SCIENCE REVIEW OF THE OLD HARRY PROSPECT EXPLORATION DRILLING PROGRAM

Context

On December 20, 2011, Corridor Resources Inc. filed its updated *Environmental Assessment of the Old Harry Prospect Exploration Drilling Program* along with the *Old Harry Drilling Mud and Cuttings Dispersion Modeling Final Report* and *Modeling in Support of Corridor Resources Old Harry Exploratory Drilling Environmental Assessment* with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). In January 2012, the Environmental Assessment and Major Projects (EAMP) division of the Ecosystems Management Branch in the Newfoundland and Labrador Region requested that DFO Science undertake a review of these documents with a review deadline of February 17, 2012.

The objective of this process was to provide review and comment on the relevant documents with respect to the following context:

- *Environmental Assessment of the Old Harry Prospect Exploration Drilling Program* – As it relates to the components under the jurisdiction of DFO (see Appendix 2) – Are the proposed VECs and the assessment approach described complete and appropriate? Is information presented complete and based on the most recent information (and modeling as applicable) available? Are the environmental effects assessments complete and based on the most recent information and modelling available? Does it adequately consider the present state of knowledge, and are the uncertainties adequately described and incorporated in the conclusions?
- *Old Harry Drilling Mud and Cuttings Dispersion Modeling Final Report* – Is the oil spill modelling presented complete and based on the most recent information and models available, does it adequately describe the present state of knowledge of potential distribution patterns, and are the uncertainties in model inputs and outputs adequately described and incorporated in the conclusions?
- *Modeling in Support of Corridor Resources Old Harry Exploratory Drilling Environmental Assessment* – Is the modelling presented complete and based on the most recent information and models available, does it adequately describe the present state of knowledge, and are the uncertainties in the model inputs and outputs adequately described and incorporated in the conclusions?

Given that DFO is not the final advisory body for this request (through the Canadian *Environmental Assessment Act* (CEAA) process), and the short timeline to carry out a review, a DFO Science Special Response process was undertaken. Science expertise within Fisheries and Oceans, across the Newfoundland and Labrador, Quebec, Maritimes, and Gulf regions, was solicited to address this review. Identified participants provided a review of the EA documentation to be collated before a draft of the prepared response underwent a group evaluation for agreement upon the final Science Response. It should be noted that DFO Science Branch comments were limited to the areas of the report where expertise was available at the time of the review.

The review found that overall; the quality of scientific content presented in the environmental assessment (EA) varies across the sections. While the potential environmental impacts of exploratory drilling regarding drilling fluids and cuttings is well-covered and conclusions are in line with many reviews and individual studies dealing with the effects, much of the preceding content relating to Valued Ecosystem Components (VECs) was deficient. Revised content, including a clear scope of work, corrected and updated information pertaining to VECs, and inclusion of modeling for noise sources is required within the assessment. At the same time, existing modeling related to trajectory of potential oil spills requires additional consideration. Finally, the declaration that "The environmental assessment indicates that no significant residual adverse environmental effects, including cumulative environmental effects, will occur as a result of the Project" needs to be reconsidered once the important information gaps are filled and taking into consideration uncertainties and potential unplanned events (e.g., spills and blowouts; events beyond the geographic scope identified).

This Science Response report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Zonal Science Special Response Process (SSRP) of March 5, 2012 on the Old Harry Prospect Exploration Drilling Program.

Background

Located in the Gulf of St. Lawrence, the Old Harry geological structure is approximately 30 km long and 12 km wide. Old Harry has the potential to contain significant volumes of hydrocarbon resources, where it is one of the largest undrilled geological structures in Eastern Canada. Corridor Resources Inc. (Corridor) has applied to the regulator, the Canada- Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), for approval to drill a single exploratory well on the Old Harry structure by the end of 2014. This would be a single exploratory well that would take up to 50 days to drill. On December 20, 2011, Corridor submitted an environmental assessment report to C-NLOPB for this exploratory drilling program (under Exploration License (EL) 1105) in the Newfoundland and Labrador offshore area (of the Gulf of St. Lawrence).

Unlike areas of the Newfoundland and Labrador Shelves, the oil and gas industry in the Gulf continues to be at its infancy – as is the practice of identifying and addressing the potential impacts of petroleum activities for the area. Allowing for this, as well as the fact that the Gulf of St. Lawrence is documented as a unique semi-enclosed ecosystem that supports many aquatic and non-aquatic species, and forms the basis for economic activity in key industries such as fishing, aquaculture, marine transportation and tourism, the considerations of potential direct and cumulative impacts surrounding new petroleum activities are many.

An awareness of the risks inherent in marine petroleum development has been heightened by the extensive coverage of the BP Deep Horizon oil well explosion in the Gulf of Mexico in 2010. It has also been reported that “Any impacts from oil and gas exploration activities [in the Gulf of St. Lawrence] will be amplified due to the small, shallow, enclosed nature of the environment and the high biomass and diversity year-round” (Moriyasu et al. 2001). In turn, public concern over potential impacts of Old Harry exploration on this unique and productive ecosystem has been significant to date.

Pursuant to Section 5(1)(d) of the *Canadian Environmental Assessment Act* (CEAA), the C-NLOPB is a Responsible Authority and Federal Environmental Assessment Coordinator and must undertake an environmental assessment of the Old Harry Project. The environmental assessment submitted by Corridor is to be reviewed by other stakeholders, including DFO, who have broad knowledge of the Gulf and can provide comment and direction on the EA. Factors targeted for consideration within the EA are outlined in the scoping document (C-NLOPB 2011a). Following a Valued Ecosystem Components (VEC) approach, the EA addresses potential impacts on the marine ecosystem, the physical environment, species at risk, sensitive areas, commercial fisheries, marine and migratory birds, and accidental events and cumulative effects.

Fisheries and Oceans Canada plays a significant scientific and regulatory role in the overall management of Canada's oceans. The Gulf of St. Lawrence is multi-jurisdictional in that it borders five Canadian provinces (Québec, Newfoundland and Labrador, New Brunswick, Prince Edward Island, and Nova Scotia) and four DFO Regions (Quebec, Newfoundland and Labrador, Gulf, and Maritimes). In this, comprehensive consideration of all available information and expertise in the context of healthy oceans is required during a review of this nature and aims to be coordinated accordingly.

Analysis and Responses

Review of Environmental Assessment of the Old Harry Prospect Exploration Drilling Program

General Comments

- This review was undertaken in English and French versions of the document. In general, the quality of French in the assessment is poor and many sentences are difficult to understand. For example, the French translation is sometimes technically bad, even truncated compared to the English version, making the text incomprehensible. Incomprehensible paragraphs should therefore be reviewed for content or edited by an individual fluent in French and with scientific knowledge.
- Overall, the quality of scientific content presented in the environmental assessment (EA) varies across the sections. In general, literature on the potential environmental impacts of exploratory drilling regarding drilling fluids and cuttings is well-covered and conclusions are in line with many reviews and individual studies dealing with the effects (e.g., MMS, 2000; CAPP 2001; NEB et al 2002; Buchanan et al 2003; Hurley and Ellis, 2004; Neff 2005; Mathieu et al 2005). However, content relating to VECs (regularly referred to as Valued Ecosystem Components; but referred to as *ecosystem* components in the scoping document and *environmental* components in the EA) is largely uneven among the various sections, with little evidence of effort to ensure that information is necessary, useful, and consistent, that there are no contradictions, and that information is properly presented for interpretation.
- As outlined in the Scoping Document, discussions of each VEC (including components or subsets thereof) identified for the purposes of environmental assessment, and the rationale for its selection, should be provided – although this does not occur within the assessment. Species selection criteria and assessment methodologies need to be explicit and clearly presented. At the same time, the biological and physical environments should consider all the data available for the project and affected area; and clearly identify where data gaps exist. It should be recognized that the accuracy of this information is especially important to potential environmental effects of potential unplanned (e.g., accidental) events.
- Within the discussions on VECs, the most relevant and up-to-date information should be provided. As such, the seasonal distribution of marine fish in the Gulf requires greater consideration to this end. Attention to including all proper references and to figure numbering and quality is also required.
- Minimal integration of the information across the different strata (benthos, fish species, marine mammals, physical and chemical environments), i.e., using an ecosystem based

approach, exists within the assessment. Key documents for consideration to this end include, for example, Chouinard and Dutil (2011) for consideration of fish assemblages and indicator species of the northern Gulf of St. Lawrence; and Dutil et al. (2011) for classification of megahabitats of the St. Lawrence estuary and Gulf for demersal communities, with the latter including shapefiles that may be considered for use for the various sections dealing with habitats and ecosystems (and various subsections within sections 5, 6, 7) useful to assessing potential impacts, on both the local and more distant habitats around the project area.

- Regarding data, the assessment considers commercial fisheries data updated to 2010. However, DFO RV survey data, used as the basis for mapping fish distributions, is only updated to 2002 and 2005 for several key species (especially for juvenile fish distributions). Trawl surveys of the northern Gulf, conducted yearly in January from 1978 to 1994 by DFO Quebec Region, is also important information that should be considered for this assessment.
- Regarding endangered fish species assessed by COSEWIC, redfish (*Sebastes mentella* and *S. fasciatus*) has the potential to be among the most affected by the drilling activities of Old Harry since their breeding area is located in the region where wells are located (central Gulf). However, that information is not highlighted well in the report. At the same time, hot spots of distribution for the northern and spotted wolffish species have been identified close to the project, yet the distance between the project and those hot spots and the risk that potential effects may occur as far away as those hot spots is not communicated.
- Regarding topics on habitat, including corals and sponges, as well as sensitive areas, the information put forward is largely unstructured and varies its relevance. Information on corals and sponges should consider the most up-to-date and area specific information (e.g., Kenchington et al. 2010) – since this is not the case, the conclusions that EL1105 location is likely not suitable habitat for corals and sponges is not supported in the current assessment. With respect to sensitive areas, while section 5.7 identifies sensitive areas, the effects assessment of these addresses the redfish mating area, but overlooks consideration of other fish and marine mammals for which the EBSAs (individual components of) and other sensitive areas were identified for.
- In regards to evaluating potential impacts, the document itself does not provide a clear scope of work to be undertaken during the project – which is essential to a proper assessment. For example, duration of the work (20 to 50 days to drill a well) is indicated, but the season of activity is not. At the same time, the commonly used term “near” requires greater definition. These are particularly important in terms of potential level of impact on the ecosystem and its components.
- The assessments of effects are largely limited to immediate effects of the exploratory drilling and associated activities. Presumably, effects of accidents like blow-outs should also be considered, taking into account lessons learned from the 2010 BP spill in the Gulf of Mexico. From that standpoint, the location of EL1105 should be a major concern given its proximity to the overwintering grounds and migration routes of cod and other groundfish and marine mammals, as well as the pre-spawning aggregation of witch flounder.
- In general, modeling pertaining to assessing the behavior and trajectory of oil spills that might occur during exploration drilling activities requires significant reconsideration of many of the inputs (e.g., currents, winds, tides, outflows, timing, etc.), as well as the models in some cases. Scenarios are also often not clearly described (e.g., for blowouts),

and overall, modeling results are not clearly presented. For example, information on current speed and direction to describe which habitats will be impacted and to map the fate (geographically) of any material released from the project, both the vertical extent and horizontal extent is lacking. For instance, where will the suspended particulate matters be deposited, North at 6 km, South-West at 200 km? It is also recommended to make use of information gained from The Gulf of Mexico spill for this purpose as the setting and the expected type of oil to be found at Old Harry share commonalities.

- Finally, the declaration that "The environmental assessment indicates that no significant residual adverse environmental effects, including cumulative environmental effects, will occur as a result of the Project" is not supported when taking into consideration uncertainties and potential unplanned events (e.g., spills and blowouts beyond Cohasset oil modeling) and the important information gaps in the report. As such, the conclusion should be reassessed once the information gaps are filled. At the same time, it is only partial to assess the direct risk of accidental events in isolation from all other indirect risks that the event may cause, e.g., increased traffic, requirement for use of control methods, etc.

Specific Comments

2.0 DESCRIPTION OF THE PROJECT

2.6 Project Scheduling

- Overall, this section is too vague to allow proper evaluation of the project and its environmental effects. The duration of the work and the season of activity is key information vital to determining the level of impact on the ecosystem and its components.
- The EA should also indicate if a follow-up exploration program is required, including a seismic program or another exploration well, if another EA would result or if considerations are included in the current assessment.

2.10 Project Activities

- Regarding the evaluation of the well over a few stages – the information is overly vague and is insufficient to adequately assess impacts. An illustration of the well section would also be useful in this regard.

4.0 PHYSICAL ENVIRONMENT

- This section of the review should include a sub-section of the potential environment changes (physical oceanography and meteorology) in the next decades from the climate change perspective.

4.1.5 Physical Oceanography

- Although the volume measure (3,553 km^3) is from Dufour and Ouellet (2007), it is incorrect. The volume is about 35 000 km^3 (see for example Dufour et al. 2009)

4.1.7 Ocean Currents

- While the EA acknowledges that *"Knowledge of ocean currents is essential to the planning of oil and gas related operations in any area",* the section on ocean currents simply states broad facts and shows maps from different sources without any proper interpretation or comparison. The currents that the EA uses in the report are cited but are never shown (i.e. *Surface water current fields developed by the Ocean Sciences Division, Maritimes Region of DFO (Tang et al. 2008) were used in the spill trajectory modelling*).

- The statement, “Driven by wave and tidal movement, cold, dense water flows into the Gulf through the Strait of Belle Isle from the Arctic via the Labrador Current.” is incorrect. The inflow through the Strait of Belle Isle is not driven by waves or tides and it isn’t from the Arctic (although contains some dilution of Arctic waters) or from the (deep) Labrador Current. It is noted that this text is out of context in the Ocean Currents section.
- The EA text that begins (p.92), “Surface temperatures typically reach maximum values in mid-July to mid-August (Galbraith et al. 2011)…and ends (p.93), “The surface winter layer exhibits temperatures near freezing (-1.8 to 0°C) (Galbraith 2006),” comes almost verbatim from Galbraith et al (2011) but is out of context in the Ocean Currents section.
- Regarding the statement (p.94), “Tidal mixing is also a permanent and dominant modifier of the intermediate and deeper waters near the head of Jacques Cartier Strait and in the Strait of Belle Isle (Lu et al. 2001; Saucier et al. 2003).”, Lu et al (2001) showed that where bathymetry was sufficiently shallow that tidal mixing should be strong enough to mix the layer (typically around 50 m depth), and therefore should not by cited in relation to modifying deep water masses.
- Figure 4.12 – the caption indicates two panels; only one panel shown (French version).
- Figure 4.13 – panels for M2 and K1 are not identified.
- Figure 4.19 – surface currents in the Gulf of St. Lawrence (top: February 4, 2011@ 1100 hours and bottom: September 29, 2011 @ 0800 hours) - there is no bottom panel in the EA.

4.1.8 Tides

- It is not evident that tides were used in spill trajectory modelling within the EA. Why not?
- Sources of water current estimates are included (p.101) in the EA, but are out of context here. This information should appear in Section 4.1.7 and be compared with other results shown.

4.1.11 Ice

- Regarding the statement, “All sea ice in EL1105 is first-year ice, ranging in its un-deformed thickness from 30 to 120 cm (SLGO 2011; Figure 4.20).” Figure 4.20 does not actually show ice. It is not obvious what is meant by un-deformed thickness here, but ice thickness in the Gulf has been known to exceed 2 m in places by rafting during heavy ice years. Ridges can be much thicker still (> 10 m). As such, these extremes should be mentioned in the assessment rather than showing median quantities such as average thickness.
- The EA states (p.104), “The main oceanographic factors influencing the ice regime are bathymetry, currents, and tides.” However, the EA then proceeds to describe each of these components in a very superficial manner (currents and tides were covered differently in prior sections). The above sentence and similarly weak descriptions that follow to the end of p.106 are found verbatim on the Environment Canada web site, referenced later in the report. Also, Fig 4.25 is not authoritative but was likely meant by Environment Canada to be very schematic rather than accurate.
- Based on the above, the reader might surmise that since bathymetry, currents and tides are very predictable, then so is ice cover. However, the premise of the initial statement is misleading: the thermodynamics of the ocean surface layer are not even mentioned here.

To produce ice, the winter mixed layer must first be cooled to the freezing point over a large layer (a typical thickness of 75 m was mentioned on Page 92).

- The EA states (p.108), "The Project Area is located in an area that ranges from 51 to 84 percent 30-Year frequency for the presence of sea ice (green and purple color bands) depending upon the month." However, Figures 1.27 to 4.28 don't have any green as mentioned. Caution should also be used in interpreting these three figures. For example, the March figure shows the average probability of encountering sea ice over the entire month, and not the probability of encountering ice at least once during the month.
- The EA states, "EL1105 is located in the area that has an average ice freeze up date of January 29 (Figure 4.31). The normal ice free period for EL1105 extends from April 9th to February 12th of the following winter…" However, this seems in contradiction. If the average ice freezup date is January 29, then the area cannot be ice-free after break-up until the following February 12th.
- Fig. 4.23 – this is unreadable with insufficient resolution.
- Fig. 4.34 – legend = 2009; figure shows 2010 and not 2009.

4.2 Physical Oceanography

Overall, the literature information is not well integrated to present a clear picture in this section. The review of circulation features in Section 4.2.6 is redundant. The information should be integrated into 4.2.2. It seems more appropriate to place the MLI ocean forecasts at the end of the subsection. A more thorough literature search should be conducted and better integrated to provide a structured review here.

Circulation subsection, Han et al. (1999, Journal of Physical Oceanography) provided detailed seasonal mean circulation fields in the Gulf of St. Lawrence, especially in terms of the gulf-shelf interactions, including the inflow from the Labrador Shelf through the Strait of Belle Isle, as well as the outflow on to the Scotian Shelf and the inflow from the Newfoundland Shelf, both through Cabot Strait. This paper should be included in the review under 4.2.2 (p.55).

4.2.1 Climate

- Average daily temperatures in the vicinity of EL1105 as presented are not the true range of observations, but rather the 30-year monthly average temperature minimum and maximum. Far colder and warmer temperatures have been recorded. Therefore variability is missing on the monthly scale, but also at the inter-annual scale.
- Reference in the EA to *"…average monthly air temperatures for several land-based weather stations surrounding the Gulf…"* does not add much long term context. Instead, Galbraith et al (2011) show mean winter air temperatures at these land stations since 1971, which should be used to describe interannual variability.
- The EA describes (p.114) sea surface temperatures such that *"…the minimum mean temperatures for February and March are approximately -0.8°C."* However, in years of maximum ice year such as 1993, the winter mixed layer was near-freezing at -1.7°C in the area of EL1105. The area also borders the warm waters (T > 0°C) seen in many winters entering the Gulf on the Newfoundland side of Cabot Strait (see Galbraith 2006).

4.2.2 Wind Climate

- It is unusual that the MSC50 reanalysis shows no winds above 20 m/s (90 km/h) between June and November, and extremely rarely in other months. The EA presents that the highest winds are less than 2% in winter; however winter interpreted as Dec-Jan-Feb is in fact 0.02%, and the highest as occurring in spring (Mar-Apr-May) at less than 0.2%.

4.3 Climate Change

- The section on climate change addresses air temperature rise, but not its impacts; it addresses sea level rise, but doesn't mention local post-glacial rebound.

5.0 BIOLOGICAL ENVIRONMENT

5.2 Species at Risk

- It has been noted in this and other sections on addressing fish species (e.g., 5.4 Marine Fish and Fish Habitat) that the data on which many of juvenile/adult fish distribution figures are based is often dated – and only a single or several years of RV data compiled into figures is also common. As such, updated and additional years are required indicate the current distribution of these species as RV surveys referenced are likely stratified-random surveys and any one year may not yield any sets within the Old Harry project area. Figures are also lacking the location of the exploration licenses covering the Old Harry area superimposed on distribution maps for reference. Information on the size and/or age of juvenile fish should be included with figures and descriptions.
- Section 5.1, indicates that Section 5.2 will cover species at risk from both the St. Lawrence Estuary and the Gulf of St. Lawrence. Section 5.2 states that Table 5.2 covers all species in the Gulf that are designated at risk by COSEWIC. The following Atlantic salmon populations are assessed as at risk by COSEWIC (2010), but are treated neither in the text of Section 5.2 nor in Table 5.2: Quebec Eastern North Shore population - special concern; Quebec Western North Shore population - special concern; Inner St. Lawrence population - special concern. In general, the migration routes of these populations are unlikely to take them close to EL1105 or for an extended period of time. However, if it is the intent of the assessment to exclude these populations from consideration, it should be explicitly stated why.
- Table 5.1 – Northern Wolffish - “Non-migratory spawning occurs” – based on current information it is unknown if Northern wolffish do or do not have spawning migrations. Also occurs in waters shallower than 500m.
- Table 5.1 – Spotted Wolffish - “Non-migratory spawning occurs” – based on current information it is unknown if Spotted wolffish do or do not have spawning migrations.
- Table 5.1 – Atlantic Wolffish – This species occurs in waters greater than 350m.
- Table 5.1 – White Shark (added to SARA Schedule 1 on July 6, 2011) should be included in the table.
- Table 5.2 – requires explanation of how is potential for occurrence defined and calculated and what metric is used.
- Table 5.2 – White Shark should be removed from the table. This species was added to SARA Schedule 1 on July 6, 2011.
- Table 5.2 – Deepwater Redfish - species name is *Sebastes mentella* (not *mentalla*). Spawning does not occur in fall. Mating between males and females occurs in fall but female extrude larvae (=spawn) from April-July.
- Table 5.2 – Acadian Redfish (Atlantic) – spawning does not occur in fall. Mating between males and females occurs in fall but female extrude larvae (=spawn) from May-August.

- Table 5.2 – Atlantic Cod (Laurentian South population) – the description is inaccurate. There are two populations in this designatable unit; the population of concern here is the southern Gulf of St. Lawrence population.
- Table 5.2 – Atlantic Cod (Laurentian South population) – occurrence should be amended to correct inaccuracies. This population is distributed throughout the southern Gulf in summer and overwinters along the side of the Laurentian Channel, with dense aggregations typically occurring in the Laurentian Channel north of St. Paul Island. Cod use two migration routes between these overwintering grounds and summer grounds in the southern Gulf, the Cape Breton Trough and the southern slope of the Laurentian Channel (north of the Magdalen Islands). Essentially the entire population moves through this area in proximity to EL1105 each spring and fall.
- Table 5.2 – Winter Skate (Southern Gulf of St. Lawrence population) – the description is inaccurate. This population occurs just within the Gulf (are distinct from populations on the Scotian Shelf and Georges Bank). Winter Skate lay egg cases and emerge as juveniles. The seasonality of “spawning” is not well known.
- Table 5.2 – American plaice (Maritime population) – the description is inaccurate. This population overwinters in deep water in the Laurentian Channel.
- Table 5.2 should consider Swain et al. (1998); and Chouinard and Hurlbut (2011) as sources of information.

5.2.1 Marine Fish Species at Risk

- In this and other sections on fish species (e.g., 5.2 Species at Risk) the EA reproduces a number of juvenile fish distributions from RV surveys. The data on which many of these figures are based is dated (at least 6 years old) and only a single year of RV data compiled into figures is common. Updated and additional years are required indicate the distribution of juveniles for these species as RV surveys referenced are likely stratified-random surveys and any one year may not yield any sets within the Old Harry site. It would also be useful for figures to have the location of the exploration licenses covering the Old Harry area superimposed on distribution maps for reference.
- Regarding shark species discussed within the assessment, data is not particularly limited for any of the shark species other than white sharks. CSAS Res Docs are available for porbeagle, mako, basking sharks, spiny dogfish and blue sharks (all can be downloaded from the Publications page of the Shark website) and should be consulted and cited as such within the assessment. In addition, there is ample observer data on all of these species.

5.2.1.1 Wolffish

- References for depth distribution of northern wolffish are not provided – which also contradicts Table 5.1 content. However, for the Newfoundland and Labrador region, the densest concentrations of northern wolffish tend to be found at 400-900 m (Kulka et al. 2004).
- Fecundity/number of eggs and parental care of northern wolffish are not known in Canadian waters, yet the EA states that northern wolffish can lay up to 27,000 eggs and guard their eggs. References are required for this information.
- Figure 5.2 – potential for occurrence of northern wolffish is listed as low in Table 5.2, yet based on this figure its distribution in the Gulf is centered on the EL1105 area.

- Figs. 5.2-5.8 – the information presented here is dated. More recent data exist from the study area. The data from 2003-2011 should be presented to illustrate current distributions - not the distribution from a decade ago.
- Depth discussion of Spotted wolffish contradicts Table 5.1 content.
- Figures 5.6, 5.7 and 5.8 clearly show that highest densities of both juvenile and adult Atlantic wolffish are observed within 50-100 km of EL1105 (off western Newfoundland); but Table 5.1 indicates a low potential of occurrence in relation to EL1105.
- Figure 5.9 – only one year of data is presented. Data should be expanded to illustrate current distribution.
- Figures 5.10 and 5.11 – information is dated. More recent data exist from the study area. The data from 2003-2011 should be presented to illustrate current distributions not the distribution from a decade ago.
- Figure 5.12 legend does not correspond with the figure; lower panel shows distribution in 2005-2009. RV catch rates are not shown for the Newfoundland and Labrador continental shelves and not for the study area and no units (kg/tow?, number of fish/tow?) are shown in this and other figures (Section 5.2).
- Figure 5.13 – information is dated. More recent data exist from the study area. The data from 2003-2011 should be presented to illustrate current distributions not the distribution from a decade ago.

5.2.1.2 Atlantic Cod

- This section is inadequate in its purpose. Only four paragraphs describe past and present designatable units of cod used by COSEWIC and a short paragraph on general biology that appears to be from some general text (possibly Scott and Scott). There is a wealth of information available on the distribution and biology of the two populations that need to be considered here (northern and southern Gulf cod stocks - components of the Laurentian North and Laurentian South designatable units of COSEWIC).
- At a minimum, seasonal distributions and migrations need to be described for Atlantic Cod. This should use distribution information from summer surveys in both the southern and northern Gulf (i.e., September survey of the southern Gulf and August survey of the northern Gulf; also summer sentinel trawl surveys in both areas). Migration routes and timing and overwintering distributions should also be described.
- Based on information that is not currently included in the report, it may be suggested that there is a significant concern regarding potential impacts on the southern Gulf cod stock in addition to the northern Gulf stock. An increasing proportion of the southern Gulf stock occurs on summer grounds in the region between the Magdalen Islands and northwestern Cape Breton, including waters along the southern slope of the Laurentian Channel. The entire stock migrates through the Cape Breton Trough or along the southern slope of the Laurentian Channel (past EL1105) each spring and fall. The entire stock overwinters in dense aggregations along the south side of the Laurentian Channel, in particular north of St. Paul Island.
- The EA refers to the four populations identified by COSEWIC in this section. However, there are only two residents (Laurentian North and South). Incursions of two other Atlantic populations are possible, but this should be distinguished.

- The legend of Figure 5.10 shows "*Atlantic Cod Distribution in the Gulf of St. Lawrence from 1990 to 2002*," however, only the result of the August survey in the northern Gulf is presented. The results of the September survey in the southern Gulf should be added with the result representing the two cod stocks in the Gulf. This mistake occurs in several maps of other species.
- The spawning area for cod in the northern Gulf (3Pn, 4RS) that was identified some time ago off St. George's Bay (west coast of Newfoundland) is not mentioned in the EA. This area is closed to all fishing from April to mid-June and occurs only approximately fifty kilometres east of the drilling area. This information is significant as fertilized eggs of cod are at surface and are therefore very vulnerable to any oil spill.
- Some key sources of information include: Swain et al. (1998); Chouinard and Hurlbut (2011); Comeau et al. (2002); Benoît et al. (2003); Darbyson and Benoît (2003); and recent CSAS Science Advisory Reports and Research Documents coming from stock assessments.

5.2.1.3 Winter Skate

- Only general information is presented in this section; not information focused on winter skate in the Gulf. Information is available from sources above, as well as CSAS Res Docs 2006/003; 2006/004; Swain et al. 2009 (and the associated supplementary material).
- It should be noted that winter skate in Gulf are primarily distributed in the southern Gulf, where they are distinct from winter skate elsewhere.

5.2.1.5 Porbeagle Shark

- The EA notes this species as having a low potential for occurrence in the study area. However, relative to its overall population size, the likelihood of occurrence is moderate or high, although not in large numbers. As such, Table 2 needs to be amended to reflect this. A distribution map should also be presented.
- Porbeagle shark mating occurs off southern Newfoundland and at the entrance to the Gulf, between late August and November. Pregnant females are present in this area from late August through to December and are seldom seen from January through to June (Jensen et al 2002).

5.2.1.6 White Shark

- Criteria for low occurrence need to be stated clearly. A distribution map should also be presented.
- It should be noted in the EA that White Sharks are now listed as Endangered under SARA.

5.2.1.7 Redfish

- The EA states *"…The deepwater redfish has declined by 98 percent since 1984 and the Acadian redfish has declined by 99 percent…."* References to "declines" should be clarified that declines are in mature abundance as per the COSEWIC criteria.
- The three recent scientific advices on redfish require mentioning in the EA: Stock Discrimination (CSAS SAR 2008/026), Stock Assessment of Units 1 and 2 (CSAS SAR 2010/037) and Recovery Potential Assessment (CSAS SAR 2011 /044).

5.2.1.8 Shortfin Mako

- Criteria for low occurrence need to be stated clearly. A distribution map should also be presented.

5.2.1.9 American Plaice

- This section is inadequate in its purpose. Information on seasonal distributions is lacking (see sources listed under cod for *information*). Winter distribution for plaice that spend the summer on the Magdalen Shallows and move into deep water in the Laurentian Channel is particularly relevant, and is not mentioned within the EA.

5.2.1.10 Striped Bass

- COSEWIC's (2004) assessment for striped bass is not a good reference nor is it used properly.
- If indicating spawning in the St. Lawrence estuary, reference should also be made to spawning in the Miramichi. The introduction of these two populations should set up the rest of the text as they pertain to EL1105. Further, mention of St. Lawrence striped bass requires St. Lawrence striped bass be introduced in Table 5.1 as extirpated.
- There is some evidence that there may be more than one striped bass population in the Bay of Fundy. It is relevant that Miramichi bass are genetically isolated from populations further south. However, Fundy striped bass are not relevant to the assessment and therefore it is not necessary to give any information on their biology.
- Spawning of Striped Bass does not occur primarily in freshwater. This occurs near the fresh-salt boundary at the head of estuaries.
- The Bay of Fundy (Shubenacadie River) does not occur in the southern Gulf.
- “school to fish” requires clarification. This may refer to predatory schooling behavior, in which case should also be qualified by “CAN cover tens…..
- Contrary to the EA, striped bass DO currently exist and spawn in the St. Lawrence Estuary. While extirpated there in the 1960s, they were re-introduced in 2002 and have potentially established a successful spawning population (DFO 2010).
- Striped bass are highly mobile and range very widely around the edge of the southern Gulf. However, they stay close to land, and hence are very unlikely to be in the area of proposed drilling. Therefore the most obvious omission in the text is the link between the striped bass populations and their 'low potential of occurrence' at EL1105.
- At a minimum, coastal behaviour at all life stages should be identified, but could be strengthened within the EA easily for the sGSL population by either COSEWIC's (2004) evaluation of Extent of Occurrence and/or its proposed refinement in Douglas and Chaput (2011).

5.2.1.12 Spiny Dogfish

- Information is dated. More recent data exist from the study area. The data from 2003-2011 should be presented to illustrate current distributions and not the distribution from a decade ago. Criteria for low occurrence should also be stated clearly.

5.2.1.13 Blue Shark

- Criteria for low occurrence need to be stated clearly. A distribution map should also be presented.

5.2.1.14 Basking Shark

- Basking Sharks are regularly found in the study area; although not in large numbers. Since their overall population size is low, relative occurrence in the area is moderate as opposed to low. The EA text and Table 2 needs to be amended to reflect this. A distribution map should also be presented.

5.2.1.15 American Eel

- The EA should indicate the special vulnerability of the St. Lawrence River eel populations due to their depressed population size and their use of migratory routes at or in the general vicinity of the proposed drilling site. COSEWIC assessed the American eel in Canada as Special Concern. Eels have been declared Endangered under Ontario provincial law. American eels in the St. Lawrence River basin have declined greatly. The most dramatic reductions are in Lake Ontario (formerly the site of large eel populations and a major commercial fishery). There are also major declines in the Quebec portion of the St. Lawrence River basin. All of these eels migrate through Cabot Strait as glass eels and silver eels, and it is likely that many or most follow the general route of the Laurentian Channel, which would put them near the general area of proposed drilling.
- American eels that use the St. Lawrence system as a rearing area migrate through Cabot Strait twice during their lives. The distribution of glass eel catches in icthyoplankton surveys (Dutil et al. 2009) suggests that the eastern end of the Laurentian Channel, including the area of the proposed drilling, is a main migratory corridor for glass eels entering the Gulf system. Most migration occurs between the end of the first week in May and the end of the first week in June (Dutil et al. 2009).
- Pre-spawning silver eels enter the sea from fresh water and coastal growth areas in the fall. The timing and location of silver eel migration through Cabot Strait has not been directly observed. Silver eels were found to exit Prince Edward Island coastal ponds primarily in September (Cairns et al. 2007). These eels probably reach the Cabot Strait area a few days later.
- *“Return to fresh water"* in the EA text should be amended to "return to sheltered bays and estuaries or fresh water"; "adult" should be replaced with "lifetime."
- Larval eels are not *“completely physiologically dissimilar”* to adults. Delete the word “completely”.
- The use of the word "transient" in the text and at various other places in Table 5.2 implies that the species would incur little or no risk if there is an oil spill or other environmental accident. However, if an animal is killed or harmed during migration, the damage is no less serious than if an animal is killed or harmed during a non-migratory phase. It is agreed that there is a high probability that any encounter with the project will be transient in nature but this has not been researched.

5.2.1.16 Atlantic Salmon

- Use Salmo (genus) instead of salmo.

- Much of this material in 1st paragraph, 1st three sentences is incorrect or only partly correct. Most Atlantic salmon are anadromous, but not all. Many salmon spend two years in fresh water, but many do not. Many salmon migrate to the Labrador Sea, but some also migrate to Greenland. Pertinent literature on Atlantic salmon should be consulted and accurately summarize key points of their life history. In insular NL most Atlantic salmon remain in fresh water for 2 to 5 years not 2 years as stated. Atlantic salmon over winter in the waters off the Grand Banks, Labrador and west Greenland.

Atlantic Salmon migration timing and routes need to be reviewed and summarized. Reddin (2006) summarizes the broad pattern of migration routes followed by post-smolts out of the Gulf and returning adults into the Gulf. However, routes are generally not known at a detailed level, which leaves some uncertainty as to how often salmon pass through or near EL1105. Recent unpublished studies using acoustic pingers indicate that post-smolts from a variety of Gulf rivers pass through the Strait of Belle Isle during a short period in early July (http://www.asf.ca/smolt-tracking_1.html)

- Although the relative importance of the Strait of Belle Isle and Cabot Strait as salmon migration routes is not clearly understood, it seems likely that use of the Belle Isle route would be highest in salmon from the northern Gulf, including those from Anticosti Island. The forthcoming completion of an acoustic receiver string across the Cabot Strait may provide insight into the relative importance of the two Gulf entrance straits, and the likelihood of salmon traffic in the EL1105 area.
- *"All of these populations are considered to have a low potential for occurrence within EL1105, with any presence being transient in nature"* should be replaced with *"All of these populations are considered to have a moderate potential for occurrence within EL1105 during their post-smolt and returning adult migrations."* "Transient" should not be used to describe these migrations.

5.2.1.17 Atlantic Bluefin Tuna

- This section is deficient, and requires revision. Most significantly, the assessment does not include bluefin tuna as a potential species at risk based on COSEWIC's recent determination that the Western Atlantic population is endangered. Accordingly, this species should also be included in Table 5.1., and much more consideration of the possible impacts on this high-profile stock is required in the EA. The western population of Atlantic bluefin tuna relies heavily upon the Gulf of St. Lawrence for critical foraging opportunities; and the largest and oldest individuals, typically comprising breeding adults, are found in the southern Gulf of St. Lawrence.
- It is incorrect (p.141) that both the western and eastern populations can occur in the southern Gulf of St. Lawrence. More recent studies have shown convincingly that the fish occupying the southern Gulf of St. Lawrence are almost exclusively western origin fish (Schloesser et al. 2010).
- Since the new and evolving recreational fishery for bluefin tuna in the southern Gulf has huge potential for economic development, the EA should include this information and completely examine this in the context of recreational fisheries.
- Notably, the assertion that there is a low probability of occurrence of bluefin tuna in the study area could be evaluated through satellite archival tagging data that is currently unpublished. This could be examined with this specific objective within the next few months.

5.2.3 Marine Mammal Species at Risk

The EA cites the TNASS 2007 inventory (Lawson and Gosselin, 2009) as the sole source of data to determine the probability of meeting of various species in the study area and the Gulf of St. Lawrence. However, there are other significant sources of information which are completely ignored, including Kingsley and Reeves (1998) in particular, but also Lesage et al. (2007).

Additionally, the level of information provided on the various marine mammal species is very uneven and inconsistent. The following information should be provided for each species: structure of the stock, seasonal movements, reasons for their presence in the Gulf of St. Lawrence, abundance, probability of meeting in the Gulf and the sector of EL1105, and threats to their recovery identified by COSEWIC or Sara.

5.2.3.1 Blue Whale

- The presentation of current knowledge on distribution of blue whales does not consider the bias in observation effort / sampling of blue whales. Most past effort has been concentrated in the Northwest of the Gulf.
- A pattern of seasonal migration following a North-South axis is not only unrecognized, but is in fact challenged by recent data. Below is a more accurate description of the state of knowledge on seasonal migration by V. Lesage et al., extracted from a research document in prep:
    - *The agreement that blue whales follow a general north-south movement to warmer and less productive waters is not fully supported by current data (CETAP 1982; Charif and Clark 2009, Mitchell 1991, Reeves et al., 2004, Sears 2002, Sergeant 1977). Recent monitoring studies of whale vocal activity over long periods suggest that blue whales and fin whales are still present in winter (December to Jan or February) in the Davis Strait (Simon et al., 2010: fin), off the Grand Banks (Clark 1995: blue whale), as well as west of the British Isles in the north-east Atlantic (Charif and Clark 2009), but some migrate farther south (Nieukirk et al., 2004: fin and blue whales). The ratio of winter and spring catches of blue whales by whaling station south of Newfoundland from December to May (Dickinson and Sanger 1990), mortality in the ice in March-April in southwestern Newfoundland (Stenson et al., 2003), and anecdotal observations in the lower estuary of the St. Lawrence and Gaspé (Sears and Calambokidis 2002, Archives of www.baleinesendirect.com) confirm that at least part of the population of blue whales remains at our latitude throughout the year.*
- It is incorrect to report this population has 250 mature individuals since its size is actually unknown. Sears and Calambokidis (2002) was the source report for designation of the blue whale as endangered by COSEWIC. In this review of the available scientific information, there is no mention of such a figure (250 mature individuals). In fact, a maximum of 250 mature individuals is the COSEWIC assessment threshold for designating a population as endangered.

5.2.3.3 Beluga Whale

- In recent years, occasional observations of belugas, at times herds of several hundreds of individuals, have been reported (e.g., J. Lawson, DFO NL, unpubl. data). The origin of these animals, whether it is the St. Lawrence population or one of the Arctic stocks, could not be determined. However, it is indisputable that these animals come from a population at risk, as all stocks to which these individuals may belong to are considered as such by COSEWIC.

5.2.3.5 Fin Whale

- The abundance data cited for this species is incorrect. The estimated abundance is 462 individuals (270−791) for the Gulf of St. Lawrence and Scotian Shelf combined (Lawson and Gosselin, 2009, Table 10) or 1,352 individuals (above 821−2226) for the portion of eastern Canada identified during the TNASS (Table 11). The estimate of abundance was 380 individuals (SD = 300) in 1995−1996 (Kingsley and Reeves 1998).

5.2.4 Sea Turtles

- In general, the EA relies heavily on citing dated grey literature documents (e.g., COSEWIC report and Recovery Team documents) rather than the available primary scientific literature for sea turtles. The EA contains only slight reference to studies that have specifically focused on leatherback movements in and around the proposed development site and the most recent information available on the biology and distribution of sea turtles in Canadian waters is not integrated into the assessment. Direct consultation of the primary literature is recommended.
- Notably, the exploration licenses overlap directly with important foraging habitat for leatherbacks – including an area currently being considered critical habitat for the species. Moreover, the exploration site lies directly in line with the route many leatherbacks take in and out of the Gulf of St. Lawrence. If the proposal for further exploration of this site is ultimately approved, consideration should be given to limiting activities (well drilling, etc.) outside of the seasonal residency period for most leatherbacks foraging in the Gulf of St. Lawrence (August through to the end of October) to mitigate against potential impacts on the species.

5.2.4.1 Leatherback Sea Turtle

- The COSEWIC document referenced for this section is outdated and precedes most directed research on leatherbacks in Canada. Information of the distribution of leatherbacks in Canadian waters has been published in several articles (e.g., James et al. 2005; James et al. 2006; James et al. 2007).
- References should include James et al. (2005; for source of mortality in Canadian waters) as well as to recovery documents as posted on the SARA public registry.
- Specific mention of leatherback sightings in the Bay of Fundy can be misleading – while the species has been recorded there, it is conspicuously rare in this area.
- It is now known that leatherbacks forage in the vicinity of EL1105 – amend “may occur” to “occurs”.
- A long lifespan does NOT contribute to species decline as stated in the EA.

5.2.4.2 Loggerhead Sea Turtle

- More recent references exist and are available for loggerhead population size – see recent NMFS Loggerhead Turtle Expert Working Group stock assessment.
- Most loggerhead nesting in the North Atlantic does not occur at “near-equatorial nesting areas”, and instead occurs in the states of Florida, Georgia, and, to a lesser extent, the Carolinas.
- The size distribution (and therefore life history stage) of loggerheads in Canadian waters has not been reported, although sampling in adjacent areas suggests those that forage in Canada are mainly juveniles.

- Loggerheads are opportunistic feeders. Therefore, while squid and zooplankton are known prey items, it may be misleading to reference only those prey (i.e., maybe preface with "including"). Finfish should also be included as prey as this can contribute to vulnerability of loggerheads hooking in pelagic longline fisheries
- All loggerhead foraging is at sea, so remove "at sea" within the text.

5.3 Marine Ecosystem

- It is not accurate that "...fish habitat is divided into two areas, the shelf areas and the deep channels. The shallow waters along the shelf areas are characterized by warm, high productivity waters in the summer..." In fact, the bottom over much of the Magdalen Shallows is within the Cold Intermediate Layer (CIL), so that bottom waters are colder than those in the deeper waters of the channels.
- DFO 2007a is cited but is not listed in the References.

5.3.1.1 Algal Communities

- Tables 5.3 and 5.4 are based upon a book by G.R. South entitled 'Benthic Marine Algae'. However, the taxonomy of seaweeds has changed since that publication in 1983[1]. There are also many more species of algae found in western Newfoundland than are listed in the associated tables. A more appropriate and up to date listing can be found in 'NEAS Keys to Benthic Marine Algae of the Northeastern Coast of North America from Long Island Sound to the Strait of Belle Isle' (Sears 2002).
- Tables 5.3 and 5.4 fail to define those algal and invertebrate species most likely found in the intertidal zone, the zone of greatest impact for an oil spill on a shore. The first column of species is for 'high water mark to 5m' rather than high water mark to chart datum (the definition of the intertidal zone). As a result, this column contains a mix of intertidal and subtidal species. Lichens, *Fucus* and *Ascophyllum* are primarily intertidal while the kelps *Alaria* and *Saccorhiza* are mainly subtidal. In order to be more informative this table and section of associated text should describe the intertidal community in more detail, including both algae and associated invertebrates, and describe how this community may be affected by an oil spill.
- Table 5.3 and 5.4 – some of these species are not algae (maritime lichens, *cyanophyta?, Balanus, Mytilus, Zostera marina, Spartina sp., Plantago sp.).* Add *Laminaria digitata.*
- Table 5.4 – *Ascophyllum*, *Fucus*, *Ahnfeltia* and *Chaetomorpha* are not typically found associated with sand or mud. The listing infers that they may be common on this substrate.
- Note: *Agarum cribropsum* (in the french version) should be *Agarum cribrosum* (correct in the English version), but is now called *Agarum clathratum. Lamninaria longicruris* is now called *Saccharina longicruris.* Pophyra should be Porphyra.

5.3.1.2 Eelgrass Community

- The eelgrass beds described in this section are large and dominate soft bottoms in the shallow subtidal – they are considered extremely important habitat for the region. Expertise on eelgrass in the area described exists within DFO in Newfoundland and should be consulted for determination of potential impacts.

[1] For example, *Saccharina* is now the genus name for a number of species of kelps formerly associated with the genus *Laminaria*.

- Add sea urchin to the list at the end of the first paragraph (p.157).

5.3.1.3 Salt Marsh Community

The high and low salt marsh communities described are also extensive and important habitat for the region. Salt marshes are more likely to be impacted from an oil spill than subtidal eelgrass.

- The conclusion in the first paragraph of section 8.7.2 assumes that "there will be no interaction between a spill at the wellsite and coastal ecosystems (algal, eelgrass and saltmarsh communities)". However, the wellsite is in quite an extreme environment for waves, currents, storms and ice. A blow out or spill of long duration (days or weeks) could potentially allow large amounts of oil to reach shore.
- Identify which species of rockweed is an algae too.

5.3.2 Marine Habitats

Overall this section is very general with only one reference cited – should be considered incomplete.

- The intention of the opening paragraph of this section is unclear. It seems to imply that the eggs of benthic spawners are associated with the substrate. However, eggs and larvae of many demersal fishes are actually associated with the pelagic zone.
- Although it is noted that fish distribution varies seasonally, this seasonal variation is not described in any detail in the report.

5.3.3 Deep-Water Corals and Sponges

In general, the main source of information for the corals and sponges section of the EA is Cogswell et al (2009), which focuses on the Maritimes region. Additional important data that is available on coral and sponge distributions has not been included in the report – this includes 2010 and 2011 data from the Gulf (mostly for sea pens) and some of the more recent NL records. As a result, the conclusions that EL1105 location is likely not suitable habitat for corals and sponges (p.155) may not be the case. Kenchington et al. (2010) show significant abundances of sea pens in the Gulf and Laurentian channel that could be considered near EL1105. Sponges also need to be dealt with more consideration and relevance somewhere in this general section of this report.

The following is offered as an opening paragraph for this section: Deep-water corals are sessile or sedentary, largely colonial animals that can occur individually at low density or in significant concentrations, depending on the taxa considered and ecological conditions. They are generally slow growing, and may represent decades or centuries of growth. They are considered suspension feeders, but not a lot of attention has been given to food and feeding in the scientific literature. Numerous species of deep-water coral are present in the Gulf of St. Lawrence, with significant areas of coral concentrations occurring in the Gulf and Laurentian Channel (Cogswell et al. 2009; Kenchington et al. 2010). At least six species of sea pen occur (*Pennatula borealis*, *Pennatula phosphorea*, *Anthoptilum grandiflorum*, *Crassophyllum* spp., *Funiculina quadrangularis*, *Halipterus finmarchica*), including significant concentrations located adjacent to EL1105, on the western flank of the Laurentian Channel (Cogswell et al. 2009; Kenchington et al. 2010). Soft corals, especially *Gersemia rubiformis*, but also including *Duva florida* and *Anthomastus grandiflorus*, are also common, especially in the western Gulf. However, they are not considered as vulnerable to disturbance as other types of corals, including sea pens (Fuller et al. 2008; Kenchington et al. 2010). At least two species of large gorgonian corals occur, *Primnoa resedaeformis* and *Paramuricea* spp., as well as the solitary stony cup coral, *Flabellum* *alabastrum*, but these don't appear to be nearly as common or abundant in the Gulf as either of the other types of coral.

- It is uncertain as to the point in noting that sea pens are not true stony or soft corals.
- Orders Stolonifera and Heliporacea are not present in Canadian waters – as such this reference is irrelevant.
- The EA comments on sea pens hundreds of km away off Baffin Island, but ignores other significant records in the Gulf.
- It is incorrect that *Pennatula phosphora* is not observed near the Project - *Pennatula phosphorea* has been observed "near" the project in great numbers (Kenchington et al. 2010). The EA also needs to define "near".
- The October 2010 geohazard survey does not identify the presence of any deep-water corals or sponges – however, sea pens are corals.
- It is incorrect that there are no data on presence / absence of corals and sponges within the Laurentian Channel outside the Gulf – data are figured in Cogswell et al. (2009).
- The statement that *"water depth may not be a limiting factor in their distribution"* is misleading since factors determining distribution include depth, and most others are typically correlated with depth, therefore responding quite clearly to depth, even though it is not just depth itself.
- Many forms and species of deep water coral are not generally found on hard substrate as inferred in the EA.
- The report by LGL (2007) indicates that "*In general, the low abundance of corals in the Laurentian Channel (other than the Stone Fence at the southern end of the Laurentian Channel) probably reflects the low cover of cobble and boulder in the area (Mortensen 2006).*" This is out of context (refers to large gorgonians only or is or outdated) See Kenchington et al. (2010).
- It is questionable re: the relevance of The Stone Fence Coral Conservation Area to this assessment.
- Deep-water corals may benefit from rather than require higher water current speeds. It's also not clear exactly what they feed on, though plankton is probably an important source for some if not many species, at least at shallow to relatively moderate depths. Occurrence along continental slopes and shelves may also be more to do with the availability of food or increased substrate variability at the appropriate depths rather than currents.
- The commentary around favorable habitat for deep-water corals and sea pens in reference to EL1105 is confusing.
- Not all sponges depend on plankton for food. Some are carnivores and there is the possible role of bacteria as food also.
- Coral and sponge data from NL and the eastern Canadian Arctic is overemphasized, while ignoring or minimizing other relevant information actually from within the Gulf of St. Lawrence and Laurentian Channel. The most recent, peer reviewed, published information is not referenced (e.g., Kenchington et al. 2010). This information is the definitive culmination and summary of all quantitative data concerning coral and sponge from the eastern Arctic to the U.S. border, and should not be ignored. Data is presented within that clearly demonstrates significant concentrations of both coral and sponge in the

Gulf, and must at least be presented and considered as being near the proposed development.

- There is apparent ambiguity with classifying sea pens as being corals. Sea pens are considered corals, phylogenetically, biologically/ecologically and by policy makers, including DFO. Sea pens are octocorals, belonging to the subclass Octocorallia, along with gorgonian corals and soft corals. Ambiguously framing sea pens in any way confuses the assessment.
- The term "near" is used often, and proximity is used as potential factor implying mitigation of any impacts. Therefore a clearer definition of "near" should be provided. If there have been few observations of coral and sponge from within the proposed site, fine, but it is potentially misleading to simply state that corals and sponge are also not concentrated "near" the development. Actual distance would be more useful in this context. If more scrutiny is placed on this term, we believe it will be unavoidable to conclude that significant concentrations of coral and sponge are nearby. The question will be how many of these areas of concentration are considered "near" and what exactly is their proximity.
- Kenchington et al. (2010) report that the highest abundances (trawl catch data) of seapens in eastern Canada occur in the Gulf region. The area is certainly suitable habitat for seapens which are found on unconsolidated sediments (p.154). The author of the EA should review Kenchington et al. (2010) (with link) and current information on the classification and conservation considerations for sea pens below, including the geo-referenced map summarizing data on the concentrations of sea pens and sponge near the proposed Old Harry development (Appendix 1 (figure prepared by Cam Lirette)).
- Figures 5.22 and 5.23 – (coral and sponge records) show high coverage on the Scotian shelf and Gulf regions with almost no occurrences in the Newfoundland region. This is attributable to NL data not being included in the assessment.
- The EA states (p.155), *"These factors suggest that the area for which the Project is planned is not a favourable habitat for deep-water corals and likely for sponges as well, since they too depend on plankton for food."* The term 'plankton' as used here is too general. We know that corals and sponges represent a diverse range of trophic groups including carnivores (feeding on zooplankton) and suspension feeders (feeding on suspended organic particulate matter). Their food sources include organisms and detritus resident near the seabed surface and organic matter sinking from surface layers which is why they can survive at deep depths below the photic zone.
- Inconsistency exists in the spelling of *Anthoptilum grandiflorum*. This is the correct spelling.
- It would be useful to the EA to recognize that various NAFO working groups concluded that for corals the following taxa formed the conservation units (from Kenchington et al. 2010): Sea pen fields (Pennatulaceans); Small gorgonians (*Acanella arbuscula* was the only species in the NAFO Regulatory Area within this group); Large gorgonians (Sea fans: genera: *Primnoa*, *Paragorgia*, *Keratoisis*, *Paramuricea*; *Radicipes,* etc.); Cerianthid anemone fields; Antipatharians (black corals), and Reef-building corals (e.g., *Lophelia pertusa*).
- Table 5.9 – the record of *Littorina littorea* from a grab sample (GS-02) from a depth of > 400 m is remarkable given that this is primarily an intertidal species extending into the shallow subtidal (< 20 m). Only the lab that processed the samples can respond to this discrepancy, but this may have been an empty shell that had been transported to deep water.

5.3.4 Plankton

- The statement (p.165), "The transect line across Cabot Strait (identified as TDC in the AZMP program) is of most relevance because it spans across the Laurentian Channel between Newfoundland and Cape Breton Island and is situated approximately 70 km southeast of EL1105. General water flow through EL1105 and water properties would likely resemble those at Cabot Strait.", requires second consideration. The continental shelf waters entering the Cabot Strait do not point directly to the EL1105 site. In terms of plankton communities, AZMP transects within the Gulf (especially the center transect - at the eastern tip of Anticosti Island) would be more appropriate in this case.
- 5.3.4.1 Phytoplankton and Primary Production
- The EA states, *"Harmful algal blooms are not known to occur in open areas of the Gulf or EL1105."* However, there is no reason to believe that there is no presence of toxic algae in this area.

5.3.4.3 Ichthyoplankton

- It should be noted (p.170) that this area also represents an important area for Atlantic mackerel spawning and for the southern Gulf population of Atlantic cod.

5.4 Marine Fish and Fish Habitat

5.4.1 Fish Habitat

The magnitude of the photographic coverage of the sea floor seems low and mainly located in western margin of the area for which the license is applied (Figure 5.26). The determination of animal biodiversity of soft bottoms, particularly the macro-and mega-benthic fauna, must be based on the use of a variety of sampling tools (grab, drag, epi-and supra-benthic sled, beam trawl). One cannot determine the nature of macro and mega-benthic communities simply based on a number of photos and some samples or grab sampler (three, according to Table 5.9).

Legend of Figure 5.27 should refer to Figure 5.26 for the position of the stations, NOT to the Figure 5.23. In the legend of Figure 5.26 and elsewhere in the text, it refers to the "ocean floor".

Table 5.9 – this table does not reflect the extent of benthic biodiversity in the targeted region (see previous comment). At a minimum, the EA report should include an inventory of many benthic species listed in the bilingual document written by Brunel et al. (1998). The study area is included in LCI, historically less well sampled for benthos than LCH, but both areas could have a rather similar fauna.

Table 5.9 – *Limacina helicina* is a pteropod (mollusc) epipelagic, not a benthic species. *Littorina littorea* is a coastal species that likes the intertidal and subtidal: although one may occasionally find it in bathyal environment, it is very rare and certainly not representative of the bathyal fauna. Finally, Brunel et al. (1998) and the virtual catalog WoRMS do not report the presence of *Spio limicola* in the Gulf of St. Lawrence. This species is found further south along the coast of North America, though not inconceivable that it enters the southern Gulf, it is suspected there could be error in the determination of the species

5.4.2 Shellfish

- The structure of the introduction may suggest that the species of shellfish listed in the following sentence (e.g., lobster, rock crab ...) are found in the area of EL1105.
- The document refers to "giant snow crab". This is not a species.

- The list of other commercially important species in coastal areas around EL1105 does not include the Iceland scallop (*Chlamys islandicus*), sea cucumber (*Cucumaria frondosa*) and sea urchins (*Strongylocentrotus droebachiensis*) which also support established or emerging fisheries in the area.
- Northern Stone Crab (*Lithodes maja*) is not mentioned in this assessment. It is not a commercially important species but is present near Old Harry.
- The Atlantic razor is not *Siliqua costata* but *Ensis directus*, caught in eastern Canada.

5.4.2.1 American Lobster

- The first paragraph contains inaccuracies and should be re-written. The following is proposed: American lobsters are distributed in localized reefs in nearshore areas around the four Atlantic Provinces and eastern Quebec. The spring fishing season removes individuals from the population prior to moulting and spawning. Adult female moulting and mating occurs during one summer, whereas the second summer is dedicated to laying the eggs. With proper conditions, some young females could moult, spawn and lay eggs in the same summer (DFO 2003).
- "Courtship" is a term that should apply only to birds – mating applies to lobsters and crabs.
- The last sentence of the 2nd paragraph of p.192 is incorrect – may be bad translation.
- The statement that one in ten fertilized eggs will grow to become adults is likely incorrect. Also stages I II and III are not at the surface and are next to impossible to find.
- The diet of juvenile lobsters is significantly different from that of adult lobsters (see Sainte-Marie and Chabot 2002)
- Referring to "the coastal zone between the outer Port au Port Bay and Island Shag", these localities are in Newfoundland and Îles-de-la-Madeleine respectively. It is the Laurentian Channel, which separates them, where there are no lobsters. And this is certainly not a ‘spawning’ area.

5.4.2.2 Snow Crab

- Some descriptions of snow crab are not correct. In the southern Gulf of St. Lawrence, snow crab does not move to shallower water to mate. They do not migrate to shallower waters for speeding up embryonic development. Mating does occur for pubescent females after the terminal molt but multiparous females (terminally molted) do not molt before mating. Females can use stored sperm to fertilize oocytes but it is not a general event. When mating partners are present they mate again. The statement *"Males continue to molt into adulthood and only a portion will recruit into the fishery"* has to be rewritten as it is ambiguous. Adult is the terminally molted crabs and a portion of terminally molted crab larger than the minimum size limit will recruit to the fishery when they harden their carapace in a following year. The description of snow crab life cycle/biology has to be re-written.
- Snow crab distribution is also available from September multispecies survey as well as snow crab annual survey from Gulf Region. And/or snow crab fishing area (CFA) map in the southern Gulf of St. Lawrence, Eastern Nova Scotia and southwestern NL can be put here as it was done for lobster. Especially CFA 12F, 19, 4Vn, and 12A-C are very close to Old Harry.

- Regarding stock structure, Atlantic snow crab have recently been identified as a single stock complex ranging from Labrador to Gulf of Maine and encompassing the Gulf of St. Lawrence (see recent paper by Puebla et al.). This information should be amended in the text.
- In reference to presence of green crab *in "the waters off Newfoundland…"* what is meant by this is – that green crab is in the area EL1105? Green crab (*Carcinus maenas*) is also present around Cape Breton Island and Prince Edward Island. Reference search should be done to include the recent distribution records of this species in the southern Gulf and northern Cape Breton.
- It is incorrect that snow crabs generally move to shallow waters to spawn because the temperature increases the speed of embryonic development.
- Spermatophores are stored in the spermathecae.
- Smaller crabs are not found *"within the interstitial spaces of harder substrates."* The first benthic stages are furtive and live hidden among woody debris, biogenic structures or buried in the fine silt.

5.4.2.3 Rock Crab

- This description is very confusing and contains many erroneous statements. The following is proposed: Rock crabs are decapod crustaceans that congregate in waters typically less than 20 m deep and occupy different substrates from sandy bottom to rocky habitats. There is a sexual dimorphism in the size of rock crab, with males growing to bigger sizes (140 mm) than females (100 mm). Sexual maturity is generally attained at carapace widths of 57 and 75 mm for females and males respectively. Molting peak period for males usually happen in the late winter months to allow carapace hardening before mating with soft-shell females in late summer-early fall. Fertilized eggs are extruded soon after mating and are stored under the female's abdomen for up to 10 months. Larval hatching occurs in the late spring / summer months, with the free-swimming larvae aggregating near the surface. The larvae go through six stages which can take up to three months in total before settling to the seafloor as a benthic crab. Rock crab larvae are omnivorous planktivores.
- Rock crabs play an important ecological role in northern subtidal communities, mainly because of their wide abundance. Their diet includes bivalves, snails, green sea urchins, sea stars, amphipods, sand shrimp, and polychaetes. Rock crab is an important prey item for lobster of all sizes. Adult male rock crabs will reach commercial size (102 mm) at about six years of age.

5.4.2.5 Whelk

- Several statements regarding whelk are incomplete or incorrect. Females lay capsules that contain numerous eggs – it is the capsules which are attached to hard substrates, and not "young larvae" emerge from these capsules, but rather juveniles. If reproduction occurs mainly towards the beach and development is direct, then whelks cannot move from "deep...substrates to shallower substrates...as they grow" as they are already there.

5.4.2.6 Northern Shrimp

- It is stated that shrimp are usually hermaphroditic. However, this species is always hermaphroditic.

5.4.3 Fish

The EA needs to be clear in which species are/are not being presented with species-specific distribution and life history information and why. For example, Thorny skate are presented within the assessment and not Smooth skate. Accordingly, the entire section following table 5.10 should be amended for clarification.

- Atlantic hagfish (also Table 5.10), Thorny skate, Smooth skate, and Black Dogfish are not pelagic species as stated in the text – they are groundfish species.
- Contrary to that stated in the EA, there are currently moratoria on directed fishing for cod in the Laurentian South DU.

5.4.3.1 Pelagic Fish

Overall, the information presented on pelagic fish is incomplete. The most recent DFO CSAS Research documents and Science Advisory Reports pertaining to pelagic fish should be consulted for this assessment. Notably, a section on capelin should be added here.

- Table 5.10 – for herring, add "spring spawning"; for mackerel, it is not present all year round, but from May to November, and there are also eggs and larvae, not only adults; for capelin, there is also immature. Also, the text mentions spring spawning which is not presented in Table 5.10.
- Table 5.10 – this table is taken from the survey of northern Teleost. Caution should be employed in the interpretation of results (survey of groundfish vs. pelagic fish).
- Table 5.11 – add April to July for herring; and add capelin to the table.
- Figure 5.32 – data from the southern Gulf survey (the southern Gulf is presented for some species) should be added.
- Figure 5.33 – the distribution presented for Atlantic mackerel in the Estuary and northern Gulf is incorrect. For pelagic fish such as herring, mackerel, capelin, using data from bottom trawl catches does not provide the distribution of these species as shown here. Other techniques are required to establish such a distribution.
- Figure 5.33 – this should be replaced by maps of eggs and catches from commercial fishing (purse seine) (the fishing positions of herring and capelin catches should also be included).

5.4.3.2 Demersal Fish

- Figure 5.40 – information is dated. More recent data exists for the study area. The data from 2003-2011 should be presented to illustrate current distributions as opposed to the distribution from a decade ago. Criteria for low occurrence need to be stated clearly.
- Figures 5.42, 5.43, 5.48 – only present one year of data. This should be expanded to illustrate current distribution.
- It is stated (p.156) *"Yellowtail flounder is a demersal flatfish found in the waters from Chesapeake Bay to Labrador..."* However, Yellowtail flounder are at the northern extension of their range on the northern Grand Bank in 3L off eastern Newfoundland….certainly not Labrador.
- Atlantic Halibut – information on distribution is restricted to data from the 2009 and 2010 August surveys of the northern Gulf. There is much additional information available on summer distribution from the sources listed above (see cod), including areas not covered

or poorly covered by the August survey (information from the 2010 survey appears incomplete, or survey coverage was incomplete). Information on distribution in other seasons should also be presented (see sources above).

- Haddock – information on distribution is limited to an old ECNASAP map. A considerable amount of more current information is available from the sources listed above.
- Turbot and longfin hake – information on distribution is restricted to data from the 2009 and 2010 August surveys of the northern Gulf. This is a particular error since survey coverage was incomplete in 2010 and with the area of greatest interest for this report (the area around EL1105) not sampled.
- Greenland Halibut – an important information, while only recently published, should be included in this assessment. Ouellet et al (2012) present evidence that the project area corresponds to the main site of the spawning population of Greenland halibut in the Gulf of St. Lawrence. The species lays bathypelagic eggs (which grow in deep water) and eggs and larvae will be therefore abundant in the work area at the time of breeding (February-May). Greenland halibut is a major fish species for fisheries in the Gulf of St. Lawrence.
- Monkfish – the text refers to monkfish outside of the Gulf in NAFO areas 3LNOPs. It is likely incorrect that “the Gulf provides habitat for an abundant population [of monkfish] within the warmer shelf waters.”
- Pollock – the text refers to Pollock outside of the Gulf.
- White Hake – this section is inadequate. Information from southern Gulf surveys, noting that hake are distributed in either shallow inshore waters or in deep water along the Laurentian Channel in summer, migrating to overwintering grounds in deep waters of the Laurentian Channel should be included in the assessment (see sources above – Atlantic Cod).
- Witch Flounder – this section is inadequate. Much of the text is only general in descriptions of species range outside of the Gulf. It should be emphasized that in winter pre-spawning adults appear to be aggregated in the area of EL1105 (Bowering and Brodie 1984).
- The pre-spawning aggregation of witch flounder located within or near EL1105 should be considered as a sensitive/significant area. Also the overwintering aggregations of southern Gulf cod, and their migration route along the Laurentian Channel, represent other sensitive/significant areas near EL1105.
- Thorny Skate – this section is inadequate. Much of the text is only general in descriptions of species range outside of the Gulf (e.g., the Grand Banks). See the above sources for information on the seasonal distribution of thorny skate within the Gulf. See Swain and Benoît (2006) for a description of recent changes in summer distribution, with an increasing concentration in deep water along the south side of the Laurentian Channel. Note: Thorny Skate (p.158) has undergone declines and is being considered by COSEWIC as a species at Risk.

5.6 Marine Mammals and Sea Turtles

- Table 5.16 – Virtually no effort has been deployed to identify blue whales in the project area. To conclude in this case that the potential occurrence of the species in relation to the Project is uncommon is incorrect. This probability of occurrence is unknown, and may be higher in the spring and autumn when the blue whales migrate via the Cabot Strait, or in autumn through the area. Moreover, according to table 5.17 and DFO data presented therein, blue whale is a species that would be at least as common as the fin whale. The text should therefore be reviewed, as well as information at the beginning of p. 216.

- The frequency of occurrence of belugas is probably very occasional. However, considering the high numbers recently reported along the West coast of Newfoundland (J. Lawson, DFO, Newfoundland, unpublished data), the characterization of rare does not do justice to their possible exposure to activities related to the project. The text of p. 219 should therefore also be edited.
- Is OBIS appropriate to establish such an inventory? What proportion of existing data does OBIS include? Does it include inventories mentioned earlier in the section on endangered species?

5.6.1 Mysticetes (Toothless / Baleen Whales)

- Evaluation of abundance and potential presence of species in the study area should be carried out taking into account not only the study of Lawson and Gosselin (2009), but also that of Kingsley and Reeves (1998). Lawson and Gosselin (2009) estimates of abundance (with standard deviation) differ substantially from those obtained by Kingsley and Reeves (1998) very likely due to a delay in entry of animals into the Gulf. This hypothesis is substantiated by observations made on the Scotian Shelf and in U.S. waters during the survey period (see discussion of the paper). Estimates of distribution and abundance of Kingsley and Reeves (1998) are therefore also relevant and cover the area of the EL 1105.

5.6.3 Pinnipeds (Seals)

- It is incorrect to state that the four species of seals are hunted commercially in the Atlantic. Harbour seals, hunted to very low levels in the 1960s and 70s, are no longer included on personal sealing licenses. There is no commercial hunt for them anywhere in Canada.
- Harp seal diet data requires updating. Capelin and not Arctic cod now appears its main source of food.
- It should be noted that the area of the EL 1105 is part of the highly preferred hooded seal habitat, particularly males, when present in the Gulf of St. Lawrence (Lesage et al. 2007, Fig. 22; Bajzak et al. 2009)

5.6.4 Sea Turtles

- The leatherback is unequivocally found in the vicinity of EL1105. Therefore “potentially” should be removed within the text.
- There are actually four (not three) species of sea turtles that may be found in the area – need to add green turtle (*Chelonia mydas*) to list.
- Include primary publication reference for Kemp’s Ridleys preferring shallow water, and remove “apparently” and repetition of shallow water preference.

5.7 Sensitive Areas

- Fig. 5.57 – this should also include the pre-spawning aggregation of witch flounder in EL1105. Although mentioned somewhat in the text of the EA, the overwintering aggregation of cod north of St. Paul Island and the migration paths of southern Gulf cod (and other demersal fish) should also be emphasized, as should the fact that most large demersal fishes in the southern Gulf overwinter in the Laurentian Channel.

5.7.1 Ecological and Biologically Sensitive Areas

The title should be Ecologically and Biologically SIGNIFICANT Areas if this is what is meant. Otherwise, EBSAs should not be used as an acronym as it is more commonly associated with SIGNIFICANT areas within the context of ecosystem based management.

Considering the extremely complex and dynamic nature of the Estuary and Gulf of St. Lawrence (EGSL), EBSAs and their boundaries are meant to be presented only as a reference. It should also be recognized that EBSAs require re-evaluation over time (DFO 2011). Analyses leading to the identification of the ten potential EBSAs were based on the best scientific data available at the time – in this, several data sets were not included due to either of lack of geo-referencing or suitable electronic versions as well as large areas of the Gulf being poorly sampled. Therefore it should be noted that EBSAs for the ESGL do not cover all the areas or species that contribute in a significant way to the dynamic of the system. For example, only a small proportion (approximately 0.02%) of the benthic invertebrate species known to be present in the EGSL were considered in the EBSA process (Chabot et al., 2007).

- The EA correctly identifies that EL1105 is within several identified important areas – including a wintering area for many demersal fish species; and an area important for marine mammals. However, EL1105 is within an area where the number of overlapping Important Areas (IAs) across thematic layers and dimensions was high (see Figure 17 in Savenkoff et al., 2007). The EA also does not mention the area of interest for the marine protected area surrounding the Îles-de-la Madeleine (project under study by Parks Canada).
- The EA should also specify that there is a co-occurrence of several marine mammals in the area in winter for feeding – including deep-divers and blue whale (listed as endangered under the Canadian Species at Risk Act in 2005; northwest Atlantic population).
- The EA should include that this region is one of the rare significant areas for soft corals and the only area where certain deep water shrimp species are found (*Pasiphaea tarda*, *Sergestes arcticus*, *Atlantopandalus propinqvus*, *Acanthephyra pelagica*) (Chabot et al., 2007).

5.8 Commercial Fisheries and Other Users

5.8.1 Commercial Fisheries

- Information related to the DFO quota system is inaccurate. For example, herring and mackerel are under quota system.

5.8.1.2 Principal Commercial Fish and Shellfish Species

- The criterion used to evaluate the importance of fishery resources seems to be total weight landed between 2004 and 2010. Other criteria that should be considered include: the landed value, number of licenses and socio-economic impact of the resource, ecosystem role.
- A long list of "important" species is presented, but there is only discussion of some characteristics of the fishery (number of permits or season). This is in the case of redfish and snow crab, but should consider other species.
- Bourdages, not Bordages is correct.

5.8.1.3 Historical Fisheries

- The section on the cod fishery is very confusing – mixing figures for all of Newfoundland (including northern cod) in some periods and southern Gulf cod in others.
- Northern Gulf sentinel fisheries and research vessel surveys should not be included under the commercial fisheries section.

5.8.1 Other Users

- The EA refers to an eel hatchery in Robinsons. There are no commercial eel hatcheries anywhere in the world – it is uncertain as to what this refers to.

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT METHODS

6.3.1 Boundaries

The study area should be defined by the limitations associated with the greatest potential impact. For example, if the radius of action of seismic noise exceeds that of modeling the drift of an oil slick, this area should prevail for the definition of the study area. It should be noted in the assessment whether or not this was a consideration.

6.3.6 Environmental Effects Assessment

Table 6.2 – this table is incomplete, and serves only as an example of evaluation framework; its title is incorrect, and therefore should be amended. For example, include the information on page 290: ***"These criteria are used to provide a common basis for summarize the potential effects of each activity for each VEC."***

7.0 ENVIRONMENTAL EFFECTS ASSESSMENT

Literature on the potential environmental impacts of exploratory drilling is covered quite well and conclusions are in line with many reviews and individual studies dealing with the effects of drilling fluids and cuttings (e.g., MMS2000; CAPP 2001; NEB et al 2002; Buchanan et al 2003; Hurley and Ellis 2004; Neff 2005; Mathieu et al. 2005). Discharges associated with the drilling of a single exploratory well would normally be expected to disturb/impact habitat within a few to tens of meters from a drilling site. The National Academy of Science has drawn attention to the disturbance caused by drilling a single exploratory well compared with the disturbance caused by one clam dragger in a single day – the impact being greater for the latter.

7.1 Overview of Project Interactions and Potential Effects

- The impact of light is not considered in the EA. The effect of light that has not been considered is that on the circadian cycle of diel vertical migrations of pelagic organisms, rising to the surface to feed during the night, and take refuge deep to escape predation by visual predators (e.g., fish, birds). The presence of light around the platform at night will change local dynamics. We refer to this dynamic only on page 354 of the English version.
- Given the relative prevalence of basking sharks in the study area, and given that porbeagles mate in the study area, these should be given more specific consideration within the assessment of potential effects – especially given that potential for occurrence is NOT LOW (see section 5.2 comments) as originally determined by the assessment.

7.1.1 Presence of the Drill Platform

- The EA notes that, "Such a study has not been done for leatherback turtles; however, this species is recognized as being the fastest reptile 35.2 km/hr (19 knots) when frightened (McFarlan 1992) and might be expected to be better able to avoid a strike." This is an inappropriate and misleading suggestion, as it is not necessarily the potential top speed of a marine vertebrate which influences its susceptibility to ship strikes. More relevant variables include whether or not the animal is in foraging "mode" versus transiting, as foraging animals are particularly vulnerable. EL1105 is located in key leatherback foraging habitat. It would be prudent to remove this argument from the assessment.

7.1.2 Drill Muds and Cuttings

- Although monitoring is not presently required for exploratory drilling, seemingly in any country, if OBM are used it would be useful to carry on some pilot observations to determine if sediment contamination and potentially anaerobiosis is only confined to a few to tens of meters from the site.
- Barium is the main metal in OBM and WBM. Questions have been raised about the potential for chronic toxicological effects in fish. A recent publication reported no health effects as assessed by a variety of indices, in fish chronically exposed to barite for several months (Payne et al 2011).

7.1.5 Underwater Sound Sources Associated with Exploratory Drilling

For the impact of noise generated by the work, no modeling of the affected area by the different sources of noise, continuous and impulse, is done to provide realistic estimates of noise levels at different frequencies and to map them on vertical and horizontal plane.

- The exploration well is in relatively deep water (~470m). Sound in deep water will propagate to ranges of kilometers to tens of kilometers with less attenuation than characteristic of shallower more typical areas of the Grand Banks or Scotian Shelf – this would be especially so for sound propagating along the axis of the Laurentian Channel.
- Considerable seasonable variation might also be expected in the amplitude of long-range propagated sound. In summer near-surface originating sound, as from air guns, will tend to be generally refracted downward by the prevailing sound speed stratification leading to substantial interaction with the bottom and rapid attenuation with range. In winter and spring the conditions in the deep water of the Laurentian Channel may be upward refractive (at least this is the case on the Scotian Shelf) and near-surface sound can be trapped in sound channels in the upper water column leading to substantially reduced sound attenuation at long range. While these effects are probably negligible close to a surface sound source at short range where acute effects on organisms might be expected, they could be of some consequence at long ranges where low levels of sound might, for example, exert behavioral effects on marine mammals such as influencing their movement. This would be especially relevant to the time of year the activities are taking place.

7.1.5.1 Sounds Associated with Vertical Seismic Profiles

It is agreed that the most intense sounds emitted into the environment will likely originate from the VSP survey – this is unless explosive shaped charges are required to be used to eventually abandon the well.

The noise associated with seismic surveys and large ships which traverse the area on a daily (weekly?) basis might be a source of disturbance for whales.

- There appears to be some confusion in the EA in referring to VSP and "well site" surveys. For example, within the text, *"A typical well site survey (VSP survey) could..." - However, the "well site survey"* discussed in the quoted reference (Davis et al. 1998) is a conventional 2-D seismic survey conducted using a smaller, higher frequency air gun array to gather detailed geological/geotechnical info on shallow sediment structures around the well in order to plan well initiation and placement of any necessary equipment on bottom. The VSP survey generally looks at deeper geological structures and requires placing the receiving array down the well bore – and appears to be the type of survey proposed for Old Harry given the quoted source level of 242 dB re 1µPa @ 1m is typical for a true VSP survey. This information requires clarification.
- The intent of the sentence *"The energy levels emitted from the VSP will be considerably less in source (760 in^3)."* is unclear. Lower source energy normally implies a lower total volume airgun array. The key point should be that VSP sources have a sound pressure level intermediate between sources intended for shallow, local geotechnical type surveys and sources typically used for deep 2 or 3-D exploration seismic surveys.
- It has been identified that either a semi-submersible or a drill ship platform may eventually be chosen for the Old Harry exploratory well. As per Table 7.5, semi-submersibles are generally significantly quieter than drill ships. Noise levels emitted by a drill ship are roughly comparable to those emitted by other vessels of similar size; however, a drill ship represents a stationary, long duration noise source (20 – 50 days as per project scheduling) as opposed to a temporary noise source of a passing vessel.
- The statement *"...low frequency noise from a drilling platform might be detectable no more than 2 km away near a shelf break.."* may be best case scenario given that Table 7.5 identifies noise from a moored drill ship will attenuate to 115 to 120 dB (well above quiet ambient noise levels) at distances of 1 to 10 km. This 2 km detection range for drilling is also mentioned (p. 350) in the context of the avoidance of drill platforms by baleen whales. This appears as overuse of one favorable piece of literature without consideration of other weights of evidence.
    - o Accurate estimates are required. Also, essential measures are not included here: i.e., the levels of ambient noise, noise from the source at the frequencies considered and the estimated losses by propagation. Moreover, to what depths of the water column do we refer?
- Table 7.5 – the "Noise Level (dB re 1µPa)" column contains some error in presentation. Two, and possibly three, quite different acoustic measures are presented in this column without distinction. As such they are misleading for use in making determinations. For example, based on how they are labeled, it is natural to believe these numbers to refer to broadband acoustic pressure level measurements at a point in space. However, a numeric level of 60 for "calm seas" appears much too low for a broadband pressure measurement – although is reasonably consistent with a typical power spectral level reported over a 1 Hz bandwidth in the frequency range 10 – 1000 Hz under calm conditions (and the correct units being dB re 1 µPa/Hz$^{1/2}$. The quantity for "Moderate (not 'Modern' sic) Waves/surf" (100 – 700 Hz) seems to be properly labeled as broadband and 102 dB re 1µPa is not unreasonable. The quantity for "Pile-driving" appears to revert to the originally labeled point measurement of broadband noise (given the observation distance of "1 km"). The original literature should be checked to determine how "Fin whale" (probably source level), island drill rigs, or helicopter levels were measured or defined also. This becomes more important if these numbers are used elsewhere in the report to arrive at conclusions about the Old Harry drilling environmental impacts. For example, the EA notes bad weather

ambient noise levels are stated in the range 90 to 100 dB re 1µPa – actually less than the moderate wave and surf levels of Table 7.5

- It should be understood and noted that broadband levels are quite dependent on how "broadband" is defined. The "jack-up", "semi-submersible", "moored drill ships", and various specialized vessel noise levels would appear to be acoustic source levels where the broadband acoustic noise levels expected from these devices if measured at a (mathematical only) reference distance of 1 m, the correct acoustic units in this case being dB re 1 µPa @ 1m.
- Table 7.5 – the EA presents the frequency at which the intensity of the sound is observed. However, none of the sources presented is limited to a single frequency; the energy spreads on a band of frequencies, which may be more or less wide according to the sources. A presentation of the SPL with frequencies for each of the sources would have been much more informative to evaluate the impacts of each.
- Table 7.5 – this should specify whether the levels @ 1 m are for discrete sources or other distances (e.g., fin whales, drilling platform)
- Table 7.5 – the statement *"Overall broadband sound level did not exceed ambient beyond about 1 km…received levels at 100 m would be approximately 114 dB re 1 µPA."* is inconsistent. How can the overall broadband sound level at 1 km be less than ambient levels beyond 1 km, while it is still as high as 114 dB re 1 µPa at 110 km? This reference is probably not applicable here. In the St. Lawrence, the median broadband in the waterway is approximately 112 dB re 1 µPa (Simard et al. 2010).

7.1.5.2 Sound Associated with Support Vessels

Vessels can be quite significant continuous (although generally moving) noise sources; and individual vessels can have quite distinct spectral signatures which vary with vessel speed and propeller settings.

- The exploration well will be drilled in the Laurentian Channel, a major shipping channel, which is already subject to frequent high level ship noise. Therefore, near the well, on a long term average, the incremental noise level increase from support vessel activity as a fraction of the pre-existing ambient background should be less than if similar operations were conducted in other areas further removed from shipping lanes.
- Figure 7.5 – there is error in the Y axis and legend. The indication of the Y axis is perplexing. From the English version (OB = octave band), one can deduce that these noise levels in third octave. The English legend indicates 1 m, the French 10 km.

7.1.5.3 Biological Effects

This EA generally concludes that few if any serious environmental effects should result from projected acoustic activities. This is not overly surprising since the most extreme acoustic exposures would likely arise from the VSP surveys and these surveys are both much shorter (typically several days vs. several months for exploration surveys) and use lower level air gun sources (10 – 15 dB lower) than exploration seismic surveys. However, levels of impacts will depend also on the period when this activity is conducted, information which was not provided in this assessment.

The following is noted on the biological effects of sound:

The statement, *"The seismic signals are typically in the range of 10 to 200 Hz (Turnpenny and Nedwell 1994)"* is incorrect. This reference is 25 years old. Studies since that time showed that the sounds of airguns are on a broader band (e.g., see Potter et al. 2007).

The EA uses conclusions of Turpenny et al. (1994). These are questioned in the expert review of Popper and Hastings (2009) who note: Turnpenny et al. (1994) examined the behaviour of three species of fish in a pool in response to different sounds, but results are not useable due to lack of calibration of the sound field at different frequencies and depths and many other problems with experimental design. In enclosed chambers that have an interface with air, such as tanks and pools used by Turnpenny et al., the sound field is known to be very complex and will change significantly with frequency and depth (Parvulescu, 1967; Blackstock, 2000; Akamatsu et al., 2002). As a consequence, responses of the animals in the Turnpenny et al. (1994) study cannot be correlated with any aspect of the acoustic signal, and the findings are highly questionable.

“250 to 255 dB re 1 µPa” is incomplete in units – lacking "a ... @1m".

The statement, "The limited studies available suggest that anthropogenic sounds, even from very high intensity sources, might have no effect in some cases …" is incorrect and incomplete. This statement does not match current knowledge. See more references from Hastings, Fay and Popper on the effects of noise on fish.

Lines 1-4 of p.323 are unnecessary. Non-essential text found throughout weighs down the document and makes the message confusing. Moreover, it seems borrowed from other documents (in this case copied verbatim from Slabbekoorn et al., 2010.)

The statement, “There are numerous anecdotal observations of fish under noisy bridges or near noisy vessels indicating that adverse effects are not necessarily overt and obvious, but anecdotal observations are unable to indicate whether fish experience any negative consequences related to the noise (Slabbekoorn et al. 2010).” is an opposite interpretation of the Slabbekoorn et al. 2010 conclusion, and other information that follows (p.325) that show with references to support it the different ways in which anthropogenic noise can significantly affect fish, including: “(1) Noise-dependent fish distributions…(2) Reproductive consequences of noisy conditions…(3) Masking effects on communicative sounds…impact the ability of fish to communicate acoustically or use the acoustic ‘soundscape’ … (4) Masking effects on predator–prey relationships…ability of fish to find prey (get food) or detect the presence of predators…”

The statements, “Available data suggest that they are capable of detecting vibrations but they do not appear to be capable of detecting pressure fluctuations.” and “Crustaceans appear to be most sensitive to sounds of low frequencies (i.e., <10,000 Hz).” require explanation. How does one distinguish the vibrations of pressure fluctuations? These are contradictory. Also, low frequencies are referred to in reference to frequencies up to 10 000 Hz, which is well beyond the usual range of low frequencies.

The statement, “The rate of injury experienced by macroinvertebrates due to the passage of a seismic survey should be less than indicated for planktonic organisms and fish. Lobsters are similar to crab in that they are thought to be resilient to seismic activity because decapods lack the gas-filled voids that would make them sensitive to changes in pressure.” is speculative and must be supported by references or removed. The differences in density and sound velocity of various tissues of crabs and lobsters (hepatopancreas, gonad, muscle, eggs, etc.) do not support this speculation that they are insensitive to pressure changes, however.

The following is noted on the biological effects of sound on marine mammals:

- The developer assumes that *the discontinuous, short duration nature of these pulses is expected to result in limited masking of baleen whale calls.* This is true for short distances. However, periods of silence are reduced as one moves away from the source by the reflection of sound, which increases the potential for masking.

- The text, *"Sound levels decrease with range … Audibility is limited by the sound dropping ... An audiogram is a graph showing hearing thresholds …"* is again unnecessary text. This is already provided in the previous pages, and is repetitive.
- The discussion on 1/3 octave band levels on p.331 is again unnecessary text, borrowed elsewhere, and even confusing because in associated Figure 7.7 is not in 1/3 octave.
- Figure 7.7 and 7.8 – a source is required for these figures.
- The statement (p.333), *"Whistles have a fundamental frequency below 20 to 30 kHz plus higher harmonics…plus higher harmonics."* is inaccurate here; a reference is required and the list of species which have been shown *"…whistling harmonics above 30 kHz "*
- The descriptions (p.333) on various emission pulses are not obviously relevant to this study. Do we use these frequencies? Where this information is presented?
- The statement (p.333), *"Baleen whales communicate using low frequency sounds (generally between 25 Hz…"* is incorrect. This lower limit of 25 Hz excludes the most frequent vocalizations of blue whales and fin whales.
- The EA states (p.334), *"…but the discontinuous, short duration nature of these pulses is expected to result in limited masking of baleen whale calls."* This is incorrect. Several studies have shown that the propagation effects by multipath have the effect of producing multiple replicas of the pulses, thus increasing the risk of masking over long distances. (e.g., Madsen et al. 2006)
- The EA notes that "Several species of baleen whales have been observed to continue calling in the presence of seismic pulses, including bowhead whales (Richardson et al. 1986), blue whales and fin whales (McDonald et al. 1995)." Continuation of vocal activity during seismic surveys does not imply a lack of masking as proponents claim (see previous sentence of the EA). Animals that vocalize likely cannot be heard by their conspecifics due to noise generated by the project activities. Masking of vocalizations during a period where the voice activity is used for functions such as the search for partners for reproduction may have non-negligible effects on individuals and these life history patterns. This can be particularly significant during the fall for large whales, when an increase in social activity has been documented in species such as the blue whale (Doniol-Valcroze et al. 2011).
- The effects of seismic surveys on echolocation are discussed for the odontocetes within the project. However, the more likely issue will arise due to the masking of vocalizations for communication, which are broadcast in some odontocetes such as beluga, at much lower frequencies (between 0. 5−16 kHz) than discussed in the EA (Lesage et al. 1999), and where the beluga's signal components could be obscured by the higher frequencies of seismic pulses.
- The statements (p.335 and 337), *"...masking effects are expected to be negligible for toothed whales."* and *"The sounds produced by seismic air guns are in the frequency range of low hearing sensitivity for toothed whales."* are incorrect. Madsen et al. 2006 shows that the sounds received by the animals reach frequencies of several kHz, audible by odontocetes.
- The EA notes, *"The impact of both natural and man-made noise is less severe when it is intermittent rather than continuous (NRC 2003)*." However, this conclusion is not obviously stated within this reference – therefore it must be qualified within the EA. This assertion is probably true in the context where the intermittent nature of noise is likely better communication during periods of silence between the pulses. However, to conclude that

intermittent noise essentially has less impact on marine mammals is probably not a generality, since a strong impulse noise can have major impacts on an animal rather than a lesser intensity continuous noise.

- Richardson et al. 1995 are cited for *"…limited documented situations…"* This should be updated as it dates back 15 years, and several studies have been conducted since, for many species.
- The statement (p.338) *"In addition, baleen whales have often been seen well within distances where seismic sounds would be audible and yet show no obvious reaction to those sounds (LGL 2005b)…"* is incomplete and requires updated references (e.g., Nieukirk, et al. 2012; Castellote, et al. in press; Yazvenko et al. 2007).
- The EA notes, *"The sound emission associated with the VSP and drilling noise would result in avoidance or temporary displacement, negating any potential positive effect. The Project Area does not represent any known critical habitat for any of the species that may pass through the area... The residual adverse environmental effects are therefore assessed as not significant."* The EA uses the project area as the area of influence. However, in the case of seismic surveys, the area of influence is likely much larger than this. The proponent assumes that avoidance of the area ensonified (by drilling activity, dynamic repositioning jets of the platform, or seismic surveys) for a period up to 2 months (50 days) in the case of the drilling, has no impact on the use of the area as migration or feeding area. It is actually likely that, at certain times of the year as in the fall and in the spring, this area is a migration route for blue whales in particular. The use of this area for feeding by turtles or large whales is presumed low, whereas in fact, recent data indicate it is used as a foraging area by leatherback turtles. More significant effort is needed to document the use of this sector before concluding no impact on whales in particular, since the effort has been almost zero up to this time.
- Considering that low level seismic sounds have been known to affect baleen whales at considerable range – are there periods during which VSP activities should be avoided because vulnerable baleen whales are passing through the area? The EA mentions that endangered North Atlantic right whales and blue whales are sighted in the Gulf but gives few specifics in relation to the well site.

The following is noted on the biological effects of sound on sea turtles:

- Ketten and Bartol (2005) and other more recent references included in the topic of sea turtle hearing would be useful inclusions in this assessment.
- The following statements in the EA are misleading: "Avoidance of the Project Area by sea turtles as a result of sound is also not expected to cause any adverse biological effects given that the area is not known to congregate jellyfish, a primary prey item. Jellyfish are transitory, with distributions changing within and between years, so there is no more reason to expect jellyfish within the Project Area than any other area of the Gulf." Also, "The Project Area offers no unique habitat or feeding areas for sea turtles."
- The area corresponding to EL1105 is part of a broader high-use foraging area for leatherback turtles, as demonstrated through satellite telemetry (see James et al., 2005). As leatherback presence in this area is well documented, spanning multiple years of data collection, etc., there is good evidence that jellyfish *are* concentrated in this areas and that there is a *predictable* concentration of leatherback prey in the Project Area. At this time, it cannot be concluded that the area of EL1105 does not provide unique habitat or feeding areas for leatherbacks.

<u>*7.2 Species at Risk*</u>

- The wording in the EA implies that Schedule 1 of SARA lists *all* species that have been assessed as at risk. However, this is misleading, in that Schedule 1 of SARA includes only listing decisions under the *Species at Risk Act*, a subset of species which have been scientifically assessed as at risk by COSEWIC. Therefore COSEWIC should be the referred to for the full list of species that have been assessed as at risk.

<u>*7.2.2 Effects Assessment*</u>

- The statement (p.343), "As many Project-related activities are limited to the Project Area, they would only interact with species likely to occur in EL1105." is unproven. No simulated noise fields have been performed and it is likely they will extend beyond EL1105. Impacts can also spread beyond the area, for example by pushing organisms outside, modifying, interrupting their migrations, as it is repeated several times that the animals avoid the area because of the noise that will be generated.

<u>*7.2.2.5 Drilling Noise / Vertical Seismic Profiles*</u>

- The EA notes, "Much of the information presented on sound in subsequent sections will be related to seismic sources, as seismic sound sources using a risk management process has the potential to produce the more pronounced responses as it will be the most probable source of the most intense sounds undertaken as part of the exploration drilling activities." Although it is true that the noise associated with seismic surveys has the highest energy output during a pulse, and therefore could generate the greatest responses in marine mammals or turtles, not considering the other the noise generated by the drilling rig and its dynamic positioning thrusters is unjustified. The potential impacts of these two noise sources – operating over longer time frames than seismic profiling (days for the seismic versus months for the platform) – could be as significant for marine mammals as the seismic exposure. The total duration and magnitude of sound energy exposure must be accounted for in the assessment of impacts.
- The EA states, *"It is likely that any behavioural changes in baleen whales, toothed whales, pinnipeds and sea turtles (including species at risk) triggered by a MODU and its support vessels will be temporary. The proposed surveys(s) are of short duration and will occur over a relatively small area within the Project Area boundary. Thus, disturbance from vessel traffic is expected to be low*." It is likely that the effect of the project on the use of the area will be temporary. However, certain activities such as drilling can last two months. If these activities occur during a period of heavy use of the area by certain species at risk, as it is assumed to be in the spring and fall for blue whales, or during August and September for the leatherback turtle, the impact may be more important than alleged. At the same time, there are two types of possible platforms – that attached to the bottom by a cable network presents a greater risk of collision by animals.
- The statement (p.350), *"Under typical ambient sound conditions, low frequency sound from a drilling platform might be detectable no more than 2 km away near a shelf break (Richardson and Malme 1995)."* is incorrect. See previous comments.
- The statement (p.350), "*Overall, the residual adverse effects of Project-related noise from drilling, ships and VSPs is not predicted to result in any significant residual adverse environmental effects."* is unsupported as a conclusion. No noise modeling has been presented, and it is unknown the duration or the production season of this noise.
- The EA states, *"Avoidance of the Project Area by sea turtles as a result of sound is also not expected to cause any adverse biological effects given that the area is not known to*

congregate jellyfish, a primary prey item. *Furthermore, the Project Area is not an area that would be used for nesting or hatching."* To our knowledge there is no study specifically describing aggregations of jellyfish and other jellies in the Gulf of St. Lawrence. This assertion of a lack of accumulation zone of jellyfish in the project area is therefore totally unfounded. Observations of turtles are reported for the area. As the turtles visit the Gulf of St. Lawrence mainly to feed, an inference based on their presence would lead to an opposite conclusion of that presented here, in that this area is used for vital functions. The zone may be vital for the survival of the species even if it does not serve the duties breeding or rearing, in contrast to the conclusions presented.

- The EA states, *"Overall, the residual adverse effects of Project-related noise from drilling, ships and VSPs is not predicted to result in any significant residual adverse environmental effects."* However, there is great uncertainty in the degree of use of the project study area as sampling efforts were very limited. The functions served by these areas to marine mammals and turtles, are likely a vital function for the survival and recovery of populations at risk such as the leatherback turtle and the blue whale. Everything suggests a degree of use of the project area, at least on a seasonal basis, by these species (August-September for the turtles; spring and fall to blue whales). The reaction of the animals to the noise generated by the project activities is unknown. The number of individuals who may be affected, and the duration on which they could be are also. Therefore, one cannot conclude that the effects of this project are negligible with any degree of certainty.
- Table 7.8 and 7.12 – contain inaccuracies. Firstly, in the event that a whale entwines in cables of the platform, the possibility of a permanent non-reversible risk exist. The R rating should be changed to I, the whale species at risk cannot lose individuals. Secondly, a collision implies the possibility of a permanent non-reversible risk. Thirdly, the geographic extent of the noise was not modeled to warrant a 1 rating. Furthermore it is already known that elsewhere it reaches the rays lying in the ranges 2 and 3.

7.2.2.7 Well Abandonment / Suspension

The discussion on well abandonment/suspension is incomplete. No failure of this operation is considered. Recent history in the Gulf of Mexico should pay for caution in estimating risks and implementing appropriate measures.

7.4 Marine Fish, Shellfish and Habitat

7.4.2 Effects Assessment

7.4.2.1 Presence of Platform

- Regarding the statement (p.330), "Several benthic sessile species have a very long generation time (e.g., Corals)." Sea urchins and brittle stars are not sessile.
- There is a lack of references to support recovery in 3-5 years. This is recognizably much longer for corals and sponges.

7.4.2.5 Drilling Noise / Vertical Seismic Profiles

References or examples of are required for *"Most available literature indicates…"*, as well as all other statements of fact contained in this section regarding effects on fish and shellfish.

7.6 Marine Mammals and Sea Turtles

Comments provided for Species at Risk should be taken into consideration as appropriate here.

7.6.2.5 Drilling Noise / Vertical Seismic Profiles

- The statements, "A broadband received sound pressure level of 160 dB re 1 µPa (rms) or greater is currently the best estimate available to indicate potential concern for disruption of marine mammals behavioural patterns (NMFS 2000), however, noise levels below 160 dB re 1 µPa have also been known to elicit behavioural disturbances in marine mammals (NRC 2003)." *and* "The spatial extent of any such avoidance behaviour by most common species in the area (i.e., humpback and minke whales) can be expected to be 0.5 to 1 km." *are erroneous. Also the second part of the sentence contradicts the first. The current consensus among experts is that the approach dose / response (i.e., levels, duration) is not sufficient to assess the impacts of noise on animals. Several more recent references than those mentioned report it eloquently*. *No data was presented to demonstrate this statement, both for the presence of dominant species and for the reaction radius.*
- The statement, "The Project Area offers no unique habitat or feeding areas for marine mammals. Similar alternate sites are available in the immediate area, so the fitness of any species of marine mammals will not be affected. The residual environmental effects on marine mammals are therefore predicted to be not significant." is incomplete. This ignores completely the strategic importance of the site for migrating animals to feeding sites further upstream in the Gulf, and the risk of disruption of migration and access to sites.

7.6.3 Mitigation

- The measures to be put in place to limit the effects of the project on marine mammals and turtles are not described in enough detail to assess their effectiveness. For example, the proponent proposes the use of an experienced observer, but does not describe the Protocol to be followed or the place where this observer will be positioned (drilling rig, boat escort, helicopter), if it will be dedicated and what instruments will be used to detect the animals. As operations move to longer term, the efficiency of a single observer is limited, and effects may occur at distances not observable from the platform sourcing the effects (e.g., noise), it is preferable to consider the use of more than one observer. Also, a complete protocol from the detection to action mitigation (e.g., stop work) is required.
- The EA does not mention the protocol for times when conditions do not permit observations for the detection of turtles and marine mammals (night, bad weather, fog). Therefore, the effectiveness of mitigation measures cannot be evaluated based on the information provided.
- Given the importance of the effects that could result from this project, mitigation of the effects and monitoring measures should be presented explicitly in the document.
- It should be noted that while leatherbacks must surface to breathe, short of the rare occasion when there is an almost flat sea state, they are difficult to spot from the vantage of a vessel or fixed platform. Therefore any reliance on marine mammal observers to mitigate impacts on turtles and account for their presence/absence in an area is questionable.

7.7 Sensitive Areas

7.7.2 Effects Assessment

The EA evaluates the activities of the project which can interact with previously identified sensitive areas (see map 5.57). It argues that the five sensitive areas that overlap the study area will not interact with the day-to-day activities of the project and that many project activities and their potential influence zones are located in the project area. However, it seems unlikely that the scale of activities proposed would not impact surrounding sensitive areas – this includes the Area of Interest for a Marine Protected Area around Îles-de-la-Madeleine, as well as EBSAS 4 and 10, whose boundaries are approximate.

Notably, the environmental effects associated with the disposal of muds and drill cuttings and waste disposal and wastewater can impact on benthic animals (epibenthos and endobenthos). In the EA it is argued that this fauna is poorly diversified. However, the supporting data used to reach that conclusion are insufficient.

The EA identified and assessed potential environmental effects of the Project activities mainly on redfish mating area, but omitted consideration of other fish and marine mammals for which the EBSAs (individual components of) and other sensitive areas were identified (from section 5.7). The report should also comment on those species, identifying whether the effects assessment for these was considered elsewhere in the document if this was the case.

7.7.2.1 Presence of Platform

- EL1105 is included in an area important for marine mammals. However, EA did not mention any potential effect of the presence of platform on marine mammals (e.g., noise, collision). At least, the report should indicate a link to sections where is discussed.

7.7.2.2 Drill Muds and Cuttings

- The EA states that "…the effects of SBM discharges are limited to benthic organisms…" and "The residual environmental effects are predicted to be not significant…" for fish species. However, the region of interest is one of the rare significant areas for soft corals. The report overlooked the effects on these benthic invertebrates.
- Only the potential interactions / environmental effects on fish were considered in this section. The effects on marine mammals and benthic invertebrates should be included.

8.0 ACCIDENTAL EVENTS

Although statistically "unlikely", given the large number of wells drilled to date (some 30,000 in the Gulf of Mexico alone) without major mishap – the Maconda spill being an exception – a large oil spill from either ship traffic or well release in the Gulf could have environmental and fisheries impacts greater than spills in more open-sea areas.

8.7 Environmental Effects Assessment

- It is agreed there are low residual effects considering that a single well will be drilled, that drilling is limited in time (less than 2 months) and that the probability of an accidental event are low.
- No risk of failure of closure of the well is considered. Recent event in the Gulf of Mexico and elsewhere should pay for caution in estimating risks and implementing appropriate measures to minimize them.

8.7.1 Species at Risk

8.7.1.1 Marine Fish Species at Risk

- First bullet, also second paragraph – the text states that pelagic and benthic fish have low exposure risk because they are highly mobile and able to avoid oiled areas. Larval and early juvenile fish are less mobile than older fish and so may be at greater risk. American eels at the glass eel stage migrate through the EL1105 area. This migration includes glass eels headed towards the ince of Ontario. Glass eels may not be able to avoid oiled areas because they cannot swim as rapidly as older eels.

- There is no mention in this section about the potential impact of spilled oil drifting towards adjacent areas where marine fish species at risk are found in high densities. For example, residual surface and deep water currents in the project and adjacent areas tend to move from east to west around the southwest and west coasts of Newfoundland (Figs. 4.6-4.7, 4.9-4.11) where high concentrations of juvenile and/or adult fish occur (e.g., Figs. 5.5 through 5.10).
- The EA states (p.402) *"…Perhaps the species of greatest concern would be redfish as the Project Area overlaps a potential redfish mating area. Redfish typically mate in the fall; however, eggs are hatched within the female and are not extruded until the following April to July (Section 5.2.1.7). An oil spill would not affect redfish larvae, as the potential larvae extrusion area is outside (to the north, in the Cabot Strait) of the Study Area (Figure 5.56)."* However, this paragraph suggests the project area overlaps a potential redfish mating area, then goes on to suggest a potential larval extrusion area is outside the Study area. Is this speculation or is there a publication to reference for these claims? It is also possible that the project area is also a potential larval extrusion area.

8.7.1.3 Marine Mammal Species at Risk

- Sea turtles should be specifically referenced in the caption if there is discussion of them in the corresponding text, as they are not marine mammals.

8.7.5 Marine Mammals and Sea Turtles

- There is ample evidence following the recent well blow-out in the Gulf of Mexico (Deepwater Horizon) that hydrocarbon spills can be debilitating and lethal for sea turtles. Suggest including technical reports from NOAA, other sources here, as the impact is not negligible and should be recognized within the assessment.

8.7.6 Sensitive Areas

- This section presented only potential effects on fish species. The report should also describe the effects to marine mammal and invertebrate species habitat in the Project Area since the study region is also within a marine mammal feeding area and a significant area for soft corals and certain deep water shrimp (see comments on 5.7.1).

9.0 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

9.5 Marine Mammals and Sea Turtles

- The sponsor indicated that seismic surveys West of Newfoundland could occur during the period of the Old Harry deposit exploratory drilling project. However, the location of the areas where seismic surveys will occur is not provided. Therefore, it is not possible to evaluate the proximity of these sites to the project, or the probability of use of these areas by various species of marine mammals and turtles. As a result, it is not possible to assess the cumulative effect of seismic potential in these various sites and to validate or invalidate the findings of the proponent on nullity of the anticipated effects. Moreover, cumulative effects are not only measured on the basis of their simultaneous realization; projects in succession in areas frequented by a given species can also lead to cumulative effects, since they have the potential to reduce the quality of the habitat on a time scale that related to a single project. Therefore, the analysis of cumulative effects, as presented, is incomplete and does not support the findings of cumulative effects.

- The statement (p.416), *“Richardson et al. (1995) predicted a radius response to noise during development and production activities for baleen and ondontocetes to be less than 100 m.”* is erroneous and requires correction. This general source, which contains several hundred pages should not be cited. The authors did not predict a "radious response." The effects of changing the behavior of animals can spread over very large distances (e.g., Risch et al. (2012).
- Regarding the statement (p.416), *“Limited data suggest that vessels speeds below 26 km/hr (14 knots) may be beneficial in reducing marine mammal vessel collisions (Laist et al. 2001).”* See also: Vanderlaan et al. (2008); and Vanderlaan and Taggart (2007).

9.6 SENSITIVE AREAS

This section presented only potential effects on fish species. The report should also describe the effects to marine mammal and invertebrate species habitat in the Project Area since the study region is also within a marine mammal feeding area and a significant area for soft corals and certain deep water shrimp (see comments on 5.7.1).

10.0 RESIDUAL ADVERSE ENVIRONMENTAL EFFECTS SUMMARY

- Whereas noise is considerably higher associated with the use of a dynamic repositioning platform rather than one that is anchored, the use of the latter type of platform should be privileged to mitigate the potential impacts of the project.
- Considering an accidental event (Surface or subsea oil spill) it is noted that “…significant environmental effects are predict to occur for marine birds (both at risk and not at risk species).” The conclusion that a spill would significantly affect only birds is very doubtful. Why it would not affect other marine organisms, including endangered species? Ranking "NS / 3" (not significant / high confidence) for any of the other VECs besides marine birds in this context is unjustified. Given the events around the world, this assessment of negligible effects with high confidence is not credible.

Review of Modeling in Support of Corridor Resources Old Harry Exploratory Drilling Environmental Assessment

General comments

In general, the scenarios in this document were not clearly described. The subsurface transport of dispersed oil (majority of the total oil) was not sufficiently modeled. The model only considered the re-entrained oil from surface in a 30m layer and did not consider the dispersion into water column during the rise of oil while oil was released from 470m. Overall, the results were not clearly presented.

Notably, the document did not take the expertise gained from the oil spill in the Gulf of Mexico into consideration for the Gulf of St. Lawrence which shares a good deal of similarities. We do not have the specific oil category that is to be extracted in the Gulf of St. Lawrence. However, the indications show that we expect it to be on the lighter side of the crude, close to the category of the one in the Gulf of Mexico. In short, the nature of the crude and the physical setting of both areas, a semi-enclosed sea, make it appropriate to use the expertise gained in the Gulf of Mexico to project the potential risks in the Gulf of St. Lawrence. As such, it is recommended to project the potential risks in the Gulf of St. Lawrence using the results of the oil spill in the Gulf of Mexico.

2. OIL SPILL SCENARIOS AND MODELING INPUTS

Regarding the trajectories of the oil spill, the trajectories presented in the document are unrealistic and do not serve the purpose. They should be redone with realistic winds and surface currents.

The model used to generate the surface current fields (Tang et al. 2008) is a good one. However, the oil-spill trajectories are calculated using seasonal mean surface water velocities (2.3.3 Water Currents on page 16). This choice of currents is completely unrealistic. There is no tides, no wind induced currents, and no influence of the surface outflow from fresh water runoff. The latter part is surprising given that the seasonal mean surface currents were used. Since in a typical oil spill, all of these components are present, the trajectories should be calculated with the hourly outputs of the model driven with realistic winds from Meteorological Service of Canada outputs.

Within this section, the blow out from the surface is illustrated. However, the blowout from the bottom is not illustrated. The Gulf of Mexico spill where did not behave as text book. The blow out was not at the surface, it was from the bottom. Some of the oil spill did not reach the surface. A good part of it stayed near the bottom. There is a need to see where that oil would go using the hourly bottom currents of the ocean model. The document should therefore track the oil spills using near bottom currents.

<u>2.1.2 Subsea Blowouts</u>

The name of the model for this study is given here, but a description of the formulation, capability, and limitation of the model is not provided. It is unclear if the processed described in section 2.1.2 have been fully or partially included in SLROSM. Justifications need to be provided on why this model (SLROSM) was used instead of other models (published and probably more advanced models, such as DeepBlow by SINTEF, OILMAPDEEP by ASA, or CDOG by Clarkson University). It is important to demonstrate that the selected model is technically sound for the proposed modeling work.

Figure 3 – the illustration of vertical profile is inaccurate. With the presence of currents, the plume will be deflected rather than straight upwards.

<u>2.3.2 Discharge Volumes and Flow Rates 15</u>

Blowout scenarios were not clearly described in this section or in Table 3. Only the flowrate was provided but did not state the blowout period (10 days, or 3 months, etc.). Such information is key to the extent of oil covered area.

<u>2.3.3 Water Currents</u>

- It was stated that surface water current was used in the modeling. However, the surface only case is fine for the surface spill scenarios, but it is insufficient in the modeling subsurface blowout. Although the 470m depth was classified as shallow in terms of hydrate formation but it is depth enough that the subsurface current can play an important role to deflect and affect the plume behaviors. The deep/subsurface currents are particularly important for the study of dispersed oil transport process in the water column. The deep current is important considering the drill site is in a channel.

3. MODELING RESULTS

The duration of the trajectories presented in the document is unrealistic. The choice to stop the trajectories at a given level of ppm concentration is not documented. It is implied that all oil spills will be dispersed and absorbed in the environment at that level. In fact, a greater spill would make the oil go further and eventually reach a coastline. The document did not consider this issue which is a serious flaw.

It is recommended to use the results from the ocean model under the proper conditions and ensure that the duration is long enough to show the coastline potentially at risk.

3.1 Batch Diesel Spill Fate Modeling

- The modeling was conducted in average wind conditions, how about under worst case scenarios without wind? This scenario is missing.
- It is stated that "The subsurface oil also diffuses laterally as it is moved away from the spill site by the prevailing surface water currents". Again, this is very confusing that subsurface oil is dispersed by surface current.
- It is stated that "It has been assumed that the oil will mix in the upper 30 m of water as this is the minimum surface water mixing depth reported in the literature for the region (Drinkwater & Gilbert 2004)". Why assume the mixing depth while there are models available to simulate the 3D (including vertical) transport behaviors? This simplification (30m mixing) may cause overestimates of concentration in some areas and underestimations in other areas.

3.2 Subsea Blowout Fate and Behaviour Modeling

Without knowing the blowout period, it is difficult to interpret the results. It was stated that between 16 and 29% will evaporate and remainder will disperse, but the associated time step was not given as the mass balance will continue to change with continuous blowout (maybe month long). Therefore the result in Table 7 only represent the condition at a given time point but the evolution with time is missing here. Furthermore, very little has been presented here about the fate of dispersed oil (84 to 71% of total oil, majority), including the vertical distribution. A contour plot of horizontal and vertical area should be provided, as should the depths where 0.1 ppm concentrations are found. Also, without the using of deep currents, the distances in Table 7 are questionable as the deflection of plumes was not considered. The bathymetry around the site is not provided, which may also affect the behaviors of dispersed oil, but there is no discussion on this subject.

- One important factor that affects the fate of dispersed oil is the droplet size distribution. What distribution was used and how was it calculated?

3.3 Surface Blowout Fate and Behaviour Modeling

In referring to "*throughout the blowout period*"? How long is the period? This is not provided anywhere in this section. Section (4) provides this information for surface oil trajectory, but it was stated there that "This does not represent a scenario that would actually occur in a continuous blowout situation but rather provides a reasonable worst-case assessment of spill behaviour", it is unclear if this "every 6-hour batch for a month" release case used in section 4 was also used in section 3.

4. SURFACE OIL SLICK TRAJECTORIES

4.2 Typical Monthly Surface Oil Slick Trajectories

The document states, "Each one of these six-hour quantities of oil has been tracked until the surface oil is completely evaporated and dispersed from the surface." However, have the emulsification process been modeled? Although this may not be important in summer conditions, it cannot be neglected in winter conditions as a fraction of emulsion may stay on surface much long and transport far beyond the modeled 3-4 km radii (Fig 5).

5. DISPERSED OIL PLUME TRAJECTORIES

5.1 Introduction

The title is “dispersed oil plume trajectories”, however, this section only covers the re-entrained oil from above surface release as mentioned in page 33 “In these simulations, the quantity of oil that would be released from six hours of a continuous above sea blowout has been introduced on the surface at the exploration site as a batch spill every six hours over month-long periods” The behaviour of near bottom release and mass in water column will be entirely different and not covered here.

5.2 Typical Monthly Dispersed Oil Plume Trajectories

The document states, *“The initial movement of the dispersed oil plume is assumed to be due to* a combination of winds and surface water currents. The prevailing surface water currents alone are assumed to drive the dispersed oil plume once the surface slick is depleted.” As discussed before, once the oil is entrained into water column, surface current should not be used, as the high amplitude of surface current may cause over flushing/dilution and underestimate oil concentration.

Conclusions

It should be noted in these conclusions that the results of this specific review were reliant upon the availability of expertise within the DFO Regions during the requested timeframe for document review. Given the deadline to provide review in the assessment was short, not all subject matter experts may have been available to provide input to either the initial review of the documentation or to the subsequent review of the draft document. An overview of the key Science comments, that is those outside of those provided on specific inaccuracies, omissions, or recommendations, are as follows:

- Overall, the quality of scientific content presented in the environmental assessment (EA) varies across the sections. While the potential environmental impacts of exploratory drilling regarding drilling fluids and cuttings is well-covered and conclusions are in line with many reviews and individual studies dealing with the effects, much of the preceding content relating to Valued Ecosystem Components (VECs) is uneven. Substantial inaccuracies and omissions noted here can threaten the ability to properly assess potential effects, depending on scale.
- The environmental assessment does not provide a clear scope of work to be undertaken during the project, essential to a proper assessment of potential effects on the ecosystem and its components. While the duration of the work is identified, the season of activity is not.
- An effects assessment requires a thorough understanding of the biological and physical setting. Given inaccuracies or omissions in many of the discussions provided on VECs, the revised content contained there within should be reconsidered in the context of the assessment of potential effects. For example, changes in the relative prevalence of benthos, fish and mammals in the study area (e.g., corals, several shark and fish species, and several marine mammals), species mating activities identified within the study area (e.g., porbeagle shark, Greenland halibut, etc.), individual components of nearby sensitive areas, etc.
- Recognizing that a seismic effects evaluation must be presented in context of other sources of noise in the area, modeling for noise sources is lacking in the assessment.

- In general, modeling pertaining to assessing the behavior and trajectory of oil spills that might occur during exploration drilling activities requires significant reconsideration of many of the inputs (e.g., currents, winds, tides, outflows, timing, etc.), as well as the models in some cases. Scenarios were also often not clearly described (e.g., for blowouts), and overall, modeling results are not clearly presented. Information gained from the The Gulf of Mexico spill should also be considered for informing this exercise.
- The declaration that "*The environmental assessment indicates that no significant residual adverse environmental effects, including cumulative environmental effects, will occur as a result of the Project*" is not supported when taking into consideration uncertainties and potential unplanned events (e.g., spills and blowouts beyond the geographic scope identified) and the important information gaps in the report. As such, the conclusion should be reassessed once the information gaps are filled.
- The environmental assessment should undergo appropriate and specialized quality control of content for translation, relevancy, agreement between text and figures and tables, and the appropriate use of up-to-date information and references. Future assessments produced for the same Project should be cognizant of the same.

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Appendix 1

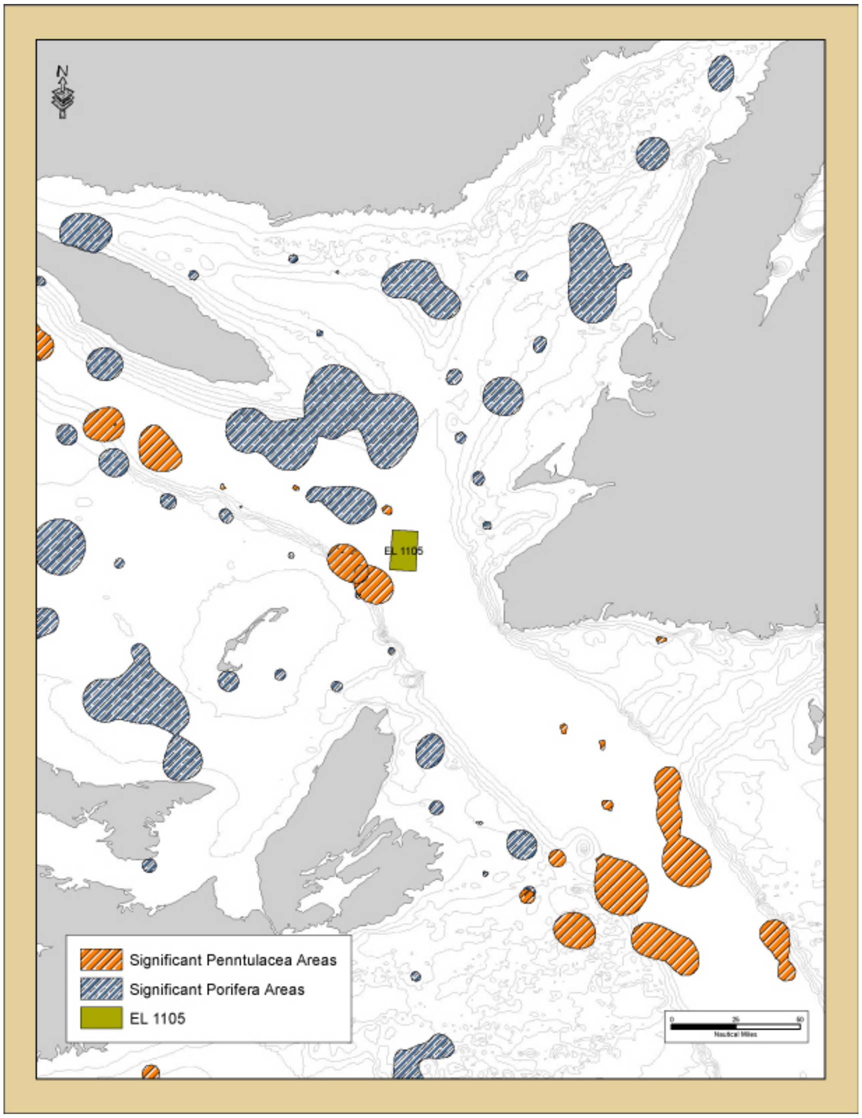

Figure 1. Summarizing most recent data on deep-sea coral and sponge in the Gulf of St. Lawrence. Figure compiled by Cam Lirette, data from Kenchington et al. 2010.

Appendix 2

Table 2. List of sections for DFO Science review within "Environmental Assessment of the Old Harry Prospect Exploration Drilling Program"

Section/ subsection	*Topic*
2.12	*Project-specific Model Inputs and Results*
4.0	*Physical Environment*
5.2.1	*Marine Fish Species at Risk*
5.2.3	*Marine Mammals Species at Risk*
5.2.4	*Sea Turtles*
5.3	*Marine Ecosystem*
5.4	*Marine Fish and Fish Habitat*
5.6	*Marine Mammals and Sea Turtles*
5.7	*Sensitive Areas*
5.8	*Commercial Fisheries and Other users*
6.0	*Environmental Effects Assessment Methods*
7.2	*Species at Risk*
7.3	*Marine Ecosystems*
7.4	*Marine Fish, Shellfish and Habitat*
7.6	*Marine Mammals and Sea Turtles*
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