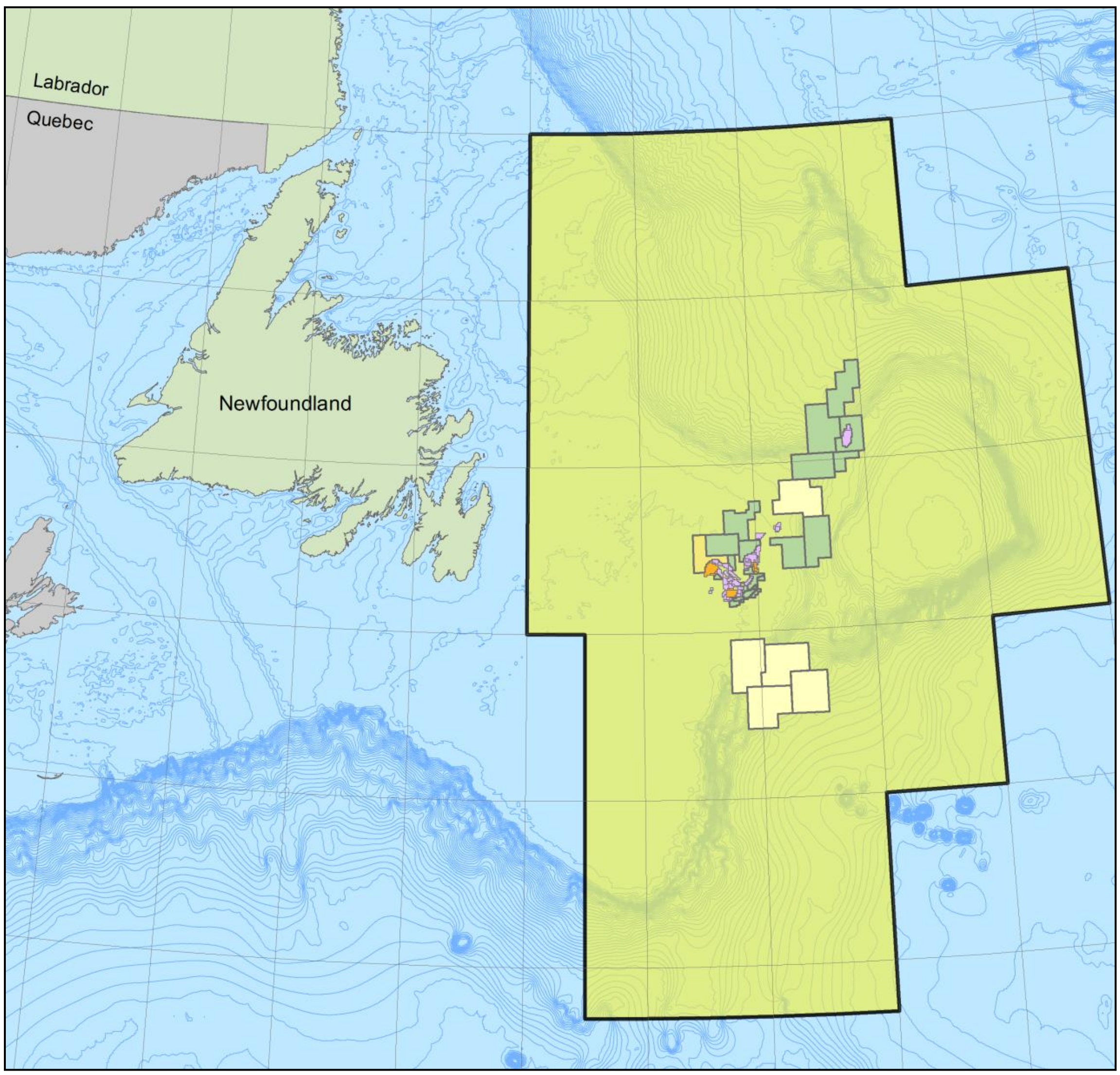
CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

# EASTERN NEWFOUNDLAND STRATEGIC ENVIRONMENTAL ASSESSMENT

## Final Report

**August 2014**



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# EASTERN NEWFOUNDLAND
# STRATEGIC ENVIRONMENTAL ASSESSMENT

**Final Report**

For:

**Canada-Newfoundland and Labrador**
**Offshore Petroleum Board**
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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACSS | Atlantic Canada Shorebird Survey |
| ACW | Approval to Alter the Condition of a Well |
| ADW | Approval to Drill a Well |
| AIS | Aquatic Invasive Species |
| AMOC | Atlantic Meridional Overturning Circulation |
| AOI | Area of Interest |
| ASP | Association of Seafood Producers |
| BIO | Bedford Institute of Oceanography |
| BOEM | Bureau of Ocean Energy Management |
| BOEMRE | Bureau of Ocean Energy Management, Regulation and Enforcement |
| BOP | Blowout Preventer |
| BSEE | Bureau of Safety and Environmental Enforcement |
| CAPP | Canadian Association of Petroleum Producers |
| CARTS | Conservation Areas Reporting and Tracking System |
| CCG | Canadian Coast Guard |
| CEAA | Canadian Environmental Assessment Act |
| CHS | Canadian Hydrographic Services |
| CIS | Canadian Ice Service |
| CMC | Canadian Meteorological Centre |
| CMP | Common Mid Point |
| C-NLOPB | Canada – Newfoundland and Labrador Offshore Petroleum Board |
| COSEWIC | Committee on the Status of Endangered Wildlife in Canada |
| CPAWS | Canadian Parks and Wilderness Society |
| CSEM | Controlled Source Electromagnetics |
| CWS | Canadian Wildlife Service |
| DFO | Fisheries and Oceans Canada |
| DND | Department of National Defence |
| EA | Environmental Assessment |
| EBSA | Ecologically and Biologically Significant Areas |
| EC | Environment Canada |
| ECRC | East Coast Spill Response Corporation |
| ECSAS | Eastern Canadian Seabirds at Sea |
| EEM | Environmental Effects Monitoring |
| EMOBM | Enhanced Mineral Oil Based Mud |
| EPP | Environmental Protection Plan |
| ESRF | Environmental Studies Research Fund |
| ETL | Effect Threshold Level |
| FFAW | Fish, Food and Allied Workers |
| FLO | Fisheries Liaison Officer |
| FPSO | Floating, Production, Storage and Offloading |
| FY | First Year |
| GB | Grand Banks |
| GBS | Gravity Based Structure |
| GMSL | Global Mean Sea Level |
| GOM | Gulf of Mexico |
| GPA | Geophysical Program Authorization |

| | |
|---|---|
| HMDC | Hibernia Management and Development Company Limited |
| HYCOM | Hybrid Coordinate Ocean Model |
| IA | Important Area |
| IBA | Important Bird Areas |
| ICOADS | International Comprehensive Ocean-Atmosphere Data Set |
| IIP | International Ice Patrol |
| ISDM | Integrated Science Data Management |
| IUCN | International Union for the Conservation of Nature |
| LOMA | Large Ocean Management Areas |
| MBS | Migratory Bird Sanctuary |
| MCTS | Marine Communications and Traffic Services |
| MMS | Minerals Management Service |
| MODU | Mobile Offshore Drilling Unit |
| MPA | Marine Protected Area |
| MWA | Marine Wildlife Areas |
| NAFO | North Atlantic Fisheries Organization |
| NAIS | North American Ice Service |
| NAO | Northern Atlantic Oscillation |
| NCEP | National Centers for Environmental Protection |
| NL EPA | Newfoundland and Labrador Environmental Protection Act |
| NL ESA | Newfoundland and Labrador Endangered Species Act |
| NL | Newfoundland and Labrador |
| NMCA | National Marine Conservation Area |
| NOAA | National Oceanic and Atmospheric Administration |
| NRA | NAFO Regulatory Area |
| NRC | National Research Council |
| OA | Operations Authorization |
| OBM | Oil-based Mud |
| OCS | Outer Continental Shelf |
| ODI | Ocean Data Inventory |
| OWTG | Offshore Waste Treatment Guidelines |
| PB | Placentia Bay |
| PERD | Panel on Energy Research and Development |
| PRNL | Petroleum Research Newfoundland and Labrador |
| RMA | Representative Marine Area |
| Ro-Ro | Roll-on Roll-off |
| ROV | Remotely Operated Vehicle |
| SARA | Species at Risk Act |
| SBM | Synthetic-based Mud |
| SEA | Strategic Environmental Assessment |
| SPL | Sound Pressure Level |
| SSAC | Species Status Advisory Committee |
| TCH | Trans Canada Highway |
| TTS | Temporary Threshold Shift |
| USCG | US Coast Guard |
| UXO | Unexploded Ordnance |
| VEC | Valued Environmental Component |
| VME | Vulnerable Marine Ecosystems |

| | |
|---|---|
| VMS | Vessel Monitoring System |
| VSP | Vertical Seismic Profile |
| WBM | Water-based Mud |
| WF | World Wildlife Fund |
| WHSRN | Western Hemisphere Shorebird Reserve Network |

## NOTICE – LIMITS OF THE CONTINENTAL SHELF (UNCLOS)

Any sector, parcel or licence depicted beyond 200 nautical miles off the coast of Newfoundland and Labrador is not represented by the Canada-Newfoundland and Labrador Offshore Petroleum Board to reflect the full extent of Canada's continental shelf beyond 200 nautical miles. Canada has filed a submission regarding the limits of the Outer Continental Shelf in the Atlantic Ocean with the Commission on the Limits of the Continental Shelf, the review of which is pending. The boundaries of sectors, parcels or licences in areas beyond 200 nautical miles may be revised to reflect the limits of the Outer Continental Shelf established by Canada. All interest holders of production licences containing areas beyond 200 nautical miles may be required, through legislation, regulation, licence terms and conditions, or otherwise, to make payments or contributions in order for Canada to satisfy obligations under Article 82 of the United Nations Convention on the Law of the Sea (UNCLOS).

# 1 INTRODUCTION

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB, or the Board) is responsible, on behalf of the Government of Canada and the Government of Newfoundland and Labrador, for petroleum resource management in the Newfoundland and Labrador (NL) Offshore Area.

The *Canada-Newfoundland Atlantic Accord Implementation Act* and the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (the *Accord Acts*), administered by the C-NLOPB, govern all petroleum operations in the NL Offshore Area. The C-NLOPB's mandate is to interpret and apply the provisions of the *Accord Acts* to all activities of operators in the NL Offshore Area, and to oversee operator compliance with those statutory provisions.

In the implementation of its mandate, the role of the C-NLOPB is to facilitate the exploration for and development of the petroleum resources in the NL Offshore Area in a manner that conforms to the statutory provisions for:

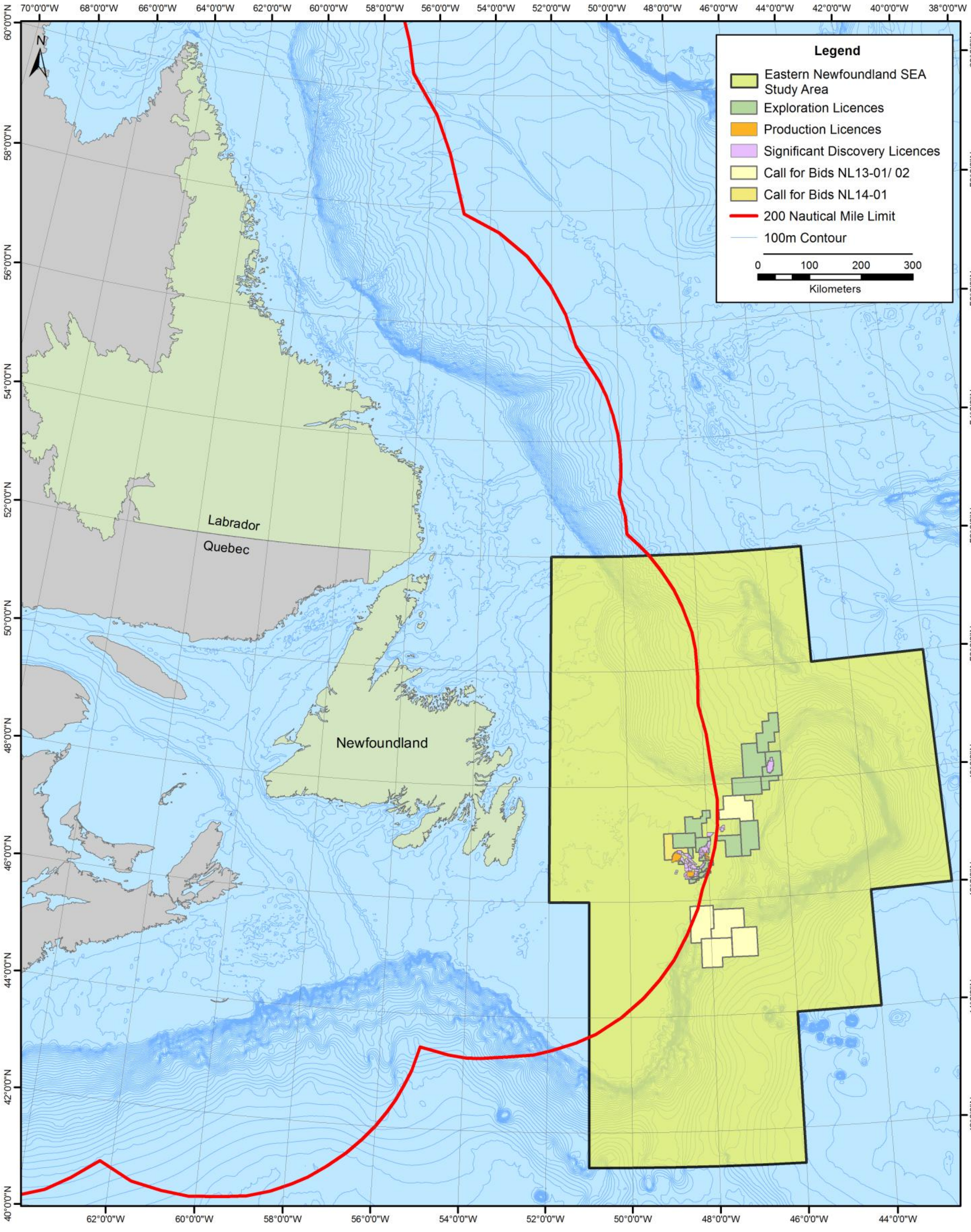
- Worker safety;
- Environmental protection;
- Effective management of land tenure;
- Maximum hydrocarbon recovery and value; and
- Canada / Newfoundland and Labrador benefits.

The Board's regulatory responsibilities include the administration and issuance of specific licences, authorizations and approvals pertaining to offshore petroleum (as defined in the *Accord Acts*) exploration and development activities in the NL Offshore Area. As part of these processes, since 2002 the C-NLOPB has been undertaking Strategic Environmental Assessments (SEAs) of portions of the NL Offshore Area in which the issuance of Exploration Licences could be contemplated and which have not been subject to substantial levels of previous, project-based environmental assessments (EAs). The Board has conducted a number of SEAs for various portions of the NL Offshore Area, which provide information on the regional environmental setting and associated environmental considerations, and which then help to inform subsequent regulatory decisions regarding future offshore oil and gas activities in the area in question. The Board has also committed to regularly review its SEAs and to update them as required.

This SEA for the Eastern Newfoundland Offshore Area covers an approximately 680,000 $km^2$ marine area to the east of the Island of Newfoundland (Figure 1.1). Planning and completing the Eastern Newfoundland SEA has included updating an SEA for the Orphan Basin region (LGL Limited 2003) and expanding its geographic coverage to the south and east.

This SEA provides information on the existing environment within the SEA Study Area and identifies and highlights key environmental features and considerations which may be associated with future oil and gas activities in the region. In doing so, the SEA is intended to help inform future licencing decisions regarding offshore oil and gas activities in the Eastern Newfoundland Offshore Area.

**Figure 1.1 The Eastern Newfoundland Offshore Area – SEA Study Area**



## 1.1 Nature, Purpose and Context of the SEA

SEA is a relatively broad-based and regional approach to EA that proactively examines the environmental issues that may be associated with a plan, program or policy proposal, and therefore allows for the identification, analysis and incorporation of environmental considerations at the earliest stages of planning and decision-making. Because SEAs are undertaken quite early in the strategic planning process, they typically focus on a general description of the environmental setting and on identifying and attempting to address overall environmental issues, thereby describing potential effects in relatively broad terms. This helps to allow any such issues to be identified and considered early in planning, before project-specific activities are defined and proposed. SEA is not intended as a replacement for project-specific EA processes and associated project planning and regulatory decisions. The objective of SEA is to provide the type and level of information necessary to aid decision-making at the early stages of the planning process.

The preparation of this SEA for the Eastern Newfoundland Offshore Area (also referred to interchangeably herein as the SEA Study Area) includes the identification, review and presentation of relevant information on the existing environment in the area, as well as an analysis of key environmental issues that may be associated with future oil and gas exploration and/or production activities in the region. It also identifies any relevant knowledge and data gaps and makes recommendations for future mitigation and planning. An important and integral component of the SEA has also been an associated program of public and stakeholder consultation.

Information from the SEA will assist the C-NLOPB in determining whether further exploration rights should be offered in whole or in part for the Eastern Newfoundland Offshore Area, as well as identifying any general restrictive or mitigative measures that may be considered for application to any future projects and activities. The SEA has a primary focus on the “exploration phase” of any future offshore oil and gas activity in the region, including potential seismic surveys and drilling programs. It also describes established production activities in the region, and generally considers potential future production activity which may take place in the area should such exploration be successful in identifying additional (technically and economically viable) hydrocarbon resources.

Any future offshore oil and gas activities that may be proposed in the SEA Study Area pursuant to any additional exploration licences will require individual review and approval by the C-NLOPB and possibly other agencies under applicable regulatory processes. The SEA will therefore also provide individual operators with an initial overview of the region’s existing environmental setting, and help define key environmental issues, interactions and mitigation measures which may require consideration in the early planning phases of individual projects, as well as in their subsequent approval processes.

## 1.2 Document Organization

This SEA Report is organized as follows:

*Chapter 1* provides an introduction to SEA, outlines the purpose and context of the assessment, and describes the overall organization of the document.

*Chapter 2* establishes the scope and purpose of the SEA. This includes a summary of the public and stakeholder consultation initiatives that have been undertaken as part of the SEA and their key findings. It identifies the Valued Environmental Components (VECs) upon which it is focussed and the rationale for their selection, as well as giving an overview of the approach and methods used to conduct the SEA.

*Chapter 3* provides an overview of the planning and regulatory processes which apply to offshore oil and gas activity in the NL Offshore Area. This is followed by a general description of offshore oil and gas exploration and development activities, as well as an overview of past, on-going and potential oil and gas activities within the Eastern Newfoundland Offshore Area.

*Chapter 4* provides a description of the existing environmental setting of the SEA Study Area (see Figure 1.1), including the relevant components of its physical and biological environments and human activities. This includes any updated information on the Orphan Basin area that has become available since that initial SEA Report (LGL Limited 2003) was completed.

*Chapter 5* provides the environmental issues, mitigation and planning analysis for each of the VECs under consideration. Each VEC is addressed in a separate section, which includes a discussion of:

- Potential environmental interactions, existing knowledge and standard mitigation measures which may be applied to offshore oil and gas activities to avoid or reduce environmental effects; and

- Key environmental planning considerations and any additional activity, site or time-specific mitigation measures which may be required or appropriate.

This Chapter also includes a discussion of:

- Potential cumulative environmental effects that may result from future offshore oil and gas activities in the region in combination with each other and with other projects and activities, and associated planning implications; and

- The availability and adequacy of existing environmental information, and any relevant data gaps, requirements and opportunities to address them.

*Chapter 6* presents a summary of the key findings and conclusions of the SEA.

*Chapter 7* provides the references used in the SEA, including the literature cited and any personal communications.

Supporting information is provided as *Appendices*.

# 2 STRATEGIC ENVIRONMENTAL ASSESSMENT: SCOPE AND APPROACH

This Chapter outlines the scope and purpose of the SEA, as well as establishing the spatial and temporal boundaries of the assessment and identifying the environmental components, issues and potential interactions upon which it is focussed. In doing so, it also describes and summarizes the nature and key findings of the public and stakeholder consultation processes that have been undertaken to date as part of the SEA. The Chapter then goes on to identify the VECs upon which the SEA is focussed and the rationale for their selection. It concludes with an overview of the approach and methods used to conduct the SEA and its associated analyses.

## 2.1 Spatial and Temporal Boundaries

This SEA focuses on describing the environmental setting and associated environmental considerations within the SEA Study Area. The boundaries of this area are as illustrated in Figure 2.1, and were chosen by the C-NLOPB based on historical activity in the area as well as with consideration of the definition of Offshore Area in the *Accord Acts*.

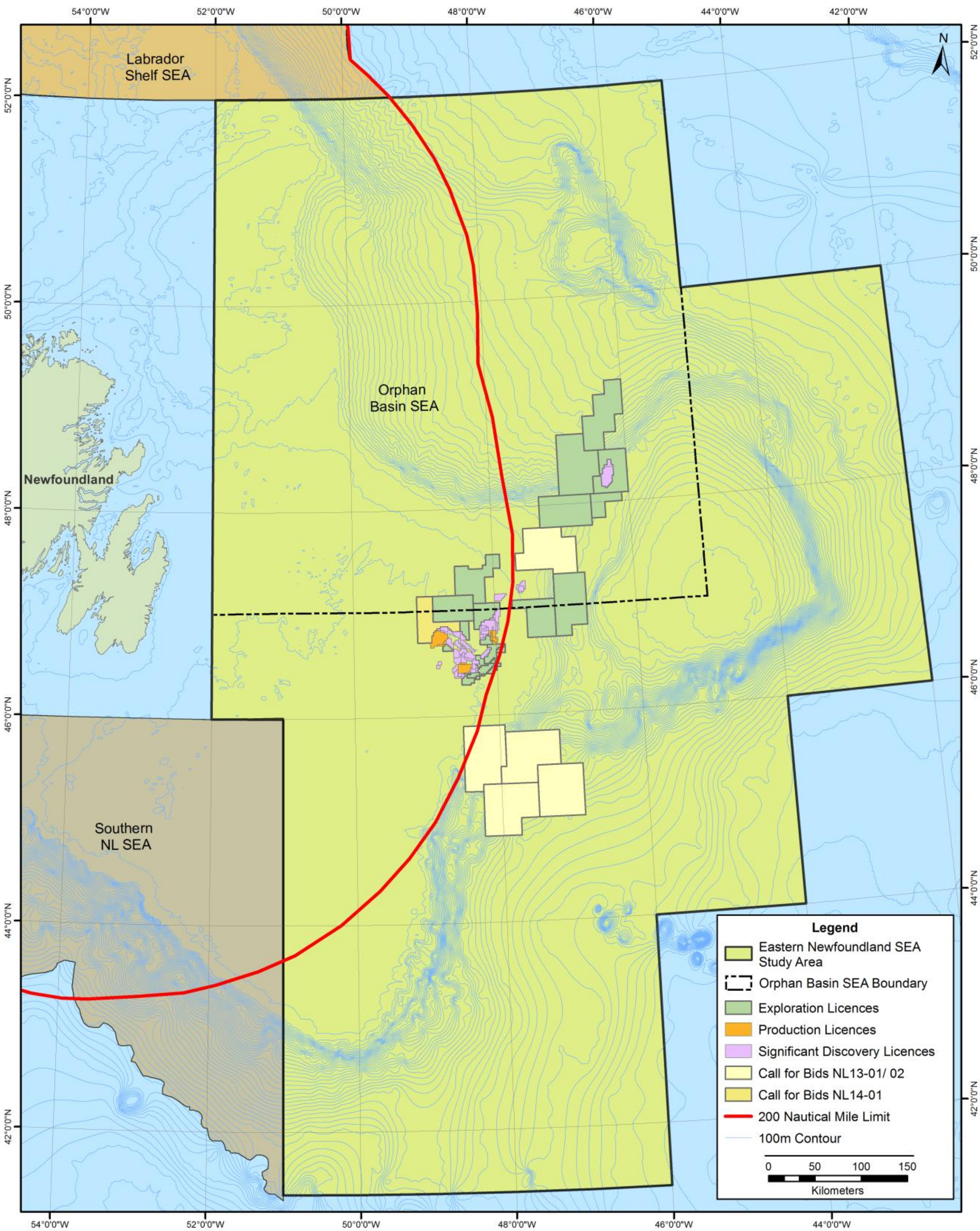
This Study Area includes the study area for the previous Orphan Basin SEA (2003) and the marine areas to the south and east, including portions of the Carson Basin and Flemish Pass area that have not previously been subject to SEA.

The boundaries of the Eastern Newfoundland SEA Study Area extend (and are adjacent) to those of the previously completed Labrador Shelf SEA (2008) to the northwest and the Southern Newfoundland SEA (2010) to the southwest (Figure 2.1), the latter of which also updated and replaced two previously conducted SEAs for the Southern Newfoundland area (Laurentian Subbasin and Sydney Basin) (C-NLOPB 2014).

As described in Chapter 3, some offshore oil and gas (particularly, exploration) activities may be relatively widespread in nature (such as seismic surveys), and often extend beyond the boundaries of individual exploration licences. In addition, it is recognized that ecological and human components and systems rarely correspond to (and indeed, typically extend beyond) such administrative boundaries, due to oceanographic conditions and the often extensive ranges and mobile / migratory nature of some marine species and activities. These marine characteristics and processes can also influence and extend the potential “zones of influence” of any environmental disturbances and effects that may be associated with oil and gas activities in the Eastern Newfoundland Offshore Area beyond this boundary.

Therefore, although the SEA has a key focus on the Eastern Newfoundland Offshore Area (approximately 680,000 $km^2$), the area studied is not confined to the SEA Study Area itself. Rather, the assessment also considers the overall areas within which the environmental components that could potentially be affected by potential exploration and production activities (including accidental events) are located.

**Figure 2.1 Eastern Newfoundland SEA – Geographic Boundaries**



The SEA focuses upon an overall time horizon of approximately 10 years, which would generally correspond to the temporal duration of any additional exploration licences that may be issued in the area upon completion of the SEA. As has been the C-NLOPB's practice in completing its SEAs over the past decade, this SEA will be again reviewed within a five year period to determine whether an update is required.

The SEA also includes general consideration of possible future oil and gas development activities in the Eastern Newfoundland Offshore Area. Whether and how any such production activities occur would obviously depend on the type and quantity of any hydrocarbons found, the location, area, depth and other characteristics of these reserves, and other factors. These and numerous other technical, economic and other considerations will determine the likelihood and feasibility, and specific characteristics, of any future exploration or development projects and their associated infrastructure and activities.

Experience with offshore oil and gas discoveries and associated planning, design, regulatory approval and implementation processes and timelines elsewhere in the NL Offshore Area also suggests that these can take well over a decade to advance to production following a significant commercial discovery. Therefore, while potential future development activities are considered very generally in the SEA, these are not and cannot be defined, described or assessed in any degree of detail at this early stage.

## 2.2 SEA Working Group and Scoping Document

The planning and preparation of the SEA and its associated consultation activities has been guided by a Scoping Document, which outlines the factors to be considered, the scope of those factors and other guidelines for preparing the SEA Report.

An SEA Scoping Document was prepared by C-NLOPB staff with the assistance of a Working Group comprised of members representing 13 federal and provincial government departments and agencies and non-governmental organizations, as listed below:

1) C-NLOPB (Chair);
2) Fisheries and Oceans Canada (Oceans Ecosystems Management – NL Region);
3) Environment Canada;
4) Natural Resources Canada (Frontier Lands Management Division Energy Sector);
5) Transport Canada;
6) Parks Canada;
7) NL Department of Natural Resources (Energy Branch);
8) NL Department of Fisheries & Aquaculture;
9) Fish, Food and Allied Workers Union (FFAW);
10) One Ocean;
11) Nature Newfoundland and Labrador;
12) World Wildlife Fund (WWF) – Canada;
13) Canadian Parks and Wilderness Society (CPAWS); and the
14) Canadian Association of Petroleum Producers (CAPP)

The SEA Scoping Document was released by the C-NLOPB in early May 2013. The document then formed the basis for the C-NLOPB's Request for Proposals for the preparation of the assessment, and has guided the SEA's planning and completion from the onset.

The Scoping Document sets out the key objectives of the SEA, which are listed below (along with a general indication of where each of these items are addressed in the SEA Report):

- Provide an overview of the existing environment of the SEA Study Area (Chapter 4);
- Generally describe typical offshore oil and gas exploration activities (Sections 3.2 and 3.3);
- Generally describe typical offshore oil and gas production activities (Sections 3.2 and 3.3);
- Generally describe (to the degree deemed appropriate) current and established petroleum production activities in the Jean d'Arc Basin (Sections 3.2 and 3.3);
- Describe and evaluate potential environmental effects associated with offshore oil and gas exploration and production activities (Chapter 5);
- Consider the potential cumulative effects on the marine environment resulting from typical offshore oil and gas activities in combination with other potential activities (Section 5.6);
- Identify knowledge and data gaps (Section 5.7);
- Highlight issues that may be of concern (Chapters 5 and 6);
- Map and identify known areas of interest (AOIs), VECs and sensitive special areas, including Ecologically and Biologically Significant Areas (EBSAs), Vulnerable Marine Ecosystems (VMEs, such as VME elements and species) and Important Bird Areas (IBAs) (Section 4.2);
- Identify opportunities to add to the knowledge base of the region (Section 5.7);
- Make recommendations for general mitigative measures that should be employed during offshore petroleum related activities (Chapter 5 and Section 6.2);
- Identify general restrictive or monitoring measures, as appropriate, that may be required for future offshore petroleum activities (Chapter 5 and Section 6.2);
- Assist the Board in determining whether exploration rights should be issued in whole or in part in the SEA Study Area (Chapter 6); and
- Assist in the scoping and focus of subsequent project-specific EAs (Sections 3.1 and Chapters 5 and 6).

As outlined in Chapter 3, there have been past and on-going oil and gas exploration and production activities undertaken and proposed in the Eastern Newfoundland Offshore Area pursuant to previous licencing and other decisions and actions by the C-NLOPB and others. It should be noted that the SEA does not revisit previous licencing or other regulatory decisions regarding offshore oil and gas activity in the region. It also does not deal with regulatory or policy decisions in areas or on topics that are not related specifically to offshore licencing decisions within the Eastern Newfoundland Offshore Area.

The specific "strategic decision" that the SEA is intended to inform is therefore whether further exploration rights should be issued in whole, in part, or at all in the Eastern Newfoundland Offshore Area, and if so, to identify any environmental components and issues which should be considered in taking these future decisions and actions.

## 2.3 Consultation Program

An important and integral component of the SEA has been a program of public and stakeholder engagement. The consultation activities that have been carried out to date have been designed and implemented to identify any associated questions or concerns regarding future oil and gas exploration and/or production activities in the Eastern Newfoundland Offshore Area.

The preparation of the SEA has therefore included discussions with government departments and agencies, stakeholder groups and the general public through a range of approaches. Various mechanisms have been used to provide interested groups and individuals with information on the SEA objectives and process, and on past, on-going and potential oil and gas licencing and activities in the region, as well as allowing them to review and consider this information and formulate and provide their questions and views.

The following sections give a summary overview of the key methods and findings of the various consultation activities that have been completed as part of the SEA. Further information and details are provided in the associated SEA Consultation Report, which is included as Appendix A.

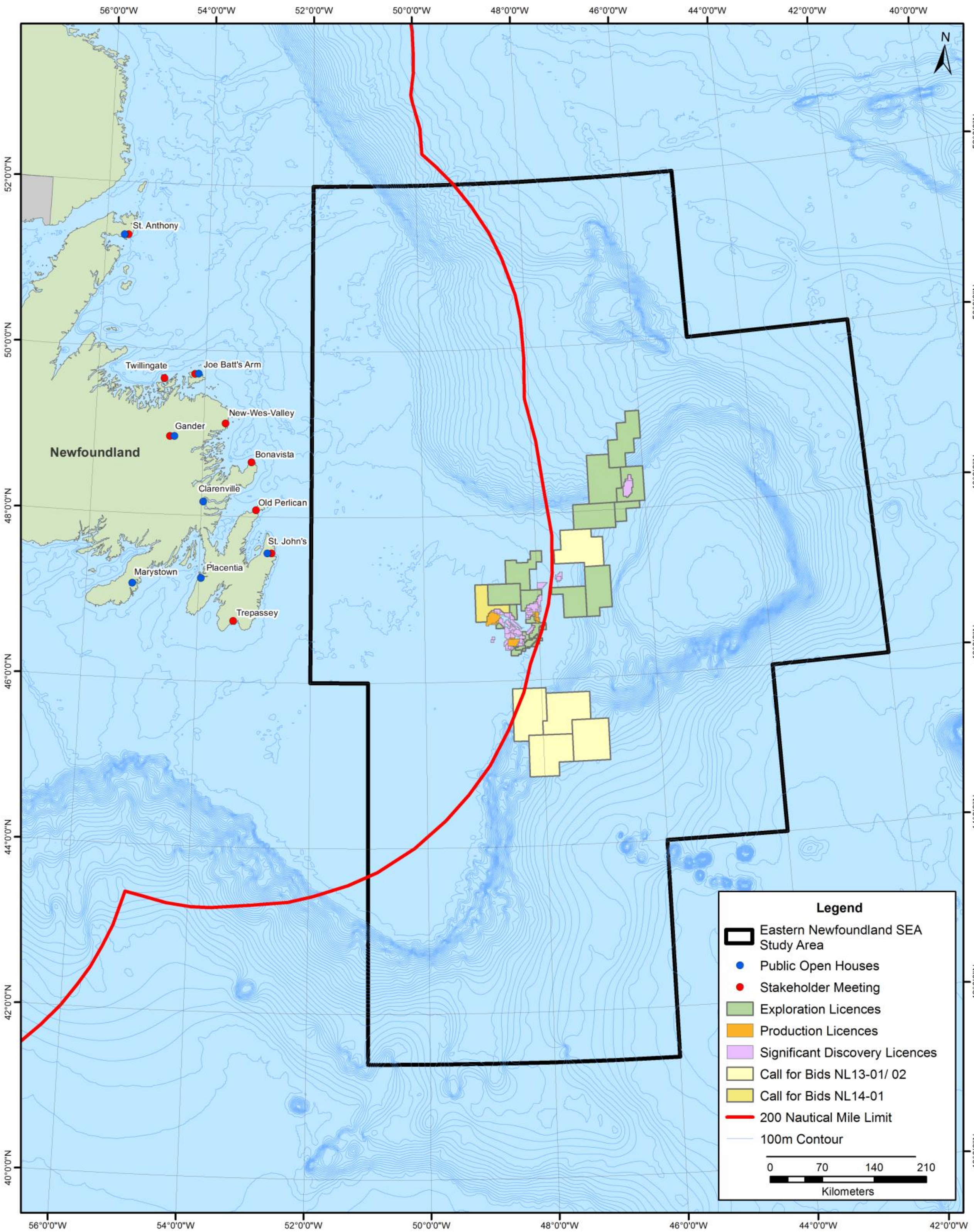
### 2.3.1 Public Open Houses

As specified in the SEA Scoping Document, the consultation program included a series of "Public Open Houses" held in locations throughout Eastern Newfoundland and elsewhere in the province, as listed in Table 2.1 below and illustrated in Figure 2.2:

**Table 2.1 Public Open Houses held as part of the SEA Consultations**

| Community | Date and Time | Location | Number of Attendees |
|---|---|---|---|
| Joe Batt's Arm NL | Mon Sept 9 2013 (6-9 pm) | Community Hall | 0 |
| Gander NL | Tues Sept 10 2013 (6-9 pm) | Gander Hotel | 2 |
| Clarenville NL | Wed Sept 11 2013 (6-9 pm) | Clarenville Inn | 5 |
| Marystown NL | Thurs Sept 12 2013 (6-9 pm) | Marystown Hotel | 2 |
| Placentia NL | Mon Sept 16 2013 (6-9 pm) | Cultural Arts Centre | 2 |
| St. John's NL | Tues Sept 17 2013 (6-9 pm) | Comfort Inn | 9 |
| St. Anthony NL | Thurs Sept 19 2013 (6-9 pm) | Lions Club | 0 |

## Figure 2.2 SEA Public Open House and Stakeholder Meeting Locations



The public open houses took the form of evening “drop in” sessions, held from 6 – 9 pm at the identified venue in each community. This format was selected by the SEA Study Team, in discussion with the C-NLOPB and SEA Working Group, for various reasons. Firstly, it allows all interested parties to come to the sessions on their own time, and to proceed to receive information, ask questions and provide input at their own pace and in whatever manner and format that they felt most comfortable. By adopting this open house format, the SEA Study Team attempted to establish a relatively informal and relaxed environment, where participants could provide input and ask questions through one-on-one conversations, and/or in small groups, however they preferred.

These consultations intentionally occurred at a very early stage of the SEA process, before the completion of the SEA Report itself. The intended purpose of the consultation program was therefore to provide the SEA Study Team with early input and understanding regarding the key public and stakeholder questions, issues and perspectives related to potential future oil and gas activities in the region, so that this information could help inform and shape the nature and content of the SEA analyses and eventual report.

The consultation sessions were advertised through newspaper ads that provided details on the purpose, location and timing of the sessions, as well as through other local and province-wide media and other means. The consultation sessions were also covered by local media, both before and following the open houses, which provided a degree of additional information regarding, and advertising for, the SEA consultations.

Representatives of the C-NLOPB and the SEA Study Team (AMEC) were present at all consultation meetings to provide information and clarification, answer questions, and to record any and all questions, issues and perspectives raised.

Upon arrival, public open house participants were greeted by a SEA Study Team representative at a sign-in table, who provided an overview of the open house purpose and format. The open houses included an introductory presentation at the beginning of each session, which was then repeated at approximately the half way point of the meeting (as required), as was specified in the newspaper ads. This short presentation provided a general description of the nature and purpose of the SEA, the format and objectives of the public consultations and how their results will be recorded and used, as well as the future processes for preparation, release and public review of the Draft SEA Report. The presentation generally included and summarized the information on the SEA information display panels (see below and Appendix A), and was also made available on the C-NLOPB website. At the end of the presentation, participants were encouraged to ask questions or provide comments, and then invited to view the information panels and maps and engage in discussion with the SEA Study Team.

The public consultation sessions also included six information stations arranged throughout the open house venue, consisting of tables with large information panels. These included the following themes:

1) *C-NLOPB Overview* (purpose, role, mandate, map of NL Offshore Area);

2) *Offshore Oil and Gas Licencing and Activities* (overview of C-NLOPB land rights issuance / licencing process, and generic descriptions of offshore oil and gas exploration activities that may be undertaken);

3) *Eastern Newfoundland Offshore Area* (including a map and description of the SEA Study Area, existing licences, previous and on-going oil and gas activities);

4) *C-NLOPB SEA Process and Eastern Newfoundland SEA* (nature, purpose, objectives);

5) *Environmental Setting and Considerations* (components of the existing environment being addressed in the SEA, environmental issues that may be associated with offshore oil and gas activities, standard environmental protection / mitigation measures); and

6) *2013 Eastern Newfoundland SEA* (process, outcomes and timeline / next steps) and the *2003 Orphan Basin SEA* (summary of its key information and findings).

The purpose of these information panels was to provide general background information, and to serve as a basis for prompting dialogue and the sharing of information and input by consultation participants.

At each public open house, representatives of the SEA Study Team (C-NLOPB and AMEC) were clearly identified through name tags, and were positioned at and/or between stations. A key focus was on obtaining and recording information and input related to:

- Questions, issues or concerns regarding offshore oil and gas activities and their potential effects in the Eastern Newfoundland Offshore Area;

- Suggestions for any mitigation measures or other means through which these issues could be addressed in future planning and decisions / actions;

- Local knowledge regarding the existing biophysical environment in the SEA Study Area, and

- Information on fisheries and/or other marine activities and components in the region.

Comment / feedback forms were provided, which addressed each of the questions and issues noted above. Attendees were given the option of completing these at the session and leaving them with the SEA Study Team, or completing and submitting them later (full contact information was included). It was also made clear that participants could submit their input in any format they choose, and this need not be restricted to the structure of / questions on the feedback form itself, and it could be submitted at any time in the SEA process. Feedback forms were also posted on the C-NLOPB website (in both pdf and ms word formats).

The SEA Study Team members continuously took notes and recorded any and all input received throughout the public open house. The consultation team also met as a group to debrief and compile all information and input received.

### 2.3.2 Stakeholder Meetings

As part of the SEA consultation program, and as specified in the Scoping Document, a series of stakeholder meetings were also arranged with identified organizations (Table 2.2). These meetings were intended to supplement the larger public open house sessions, and in particular, they provided an opportunity to meet with identified stakeholder groups in key areas, during the daytime “working hours” for these organizations. Figure 2.2 also illustrates the locations of these meetings.

**Table 2.2 Stakeholder Meetings held as part of the SEA Consultations**

| Community | Date and Time | Location | Number of Attendees |
|---|---|---|---|
| Joe Batt's Arm NL | Monday Sept 9 2013 (1-3 pm) | Community Hall | 0 |
| Twillingate NL | Tuesday Sept 10 2013 (10 am – 12 pm) | Anchor Inn Hotel | 5 |
| Gander NL | Tuesday Sept 10 2013 (3-5 pm) | Gander Hotel | 3 |
| New-Wes-Valley NL | Wednesday Sept 11 2013 (10:30 am – 12:30 pm) | Barbour Heritage Site | 5 |
| Bonavista NL | Thursday Sept 12 2013 (10:30 am – 12:30 pm) | Royal Canadian Legion | 12 |
| Old Perlican NL | Friday Sept 13 2013, (1-3 pm) | Old Perlican Fire Hall | 7 |
| Trepassey NL | Monday Sept 16 2013 (10:30 am – 12:30 pm) | Father Mullowney Social Centre | 2 |
| St. John's NL | Tuesday Sept 17 2013 (1-3 pm) | Comfort Inn | 17 |
| St. Anthony NL | Thursday Sept 19 2013 (2-4pm) | Lions Club | 10 |

Organizations were identified by the SEA Study Team through a general search process, using the internet, telephone directories, the team's knowledge and experience in working in these areas as well as their existing contacts and networks, and with the advice and input of the C-NLOPB and its SEA Working Group. Based on these searches and discussions, an initial list of local stakeholder organizations was developed, each of which were sent an invitation to the Stakeholder Meeting(s) in their area by email. The newspaper advertisement for the SEA public consultations also referenced and listed the planned stakeholder meetings, and invited any and all interested organizations to contact the SEA Study Team to confirm and arrange their attendance at one or more of the meetings. The invitations also asked all recipients to forward the invitation to any other stakeholder groups that they felt would have an interest. Through this "snowball" process, a number of additional groups were identified and invited, and it became clear that the invitation was distributed widely by and amongst various organizations.

Through the stakeholder meetings, the SEA Study Team attempted to reach the largest number of groups possible, and include a cross section of the various types of groups and interests that may be interested in the SEA – including local communities, fishers groups, environmental and social interest groups, industry and business associations. Any and all organizations that requested an invitation or who otherwise chose to attend a meeting were permitted to do so and were welcomed at the meetings.

These Stakeholder Meetings involved an approximately two hour meeting at the identified venue at each location, which began with a presentation by the SEA Study Team outlining the nature and purpose of the SEA. This presentation was the same as that provided during the public open house sessions. This was then followed by a general, round table discussion. Notes were again taken by the SEA Study Team at each meeting, highlighting the various questions, issues and perspectives.

In addition to the planned Stakeholder Meetings and Public Open Houses at each identified, location, the SEA Study Team also allotted time in several locations to meet with fishers and fishing groups if requested. Although no meetings were requested, FFAW representatives and individual fishers attended several of the Public Open Houses and were the main participants at most of the stakeholder meetings, as described in Appendix A.

### 2.3.3 Overview of Consultation Findings

The following sections provide a high level summary of the key outcomes and findings of the consultation activities undertaken to date as part of the Eastern Newfoundland SEA. Further details are provided in the SEA Consultation Report (Appendix A).

The SEA consultation process resulted in the collection and documentation of a variety of information and perspectives related to potential oil and gas activity in the Eastern Newfoundland Offshore Area and its possible environmental and socioeconomic implications. In some cases the questions and comments received were quite specific, and were considered in that form in planning and preparing the SEA, it is also clear that many of these touch upon several principal and recurring themes related to the existing environmental setting of the area, potential environmental outcomes, and larger regulatory, policy and procedural issues.

Table 2.3 provides a general listing and summary of the main topics and overall themes which were raised throughout the SEA consultations, as well as a general indication of where these are addressed in the SEA Report. Again, a more detailed description of the consultation activities and inventory of the various questions and issues raised is provided in Appendix A.

**Table 2.3 Summary of Key Themes Raised in the SEA Consultation Program**

| General Topic / Theme | Where Addressed in the SEA Report |
|---|---|
| **Environmental Setting** | |
| The overall vastness, diversity and dynamic nature of the marine environment | Sections 4.1, 4.2, 4.3 |
| Oceanographic conditions and water flows | Section 4.1.4 |
| Water temperatures | Section 4.1.4.3 |
| Sea ice and icebergs | Section 4.1.5 |
| Fog and visibility considerations | Sections 3.5; 4.1.3.4 |
| The Bonavista Corridor and its importance for cod and other species | Sections 4.2.1; 5.1.3 |
| Corals and sponges, their locations, and sensitivity to disturbance | Section 4.2.1.5 |
| Fish feeding (times, areas, species) | Section 4.2.1.6 |
| Fish spawning areas and times | Section 4.2.1.6 |
| The importance of the Flemish Cap for fish and fisheries | Section 4.2.1.6 |
| Marine bird numbers / presence, colonies, seasonal presence and migrations | Section 4.2.2 |
| Marine mammals and their movements through and use of the area | Section 4.2.3 |
| Species at risk | Sections 4.2.1.7; 4.2.2.5; 4.2.3.3 |
| Reproduction times and activities for marine animals | Sections 4.2.1; 4.2.2; 4.2.3 |
| Protected areas (e.g. Mistaken Point) | Section 4.2.4 |
| The complexity of the marine ecosystem and interrelationships between its various components and areas | Section 4.2 |
| Recent and on-going environmental changes, including fish species, distributions and times (regime shifts, climate change) | Section 4.2.1.2; 5.1 |
| Existing and available information sources on the marine biophysical environment and data gaps | Sections 4.1, 4.2, 4.3; 5.7 |
| Bottom surveys at planned drill site locations, and the geographic extent of same | Section 5.1 |
| Information availability, distribution and sharing | Sections 4.1, 4.2, 4.3; 5.7 |
| The importance, utility and validity of both scientific and local ecological information | Sections 4.1, 4.2, 4.3; 5.7 |
| Fisheries management and available datasets | Section 4.3.4 |
| The cultural and economic importance of the fishing industry | Section 4.3.4 |
| Important fishing areas and times, and dynamic nature of the fishery | Section 4.3.4 |

| General Topic / Theme | Where Addressed in the SEA Report |
|---|---|
| The need to consider present but also possible future fishing activities (changes in species, locations, times, gear types) | Section 4.3.4 |
| Marine vessel traffic to and through the region | Section 4.3.5 |
| Foreign fishing activity in the SEA Study Area | Section 4.3.4 |
| **Environmental Considerations and Possible Mitigation** | |
| Possible effects of offshore oil and gas activities on fish migrations (especially, cod and salmon) | Section 5.1.1 |
| Potential interference with fishing activity (direct and indirect) | Section 5.5 |
| Safety zones and iceberg management around offshore platforms and the need for communication of these | Section 5.5 |
| Potential environmental and socioeconomic effects of oil spills | Sections 3.2.5, 5.1; 5.2, 5.3; 5.4; 5.5 |
| Oil spill prevention measures (equipment and procedures) | Sections 3.2.5, 5.1; 5.2, 5.3; 5.4; 5.5 |
| Oil spill response / clean up (recovery) procedures and requirements (including fisher involvement in same) | Sections 3.2.5, 5.1; 5.2, 5.3; 5.4; 5.5 |
| Possible effects of spills on commercial fisheries (direct and indirect) | Section 5.5 |
| Compensation for damages resulting from accidental events (direct and indirect) and the need for better information on this | Sections 3.2.5, 5.5 |
| Other past and on-going disturbances in the marine environment | Sections 3.3; 4.2; 5.6 |
| Well abandonment procedures | Section 3.2.2 |
| Possible introduction of invasive species | Sections 4.2.1.9; 5.1 |
| Possible avoidance of bays and coastal areas near the Newfoundland shoreline | Section 5.1.3 |
| Potential social and economic benefits of oil and gas activity | Section 3.2 |
| Communication and cooperation between the oil and gas and fishing industries | Section 5.5 |
| Potential effects of seismic noise on marine fish and animals and associated uncertainty (and possible implications for fish survey work) | Section 3 5.1, 5.2, 5.3 |
| Proximity of licences and seismic and drilling activity to shore | Section 3.3 |
| Vessel traffic and its effects and management | Section 4.3.5 |
| Cumulative environmental effects | Section 5.6 |
| Environmental compliance and effects monitoring during oil and gas activities, and the need for strict enforcement of regulations | Section 3.2, Chapter 5 |
| **Regulatory, Policy and Procedural Issues** | |
| The C-NLOPB and its role, mandate, composition and responsibilities | Section 3.1 |
| C-NLOPB licencing and approvals / authorizations processes | Section 3.1 |
| Nature and purpose of the SEA and its outcomes and schedule | Sections 1.1; 2.1, 2.2 |
| Relationship of the SEA to project EA reviews | Section 1.1, 3.1.3 |
| SEA outcomes and recommendations, and their use in licencing decisions | Sections 1.1; 2.1, Chapter 6 |
| Past licencing and exploration activities in the SEA Study Area | Section 3.3 |
| Approvals required for seismic surveys | Section 3.1.2 |
| Timing / seasonality of oil and gas activities | Sections 3.2; 3.3 |
| Environmental regulations and standards | Sections 3.1.2; 3.2; 5.1; 5.2; 5.3; 5.4; 5.5 |
| Offshore jurisdictions (C-NLOPB and others, 200 mile limit and beyond) | Section 3.1 |
| Interjurisdictional and policy considerations around oil and gas activity | Sections 3.1; 3.2 |

The information and input gathered through the consultation process has informed and shaped the nature and focus of the SEA, by helping identify key information requirements and issues that require consideration in the analyses and report.

## 2.4 Identification of Valued Environmental Components

It is generally acknowledged that an EA should identify and focus on those components of the environment that have the potential to be significantly or materially affected by the proposed project, program, plan or policy in question, including those which are particularly valued by society and/or which can serve as recipients, pathways and/or indicators of environmental change. In an EA context, these are known as Valued Environmental Components (VECs), and may include both biophysical and socioeconomic elements of the environment.

The above sections have generally described a number of consultation activities and initiatives that have helped to identify the environmental components, issues and interactions that may be relevant to possible future oil and gas activity in the Eastern Newfoundland Offshore Area and which require consideration in the SEA. These have included the Scoping Document prepared and issued by the C-NLOPB and the SEA Working Group on May 8, 2013, as well as a series of public open houses and stakeholder meetings, and the continuous provision of information, updates and opportunities to provide input through the Board's website and other means.

In addition to these past and on-going consultation activities, the scoping exercise for the SEA has also included consideration of the nature of past and potential future oil and gas activities in the Eastern Newfoundland Offshore Area (Chapter 3), and the existing biophysical and human environments of the region (Chapter 4), in order to identify key potential interactions and issues (Chapter 5). Other SEAs undertaken in relation to offshore exploration and development in Newfoundland and Labrador and elsewhere were also reviewed and considered, as well as project-specific EAs conducted in relation to individual seismic surveys, exploration drilling programs and production projects. The results of these previous assessments and studies were considered as part of the scoping exercise, as appropriate, with due consideration of differences between their environmental settings and study areas and that for this SEA.

Based on the results of the issues scoping exercise described above, and as specified in the SEA Scoping Document, the following VECs are considered in this assessment:

- Fish and Fish Habitat;
- Marine Birds;
- Marine Mammals and Sea Turtles;
- Species at Risk and Other Key Species;
- Sensitive and Special Areas; and
- Commercial Fisheries

The rationale for the selection of these VECs is generally described below:

*Fish and Fish Habitat*: This VEC includes coverage of relevant fish species, as well as plankton, algae, benthos and benthic habitat, deep-water corals, plant communities and relevant components of fish habitats (such as water and sediment), given the clear interrelationships between these environmental components. The consideration of Fish and Fish Habitat within a single VEC is in keeping with current and standard practice in EA.

*Marine Birds*: A variety of bird species inhabit the marine and coastal environments off Eastern Newfoundland at various times of the year, including seabirds, shorebirds and other avifauna. Marine

Birds are important from an ecological, social and economic perspective, as they typically function near the top of the food chain, may be relatively vulnerable to certain types of environmental disturbances (such as oil spills) and are an important resource for recreational and tourism related pursuits.

*Marine Mammals and Sea Turtles:* Whales, seals and other marine mammal species have been and remain an important element of the marine and socio-cultural environments of the region, due to historic (whale) or current (seal) harvests, and because whale watching and associated activities is an important tourism attraction in parts of Eastern Newfoundland. A number of marine mammal species are of special conservation concern and have been designated as species at risk under Canadian legislation. Although sea turtles are generally uncommon in the area, they are also typically included as part of this VEC, particularly given their rare and often protected status.

*Species at Risk* and *Other Key Species:* As indicated above, a number of marine fish, bird, mammal and reptile species that occur in the Eastern Newfoundland Offshore Area have been designated as being at risk and are protected under provincial and/or federal legislation. Other species, while not having formal (legal) protection, have also been identified as being of importance to sustaining the structure and function of particular marine ecosystems.

*Sensitive and Special Areas:* Several locations in Eastern Newfoundland have been designated as protected under provincial, federal and/or other legislation and processes, due to their ecological, historical and/or socio-cultural characteristics and importance. These areas, and the potential for interactions and effects resulting from future oil and gas activities on them, are also given a particular focus in the SEA. In addition to areas that have existing and formal designations as being protected, a number of other locations have been identified as being especially sensitive to possible environmental disturbances, including some that are important ecologically and/or for associated human activities and values.

*Commercial Fisheries:* Fisheries have the potential to be affected both directly (through possible interactions between offshore oil and gas operations and fishing activity and gear) and indirectly (due to any negative changes in the size, distribution and health of fish populations).

These VECs represent the main environmental components which are assessed in this SEA. This assessment focuses on those environmental components and potential interactions which are of primary concern, and thus, which have the most relevance to strategic planning and decision-making related to possible future oil and gas activities in the Eastern Newfoundland Offshore Area.

The following sections describe the approach and methods used in conducting the environmental effects analysis for each of the VECs under consideration.

## 2.5 SEA Approach and Methodology

At the early stages of strategic planning processes (e.g., exploration licencing) there is typically little or no information available regarding the specific nature, timing and location of projects and activities as these have yet to be defined, designed and proposed. Whereas an EA of a proposed offshore exploration drilling program would consider particular project characteristics and activities (e.g., seismic survey areas, drilling locations) and predict specific environmental effects (e.g., area covered by released drill cuttings, oil spill probability and behaviour), SEAs usually describe potential environmental issues and effects in relatively broad terms. SEAs therefore usually focus on providing a general and regional-scale description of the overall environmental setting, and on identifying and attempting to manage general environmental issues through appropriate strategic planning and decision-making.

### 2.5.1 Environmental Setting

The SEA initially provides a description of the environmental setting of the SEA Study Area, including the relevant components of its physical and biological environments and human activities based on existing and available information and datasets. This is used as a basis for identifying potential environmental issues and interactions, required mitigation and associated planning considerations to attempt to avoid or reduce potential adverse environmental effects.

This description of the existing environment in the SEA Study Area does not focus exclusively upon the identified VECs, but rather also includes other aspects of the physical and biological environments and human activities which are relevant and/or have been specified in the Scoping Document for the SEA.

### 2.5.2 Potential Environmental Interactions and Effects

This SEA includes the identification of general environmental issues and effects which may be associated with offshore oil and gas activities in the Eastern Newfoundland Offshore Area. The analysis for each of the identified VECs includes consideration of the components and activities which are typically associated with offshore oil and gas activity (Chapter 3) and the region's existing environment (Chapter 4), in order to identify potential interactions between them (Chapter 5).

This analysis has been generally informed by the available literature and other existing information on the effects of offshore oil and gas activities and their associated environmental interactions on each of the VECs. These sections of the SEA Report include a general identification and overview of the known and likely environmental issues and interactions associated with offshore exploration and/or development activities, as background and context for identifying key issues and associated environmental planning considerations.

### 2.5.3 Environmental Mitigation Measures

These sections give a summary overview of standard mitigation measures which are often implemented during offshore oil and gas exploration activities to avoid or reduce potential environmental effects. Environmental monitoring and follow-up programs which are typically required are also discussed, as applicable.

### 2.5.4 Environmental Planning Considerations

Based on the overview of the existing environmental setting of the Eastern Newfoundland Offshore Area and the potential environmental interactions and issues identified through the above, the SEA also then identifies key environmental considerations to help guide future planning and decision-making.

In doing so, this section highlights relevant aspects of the existing environmental setting of the area (particularly important species, areas and/or times). Key planning and management considerations that may help to inform future licencing discussions are identified and described here, as well as any other activity, issue, site or time-specific measures which may help to avoid or reduce potential environmental effects.

### 2.5.5 Cumulative Environmental Effects

Cumulative effects which may result from future offshore oil and gas activities in the Eastern Newfoundland Offshore Area are also assessed as part of the analyses, to the degree possible given that their specific number, characteristics, locations and timing is not known at this stage.

For each VEC, the SEA also considers the potential cumulative effects of offshore oil and gas activities in the Eastern Newfoundland Offshore Area in combination with other projects and activities in the region (e.g., general marine vessel traffic, fisheries).The overall objective at the SEA level is to generally identify and evaluate potential issues with regard to possible cumulative effects, at an early and relatively broad scale of analysis, for general consideration in licencing decisions, but also, for planning and assessing any future associated oil and gas projects to avoid or reduce such effects.

### 2.5.6 Information Availability, Requirements and Opportunities

The SEA also discusses the overall nature and adequacy of available information on each VEC in the SEA Study Area, and identifies any important data gaps and information requirements that may be relevant to planning and decision-making. It also explores any opportunities to add to the knowledge base of the region through future information collection and/or sharing initiatives.

# 3 OFFSHORE OIL AND GAS ACTIVITIES IN THE SEA STUDY AREA

The following provides an overview of the regulatory and planning processes that apply to offshore oil and gas activities in the Eastern Newfoundland Offshore Area (summarized from C-NLOPB 2014). This is followed by a general description of the equipment and activities that are typically associated with oil and gas exploration and development projects, as well as an overview of existing licences and past, on-going and proposed oil and gas activities in the region.

## 3.1 Canada-Newfoundland and Labrador Offshore Petroleum Board

The C-NLOPB began operations in January 1986 and is responsible, on behalf of the Governments of Canada and Newfoundland and Labrador, for petroleum resource management in the NL Offshore Area (see Chapter 1).

The Board reports to both the federal and provincial Ministers of Natural Resources and is comprised of seven persons, three of which are appointed by the federal government, three by the provincial government, and a Chair and CEO that is appointed jointly by both governments.

The overall mandate, role and objectives of the C-NLOPB are as summarized below:

**Mandate**

To interpret and apply the provisions of the *Atlantic Accord* and the *Atlantic Accord Implementation Acts* to all oil and gas-related activities in the Newfoundland and Labrador Offshore Area, and to oversee compliance with those statutory provisions.

**Role**

To facilitate the exploration for and development of the hydrocarbon resources in the Newfoundland and Labrador Offshore Area in a manner that conforms to the statutory provisions for:

- Worker safety
- Environmental protection
- Effective management of land tenure
- Maximum hydrocarbon recovery and value, and
- Canada / Newfoundland & Labrador benefits

**Objectives**

*Safety*

- To verify that Operators have appropriate safety plans in place
- To verify, through audits and inspections, that Operators follow their safety plans and applicable statutory requirements
- To verify, through compliance actions, that deviations from approved plans and applicable statutory requirements are corrected

*Environmental Protection*

- To verify that Operators assess and provide for any effects of the environment on the safety of their operations
- To verify that Operators perform an environmental assessment, pursuant to Canadian laws, of the effects of their operations on the environment and prepare a plan and provide for mitigation where appropriate
- To verify, through compliance actions, that Operators comply with their environmental plans

*Resource Management*

- To effectively and efficiently administer land tenure
- To oversee production activities for consistency with maximum recovery, good oilfield practice, production accounting and approved plans
- To build a knowledge base for the Newfoundland & Labrador Offshore Area through the acquisition and curation of samples and data from exploration and production activity

*Industrial Benefits*

- To verify Operators have an approved Canada / Newfoundland & Labrador Benefits Plan that addresses their statutory obligations

The *Canada-Newfoundland Atlantic Accord Implementation Act* and the *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act,* administered by the C-NLOPB, govern all petroleum operations in the NL Offshore Area (which covers some 185 million hectares in total).

The Board's responsibilities under these Acts include: issuance and administration of petroleum and exploration and development rights; administration of statutory requirements regulating offshore exploration, development and production; and approval of Canada-Newfoundland benefits and development plans.

### 3.1.1 Rights Issuance Process

In the Fall of 2013, the C-NLOPB introduced a scheduled land tenure system to provide for transparency and predictability for rights issuance in the NL Offshore Area. The offshore area has been divided into eight geographic areas and will be administered based on the following cycles based upon activity levels:

- *Low Activity Areas*: 4 -year cycle
- *High Activity Areas*: 2 -year cycle
- *Mature Areas:* 1 -year cycle.

Each geographic area will be divided into sub units referred to as “sectors”. The rights issuance in this scheduled land process will commence with an initial nomination of sectors. Upon sector selection, there will be a period of time appropriate to the cycle for exploration efforts to be undertaken and then a call for nomination of parcels will be issued for lands within an identified sector. A call for bids will be issued for parcels from which successful bidders will be issued an exploration licence. Nominations may otherwise be received for lands that are not offered in a scheduled cycle and a call for bids may be issued. Normally, an interest owner of an exploration licence will explore that licence and, upon finding a discovery, be issued a significant discovery licence to further delineate the discovery in anticipation of finding commercial resources which may lead to the issuance of a production licence. The issuance of a call for bids and the terms and conditions in relation thereto are fundamental decisions approved by the *Accord Acts* Ministers.

Further information on sectors rights issuance and active calls for nominations and bids can be found on the C-NLOPB website at *www.cnlopb.nl.ca*, under "*Legal and Land*".

#### 3.1.1.1 Exploration Licence

Based on the results of the call for bids and their subsequent review by the C-NLOPB, and upon receipt of the required security deposit and Ministerial approval, an exploration licence is issued to the successful bidder. An exploration licence confers:

- the right to explore for, and the exclusive right to drill and test for, petroleum;
- the exclusive right to develop those portions of the offshore area in order to produce petroleum; and
- the exclusive right, subject to compliance with the other provisions of the Act, to obtain a production licence.

The term of an exploration licence does not exceed nine years and cannot be extended or renewed thereafter. Exploration licences have a maximum nine year term consisting of two consecutive periods of five years and four years. Period 1 may be extended with the filing of a drilling deposit. The interest owner is required to drill or spud and diligently pursue one exploratory well on or before the expiry date of Period I as a condition of obtaining tenure to Period II. Failure to drill or spud a well will result in reversion to Crown reserve of the licence, and forfeiture of the security deposit or any balance thereof. If the licence requirement is fulfilled, the interest owner is entitled to obtain tenure to Period II.

It is also important to note that the issuance of an exploration licence for a particular portion of the NL Offshore Area does not, in and of itself, authorize the licence holder to carry out physical exploration activities (fieldwork) within that licence area. The drilling of an exploration well, for example, requires various project-specific regulatory approvals and authorizations, through which the operator must present detailed information on its planned exploration activities, and in doing so, demonstrate that they can undertake such work in a manner that is in keeping with applicable requirements and standards for safety and environmental protection. These required authorizations and approvals are described further in subsequent sections.

#### 3.1.1.2 Significant Discovery Licence

At the expiration of the term of an exploration licence, any portions of the associated offshore area that are not subject to a significant discovery or production licence become Crown reserve. If a drilling program results in a significant discovery and a declaration of same has been made, an interest owner is entitled to a significant discovery licence. A significant discovery is defined in the *Acts* as:

> *A discovery indicated by the first well on a geological feature that demonstrates by flow testing the existence of hydrocarbons in that feature and, having regard to geological and engineering factors, suggests the existence of an accumulation of hydrocarbons that has potential for sustained production.*

Upon receipt of an application for a declaration of significant discovery, the C-NLOPB first determines whether a significant discovery has been made, and if so, indicates the portions of the offshore area where there are reasonable grounds to believe that the significant discovery may extend. The applicant is then notified of the Board's decision and, pursuant to the *Acts*, may request a hearing with respect to that decision. A declaration of significant discovery may also be made by the Board on its own initiative.

A significant discovery licence confers the same rights as that of an exploration licence, and is the document of "title" by which an interest owner can continue to hold rights to a discovery area while the extent of that discovery is determined and, if it has potential to be brought into commercial production in the future, until commercial development becomes viable. A significant discovery licence is effective from the application date and remains in force for so long as the relevant declaration of significant discovery is in force, or until a production licence is issued for the relevant lands. The Crown's position as resource owner is fully protected, notwithstanding this grant of open-ended tenure, by provisions empowering the making of drilling orders, and in the event the discovery is established to be a commercial discovery, development orders.

#### 3.1.1.3 Production Licence

In cases where a commercial discovery is declared, the interest owner is then entitled to a production licence. A commercial discovery is defined as:

> *A discovery of petroleum that has been demonstrated to contain petroleum reserves that justify the investment of capital and effort to bring the discovery to production.*

A declaration of commercial discovery is made in accordance with the same procedure as outlined above for a declaration of significant discovery. A production licence confers:

- the right to explore for, and the exclusive right to drill and test for, petroleum;
- the exclusive right to develop those portions of the offshore area in order to produce petroleum;
- the exclusive right to produce petroleum from those portions of the offshore area; and
- title to the petroleum so produced.

A production licence is effective from the date it is issued for a term of 25 years or for such period thereafter during which commercial production continues.

### 3.1.2 Authorizations and Approvals

The C-NLOPB's regulatory role also includes the issuing of specific authorizations and approvals pertaining to offshore oil and gas exploration (geophysical and drilling programs) and development projects and activities in the NL Offshore Area.

Before carrying out any work or activity respecting oil and gas operations, an Operator must obtain both an Operating Licence and an Authorization as specified in the *Accord Act*. Various authorizations and approvals are also required for particular activities and other matters. A centralized regulatory coordination function has been established within the C-NLOPB to ensure a consistent and timely review of applications for authorizations and approvals.

The following sections provide a brief overview of a number of these authorizations and approvals which are particularly relevant to the SEA.

#### 3.1.2.1 Operating Licence

Again, an Operating Licence is a prerequisite for any oil and gas activity in the NL Offshore Area which involves fieldwork. An individual or corporation may apply for an Operating Licence by completing and forwarding the relevant application form to the C-NLOPB's Legal and Land Department. Operating Licences are issued for a maximum period of one year, are valid from their commencement date until March 31st of the following year and are not transferable. The statutory requirements pertaining to Operating Licences are specified in the *Accord Act* and in the Newfoundland and Labrador *Offshore Area Oil and Gas Operations Regulations*.

#### 3.1.2.2 Authorizations

There are three types of authorizations administered by the C-NLOPB:

1) Operations Authorization
2) Geophysical Program Authorization
3) Diving Program Authorization

In order to obtain an authorization, the Operator must ensure that the statutory and regulatory requirements pertaining to the work or activity are satisfied, including with regard to safety, environment, resource management, exploration, legal and land and industrial benefits.

An Operations Authorization (OA) may include authorization for a drilling program, production project, well operations or all of these activities or other activities or components that are not covered by other types of authorizations. The expiry date of an OA depends on the anticipated duration of the program, and for a drilling program or production project an OA is normally issued for a maximum of three years.

Operators applying to undertake a seismic program, a wellsite seabed survey, vertical seismic profiling, an electromagnetic program, any other type of geological or geophysical program (including any that do not involve fieldwork), a geotechnical program or an environmental program, may apply for a Geophysical Program Authorization (GPA) by submitting one of the following applications to the C-NLOPB:

- Geophysical Program Authorization (2D, 3D Seismic, Wellsite Survey)
- Geological Geotechnical Environmental Program Authorization
- Geophysical Geological Application for Programs Without Field Work
- Vertical Seismic Profile Program Application
- Electromagnetic Program Authorization

The process for obtaining a GPA and a description of the information to be provided in support of the application for authorization is described in the C-NLOPB's *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012), including various processes and measures related to environmental planning, mitigation and reporting. For producing projects, wellsite seabed surveys and vertical seismic profiling can be addressed as part of the OA.

Although an exploration licence is required to undertake drilling activity, such a licence is not required to conduct geophysical surveys. Seismic survey areas can extend beyond exploration licence boundaries.

#### 3.1.2.3 Approvals

C-NLOPB approvals may involve the approval of certain documents, plans or other matters as specified by the legislation or regulations, or the approval of specific activities conducted under an earlier authorization. These include an:

- Approval to Drill a Well
- Approval to Alter the Condition of a Well
- Approval of a Formation Flow Testing Program
- Development Plan Approval
- Approval of a Canada-Newfoundland and Labrador Benefits Plan
- Approval of Flow System and Flow Calculation and Allocation Procedures
- Approval to Commingle Production

Of particular relevance to previous and potential future offshore oil and gas exploration activities in the Eastern Newfoundland Offshore Area, an Approval to Drill a Well (ADW) is required for operations involving drilling within or under the marine environment. An ADW covers the operations on a well up to, and including, the termination of the well, which itself could include suspension, abandonment or completion. A wellsite seabed survey must be completed prior to the issuance of such an ADW. If the well is to be tested, Approval of a Formation Flow Testing Program is also required in accordance with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*.

A Notification to Abandon / Suspend or a Notification to Complete is required to be provided to the C-NLOPB no later than five working days prior to suspending, abandoning or completing any well. A Well Termination Record is required to be provided to the C-NLOPB within 30 days of completing the well termination operations. Any operation following the termination of a well is covered by an Approval to Alter the Condition of a Well (ACW), including re-entering a well following completion of the scope of activities covered by the ADW.

### 3.1.3 Environmental Assessment

In Newfoundland and Labrador, proposed projects may be subject to provincial and/or federal EA legislation and processes.

The Newfoundland and Labrador *Environmental Protection Act* (*NL EPA*, Part 10) requires anyone who plans a project that could have a significant effect on the natural, social or economic environment (an "undertaking") to present it for examination through the provincial EA process. The associated *Environmental Assessment Regulations* list those projects that require registration and review, and outlines the various procedures and timelines associated with the initiation and completion of the EA review of projects and eventual regulatory decision-making. Although proposed projects that involve components and activities that occur primarily or exclusively in the offshore marine environment often do not trigger provincial regulatory interest or associated EA requirements, EA registration, review and approval is at times required for proposed oil and gas exploration and development projects that involve or include on-land or near shore elements.

The *Canadian Environmental Assessment Act* (*CEAA*) is the legislative basis for federal EA in Canada. On July 6, 2012 a new *CEAA* and associated *Regulations* came into force, which updated the nature and focus of the federal EA process, including the projects that it applies to and its various procedural elements. The new federal EA process focuses on potential adverse environmental effects that are within federal jurisdiction, including: fish and fish habitat; other aquatic species; migratory birds; federal lands (including waters); effects that cross provincial or international boundaries; those that affect Aboriginal peoples, such as their use of lands and resources for traditional purposes; and changes to the environment that are directly linked to or necessarily incidental to any federal decisions about a project.

The new *CEAA* also has an associated set of *Regulations Designating Physical Activities*, which identify the physical activities that constitute the "designated projects" that may require a federal EA. These Regulations specify a number of types and scales of onshore and offshore oil and gas development activities that are now subject to federal EA review. Offshore exploration (seismic and drilling) projects and programs are not currently listed specifically in the *CEAA Regulations Designating Physical Activities*. The Minister of the Environment may designate a project that is not currently listed in the *Regulations* if there is the potential for environmental effects in areas of federal jurisdiction or public concerns about such environmental effects.

If the federal EA process does apply to a proposed project, it commences with the proponent's submission of a Project Description document to the Government of Canada for review. Upon receipt of an adequate Project Description from a proponent, the Canadian Environmental Assessment Agency will have 45 days, including a 20-day public comment period, to determine whether to require a federal EA. During this "screening" step, government will examine whether the project may cause adverse environmental effects on areas of federal jurisdiction or as a result of an associated federal decision. If further EA review is deemed to be required, this may take one of two forms: 1) Standard EAs, or 2) Review Panels (with legislated timelines being defined for each). Designated projects that are regulated by the Canadian Nuclear Safety Commission or the National Energy Board automatically require an EA by those regulators. The federal EA process culminates in a decision as to whether or not the project can proceed, and if so, under what conditions.

Following the July 2012 changes to the federal EA process pursuant to *CEAA* (2012) and its *Regulations*, the C-NLOPB announced that it would be continuing with the various EAs that were in progress prior to this new EA legislation. The C-NLOPB has also indicated that, notwithstanding the recent changes to the federal EA legislation and process (and its application), it will be continuing to require that project-specific EAs be conducted and submitted by proponents in relation to proposed oil and gas exploration activities in the NL Offshore Area, in accordance with Section 138(1)(b) of the *Canada-Newfoundland Atlantic Accord Implementation Act* and Section 134(1)(b) of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act*.

As of the time of writing, 11 EAs were in progress related to proposed oil and gas related projects in the NL Offshore Area, including the following on-going assessments related to proposed exploration (geophysical and drilling) programs in the SEA Study Area (C-NLOPB 2014):

1) Electromagnetic Geoservices Canada, Inc. *Controlled Source Electromagnetic (CSEM) Survey 2014-2018;*

2) GXT *GrandSPAN Marine 2D Seismic Gravity and Magnetic Survey 2014-2018*;

3) MKI *Southern Grand Banks Seismic 2014-2018*;

4) Suncor Energy Inc. *Eastern Newfoundland Offshore Area 2D/3D/4D Seismic Program*, 2014-2024;

5) Hibernia Management and Development Company Ltd. *2D/3D/4D Seismic Projects for the Hibernia Oil and Gas Production Field, 2013 to Remaining Life of Field; and*

6) Western Geco Canada, *Jeanne d'Arc Basin Seismic Program, 2012-2015*

In April 2013 the Government of Canada published a proposed set of *Regulations Amending the Regulations Designating Physical Activities* pursuant to *CEAA* (2012), for public review and comment. These identified a number of further proposed changes to the type and scale of projects that the federal EA process would apply to, including the addition of "the drilling, testing and abandonment of offshore exploratory wells in the first drilling program in an area set out in one or more exploration licences" to the list of projects subject to federal EA under *CEAA* (2012). The amendments were subsequently finalized and put into effect in November 2013.

## 3.2 Generic Description of Offshore Oil and Gas Activities

Various types of oil and gas activities may occur in the Eastern Newfoundland Offshore Area following the issuance of exploration licences and other authorizations and approvals by the C-NLOPB. The following sections provide a general description of offshore geophysical (seismic) surveys and drilling programs as they are typically proposed and carried out in the NL Offshore Area. More detailed and specific descriptions of these activities are typically included in project-specific regulatory approval documentation.

### 3.2.1 Geophysical Surveys

In oil and gas exploration, it is imperative to understand the subsurface geology of an area. Drilling is an effective way to learn what is underneath the surface but provides information for a specific location only. For this reason, prior to drilling, geophysical investigations are often conducted in order to get an understanding of what is below the surface.

The science of geophysics applies physical principles to study the Earth. Geophysical surveys can be carried out at or near the surface and provide information about how the subsurface varies vertically and laterally. The scale of a survey can range from an entire Earth investigation down to a small, localized area of interest. By studying and interpreting the results of various geophysical surveys, one can predict the subsurface geology.

#### 3.2.1.1 Types of Geophysical Survey Methods

The following provides an overview of various types of geophysical surveys that may be conducted as part of offshore oil and gas exploration activities (summarized from: Kearey et al 2002; OGP 2011).

Surveying methods generally fit into two categories: 1) those that use the natural fields of the Earth; and 2) those that require an input of artificially generated energy. The natural field methods use Earth processes such as gravitational, magnetic and electromagnetic fields. Knowing how these parameters generally behave, one can look for localized disruptions from the normal background value in the collected data, perhaps caused by a concealed geologic feature. In artificially generated methods, most commonly seismic acquisition, acoustic waves are generated and propagate through the subsurface, reflecting off, refracting along and transmitting through geologic layers of various characteristics. The transmission path of the waves is mapped and subsequently provides information about the geological boundaries at depth.

Generally speaking, natural source methods are logistically easier to carry out and the depths of investigation tend to be greater. Conversely, artificial methods tend to result in a more detailed picture of the Earth's subsurface. Depending on the survey type, data can often be collected via marine, airborne or land-based surveys. Factors such as physical location, cost, time, accessibility and data quality are all considered when deciding which type of survey to carry out, and in some instances, several methods can be carried out.

**Natural Source Methods**

*Gravity Surveying:* In gravity surveying, variations in the Earth's gravitational field due to density differences between diverse subsurface rock types are measured and recorded. A geological body, whose density differs greatly from its surroundings, will cause a change in the Earth's gravitational field, which is known as a gravity anomaly. These anomalies allow the interpreter to gain ideas about the size, depth and rock type of various features. Gravity data can be collected quite easily from an aircraft or a marine vessel using a gravimeter. Due to the relative ease of collecting from a ship, gravity data is often recorded in conjunction with a marine seismic acquisition program.

*Magnetic Surveying*: Magnetic surveys investigate subsurface geology by mapping anomalies in the Earth's magnetic field that result from varying magnetic properties in the underlying rocks. Most of the minerals that compose rocks are essentially non-magnetic; however, some iron rich minerals can produce significant magnetic anomalies. While the nature of magnetism makes it a more suitable survey type for mining prospects, it can provide large scale information about regional geologic structure. Magnetic surveys are performed on land, at sea and in the air using a magnetometer and are likewise often completed in conjunction with other surveys.

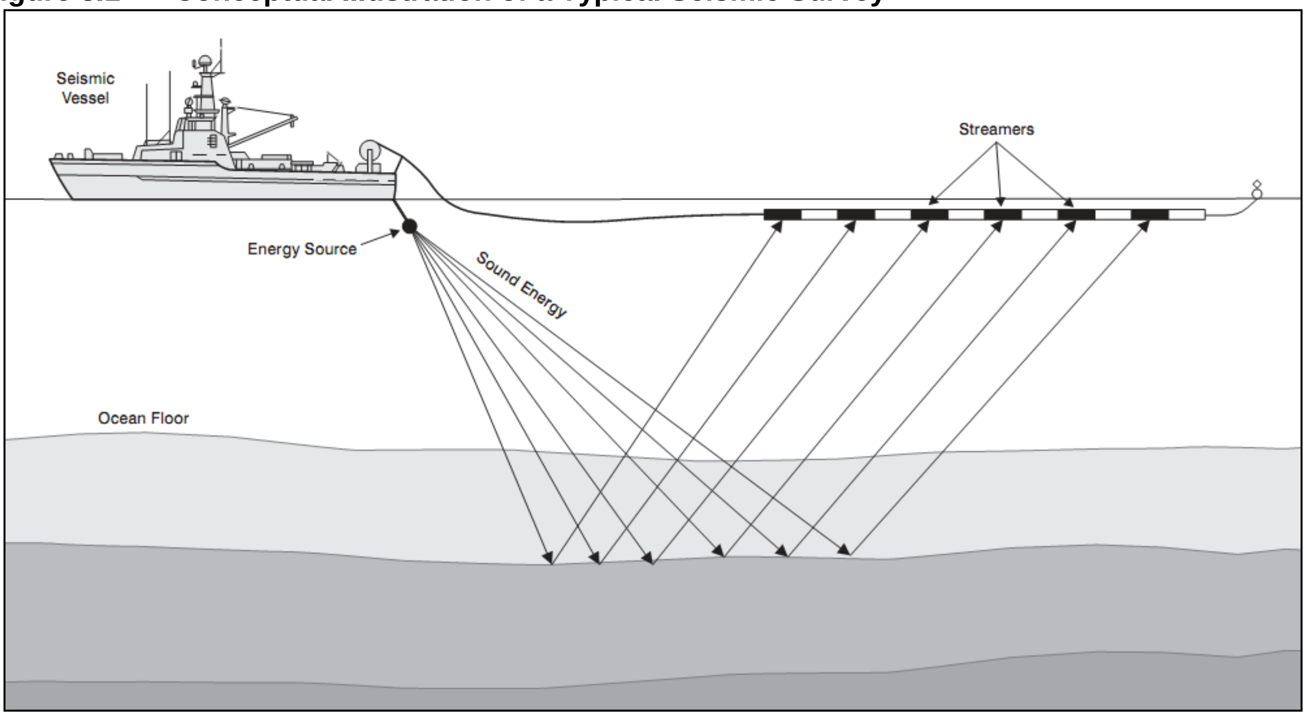
*Electromagnetic Surveying*: Electromagnetic surveying measures the ground's response to propagating electromagnetic fields. Electromagnetic fields are comprised of alternating electrical and magnetic fields, as the changing of one field generates the other. As such, any conductive body beneath the surface will result in the production of strong secondary electromagnetic fields, thus making this a useful tool in remote sensing for ore bodies. Electromagnetic principal can also be utilized for hydrocarbon exploration. Controlled Source Electromagnetics (CSEM), for example, is a marine geophysical technique used to map potential hydrocarbon accumulations below the seafloor. A dipole source that transmits an electromagnetic field is towed by the ship just above the seafloor. The field is altered by the underlying lithology, subsequently detected and recorded by a receiver array positioned on the seafloor. Interpretation of the data can help identify layers that are conductive or resistive. Typically, for hydrocarbon exploration, one looks for the more resistive features, as hydrocarbon bearing formations are relatively more resistive than the surrounding layers.

**Artificial Source Methods**

The primary components of an offshore geophysical survey for oil and gas exploration using artificial sources typically include a seismic vessel, a sound source, receivers (hydrophones) and associated supporting elements and activities. In an offshore seismic survey, high-energy sound sources (airguns) are towed behind a survey vessel while it travels along a track line in a prescribed grid crossing known or suspected hydrocarbon accumulations.

During the survey, the sound source is fired at regular intervals and directs high energy (low frequency) sound bursts toward the seafloor which can penetrate below the surface. The reflected sound energy is then recorded by sensitive hydrophones (streamers, up to several kilometres in length) which are towed behind the vessel. Computer-based data processing systems then convert the reflected sound (acoustic signals) into seismic data that can be used to map possible hydrocarbon accumulations within the survey area (Figure 3.1).

**Figure 3.1 Conceptual Illustration of a Typical Seismic Survey**




*Two-Dimensional (2D) Seismic Surveys:* These seismic surveys cover relatively large geographical areas, and are therefore of short-term duration at any given location. Survey lines tend to be over 1 km apart, and are often laid out in a number of different directions. The 2D survey is typically used for exploring a large area in order to identify sites or zones which may warrant further study, and typically uses a single source array and streamer.

*Three-dimensional (3D) Seismic Surveys:* These enable a greater resolution of potential and known oil and gas fields, and provide a more detailed picture of the area under investigation. These surveys may concentrate activity over a relatively small geographical area for extended periods, with survey lines typically spaced several hundred meters apart. 3D surveys typically use multiple source arrays and streamers.

*2D-High Resolution Survey:* Prior to the spud of a well, an operator must ensure that the well can be drilled legally, environmentally prudently and safely at the chosen location, and its exact location must therefore be verified. The seabed and the geological units just below the seafloor also need to be studied in detail to assess the potential presence of seabed features which might affect drilling and natural gas in the shallow region. For increased resolution of the seafloor and the shallow section surrounding the potential wellbore, 2D High Resolution data is often acquired. The technique is similar to a standard 2D marine seismic program except the source is a small volume compressed air source or a device that generates an acoustic pulse from an electrical discharge. The streamer used is also much shorter and is towed (along with the source) at shallower depths than conventional 2D seismic programs, which allows for higher frequency content from the source and therefore higher resolution data. In addition, side scan sonar and seafloor imagery data may also be gathered, which can further aid in studying marine life and in determining seafloor surface integrity for drilling equipment.

*Wide Azimuth Seismic Survey: A* wide azimuth survey attempts to capture wider offset data than a conventional seismic survey. Although a source produces a spherical wave, the streamers (being essentially linear in a typical seismic program) will only detect rays from a small range of source azimuths. By having additional sources on vessels separate from the streamer towing vessel, the streamer is better able to detect a broader range of signal azimuths. The desired outcome of this is enhanced data quality, in particular the capacity to resolve complex geological features, improved signal to noise ratio, and other outcomes.

While an exploration licence is required to undertake drilling activity, such a licence is not required to conduct seismic surveys, although individual geophysical survey projects require authorizations from the C-NLOPB.

#### 3.2.1.2 Seismic Survey Equipment and Methods (Artificial Source Methods)

An offshore seismic survey vessel is typically approximately 75-90 m (250-300 feet) in length, depending on local conditions and the particular characteristics of the survey and associated equipment requirements, with a crew of about 40-50 personnel. A high-energy sound source in the form of one or more airguns (each usually comprised of a steel cylinder charged with high pressure air) is towed behind the survey vessel at approximately 5-10 m below the water surface. The vessel travels along the track line in a prescribed grid at a speed of approximately 4-5 knots (7.5–10 km/h) while recording (or approximately 10 knots (20 km/hr) while in transit with towed gear onboard), similar to trawling fishing vessels. The seismic survey grid and its associated transects are carefully chosen to cross any known or suspected hydrocarbon prospects in the area.

During the survey, the sound source(s) is typically fired approximately every 25 m, and directs bursts of sound downward toward the seafloor. These source arrays are towed approximately 100-200 m behind the survey vessel, and send sound waves through the water, with geological formations beneath the seafloor then reflecting the sound waves back to one or more hydrophone streamers trailing behind the vessel. Each of these receiver arrays are typically between 5 and 10 km long and several hundred meters wide, and are towed approximately 5-15 m below the water surface. A tail buoy with radar reflectors is often attached at the end of each streamer (Figure 3.1). During a seismic survey, the vessel sails along a track for approximately 12-20 hours, depending on the size of the study area and local conditions. At the end of each transect the vessel turns around (which can take several hours and cover a radius of up to 10- 15 km) and then continues along the next transect to complete the survey grid. Seismic operations can usually continue in sea states of up to approximately 5 (based on the Beaufort Scale), or significant wave heights of about 3 m (10 feet).

#### 3.2.1.3 Sound Propagation during Offshore Seismic Surveys

During seismic surveys, multiple (often 20-30) airgun units are typically used, with individual source unit volumes ranging from about 70 to 250 cubic inches with a combined chamber volume of between 2,000 and 5,000 cubic inches and operating at about 2,000 pounds per square inch (psi). Based on these specifications, the total pressure per source for those array source volumes would be between 137 to 172 Bar-meters, and the peak-to-peak pressure output will be between approximately 240 and 260 dB re 1 µPa @ 1 m. The larger source units are typically positioned at the front of the array with progressively smaller volumes towards the back. For each air source unit, the amplitude of the acoustic signal is a function of the volume and pressure of the air inside the cylinder and the cylinder's depth under the water surface, measured as the output Sound Pressure Level (SPL).

At the commencement of a planned offshore seismic survey, just prior to arriving at the start of a survey line, the airgun array is slowly brought up to a specified power, a procedure referred to as a "ramp up" or "soft start". This procedure is intended to allow mobile marine animals to temporarily vacate an area if they perceive the sound levels as a disturbance (this standard mitigation measure is discussed further in Chapter 5 of this report). The firing of an air source generates an oscillating bubble in the surrounding water. At the time of firing, the pressure of the air inside the cylinder exceeds the outside pressure in the surrounding water. This difference in pressure causes a bubble to rapidly expand in the water around the air source, and it is this initial bubble expansion that generates the relatively broadband seismic pulse.

The output of an air source array is a function of the time vs. pressure and frequency involved. During the conduct of an offshore seismic survey, airguns are usually fired at approximately 5-10 second intervals, with seismic shots being of short duration, at most a few tens of milliseconds (ms). Although peak energy levels within a shot may be high, the short signal duration limits the total energy transmitted into the water column. The frequency characteristics of an air source array signature relate to how the signal sounds, with hertz (Hz) being the unit of measure for frequency. Air source signatures are referred to as broadband, as they contain a range of frequencies. Most of the sound energy produced by an airgun array is in the range of 10-300 Hz, with highest levels at frequencies of less than 100 Hz (Turnpenny and Nedwell 1994). For the purpose of evaluating the environmental implications of an air source, the signature is typically reported at the widest bandwidth.

During an offshore seismic survey, the arrays are configured in such a way as to maximize the amount of seismic energy projected vertically into the geologic formation being surveyed (a characteristic known as "directivity"). Although the direction of the greatest energy intensity is directed vertically downwards from the array, some is radiated in directions away from the beam axis and into the surrounding environment. Because of the pattern of air source placement in an array, the signature changes as a function of direction (azimuth) and emission angle (angle from the vertical). The firing times for all the air sources in the array are synchronized to ensure that the primary pulses from each gun align exactly with one another along the vertical axis of the array. These differences in the array signature with respect to direction and angle from the vertical are referred to as the array response. These differences are known as the acoustic radiation pattern and can be calculated and mapped in three dimensions.

The underwater sound generated from a seismic array diminishes with increasing distance from the source. This is referred to as transmission loss, and it is influenced by geometric spreading losses and attenuation. Pressure measured at some distance away for the air source array is often determined by using a model of spherical and cylindrical spreading. Sound travels out in a progressively large area from the sound source in all directions. This unrestricted spreading in water is called spherical spreading. The loss is described as $20 \log_{10} R$ dB, where R is distance from the source in metres. This calculates to a transmission loss of about 6 dB with each doubling of distance from source.

There are, however, various other factors that contribute to the nature and rate of decay in a sound wave in the marine environment, including frequency as well as local conditions such as water temperature, water depth and bottom conditions. The energy can also be trapped between the sea surface and the seafloor and other obstructions (e.g. thermal layers), thus channelling it. Therefore, sound in the marine environment typically spreads in a cylindrical fashion (Davis et al 1998; Thomson et al 2000). The transmission loss is half that of spherical spreading, and is then described as 10 log R dB, a loss of about 3 dB with each doubling of distance.

In summary, therefore, although this simple spreading discussion provides some general insight into the attenuation of sound from seismic surveys through the marine environment, a number of other activity and site-specific factors may also influence its propagation in the marine environment.

#### 3.2.1.4 Other Emissions and Potential Accidental Events and Malfunctions

Other potential emissions and discharges that may be associated with marine-based seismic surveys include vessel discharges (such as deck drainage, sanitary waste), atmospheric emissions (exhaust) and the noise and general presence of vessels and lights associated with offshore survey activity.

Because seismic surveys do not result in the recovery of hydrocarbons, the potential for and likely magnitude of any accidental events that could be associated with such surveys are considerably lower than for other type of offshore activities. As is the case for marine vessel activity of any sort, there is, however, always the possibility of accidental events occurring at sea, ranging from small spills of fuel and other materials to possible collisions with marine life, fishing gear and/or other vessels and human activities, which may in turn have implications for the natural and human environments.

### 3.2.2 Offshore Well Drilling (Exploration and Delineation)

Exploration and delineation wells are drilled to confirm the presence, or define the extent, of oil and gas resources at particular locations. Exploration wells are drilled to determine whether areas of interest identified from previous geophysical surveys contain oil and gas resources. Depending on the results of these wells, an operator may then drill delineation wells into different parts of the identified hydrocarbon accumulation to confirm its size and the characteristics of the hydrocarbons found.

As of September 2013 there had been 394 wells drilled in the NL Offshore Area, including 154 exploration wells (39 percent), 53 delineation wells (13.5 percent) and 187 development wells (47.5 percent) (C-NLOPB 2014). The following provides a brief description of typical well drilling equipment and procedures that have been or may be used in the Eastern Newfoundland Offshore Area.

#### 3.2.2.1 Offshore Drilling Installations

Exploration drilling rigs used off the coast of Atlantic Canada are often referred to as Mobile Offshore Drilling Units (MODUs) which, as the name suggests, are moved from well site to well site as required (CAPP 2006). A number of types of MODUs can be used to drill a well once a specific drill site or target is determined, with three types of installation typically being used to drill offshore wells in Atlantic Canada:

1) *Semi-Submersible Drilling Units*;
2) *Drill Ships*; and
3) *Jack-Up Drilling Units*.

The type of rig chosen is often based primarily on the characteristics of the physical environment at the proposed drill site, particularly water depth, expected drilling depth and expected weather and ice conditions and associated mobility requirements. A brief description of these various types of drill rigs is included below (summarized from CAPP 2006).

*Semisubmersible Drilling Units* are typically used in relatively deep waters (70-1,000 m on anchor or at greater depths using dynamic positions systems) or in areas where increased mobility is required due to ice or other factors and operational risks. These units can either be towed to the drill site or move under their own power, and are designed for drilling in rougher seas. The main deck of the unit is supported by a series of vertical columns, which in turn sit atop steel pontoons that float below the water surface during operations. The pontoons are filled with water so that the unit floats with the main deck above water and the remainder below the surface, and the platform can be raised or lowered by adjusting the amount of ballast water they contain. Because much of the mass of the rig is below water, these units are relatively stable in rough seas. On site, the unit is moored to the bottom with a series of large anchors, and in deeper waters (over 1,000 m), these units utilize a dynamic positioning system in which thrusters position the vessel and keep it steady (Figure 3.2).

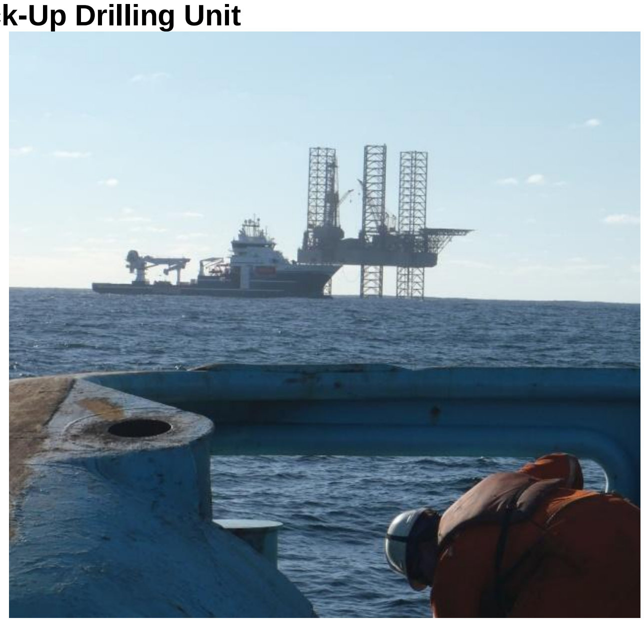
**Figure 3.2 Typical Semisubmersible Drilling Unit**

*Drill Ships* are the most mobile type of drilling installation, and are also typically used in areas of relatively deep water. These are ships which contain complete drilling systems, and are almost entirely self-contained and can therefore operate at remote sites with limited support. Drill ships can be anchored to the bottom in water depths of approximately 200-1,000 m, with dynamic positioning systems allowing some drill ships to operate in waters depths of over 1,000 m. Drill ships typically have a derrick near the centre of the vessel hull which contains and operates the drilling equipment, where a moon pool provides access from the deck surface through the centre of the ship to the water surface (Figure 3.3).

**Figure 3.3 Typical Drill Ship**

*Jack-Up Drilling Units* are typically used in shallow water depths of between 10 and 100 m. These units are towed to a drill site, at which time the rig's 3-4 retractable legs are placed above the hull structure. Once on site, the legs are lowered until they come into contact with and rest upon the sea floor, and the drilling barge or unit platform is elevated up the legs until it is at the desired height above the sea surface (Figure 3.4).

**Figure 3.4 Typical Jack-Up Drilling Unit**



The overall purpose of a drill rig is thus to provide a stable and safe supporting infrastructure at the drill site in order to house and operate the drilling equipment, the main components of which include the:

- *Drill String* (piping which connects the rig to the drill bit);
- *Drill Bit* (the device at the end of the drill string that cuts through the seabed);
- *Rotation Equipment* (electric or hydraulic motors for turning the drill string, and thus the drill bit), and
- *Drilling Muds* (fluids which lubricate and cool the drill bit and hole, circulate cuttings and carry them back to the surface, and maintain pressure in the well).

Drill rigs therefore allow for the raising and lowering of the drill pipe and drill bit, the movement (rotation) of the drill bit, and the installation and circulation of drilling fluids. Each of these types of drill rigs are essentially self-contained, provide access to the ocean surface and water column to facilitate drilling into the seabed, and include the above noted drilling equipment housed within a derrick mounted over the drill floor.

Offshore drilling installations also contain associated support infrastructure and facilities such as transportation facilities (for helicopters and support vessels), work areas, safety equipment and crew accommodations.

#### 3.2.2.2 Offshore Drilling Activities

The following general description of the various drilling activities that may occur in the SEA Study Area is based on existing and available (general) descriptions of offshore drilling (such as from LGL Limited et al 2000; CAPP 2005, 2011) and is intended to provide general background and context for the SEA. Again, more detailed and specific descriptions of offshore drilling equipment and activities are typically included in project-specific EAs and other documentation.

Once the drilling unit being used in a particular offshore drilling project arrives and is positioned at the planned well site, drilling typically occurs in a number of stages. Geohazard surveys are often conducted prior to drilling to assess the potential for hazards (such as potential obstructions, seabed instability), typically using sonar (multi-beam or side scan), video surveys, bottom sampling or small seismic arrays.

Offshore exploration wells are usually drilled over a period of one to several months, as follows:

1) *Conductor hole*: Initially a large diameter (approximately 1 m wide) hole is drilled at the beginning of the well, usually to several hundred meters below the seafloor, which is then used to install and set the equipment required for drilling the well to depth. Water-based drilling mud (WBM) is used to drill this portion of the well, and as there is no equipment in place to return them to the drilling unit at this early stage (before the riser is installed), these drilling muds and rock cuttings are released onto the seabed.

2) *Casing installation*: Once the conductor hole is completed, the drill string is removed, followed by the running and cementing of steel pipe and the installation of the blow-out preventer and

drilling riser. The casing helps to strengthen and stabilize the wall of the conductor hole and to prevent the seepage of muds and other fluids during drilling. The blowout preventer comprises a system of high pressure valves that prevent water or hydrocarbons from escaping into the environment in the event of an emergency or equipment failure during drilling. The drilling riser connects the casing set at the seafloor up to the drilling unit, and therefore allows muds and cuttings to travel back to the rig for processing and disposal.

3) *Well drilling*: With the casing and associated equipment in place, the drill bit and riser are lowered into the conductor hole from the derrick. Drilling begins at the bottom of the initial (conductor) hole and then continues on to the desired depth under the seabed. Drill pipe sections are added as drilling continues and progresses. As sections of well are completed, the drill string is pulled out of the well and the sections of the casing are joined together, lowered into the well, and cemented into place. The circulation equipment includes high pressure pumps, equipment to separate rock cuttings from the fluids, and storage facilities for the used fluids once retrieved.

4) *Vertical Seismic Profile (VSP):* Also referred to as a check-shot survey, a VSP is undertaken following completion of drilling to confirm well depth. The VSP is undertaken by placing a string of receiver (geophones) down the well, with a seismic source (usually mid-sized airguns) suspended from the drilling unit. The checkshots are recorded at multiple intervals down the well, and the resulting information assists in determining and confirming the depth of the drilled well and for reconciling drilling information with that obtained through seismic survey work.

5) *Well evaluation and testing*: If significant hydrocarbons are found during an exploration drilling program, formation fluids (which may contain hydrocarbons and/or water) flow to the drilling unit are often obtained and tested. During such testing, produced hydrocarbons are separated from any produced water on the drilling unit and are analysed. Any produced water is sent to the rig's flare or treated for disposal.

6) *Well abandonment*: Once drilling and any associated well testing is completed, offshore wells are typically then abandoned. Cement mixtures or mechanical devices are used to plug the well, the casing is cut and removed just below the surface of the seafloor and all equipment is removed. Wellheads are removed from the seafloor, often using a mechanical casing / wellhead cutting device. In the event that this device fails, operators often use a chemical / directed explosive method to detach the wellhead. A remotely operated vehicle (ROV) or other equipment is used to inspect the seabed to ensure that no equipment or obstructions remain in place.

Supply vessels and helicopters are used to transport personnel, equipment and materials to and from a drilling rig during an offshore drilling program. Supply vessels typically make several round trips per week to the drilling unit throughout a drilling program, and a dedicated stand-by vessel also usually attends the rig throughout the drilling program. Personnel are usually transported to and from the drilling rig by helicopter, according to work schedules and rotations, workforce numbers, distances and the type of aircraft being used.

Throughout the duration of an offshore drilling program in the NL Offshore Area, other marine vessel traffic is restricted within a defined area surrounding the drill unit as a safety precaution. As specified in the *Newfoundland Offshore Petroleum Drilling and Production Regulations*, this safety zone is usually the greater of either the area within a 500 m radius of the drill unit or, if the unit is anchored, a zone 50 m from the anchor pattern, as per the requirements of the *Collision Regulations* under the *Canada Shipping Act* (2001). Notices to Mariners and other measures are also used to communicate the presence and nature of these drilling activities and associated safety zones to other vessels and marine operations in the area.

### 3.2.3 Offshore Oil and Gas Production

Offshore oil production activities in the Eastern Newfoundland Offshore Area have been on-going since the 1990s, with several producing oilfields which have produced approximately 1.4 billion barrels (as of October 31, 2013) , and another currently under development.

Although the specific nature of these existing oil production projects and their associated components and activities often varies in general there are a number of common elements in that they typically involve:

- Construction of production platforms (GBS, FPSO and associated topsides) or portions thereof at a Newfoundland and Labrador and/or international location, and their eventual assembly. This has also involved the development / expansion of suitable construction and fabrication facilities in the province;

- Drilling of the required on-site production and injection wells (to increase or maintain reservoir pressure), and installation of the required subsea facilities, including wellheads, trees, manifolds, flowlines, umbilicals, risers, seabed structures (including drill centre excavations), control systems and all interfaces required to control and operate the facilities and associated test, installation, inspection and maintenance equipment;

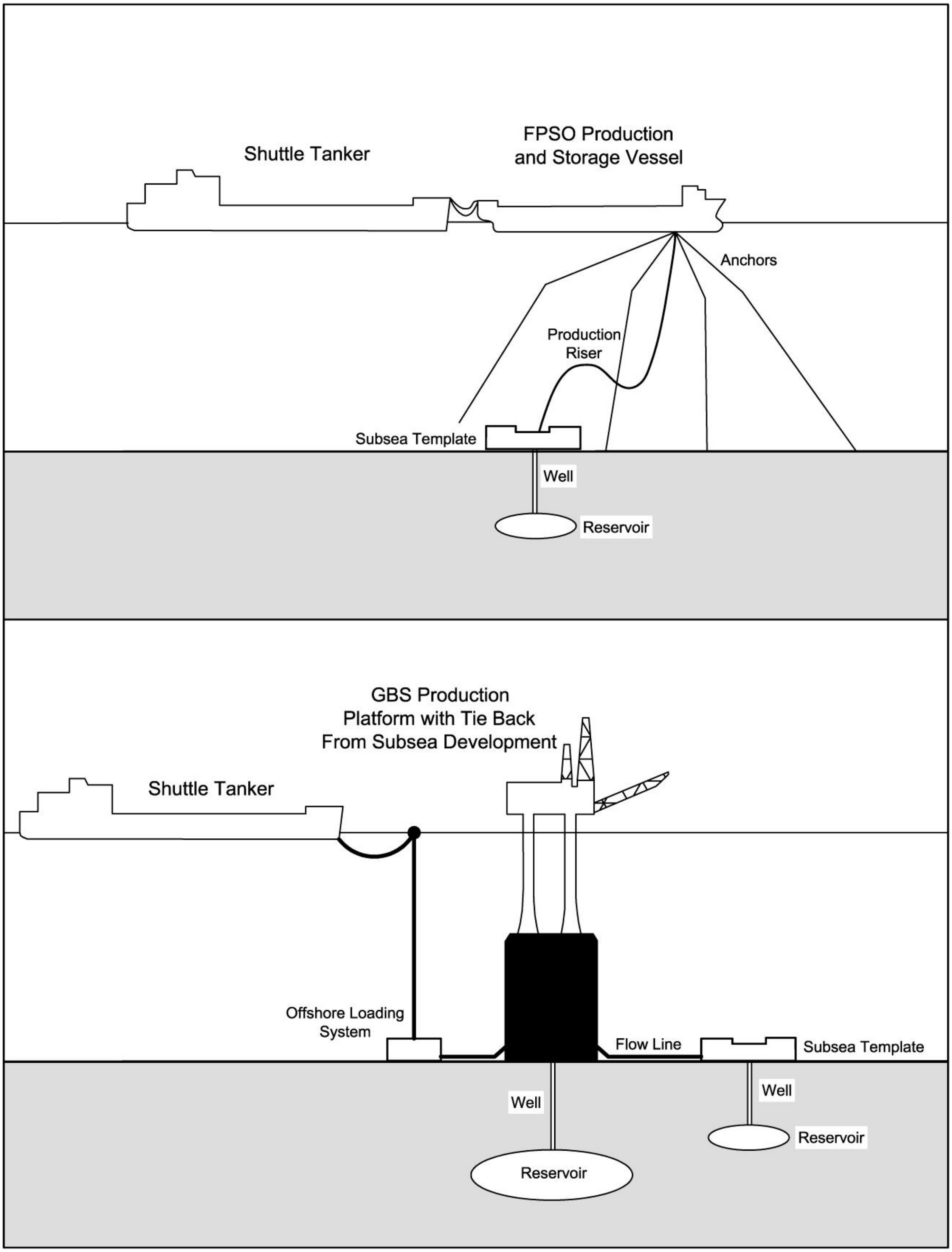
- The eventual transportation of the production platform to the site and its interconnection to the subsea infrastructure, followed by system testing, inspection and commissioning and eventually, first oil;

- On-going operational (production) and maintenance activities, including: well drilling; petroleum recovery, storage and regular transportation by shuttle tankers to processing facilities; water and gas injection into the geological reservoir for pressure maintenance; associated supply vessel and helicopter traffic; on-shore management and administrative functions; and other operational and maintenance activities throughout the life of the project; and

- Eventual decommissioning and well abandonment procedures.

A schematic of various types of offshore oil and gas production facilities and their associated components is provided in Figure 3.5 for general illustration.

**Figure 3.5 Generalized Schematic of Offshore Oil and Gas Production Facilities**



### 3.2.4 Potential Emissions from Offshore Exploration Drilling and Production

Although there may be some variations in drilling equipment and activities between operators and their programs, for the most part the various elements of a drilling program are fairly typical in terms of the primary equipment, materials, and actions involved, and therefore, in the types and volumes of their associated emissions and discharges.

The primary potential emissions and discharges that are typically associated with offshore drilling operations include:

- Drill muds and cuttings;
- Produced water;
- Other liquids and solids (e.g., sanitary wastes, deck drainage); and
- Atmospheric and noise emissions.

Again, drilling muds are fluids that are circulated in oil and gas wells to clean and condition the hole, to lubricate the drill bit and to counterbalance formation pressure. Wells may be drilled using either water-based mud (WBM) or a combination of WBM and synthetic-based mud (SBM). All substances that make up drilling muds are evaluated through the chemical management system developed by the operator in consideration of the *Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands* (NEB et al 2009).

As also indicated, the initial drilling phase typically uses WBM, the primary component of which is seawater, with other additives (primarily bentonite (clay), barite and potassium chloride). Other approved chemicals are also added as required to control and achieve the required mud properties. As the initial (conductor) portion of a well is drilled without a riser in place, the drilling muds and cuttings that are used in and result from these initial drilling activities are discharged directly to the seabed. WBMs may therefore be discharged onsite from offshore installations where these meet applicable guidelines and other regulatory requirements.

Synthetic-based muds (SBMs) may be used in drilling lower well sections if the use of water-based fluids is technically impractical. SBMs are used in potentially difficult drilling situations, such as wells drilled in reactive shales, deep wells, and horizontal and extended-reach wells where WBMs do not offer consistently good drilling performance. SBM does not react with high clay content shales where WBM may hydrate and expand into the wellbore. Gas hydrates are suppressed with SBM and the stability and flexibility of mud properties allows proper hole cleaning. SBM also prevents the formation of hydrates in blowout preventers in deepwater wells. SBMs were developed to replace oil-based muds that were historically used in drilling activities. The toxic components of the oil based fluids have been essentially removed in the synthetic based fluid, rendering then virtually non-toxic. Under the *Offshore Waste Treatment Guidelines* (OWTG), other than residual base fluid retained on cuttings (as described below) no whole SBM or any whole SBM mud is discharged to the sea.

During the drilling of an offshore well, once the conductor hole is completed and when the riser and blow-out preventer are installed and in place, drill muds and cuttings can be returned to the surface and on to the drill rig for recovery and reuse. Once onboard the rig, drill (rock) cuttings are removed from the drilling muds in successive separation stages. Some fluids are reconditioned and reused, while spent SBM is returned to shore for disposal. SBM-associated drill cuttings may be discharged at the drill site provided they are appropriately treated prior to discharge in accordance with proven and practicable best available technologies and practices (defined as a concentration of 6.9 g / 100 g or less oil on wet solids) (NEB et al 2010).

Produced water is the largest single wastewater stream in oil and gas production (NRC 2002). Produced water includes formation water, injection water and process water that is extracted along with oil and gas during petroleum production. At most offshore production installations, this water is separated from the petroleum process stream and, after treatment, is discharged to the marine environment or disposed of in a subsurface formation (see below).

Drilling units may also produce a variety of other solid, liquid and gaseous wastes and emissions, including:

- sewage and food waste;
- ballast water;
- bilge water;
- deck drainage;
- discharges from machinery spaces,
- cement and cementing products;
- cooling water;
- blowout preventer fluid;
- other solid wastes;
- atmospheric emissions (including light); and
- noise.

Waste materials and other discharges and emissions associated with offshore drilling rigs must be managed in accordance with the OWTG (NEB et al 2010), which typically involves treatment of these materials prior to discharge and/or required on-shore disposal. Although adherence with these guidelines does not completely prevent the potential for any environmental effect, they do outline recommended practices and standards for the treatment and disposal of wastes from oil and gas drilling and production operations in Canada's offshore areas, and for sampling and analysis of waste streams to ensure compliance with these standards. The Guidelines are intended to be the minimum standards to be applied by the C-NLOPB in making decisions related to waste treatment, disposal and monitoring. The OWTG are periodically reviewed (scheduled every five years) or if circumstances determine that it is necessary (e.g. information on certain wastewater treatment technologies has shown a decrease in the loadings of the OWTG parameters to the receiving environment).

All chemicals to be used in drilling programs in the NL Offshore Area are screened through the *Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands* (NEB et al 2009). These Guidelines are used by industry in making decisions related to the selection of chemicals to be used in offshore drilling and production activities, and to the treatment and disposal of the chemicals selected. Although adherence to these Guidelines does not completely avoid the potential for any type or level of environmental effect, they are intended to provide a consistent framework for chemical selection as part of the environmentally responsible management of chemicals used in offshore drilling and production activities. They are also periodically reviewed (scheduled every five years) or if circumstances determine that it is necessary (e.g. information on certain chemical usage has shown impacts to the receiving environment).

Atmospheric emissions during drilling activities may include exhaust from equipment, as well as emissions from the storage and flaring of hydrocarbons associated with well testing (where required). From the burning of diesel fuel for power generation on the drill unit and other routine activities, the primary air contaminants would be carbon dioxide ($CO_2$), carbon monoxide (CO), sulphur oxides ($SO_x$), nitrogen oxides ($NO_x$) and particulate matter. Depending on the type and size of the drilling unit, the estimated consumption of marine diesel would typically be in the range of 100-150 barrels per day, with the associated air emissions therefore being comparable to that from a single large container ship of the type that commonly transits through Newfoundland and Labrador waters (Stantec 2011).

If hydrocarbons are present and well testing is conducted, produced water may be encountered. Water contaminated with hydrocarbons generated during flow testing (within certain tolerances), can be atomized in the flare (using high efficiency burners) or shipped on-shore for disposal. If this capacity is exceeded, small amounts of treated produced water may be treated to comply with the *Offshore Waste Treatment Guidelines* and disposed of offshore or brought ashore for disposal through a licenced waste management contractor. The amount of produced water potentially encountered during exploration drilling is typically very small compared to that during production operations. Flaring, if required at all during exploration drilling, is therefore typically an intermittent and short-term activity. Noise emissions associated with an offshore drilling program include those associated with drilling itself, as well with the rig's position systems, support vessel traffic and other activities. Environmental Protection Plans (EPPs), including a Waste Reduction Plan, are typically required for offshore exploration projects to address these routine discharges and emissions.

Many of the potential environmental issues and interactions which may be associated with oil and gas production activities are similar to those associated with offshore exploration drilling, and include: air emissions, lights, noise, domestic and sanitary waste, and cooling water (LGL Limited 2005), although some of these will differ in magnitude or relative importance as compared to exploration programs given the nature, larger scale and longer duration associated with production activities (e.g., produced water and its management, seabed excavation and associated habitat alteration and sedimentation, support vessel and aircraft traffic).

Other potential environmental issues and interactions which may be associated with offshore drilling activities (exploration, delineation and/or production) are described in Chapter 5.

### 3.2.5 Potential Accidental Events and Malfunctions

During an offshore exploration drilling or production project, an accidental event or malfunction is an unlikely (based on the statistics provided in this section), although unfortunately possible, occurrence. Environmental incidents that may be associated with offshore drilling activities include potential blowouts (subsea and surface), as well as other possible batch spills of hydrocarbons or other substances from a drill rig, production platform and/or associated vessel activities. These events may vary considerably in terms of their nature, scale, duration and potential environmental consequences.

A blowout is an unplanned and uncontrolled release of petroleum from a subsea oil or gas well after a failure in the drilling system and its associated pressure control mechanisms, resulting in the continuous discharge of hydrocarbons into the surrounding waters. Blowout events could potentially occur at various stages of drilling and locations within the drilling installation (subsea, above surface), the nature, duration, behaviour and outcomes of which depend on various factors, such as water depth, the amount and properties of the hydrocarbons involved, currents and other oceanographic features, and other factors.

Batch spills to the marine environment can occur during the standard and routine use, storage and movement of fuels, drilling fluids, lubricants and other chemicals and substances on offshore installations and supply vessels. These often comprise instantaneous or short-duration discharges of oil or other materials into the marine environment during planned drilling activities. An example of batch spills is the accidental releases of SBM. These may include accidental deck release, a subsurface release through a crack / orifice in flex joint, riser or lines (possibly due to leaky or ageing equipment), or a bottom release due to an emergency riser disconnect event (due to hazardous weather or other cause).

#### 3.2.5.1 Spill History of the Offshore Oil and Gas Industry

Several information sources and statistics are available to characterize and quantify the relative proportion of petroleum types and sources released from oil and gas exploration and production activities into the marine environment. United States sources are often quoted due to the relatively long reporting period (since 1964, with frequent updates since then), as well as the high standard of reporting and analyses completed. As well, the proximity of the US operations to Atlantic Canada and generally similar drilling equipment and practices make these data particularly relevant and informative. Updates are made to the spill record as incidents occur, so that an evaluation of the most recent occurrence of events and possible trends is also possible using this information.

In the US, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly the Minerals Management Service (MMS), was replaced in October 2011 by the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE) as part of a major reorganization. Together with the US Coast Guard (USCG), BSEE shares responsibility for reporting on all deaths, serious injuries, major fires and major oil spills resulting from oil and gas exploration, development and production on the US Outer Continental Shelf (OCS). This includes Gulf of Mexico (GOM) and Pacific (PAC) activities, although over the past number of years the vast majority of activity has been in the Gulf of Mexico. While some drilling close to shore (generally between 3 and 9 nautical miles) falls under the respective state jurisdictions, this comprises a very small percentage of offshore activity in the US, and so that the sample set considered in these statistics is considered representative of the vast majority of drilling activities.

For the US OCS, the comprehensive database of substantial spills (greater than 50 bbl, or 7.95 $m^3$) resulting from oil and gas activities compiled by BSEE provides up-to-date statistics (BSEE 2013). From these data, Figure 3.6 presents annual counts of the numbers of all petroleum spills from OCS oil and gas activities from 1964 to 2012. This includes platforms / rigs, pipelines, and vessels, and counts of spills greater than or equal to 1 bbl and greater than or equal to 50 bbl. Figure 3.7 presents the total volume of all spills for the same activities and time period. Figure 3.8 presents a breakdown of the product associated with each spill incident which has been reported since 1996.

As shown in Figure 3.6 (BSEE 2013), the number of spills reported for the US OCS was comparatively small from 1964 until peaking in 1971 with 274 spills greater than or equal to 1 bbl and 11 spills greater than or equal to 50 bbl. A decreasing trend is evident until about 1989 after which the number of spills remained about constant, averaging 34.6 and 5.5 spills per year until 2003. The number of spills increased again in 2004 and 2005, and again in 2008, before 24.8 and 6.8 spills per year were averaged between 2009 and 2012. As noted by MMS at the time (August 2006), “The 2004 increase is due to Hurricane Ivan which accounted for 15 of the 24 spills. Ivan is the first hurricane for which unrecovered petroleum and chemicals on destroyed, heavily damaged, and/or missing structures were reported in a comprehensive manner”, and “The 2005 increase is due to Hurricane Katrina which accounts for 24 spills, and Hurricane Rita which accounts for 18 of the spills. Only seven of the spills are not hurricane-related. Katrina and Rita are the second and third hurricanes (following Ivan) for which unrecovered petroleum and chemicals on destroyed, heavily damaged, and/or missing structures were reported in a comprehensive manner”.

Due to a range of circumstances and conditions it is difficult to predict occurrence rates for oil spills with a high degree of certainty. It is clear from the above, however, that environmental conditions can play a significant role in determining spill occurrence rates. As noted in Chapter 4, the SEA Study Area is subject to hurricanes, tropical and post-tropical storms in the North Atlantic which can occur during the months of June through November. Additionally, extra-tropical cyclones can occur at any time of the year. Intense extra-tropical cyclones with the potential for hurricane force winds are more likely during the months of November through March. The possible implications of such events for a drilling project must be considered in planning. Ever-changing environmental conditions will also continue to be a possible compounding factor.

The total annual volume of spills in the US OCS is shown in Figure 3.7 (BSEE 2013). There are peaks in the total spill volumes up to 90,000 to 161,000 bbl (approximately 26,000 $m^3$ or 26 million L) from 1967 to 1970. Total annual spill volumes reached about 20,000 bbl in 1973, 1974, 1988 and 1990. Excluding those four years, from 1971 through 2009 the annual spill volume is fairly constant, averaging 2,600 bbl. The Deepwater Horizon spill in 2010 resulted in an estimated 4.9 million barrels (before accounting for containment) of crude oil released (USCG 2011), although the actual spill amount remains to be determined (BSEE 2013). Although drilling activity details such as type of drilling platform, water depth, and type of well would be typically recorded with many incidents, a breakdown of spill statistics by these parameters to identify possible occurrence rates or trends is not readily available from any of the above-described sources. Petroleum spills by type for the period 1996 to 2012 are summarized in Figure 3.8

**Figure 3.6 Number of Petroleum Spills from US OCS Oil and Gas Activities (1964–2012)**

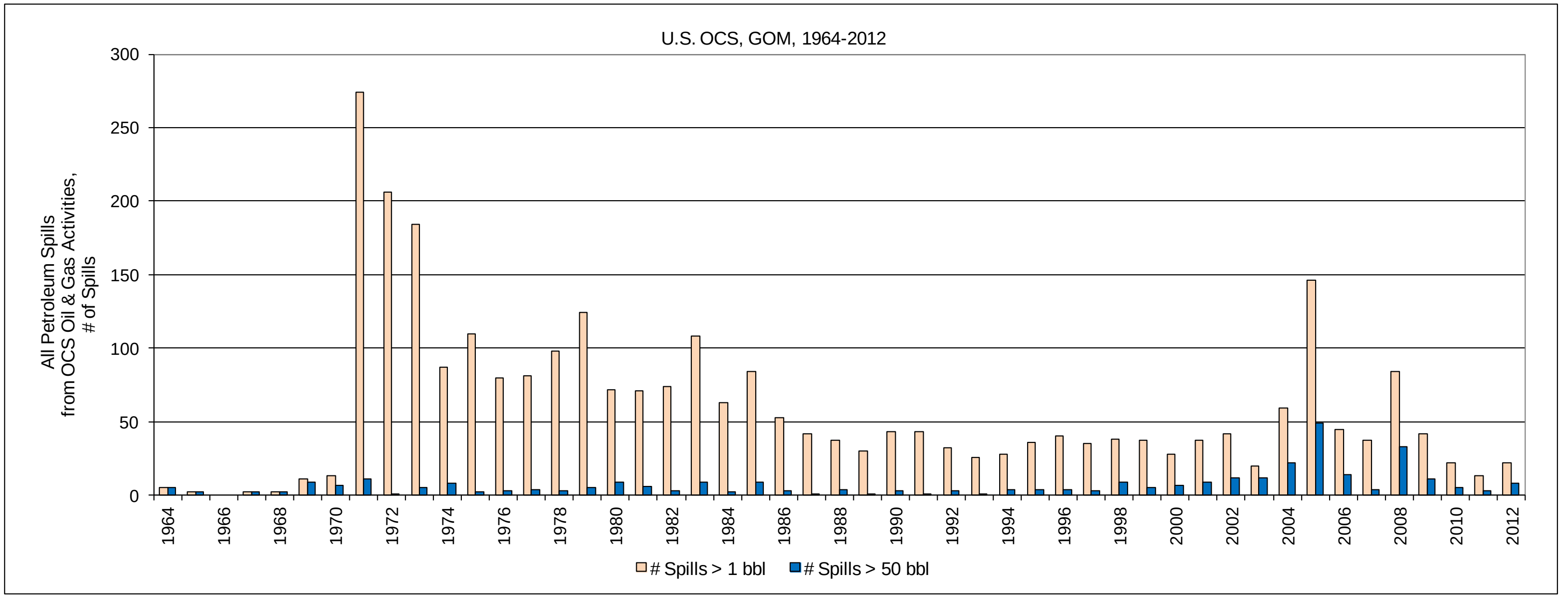



**Figure 3.7 Total Spill Volumes from US OCS Oil and Gas Activities (1964–2012)**

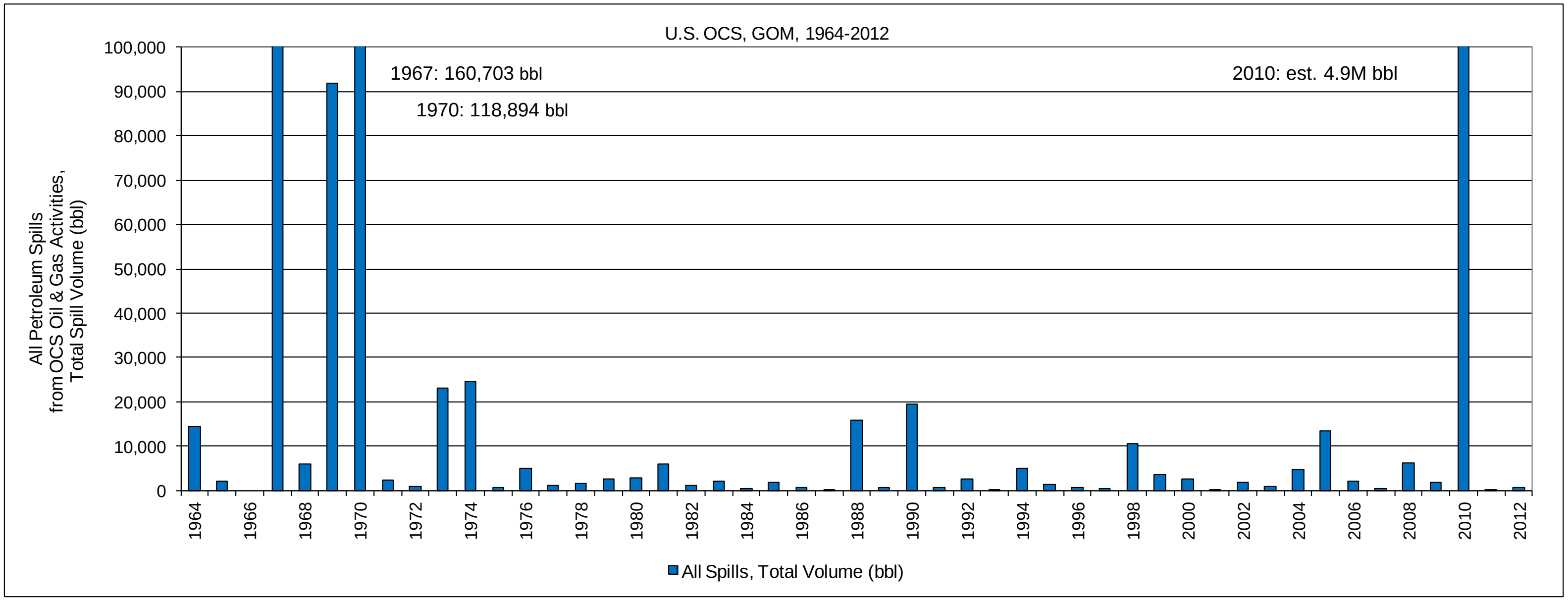
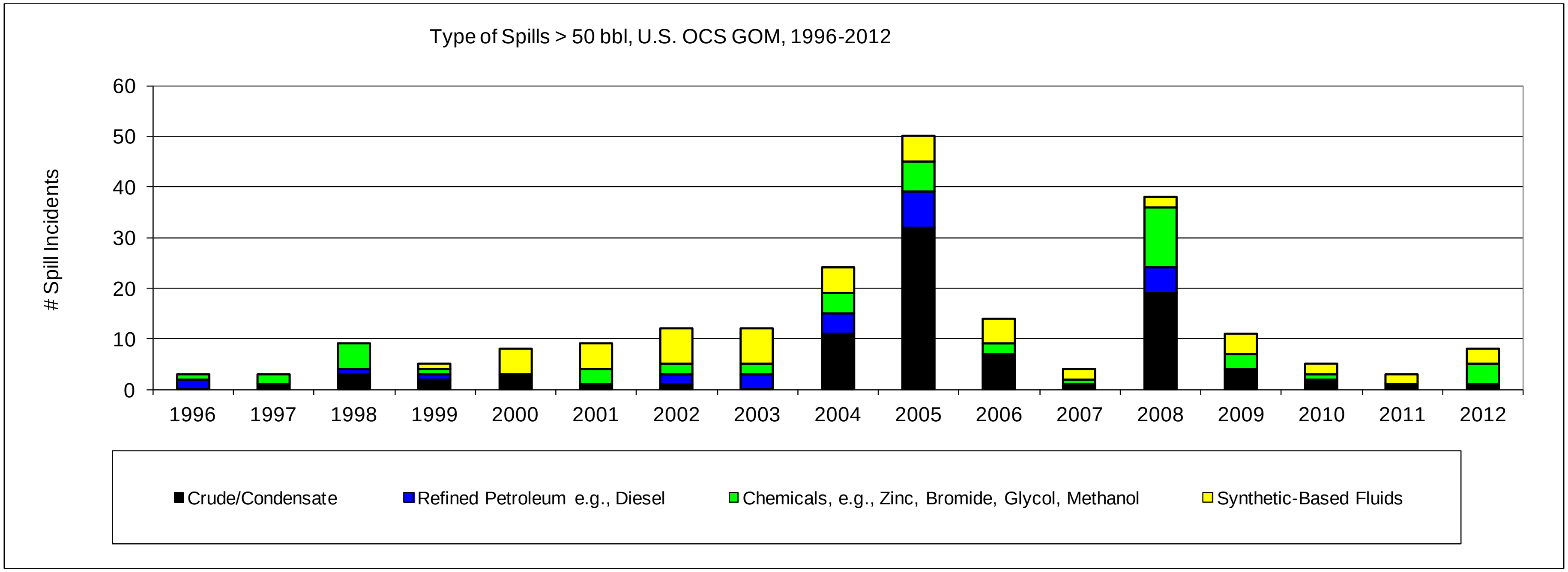


**Figure 3.8 Petroleum Spills from US OCS Oil and Gas Activities by Type of Spills (1996-2012)**



The worst case scenario in terms of an offshore accident resulting in the release of oil in the marine environment likely consists of a well blowout that could discharge large quantities of oil over a period of time. A blowout, or loss of well control, is defined as "the uncontrolled flow of formation or other fluids, including flow to an exposed formation (an underground blowout) or at the surface (a surface blowout), flow through a diverter, or uncontrolled flow resulting from a failure of surface equipment or procedures" (Etkin 2011).

There have been two blowouts in Canadian waters to date, both of which took place in the Nova Scotia Offshore Area (Angus and Mitchell 2010). The first one was a Shell exploratory gas well, at a water depth of 153 m, which experienced a blowout in February 1984, and subsequently released approximately 2 million $m^3$ (70 million $ft^3$) of gas and 48 $m^3$ (1700 $ft^3$) of condensate per day for 13 days. The second one was a Mobil exploratory gas well at a water depth of 38 m, which experienced a subsurface blowout in April 1985. The second event did not result in any release of hydrocarbons to the ocean or to the atmosphere (Angus and Mitchell 2010), and therefore, was not included as a blowout event causing a spill to the environment (Table 3.1).

In US waters there have been three oil well blowouts involving spills larger than 50,000 barrels since offshore drilling began in the 1950s, including the 2010 Deepwater Horizon Macondo well blowout in the Gulf of Mexico (Stantec 2011). Due to the relatively small number of blowouts in North American waters, the worldwide record of very large and extremely large blowout spills (following the spill categories outlined in Table 3.2) was considered for a more robust estimate of the blowout probability of occurrence. The recorded blowouts involving spills of more than 10,000 barrels are listed in Table 3.3.

The historical spill data presented in Table 3.3 include the categories of very large and extremely large spills. Apart from the spills listed in this Table, there have been no other large (>1,000 barrel) spills during offshore drilling in the waters of the US Outer Continental Shelf (OCS) and the North Sea, and only one occurrence of a 2,380 barrel spill in India in 1998 (Stantec 2011). The occurrence of these spills can be considered in the context of approximately 50,433 offshore exploration and delineation wells drilled worldwide by May 2010 (Deloitte Petroleum Services 2010; Stantec 2011).

The trend of historical frequencies of large spills (which, as noted in the Table, includes very large and extremely large spills) from exploration or development drilling through the decades is shown in Table 3.4. It is apparent that there is a downward trend until the 2000s, with an increase again in the most recent decade.

**Table 3.1 Blowout Frequencies for Exploration and Development Wells in Eastern Canada**

| Region | Number of Exploratory Wells | Number of Development Wells | Number of Blowouts | Exploration Blowout Frequency | Overall Blowout Frequency |
|---|---|---|---|---|---|
| Newfoundland and Labrador | 198 | 164 | 0 | 0 | 0 |
| Nova Scotia | 154 | 53 | 1 (exploration) | $6.5 \times 10^{-3}$ | $4.8 \times 10^{-3}$ |
| Total | 352 | 217 | 1 (exploration) | $2.8 \times 10^{-3}$ | $1.8 \times 10^{-3}$ |
| Source: Adapted from Stantec (2011), Data by Deloitte Petroleum Services (2010) | | | | | |

**Table 3.2 Definitions of Hydrocarbon Spill Categories by Size**

| Hydrocarbon Spill Category | Spill Size | |
|---|---|---|
| | bbl | $m^3$ |
| Extremely Large | >150,000 | >23,850 |
| Very Large | >10,000 | >1,590 |
| Large | >1,000 | >159 |
| Small | <1 | <0.159 |
| Sources: Stantec (2011). Note: The large, very large and extremely large categories are cumulative | | |

**Table 3.3 Historical Large Spills from Offshore Oil Well Blowouts Worldwide**

| Area | Reported Spill Size (bbl) | Date | Operation |
|---|---|---|---|
| US, Santa Barbara | 77,000 | 1969 | Production |
| US, S. Timbalier 26 | 53,000 | 1970 | Wireline |
| US, Main Pass 41 | 30,000 | 1970 | Production |
| Trinidad | 10,000 | 1973 | Development |
| Norway, North Sea | 158,000 | 1977 | Workover |
| Mexico (Ixtoc 1)[A] | 3,000,000 | 1979 | Exploration |
| Nigeria | 200,000 | 1980 | Development |
| Iran | 100,000 | 1980 | Development |
| Saudi Arabia | 60,000 | 1980 | Exploration |
| Mexico | 247,000 | 1986 | Workover |
| Mexico | 56,000 | 1987 | Exploration |
| US, Timbalier Bay / Greenhill | 11,500 | 1992 | Production |
| Australia[B] | 30,000 | 2009 | Development |
| US, Gulf of Mexico[B] | 4,000,000 | 2010 | Exploration |
| Source: Adapted from Stantec (2011)<br>Notes:<br>A: Spill volume likely underestimated.<br>B: Spill estimates are not final. | | | |

**Table 3.4 Historical Frequencies of Large Offshore Drilling-Related Blowouts by Decade**

| Period | Incidents | Number of Wells Worldwide | Blowout Frequency | Probability |
|---|---|---|---|---|
| 1971 – 1980 | 5 | 20,116 | $2.49 \times 10^{-4}$ | 1 in 4,020 wells |
| 1981 – 1990 | 1 | 29,527 | $3.39 \times 10^{-5}$ | 1 in 29,500 wells |
| 1991 – 2000 | 0 | 28,118 | 0 | 0 |
| 2001 – 2010 | 2 | 26,732 | $7.48 \times 10^{-5}$ | 1 in 13,400 wells |
| Source: Adapted from Stantec (2011), Data by Deloitte Petroleum Services (2010) | | | | |

Well blowouts can cause considerable damage to drilling rigs, injuries or fatalities to rig personnel and may result in discharges of reservoir fluids to the ocean and atmosphere. Where a gas formation is being drilled, the well would flow gas whereas an oil formation would be expected to flow mostly oil, and where the formation contains both oil and gas, a mixture of oil and gas would be released. Whether and what volume of hydrocarbons reach the surface will depend on well and site specific characteristics and other factors.

In order to take into account the occurrence of all blowouts, US OCS data representing the period from 1980 to 2010 have been compiled in Table 3.5. Although not shown in the Table, Stantec (2011) estimated from data by Deloitte Petroleum Services (2010) that approximately 12,000 exploration wells were drilled during this period.

An estimate based on more recent data (22 years from January 1, 1988 through December 31, 2009) by Scandpower (2010), and reported in Acona Wellpro AS (2010) was lower at $1.6 \times 10^{-4}$ blowouts per well, equivalent to 1 in 6,250 wells drilled.

**Table 3.5 Blowout and Spill Occurrence Statistics, US Federal Offshore Wells (1980-2010)**

| Year | Well Starts | Drilling Blowouts | | | | Non-drilling Blowouts | | | | | | Total Blowouts | | OCS Production |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exploration | | Development | | Production | | Workover | | Completion | | | | |
| | | # | bbl | # | bbl | # | bbl | # | bbl | # | bbl | # | bbl | MMbbl |
| **1980s** | 11,071 | 19 | 0 | 21 | 0 | 7 | 0 | 19 | 113 | 6 | 60 | 72 | 173 | 3,407.3 |
| **1990s** | 8,765 | 17 | 300 | 16 | 0 | 2 | 0 | 5 | 0 | 3 | 0 | 44 | 302 | 4,292.4 |
| **2000s** | 8,390[A] | 9 | 4M[B] | 9 | 1 | 8 | 378 | 7 | 12 | 1 | 0 | 29 | 380 | 5,389.64 |
| **Total** | 28,226 | 45 | 4M[B] | 46 | 1 | 17 | 378 | 31 | 125 | 10 | 60 | 145 | 855 | 13,089.34 |

Source: Stantec (2011)
Notes:
A: Most recent three years estimated.
B: Total includes an estimated 4,000,000 bbl from Macondo spill, and 316 barrels in 44 other incidents

A key objective of reviewing historical spill information is to learn from past experiences and identify areas for future planning and continuous improvement. Despite oil and gas activity technological advances, as well as enhancements in the associated safety, environmental protection and regulatory practices that have been achieved, the possibility (and prevention) of large spills remains an ongoing concern and key priority for both offshore oil and gas operators, spill responders, regulators and the public (Etkin 2011).

#### 3.2.5.2 Previous Spills in the NL Offshore Area

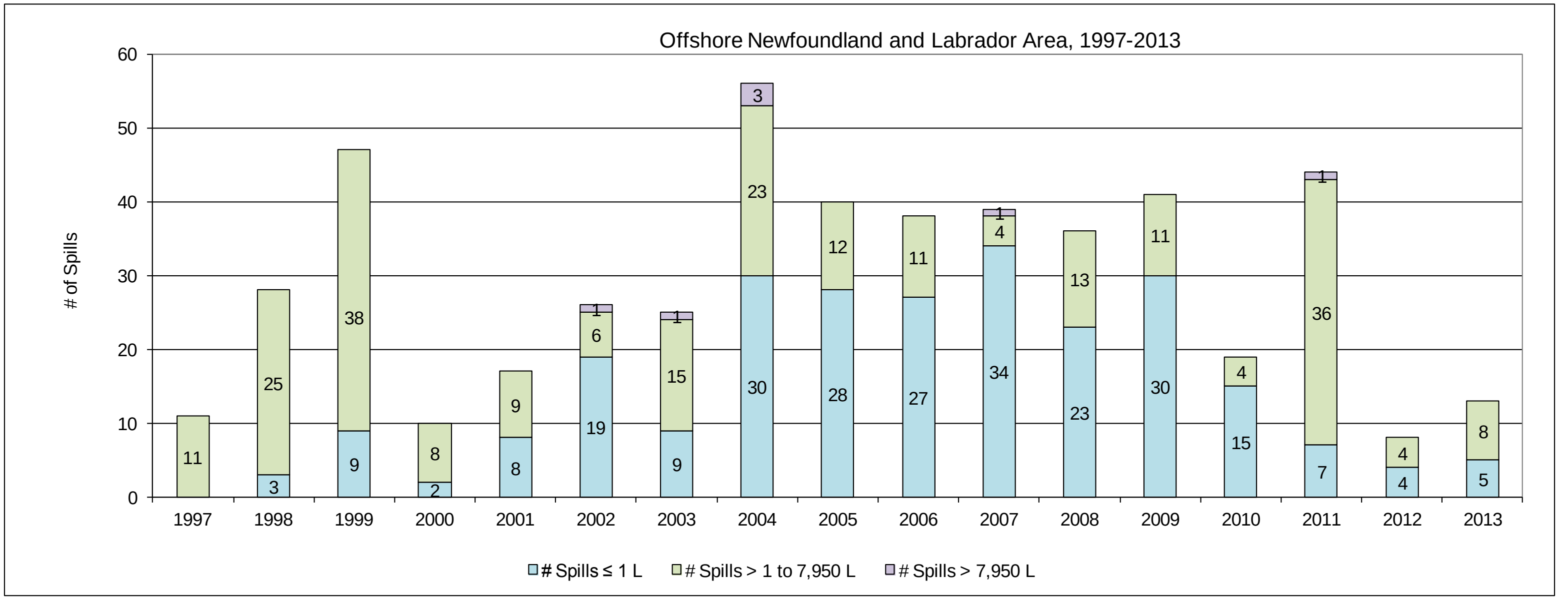
Exploration and production hydrocarbon spill Information for the NL Offshore Area can be obtained and reviewed on the C-NLOPB web site (C-NLOPB 2014).

Figure 3.9 presents an annual inventory count of oil spills for the NL Offshore Area for the period 1997 to 2013 by spill size, where three categories have been defined: a) 1 L or less; b) between 1 and 7,950 L (about 50 bbl in order to generally align with the US OCS threshold); and c) greater than 7,950 L. The historical total during this 17-year period is 498 spills: 253 spills ≤ 1 L, 238 spills of 1 L to 7,950 L, and seven spills greater than 7,950 L. Smaller, ≤ 1 L, spills have ranged in number from none in 1997 to 30 in 2004 and 2009, with an average of 14.9 and a median of nine spills per year. Spills between one and 7,950 L have ranged in number from four in 2007, 2010 and 2012 to 38 in 1999, with an average of 14.0 and a median of 11 spills per year. The seven spills > 7,950 L occurred one each in the years 2002, 2003, 2007 and 2011, and three in 2004; with an average of 0.4 spills of this size per year.

Figure 3.10 presents corresponding annual total spill volumes, including all spill sizes. The maximum annual spill total volume was 274,008 L in 2004 resulting from the November spill of 165,000 L of crude oil at Terra Nova due to produced water separation process failure, and the October spill of 96,600 L of synthetic based mud due to a diverter line source. The total spill volume over the 17-year 1997-2013 period is 475,626 L, with an average of 27,978 L and a median of 5,730 L of oil spilled per year.

Figure 3.11 presents a breakdown of the spill product associated with each incident for which the spill volume was greater than 1 L. Hydraulic and lubricating oil accounted for about 32 percent (79 of 245) of the spill incidents, while crude oil accounted for about 25 percent (62 of 245 incidents). Spills have occurred in every year; other than there being just one diesel and jet fuel type spill since 2004, there are no obvious trends over the 1997-2013 time period for the number of spills, amount of oil spilled or types of product spilled.

## Figure 3.9 Number of Spill Incidents NL Offshore Area (1997-2013)




## Figure 3.10 Total Spill Volume, NL Offshore Area (1997-2013)

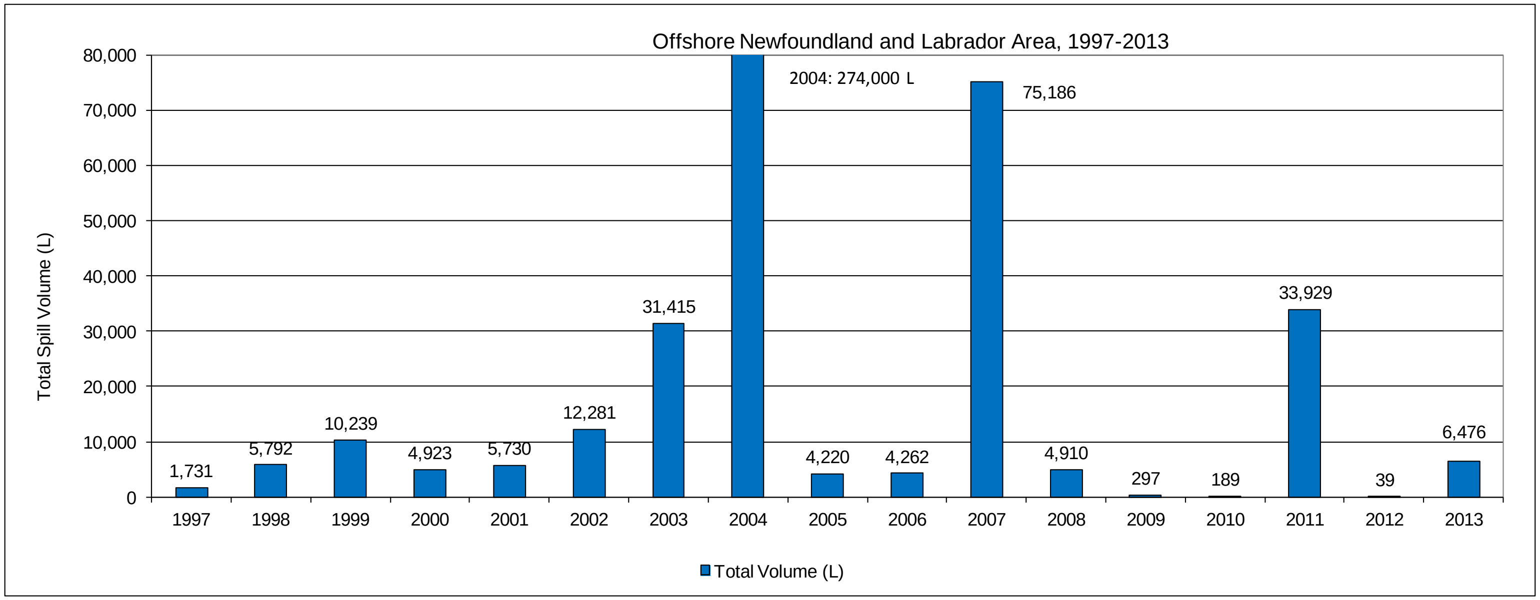
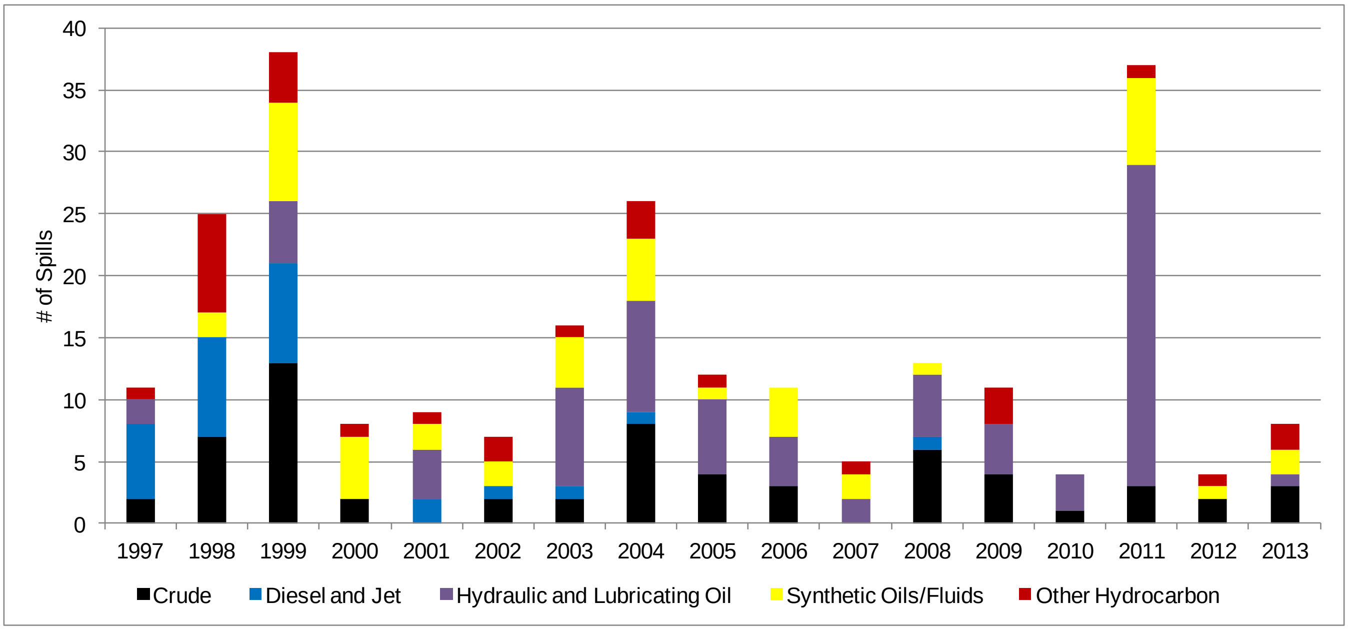


**Figure 3.11 Spills by Year by Type, NL Offshore Area (1997-2013, Spills > 1 L)**




The following Figures present the cumulative (1997-2013) spill frequency and spill volume by type for both exploration drilling (Figures 3.12 and 3.13) and development drilling and production (Figures 3.14 and 3.15) in the NL Offshore Area, based on available C-NLOPB data (updated June 2014).

For exploration drilling in the NL Offshore Area from 1997-2013, synthetic oils and fluids constituted 17.9 percent of all spill incidents, while making up 95.1 percent of the total volume of spills. For development drilling and production, synthetic oils and fluids constitute a similarly low proportion (12.1 percent) of all spill incidents, while making up 49.6 percent of the total volume of spills. Spills of crude oil, in the NL Offshore Area from 1997-2013, accounted for 2.3 percent of the total volume of materials spilled during exploration drilling and 49.4 percent of spilled volumes as a result of development drilling and production activities.

**Figure 3.12 Spill Frequency by Type, Exploration Drilling - 1997-2013 (% of Incidents)**

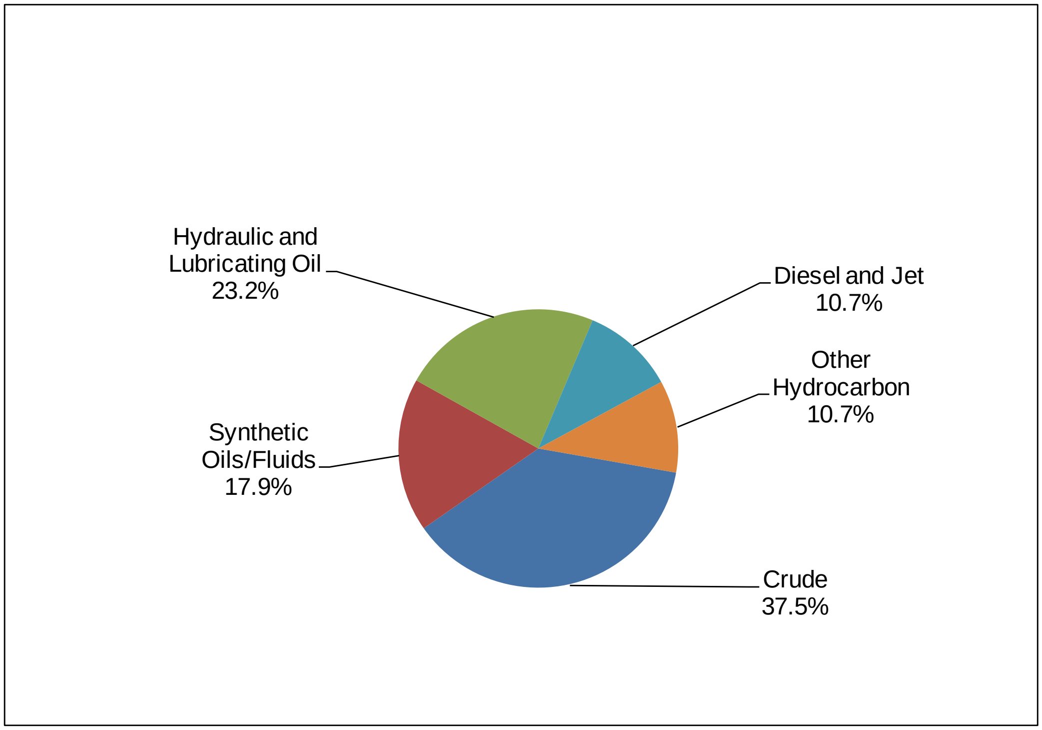



**Figure 3.13 Spill Volume by Type, Exploration Drilling - 1997-2013 (% of Volume)**

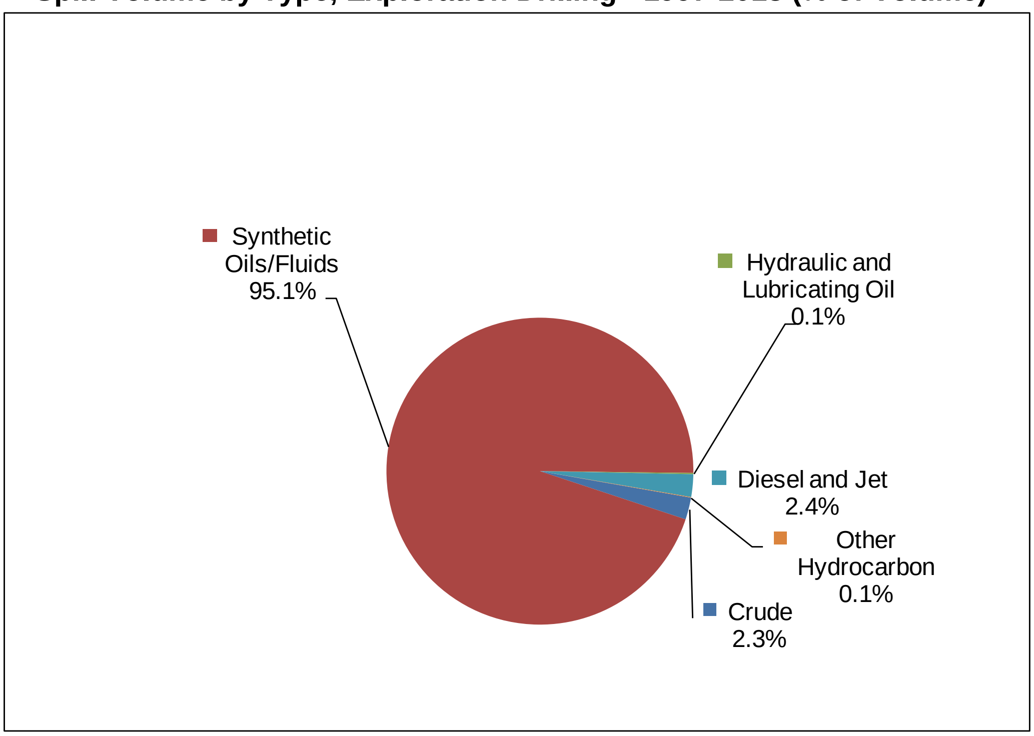


**Figure 3.14 Spill Frequency by Type, Development Drilling & Production - 1997-2013 (% of Incidents)**

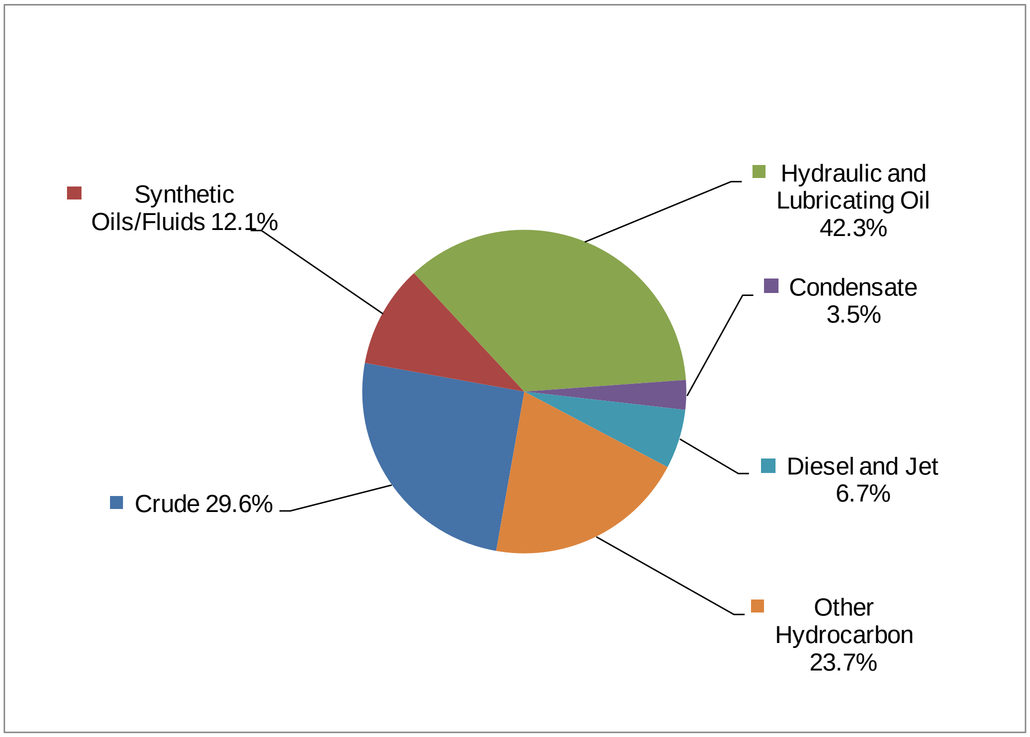



**Figure 3.15 Spill Volume by Type, Development Drilling & Production - 1997-2013 (% of Volume)**

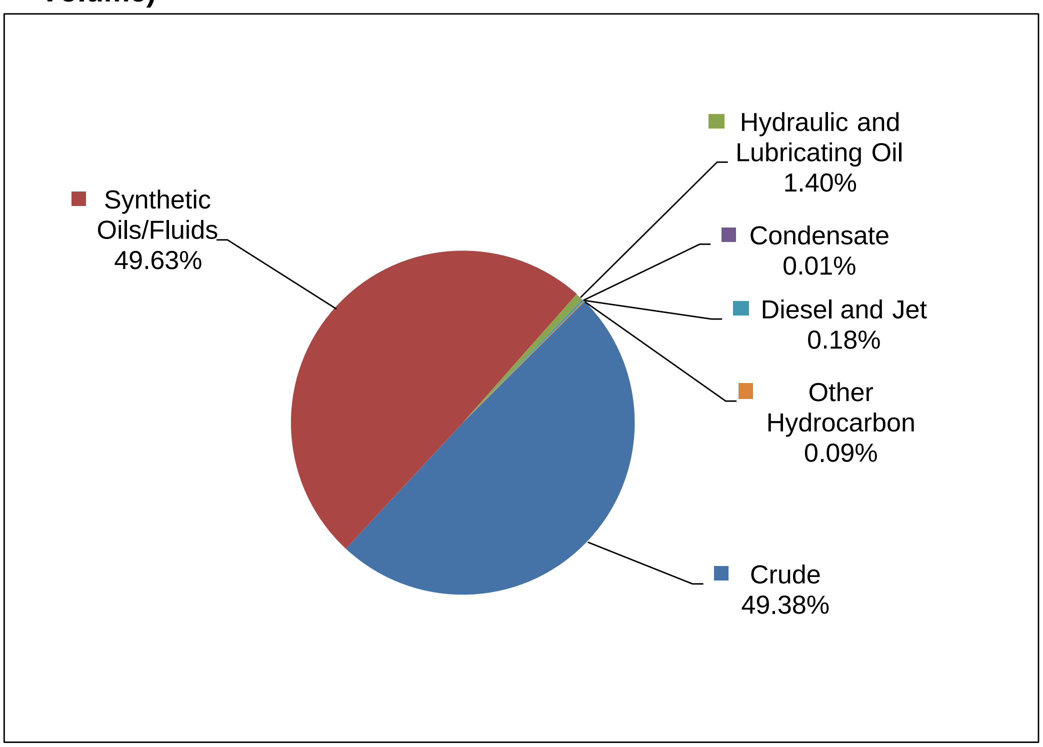


Table 3.6 provides annual and overall spill statistics for exploration and production activities in the NL Offshore Area for the five-year period from 2009-2013. Over that timeframe there were from 8 to 44 spills per year, and a total of 126 spills, which resulted in 40,930 L of synthetic based drilling fluid and all other hydrocarbons being spilled into the marine environment. The total number of spills resulting specifically from exploration activities off Newfoundland and Labrador over that five-year period was 15, which collectively totalled 28,825 L of spilled material. Almost all of the material spilled during that period was comprised of SBMs, with the remaining less than one percent coming from nine spills totalling 54 L of other hydrocarbons (Table 3.6).

**Table 3.6 Exploration and Production Hydrocarbon Spill Information, NL Offshore Area (2009 – 2013)**

| | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | Total 2009-2013 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Volume (L) | Number | Volume (L) | Number | Volume (L) | Number | Volume (L) | Number | Volume (L) | Number | Volume (L) |
| **Exploration Drilling** | | | | | | | | | | | | |
| Synthetic Based Drilling Fluid | 1 | 1.00 | 0 | 0.00 | 4 | 28,742.00 | 1 | 27.70 | 0 | 0.00 | 6 | 28,770.70 |
| All Other Hydrocarbons | 4 | 10.10 | 3 | 3.84 | 2 | 40.00 | 0 | 0.00 | 0 | 0.00 | 9 | 53.94 |
| **TOTAL** | 5 | 11.10 | 3 | 3.84 | 6 | 28,782.00 | 1 | 27.70 | 0 | | 15 | 28,824.64 |
| **Development Drilling and Production** | | | | | | | | | | | | |
| Synthetic Based Drilling Fluid | 1 | 0.10 | 0 | 0.00 | 4 | 4,601.00 | 0 | 0.00 | 2 | 223.00 | 7 | 4,824.10 |
| All Other Hydrocarbons | 35 | 286.25 | 16 | 184.82 | 34 | 546.11 | 7 | 11.10 | 12 | 6,253.17 | 104 | 7,821.45 |
| **TOTAL** | 36 | 286.35 | 16 | 184.82 | 38 | 5,147.11 | 7 | 11.10 | 14 | 6,476.17 | 111 | 12,105.55 |
| **Total: Exploration and Production** | | | | | | | | | | | | |
| Synthetic Based Drilling Fluid | 2 | 1.10 | 0 | 0.00 | 8 | 33,343.00 | 1 | 27.70 | 2 | 223.0 | 13 | 33,594.80 |
| All Other Hydrocarbons | 39 | 296.35 | 19 | 188.66 | 36 | 586.11 | 7 | 11.10 | 12 | 6,253.17 | 113 | 7,335.39 |
| **TOTAL** | 41 | 297.45 | 19 | 188.66 | 44 | 33,929.11 | 8 | 38.80 | 14 | 6,476.17 | 126 | 40,930.19 |
| Source: Environment Statistics, Summary Information (1997-2013) Spill Frequency and Volume, C-NLOPB (2014) | | | | | | | | | | | | |

#### 3.2.5.3 Oil Spill Fate and Behaviour

The fate and behaviour of accidental spills are dependent upon site and well-specific characteristics, such as the type and specific properties of the hydrocarbons involved, oceanographic conditions at the well site (e.g., wind and currents, and potentially ice), as well as the specific size, location and timing of the spill. Regulatory reviews for individual proposed drilling programs in the NL Offshore Area therefore typically include a project- and site-specific analysis of oil spill probabilities, as well as of oceanographic conditions at the drill site and hydrocarbon properties which are used to carry out detailed trajectory modelling studies of the likely behaviour of possible (hypothetical) oil spills. These modelling outputs, in turn, inform the EA analyses for these projects in terms of the probability of accidental events and malfunctions, required mitigation (prevention and response) measures, and potential for significant adverse environmental effects.

The most recently completed oil spill modelling for the SEA Study Area includes that completed as part of the Hebron Oilfield EA (ASA 2011a, ASA 2011b). Hebron is shown together with the Hibernia, Terra Nova, and White Rose oil field locations in a later Figure (3.18). A large collection of scenarios were run as summarized in Table 3.7 below, and all spill scenarios were simulated without any spill countermeasures applied.

**Table 3.7 Hebron, Grand Banks Oil Spill Modelling Scenario Summary**

| Scenarios | Description |
|---|---|
| Platform blowouts (35,000 bbl/d release rate of Hebron D-94 crude) | • Summer 30 and 100 day spill durations (with associated simulation durations of 30 d, and 100 and 300 d, respectively[1])<br>• Winter 30 and 120 day durations, open water and sea ice present (with associated simulation durations of 30, 60 and 230 d, and 120 and 320 d, respectively) |
| Sea floor blowouts (20,000 bbl/d release rate of Ben Nevis L-55 crude) | • Summer 100 day spill duration (with associated simulation duration of 100 d)<br>• Winter 120 day spill duration, open water and with sea ice (with associated simulation duration of 100 d) |
| Batch transfer instantaneous spill (5,031 bbl (800 $m^3$) of marine diesel fuel) | • Summer 30 day spill simulation<br>• Winter 30 day simulations, open water and sea ice present |
| Batch OLS transfer spill (31,449 bbl (5,000 $m^3$) of crude released over 24 h) | • Summer 30 day spill simulation<br>• Winter 30 day simulations, open water and sea ice present |

Source: summarized from ASA (2011a).
[1] This includes a number of 200 d extended run simulations for the platform blowout

The ASA SIMAP software model was used in stochastic and deterministic modes to predict the range of water surface, subsurface and shoreline oiling possible due to spills occurring for the selected scenarios. Sea floor blowouts were modelled with ASAs blowout model, and surface blowouts employed ASA's 3D fates model. The SIMAP stochastic model was used to determine the probability of oiling the water surface and the shoreline based on specified thickness thresholds, and of oiling the water column using a concentration threshold. The following thresholds were applied:

- Surface oil average thickness > 0.01 mm (10 µm)
- Shoreline oil average thickness > 0.01 mm (10 µm)
- Subsurface oil (entrained in water) average concentration > 10 ppb

Hourly wind inputs for the model were obtained from the MSC50 wind and wave hindcast (as described in Chapter 4), and the National Centers for Environmental Prediction (NCEP) at multiple locations across the North Atlantic, all for the period 1978 to 2008. The NCEP wind data are output from a numerical atmospheric model maintained by the National Center for Environmental Predictions Environmental Modeling Center Regional Spectral Model, part of the U.S. National Oceanic and Atmospheric Administration – Cooperative Institute for Research in Environmental Studies (NOAA – CIRES) Climate Diagnostics Center (CDC) in Boulder, Colorado (Kalnay et al 1996). NCEP Reanalysis data were provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at *http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.surfaceflux.html*. The wind data from NCEP consist of wind speed and direction on a 6-hour time increment (four times daily) at 10 m above the sea surface from a set of points spaced 2° apart (ASA 2011a).

Daily mean ocean current velocity inputs were obtained from the HYbrid Coordinate Ocean Model (HYCOM), implemented as part of the Real-Time Ocean Forecast System (Atlantic) HYCOM model of the National Oceanic and Atmospheric Administration (NOAA) for the period November 2003 through September 2010. Sea ice concentration inputs were obtained from the National Snow and Ice Data Center. Data from the winter of 1989-1990 were selected since they showed the greatest extent of ice coverage over the past several decades.

Some of the key results of this oil spill modelling exercise are summarized below:

- For the smaller batch spills simulated, no oil was predicted to reach shore. The marine diesel fuel is more easily dispersed into the water column than crude oil. The marine diesel is capable of reaching a smaller minimum thickness than the crude oil, resulting in a relatively higher sea surface area exposed to oil.

- None of the batch transfer spills were predicted to reach the Newfoundland shoreline. The mass balance summary table lists the volume of oil on the water surface, dispersed in the water column, evaporated or decayed, as a percent of the total spill at the end of the deterministic model simulations

- At the end of the batch marine diesel transfer simulations there was no surface oil. In summer, 60 percent of the oil had evaporated and decayed and 40 percent had been dispersed into the water column. In winter, 30 percent of the oil had evaporated and decayed and 70 percent had been dispersed into the water column. At the end of the batch OLS crude transfer spill simulation 64 percent of the oil remained on the sea surface, 36 percent of the oil had evaporated and decayed and less than one percent had been dispersed into the water column (with no seasonal difference). These percentages are at the 95$^{th}$ percentile level (of the collection of 100 individual stochastic spill trajectory runs)

- For the simulated platform blowouts, a general indication of the predicted likely extent of a spill is provided for the summer and winter (120-day) platform blowout scenarios. The general trajectory of the spills is to the east. About 70 percent of the simulations drift east of 50°W. Under all scenarios, less than one percent of the total spill volume was predicted to reach the Newfoundland shoreline. About 44 percent on average and up to a maximum of 62 percent of the total spill volume would exit the model domain of 0°W to 30°W and 40°N to 56°N.

A shoreline oiling summary for the surface blowouts (extended duration) is presented in Table 3.8 (ASA 2011b). The Table entries are from the individual spill within each platform blowout stochastic scenario that resulted in the largest volume of oil stranded onshore.

**Table 3.8 Hebron, Grand Banks Oil Spill Modelling - Shoreline Oiling Summary**

| Scenario | Probability of Shoreline Oiling (%) | First Arrival of Oil (days) | Shoreline Length Oiled (km) | Maximum Oil Ashore (bbl) | Shoreline Reached |
|---|---|---|---|---|---|
| Platform Blowout: Summer 100-day | 1 | 275 | 4.7 | 81 | Baie Verte, Bell Island (Northern Peninsula), Northeast Bonavista and Avalon Peninsulas, Eastern Avalon |
| Platform Blowout: Winter 30-day | 2 | 22 | 87 | 3,305 | Southeast tip of Avalon Peninsula near Trepassey, Baie Verte |
| Platform Blowout: Winter 120-day | 8 | 110 | 785 | 27,745 | Bonavista, Avalon, Burin Peninsulas, Trinity Bay, Placentia Bay, St. Pierre et Miquelon. |

For the simulations run for each of these three extended duration blowout simulations, the maximum percent of total spill volume remaining on the sea surface after 200 days (an arbitrary length of time) ranged from less than three percent for the 30 day winter blowout to seven percent for the 120 day winter blowout to 10 percent for the 100 day summer blowout.

At the end of the platform blowout simulations the volume of oil remaining on the sea surface ranged from about 51 to 79 percent. An estimated 20 to 50 percent of the oil had evaporated or decayed and less than one percent had been dispersed into the water column. There were minimal seasonal weathering differences. These percentages are at the 95$^{th}$ percentile level (of the collection of 100 individual stochastic spill trajectory runs).

The majority of spills at the site were predicted to travel eastward, the distance traveled being generally controlled by the blowout duration and the season; stronger winter winds result in greater oil transport. The summer and winter blowout spill simulations greater than 30 days duration were predicted to have a less than 10 percent probability of reaching the Newfoundland shoreline (ASA 2011a).

Marine diesel and crude oil released in small volume batch transfer spills were predicted to travel primarily toward the east away from Newfoundland. Marine diesel fuel is more easily dispersed into the water column than crude oil, and the ASA modeling predicted slightly higher entrained oil fractions for these spills. The marine diesel is capable of reaching a smaller minimum thickness than the crude oil, resulting in a relatively higher sea surface area exposed to oil. Table 3.9 lists the volume of oil on the water surface, dispersed in the water column, evaporated, or decayed, as a percent of the total spill at the end of the deterministic model simulations (ASA 2011a).

The winter spill in ice scenario weathering results included in the Table 3.9 scenarios are virtually identical to those of their 'no ice' counterparts.

**Table 3.9 Hebron Oil Spill Modelling, % Total Spill Volume Remaining at end of Simulation**

| Scenarios | % Water Surface | % Evaporated | % Decayed | % Water Column |
|---|---|---|---|---|
| Platform Blowout | 51-79 | 8-12 | 12-37 | 0.2-0.3 |
| Seafloor Blowout | 29-35 | 29-32 | 26-30 | 9-10 |
| Marine Diesel Batch Transfer | 0 | 6-45 | 15-24 | 40-70 |
| Crude Batch Transfer | 64 | 12-13 | 22-23 | 0.4-0.5 |
| Source: ASA (2011a) | | | | |

With regard to spills in ice, for some scenarios (30 d and 120 d platform and 120 d sea floor blowouts and batch and batch OLS transfer releases) and corresponding statistics of each scenario set of 100 spill simulations, the winter spills in ice show a slightly greater sea surface area oiled than the companion winter – no ice spills. In others (30 d platform blowout/ 60 d simulation) the opposite is true. While the shorter (30 d and 60 d duration) simulations show no difference in length of shoreline oiling predicted, for the longer (120 d duration platform and sea floor blowout) simulations, the winter spills in ice yield a slightly greater oiled shoreline length. There is no shoreline oiling for the batch releases. There is little difference in predicted amounts of entrained oil, with volumes in general being either comparable or slightly less for the spills in ice. From the individual spill within each 120 d duration stochastic scenario that resulted in the largest volume of oil stranded onshore, shoreline oiling summaries are as follows: The surface blowout in ice first reaches shore in 21 days (as opposed to 108 days for the no ice scenario), oils about half the shoreline length (138 km vs. 286 km) and half the area (413,500 $km^2$ vs. 856,500 $km^2$ for winter spill with no ice). The subsurface blowout in ice first reaches shore in 40 days (as opposed to 21 days for the no ice scenario), oils comparable shoreline lengths (117 km vs. 127 km for no ice) and area (349,900 $km^2$ vs. 381,600 $km^2$).

A number of additional oil spill modelling exercises have also been carried out for recent EAs of proposed exploration drilling within the SEA Study Area. As part of the Orphan Basin Exploration Drilling Program EA (LGL 2005), for example, SL Ross used their oil spill modelling software to model surface and subsea blowouts (5,000 $m^3$/day of Terra Nova crude assumed, and a flow rate of 177 $m^3$ / $m^3$ oil gas flow) and diesel fuel (10 and 100 barrel) batch spills at two locations: 1) a basin site at 49°N,48°W (water depth of 2,325 m) and 2) a slope site at 48°10'N, 47°45'W (water depth of 1,072 m). A total of 14,600 trajectories were run for each of the two locations, none of which contacted the shores of Newfoundland and Labrador. The monthly spill trajectory envelopes were further analysed for a 1 km x 1 km grid over the Study Area to create yearly envelopes showing the composite 99 percent probability contour. The diesel spills dispersed within 13 to 33 hours. The EA includes discussion of the spill modelling fate and behaviour results. No details of the wind and current model inputs are provided in the EA.

SL Ross also modelled summer and winter surface and subsea blowouts and batch diesel fuel spills (with similar spill rates to those for Orphan Basin) at the Mizzen (EL 1049) (approximately 48.2°N, 46.3°) location as part of the Statoil Exploration and Appraisal / Delineation Drilling Program EA (LGL 2008). The SL Ross spill model was used, assuming Hibernia crude properties and employing MSC50 wind (1954 to 2005) and current data from DFO (Han 2007). Spill fate and behaviour results are discussed, and monthly trajectory plots are presented. The modelling results indicated that none of the spills from the Mizzen location contacted the Newfoundland coast. In general it was found that any potential surface releases at Mizzen would result in an easterly movement of the oil in summer and a more southerly movement in winter.

#### 3.2.5.4 Synthetic Based Mud Spills

SBMs are drilling muds in which the continuous phase consists of a synthetic base fluid, while the dispersed phase consists of brine and other additives. SBM have been adopted for use in offshore drilling operations for nearly two decades. They exhibit several performance advantages over the more commonly used WBMs; therefore, they are commonly used for challenging wells in deep water, or in wells with highly deviated wellbores (Burke and Veil 1995).

Where there is technical justification (e.g., requirements for enhanced lubricity or for gas hydrate mitigation), operators may use SBMs or enhanced mineral oil based mud (EMOBM) in the drilling of wells and well sections. Other than the residual base fluid retained on cuttings as described in the Operator's EPP, no whole SBM or EMOBM base fluid, or any whole mud containing these constituents as a base fluid, should be discharged to the sea (NEB et al 2010). The aforementioned C-NLOPB spill incident database contains a listing of the reported accidental spills of SBM, the amounts spilled, the operators and rigs involved, as well as the locations on the rig system where the reported spill likely originated.

The SBM spills recorded in the 1997 – 2010 period have been classified by spill size in Table 3.10. The frequencies of occurrence of the various spill categories have been calculated based on 219 wells drilled during that period. The largest SBM spill to date in the NL Offshore Area was recorded in 2004, with approximately 96,600 L (96.6 $m^3$) of SBM spilled from the diverter line of the GSF Grand Banks at the White Rose location (Stantec 2011). The most substantial SBM release in Atlantic Canada of 354,000 L (354 $m^3$) occurred at the Crimson F-81 well in 2004 in the Nova Scotia Offshore Area (C-NSOPB 2005).

**Table 3.10 Synthetic Based Mud Accidental Spills in NL (1997 – 2010)**

| SBM Spill Size Range | Number of Spills | Frequency per Well |
|---|---|---|
| 1 L to 159 L | 36 | 0.16 |
| 159 to 7934 L (1 to 49.9 bbl) | 18 | 0.082 |
| 7,935 to 159,000 L (50 to 999 bbl) | 5 | 0.023 |
| Greater than 159,000 L (1,000 bbl) | 0 | 0 |
| Source: Stantec (2011) | | |

SBM exhibit a unique behaviour in the marine environment due to the fact that they are immiscible in water, and are typically negatively buoyant. Unlike WBMs, they tend to form distinct jets and droplets that fall relatively rapidly through the water column, and are prone to form visible and clearly-defined streams and pools at the seafloor, where their dispersion is in large part driven by gravity in conjunction with the local seafloor features. Approaches for modeling the dispersion of water-based fluids are therefore not applicable to SBM. Some key aspects of SBM behaviour that determine how they would spread in the marine environment include the breakup of the fluid into droplets of varying sizes and the stability of the SBM emulsion under different release and environmental conditions, as well as the terminal fall velocity of the droplets.

SwRI (2007) conducted an experimental study of fall velocities for five different batches of SBM, exhibiting a range of densities used by industry in offshore drilling in the Gulf of Mexico. They designed their experiment in such a way as to capture the most frequent spill modes. Furthermore, their experimental setup allowed them to simulate overboard spills of SBM (dropped above the sea surface), as well as to capture the different flow regimes for low- and high-speed jets for each of the SBM samples, and to measure the fall velocity distributions for each of the spill scenarios. It is not yet clear to what extent their laboratory findings are applicable to field conditions, however, but their quantitative estimates of SBM fall velocities represent a rare and valuable contribution and a basis for modeling the dispersion and spatial extent of SBM spills in the marine environment. No known studies have been completed to date that have investigated the physical dispersion and spatial extent of potential accidental SBM spills in the Eastern Newfoundland Offshore Area.

#### 3.2.5.5 Oil Spill Prevention and Response

The C-NLOPB, other federal and provincial regulatory agencies, stakeholders, and offshore oil and gas operators have clearly recognized and stated that the prevention of oil spills is by far the preferred and most effective way to avoid the potentially significant environmental consequences that may result from a large scale spill event. Indeed, in response to the recent *Report of the Commissioner of the Environment and Sustainable Development* (CESD 2012), the C-NLOPB has reiterated that while more can and will be done to prepare for major oil spills, the priority of operators and the Board must continue to be spill prevention and risk reduction. Despite the priority placed on spill prevention, an accidental event or malfunction, although unlikely, can occur during an offshore exploration or development project, and it is important that relevant parties be prepared to respond to a spill in order to help mitigate its potential effects.

Spills may vary considerably in terms of their nature, scale, duration and possible environmental outcomes. The potential for, and possible adverse environmental outcomes of, an accidental oil spill resulting from future oil and gas activities in the Eastern Newfoundland Offshore Area and elsewhere was a key subject of discussion during the consultation program for the SEA (see Chapter 2 and Appendix A).

The review and approval processes and associated regulatory requirements that apply to oil and gas activities in the NL Offshore Area are amongst the most rigorous in the world. As part of these processes, operators are required to demonstrate that they have the ability and capacity to undertake such activities in a safe and environmentally responsible manner – both in terms of the prevention of hydrocarbon spill events, as well as appropriate procedures and resources to respond to a spill.

As part of its regulatory review and decision-making regarding proposed drilling programs and other activities in the NL Offshore Area, the C-NLOPB receives and considers information from operators that detail the proposed drilling location and activities, the equipment and procedures involved, and the qualifications and training of personnel. As described previously in this Chapter, the C-NLOPB's regulatory approval process is two-tiered in nature and requires, firstly, an authorization of the overall drilling program in the form of an Operations Authorization (OA), and secondly, a well approval in the form of an Approval to Drill a Well (ADW) for each well to be drilled.

Prior to issuing an OA, a number of statutory obligations must be met pursuant to the *Accord Acts* as well as other applicable legislation. Any required EA review of a proposed drilling project includes an assessment of the potential for, and possible effects of, any accidental event or malfunction (including a spill). Operators must also:

- File a Safety Plan, an Environmental Protection Plan and a Contingency Plan that includes an Oil Spill Response Plan as part of their application for an OA;
- Submit documentation respecting financial responsibility to show that they have sufficient monetary resources for responding to a spill and providing compensation to affected parties in the event of a spill;
- Provide a Declaration of Fitness attesting that the equipment and facilities to be used during their program are fit for purpose, and the operating procedures relating to them are appropriate;
- Demonstrate that the personnel to be involved in the drilling program are appropriately qualified and competent; and
- Demonstrate that the installation meets all applicable Canadian standards.

Only after this documentation is presented to and approved by the Board may an Operator proceed with the proposed drilling activity.

The second tier of the approval process involves obtaining an ADW, which is required for each and every well that is proposed to be drilled. The application for an ADW must provide detailed information on the proposed drilling program and well design for review, with drilling and well control being critical aspects of offshore operations. This involves a review of the operator's well planning and technical capabilities regarding such aspects as:

- Well and casing design, well control matters, kick prevention and detection;
- The definition of severe weather operating limits and associated procedures;
- Emergency disconnect requirements;
- Relief well drilling arrangements; and
- Personnel training in well control and blowout prevention.

A review is also conducted to ensure the adequacy, utility and suitable redundancy of the blowout preventer (BOP) activation and control systems.

Oversight of these matters is achieved in a systematic manner through the Board's Safety Assessment System, which includes a review of the operator's safety management system and confirmation that the operator has identified the hazards and the measures to be put in place to reduce risks to a level that is "as low as reasonably practicable" (C-NLOPB 2014). This application is reviewed by a multi-disciplinary team within the C-NLOPB consisting of engineers, technicians, geologists, geophysicists and environmental scientists. This information and analysis is then considered in associated regulatory decisions around whether and how the particular drilling program in question may proceed.

Operators are also required to have oil spill prevention and response plans and procedures that include ensuring they have the ability to respond to a spill in an effective and timely manner. Oil Spill Response Plans normally describe a three tier system for responding to spills in the NL Offshore Area, as follows:

1) *Tier 1 (In-field / At-site Resources):* Where spill response involves the activation of on-board equipment, usually sufficient to address small scale batch spills, nominally less than 30 $m^3$ (200 bbls);

2) *Tier 2 (NL / Regional Resources):* Where equipment and resources on site are insufficient and requires mobilizing equipment and resources that are located locally onshore, such as the operator's own equipment, equipment available through East Coast Spill Response Corporation (ECRC) and/or from the CCG. Tier 2 spills are typically batch or continuous releases of short duration (hours), up to approximately 3700 $m^3$ (100,000 bbls); and

3) *Tier 3 (National / International Resources):* If the equipment that is available locally is insufficient and national or international resources are needed to respond to the spill, the response moves to Tier 3. A Tier 3 spill would be a continuous release spanning days, such as a very large batch release or a blowout.

Each operator exercises their Emergency Response Plan, and collectively or individually conducts a field exercise each year which involves the deployment of spill response equipment.

In the event of a spill, there are a number of processes and measures to compensate affected parties for any associated losses or damages resulting from the spill. These are listed and described in the *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity* (C-NLOPB and C-NSOPB 2000), some relevant excerpts of which are provided in italics below:

> *Inherent in the nature of oil and gas operations in offshore areas is the risk of damage to the environment and to the property and economic interests of people working and living in areas affected by such operations. Such damage may occur either as a consequence of a "spill" or as a result of "debris" left on the ocean floor. The risk takes on special significance along Canada's east coast where fishing is a dominant factor in the economy.*
>
> *These Compensation Guidelines have been prepared to:*
>
> > *i) describe the various compensation sources available to potential claimants for loss or damage related to petroleum activity offshore .... Newfoundland and Labrador; and*
> >
> > *ii) outline the regulatory and administrative roles which the Boards exercise respecting compensation payments for actual loss or damage directly attributable to offshore operators.*
>
> *Damage caused by offshore oil and gas operations will most likely occur as a result of debris, spill or authorized discharge, emission or escape of petroleum. The appropriate compensation program for persons sustaining actual loss or damage will be determined by whether or not the responsible petroleum operator can be identified.*
>
> *In most cases, spills associated with offshore petroleum operations can be readily attributed to a specific operator. Operators are required to immediately report any such spills to the appropriate Board and the Canadian Coast Guard. The location of the spill or damage resulting from a spill, combined with the ability to match oil samples through chemical analyses are also valuable in identifying the responsible party.*

*There are three options available to a claimant for the recovery of actual loss or damage when the work or activity giving rise to such loss or damage can be attributed to an offshore operator:*

*i) voluntary settlement by the operator for direct compensation*

*ii) application to the appropriate Board for recovery of damages, from the operator's security deposit; and*

*iii) a civil suit for recovery through the appropriate court of law*

*While each of these three options remain available to the claimant at any time, a settlement from the operator responsible for the work or activity giving rise to the damages should be sought before proceeding with other options.*

*In the event that a claimant is unsuccessful in obtaining satisfactory compensation from the responsible offshore operator, compensation may be sought through the appropriate Board. The Board will review the claim and, depending upon the merits of each case, may award a damage settlement (in whole or in part) directly from the financial security provided to the Board by the operator. In the east coast offshore area, the operator is required to provide proper financial security in the amount of $30 million for any damages incurred as a result of spills, discharges of petroleum or debris from oil and gas operations...*

*The Acts do not limit a claimant's right to bring a civil suit against the responsible operator in seeking to recover damages. While court action may be initiated at any time, such action would likely be considered if the claimant remains unsatisfied after failing to obtain satisfactory compensation either from the operator or through the appropriate Board.*

*Claims in excess of the amount of security provided to the Board by the operator and which therefore require proof of fault or negligence by the operator will have to be settled through the operator directly or through the courts.*

*There are [also] two mechanisms in place for compensation for damages of a non-attributable nature:*

*i) Canadian Association of Petroleum Producers' Commercial Fisheries Compensation Program for Loss Resulting from Non-Attributable Gear and Vessel Damage ... and*

*ii) Ship-source Oil Pollution Fund*

The basic objectives which the proof of financial responsibility documentation submitted by an operator are intended to achieve therefore include:

a) Providing financial compensation to any party respecting claims attributable to the work or activity. These would include without limitation, claims by third parties, the Crown or its agents, the Board including the Chief Conservation Officer and Board delegates. Eligible claims would include those relating to loss of or damage to property, financial loss, or injury/death;

b) Restoring and preserving of the natural environment, including the seabed, while the work or activity is going on and after it is completed and abandoned; and

c) Ensuring that the operator will properly terminate the authorized work or activity, having regard to environmental, safety, and other concerns.

A spill is a strict liability offence pursuant to Section 161 (*Accord Act*), and referring to Sections 162 and 163 of this legislation, Canada's offshore liability regime is comprised of three elements:

1) *Financial Responsibility Requirements*: The applicant for an authorization (operator) must demonstrate, to the satisfaction of the appropriate regulator, proof of financial responsibility. A portion of this financial responsibility, typically in the amount of the applicable absolute liability limit, must be furnished in a form that allows the appropriate regulator unfettered access to that money in the event of a spill.

2) *Unlimited "At-Fault" or Negligence" Liability*: All parties who are at fault or negligent for a spill are jointly and severally liable, without limit, for all actual loss or damage incurred by any person as a result of the spill. This can be determined by an operator accepting responsibility for its action and paying claimants out or via the courts.

3) *Limited Absolute Liability*: The operator of the activity from which the spill emanated is absolutely liable up to $30 million for all actual loss or damage incurred by any person as a result of the spill, and costs and expenses reasonably incurred by the appropriate Board, governments, or any other person taking action in response to the spill. There is also a $70 million promissory note required to be filed by an operator with the Board.

On January 30, 2014, the Federal Department of Natural Resources tabled *Bill C-22* (*Energy Safety and Security Act*). This new polluter pays legislation, once enacted by the federal and provincial governments, is intended to provide greater transparency, improve spill response, and provide regulators with direct and unfettered access to funds in the event of environmental damage to take action as necessary and to compensate affected parties.

The Guidelines respecting financial responsibility can be found on the C-NLOPB's website at *http://www.cnlopb.nl.ca/pdfs/guidelines/respecting_financial_responsibility_requirements.pdf.*

In early 2013, the C-NLOPB responded to the Commissioner of the Environment and Sustainable Development's Fall 2012 Report (CESD 2012) on issues regarding oil spill preparation and response in the NL Offshore Area. This Report included various observations and recommendations regarding: the receipt of adequate assurances that operators are ready to respond effectively to a spill; the content of emergency response plans; coordination and cooperation between the Board and supporting federal departments and other organizations; and lessons learned from past incidents.

The C-NLOPB committed to completing a review of the producing operator's assessment of their spill response capability. Although the review is complete, the C-NLOPB endeavours to have operators improve oil spill response, including techniques and equipment for responding to a spill.

In April 2011 the Department of Natural Resources, Government of Newfoundland and Labrador also released Captain Mark Turner's report on oil spill prevention and response in the NL Offshore Area.

The Report (Turner et al 2010) contained 25 recommendations stemming from associated consultations with the C-NLOPB, other provincial and federal government departments and agencies, as well as various offshore operators. Most of these recommendations have been identified as being the joint responsibility of various government departments, and those within the C-NLOPB's areas of responsibility and mandate are also being reviewed and considered by the Board.

## 3.3 Previous and On-Going Offshore Oil and Gas Activity

Offshore oil and gas exploration and production activity has occurred and is currently being proposed in the Eastern Newfoundland Offshore Area.

### 3.3.1 Existing and Potential Offshore Petroleum Licences

Existing Licences for offshore oil and gas activities in the SEA Study Area include the following (see Figure 3.16 and Tables 3.11 to 3.13):

- 16 Exploration Licences;
- 49 Significant Discovery Licences; and
- 11 Production Licences

The information provided in this section is based upon licencing data provided by the C-NLOPB in July 2014. Current information on licences issued by the Board can be viewed on the C-NLOPB website at *www.cnlopb.nl.ca*

On May 16 2013, the C-NLOPB announced three Calls for Bids in the NL Offshore Area, of which two overlap with the SEA Study Area (Figure 3.16):

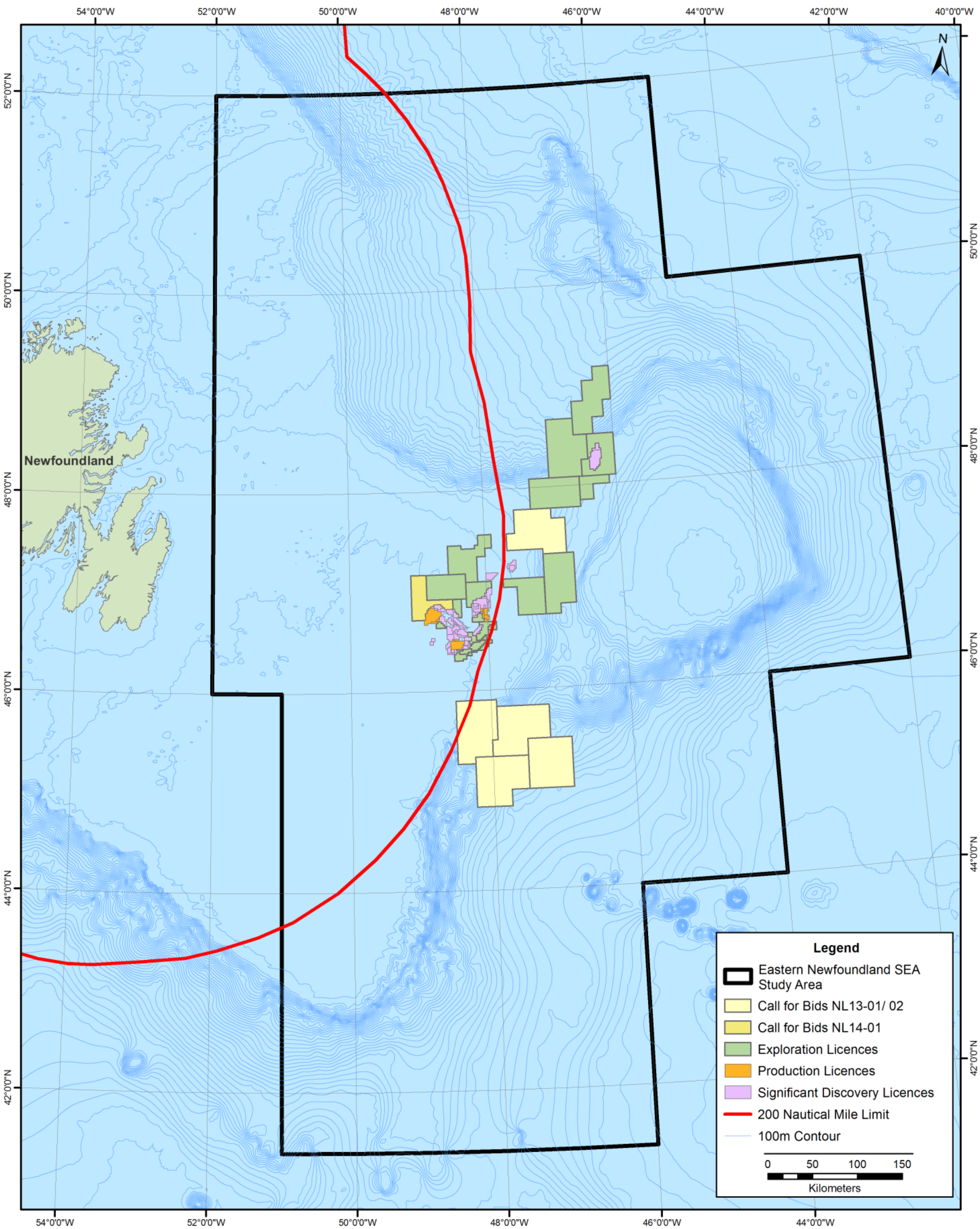
1) *Call for Bids NL 13-01* (Area "C": Flemish Pass), which consists of one parcel totalling 266,139 hectares; and

2) *Call for Bids NL 13-02* (Area "C": Carson Basin), consisting of four parcels totalling 1,138,399 hectares.

On June 11, 2014, the C-NLOPB announced *Call for Bids NL 14-01* (Jeanne d'Arc Region) which consists of one parcel totaling 108,938 hectares that overlaps the SEA Study Area (Figure 3.16).

In announcing these Calls for Bids, the Board stated that "Prospective bidders are advised that the C-NLOPB ...will complete a report for the Eastern Newfoundland SEA in 2014. The Board will consider any recommendations made in these SEA reports and, where necessary, may amend the Calls for Bids. The closing date for each Call for Bids shall be a minimum of 120 days after the completion of the relevant SEAs."

**Figure 3.16 Existing Oil and Gas Licences and Current Call for Bids**



### 3.3.2 Oil and Gas Exploration Activities

Past oil and gas exploration activity in the Eastern Newfoundland Offshore Area has consisted of the collection of approximately 390,000 line km of 2D and 1,700,000 common mid point (CMP) km of 3D seismic data from 1964 to 2013 (Figure 3.17). Exploration drilling commenced in the early 1970s, with a total of 327 wells drilled in the SEA Study Area as of August 2013 (Figure 3.18). Current, detailed information on well drilled in the NL Offshore Area can be accessed on the C-NLOPB website at *www.cnlopb.nl.ca/exp-maps.shtml*

**Table 3.11 Current Exploration Licences**

| Exploration Licence | Current Area (ha) | Effective Date |
|---|---|---|
| EL 1090R | 136,395 | 14-Jan-10 |
| EL 1093 | 7,080 | 15-Jan-05 |
| EL 1100<br>A<br>B | 30,572<br>17,767<br>12,805 | 15-Jan-07 |
| EL 1101<br>A<br>B | 19,585<br>13,533<br>6,052 | 15-Jan-07 |
| EL 1110 | 138,200 | 15-Jan-09 |
| EL 1112 | 55,957 | 15-Jan-09 |
| EL 1113 | 19,430 | 15-Jan-09 |
| EL 1114 | 121,348 | 15-Jan-09 |
| EL 1117 | 9,558 | 15-Jan-10 |
| EL 1121 | 139,617 | 15-Jan-11 |
| EL 1122<br>A<br>B<br>C | 29,783<br>22,338<br>5,315<br>2,130 | 15-Jan-11 |
| EL 1123 | 201,951 | 15-Jan-11 |
| EL 1124 | 125,421 | 15-Jan-11 |
| EL 1125 | 247,016 | 15-Jan-12 |
| EL 1126 | 186,780 | 15-Jan-12 |
| EL 1134 | 208,899 | 15-Jan-13 |

**Table 3.12 Current Significant Discovery Licences**

| Significant Discovery Licence | Current Area (ha) | Effective Date |
|---|---|---|
| SDL 197 | 7,722 | 04-Apr-87 |
| SDL 200 | 8,765 | 04-Apr-87 |
| SDL 208A | 1,424 | 04-Apr-87 |
| SDL 1001 | 3,883 | 16-Feb-90 |
| SDL 1002 | 5,664 | 16-Feb-90 |
| SDL 1003 | 3,894 | 16-Feb-90 |
| SDL 1004 | 708 | 16-Feb-90 |
| SDL 1005 | 354 | 16-Feb-90 |
| SDL 1006 | 5,325 | 16-Feb-90 |
| SDL 1007 | 3,195 | 16-Feb-90 |
| SDL 1008 | 6,372 | 16-Feb-90 |
| SDL 1009 | 6,390 | 16-Feb-90 |
| SDL 1010 | 3,550 | 16-Feb-90 |

| Significant Discovery Licence | Current Area (ha) | Effective Date |
|---|---|---|
| SDL 1011 | 5,321 | 28-Mar-90 |
| SDL 1012 | 355 | 28-Mar-90 |
| SDL 1013 | 2,136 | 28-Mar-90 |
| SDL 1014 | 2,487 | 28-Mar-90 |
| SDL 1015 | 356 | 28-Mar-90 |
| SDL 1016 | 712 | 28-Mar-90 |
| SDL 1017 | 356 | 28-Mar-90 |
| SDL 1018 | 1,062 | 16-Feb-90 |
| SDL 1019 | 1,416 | 16-Feb-90 |
| SDL 1020 | 1,062 | 16-Feb-90 |
| SDL 1023 | 353 | 16-Feb-90 |
| SDL 1024 | 354 | 16-Feb-90 |
| SDL 1025 | 4,589 | 16-Feb-90 |
| SDL 1026 | 2,471 | 16-Feb-90 |
| SDL 1027 | 1,765 | 16-Feb-90 |
| SDL 1028 | 11,649 | 16-Feb-90 |
| SDL 1029 | 2,824 | 16-Feb-90 |
| SDL 1030 | 1,412 | 16-Feb-90 |
| SDL 1031 | 7,045 | 16-Feb-90 |
| SDL 1035 | 1,420 | 27-Oct-94 |
| SDL 1036 | 1,420 | 27-Oct-94 |
| SDL 1037 | 1,065 | 25-Mar-96 |
| SDL 1038 | 356 | 25-Mar-96 |
| SDL 1039 | 2,492 | 25-Mar-96 |
| SDL 1040 | 3,195 | 08-Jan-01 |
| SDL 1041 | 3 883 | 26-Nov-01 |
| SDL 1042 | 3,897 | 01-Oct-03 |
| SDL 1044 | 354 | 15-Jan-04 |
| SDL 1045 | 353 | 15-Jan-04 |
| SDL 1046 | 5,320 | 16-Dec-04 |
| SDL 1047 | 22,006 | 22-Feb-10 |
| SDL 1048 | 3,773 | 15-Jan-11 |
| SDL 1049 | 1,424 | 01-Jun-11 |
| SDL 1050 | 3,201 | 04-Jan-12 |
| SDL 1051 | 4,240 | 24-Sep-13 |
| SDL 1052 | 3,538 | 24-Sep-13 |

**Table 3.13 Current Production Licences**

| Production Licence | Current Area (ha) | Effective Date (Terms – 25 Years) |
|---|---|---|
| PL 1001 | 22,285 | 21-Mar-90 |
| PL 1002 | 12,800 | 20-Aug-01 |
| PL 1003 | 355 | 20-Aug-01 |
| PL 1004 | 1,065 | 20-Aug-01 |
| PL 1005 | 1,416 | 14-Jan-03 |
| PL 1006 | 2,828 | 10-Aug-05 |
| PL 1007 | 2,832 | 19-Nov-07 |
| PL 1008 | 2,124 | 19-Nov-07 |
| PL 1009 | 353 | 04-Aug-11 |
| PL 1010 | 1,059 | 04-Aug-11 |
| PL 1011 | 1,062 | 31-Oct-12 |

**Figure 3.17 Released Seismic Data Completed in the SEA Study Area**

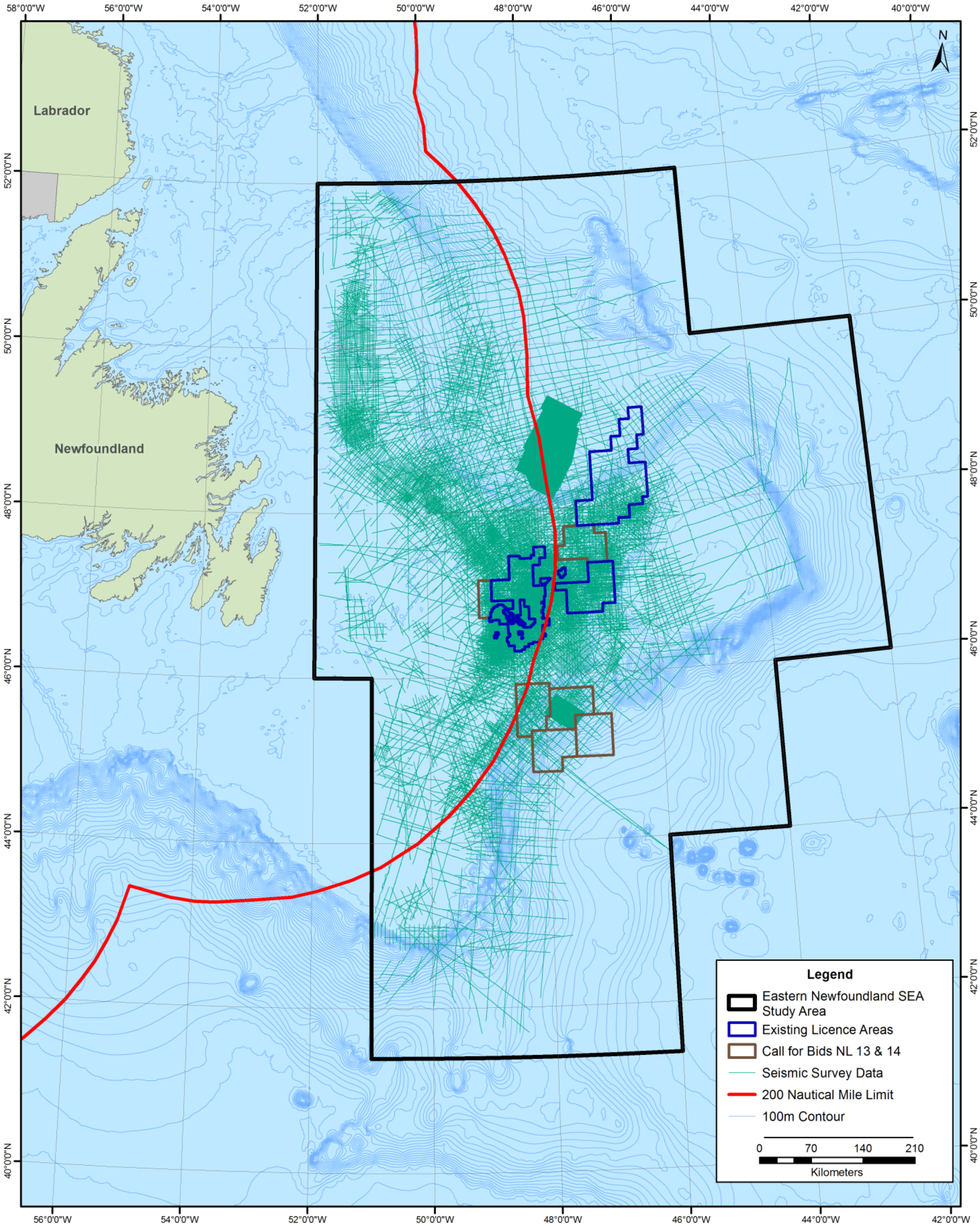
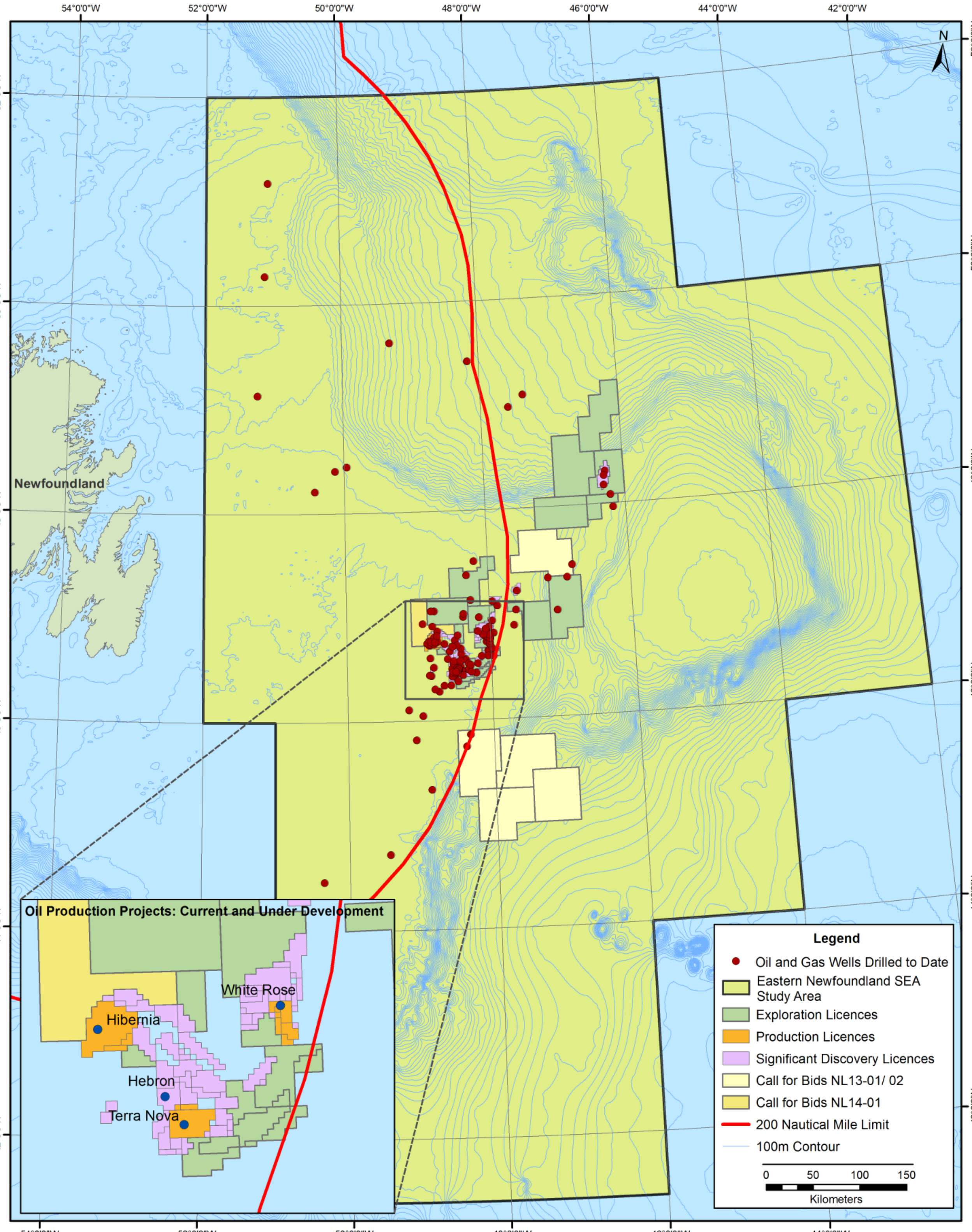


**Figure 3.18 Previous Wells Drilled and Current Production Projects in the SEA Study Area**



### 3.3.3 Oil Production Activities

Offshore oil production activities in the Eastern Newfoundland Offshore Area have been occurring since the 1990s. This currently includes several producing oilfields (with approximately 1.4 billion barrels having been produced to date) and another currently under development (see Figure 3.18).

These existing and upcoming production projects have involved the use of a number of types of production (Figure 3.19) and support infrastructure and activities, as summarized below (Government of Newfoundland and Labrador 2012; C-NLOPB 2014):

1) **Hibernia Oilfield**: Discovered in 1979, the Hibernia Oilfield is operated by the Hibernia Management and Development Company Ltd. (HMDC). The development phase of that project commenced in late 1990 and continued until the mating of the Gravity Based Structure (GBS) and its topsides at Bull Arm NL in 1997, after which the platform was towed to and installed at its site on the Grand Banks in June of that year. With estimated recoverable reserves of approximately 1.4 billion barrels (as of April 25, 2013), commercial production from the Hibernia field commenced in November 1997 and is on-going. In recent years the project has been further expanded to include the Hibernia South Extension Unit, from which production commenced in 2011.

2) **Terra Nova Oilfield**: Discovered in 1984 and declared a significant discovery in 1985, this oilfield has reserve estimates of approximately 500 million barrels of recoverable reserves (as of April 25, 2013). The Terra Nova Project is currently in operation by Suncor Energy Inc. using a floating production, storage and offloading (FPSO) vessel. Dry-dock construction of the Terra Nova FPSO vessel began in early 1999, and it arrived at Bull Arm in May 2000 where outfitting, hook-up and commissioning of the vessel took place. The FPSO arrived at the oilfield in August 2001 and began producing oil in January 2002.

3) **White Rose Oilfield and Satellite Expansion**: Discovered in 1984, a significant discovery licence for the field was issued in January 2004. The White Rose oilfield and its satellite expansions are operated by Husky Energy Inc. utilizing a FPSO vessel, and first oil was produced in November 2005 followed by the North Amethyst expansion in May 2010. Reserve estimates for White Rose and its Expansion Fields are estimated at approximately 300 million barrels (as of April 25, 2013).

4) **Hebron Oilfield**: First discovered in 1980, this oilfield is estimated to contain in excess of 700 million barrels of recoverable resources (as of April 25, 2013). The Hebron Project is currently under development and will utilize a stand-alone concrete GBS being constructed at Bull Arm, which will be designed for an oil production rate of 150,000 barrels of oil per day. First oil from the Hebron Project is planned for 2017.

**Figure 3.19 Offshore Oil Production Facilities in the Eastern Newfoundland Offshore Area**

## 3.4 Potential Future Oil and Gas Exploration and Production Activities

Given the relatively early (licencing) stage of such planning and regulatory decision-making, details on the specific number, characteristics, location and timing of potential future offshore oil and gas activities that may be planned and undertaken under any new licences are not currently available.

The SEA therefore includes consideration of all of the elements and activities which may be associated with potential seismic surveys and well drilling programs in the region, as described in Section 3.2. Additional oil and gas exploration is a prerequisite for any possible future development (production) activity in the region, and would clearly occur at an earlier time that any future production activities which might eventually result from same.

Various technical and economic considerations will determine the requirement for, and specific characteristics of, any future oil and gas development activities and associated infrastructure, activities and timeframes. Predictions concerning the likely numbers of production facilities in the SEA Study Area therefore cannot be undertaken with any degree of accuracy or certainty. Experience with offshore discoveries and associated planning, design, regulatory approval and implementation processes and timelines in other portions of the NL Offshore Area also suggests that these can take well over a decade to advance to production from the time of a commercially significant discovery.

In the event that the results of any future oil and gas exploration licencing and associated seismic and drilling projects are positive and commercially significant and technically and economically viable petroleum resources are located, any associated production activities will have to be planned and implemented in an environmentally appropriate and acceptable manner, in accordance with relevant legislation, regulations and applicable authorizations, approvals and guidelines of the day. These projects will also be subject to EA and other regulatory reviews under provincial and/or federal processes (as applicable) by the proponent(s) of those developments, as they are determined and become defined. These detailed EA reviews and other regulatory requirements and standards are intended to help avoid or reduce potential environmental effects.

## 3.5 Possible Effects of the Environment on Offshore Oil and Gas Activities

The physical environmental setting of an area is clearly an important consideration in the planning, review and conduct of oil and gas exploration and development activities. An appropriate understanding, and careful consideration, of environmental characteristics and phenomena such as winds, waves, currents, ice, precipitation and other factors is required so that offshore activities can be designed and implemented appropriately, and in a manner that helps ensure that human health and safety, equipment and infrastructure and the environment are protected. This includes avoiding or reducing the potential for any incidents and accidents that may occur as a result of unplanned interactions between oil and gas operations and the physical environment of the marine area in question.

Physical environmental conditions typically influence key elements of the design and conduct of offshore oil and gas activities in various ways, including the selection of type and size of the drill rig, seismic vessel and other equipment, which are often determined based on water depth, likely weather and sea state conditions and sea ice and icebergs and associated mobility requirements. Oil and gas activities in the marine environment also have specific operational parameters and restrictions which require that they only be commenced and completed during particular environmental conditions. These include, for example, the sea state thresholds under which seismic equipment can be deployed, used and retrieved. The potential for, and occurrence of, extreme meteorological and oceanographic conditions may also affect other program and project components, activities and schedules, including the timing of associated vessel movements and drilling activity.

A general, regional overview of the physical environmental setting of the SEA Study Area is presented later, in Section 4.1 of this report. This includes a summary of overall geological, climatological and oceanographic conditions, and the potential for adverse operating conditions and extreme events.

The iceberg season on the East Coast of Newfoundland usually extends from April (or March) to June (or July) each year. Seasonal outlooks, generally accompanied by ice surveillance flights upstream (north) of the region, are commonly completed in association with any oil and gas activity in the area. Forecasting and monitoring the presence and movements of icebergs is also part of routine operational procedures during offshore operations in areas which are subject to such seasonal intrusions of ice. Appropriate safety measures can then be taken, including deflecting of icebergs, suspension of drilling activities, and/or moving a drilling unit if required. The presence, timing and duration and thickness of sea ice are also important considerations in planning and implementing any future offshore oil and gas activities in the region, both for routine and planned activities and as well as when developing and evaluating effective and timely responses for potential accidental events and malfunctions, such as oil spills. Sea ice conditions are also typically monitored prior to and during offshore operations as applicable. The sea ice climatology for the East Coast of Canada has been extensively documented, and current conditions, 48-hour ice forecasts, 30-day ice outlooks and seasonal outlooks are prepared by the Canadian Ice Service of Environment Canada on an ongoing basis. There is therefore considerable information and knowledge available for the SEA Study Area to form the basis for project-specific ice management.

The collection and analysis of detailed and site-specific information on climatic and meteorological conditions (winds, waves, precipitation and temperatures) and oceanographic characteristics (including waves, currents, sea ice and icebergs) are also typically part of an operator's overall planning and design of an offshore program and its associated regulatory review and approval requirements. Appropriate design and planning based on this information, such as in program scheduling, equipment selection and the development and implementation of appropriate operational procedures, helps to ensure the safety of personnel, equipment, vessels and the natural environment during the execution of seismic surveys and drilling programs in offshore environments. In addition to pre-commencement analysis and planning, meteorological and oceanographic monitoring programs are often implemented throughout offshore programs to forecast and respond to any severe environmental conditions.

Fog conditions are also a common occurrence in the region, and can be dangerous for drilling and vessel operations, particularly when ice or other hazards and human activities are present. The freezing of salt spray results when the air temperature is below -1.8°C, sea temperature is below 6°C and wind speeds are greater than 10 m/s, and freezing precipitation is likewise an important consideration. These issues need to be considered and addressed in the selection of equipment and the development of appropriate operational procedures to ensure that these can operate safely and effectively under these conditions. Depending on the nature, location and timing and duration of specific offshore programs, the potential effects of the biological environment may also be a consideration in planning and undertaking such programs. These may include, for example, possible biofouling (or, the colonization of offshore structures by epibenthic communities), plankton blooms and possible interference with visual inspections of structures.

The planning, design and regulatory review and approval of any future individual seismic surveys, exploration drilling programs and/or production projects in the region will therefore be based upon the compilation and analysis of detailed information on physical environmental conditions in the area to help to ensure the safety of personnel, equipment, vessels and the natural environment. The *Guidelines Respecting Physical Environmental Programs during Petroleum Drilling and Production Activities on Frontier Lands* provide a detailed overview of requirements for the operators of oil and gas drilling or production installations regarding the observing, forecasting, and reporting of physical environmental data. The objective of these physical environmental monitoring programs is to ensure that the necessary weather, oceanographic and ice information is available during an offshore exploratory or production program to support the safe and prudent conduct of operations, emergency response, and spill counter-measures.

Finally, as further assessed and described in Chapters 4 and 5 of this SEA Report, the biophysical and human environments also often affect and influence oil and gas activities, through the analysis and consideration of environmental components and issues in the planning, regulatory review, and (if approved) conduct of such exploration and development projects and activities. The information and results of this SEA and any past, on-going and future project-level assessments allow for such environmental components and considerations to influence the nature, planning and conduct of such programs, in order to attempt to avoid or reduce adverse environmental effects.