	1
Drilling of Shot Holes	• Noise Disturbance (A)	• Transitory nature of survey	1	2	6	2	R	1
Vehicular/ATV Traffic	• Noise Disturbance (A)	• Transitory nature of survey	0	2	6	2	R	1
Unplanned Events								
Marine Fuel Spills (on surface)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Fuel Spills	• Oiling vegetation	• No on-site fuel storage	1	2	1	2	R	1

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
2 = Evidence of existing adverse effects
3 = High level of existing adverse effects

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.5.5 Cumulative Effects Assessment

Resource use including hunting, commercial forestry and agriculture has been ongoing in the Project Area for many years. Forest harvesting, including pre-commercial thinning, is ongoing. Areas on the Port au Port Peninsula have been developed for agricultural use, which has also changed the character of the environment for birds and wildlife in the area. There has been little other industrial development on the Port au Port Peninsula. Most human activity is focused on the fishery along the coastline.

The relatively small amount of forested area that will be cleared during the seismic survey will have only a minor effect on terrestrial resources and these areas will be allowed to regenerate following the survey. As well, the activity will be localized and transitory in any one area. Cumulative environmental effects resulting from any of the Project activities will not be additive or cumulative because the Project activities are transitory. Considering the current forestry and agricultural activities in the Project Area, the cumulative effects of the Project on the terrestrial environment will be minor and rated not significant.

6.5.6 Monitoring and Follow-up

Survey crews will be accompanied by a biologist.

6.5.7 Summary of Residual Environmental Effects Assessment

Effects associated with noise disturbance and habitat removal are predicted to be minor for vegetation, birds and wildlife in the Project Area. Noise and disturbance effects are predicted to be very localized and likely to affect only animals in the immediate vicinity of the activity. Should animals detect the underground discharge of the seismic shot it may cause a brief startle reaction having no measurable effect on the animals. Therefore, the residual adverse environmental effects, including cumulative effects, of the Project on the terrestrial environment are rated not significant. The significance of planned activities on the terrestrial environment is summarized in Table 6.13.

Table 6.13 Environmental Effects Significance – Terrestrial Environment

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	2	n/a
Vessel Traffic	n/a	n/a	n/a
Safety Zone	n/a	n/a	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	NS	2	n/a
Drilling Shot Holes	NS	2	n/a
Vehicular/ATV Traffic	NS	2	n/a
Unplanned Events			
Marine Fuel Spills (on-surface)	n/a	n/a	n/a
Onshore Fuel Spills	NS	2	n/a
Project Overall	**NS**	**2**	n/a

KEY:
Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).
* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

6.6 Freshwater Environment

Freshwater Environment includes all watercourses and components thereof, as well as all fish species present in those watercourses.

6.6.1 Boundaries

The spatial boundary for Freshwater Environment is that portion of the Port au Port Peninsula contained within the Project Area (see Figure 5.9). Temporal boundaries are the period of proposed activity from May to October 2006, with offshore and onshore seismic activities occurring between mid-August and October.

6.6.2 Potential Interactions and Existing Knowledge

There are few interactions with Freshwater Environment. Charges will not be set within 20 m of a water body, thereby avoiding environmental effects. The onshore seismic shooting associated with this Project will comprise detonation of small (2.5 to 5.0 kg) underground dynamite charges.

Stream crossings will be conducted primarily by foot. There may be a requirement for ATV fording at select locations, but trucks and other vehicles will not ford streams. All relevant permits and approvals will be obtained for this activity.

Stream crossings (i.e. fording) have the potential to disturb silts and fines causing suspended solids in the water column and the siltation of gravel beds, which may be used by salmonids for spawning. Siltation events can smother eggs, newly hatched fry and benthic invertebrates (food sources).

6.6.3 Residual Environmental Effects Significance Criteria

For Freshwater Environment, residual environmental effects significance criteria are defined as follows.

A **significant adverse effect** is defined as one that affects a fish population or their associated habitat in such a way as to cause a decline in abundance or distribution of the population over one or more generations.

A **non-significant adverse effect** is defined as an adverse effect that does not meet the above criteria.

A **positive effect** is defined as one that results in a measurable population increase and/or enhances the quality of habitat for freshwater fish.

6.6.4 Environmental Effects Assessment and Mitigation

6.6.4.1 Seismic Shooting

DFO have published guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998). The guideline specifies that no explosive is to be detonated in or near fisheries habitat that produces an instantaneous pressure change greater than 100 kPa in the swim bladder of a fish. The onshore program will use a 2.5 kg to 5.0 kg dynamite charge that will be fully contained within a shot hole approximately 10 to 30 m deep. As such, no charge will ever be detonated directly in fish habitat. Based on the 2.5 to 5.0 kg dynamite charge to be used during this program, the guideline set back distance is approximately 11 m from the centre of detonation to fish habitat. The guideline setback distance for spawning habitat is approximately 35 m. Pursuant to these guidelines, the charges will not be detonated within 20 m of any water body, and within 35 m of spawning habitat. A field biologist will accompany the crew to determine when the 35-m set-back is required. Therefore, no adverse environmental effects are anticipated from seismic shooting.

Effects of seismic activities on fish are discussed in detail in Section 6.2.

6.6.4.2 Siltation of Waterbodies

Potential exists for the silting of water bodies as a limited number (six) of stream crossings may be required during the drilling of shot holes and placing of recording patches. If fording is required, temporary fording sites will be applied for from the NLDOEC, Water Resources Management Division (WRMD). Selected fording sites will have low-gradient stable banks that require minimal or no clearing of streamside vegetation and have streambeds comprised of bedrock or large rubble substrates. If necessary, approaches will be stabilized using non-erodable material such as brush mats. All crossings will be made at right angles to the stream to limit the potential of silt entering streams. All necessary permits will be acquired from the WRMD.

6.6.4.3 Accidental Events

Accidental events that could potentially affect Freshwater Environment include the introduction of deleterious substances, namely hydrocarbons from an accidental spill or machinery leaks. Activities such as machinery re-fuelling will not take place within 30 m of waterbodies.

Although a fuel spill is unlikely to occur, the environmental effect of a spill on the Freshwater Environment could be significant, depending on the extent and time of year.

6.6.4.4 Summary of Potential Environmental Effects

A summary of the potential environmental effects of seismic activity on Freshwater Environment is provided in Table 6.14.

6.6.4.5 Mitigation

Potential mitigations to be applied include:

- buffer zones will be established around all water bodies ensuring that no charge detonations occur within 20 m of fish habitat, or within 35 m of spawning habitat;
- all water bodies will be viewed as being fish habitat;
- permits will be obtained from WRMD and all permitting conditions will be complied with;
- fording activities, if required, will be conducted according to conditions of Fording Permits and DFO recommended procedures outlined on DFO fact sheets (crossings will be made at right angles to the stream, crossings will be made where the stream bed consists of bedrock or large rubble substrate, approaches will have a low slope and will be stabilized by brush mats);
- cutting of streamside vegetation will be kept to a minimum;
- fuel will not be stored onsite;

- machinery refuelling will not take place within 30 m of a waterbody; and,
- any equipment leaks will be repaired immediately.

Table 6.14 Potential Environmental Effects Assessment Summary – Freshwater Environment

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Impacts on fish health (A)	• 20 m-buffer zone	0	1	5	2	R	2
Vessel Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Safety Zone	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Vegetation Clearing	• Siltation of fish habitat (A)	• Minimize cutting near stream banks	0	1	5	2	R	2
Drilling of Shot Holes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular/ATV Traffic	• Siltation of fish habitat (A)	• Minimize crossings • Stabilize approaches • Cross at right angles to stream	0	2	6	2	R	2
Unplanned Events								
Marine Fuel Spills (on surface)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Fuel Spills	• Fish habitat quality	• No on-site fuel storage • No fuelling within 30 m of a waterbody	1	1	1	1	R	2

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
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Geographic Extent
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4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.6.5 Cumulative Effects Assessment

The potential effects of the Project on Freshwater Environment include the potential for increased silting of water bodies during stream crossings and possible effects of seismic shooting on freshwater fish. Cumulative environmental effects resulting from any of the Project activities will not be additive or cumulative, because the Project activities are transitory.

Currently, there have been no licenses issued for other oil and gas exploration within the Project Area and there are no known proposals. Therefore, there will be no temporal overlaps with the proposed Project and the cumulative effects of the Project, in combination with other projects and activities, is rated not significant.

6.6.6 Monitoring and Follow-up

Follow up monitoring is not recommended.

6.6.7 Summary of Residual Environmental Effects Assessment

The significance of residual environmental effects on Freshwater Environment is summarized in Table 6.15.

Table 6.15 Environmental Effects Significance – Freshwater Environment

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	3	n/a
Vessel Traffic	n/a	n/a	n/a
Safety Zone	n/a	n/a	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	NS	3	n/a
Drilling Shot Holes	n/a	n/a	n/a
Vehicular/ATV Traffic	NS	3	n/a
Unplanned Events			
Marine Fuel Spills (on-surface)	n/a	n/a	n/a
Onshore Fuel Spills	S	2	n/a
Project Overall	**NS**	**3**	**n/a**

KEY:

Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

6.7 Land Use

Land Use is considered a VEC due to the fact that Project activities have the potential to interact with other land uses and users in the area.

6.7.1 Boundaries

The spatial boundaries for the assessment of Land Use include the terrestrial portion of the Project Area indicated on Figure 5.5. Temporal boundaries are defined by the Project schedule, covering May through October 2006, with offshore and onshore seismic activities occurring between mid-August and October.

6.7.2 Potential interactions and Existing knowledge

Potential interactions, issues and concerns related to Land Use and the Project include:

- project-related noise disturbance affecting land use activities;
- project-related removal and/or disturbance of vegetation on land use activities;
- damage of historic resources due to subsurface seismic shooting; and,
- accidental spills of fuel or other hazardous materials affecting land use activities.

6.7.2.1 Noise Disturbance

Noise related to clearing and drilling of shot holes and the seismic shooting could cause disturbance in areas where other land use activities are occurring. Specifically, Project-related noise in agricultural areas could disturb livestock or residents in the vicinity of communities.

For the most part, the Project Area is wilderness with virtually no human-made noise. Background noise levels are expected to be in the range of 20 to 30 dBA (Kinsler et al. 1982) although higher noise levels may be expected due to natural causes such as running water, wind in deciduous trees and other weather events. Beside a medium stream with small rapids, noise levels may approach 50 dBA, which is roughly the level of conversation. Noise levels decrease with distance (USDOT 1995). For example, point sources decrease by approximately 6 dBA per doubling of distance. Foliage and snow cover will tend to increase the attenuation rate.

6.7.2.2 Removal/Disturbance of Vegetation

Removal or disturbance of vegetation could negatively affect forestry activities. In areas where pre-commercial thinning has occurred or plantations have been established, removal of these trees would represent a loss of investment by the forest industry.

6.7.2.3 Accidental Events

A spill of fuel or other hazardous material spill in a waterbody could affect recreational activities such as fishing or waterfowl hunting. Fuel spills or spills of other hazardous materials may also have negative effects if they occurred in an agricultural area, potentially affecting vegetation or exposing livestock to contaminants. Similarly, a spill of fuel or other hazardous material in a berry picking area could have a negative effect on that activity.

6.7.3 Residual Environmental Effects Significance Criteria

A **significant adverse environmental effect** is one where the proposed use of land for the Project will create a change or disruption that restricts or degrades present land uses such that the activities cannot continue to be undertaken at current levels.

A **non-significant adverse environmental effect** is defined as an adverse effect that does not meet the above criteria.

6.7.4 Environmental Effects Assessment and Mitigations

6.7.4.1 Disturbance

Noise related to clearing and drilling of shot holes and the seismic shooting could cause disturbance in areas where other land use activities are occurring. Activities that may result in disturbance during May and June include surveying, clearing and shot hole drilling. Once shot holes have been placed, the activity in any particular area will cease until the seismic is shot (mid-August to October). Activities after August 15 that may result in disturbance effects include stringing of geophone cable, shooting the seismic and collection of cables and flagging. The level of noise and human disturbance in any one area will be localized and of short duration. Eight recording patches of approximately 8.4 by 2.8 km (onshore dimensions) will be required. Each recording patch will take approximately one week to lay out, shoot and pick up. The shot holes will be approximately 50 m apart along each source line. The sources will be activated or shot in a consecutive manner to create multiple sound waves. The time interval between activating each onshore source point can be as much as 5 to 10 minutes. When the seismic charge is fired, there will be a discernable “thump” that can be felt on the surface but there will be no observable effects to the ground surface. Vegetation removal, where required, will be mostly by hand (using machetes) and chainsaws will only be required to cut larger trees. The noise from chainsaws will also be audible in the surrounding area. A 20-m buffer will be maintained from landscape features such as streams and waterbodies. No seismic surveying will be conducted within municipal boundaries or residential infilling limits. A set-back distance of 180 m from any residence or concrete-foundation structure will be maintained. After the seismic charge has been fired, the hole will be capped below the surface to prevent accidental entry and the surface area around the hole will be returned to the original contour.

6.7.4.2 Removal/Disturbance of Vegetation

Removal of vegetation will only be required in areas that are forested. Areas of bog, barren, shrub and tuckamore will be traversed and surveyed without requiring any vegetation removal. In areas where vegetation is removed, the right-of-way will be limited to 3 m and the cutting of standing trees will be avoided wherever possible. There will be no cutting of trees within pre-commercially thinned areas or plantations. Most access will be on foot or ATV, which will minimize the amount of cutting required. As well, effort will be made to use existing trails, access roads and seismic lines from previous surveys. Where cutting must occur, vegetation will be cut at a height of 10 cm to accommodate natural regeneration and hand cutting with machete will be used wherever possible. Chainsaws will only be used when necessary. There will be no ground disturbance other than that required for the 10 cm diameter hole drilled to accept the small explosive charge.

6.7.4.3 Accidental Events

While subsurface seismic shooting in close proximity to drilled water wells could result in an accident having a negative effect on water supply or quality, the design of the seismic shooting grid will avoid all areas within municipal boundaries and community infilling areas where most, if not all, water wells are located. Therefore, it is not likely that a seismic shot will interfere with any water wells on the Peninsula. Similarly, the only known historic resource site is within the community of Mainland, which the seismic survey will avoid. If required, mitigation for historic resources will be developed in consultation with the PAO. A 20-m buffer will be maintained from landscape features such as streams and waterbodies.

An accidental spill of fuel or other hazardous material during placement of shot holes or firing of charges could have negative effects on land use activities. Since fuel will not be stored on site, the only potential source for fuel or other hazardous materials is a leak from vehicles. The likelihood of such an event occurring is low and should it occur it would be relatively small and localized. Access for the seismic crew over agricultural lands and municipal areas will be minimized to avoid the chance for an accidental event to negatively affect these land uses. Portable tools will not be fuelled within 30 m of a waterbody.

6.7.4.4 Summary of Potential Environmental Effects

A summary of the potential environmental effects of seismic activity on Land Use is provided in Table 6.16.

Table 6.16 Potential Environmental Effects Assessment Summary – Land Use

Project Components/ Activities	Potential Interactions/ Environmental Effects	Mitigation	Potential Environmental Effects Summary: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Seismic Shooting	• Noise disturbance (A)	• Transitory nature of survey • Noise levels low at ground surface • Avoidance of communities	0	2	5	2	R	1
Vessel Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Safety Zone	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Vegetation Clearing	• Noise disturbance (A) • Disturbance or removal of vegetation (A)	• Transitory nature of survey • Minimize removal of vegetation • Avoidance of pre-commercially thinned areas, plantations	1	2	6	2	R	1
Drilling of Shot Holes	• Noise disturbance (A)	• Transitory nature of survey • Noise levels low at ground surface • Avoidance of communities	1	2	5	2	R	1
Vehicular/ATV Traffic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Unplanned Events								
Marine Fuel Spills (on surface)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Onshore Fuel Spills	• Oiling of waterbodies or exposure of livestock	• No onsite fuel storage • No fuelling within 30 m of a waterbody	1	2	1	2	R	1

KEY:

Magnitude
0 = Negligible (essentially no effect)
1 = Low
2 = Medium
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic Context
1 = Relatively pristine area not adversely affects by human activity
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Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.7.5 Cumulative Environmental Effects Assessment

As much of the Port au Port Peninsula is uninhabited by humans, there is limited land use activity. Resource use including hunting, commercial forestry and agriculture has been ongoing in the Project Area for many years. Forest harvesting, including pre-commercial thinning is ongoing. Other areas on the Port au Port Peninsula have been developed for agricultural use. There has been little other industrial development on the Port au Port Peninsula, with most human activity focused on the fishery along the coastline.

Seismic activity will be localized and transitory in any one area. Cumulative environmental effects resulting from any of the Project activities will not be additive or cumulative because the Project activities are transitory.

Considering the current land use activities in the Project Area and the proposed mitigations, the cumulative effects of the Project on Land Use are rated not significant.

6.7.6 Monitoring and Follow-up

In accordance with the criteria outlined in Section 4.3.6, follow-up monitoring is not required for Land Use.

6.7.7 Summary of Residual Environmental Effects Assessment

Effects associated with noise disturbance and vegetation removal are predicted to be minor for Land Use in the Project Area. Noise and disturbance effects are predicted to be very localized and likely to only be detectable in the immediate vicinity of the activity. As well, land use activities are limited in most of the Project Area. Project mitigations include buffer zones around waterbodies, minimized interaction with communities, plantation and pre-commercial thinning areas, and agricultural areas. Therefore, the residual adverse environmental effects, including cumulative effects, of the Project on Land Use are rated not significant. The significance of planned activities on Land Use is summarized in Table 6.17.

Table 6.17 Environmental Effects Significance – Land Use

Project Components/Activities	Significance	Level of Confidence	Likelihood*
Planned Activities			
Seismic Shooting	NS	3	n/a
Vessel Traffic	n/a	n/a	n/a
Safety Zone	n/a	n/a	n/a
Routine Discharges (deck drainage)	n/a	n/a	n/a
Vessel Emissions (exhaust)	n/a	n/a	n/a
Onshore Vegetation Clearing	NS	3	n/a
Drilling Shot Holes	NS	3	n/a
Vehicular/ATV Traffic	n/a	n/a	n/a
Unplanned Events			
Damage to Historic Resources	NS	2	n/a
Marine Fuel Spills	n/a	n/a	n/a
Onshore Fuel Spills	NS	2	n/a
Project Overall	**NS**	**2**	n/a

KEY:
Significance: S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).
* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

7.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

The effects of the environment on the program have been considered during the planning and environmental assessment stages of program development. Successful seismic exploration programs have been executed in offshore Newfoundland waters over more than two decades. A seismic exploration program was conducted onshore in the vicinity of the Project Area in the mid-1990s by Hunt Oil. The potential effects of the environment are summarized below.

7.1 Meteorology and Oceanography

Extreme conditions may affect schedule and program operations. The survey vessel will only operate during daylight hours and will return to port each evening. Tekoil and the contractor will decide whether to conduct the day's work in consideration of the weather forecast. Tekoil will not proceed with operations during inclement weather conditions.

7.2 Sea Ice and Icebergs

Icebergs off Newfoundland and Labrador typically do not extend as far south as the Project Area. The seismic surveys will be conducted during the ice-free season and there will be little to no likelihood that icebergs or sea ice will be encountered during the program.

8.0 ENVIRONMENTAL MANAGEMENT

8.1 Offshore Seismic Survey

Mitigation measures to be implemented to reduce environmental effects that may result from activities associated with the offshore component of the proposed Project include:

- scheduling the survey (to the extent possible) to avoid sensitive fish life stages (i.e., spawning, rearing and migration times), especially for SARA-listed species;
- scheduling the survey to avoid (where possible) heavily fished areas;
- on-board Environmental Observer for marine mammals, seabirds and sea turtles;
- on-board FLO;
- implementing ramp-up procedures as follows:
  - a visual inspection (during daylight hours) of the area 30 minutes prior to soft start commencement for the presence of marine mammals and/or sea turtles,
  - allowing 20 minutes to pass before seismic activities begin if any marine mammals and/or sea turtles are sighted within 500 to 1,000 m of the centre of the air sleeve array,
  - firing a single air sleeve (preferably the smallest in terms of volume and energy output) to begin ramp-up,
  - gradually activating additional air sleeves in ascending order until desired operating level is reached over a 20- to 40-minute period. This ramping up will give marine birds, motile fish, marine mammals and sea turtles an opportunity to move away from the immediate zone of influence before decibel levels reach maximum volume,
  - shutting down all air sleeves during ramp up if any marine mammals or sea turtles are sighted within 500 to 1,000 m of the array,
  - recommencing ramp-up procedures if air sleeves are shut down for any reason, and
- ramp up procedures will still be implemented during periods of low visibility.
- establishing a land-based SPOC for coordinating communications between the survey vessel and fishers;
- ensuring a FLO is on duty onboard the source vessel during the survey to further facilitate communication between the source vessel and fishing vessels. On-board visibility conditions will be recorded by the FLO;
- conducting routine checks for stranded birds and implementation of appropriate procedures for release (a Live Seabird Salvage permit may be required);
- planning the seismic survey to coordinate activities with the fishing industry and with DFO to reduce potential conflict with commercial fishing activities during peak fishing times and to reduce effects on DFO surveys;
- fixed gear and aquaculture facilities will be avoided (compensation will be negotiated if gear is damaged); and,
- operation of vessel only in daylight hours and suitable weather conditions, with the vessel returning to port each evening.

8.2 Onshore Seismic Survey

Mitigation measures to be implemented to reduce environmental effects that may result from activities associated with the onshore component of the proposed Project include:

- in-stream activity will not occur. In most cases, streams will be crossed by foot only. If a crossing by ATV is required, a Fording Permit will be obtained. Streams will not be crossed by trucks;
- if an active migratory bird nest is identified, it will not be disturbed;
- rare plant surveys will be conducted in areas identified as having high potential, in consultation with the Inland Fish and Wildlife Division;
- vehicular travel will avoid sensitive areas such as wetlands and bogs;
- vehicles will yield to wildlife;
- no hunting, feeding or harassment of wildlife will be allowed;
- the requirement for an historic resources assessment/survey will be determined in consultation with the PAO;
- no onsite fuel storage;
- no fuelling of portable equipment within 30 m of a stream or waterbody;
- dynamite charges will not be located within 20 m of a waterbody and within 35 m of fish spawning habitat; and,
- a setback distance of 180 m from residential developments will be implemented.

9.0 ENVIRONMENTAL MONITORING

The seismic program as proposed by Tekoil (onshore and in water) was assessed in accordance with CEAA. The likely adverse residual environmental effects (i.e., those effects remaining after mitigation is applied) are rated not significant. Tekoil will implement measures to reduce environmental effects that may result from activities associated with the proposed seismic program. These measures include:

- Environmental Observer for marine mammals, seabirds and sea turtles will be on-board during the marine portion of the program;
- FLO will be on-board during the marine portion of the program;
- ramp-up procedures will be implemented for the marine portion of the program; and
- a land-based SPOC for coordinating communications between the survey vessel and fishers will be established for the marine portion of the program.

10.0 PERMITS, APPROVALS AND AUTHORIZATIONS

Permits/approvals/authorizations required prior to commencement of the Project are provided in Table 10.1.

Table 10.1 Permits/Approvals/Authorizations that May be Required for Port au Port Seismic Program

Potential Authorization Required	Applicable Legislation	Relevant Activity	Responsible Agency
Federal Permits/Approvals/Authorizations			
Geophysical/Geological/Geotechnical / Environmental Program Authorization	Accord Acts and *Geophysical, Geological, Environmental And Geotechnical Program Guidelines*	Seismic Program	C-NLOPB
"Request for Project Review" Application (for fording of watercourses after September 15)	*Fisheries Act*	Fording Activities	DFO
License for a Temporary Magazine	*Explosives Act* and *Explosives Regulations*	Blasting Materials Storage	Explosives Division, Energy, Mines and Resources Canada
Permit to Transport Explosives	*Explosives Act* and *Explosives Regulations*	Blasting Materials Transportation	Explosives Division, Energy, Mines and Resources Canada
Live Bird Salvage Permit (may be required)		Offshore Seismic Activities	Canadian Wildlife Service
Provincial Permits/Approvals/Authorizations			
Authorization to Proceed to Permitting (environmental assessment release)	*Environmental Protection Act – Environmental Assessment Regulations*	Proceed to Permitting	Newfoundland and Labrador Minister of Environment and Conservation
Exploration License		Onshore Exploration Activities	Newfoundland and Labrador Petroleum Resource Development Division
Environmental Permit for Fording a Watercourse	*Water Resources Act*	Fording Activities*	NLDOEC-WRMD
Environmental Permit for ATV Bridges	*Water Resources Act*	Stream Crossings	NLDOEC-WRMD
Commercial Cutting Permit	*Forestry Act* and *Cutting of Timber Regulations*	Clearing Shot Lines	Forestry Division, NLDNR
Blasters Safety Certificate		Blasting	Newfoundland and Labrador Department of Industrial Training Section
		Storage of Blasting Materials	
Permit to Work Within 15 m of a Body of Water		Onshore Exploration Activities	NLDOEC-WRMD
* If required, will be conducted according to DFO recommended procedures outlined on DFO fact sheets.			

11.0 FUNDING

The Project is not dependent upon government funding. Tekoil will fund the Project.

12.0 SUMMARY AND CONCLUSIONS

In accordance with the requirements of Sections 16 (1) and (2) of CEAA and the Newfoundland and Labrador *Environmental Assessment Regulations*, this Screening/Registration includes:

- a description of the proposed Project including the purpose and need, the proposed activities and the potential malfunctions or accidental events that may occur in connection with the Project;
- a summary of consultation mechanisms and issues raised during consultation (i.e., issues scoping) as well as a description of the methodological approach to the environmental assessment;
- an assessment of the environmental effects of the proposed Project for each of the VECs, including cumulative environmental effects and the significance of the effects;
- an assessment of the effects of the environment on the Project; and
- recommendations for measures to mitigate any significant adverse environmental effects.

Based on the results of the environmental assessment, it is concluded that the Project is not likely to cause significant residual adverse environmental effects, after consideration of mitigation measures that are technically and economically feasible to apply.

13.0 PROPONENT'S SIGN-OFF

Tekoil & Gas Corporation has reviewed and accepts the findings and commitments of this report.

Mr. Mark Western

Chairman and CEO

Tekoil & Gas Corporation

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APPENDIX A

Project Description Information
Provided to Consultation Stakeholders

PORT AU PORT PENINSULA, WEST NEWFOUNDLAND

INDUSTRY 3D SEISMIC SURVEY

PROJECT DESCRIPTION

OCTOBER 2005

Prepared for:

TEKOIL & GAS CORPORATION

Prepared by:

FEKETE ASSOCIATES INC.

Fekete Associates Inc.

Reservoir Engineering & Geology - Oil & Gas Property Evaluation - Well Test Interpretation - Software Development

October 28, 2005

Canada-Newfoundland and Labrador Offshore Petroleum Board
5th Floor TD Place
140 Water Street
St. John's, Newfoundland and Labrador
A1C 6H6

Attention: Mr. Dave Hawkins, Exploration Manager

Dear Sir:

Re: Port au Port Peninsula, West Newfoundland
Industry 3D Seismic Survey
Project Description

Fekete Associates Inc. is submitting the attached project description for an industry 3D Seismic Survey on behalf of Tekoil & Gas Corporation.

Please contact me at (403) 213-4235 (direct) with any questions or concerns.

Yours truly,

FEKETE ASSOCIATES INC.

ORIGNAL SIGNED BY

Ray Mireault, P. Eng.
Specialist, Reserves Development

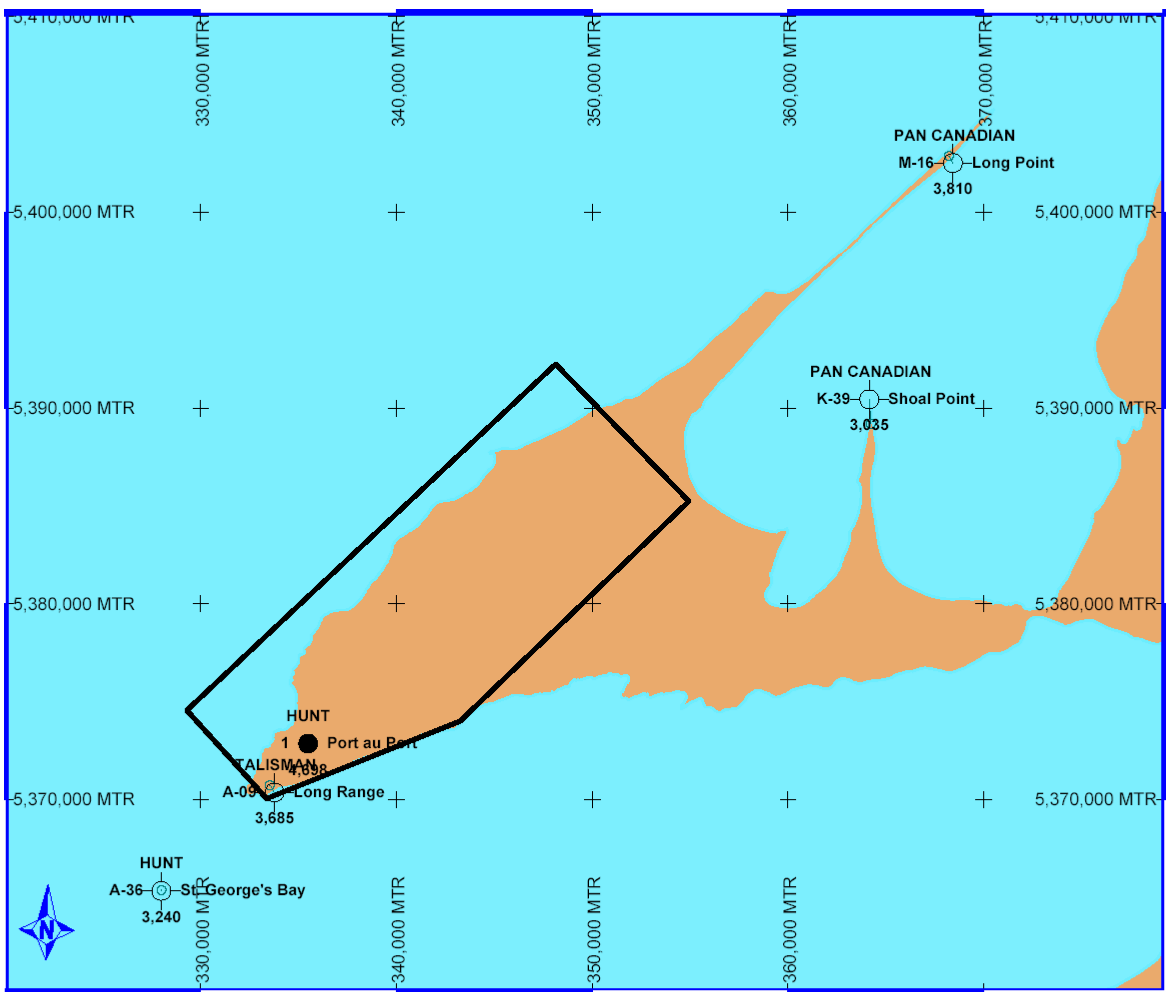
RAM/
TEK04_100
cc: M. Western, Tekoil & Gas Corporation
L. Stead, Nfld. Dept. of Natural Resources

2000, 540 - 5th Avenue S.W., Calgary, Alberta, Canada T2P 0M2
Tel: (403) 213-4200 Fax: (403) 213-4298 E-Mail: fast@fekete.com

INTRODUCTION

Houston based Tekoil & Gas Corporation, is a technology driven, oil and gas exploration and production company that utilizes advanced production technologies. The company is focused on the development, acquisition, stimulation, rehabilitation, and asset improvement of oil and gas fields throughout the North American Continent.

Tekoil wishes to undertake an industry 3D seismic survey over much of the Port au Port Peninsula, Western Newfoundland. This industry survey is intended to map hydrothermal porosity development through the Ordovician carbonate platform reservoir system. Past attempts to explore and develop Ordovician age reservoirs have been frustrated by a complex geological history and non-uniform porosity development. Mapping of the existing 2D seismic data indicates that a 3D survey of the size proposed is necessary to properly image the structure tested by the Port au Port #1 well.



PROGRAM DESCRIPTION

The proposed program covers an area of approximately 244 km2 that includes much of the Port au Port peninsula, as well as the onshore to offshore transition area along the northwestern shore, to a maximum water depth of 50 m (above and attachment).

The onshore portion of the survey will be acquired using a conventional dynamite shot hole source effort and conventional surface geophone detectors. Geophones will be spaced at 60 m intervals in a north/south and east/west alignment forming the necessary regular spaced receiver pattern necessary for three dimensional seismic surveys. In order to extend the onshore 3D seismic coverage in a continuous fashion across the coastline and into the near offshore environment (the transition zone), submersible geophones positioned within specially designed ocean bottom cables will be used to extend the recording array from onshore to offshore to a maximum water depth of 50 m, which is the approximate edge of the survey area.

The recording array will be acquired in “patches” beginning on the northeastern edge of the survey and rolling along from east to west across the peninsula in approximately 480m wide sections. As all shot points within a particular patch have been recorded, the patch recording array will be disassembled and moved/re-assembled to the adjacent 480 m width. Ideally, recording will start on the northeastern boundary of the 3D survey area and will progress sequentially to the other end. However, environmental or other considerations may necessitate some deviation from this ideal sequence.

Onshore shot holes will be drilled at 180 m intervals to a depth of up to 30 m and loaded with a small (0.4 to 0.9 kg) dynamite charge. Individual charges will be set off one at a time from east to west within the active recording patch. The shooting sequence will be extended offshore using a shallow draft marine source vessel equipped with a small airgun and accurately located using GPS to position and deliver up to 100 bar meters of source energy. After the last (westernmost) shot has been fired along an east-west line, the easternmost shot point of the next array would then initiate the next sequence of firings.

Both the onshore and offshore geophone receiver arrays will tie into an onshore recording truck that is usually positioned within the active recording patch. The recording station is a mobile unit, usually mounted on a conventional 3 ton truck.

Setback distances from residential development, as well as from environmentally sensitive areas and/or other considerations may mean that the program achieves less than 100% coverage over the Port au Port Peninsula. As the program can accommodate some gaps in coverage, the impact on data quality can be assessed once the size and location of restricted areas are made known to the applicant.

PROJECT COMPONENTS

This 3D onshore and offshore transitional survey will use a combination of conventional onshore equipment and offshore transitional geophones rated to 50 m water depth.

Energy Source: 0.4 to 0.9 kg dynamite charges onshore
1200 inch3/minute gunboat capable of up to 100 bar meters energy offshore

Detector Parameters: .075% distortion with 240 hz spurious frequency response.
Damping is not heat sensitive. Offshore geophones lie on seafloor.

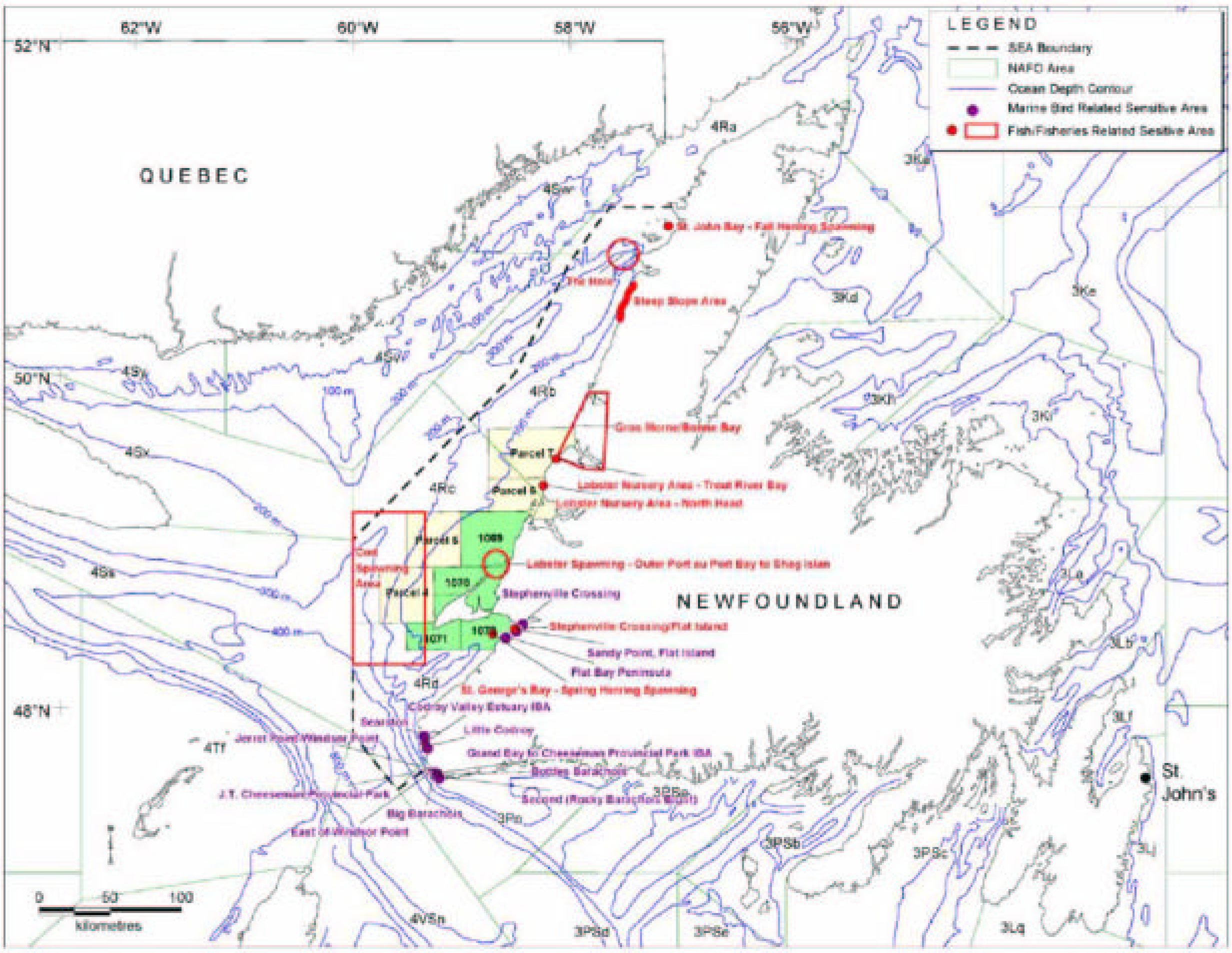
Fold: Nominal 48 fold.

Tekoil has retained dB.LLC Petroleum Advisors for the survey program design and data interpretation. Contractors for data acquisition and data processing have yet to be determined.

The number of persons employed and goods and services required for the survey will be determined once contracts are let. First priority will be given to qualified local residents, goods and services where such are competitive in terms of price, quality and delivery.

ENVIRONMENTAL IMPACT

The Western Newfoundland and Labrador Strategic Environmental Assessment draft dated September 2, 2005 indicates that the survey's offshore transition area does not encompass any potentially sensitive offshore areas. The draft was prepared for the CNLOPB by LGL Environmental Research Associates Limited.



Tekoil will undertake further environmental assessments as considered necessary under the CNLOPB scoping document for the project, to further minimize the survey's impact on the environment.

REGULATORY CONTEXT

Approval for the survey is being sought concurrently from:

- The Newfoundland and Labrador Dept. of Natural Resources for the onshore portion.
- The Canada Newfoundland and Labrador Offshore Petroleum Board (CNLOPB) for the offshore component.

An Exploration Licence Application dated October 14, 2005 has been submitted to the Dept. of Natural Resources for approval of the onshore component of the survey. Questions concerning jurisdictional coordination should be directed to:

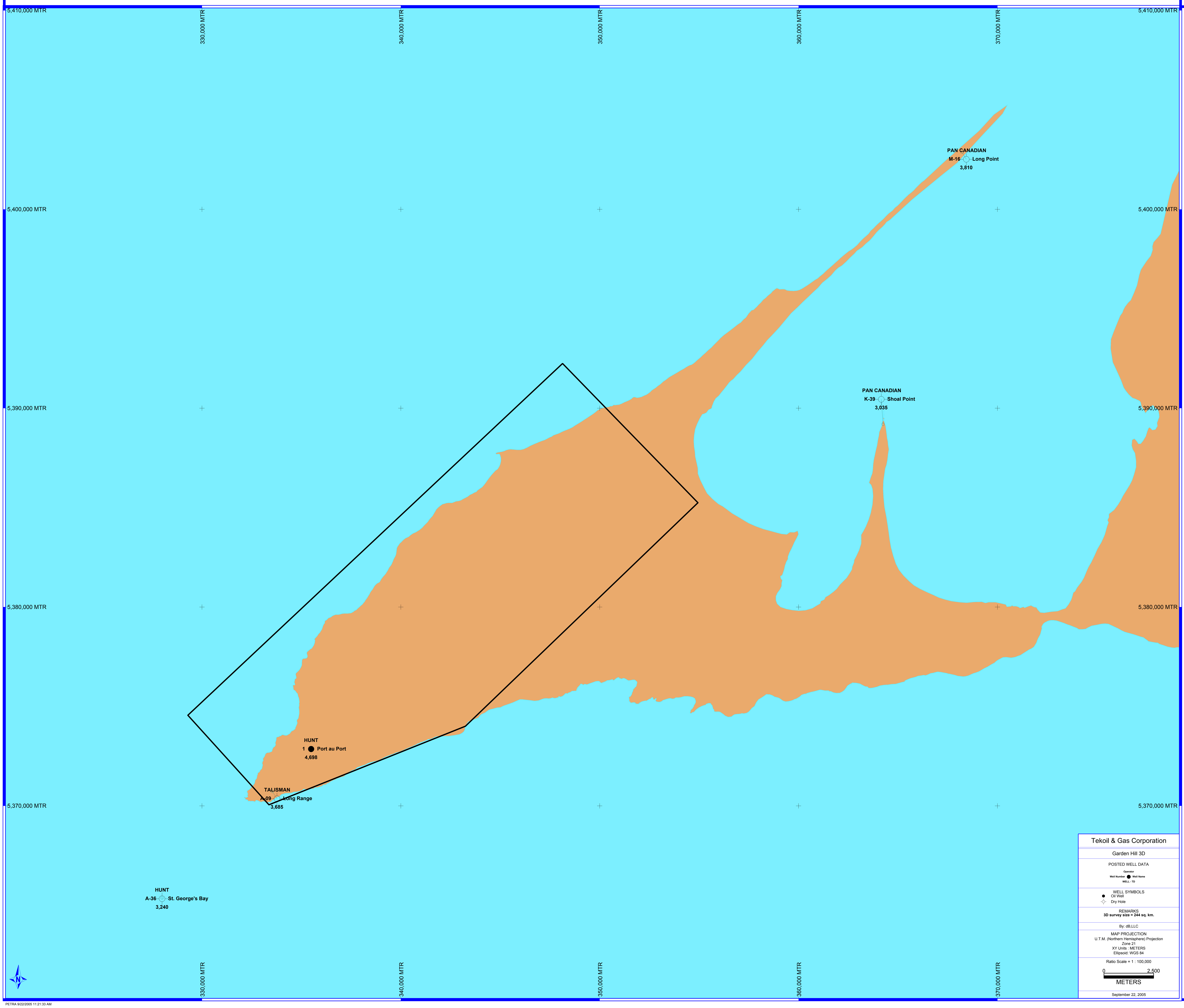
Leona C. Stead
Petroleum Geophysics Technologist
Dept. of Natural Resources
Government of Newfoundland and Labrador
50 Elizabeth Ave.
St. John's, NL
A1B 4J6
(709) 729-6877

TIMING

A period from May to October 2006 has been set as an initial estimate for the survey. The actual timing will be jointly determined by conditions of approval set out by:

- The Newfoundland and Labrador Dept. of Natural Resources for the onshore portion.
- The Canada Newfoundland and Labrador Offshore Petroleum Board (CNLOPB) for the offshore component.

Preparation of shot holes for the onshore component of the shoot could commence as soon as the winter snows have cleared sufficiently in spring 2006. Conventional rubber tired water well drilling rigs would be locally contracted to drill the shot holes. Ideally, about ½ of the shot holes would be loaded and capped to prepare an adequate area for the arrival of the recording crew and equipment. Offshore work could not commence until after the winter ice has cleared, at the earliest.


5,410,000 MTR
330,000 MTR
340,000 MTR
350,000 MTR
360,000 MTR
370,000 MTR
5,400,000 MTR
5,390,000 MTR
5,380,000 MTR
5,370,000 MTR
PAN CANADIAN
M-16 Long Point
3,810
PAN CANADIAN
K-39 Shoal Point
3,035
HUNT
1 Port au Port
4,698
TALISMAN
A-09 Long Range
3,685
HUNT
A-36 St. George's Bay
3,240
N
Tekoil & Gas Corporation
Garden Hill 3D
POSTED WELL DATA
Operator
Well Number Well Name
WELL - TD
WELL SYMBOLS
Oil Well
Dry Hole
REMARKS
3D survey size = 244 sq. km.
By: dB,LLC
MAP PROJECTION
U.T.M. (Northern Hemisphere) Projection
Zone 21
XY Units : METERS
Ellipsoid: WGS 84
Ratio Scale = 1 : 100,000
0
2,500
METERS
September 22, 2005
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APPENDIX B

Canadian Commercial Fisheries Catches
and Values for Northwest Atlantic Fisheries
Organization Unit Area 4Rc, 2002 to 2003

Catches and Revenues for Fisheries in 4Rc from 2000 to 2003

Unit Area 4Rc	**Live Weight (kg)**					**Landed Value ($)**				
Species	**2000**	**2001**	**2002**	**2003**	**Total**	**2000**	**2001**	**2002**	**2003**	**Total**
LOBSTER	212,409	288,987	272,264	422,932	1,196,592	2,263,456	3,538,282	3,152,641	na	8,954,379
CRAB, QUEEN-SNOW	422,221	608,860	860,474	832,270	2,723,825	2,001,277	2,349,009	3,319,752	na	7,670,038
COD	764,638	997,162	794,043	20,596	2,576,439	1,193,937	1,402,581	992,355	na	3,588,873
HERRING	6,469,096	6,446,308	7,660,120	2,593,393	23,168,917	998,935	1,001,879	1,351,014	na	3,351,828
MACKEREL	576,222	3,400,927	2,778,874	9,943,087	16,699,110	190,468	601,669	1,038,944	na	1,831,081
CAPELIN	4,773,444	604,590	2,331,507	3,449,851	11,159,392	1,420,625	97,301	308,406	na	1,826,332
ATLANTIC HALIBUT	18,132	24,681	22,041	18,681	83,535	104,859	126,151	125,331	na	356,341
SHRIMP, PANDALUS BOREALIS		58,757	74,927	15,084	148,768		70,683	89,145	na	159,827
LUMPFISH ROE	36,841	2,978	36	522	40,377	81,231	13,936	230	na	95,397
TURBOT-GREENLAND FLOUNDER	21,040	30,089	1,951	24,203	77,283	34,042	27,382	3,445	na	64,870
REDFISH	27,030	14,000	65,010	9,037	115,077	14,805	10,334	35,849	na	60,987
AMERICAN PLAICE	24,401	10,816	7,300	13,342	55,859	18,108	9,099	5,882	na	33,089
CRAB, ROCK		14,874	20,904	23,666	59,444		13,115	15,375	na	28,490
SKATE	49,003	15,236	10,011	32,570	106,820	12,456	3,746	2,559	na	18,762
CATFISH	9,091	15,119	21,757	318	46,285	2,596	6,193	8,695	na	17,483
WINTER FLOUNDER	9,875	3,024	2,322	482	15,703	5,940	1,983	1,451	na	9,374
SCALLOPS, ICELANDIC	1,022		3,379		4,401	1,838		5,670	na	7,508
WHITE HAKE	2,441	1,431	1,166	93	5,131	1,259	901	714	na	2,874
SEA URCHINS	415	267			682	867	530		na	1,398
GREYSOLE-WITCH	0	1,452	31	21	1,504	0	1,282	0	na	1,282
SHARK, MACKEREL, MAKO	336	327	17		680	338	380	19	na	737
CUSK			439		439			403	na	403
MONKFISH	476	30	58	20	584	269	19	88	na	377
CRAB, SPIDER-TOAD		380		2,855	3,235		335		na	335
SHARK, UNSPECIFIED	160	21			181	104	20		na	124
HADDOCK			27		27			31	na	31
SHARK, BLUE		20			20		18		na	18
POLLOCK	39				39	10			na	10
GROUNDFISH, UNSPECIFIED	505				505	6			na	6
ARGENTINE		12	84		96		4	1	na	5
MAKO SHARK, MACKEREL				40	40				na	
EELS				10,212	10,212				na	
Total	**13,418,837**	**12,540,348**	**14,928,742**	**17,413,275**	**58,301,202**	**8,347,425**	**9,276,833**	**10,457,999**		**28,082,257**

Note: Seal products not reported under Live Weight because seal products are counted, rather than weighed; 2003 data are preliminary and cash landings are not available.

Source: DFO catch statistics (DFO 2004g).

APPENDIX C

Seabird Monitoring Protocol

Framework for Conducting Seabird Observations on Seismic Vessels

(adapted from Komdeur et al. 1992)

Following is an outline of a protocol for counting birds from a vessel. The method to be used is a combination of scan with band transect. This method comprises scanning for and recording all birds seen ahead of the vessel with a 90 degree or 180 degree field of observation. Additionally, birds that occur within an approximate 300-m wide transect are noted as being “in transect”. This additional piece of information attempts to quantify the number of birds seen per square kilometre surveyed. Only birds that are actually sitting on the water within the transect are recorded as being “in transect”. Following are considerations related to the survey:

- if possible, select an observation point that is high on the vessel with a clear view forward, to the sides and overhead;
- scan ahead of the vessel using the naked eye; use binoculars to identify species;
- binocular scanning should be conducted at least one per minute to pick species that may be flying at a distance away from the vessel (i.e., those not necessarily visible to the naked eye);
- use only one observer to count birds;
- each bird should only be recorded once and birds associated with the vessel (i.e., tend to hang around and follow the vessel) should be ignored or recorded separately from birds picked up in the scan;
- observations should be divided into 10 minute intervals and start time should be recorded at the beginning of each new interval;
- the position of the vessel at the start of the observation period and at the end of the observation period should be recorded;
- if no birds are observed in the 10 minute period, record “zero birds observed”;
- record weather conditions, particularly visibility and sea state;
- information to be recorded about each bird:
  - number of individuals present (precise count where possible, estimate if required),
  - “in transect” or not “in transect”,
  - species or taxon (do not guess, if unsure, indicate “gull” or “alcid”),
  - behaviour (i.e., flying, sitting on water),
  - estimated distance from vessel,
  - estimate of birds flight direction, and
  - notes on feeding, associations between individuals, etc.; and
- any evidence of oiling on a bird(s) should also be recorded.