

**Response to Reviewer(s) Comments on:  
Petro-Canada Vertical Seismic Profiling Environmental Assessment,  
Terra Nova Development (June 2006)**

**GENERAL COMMENTS**

*Comment #1a (Sections 4.2-4.8)—The EA did not adequately address the information and analysis requirements outlined in Section 4 (see details below).*

**Response:** Based upon a discussion with the C-NLOPB and Petro-Canada, the VSP Survey EA Update (LGL 2006) was prepared with the intent that the document would be a brief update of the previous VSP EA with emphasis on addressing *Species at Risk Act*. Reviewer comments are addressed below. In addition, the EA has been revised to take account of relevant reviewer comments; the revised EA can be cited as:

LGL Limited. 2006. Environmental assessment of Petro-Canada's vertical seismic profiling program at the Terra Nova Development. LGL Rep. SA890a. Rep. by LGL Limited, St. John's, NL, for Petro-Canada, St. John's, NL. 92 p + appendix.

*Comment #1b (Section 4.2, 4.4, 4.5, 4.6)—In an EA report, the environmental impact analysis sections typically include these information requirements. However, this environmental impact analysis presented in the EA report is inadequate.*

**Response:** Sections 4.2 and 4.4 of the scoping document are addressed in response to Reviewer Comments #1c and #1h. Sections 4.5 and 4.6 of the scoping document are addressed in response to Reviewer Comment #1i.

*Comment #1c (Section 4.3)—Cumulative Environmental Effects. There is no discussion of cumulative effects within and between offshore oil and gas activities for the temporal scope of the project. The cumulative effects assessment is typically limited to those activities that are ongoing, or have been carried out over the duration of the proposed activity. A quick review of the temporal scope of current environmental assessments under review or recently completed, as listed on the C-NLOPB, could provide some measure of likely activity in the project area for the near future.*

**Response:** Cumulative effects are addressed for activities within the Project and for activities from other oil and gas projects offshore Newfoundland and Labrador. [See section 5.7 of LGL Limited (2006).]

**Cumulative Effects within the Project**

Any potential effects from a VSP program are related to underwater noise, presence of a supply boat (if one is in fact used), and accidental events. The presence of a supply boat and accidental events are captured within the Terra Nova Development EIS and are not considered here. This is

valid because these activities are well within the original Project Description and EIS. It should be noted that a VSP program does not normally use streamers, which in a typical seismic program would be filled with Isopar (a kerosene-like petroleum product not that different from diesel oil, which *was* covered in the EIS). Thus, underwater noise becomes the primary issue associated with a VSP program.

The sound from a VSP airgun array will be additive to other underwater sounds produced by the Terra Nova Project from supply vessel and tanker propulsion systems, drill rig machinery, and FPSO station-holding thrusters. To our knowledge there are no baseline data on the ambient underwater sounds (natural and anthropogenic) in the Terra Nova Development area. However, it should be noted that the temporal and spatial boundaries for a VSP survey are very limited relative to the Project as a whole. For example, the time frame of a VSP survey is short (eight to 36 hours), and there are a limited number of surveys (normally one per well; thus there may be on the order of another six surveys, depending upon the number of additional wells, over the life of the Terra Nova Development). In addition, the potentially affected area from any particular survey is likewise relatively small compared to a typical exploratory seismic survey because the array is normally smaller and less powerful. Thus, no significant cumulative effects will result from the VSP surveys. The confidence level in the prediction is high as confirmed by similar predictions of non-significant cumulative effects for much larger area seismic programs using much larger and more powerful arrays over a much longer period of time (e.g., Orphan Basin 3-D 2004-2005 surveys, Laurentian Sub-basin 2004 2D and 2005 3D surveys).

### **Cumulative Effects with Other Oil and Gas Activities**

In addition to cumulative effects within a project, it is necessary to assess cumulative effects with other projects in the region. Based upon an examination of the C-NLOPB website registry of projects undergoing, or recently completed, and Petro-Canada's general knowledge of the availability of seismic vessels and drill rigs, the following levels of activity in eastern Newfoundland and Labrador waters can be expected over the next several years.

- Labrador Shelf – one 2D or 3D seismic survey per year
- Orphan Basin –one 3D or CSEM survey and one exploratory well per year
- NE Grand Banks—one 3D survey and three VSP surveys (one each for Hibernia, Terra Nova, and White Rose); White Rose glory hole excavation; two or three wells drilled per year using a semi-submersible and a jack-up
- SW Grand Banks/Laurentian Sub-basin—one 3D program and one drilling program per year

The above programs will have support vessels, typically offshore supply tugs.

As discussed above, there are no broad-scale, broadband underwater sound measurements available for the regional area and thus one can only provide qualitative predictions of cumulative effects of an additional sound source from the VSP. The proposed Terra Nova VSP program will add some additional sound to the background sound from larger scale seismic programs, drill rig machinery, a dredge operating at White Rose, and seismic and support vessels. Other noise sources include those from marine transportation, fishing vessels, military

ships, and private yachts. Again, because the VSP surveys are low magnitude (relative to large seismic), short duration (up to 36 h), low frequency (perhaps one or two per year), little cumulative effects are predicted from this source. Thus, there will be no significant cumulative effects between the Terra Nova VSP and other oil and gas activities (or other general marine activities).

***Comment #1d (Section 4.8)—The EA report does not describe consultations undertaken regarding the proposed VSP activities. Referencing previous EAs would not be sufficient.***

**Response:** [See section 1.3 of LGL Limited (2006).] Consultations for Petro-Canada's VSP Program were undertaken with relevant agencies and interest groups via email and telephone. None of these stakeholders had any particular questions or concerns about these proposed activities.

In previous, similar VSP Programs, these groups have not raised any issues or questions regarding these kinds of offshore exploration activities (S. Canning, Canning & Pitt, pers. comm.).

Agencies/persons contacted regarding Petro-Canada's VSP program included:

DFO : Randy Power and Sigrid Kuehnemund  
 Environment Canada : Glenn Troke  
 One Ocean : Maureen Murphy  
 FPI : Derek Fudge  
 Association for Seafood Producers : E. Derek Butler  
 Natural History Society : Len Zedel

***Comment #1e (Section 5.1)—while the temporal boundary is stated to be the life of the Terra Nova project, an estimate of actual duration should be provided.***

**Response:** [See sections 2.5 and 5.1.3 of LGL Limited (2006).] The temporal boundaries are the estimated remainder of the life of the Terra Nova Development (15-17 years) with each VSP acquisition period lasting from 8-36 hours. Within a given year, there would be a maximum of two VSP surveys.

***Comment #1f (Section 5.3)—The scoping document states “where information is summarized from existing EA reports, the sections referenced should be clearly indicated”. For certain sections of the EA report, there is no summary information provided only a statement that there has been no change from previous EAs. This is insufficient. Additionally, where summary information is provided, there is no cross-reference to the EA referenced.***

**Response:** Upon review of the VSP EA Update, the following changes are provided:

“Meteorological and oceanographic conditions are described in Sections 3.1 and 3.2 of Petro-Canada (1996a)”. For this topic, see response to reviewer Comment #1h .

“Documents such as Davis et al. (1998: pages 90-99 and 142-150), Moulton et al. (2003: section 8) and Lawson et al. (2000: sections 5 and 6) provide a good overview of the effects of seismic ...” [See section 5.5 of LGL Limited (2006).]

The summary level statement for EA Methodology has been addressed in response to reviewer Comment #1g. [Also, see section 5.1 of LGL Limited (2006).]

The summary level statement regarding changes in the fishery has been addressed in response to reviewer Comment #1m. [Also, see section 4.1 of LGL Limited (2006).]

The summary level statement(s) in the “Scoping” section of the VSP EA Update have been addressed in response to reviewer Comment #17. [Also, see section 5.1.1 of LGL Limited (2006).]

***Comment # 1g (Section 5.3.1)—The EA methodology has not been described.***

**Response:** The following text describes the methodology employed for the EA. [See section 5.1 of LGL Limited (2006).]

## **Effects Assessment Methodology**

### **Scoping**

This is addressed in response to Reviewer Comment #16.

### **Valued Ecosystem Components**

The valued ecosystem components (VEC) approach was used to provide focus for the EA because it is neither feasible nor advisable to consider every species of the thousands that occur on the Grand Banks.

This approach is more or less standard practice for Canadian EA. It was recognized by the authors that this approach does not capture every conceivable situation for every species but it does consider potentially important effects on those species or groups of species that are of most interest commercially, socially, culturally and aesthetically to society.

VEC selection was based upon project scoping with the following foremost considerations:

- commercial, social, cultural and aesthetic importance to society
- at least some potential sensitivity to project activities, and

- potential for interaction with project activities

The following VECs were selected:

- Commercial fish and fisheries (including fish habitat considerations) with emphasis on snow crab and the Species at Risk (e.g., Atlantic cod and wolffish)
- Seabirds with emphasis on those species most likely sensitive to VSP activities (e.g., deep divers such as murres) or vessel stranding (e.g., petrels), and Species at Risk (e.g., Ivory Gull)
- Marine Mammals with emphasis on those species (thought to be) most sensitive to low-frequency sound (e.g., baleen whales) or Species at Risk (e.g., blue whale).
- Sea Turtles with emphasis on those species most likely to occur in the Study Area and considered at risk under SARA (i.e., leatherback sea turtle)
- Species at Risk including those mentioned above plus several others

## Boundaries

For the purposes of this EA, the following boundaries are defined.

**Temporal**—the temporal boundaries are the estimated remainder of the life of the Terra Nova Development (15-17 years) with each VSP acquisition period lasting from 8-36 hours. Within a given year, there would be a maximum of two VSP surveys.

**Project Area**—the ‘Project Area’ was defined as the Terra Nova Development area, including all of Petro-Canada’s production licenses.

**Affected Area**—the ‘Affected Area’ varies according to the specific vertical and horizontal distributions and sensitivities of the VECs of interest and is defined as that area within which effects (physical or important behavioural ones) have been reported to occur.

**Regional Area**—the regional boundary (or Study Area) is the boundary of the Grand Banks as defined in the Hibernia, Terra Nova, White Rose, and other EAs.

**Transboundary**—this boundary is not relevant in the present case as neither the Project nor affected areas will extend across any international boundaries.

## Effects Assessment Procedures

The systematic assessment of the potential effects of the Project phase involved three major steps:

1. preparation of interaction (between Project activities and the environment) matrices;
2. identification and evaluation of potential effects including description of mitigation measures and residual effects; and

3. preparation of residual effects summary tables, including evaluation of cumulative effects.

### **Identification and Evaluation of Effects**

Interaction matrices are provided below that identify all possible Project activities that could interact with any of the VECs (e.g., Table 1). The matrices include times and places where interactions could occur. The interaction matrices are used only to identify potential interactions; they make no assumptions about the potential effects of the interactions.

Interactions were then evaluated for their potential to cause effects. In instances where the potential for an effect of an interaction was deemed impossible or extremely remote, these interactions were not considered further. In this way, the assessment could focus on key issues and the more substantive environmental effects.

An interaction was considered to be a potential effect if it could change the abundance or distribution of VECs, or change the prey species or habitats used by VECs. The potential for an effect was assessed by considering:

- the location and timing of the interaction;
- the literature on similar interactions and associated effects (including the Hibernia and Terra Nova EIS, White Rose EA; drilling EAs, other VSP EAs for offshore Newfoundland);
- when necessary, consultation with other experts; and
- results of similar effects assessments and especially, monitoring studies done in other areas.

When data were insufficient to allow certain or precise effects evaluations, predictions were made based on professional judgement. Effects were evaluated for the proposed VSP surveys, which include mitigation measures that are mandatory or have become standard operating procedure in the industry.

### **Classifying Anticipated Environmental Effects**

The concept of classifying environmental effects simply means determining whether they are negative or positive. The following includes some of the key factors that are considered for determining adverse environmental effects, as per the CEA Agency guidelines (CEAA 1994):

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

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

## **Mitigation**

Mitigation measures appropriate for each effect predicted in the matrix were identified and the effects of various Project activities were then evaluated assuming that appropriate mitigation measures are applied. Residual effects predictions were made taking into consideration both standard and project-specific mitigations.

## **Application of Evaluation Criteria for Assessing Environmental Effects**

Several criteria were taken into account when evaluating the nature and extent of environmental effects. These criteria include (CEAA 1994):

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

Magnitude describes the nature and extent of the environmental effect for each activity. Geographic extent refers to the specific area (km<sup>2</sup>) affected by the Project activity, which may vary depending on the activity and the relevant VEC. Duration and frequency describe how long and how often a project activity and/or environmental effect will occur. Reversibility refers to the ability of a VEC to return to an equal, or improved condition, at the end of the project. The ecological, socio-cultural and economic context describes the current status of the area affected by the project in terms of existing environmental effects. Two tables are provided for each group of VECs, indicating the results of the effects analysis and the significance of those effects (e.g., refer to Tables 2 and 3 below).

Magnitude was defined as:

Negligible	An interaction that may create a measureable effect on individuals but would never approach the 10% value of the 'low' rating. Rating = 0.
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Low	Affects >0 to 10 percent of individuals in the affected area (e.g., geographic extent). Effects can be outright mortality, sublethal or exclusion due to disturbance. Rating = 1.
Medium	Affects >10 to 25 percent of individuals in the affected area (see geographic extent). Effects can be outright mortality, sublethal or exclusion due to disturbance. Rating = 2.
High	Affects more than 25 percent of individuals in the affected area (e.g., geographic extent). Effects can be outright mortality, sublethal or exclusion due to disturbance. Rating = 3.

Definitions of magnitude used in this EA have been used previously in numerous offshore oil-related environmental assessments under CEAA. These include assessments of exploratory drilling (LGL 2005a), development drilling (Petro-Canada 1996a; Husky 2000, 2001, 2002), 3D seismic surveys (Buchanan et al. 2004), VSP surveys (LGL 2003), and wellsite geohazard surveys (LGL 2004a).

Durations are defined as:

1	=	< 1 month
2	=	1 – 12 month
3	=	13 – 36 month
4	=	37 – 72 month
5	=	>72 month

Short duration can be considered 12 months or less and medium duration can be defined as 13 to 36 months.

### **Cumulative Effects**

Projects and activities considered in the cumulative effects assessment included:

- Survey program within-project cumulative impacts. For the most part, and unless otherwise indicated, within-project cumulative effects are fully integrated within this assessment;
- Hibernia, Terra Nova, and White Rose oilfield developments;
- Other offshore oil exploration activity (seismic surveys and exploratory drilling);
- Commercial fisheries; and
- Marine transportation (tankers, cargo ships, supply vessels, naval vessels, fishing vessel transits, etc.).

## **Integrated Residual Environmental Effects**

Upon completion of the evaluation of environmental effects, the residual environmental effects (effects after project-specific mitigation measures are imposed) are assigned a rating of significance for:

- each project activity or accident scenario;
- the cumulative effects of project activities within the Project; and
- the cumulative effects of combined projects on the Grand Banks.

These ratings are presented in summary tables of residual environmental effects. The last of these points considers all residual environmental effects, including project and other-project cumulative environmental effects. As such, this represents an integrated residual environmental effects evaluation.

The analysis and prediction of the significance of environmental effects, including cumulative environmental effects, encompasses the following:

- determination of the significance of residual environmental effects;
- establishment of the level of confidence for prediction; and
- evaluation of the scientific certainty and probability of occurrence of the residual impact prediction.

Ratings for level of confidence, probability of occurrence, and determination of scientific certainty associated with each prediction are presented in the tables of residual environmental effects. The guidelines used to assess these ratings are discussed in detail in the sections below.

### **Significance Rating**

Significant environmental effects are those that are considered to be of sufficient magnitude, duration, frequency, geographic extent, and/or reversibility to cause a change in the VEC that will alter its status or integrity beyond an acceptable level. Establishment of the criteria is based on professional judgment, but is transparent and repeatable. In the VSP EA, a *significant* effect is defined as:

- *Having a high magnitude or medium magnitude for a duration of greater than one year and over a geographic extent greater than 100 km<sup>2</sup>*

An effect can be considered *significant, not significant, or positive*.

### **Level of Confidence**

The significance of the residual environmental effects is based on a review of relevant literature, consultation with experts, and professional judgment. In some instances, making predictions of potential residual environmental effects is difficult due to the limitations of available data (for example, technical boundaries). Ratings are therefore provided to indicate, qualitatively, the level of confidence for each prediction.

### **Determination of Whether Predicted Environmental Effects are Likely to Occur**

The following criteria for the evaluation the likelihood of any predicted significant effects are used.

- probability of occurrence; and
- scientific certainty.

### **Follow-up Monitoring**

Because any effects of the Project on the environment will be short-term and transitory, and for the most part negligible, there is no need to conduct follow-up monitoring. However, there will be some level of monitoring during the course of the Project, and if these observations indicate an accidental release of fuel or some other unforeseen occurrence, then some follow-up monitoring may be conducted under the guidance of the C-NLOPB and other appropriate agencies.

***Comment #1h (Section 5.3.4) –has not been addressed. [Referring to an update of meteorological and oceanographic characteristics of the Study Area.]***

**Response:** The most recent oceanographic review of the area is contained in Oceans (2005). This report is appended in its entirety to LGL Limited (2006).

The effects of the environment on the project [see section 5.2 of LGL Limited (2006)] are *negligible* (and thus *not significant*) for the following reasons:

- The VSP surveys are sometimes conducted from the drill rig and thus are relatively unaffected by wave conditions.
- VSP surveys are typically scheduled during the summer months when the weather and ice conditions are good for operations.

- Surveys are of short duration (8-36 h) and thus any potential effects of bad wind or wave conditions can be mitigated by judicious scheduling.
- VSP surveys are less affected by surface weather noise because the receivers are in the well bore and not being towed on streamers near the surface as with large seismic surveys.

**Comment #1i (Section 5.3.5)—there is no assessment of effects provided (as described in the last bullet of this section)**

Response: The following text and corresponding tables provides an effects assessment for each VEC. [See sections 5.3-5.7 of LGL Limited (2006).]

### Fish/Commercial Fishery VECs

#### Fish VEC

Potential interactions between the Project and fish VEC are shown in Table 1.

The minimal spatial and temporal overlap and the relatively small nature of the proposed Project suggest that there is no potential for significant effects on the fish VEC. The proposed VSP survey is predicted to have *negligible to low* physical effects on the various life stages of the fish VEC species over a duration of *<1 month* in an area *<1 km<sup>2</sup>*. Therefore, any physical effects of the Project on the fish VEC would be *not significant*.

**Table 1. Potential interactions between the Project and Fish VEC.**

Valued Environmental Component: Fish						
	Feeding		Reproduction		Adult Stage	
	Plankton	Benthos	Eggs/Larvae	Juveniles <sup>1</sup>	Pelagic Fish	Groundfish
<b>PROJECT ACTIVITIES</b>						
Vessel Lights	x		x		x	
Sanitary/Domestic Waste	x		x		x	
Air Emissions	x		x		x	
Garbage (N/A) <sup>2</sup>						
<b>Noise</b>						
Vessel	x	x	x	x	x	x
Seismic Array	x	x	x	x	x	x
Shore Facilities (N/A) <sup>3</sup>						
Accidental Spills (N/A) <sup>4</sup>						
<b>OTHER PROJECTS AND ACTIVITIES</b>						

Valued Environmental Component: Fish						
	Feeding		Reproduction		Adult Stage	
	Plankton	Benthos	Eggs/Larvae	Juveniles <sup>1</sup>	Pelagic Fish	Groundfish
<b>Hibernia</b>	x	x	x	x	x	X
<b>Terra Nova</b>	x	x	x	x	x	X
<b>White Rose</b>	x	x	x	x	x	X
<b>Exploration</b>	x	x	x	x	x	X
<b>Fisheries</b>	x	x	x	x	x	X
<b>Marine Transportation</b>	x		x		x	X

<sup>1</sup> Juveniles are young fish that have left the plankton and are often found closely associated with substrates.  
<sup>2</sup> Not applicable as garbage will be brought ashore.  
<sup>3</sup> There will not be any new onshore facilities. Existing infrastructure will be used.  
<sup>4</sup> Accidental spills were assessed in the original Terra Nova EIS (see Section 5.7 in Petro-Canada 1996)

Similarly, the proposed VSP survey is predicted to have *negligible to low* disturbance (behavioural) effects on the various life stages of the fish VEC species over a duration of <1 month in an area 101-1,000 km<sup>2</sup>. Therefore, any disturbance (behavioural) effects of the Project on the fish VEC would be *not significant*. The effects assessment is shown in Table 2.

**SARA Species.**—The fish VEC was defined in a previous section as including four of the five fish species presently listed under SARA; northern wolffish, spotted wolffish, Atlantic wolffish, and Atlantic cod. Northern and spotted wolffish are listed as ‘threatened’ on Schedule 1, Atlantic wolffish as ‘special concern’ on Schedule 1, and Atlantic cod as ‘special concern’ on Schedule 3. The fifth fish species referred to above is Atlantic salmon (*Salmo salar*) in the Inner Bay of Fundy. It is uncertain if this population is relevant to this update. As indicated above, the physical and disturbance (behavioural) effects of the proposed VSP survey on these SARA species are assessed as *not significant*.

Table 2. Effects assessment on Fish VEC.

Valued Environmental Component: Fish																																																		
PROJECT ACTIVITY	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects																																															
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-Cultural and Economic Context																																										
Vessel Lights	Attraction (N)	-	0	1	1	1	R	2																																										
Sanitary/Domestic Waste	Increased Food (N/P)	-	0	1	1	1	R	2																																										
Air Emissions	Surface Contaminants (N)	-	0	1	1	1	R	2																																										
<b>Noise</b>																																																		
Vessel	Disturbance (N)	-	0-1	1	1	1	R	2																																										
Seismic Array	Disturbance (N) Physical Effects (N)	Ramp up	1	4	1	1	R	2																																										
<p>Key:</p> <table> <tr> <td>Magnitude:</td> <td>Frequency:</td> <td>Reversibility:</td> <td>Duration:</td> </tr> <tr> <td>0 = Negligible, essentially no effect</td> <td>1 = &lt; 11 events/yr</td> <td>R = Reversible</td> <td>1 = &lt; 1 month</td> </tr> <tr> <td>1 = Low</td> <td>2 = 11-50 events/yr</td> <td>I = Irreversible (refers to population)</td> <td>2 = 1-12 months</td> </tr> <tr> <td>2 = Medium</td> <td>3 = 51-100 events/yr</td> <td></td> <td>3 = 13-36 months</td> </tr> <tr> <td>3 = High</td> <td>4 = 101-200 events/yr</td> <td></td> <td>4 = 37-72 months</td> </tr> <tr> <td></td> <td>5 = &gt; 200 events/yr</td> <td></td> <td>5 = &gt; 72 months</td> </tr> <tr> <td></td> <td>6 = continuous</td> <td></td> <td></td> </tr> </table> <table> <tr> <td>Geographic Extent:</td> <td>Ecological/Socio-cultural and Economic Context:</td> </tr> <tr> <td>1 = &lt; 1 km<sup>2</sup></td> <td>1 = Relatively pristine area or area not adversely affected by human activity</td> </tr> <tr> <td>2 = 1-10 km<sup>2</sup></td> <td>2 = Evidence of existing adverse effects</td> </tr> <tr> <td>3 = 11-100 km<sup>2</sup></td> <td></td> </tr> <tr> <td>4 = 101-1000 km<sup>2</sup></td> <td></td> </tr> <tr> <td>5 = 1001-10,000 km<sup>2</sup></td> <td></td> </tr> <tr> <td>6 = &gt; 10,000 km<sup>2</sup></td> <td></td> </tr> </table>									Magnitude:	Frequency:	Reversibility:	Duration:	0 = Negligible, essentially no effect	1 = < 11 events/yr	R = Reversible	1 = < 1 month	1 = Low	2 = 11-50 events/yr	I = Irreversible (refers to population)	2 = 1-12 months	2 = Medium	3 = 51-100 events/yr		3 = 13-36 months	3 = High	4 = 101-200 events/yr		4 = 37-72 months		5 = > 200 events/yr		5 = > 72 months		6 = continuous			Geographic Extent:	Ecological/Socio-cultural and Economic Context:	1 = < 1 km <sup>2</sup>	1 = Relatively pristine area or area not adversely affected by human activity	2 = 1-10 km <sup>2</sup>	2 = Evidence of existing adverse effects	3 = 11-100 km <sup>2</sup>		4 = 101-1000 km <sup>2</sup>		5 = 1001-10,000 km <sup>2</sup>		6 = > 10,000 km <sup>2</sup>	
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## Commercial Fishery VEC

Potential interactions between the Project and the commercial fishery VEC (includes DFO research surveys) are shown in Table 3.

**Table 3. Potential interactions between the Project and Commercial Fishery VEC.**

Valued Environmental Component: Commercial Fishery			
	Catch Success	Gear Conflict	Research Surveys
<b>PROJECT ACTIVITIES</b>			
Vessel Lights			
Sanitary/Domestic Waste	x	x	x
Air Emissions			
Garbage (N/A)			
Noise			
Vessel	x		x
Seismic Array	x		x
Vessel Activities			x
Physical presence of vessel and VSP equipment	x	x	x
Accidental Spills <sup>1</sup>			
<b>OTHER PROJECTS AND ACTIVITIES</b>			
Exploration	x	x	x
Marine Transportation	x	x	x

<sup>1</sup>Accidental spills were assessed in the original Terra Nova EIS (see Section 5.7 in Petro-Canada 1996)

The chief sources for potential impacts of the Project on the commercial fisheries would be related to (1) changes in catch rates resulting from sound-induced behavioural changes (scaring) of fish, (2) interference with fishing activities - particularly fixed gear - owing to gear or vessel conflicts, or (3) as a result of effects on stock assessments and DFO research, which is used, among other purposes, for setting fishing quotas or exploring new fisheries. [Impacts related to physical effects on fish and invertebrates are not discussed here as they were assessed in previous sections, and predicted to be *not significant*.]

There is typically minimal commercial harvesting within the proposed Project Area. Given the small spatial and temporal footprint of the proposed Project, there will be minimal conflict between the commercial fisheries and the Project. Mitigations such as advisories will lessen the

potential for effects and a compensation program for gear loss will lessen any potential effects to *negligible*. The primary commercial fishery gear type used in the area is the fixed-gear crab pot.

The schedule for 2006 DFO research surveys offshore Newfoundland is presented in section 4.1.5 of LGL Limited (2006).

The proposed VSP survey is predicted to have *negligible to low* disturbance (behavioural) effects on the commercial fishery VEC over a duration of *<1 month* in an area *101-1,000 km<sup>2</sup>*. Therefore, any disturbance (behavioural) effects of the Project on the commercial fishery VEC (and research surveys) would be *not significant*. The effects assessment is shown in Table 4.

### **Seabird VEC**

Potential interactions between the Project and seabird VECs are shown in Table 5. The effects assessment is shown in Tables 6. Murres are potentially the most sensitive group to underwater sound because of their time spent underwater. Murres and shearwaters may be the most sensitive bird species for the Project, the former because of its feeding habits, spending large amounts on and under the water, and the latter because of their relatively large numbers in the Project Area during periods when VSP surveys are likely to be conducted (i.e., summer-early fall). Petrels also have some sensitivity to the Project if they are attracted to the survey vessel and become stranded but the numbers involved for the duration of a VSP survey would be low. It is unlikely that the Ivory Gull will occur in a Project Area and its feeding strategy would not expose it for long periods of time to underwater sound.



**Table 5. Potential interactions between the Project and seabird, sea turtle and marine mammal VECs.**

<b>Project Activity</b>	<b>Seabirds</b>	<b>Sea Turtles</b>	<b>Marine Mammals</b>
<b>Vessel Lights</b>	x	x	
<b>Sanitary/Domestic Waste</b>	x	x	x
<b>Air Emissions</b>	x	x	x
<b>Garbage (N/A)</b>			
<b>Noise</b>			
Vessel	x	x	x
Seismic Array	x	x	x
<b>Shore Facilities (N/A)</b>			
<b>Accidental Spills (N/A)<sup>1</sup></b>			
<b>Hibernia</b>	x	x	x
<b>Terra Nova</b>	x	x	x
<b>White Rose</b>	x	x	x
<b>Exploration</b>	x	x	x
<b>Fisheries</b>	x	x	x
<b>Marine Transportation</b>	x	x	x
<sup>1</sup> Accidental spills were assessed in the original Terra Nova EIS (see Section 5.7 in Petro-Canada 1996)			

**Table 6. Effects assessment on Seabird VEC.**

Valued Environmental Component: Seabirds																																																		
Project Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects																																															
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-Cultural and Economic Context																																										
<b>Project Activities</b>																																																		
Vessel Lights	Attraction (N)	Release Program, minimize lighting	0-1	1	1	1	R	2																																										
Sanitary/Domestic Waste	Increased Food (N/P)	-	0-1	1	1	1	R	2																																										
Air Emissions	Surface Contaminants (N)	-	0	1	1	1	R	2																																										
<b>Noise</b>																																																		
Vessel	Disturbance (N)	Avoid concentrations	0-1	1	1	1	R	2																																										
Seismic Array	Disturbance (N) Physical Effects (N)	Ramp up	1	2-3	1	1	R	2																																										
<p>Key:</p> <table> <tr> <td>Magnitude:</td> <td>Frequency:</td> <td>Reversibility:</td> <td>Duration:</td> </tr> <tr> <td>0 = Negligible, essentially no effect</td> <td>1 = &lt; 11 events/yr</td> <td>R = Reversible</td> <td>1 = &lt; 1 month</td> </tr> <tr> <td>1 = Low</td> <td>2 = 11-50 events/yr</td> <td>I = Irreversible</td> <td>2 = 1-12 months</td> </tr> <tr> <td>2 = Medium</td> <td>3 = 51-100 events/yr</td> <td>(refers to population)</td> <td>3 = 13-36 months</td> </tr> <tr> <td>3 = High</td> <td>4 = 101-200 events/yr</td> <td></td> <td>4 = 37-72 months</td> </tr> <tr> <td></td> <td>5 = &gt; 200 events/yr</td> <td></td> <td>5 = &gt; 72 months</td> </tr> <tr> <td></td> <td>6 = continuous</td> <td></td> <td></td> </tr> </table> <table> <tr> <td>Geographic Extent:</td> <td>Ecological/Socio-cultural and Economic Context:</td> </tr> <tr> <td>1 = &lt; 1 km<sup>2</sup></td> <td>1 = Relatively pristine area or area not adversely affected by human activity</td> </tr> <tr> <td>2 = 1-10 km<sup>2</sup></td> <td>2 = Evidence of existing adverse effects</td> </tr> <tr> <td>3 = 11-100 km<sup>2</sup></td> <td></td> </tr> <tr> <td>4 = 101-1000 km<sup>2</sup></td> <td></td> </tr> <tr> <td>5 = 1001-10,000 km<sup>2</sup></td> <td></td> </tr> <tr> <td>6 = &gt; 10,000 km<sup>2</sup></td> <td></td> </tr> </table>									Magnitude:	Frequency:	Reversibility:	Duration:	0 = Negligible, essentially no effect	1 = < 11 events/yr	R = Reversible	1 = < 1 month	1 = Low	2 = 11-50 events/yr	I = Irreversible	2 = 1-12 months	2 = Medium	3 = 51-100 events/yr	(refers to population)	3 = 13-36 months	3 = High	4 = 101-200 events/yr		4 = 37-72 months		5 = > 200 events/yr		5 = > 72 months		6 = continuous			Geographic Extent:	Ecological/Socio-cultural and Economic Context:	1 = < 1 km <sup>2</sup>	1 = Relatively pristine area or area not adversely affected by human activity	2 = 1-10 km <sup>2</sup>	2 = Evidence of existing adverse effects	3 = 11-100 km <sup>2</sup>		4 = 101-1000 km <sup>2</sup>		5 = 1001-10,000 km <sup>2</sup>		6 = > 10,000 km <sup>2</sup>	
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Most effects of the Project on seabirds will be *negligible* because available information (albeit limited for seismic sound) for the most part suggests that birds are not particularly sensitive to underwater sound. Some petrels could be affected if they become attracted to and then stranded on the ship, but mitigation/handling methods should reduce or eliminate mortalities. In addition, lighting on the survey ship at night and in poor weather conditions will be reduced as much as possible. Furthermore, there is no streamer flotation liquid associated with this project. Thus,

the number of birds affected by the Project should be quite low and thus any effects (including those on Ivory Gulls) will be *not significant*.

### **Marine Mammal and Sea Turtle VECs**

Potential interactions between marine mammals, sea turtles and the Project are shown in Table 5. The VSP project proposed by Petro-Canada is of short duration (8-36 hours of data acquisition per survey) and will occur in a small area (up to 5 km from the wellhead for Walkaway VSP). Relative to a full-scale 2-D or 3-D seismic program, any effects on VECs will be minimal as source levels are lower and the duration seismic sound is emitted in the water column is much reduced.

### **Mysticetes**

There is little potential for the proposed VSP program to cause hearing impairment and physical effects on mysticetes or baleen whales given that baleen whales would likely exhibit localized avoidance from the survey ship and sound source. Available evidence indicates that baleen whales are able to hear the seismic array. If some whales did experience hearing impairments, the effects would likely be “temporary” (minutes to hours to days in duration). The likelihood of baleen whales experiencing hearing impairment or other physical effects is reduced by implementing mitigation measures including ramp up of the array, delay of start up of the array for baleen whales within a 500 m safety zone, and for the endangered blue whale shutdown of the airgun array anytime this species enters the safety zone. With mitigation measures in place, the proposed VSP program is predicted to have *negligible to low* physical impacts on baleen whales, over a duration of *<1 month*, in an area *<1 km<sup>2</sup>* (Table 7). Therefore, hearing impairment and physical impacts of VSP surveys on baleen whales (including the endangered blue whale) would be *not significant*.

With the implementation of the mitigation measure of ramping up the airgun array and implementation of a safety zone (for more details see Response to Reviewer Comment #19), disturbance effects on baleen whales (including endangered species, i.e., blue whale) are predicted to be *negligible to low*, over a duration of *<1 month*, in an area of *<1 km<sup>2</sup> to 101-1000 km<sup>2</sup>*. Therefore, impacts related to disturbance, are judged to be *not significant* for baleen whales.

## Odontocetes

There is little potential for the VSP program to cause physical effects on odontocetes (toothed whales, dolphins, porpoises) given that odontocetes would likely exhibit localized avoidance from the survey ship and sound source and toothed whales are likely most sensitive to higher frequency sound. If some odontocetes did experience hearing impairments, the effects would likely be “temporary” (minutes to hours to days in duration). The likelihood of odontocetes experiencing hearing impairment or other physical effects is reduced by implementing mitigation measures including ramp up of the array and delay of start up of the array for odontocetes within a 500 m safety zone. With mitigation measures in place, the proposed VSP program is predicted to have *negligible to low* physical impacts on odontocetes, over a duration of *<1 month*, in an area *<1 km<sup>2</sup>* (Table 7). Therefore, hearing impairment and physical impacts of VSP surveys on odontocetes are predicted to be *not significant*.

With the implementation of the mitigation measure of ramping up the airgun array and delaying start-up for odontocetes sighted within the 500 m safety zone, disturbance effects on odontocetes are predicted to be *negligible to low*, over a duration of *<1 month*, in an area of *<1 km<sup>2</sup> to 101-1000 km<sup>2</sup>*. Therefore, impacts related to disturbance, are judged to be *not significant* for odontocetes.

## Pinnipeds

There is little potential for the VSP program to cause hearing impairment or physical effects on seals given that few seals are expected to occur in the area during the program. Also, any seals in the area would likely exhibit localized avoidance from the survey ship and sound source. If some seals did experience hearing impairments, the effects would likely be “temporary” (minutes to hours to days in duration).

The likelihood of seals experiencing hearing impairment or other physical effects is reduced by implementing mitigation measures including ramp up of the array and delay of start up of the array for seals within a 500 m safety zone. With mitigation measures in place, the proposed VSP program is predicted to have *negligible to low* physical impacts on seals, over a duration of *<1 month*, in an area *<1 km<sup>2</sup>* (Table 7). Therefore, hearing impairment and physical impacts of VSP surveys on seals would be *not significant*.

With the implementation of the mitigation measure of ramping up the airgun array and delaying start-up for seals sighted within the 500 m safety zone, disturbance effects on seals are predicted

to be *negligible to low*, over a duration of *<1 month*, in an area of *<1 km<sup>2</sup> to 101-1000 km<sup>2</sup>*. Therefore, impacts related to disturbance, are judged to be *not significant* for seals.

### **Sea Turtles**

There is little potential for the proposed VSP program to cause hearing impairment or physical effects on sea turtles given that few sea turtles are expected to occur in the area during the program. Also, any sea turtles in the area would likely exhibit localized avoidance from the survey ship and sound sources. If some sea turtles did experience hearing impairments, the effects would likely be “temporary”. The likelihood of sea turtles experiencing hearing impairment or other physical effects is reduced by implementing mitigation measures including ramp up of the array, delay of start up of the array for sea turtles within a 500 m safety zone, and for the endangered leatherback sea turtle shutdown of the airgun array anytime this species enters the safety zone. With mitigation measures in place, the proposed VSP program is predicted to have *negligible to low* physical impacts on sea turtles (including leatherback turtles), over a duration of *<1 month*, in an area *<1 km<sup>2</sup>* (Table 7). Therefore, hearing impairment and physical impacts of VSP surveys on sea turtles would be *not significant*.

With the implementation of the mitigation measure of ramping up the airgun array and implementation of a safety zone (for more details see Response to Reviewer Comment #19), disturbance effects on sea turtles (including endangered species, i.e., leatherback sea turtle) are predicted to be *negligible to low*, over a duration of *<1 month*, in an area of *<1 km<sup>2</sup> to 101-1000 km<sup>2</sup>*. Also, the survey site is not located in an important habitat area for turtles (i.e., breeding or feeding). Therefore, impacts related to disturbance, are judged to be *not significant* for sea turtles.

**Table 7. Effects assessment on marine mammal and sea turtle VECs.**

Valued Environmental Component: Marine Mammals and Sea Turtles								
Project Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-Cultural and Economic Context
<b>Project Activities</b>								
Vessel Lights	Attraction (N)	Minimize lighting	0-1	1	1	1	R	2
Sanitary/Domestic Waste	Increased Food (N/P)	-	0-1	1	1	1	R	2
Air Emissions	Surface Contaminants (N)	-	0	1	1	1	R	2
Noise								
Vessel	Disturbance (N)	-	0-1	1	1	1	R	2
Seismic Array	Disturbance (N) Physical Effects (N)	Ramp up, safety zone for ramp up, shutdowns for endangered MM & turtles	1	1-4	1	1	R	2
<p><b>Key:</b></p> <p>Magnitude: 0 = Negligible, essentially no effect 1 = Low 2 = Medium 3 = High</p> <p>Frequency: 1 = &lt; 11 events/yr 2 = 11-50 events/yr 3 = 51-100 events/yr 4 = 101-200 events/yr 5 = &gt; 200 events/yr 6 = continuous</p> <p>Reversibility: R = Reversible I = Irreversible (refers to population)</p> <p>Duration: 1 = &lt; 1 month 2 = 1-12 months 3 = 13-36 months 4 = 37-72 months 5 = &gt; 72 months</p> <p>Geographic Extent: 1 = &lt; 1 km<sup>2</sup> 2 = 1-10 km<sup>2</sup> 3 = 11-100 km<sup>2</sup> 4 = 101-1000 km<sup>2</sup> 5 = 1001-10,000 km<sup>2</sup> 6 = &gt; 10,000 km<sup>2</sup></p> <p>Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity 2 = Evidence of existing adverse effects</p>								

***Comment #1j (Section 5.3.6)—not adequately addressed. [Referring to effects of the VSP program on Marine Fish and Shellfish.]***

**Response:** See response to Comment #1i, including Tables 1-4. [See section 5.3 of LGL Limited (2006).]

***Comment #1k (Section 5.3.9)—not addressed [Referring to description of sensitive areas and effects of the VSP program on any identified sensitive areas.]***

**Response:** As indicated in the original EA submitted in June 2006 and again in LGL Limited (2006; section 4.4), specific sensitive areas were not identified within the Project Area. It was noted that the most important fishery areas were located at more than 25 km from Terra Nova. The original EA stated that SARA- and COSEWIC listed species may occur in the Terra Nova area but sensitive habitat has not been identified. The potential effects of a VSP program on species considered at risk under SARA was addressed in response to Comment #1i and are considered in sections 5.3-5.6 of LGL Limited (2006).

***Comment #1l (Section 5.3.11)—not adequately addressed. [Referring to an assessment of the effects of the presence of a seismic vessel.]***

**Response:** See response to Comment #1i. Note that the potential disturbance to VECs by the presence of a survey vessel is likely related to noise from the ship or drilling structure.

***Comment #1m (Section 5.3.12)—respecting consideration of underutilized species and species under moratoria. In particular, the EA report states that the fishery has changed considerably since the Terra Nova EIS but does not describe those changes.***

**Response:** [See section 4.1 of LGL Limited (2006).] Commercial fish harvesting within the Study Area and on the Newfoundland Grand Banks generally has changed significantly over the last two decades, shifting from a groundfish-based industry to primarily invertebrate harvesting. Until the early 1990s, the eastern Grand Banks fisheries were dominated by stern otter trawlers harvesting groundfish, primarily Atlantic cod, as well as redfish, American plaice and several other species. In 1992, with the acknowledgement of the collapse of several groundfish stocks, a harvesting moratorium was declared and directed fisheries for cod are no longer permitted in these areas. Since the collapse of the groundfish fisheries, formerly underutilized species – mainly shrimp and snow crab – have come to replace them as the principal harvest in the general region, as they have in many other areas offshore Newfoundland and Labrador.

Analysis of DFO RV survey data collected in the western portion of 3Lt between 2002 and 2005 indicated that the mean depth of catches ranged between 59 and 119 m. Sand lance dominated the catches in terms of both weight (78%) and number of individuals (92%). The mailed sculpin was the only other species to account for more than 1% of the total number of specimens caught. Other

species that accounted for more than 1% of the catch weight included unspecified invertebrates (7%), American plaice (4%), mailed sculpin (2%), thorny skate (2%), shrimp (2%), and snow crab (2%).

***Comment #1n (Section 5.3.13)—not addressed. [Referring to effects of accidental effects.]***

**Response:** As indicated in the response to Comment #1c, page 1, accidental events are captured within the Terra Nova Development EIS and are not considered here. This is valid because these activities are well within the original Project Description and EIS. It should be noted that a VSP program does not normally use streamers, which in a typical seismic program would be filled with Isopar (a kerosene-like petroleum product not that different from diesel oil, which *was* covered in the EIS).

***Comment #2: The temporal and spatial boundaries of the project have not been clearly defined in the EA.***

**Response:** See response to Comment #1g, “Boundaries” section. [See sections 2.5 and 5.1.3 of LGL Limited (2006).]

***Comment #3: Even though (Seabirds) have been identified as a VEC in the EA, they are not assessed.***

**Response:** See response to Comment #1i, including Tables 5 and 6. [See section 5.4 of LGL Limited (2006).]

***Comment #4: Not enough attention has been given to the affects assessment, mitigations and effects significant.***

**Response:** See response to Comment #1i. [See sections 5.2-5.7 and 6 of LGL Limited (2006).]

## SPECIFIC COMMENTS

*Comment #5. (Page 6, Section 2.8 Scheduling)—An approximate timeframe (e.g., months, years) for the program would be beneficial information and should be provided.*

**Response:** See response to Comment #1g, “Boundaries” section.

*Comment #6 (Page 7, Section 2.9.6, last sentence)—“...acquisition of up to 400 levels.” No units are given so the meaning is unclear (400 dB?). Please revisit and clarify.*

**Response:** The 400 levels refer to 400 levels within the well bore that the receiver tool would acquire recordings of the airgun pulses; thus, units are not relevant here. [See section 2.6.6 of LGL Limited (2006).]

*Comment #7 (Page 14, Section 3.2.1). Seabird observation data is (sic) continually collected at the Terra Nova field. The EA report however, does not include this (sic) data in its discussion of seabird distribution, why?*

**Response:** The EA report does include data collected by observers at the Terra Nova field; these data were analyzed and presented in Baillie et al. (2005). [Note that CWS has been provided with seabird data collected at the Terra Nova site.]

*Comment #8 (Page 17, Section 3.3.1). What is Lang et al., in prep? It is not listed in the references?*

**Response:** Lang et al. (in prep.) is referenced as:

Lang, A.L., V.D. Moulton and R.A. Buchanan. 2006. Marine mammal and seabird monitoring of Husky Energy’s 3-D seismic program in the Jeanne d’Arc Basin, 2005. LGL Rep. SA887. Rep. by LGL Limited, St. John’s, NL, for Husky Energy, St. John’s, NL. xx p. + appendices.

This report is awaiting review and will be submitted to the CNLOPB shortly.

*Comment #9 The project area lies well within the foraging range of millions of marine birds from colonies on the northeast coast of Newfoundland and the Avalon Peninsula as well as*

*many migratory species. Given the high number of birds present in the area during the breeding and migration periods, the foraging areas of marine birds within the study area would also be considered a “Sensitive” Area (Section 3.4 in the document).*

**Response:** It is unclear if the reviewer is suggesting that the entire Project Area or Study Area be considered a Sensitive Area for seabirds. Regardless, designating either of these areas as sensitive is out of step with the intent of the identification of areas as sensitive. Although some seabirds likely use the Project Area on a regular basis for feeding, the area has not been identified as essential; the area is a relatively small segment of the larger Grand Banks and surrounding area where seabirds are also known to occur and forage. If seabirds were excluded from the Project Area (note there is no to very little potential for the VSP program to adversely affect seabirds including their foraging activity), foraging areas would be available in other parts of the Grand Banks and surrounding area.

*Comment #10 (Page 32, Section 4.0, Species at Risk)—Table 7 identifies the Atlantic salmon as a species potentially occurring in the Jeanne d’Arc Basin Area. Even though it is Schedule I-Endangered under SARA, it is not discussed in the EA.*

**Response:** [See section 4.5.4 of LGL Limited (2006).] Inner Bay of Fundy Atlantic salmon is included as ‘endangered’ on Schedule I of SARA. Atlantic salmon (*Salmo salar*) is an anadromous fish that lives in freshwater rivers for the first two years of life before migrating to sea. During the spring and summer, salmon migrate from northeastern North America to waters off Labrador and Greenland to feed for one or more years. While at sea, adult salmon consume euphausiids, amphipods, and fishes such as herring, capelin, small mackerel, sand lance, and small cod, and are prey of seals, sharks, pollock and tuna (Scott and Scott 1988). They return to coastal North America in the fall, possibly passing through the Grand Bank region during their migration from sea (Ritter 1989 in JWEL 2003). Therefore, it is possible that Atlantic salmon migrate through the proposed Study Area during movements to and from the ocean feeding grounds. There is some thought that the Inner Bay of Fundy salmon feed in the Gulf of Maine and therefore, probably do not migrate through the Project Area. However, there is still considerable uncertainty associated with the migratory patterns of these fish. Specifics such as dimensions and location of a migratory corridor, size and timing of migration through the area, and the origins of the migrating salmon are unknown. As indicated in the response to reviewer comment #1i, Tables 1 and 2, no significant impacts of the VSP program were predicted for fish, including Atlantic salmon.

*Comment #11 (Page 33, Table 7) The comment on leatherback turtle and its association with the slope of the banks more so than the shelf is inaccurate and unreferenced and should be removed. Also, striped wolfish (sic) should be added to the species list.*

**Response:** The reviewer’s comment implies that the EA Update emphatically states that leatherback sea turtles occur more on the slope vs. the shelf of the Grand Banks. In fact, Table 7

of the original EA (June 2006) states that leatherback sea turtle is “potentially associated more with the slope of the banks than the shelf itself”. This statement was based on by-catch data for the southern Grand Banks summarized in Witzell (1999). In addition, the proposed Leatherback Turtle Recovery Strategy issued by DFO in June 2006 notes in several places (e.g., pages 18, 19) that leatherbacks “aggregate” and “spend long periods of time” in slope waters. In retrospect, the original VSP EA Update should have stated that available data are insufficient to determine if leatherbacks spend more time in slope vs. shelf waters. This change has been made to LGL Limited (2006; see section 4.5.7).

Striped wolffish was already listed in Table 7 of the original EA . It was listed as Atlantic wolffish.

***Comment #12 (Page 34, Section 4.1. Wolffishes)—“Wolffish Recovery Plan” is now “Wolffish Recovery Strategy and Management Plan.” Also, “DFO (2004e) conducted an allowable harm assessment on northern and spotted wolffish...” Finally, the commercial fishery was not deemed the greatest threat to northern and spotted wolffish. Rather, the commercial fishery is the greatest source of human induced mortality for these fish and mortality is also expected to decline.***

**Response:** [See section 4.5.1 of LGL Limited (2006).] DFO is presently preparing a ‘Wolffish Recovery Strategy and Management Plan’. During DFO’s workshop regarding allowable harm assessment on northern and spotted wolffish (DFO 2004a), the commercial fishery was identified as the greatest source of human induced mortality for these fish. The workshop also concluded that mortality of the two wolffish species is expected to decline.

***Comment #13 (Page 36, Section 4.2. Atlantic Cod)—Paragraph 2 needs to be updated. There were status assessments conducted in both 2005 and 2006, as indicated on the CSAS website. The Cod Action Team (CAT) and the resulting Canada-NL Strategy for the Recovery and Management of Cod Stocks should be referenced. The last paragraph is out of date.***

**Response:** The following text has been added to section 4.5.2 of LGL Limited (2006). In August 2003, the Government of Canada and the Government of Newfoundland and Labrador formed the Canada-Newfoundland and Labrador Action Team for Cod Rebuilding. This Cod Action Team (CAT) was to be led at the federal level by the Department of Fisheries and Oceans (DFO) and provincially by the Newfoundland and Labrador Department of Fisheries and Aquaculture (DFA), and was mandated to develop a stock rebuilding and long-term management strategy for the four major cod stocks adjacent to the province of Newfoundland and Labrador ([http://www.dfo-mpo.gc.ca/cod-morue/strategy\\_overview\\_e.htm](http://www.dfo-mpo.gc.ca/cod-morue/strategy_overview_e.htm)).

The Canada-NL CAT has engaged in collaborative efforts. In addition to the regular exchange of documents and information among the three CATs, there have been numerous face-to-face meetings, workshops and teleconferences where content and process issues were discussed. As

well, the Cod Action Teams have provided regular updates to Deputies and Ministers through the Atlantic Council of Fisheries and Aquaculture Ministers (ACFAM) processes.

The plans of all three CATs propose advancing precautionary management decision-making frameworks that use multiple indicators of stock status and productivity, that define reference points for delimiting the "healthy", "cautious" and "critical" zones proposed by the DFO precautionary approach model, and specify the need for pre-agreed decision rules.

All plans propose using a suite of biological indicators related to stock abundance and productivity conditions in decision rules, although possibly in different ways. Of course, there are variations among the CATs related to their proposals: The Quebec plan is unique in proposing the inclusion of social and economic indicators (termed "objectives"), while the Canada-Maritimes Scotia-Fundy Strategy is unique in proposing inclusion of regulatory compliance indicators in Total Allowable Catch (TAC) decision rules.

On November 14, 2005, the Cod Rebuilding Strategy Report was presented to the ACFAM for their review. The ACFAM approved the release of the Report, noting that it represents an important step toward the rebuilding of Atlantic cod stocks, but that considerable work has yet to be done, including analysis of some of the recommendations and development of an implementation plan.

All governments recognize the need for continued multilateral cooperation and collaboration for the rebuilding of Atlantic cod stocks. As such, the ACFAM directed the Atlantic Fisheries and Aquaculture Committee (AFAC) to continue to monitor progress and implementation of the Strategies, and to report back to Deputies and Ministers, as necessary.

According to DFO's 2006 assessment of 2J3KL northern cod, mortality of cod in the offshore is exceedingly high. Spring and fall research bottom-trawl surveys in 2005 indicated that biomass of cod remains low. The average biomass index from fall surveys between 2003 and 2005 was approximately 2% of the average during the 1980s. Fall survey data indicate that recruitment in the offshore is low and that total mortality has been extremely high since at least the mid-1990s (DFO 2006).

[http://www.dfo-mpo.gc.ca/cod-morue/strategy\\_overview\\_e.htm](http://www.dfo-mpo.gc.ca/cod-morue/strategy_overview_e.htm)

***Comment #14 (Page 41, Section 4.7, Leatherback sea turtle, Paragraph 5). The dates presented are very old and should be updated, if possible, as this would indicate they are much more abundant than these figures suggest. Also, mostly out-of-date information is presented. Check 2004 allowable harm assessment for leatherback turtles on the CSAS website.***

**Response:** The primary purpose of the paragraph referenced by the reviewer was to point out that leatherbacks have a more northerly range than other sea turtle species and that they have been observed amongst ice. Further, to the best of our knowledge, the reference to Goff and Lien (1988) is the only publication in a peer-reviewed journal that makes specific reference to

numbers of sea turtles observed off Newfoundland. Therefore, although, this information may be perceived as “out-of-date” by some, it is important to include. The “2004 allowable harm assessment for leatherback turtles” (DFO 2004) offers very little new information on the numbers of leatherback turtles that have been sighted off Newfoundland. The most relevant information about leatherback distribution (James et al. 2005) was included in the original VSP EA Update and again in the revised EA (LGL Limited 2006).

***Comment #15 (Section 5.1)—A summary of the EA methodologies used should be provided.***

**Response:** see response to Comment 1g. [See section 5.1 of LGL Limited (2006).]

***Comment #16 (Section 5.2)—The title of the section is “Scoping”, however, the section provides a brief environmental assessment analysis. In addition, the EA analysis appears to be the only analysis provided for in the document and is insufficient in terms of addressing significance of effects, mitigation, residual environmental effects, and cumulative effects.***

**Response:** [See section 5.1.1 of LGL Limited (2006).] Extensive scoping was undertaken for the VSP EA Update; scoping was conducted by reference to the Project Description (dated March 2006), previous VSP EAs for the Grand Banks (e.g., LGL 2003, 2004b) and seismic EAs for the Grand Banks region (Buchanan et al. 2004; LGL 2005b), consultation with the fishing industry and regulatory agencies, the C-NLOPB Scoping Document (dated 2 May 2006), and a scoping meeting with Ms. Kim Coady (15 May 2006).

Reviewer concerns about “...significance of effects, mitigation, residual environmental effects, and cumulative effects”, have been addressed in response to Comment #1c and #1i.

***Comment #17 (Page 43, last paragraph)—It is inappropriate to provide blanket summary statements indicating “there have been no significant changes in the biological resources of the study area” in the past 10 years and to state that there are “no unique biological features at Terra Nova”, particularly without reference to any literature other than that provided by past industry EAs. Also, there is relatively little scientific information available regarding the effects of seismic activity on invertebrates. This is considered a data gap and caution should be taken when drawing conclusions in this area. When making reference to the 2002 study of the effects of seismic energy on snow crab, it should be noted that this study can only draw conclusions about effects on commercial-sized snow crab.***

**Response:** Reword as “ there appears to have been no significant changes...”. [See section 4.0 of LGL Limited (2006).]

Reword as “no apparent unique biological features at the Terra Nova Development relative to those in the adjacent areas of Jeanne d’Arc Basin”. [See section 4.0 of LGL Limited (2006).]

The original text in the VSP EA Update stated quite clearly that results of the study by Christian et al. applied to commercial-size male snow crabs only.

It should be noted that reference to documents produced and/or commissioned by oil and gas companies is appropriate as quite often this is the only available information.

***Comment #18 (Page 44)—It is stated that Petro-Canada will enforce a 1000 m safety zone, however on page 45, a 500 m safety zone is discussed. Typically, the shut-down safety zone is 500 m.***

**Response:** Petro-Canada will employ a 500 m safety zone (see below for more details).

***Comment #19 (Page 45, Section 6.0, Mitigations and Follow-up)—It is noted that this section does not make reference to shut-down of the air-gun array. Details should be provided regarding specific measures to be taken in the event of an encounter with SARA listed threatened or endangered species during ramp-up or at anytime the airgun is active. These shut-down requirements are in addition to those listed in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines respecting shut-downs during ramp-up.***

**Response:** [See section 6.0 of LGL Limited (2006).] Petro-Canada’s monitoring and mitigation approach involves the shutdown of any active airguns if a threatened or endangered marine mammal or turtle is sighted within or about to enter the 500 m safety zone. More specifically, for marine mammals and sea turtles:

*For 30 minutes prior to the commencement of ramping up of the seismic array*

- an Environmental Observer (EO) will maintain a watch for marine mammals and sea turtles
- if any marine mammal or sea turtle species comes within the 500 meter zone<sup>1</sup> during this period ramp up will not commence until the animal has left the zone (or the EO has not seen the marine mammal or sea turtle for 20 minutes)

*During the ramp up of the array*

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<sup>1</sup> Observers will consider the safety zone to be 500 m from the bridge (location of the observer) not the center of the array.

- the EO will maintain a watch for marine mammals and sea turtles and if an endangered species (blue whale, North Atlantic right whale, or leatherback sea turtle) enters the 500 meter zone, ramp up will be halted until the animal leaves the zone (or the EO has not seen the marine mammal or sea turtle for 20 minutes)
- ramp up will take a minimum of 30 minutes starting with the smallest airgun and gradually adding airguns at evenly spaced intervals, increasing the volume over a 30-minute period until all airguns are active.
- these ramp up procedures will be followed at night and in periods of negligible visibility (i.e., fog) with the exception that the EO will not be able to perform the 30 minute watch prior to ramp up at night
- note that ramp up procedures should be implemented when the airguns have been off for 20 or more minutes

*During periods of data acquisition (i.e., line shooting) of the array*

- during data acquisition (or periods of seismic testing), if the EO sights a blue whale, North Atlantic right whale, or leatherback turtle within the 500 meter zone the airgun array will be shut down until the animal has left the zone or the EO has not seen the blue or right whale, or leatherback turtle for 20 minutes

***Comment #20 “The observers will watch...of these animals.” In addition to noting location and behaviour, will attempts be made to identify these animals? Also, will observers be watching continuously (8-36 hours) during the VSP programs? More information should be provided.***

**Response:** Yes, mammals and turtles will be identified to species level whenever possible. An observer will be on watch during all daytime periods that the airgun array is active (as indicated in Section 6.0 of the original EA) and during the 30 minutes preceding ramp ups.

***Comment: This section also indicates the mitigations to be employed. This is precisely the same information included in Section 2.10 on page 8.***

**Response:** Noted.

***Comment: Remove reference to “follow-up” in the section. A follow-up program, as defined by CEAA, means one for verifying the accuracy of an EA and determining the effectiveness of any measures taken to mitigate the adverse environmental***

**Response:** We suggest including “follow-up” in the section heading (see section 6 of LGL Limited 2006) as it is important to note that for the VSP surveys that:

A follow-up program will not be implemented for the VSP surveys but a monitoring report detailing marine mammal and seabird observations will be provided to the C-NLOPB.

## **Literature Cited**

- Baillie, S.M., G.J. Robertson, F.K. Wiese and U.P. Williams. 2005. Seabird data collected by the Grand Banks offshore hydrocarbon industry 1999-2002: results, limitations and suggestions for improvement. Canadian Wildlife Service Technical Report Series No.434. Atlantic Region.
- Buchanan, R.A., J. Christian, V. Moulton and B. Mactavish. 2004. Orphan 3-D Seismic Program, 2004-2006 environmental assessment. LGL Report No. SA799. Prepared for Chevron Canada Resources and ExxonMobil. 209 p. + App.
- CEAA. 1994. Environmental Assessment Guidelines Canadian Environmental Assessment Agency, Ottawa.
- Davis, R.A., D.H. Thomson and C.I. Malme. 1998. Environmental assessment of seismic exploration on the Scotian Shelf. TA2205. Rep. by LGL Limited, King City, ON, for Mobil Oil Properties Ltd., Shell Canada Ltd., Imperial Oil Ltd. and Canada/Nova Scotia Offshore Petroleum Board, Halifax, NS. 181 p.
- DFO. 2004a. Proceedings of Species at Risk Atlantic Zonal Assessment Process-Determination of allowable harm for spotted and northern wolffish, May 7, 2004, St. John’s, Newfoundland and Labrador. Can. Sci. Advis. Secret. Proc. Ser. 2004/028.
- DFO, 2006. Stock Assessment of Northern (2J3KL) cod in 2006. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/015.
- Goff, G.P. and J. Lien. 1988. Atlantic Leatherback Turtle, *Dermochelys coriacea*, in cold water off Newfoundland and Labrador, Can. Field-Nat. 102: 1-5.
- Husky. 2001. White Rose Oilfield Comprehensive Study Supplemental Report. Responses by Husky Oil Operations Limited to comments from Canada-Newfoundland Offshore Petroleum Board, Dept. Fisheries and Oceans, Environment Canada, Natural Resources Canada, and Canadian Environmental Assessment Agency. 265 p. + App.
- Husky. 2002. Husky Jeanne d’Arc Basin Exploration Drilling Program project description and environmental assessment. Prepared by LGL Limited, Oceans Ltd., Provincial Airlines Ltd. and SL Ross Ltd. for Husky Oil Operations Limited, St. John’s, NL. 179 p.
- Husky. 2003. White Rose Addendum: vertical seismic profiling project description and environmental assessment. Prepared by LGL Limited for Husky Oil Operations Limited, St. John’s, NL. 17 p.
- James, M.C., S.A. Eckert, and R.A. Myers. 2005. Migratory and reproductive movements of male leatherback turtles (*Dermochelys coriacea*). Mar. Biol. 147: 845-853.
- Jacques Whitford Environment Limited (JWEL). 2003. Strategic Environmental Assessment Laurentian Subbasin. Report by JWEL, St. John’s, NL for Canada-Newfoundland Offshore Petroleum Board (C-NOPB), St. John’s, NL.

- Lawson, J.W., R.A. Davis, W.J. Richardson and C.I. Malme. 2000. Assessment of Noise Issues Relevant to Key Cetacean Species (Northern Bottlenose and Sperm Whales) in the Sable Gully Area of Interest. Report prepared by LGL Ltd. Environmental Research Associates and Charles I. Malme Eng. and Sci. Services for Oceans Act Coordination Office, Maritimes Region, Fisheries and Oceans Canada. LGL Report TA2446-2.
- LGL. 2003. Husky Jeanne d'Arc Basin Exploration Drilling Program Project Description and Environmental Assessment Addendum for Vertical Seismic Profile Activities. Report by LGL Limited for Husky Oil Operations Limited, St. John's. 6 p.
- LGL. 2004a. Wellsite geohazard survey environmental assessment Terra Nova Development. Rep. by LGL Limited, St. John's, NL for Petro-Canada, St. John's, NL.
- LGL. 2004b. Vertical seismic profiling environmental assessment Terra Nova Development. Rep. by LGL Limited, St. John's, NL for Petro-Canada, St. John's, NL.
- LGL. 2005a. Husky delineation/exploration drilling program for Jeanne d'Arc Area environmental assessment update. Rep. by LGL Limited, St. John's, NL for Husky Oil Operations Limited, St. John's, NL.
- LGL. 2005b. Northern Jeanne d'Arc Basin seismic program environmental assessment. LGL Rep. SA836. Rep. by LGL Limited, St. John's, NL, Oceans Limited, St. John's, NL, Canning & Pitt Associates Inc., St. John's, NL and PAL Environmental Services, St. John's, NL for Husky Energy Inc., Calgary, AB. 230 p. + appendices.
- LGL. 2006. Vertical Seismic Profiling Environmental Assessment Terra Nova Development. LGL Rep. SA890. Rep. by LGL Limited, St. John's, NL, for Petro-Canada, St. John's, NL. 55 p.
- Moulton, V.D., R.A. Davis, J.A. Cook, M. Austin, M.L. Reece, S.A. Martin, A. MacGillivray, D. Hannay, and M.W. Fitzgerald. 2003. Environmental assessment of Marathon Canada Limited's 3-D seismic program on the Scotian Slope, 2003. LGL Rep. SA744-1. Rep. by LGL Limited, St. John's, Newfoundland, for Marathon Canada Ltd., Halifax, Nova Scotia. 173 p. + Appendices.
- Petro-Canada. 1996. Development Application Terra Nova Development Environmental Impact Statement. Prepared by Petro-Canada on behalf of Terra Nova Proponents: Petro-Canada, Mobil Oil Canada Properties, Husky Oil Operations Limited, Murphy Oil Company Ltd., and Mosbacher Operating Limited.
- Ritter, J.A. 1989. Marine migration and natural mortality of North American salmon (*Salmo salar* L.). Canadian Manuscript Report of Fisheries and Aquatic Sciences, No. 2041
- Scott, W.B. and M.G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.
- Witzell, W.N. 1999. Distribution and relative abundance of sea turtles caught incidentally by the U.S. pelagic longline fleet in the western North Atlantic Ocean, 1992-1995. U.S. Fisheries Bulletin 97: 200-211.