April 28, 2014

Ref: 10-L-0034-14

Ms. Elizabeth Young
Environmental Assessment Officer
Canada-Newfoundland and Labrador Offshore Petroleum Board
5th floor, TD Place, 140 Water Street
St. John's, NL A1S 6H6

RE: Corridor Resources Inc. – Addendum to the 2013 EA Report for the Old Harry Prospect Exploration Drilling Program

Dear Ms. Young,

Corridor Resources Inc. (Corridor) is proposing to conduct one exploration well on the Old Harry prospect in the Gulf of St. Lawrence, within Exploration Licence (EL) 1105 (refer to Attachment 1 for a map and geographic coordinates). In December 2011, Corridor submitted an environmental assessment (EA) and supporting documents (Drilling Mud and Cuttings Report, Oil Spill Modelling Report) to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) for regulatory and public review to fulfill screening-level EA requirements under the *Canadian Environmental Assessment Act* (CEAA) and EA requirements for an authorization under the *Canada-Newfoundland Atlantic Accord Implementation Act* and *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (the Accord Acts).

Since this 2011 EA filing, there have been various regulatory and public comments to which Corridor has responded. These comments and response documents (including French translations) are posted on the Project-based EA Registry maintained by the C-NLOPB (http://www.cnlopb.nl.ca/environment/corridorresinc.shtm). In response to review and discussion of Environment Canada's comments on the oil spill modeling conducted for the Old Harry Project, Corridor, in consultation with the C-NLOPB, contracted RPS ASA to perform an independent assessment of the persistence of instantaneous spills of Cohasset crude and diesel fuel. The RPS ASA Report, along with a commentary from SL Ross, was submitted to the C-NLOPB in September 2012. A revised EA Report (dated February 13, 2013) was submitted by Corridor to the C-NLOPB in April 2013 to address comments received on the 2011 EA Report.

Following the revised EA submission in April 2013, there have been additional review comments from regulators (e.g., Environment Canada, Fisheries and Oceans Canada (DFO), and C-NLOPB) as well as special interest groups. These comments and responses are posted on the C-NLOPB EA Registry. As requested by the C-NLOPB, Corridor has consolidated all of these review comments and responses since April 2013, as well as the RPS ASA Report into an Addendum to the 2013 EA.

Specifically, this Addendum compiles the following documents:

- Comments on ASA and SL Ross Modeling Results by SL Ross (September 17, 2012)
- Corridor Response to Environment Canada Comments – Comparison of Differences in Old Harry Oil Spill Fate Modelling Conducted by Applied Science Associates, SL Ross Environmental Research and Environment Canada (April 12, 2013)
- Corridor Responses to Environment Canada and DFO Comments Received on August 20, 2013 from the C-NLOPB (September 11, 2013)
- Corridor Response to Ecojustice Comments (November 29, 2013)

This Addendum, along with the revised EA Report (dated February 2013) constitute the most up-to-date information on the Project to fulfill EA requirements under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and EA requirements as part of an application to drill an offshore exploration well with the C-NLOPB.

If you have any questions or require any further clarifications, please contact me at (902) 406-8007.

Sincerely Yours,

[redacted]

[redacted] Chief Geophysicist
Corridor Resources Inc.

Attachments

ATTACHMENT 1

Figure 1 Location of the Project Area and Study Area and GCS Coordinates

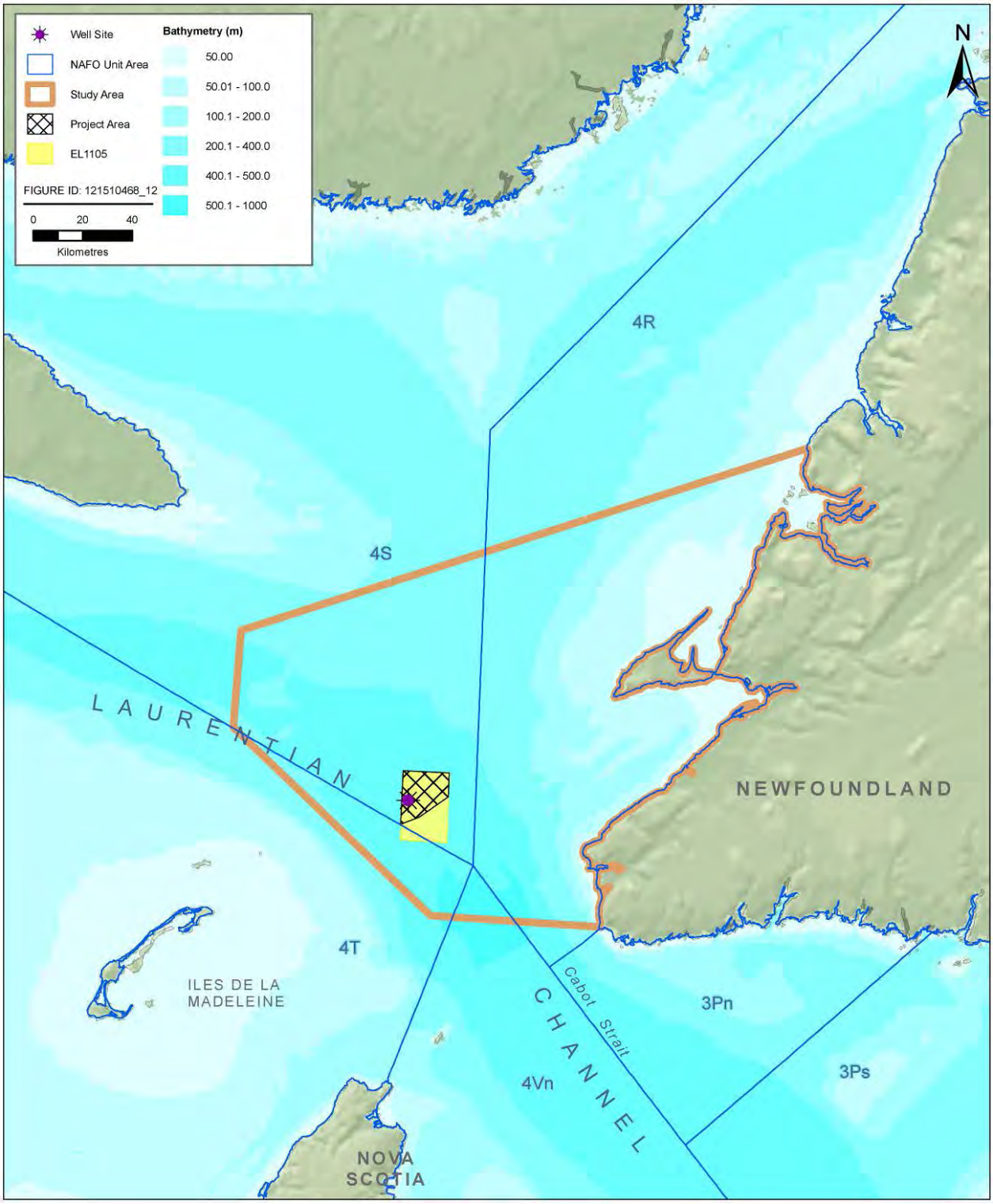

Figure 1 Location of Project Area and Study Area

The coordinates (NAD 83) outlining the boundaries for the Project Area are as follows:

Latitude DMS	**Longitude DMS**
48° 9' 59.740" N	-60° 23' 56.094" W
48°10' 0.084" N	-60° 8' 57.480" W
48° 4' 45.681" N	-60° 8' 57.515" W
47° 59' 11.547" N	-60° 18’ 15.914” W
47° 58' 22.285" N	-60° 23' 55.732" W

The coordinates outlining the boundaries for the Study Area are as follows:

Latitude DMS	**Longitude DMS**
48° 38' 43.08" N	-61 ° 19' 1.56" W
48° 17' 34.44" N	-61 ° 19' 51.24" W
47° 38' 47.76" N	-60° 13' 1.92" W
47° 37' 35.76" N	-59° 18' 36.72" W
49° 22' 43.32" N	-58° 14' 18.24" W

ATTACHMENT 2

RPS ASA Model Simulations Results and Commentary by SL Ross (September 2012)

September 21, 2012 Ref: 10-L-0083-12

Mr. David Burley
Manager, Environmental Affairs
Canada-Newfoundland and Labrador Offshore Petroleum Board
TD Place 5th Floor
140 Water Street
St. John's NL A1C 6H6

Dear Mr. Burley:

Re: Oil Spill Modeling Update

This letter is in follow-up to our discussions with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Environment Canada (EC) on the discrepancy between the oil spill modeling conducted by SL Ross for Corridor Resources' Old Harry project and the modeling conducted by Merv Fingas for Environment Canada. There was still discrepancy after review and discussion of the EC documents titled "Modeling of Possible Spills from the Old Harry Drilling Site, Newfoundland and Labrador, Environment Canada, March 2012" and "Comments on Issues Related to the Old Harry Modeling Scenarios for Environment Canada Staff, Merv Fingas, July 2012" and the associated teleconferences. Therefore Corridor, in consultation with the C-NLOPB, contracted RPS ASA, the creator of the OILMAP model used by EC, to perform an independent assessment of the persistence of the Cohasset hydrocarbon product and diesel.

I have appended to this letter the RPS ASA Report as well as a short commentary from SL Ross on the ASA Report. Together, these reports assist in describing the reasons for the discrepancies between the SL Ross and EC modeling work. Basically, the existing ADIOS database for the Cohasset hydrocarbon was incomplete and corrupted in the OILMAP model used by EC, which skewed their modeling results toward greater persistence of the Cohasset product in the marine environment. The difference in diesel persistence is due to the use of different types of diesel with differing properties. The flaws in the ADIOS database for Cohasset have been acknowledged by ASA, and help explain the results of the EC modeling work. We would anticipate that EC might wish to revise its comments on the Old Harry Environmental Assessment in light of these facts.

Based on this information, Corridor's position remains that SL Ross's modeling work represents the persistence and fate of the Cohasset hydrocarbon product and diesel and it is an appropriate basis for the environmental effects assessment of the Old Harry project.

If you need any additional information or clarification, please let me know. We are available to meet to discuss the reports at your convenience.

Yours truly,

[redacted]

Dena Murphy, QHSE Manager
Corridor Resources Inc.

cc. Elizabeth Young, Environmental Assessment Officer, C-NLOPB
Darren Hicks, Environmental Analyst, C-NLOPB

Enclosures

Comments on ASA and SL Ross Modelling Results

Prepared for:

Corridor Resources Inc.

By

SL Ross Environmental Research Ltd.

September 17, 2012

Comments on ASA and SL Ross Modeling Results

Batch spills of Cohasset crude and automotive diesel were modelled by ASA using Oilmap and by SL Ross using their in-house spill model (SLROSM) for comparison of outputs. The modelling by ASA was commissioned to provide independent results from the Oilmap product to verify the results prepared by Environment Canada that appeared to contain questionable natural dispersion predictions. Ten thousand litre instantaneous releases of Cohasset and 1,000 L instantaneous releases of diesel were modelled to provide predictions for comparison purposes. The Cohasset dataset identified by ASA as the one developed using Environment Canada data used the identical base Environment Canada oil property data as used in the SL Ross Cohasset dataset. This discussion focuses on the ASA results using the Environment Canada dataset (as opposed to the ADIOS sourced Cohasset data) as we feel this is the best data available and provides consistency between the two modeling efforts. (Note the discussion in the ASA report regarding the problems with the corrupted ADIOS Cohasset dataset.) The diesel oil data files used by the two models were not identical as slightly different diesel data sets in Oilmap and SLROSM were used in the two cases.

The SL Ross and ASA models use the same evaporation algorithms. The primary difference in the model's results for the Cohasset scenarios is due to the use of different dispersion algorithms by the two models. Oilmap uses the Delvigne algorithms and SL ROSM uses Audunson's.

The Audunson method used in SLROSM results in a more rapid dispersion with the loss of the Cohasset surface oil occurring in less than 2 hours under all wind conditions (from 10 to 20 knots). Due to this rapid dispersion the time available for the Cohasset oil to evaporate is limited so only 20 to 25% evaporates in the SL Ross model for the Cohasset scenarios.

The Delvigne dispersion method used in Oilmap results in loss of the Cohassett crude from the surface in less than about 24 hours for winds of 12 knots, 10.5 hours in 15 knot winds and about 5 hours in 20 knot winds. Approximately half of the surface oil was lost to evaporation and half to natural dispersion under these wind speeds. At 10 knots the Delvigne method resulted in surface oil persisting for up to about 5 days. We feel that this persistence is excessive since breaking waves still will be prevalent at these wind speeds. The Beaufort Scale indicates that wave crests will be breaking and scattered white horses will exist in winds from 7 to 10 knots. The Delvigne method assumes that no breaking waves occur at wind speeds below 5 m/s or 9.7 knots. As a result, the algorithm used by ASA for natural dispersion (Delvigne's) severely limits natural dispersion at wind speeds of 10 knots since this is very close to the 9.7 knot 'cutoff' for dispersion.

The estimated persistence of the Cohasset crude by the two models (Oilmap and SLROSM) is not too different from an offshore spill response and impact perspective, with the exception of the 10 knot wind speed results. The 5 day Oilmap predicted persistence in 10 knot winds is not

realistic based on the 1984 Uniacke spill experience off Nova Scotia which involved oil very similar to Cohasset crude. No surface oil was observed during over flights the day after the Uniacke blowout was capped indicating that the oil persisted for less than 24 hours in this actual spill. (Martec Limited, 1984. Report on the Environmental Program associated with the blowout at Shell et al. Uniacke G-72 to Shell Canada Resources Limited). The winds from the time the blowout was killed (17:00 hrs on March 3rd) to the time of the over flight (12:00 hrs on March 4th) averaged about 15 km/hr or 8 knots (based on Sable Island wind station data).

The SL Ross results for the 1000L diesel spill show longer persistence than the Oilmap results for winds greater than 12 knots (SLROSM persistence of 12 to 24 hours versus 3 to 12 hours for Oilmap). These differences are likely primarily due to the different diesel data sets used in the modeling with the SLROSM diesel being slightly more persistent. The Oilmap surface oil persistence for diesel, in 10 knot winds, is higher than SLROSM due to differences in dispersion algorithms previously discussed.

Comparison of Previous Environment Canada Modelling Results to ASA Oilmap and SLROSM Modelling Results

The following table provides a brief summary of the on-water persistence predictions by Environment Canada, ASA and SL Ross for comparison. The Environment Canada results show a much higher persistence for the diesel and Cohasset crude than both the independent ASA results, that used the same oil spill model, and the SL Ross results. It is apparent that the Environment Canada modelling used an oil dataset that was in some way corrupted or incomplete based on the assessment presented by ASA.

Spill	Env. Can. OilMap 6.7.1	ASA OilMap 6.7.4		SLROSM	
		(at 10 knots)	(at 12 knots)	(at 10 knots)	(at 12 knots)
1000 L diesel	From Summary Table 30% remaining after 10 days	Less than 1% remaining after 5 days (ASA Figure 8)	Less than 1% remaining after 12 hrs (ASA Figure 8)	No surface oil after 38 hrs	No surface oil after 28 hrs
10,000 L Cohasset	From Summary Table 41% remaining after 10 days	Less than 1% remaining after 5 days (ASA Figure 6)	Less than 1% remaining after 24 hrs (ASA Figure 6)	No surface oil after 1.9 hrs	No surface oil after 1.5 hrs

FINAL REPORT

Results from Model Simulations of Cohasset Crude

PREPARED FOR:

Dena Murphy
Corridor Resources Inc.

AUTHOR:

Chris Galagan

DATE SUBMITTED

20 September, 2012

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Introduction

The OILMAP model system was used to simulate instantaneous spills of Cohasset Crude and diesel fuel under constant wind conditions. The goal of the simulations was to compare the oil mass balance for surface, evaporated and entrained oil between two different specifications of Cohasset Crude and one diesel product. Oil mass balance information is presented from each model simulation. OILMAP version 6.7.4 was used for all model simulations.

Scenario Matrix

A total of 16 spill scenarios were simulated as defined in Table 1. Wind was held constant at the indicated speed for the entire 30 day simulation. All spills were modeled as instantaneous releases on the water surface.

Table 1. Spill scenarios.

Oil Type	Spill Volume (liters)	Wind Speeds (knots)	Water Temperature (°C)
Cohasset crude using Adios oil database (unmodified)	10,000	10, 12,15, 20	10
Cohasset crude using Adios oil database (modified for zero emulsification)	10,000	10, 12,15, 20	10
Cohasset crude using Environment Canada data (provided to ASA by SL Ross)	10,000	10, 12,15, 20	10
Diesel (automotive grade)	1,000	10, 12,15, 20	10

Oils Used in the Simulations

Table 2 lists the main oil properties for each product modeled. There are important differences between the two Cohasset oils used in the modeling. As noted in Table 2, the viscosity is different, particularly at 15°C. The other differences are that maximum water content and distillation data are not present for the Adios Cohasset. These differences have significance for how the model calculates entrainment and evaporation which are discussed more fully in the following sections. A complete listing of oil parameters used in the model simulations is provided in the Appendix.

Table 2. Cohasset crude properties for fresh oil.

Oil	Density of fresh oil (g/cm^3)	Dynamic Viscosity of fresh oil (cP)	Interfacial Tension (dyne/cm) {oil-seawater}	Maximum Water Content
Cohasset Crude (E.C.)	0.8002 @ 0° C 0.7900 @ 15° C	2.23 @ 0° C 1.63 @ 15° C	15.3	0
Cohasset Crude (Adios)	0.8002 @ 0° C 0.7900 @ 15° C	2.401 @ 0° C 2.370 @ 15° C	15.3	Not defined
Diesel	0.8310 @ 15° C	2.76 @ 15° C	27.5	0

The Adios Oil Database

The Adios database contains specifications for a large number of oils but many of the data fields contain no values. When data are missing from the database, both the Adios model and the OILMAP model utilize default values or calculations based on proxy oils that can have significant effects on the fate of the oil. In the simulations performed here we address the implications of the oil parameters that are missing from the Cohasset Crude specification in the Adios database. There is also the possibility that the Adios database file used by OILMAP can become corrupted in which case the model reads the oil specification from the database incorrectly and generates invalid oil mass balance results.

Corrupt Database File

During the course of modeling the Cohasset spills it was determined that a corrupt version of the Adios oil database was being used and that mass balance results, particularly for entrainment, were erroneous. When the spills of the Cohasset crude were simulated using the corrupted Adios database, the OILMAP model used incorrect oil parameters which affected the results. When the corrupt database was replaced with an uncorrupted version the oil mass balance results looked more reasonable and the comparison with the results using the Environment Canada Cohasset specification was better.

Missing Data

Some important parameters are missing from the Adios specification of Cohasset Crude oil that affects the oil mass balance predicted by OILMAP. The first is the distillation data used by OILMAP to calculate oil evaporation. The method used by OILMAP for calculating the distillation data and how the model deals with missing oil data are described below. The second important piece of information missing from Adios is the maximum water content of the oil which is used to calculate emulsification. The method used by the model to deal with this missing information is also discussed below.

Distillation Data and Evaporation

The OILMAP model uses the evaporative exposure model of Stiver and Mackay (1984) which is an analytical approach for predicting evaporation. It uses distillation data to estimate parameters needed for the analytic equation.

The fraction evaporated, F_v, is defined as

$$F_v = \ln [1 + B (T_G /T) \theta \exp (A - BT_0 /T)][T/(BT_G)]$$

where

- T_0 - initial boiling point of the modified distillation curve (K)
- T_G - gradient of the modified distillation curve
- T - environmental temperature (K)
- A,B - dimensionless constants

t - time (sec)

θ - evaporative exposure.

The evaporative exposure, θ, is given by

$$\theta = \left(\frac{K_m A t}{V_o} \right)$$

where

K_m - mass transfer coefficient (m/sec)
A - slick area (m^2)
t - time (sec)
V_o - volume of oil spilled (m^3).

Distillation data (T_0, T_G, A, B) for many crude oils are available in Environment Canada's oil properties database (http://www.etc-cte.ec.gc.ca/databases/OilProperties/oil_prop_e.html).

If distillation data are present in the oil specification, OILMAP uses them, but if the data are missing, as is the case with the Adios Cohasset, the values used in the distillation calculations are determined using a method from the Adios version 1.0 technical documentation as follows:

T_0 = 532.98 - 3.1295 * API
T_g = 985.62 - 13.597 * API
A coeff = -0.572 - (0.016* T_g) + (0.045* T_0)
B coeff = 7.288 - (0.008* T_g) + (0.024* T_0)

Table 3 lists the oil distillation parameters used in the model simulations for both Cohasset oils. The values listed for the Adios oil were calculated using the formulas above, data for the Environment Canada oil were calculated using distillation data from the Cohasset Crude specification.

Table 3. Oil distillation data used by OILMAP for the Adios and Environment Canada Cohasset oils.

Parameter	Adios Cohasset Oil	E.C. Cohasset Oil
T_0	384.33	453.75
T_g	339.76	196.91
A coefficient	11.29	13.91
B coefficient	13.79	15.51

Emulsification and Entrainment

Surface oil is entrained by breaking waves, and in the OILMAP model, breaking waves will occur if the wind speed exceeds 10 knots, so one would expect to see oil entrainment in the simulations performed here. In the OILMAP formulation for entrainment developed by Delvigne and Sweeney (1988), oils with higher viscosity entrain at lower rates than low viscosity oils.

Emulsification increases oil viscosity significantly so it can significantly slow the rate of entrainment. The OILMAP model uses a value for the maximum allowable water content specified in the oil database that sets an upper limit on oil emulsification. Oils with 0% water content specified will not emulsify, while oils with >0% water content will emulsify up to the specified limit.

The increase in the amount of oil entrained in the water column as wind speed increases is due to the increased energy that is transferred from the wind to the water surface causing the formation of breaking waves. As oil on the sea surface is exposed to wind and waves, it is entrained or dispersed into the water column (Figure 1). Entrainment incorporates small particles of oil into the water where they further break down and dissolve or disperse, or rise back to the surface. Entrainment is strongly dependent on turbulence and is greater in areas of high wave energy. Because all of the spills simulated here are instantaneous releases and because the wind used is constant, once oil is entrained, all but a very small fraction remains in the water column for the entire time in the simulation. Under changing wind conditions where wind speed drops below 10 knots the entrained oil could rise to the surface and form a slick.

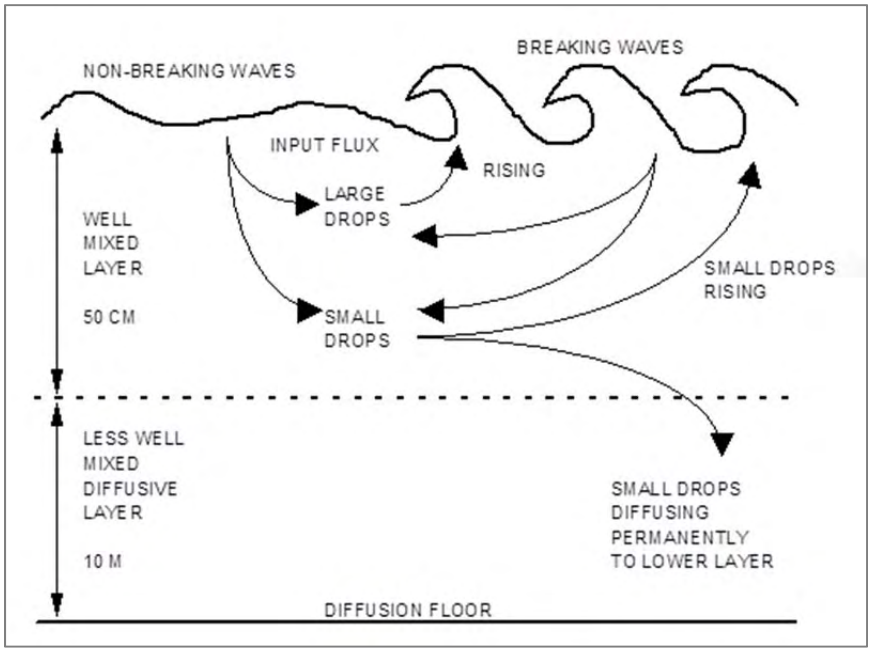


Figure 1. Schematic diagram if the oil entrainment process (Mackay, et al., 1980).

The Cohasset oil specification in the Adios database does not include a value for the maximum allowable water content. In the OILMAP model if the maximum water content is not specified a default value of 0.74 is used for crude oils and the oil is allowed to emulsify to this limit. A value of 0.74 is typical for a wide range of crude oils but Cohasset is at the very light end and this value is not really appropriate. The spill simulations of the Adios Cohasset presented here used the default maximum water content value of 0.74, but for purposes of comparison, additional simulations were run with a maximum water content of 0% assuming that the Cohasset oil does not emulsify. This is a reasonable assumption as the Environment Canada data indicate that the Cohasset Crude has a zero emulsion formation tendency up to 25.6 percent volume evaporation.

Model Results

The oil mass balance results from the model simulations are presented in graphs in Figures 2 through 6. Each page contains plots of oil mass balance from each wind speed for the entire 30 day period. It is not necessary to look at mass balance beyond about 200 hours under most wind speeds because the values for surface, evaporated and entrained oil are unchanged beyond this time. Table 4 lists the Figures containing the oil mass balance results.

Table 4. List of model output.

Figure	Spill Volume (liters)	Oil Type	Wind
2	10,000	Cohasset Adios (unmodified)	Wind = 10, 12, 15 and 20kts
3	10,000	Cohasset Adios (unmodified)	Wind = 15kts
4	10,000	Cohasset Adios (max water content = 0)	Wind = 10, 12, 15 and 20kts
5	10,000	Cohasset E.C.	Wind = 10, 12, 15 and 20kts
6	1,000	Diesel Fuel	Wind = 10, 12, 15 and 20kts

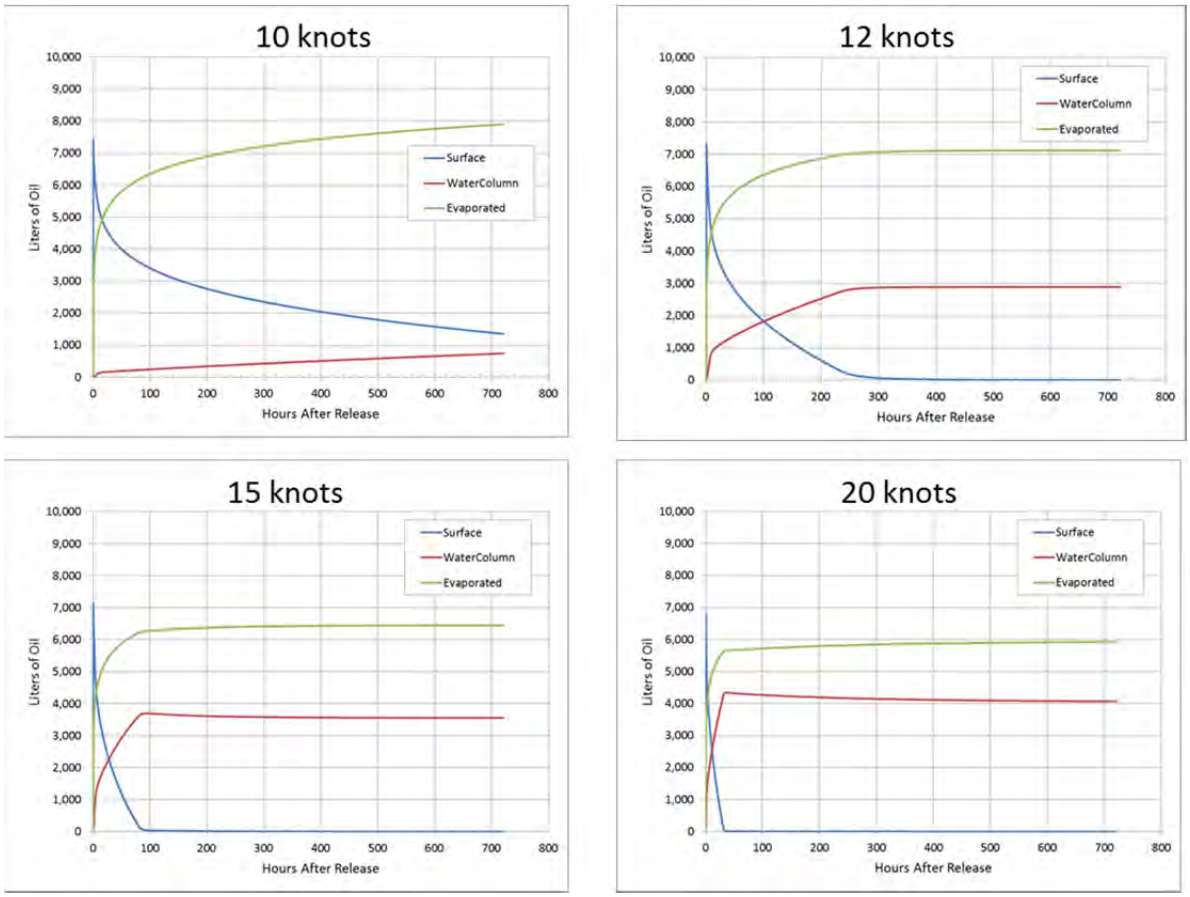


Figure 2. Oil mass balance for 30 days under 4 constant wind speeds using the unmodified Cohasset Crude specification from the Adios oil database. These results include emulsification up to a 74%.

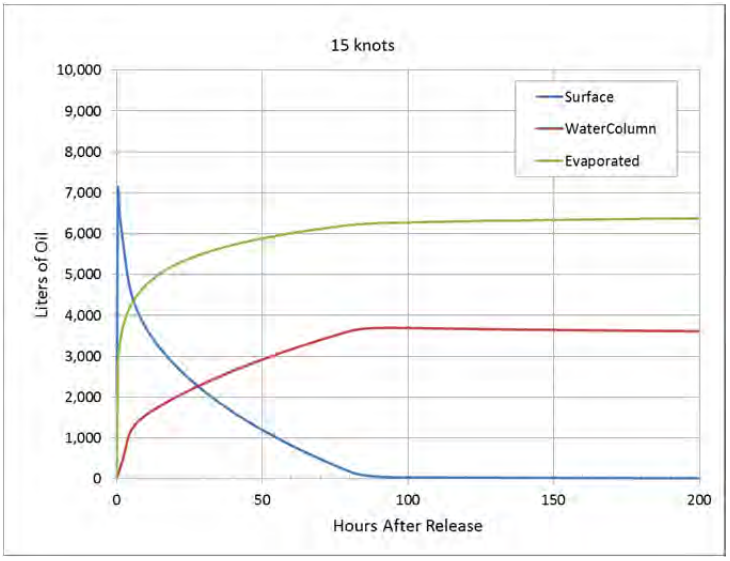


Figure 3. Oil mass balance for 200 hours under 15 knot constant wind using the unmodified Cohasset Crude specification from the Adios oil database. These results include emulsification up to a 74%.

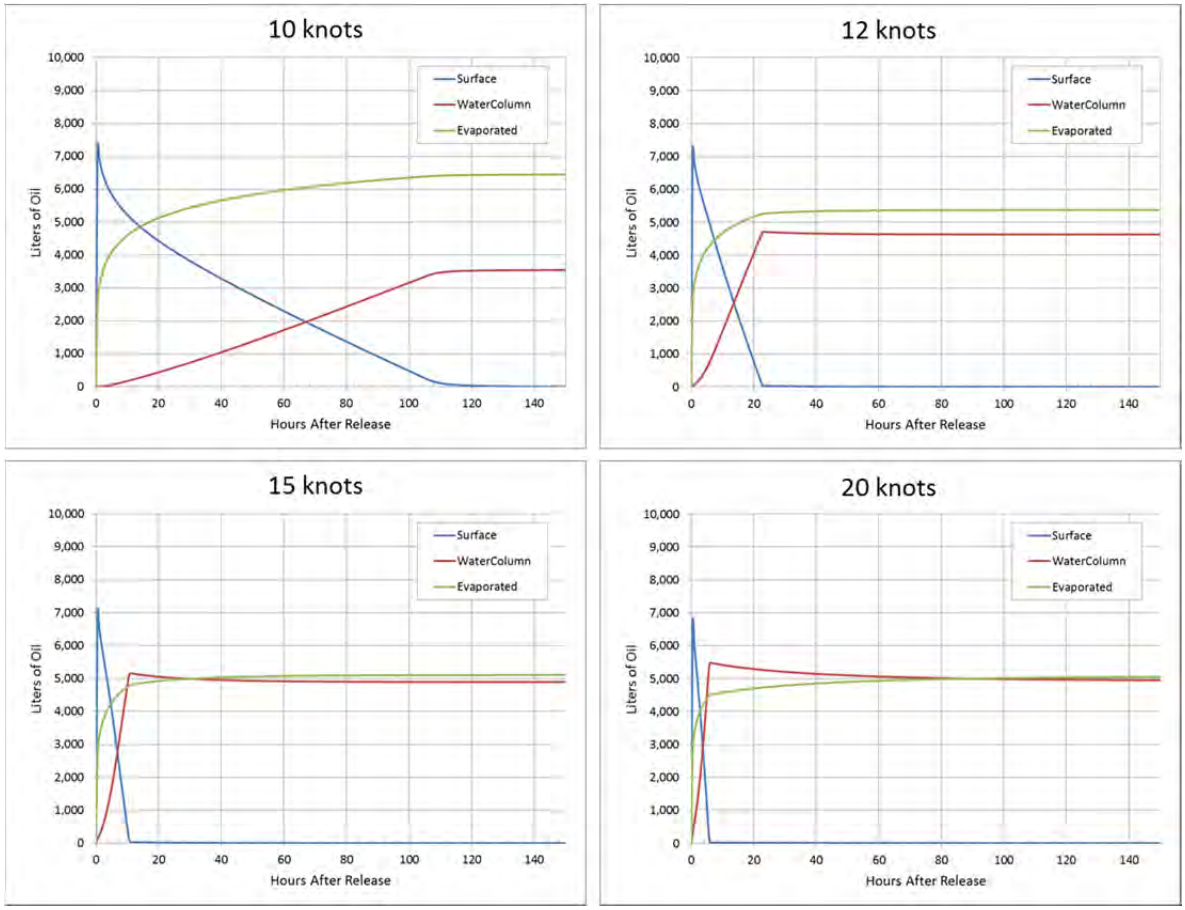


Figure 4. Oil mass balance for 30 days under 4 constant wind speeds using Cohasset Crude specification from the Adios oil database with maximum water content set to zero.

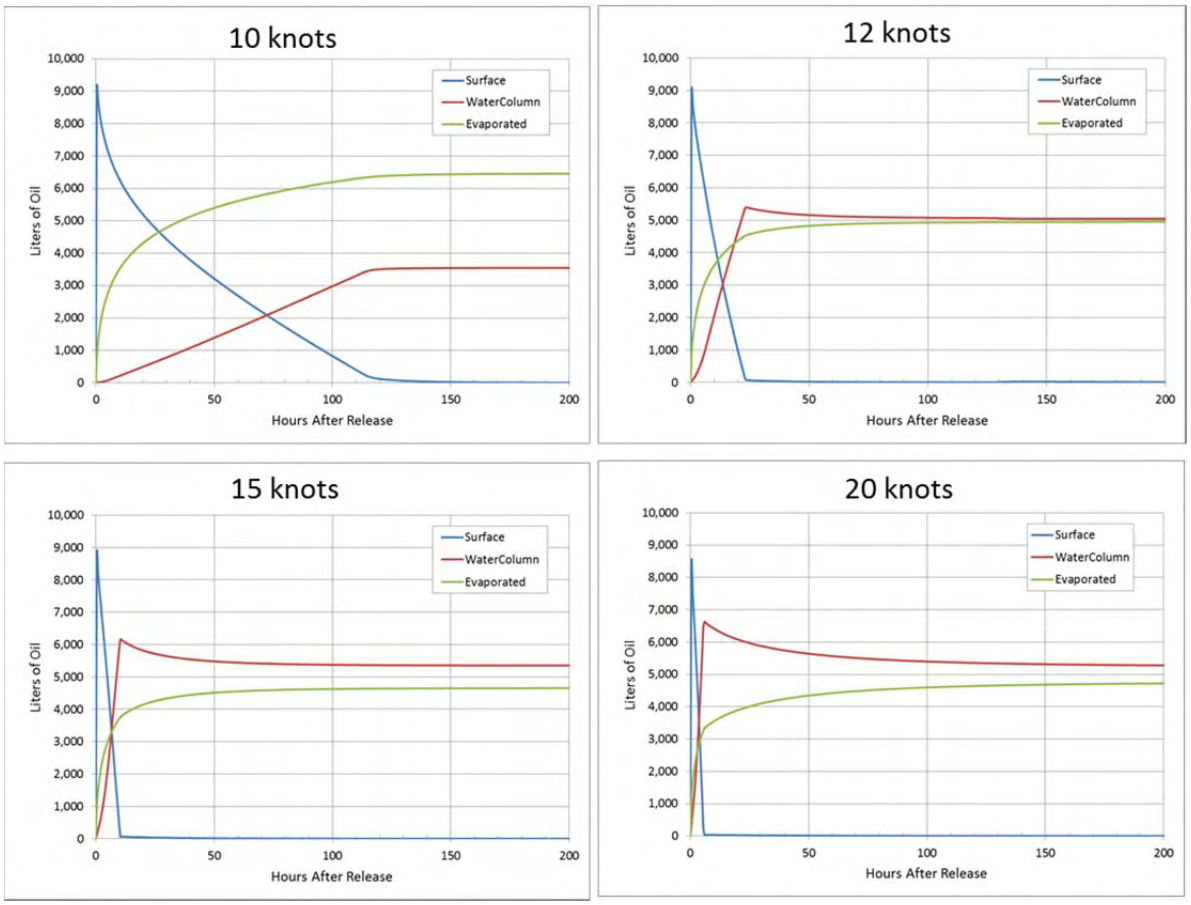


Figure 5. Oil mass balance for 30 days under 4 constant wind speeds using the Cohasset Crude specification provided by Environment Canada.

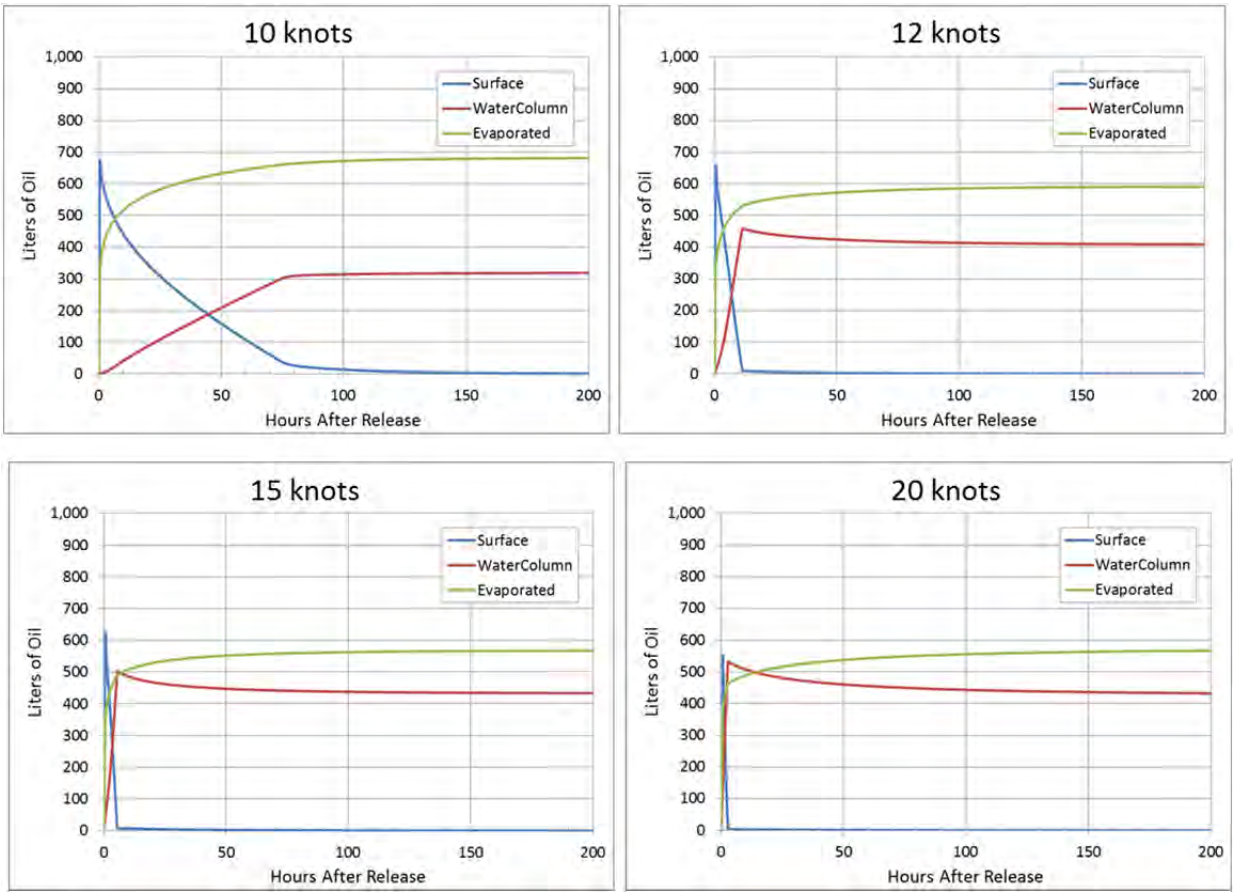


Figure 6. Oil mass balance for 30 days under 4 constant wind speeds using a Diesel fuel specification.

Summary

Simulations of instantaneous releases were performed using three different specifications of Cohasset Crude and one diesel fuel under 4 constant wind speeds:

1. Cohasset from Adios (unaltered)
2. Cohasset from Adios (assuming no emulsification)
3. Cohasset from Environment Canada
4. Diesel fuel

The quantities of oil entrained in the water column and left on the water surface for all Cohasset oils are what one would expect for light crude oils under these environmental conditions. The different oil properties of the Environment Canada Cohasset Crude and the Adios Cohasset Crude account for the differences seen in the oil mass balance predicted by OILMAP.

The difference in oil evaporation rate between the Environment Canada Cohasset oil specification and the Adios Cohasset oil specification is due to the different distillation data for each oil. The Adios

database does not contain distillation data so it is calculated by the OILMAP model. This results in different evaporation rates for these different oil specifications.

The difference in oil entrainment between the Environment Canada Cohasset oil specification and the Adios Cohasset oil specification is due to emulsification of the oil as it weathers and the subsequent increase in viscosity. The Adios oil database does not include water content data for Cohasset Crude so the OILMAP model uses a default value of 0.74 which results in a significant reduction of entrainment and prolonged surface oil transport. Model results using the Adios Cohasset oil with the maximum water content set equal to zero show remarkably good agreement with the results using the Environment Canada Cohasset Crude. The data from the Environment Canada database indicate that Cohasset does not emulsify.

The time required for surface oil to go below 1% of the total spill volume under a 15 knot wind:

Oil Type	**Hours to < 1% Surface Oil**	
Adios Cohasset	84	Assumes maximum water content up to 74%
Adios Cohasset (assuming no emulsification)	11	Assumes 0% water content
Environment Canada Cohasset	10.5	
Diesel	5.5	

References

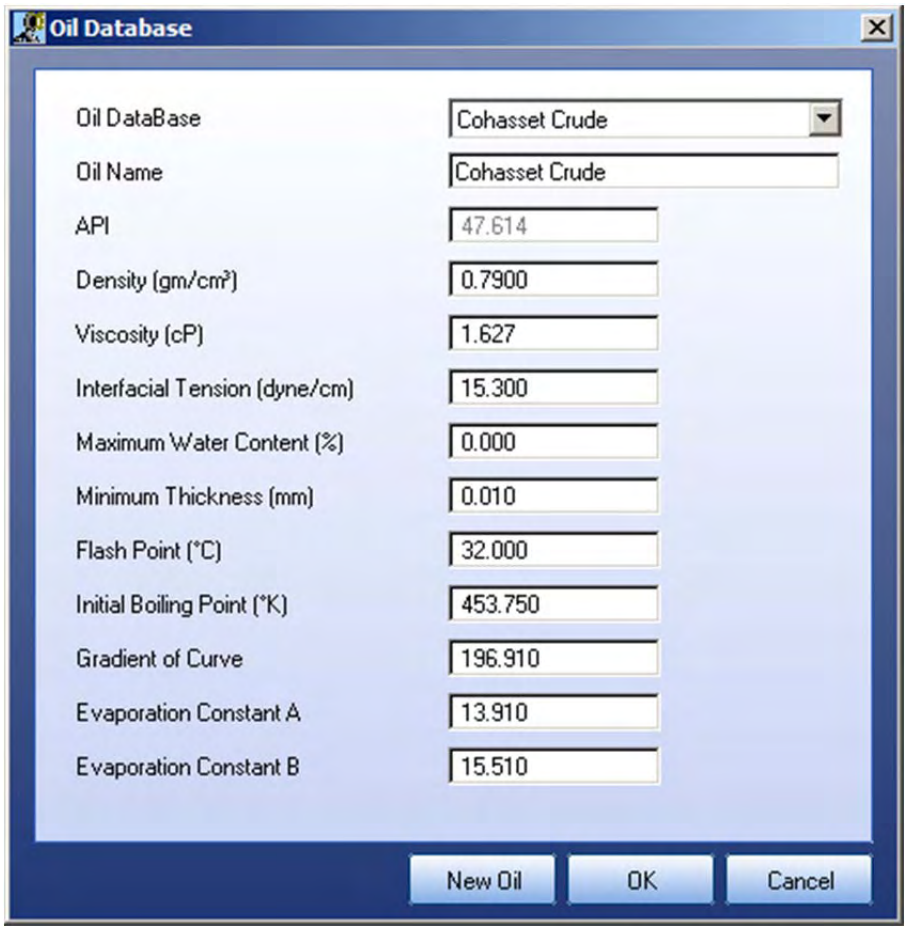
Delvigne, G.A.L. and C.E. Sweeney, 1988. Natural dispersion of oil. Oil and Chemical Pollution, 4:281-310.

Mackay, D., S. Paterson and K. Trudel, 1980a. A mathematical model of oil spill behavior. Department of Chemical and Applied Chemistry, University of Toronto, Canada.

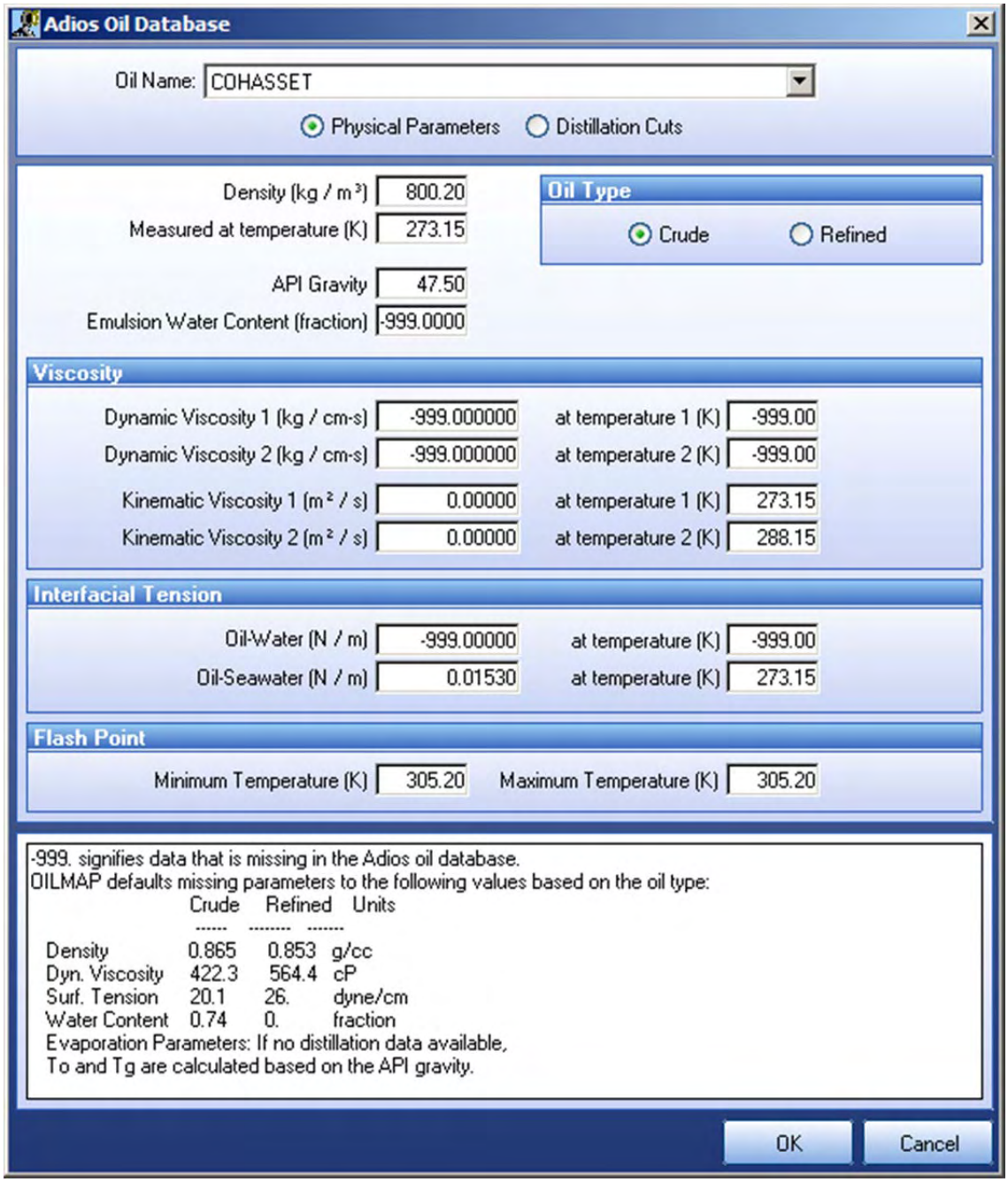
Stiver, W. and D. Mackay, 1984. Evaporation rate of spills of hydrocarbons and petroleum mixtures. Environmental Science and Technology, 18:834-840.

Appendix – Oil Specifications

Cohasset Crude properties defined using Environment Canada database



Cohasset Crude properties defined in Adios oil database



Adios Oil Database

Oil Name: COHASSET

Physical Parameters | Distillation Cuts

Density (kg / m³)	800.20
Measured at temperature (K)	273.15
API Gravity	47.50
Emulsion Water Content (fraction)	-999.0000

Oil Type: Crude | Refined

Viscosity

Dynamic Viscosity 1 (kg / cm-s)	-999.000000	at temperature 1 (K)	-999.00
Dynamic Viscosity 2 (kg / cm-s)	-999.000000	at temperature 2 (K)	-999.00
Kinematic Viscosity 1 (m² / s)	0.00000	at temperature 1 (K)	273.15
Kinematic Viscosity 2 (m² / s)	0.00000	at temperature 2 (K)	288.15

Interfacial Tension

Oil-Water (N / m)	-999.00000	at temperature (K)	-999.00
Oil-Seawater (N / m)	0.01530	at temperature (K)	273.15

Flash Point

Minimum Temperature (K)	305.20	Maximum Temperature (K)	305.20

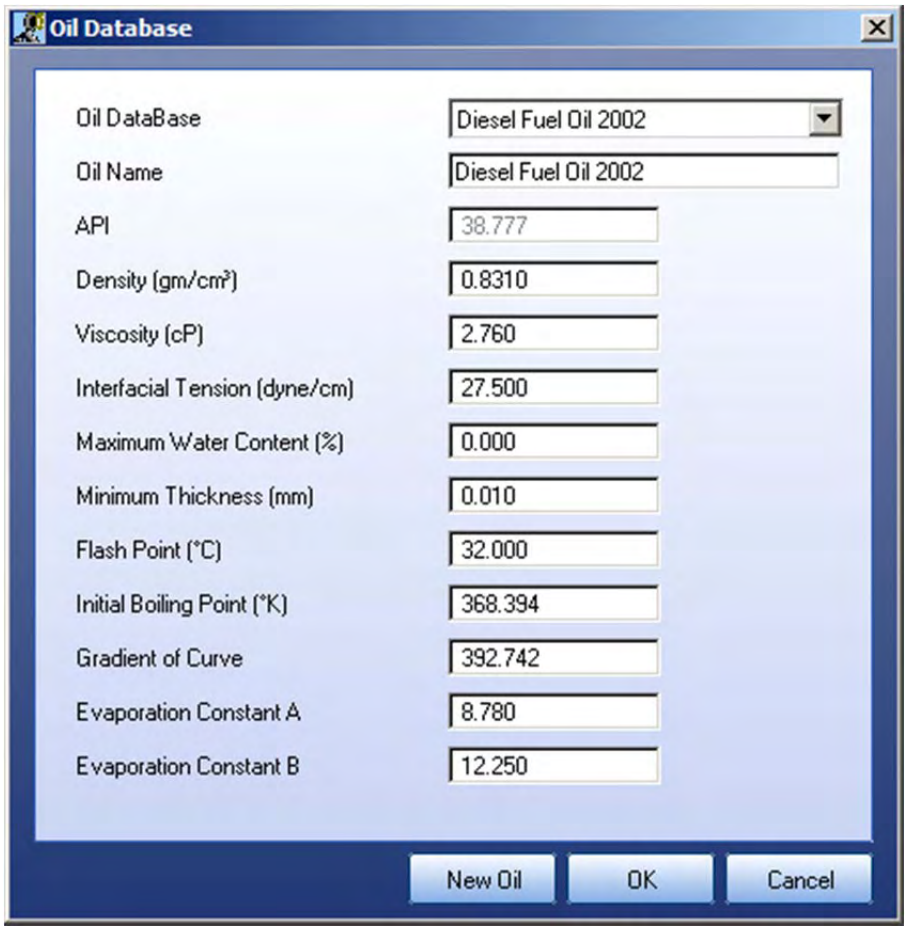
-999. signifies data that is missing in the Adios oil database.
OILMAP defaults missing parameters to the following values based on the oil type:

	Crude	Refined	Units
Density	0.865	0.853	g/cc
Dyn. Viscosity	422.3	564.4	cP
Surf. Tension	20.1	26.	dyne/cm
Water Content	0.74	0.	fraction

Evaporation Parameters: If no distillation data available,
To and Tg are calculated based on the API gravity.

OK | Cancel

Diesel Fuel oil properties



ATTACHMENT 3

Corridor Response to Environment Canada Comments – Comparison of Differences in Old Harry Oil spill Fate Modelling Conducted by Applied Science Associates, SL Ross Environmental Research and Environment
(April 12, 2013)

April 12, 2013

Ref: 10-L-0010-13

Ms. Elizabeth Young,
Environmental Assessment Officer
Canada-Newfoundland and Labrador Offshore Petroleum Board
TD Place 5th Floor
140 Water Street
St. John's NL A1C 6H6

Dear Ms. Young:

Re: Response to the Latest Environment Canada Comments

Corridor Resources Inc. (Corridor) is submitting this letter in response to the latest comments from Environment Canada (EC) sent to Corridor by the Canada-Newfoundland and Labrador Offshore Petroleum Board on March 6, 2013, on the Old Harry spill modelling that was conducted for Corridor by SL Ross Environmental Research Ltd. (SL Ross) and Applied Science Associates (ASA). Corridor has been involved in discussions with EC and the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) since May of 2012 on this spill modelling issue - almost a full year. This situation has materially delayed the processing of the Old Harry Environmental Assessment (EA) and placed Corridor's project schedule at risk.

Corridor remains of the opinion that the modelling conducted by SL Ross is valid for the purposes of the EA. We further believe that the additional information and context provided in this response letter and the accompanying report should close out this issue and allow the EA review to be completed. Corridor's detailed response, after thorough discussion with SL Ross and Stantec, is included in the accompanying report to this cover letter. Our detailed response includes: (i) Information to address the key issues, namely, emulsification and dispersion that have resulted in the discrepancy between the EC and SL Ross results; (ii) additional modelling results by SL Ross, where they have used, for comparison purposes, the same dispersion algorithm used by ASA; and (iii) a detailed, line-by-line response to the specific issues raised in the EC January 25, 2013 letter.

The following critical points, described in more detail in the accompanying report, support the validity of the SL Ross modelling work as appropriate for the Old Harry EA:

- Evidence has been provided from EC's own dataset and actual documented spill examples that the light, Cohasset oil surrogate will **not** emulsify. Therefore, only modelling results that exclude emulsion formation are appropriate in this case. Note that the ASA modelling (September 20, 2012) used an emulsification factor only to demonstrate that a model of the Cohasset oil will emulsify if the default values in OILMAP are used. ASA notes that emulsification is not appropriate for a very light oil such as Cohasset;
- Scientific references and actual spill examples are included as evidence that natural dispersion plays an important role in the fate of diesel and the light, Cohasset crude oil used as a surrogate for the potential Old Harry product;
- Scientific references presented in the report indicate that natural dispersion will occur as long as breaking waves are present and breaking waves are known to begin in offshore waters at wind speeds as low as 7 knots (3.6 m/s);

- It is Corridor's view, in agreement with SL Ross, that spill models appropriate for Old Harry should account for natural dispersion through the full range of wind speeds when breaking waves are present;
- Winds greater than 10 knots (5 m/s) exist in the vicinity of the Old Harry project for more than 50% of the time in all seasons, so wind speeds higher than 10 knots need to be considered when looking at realistic modelling scenarios;
- The full variability of winds in the region has been accounted for in past modelling efforts through the use of the 52 years of hourly MSC 50 time series wind data, which is the most appropriate dataset to use in our view;
- New modelling by SL Ross using a natural dispersion cut-off at 10 knot wind speeds shows that the area potentially affected from the operations is small, would not interact with any shoreline, and would not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such that it would change EA conclusions); and
- SL Ross has been responsible for the modelling of the fate and behavior of potential spills for almost all of the exploration and development operations on Canada's east coast since the early 1980s. These reports have all been reviewed and accepted by the appropriate government agencies, including EC, over this extensive time period. We respectively submit that the SL Ross model is well known and respected in the region.

In summary, Corridor is of the view that it has completed a thorough investigation into this spill modelling issue and has illustrated, through a preponderance of evidence, that the modelling work completed to date (three different sets of modelling, involving two spill modelling expert companies) is adequate for the assessment of environmental effects of the single exploratory well planned at the Old Harry site. Corridor identified, early in its planning stage, that spill modelling would be a critical issue and we have been duly diligent in our efforts to contract internationally recognized spill modelling experts with a depth of experience in this field, to conduct modelling appropriate for the type of products likely to be produced at Old Harry, and to provide timely information to respond to issues raised by EC. We do not believe that additional work is warranted on this issue.

If you have any questions on the information provided, please let us know. We are available at your earliest convenience to discuss how best to close out this issue.

Yours truly,

[redacted]

Dena Murphy, QHSE Manager
Corridor Resources Inc.

cc. David Burley, Manager, Environmental Affairs, C-NLOPB
Darren Hicks, Environmental Analyst, C-NLOPB

Enclosures

Comparison of Differences in Old Harry Oil Spill Fate Modelling Conducted by Applied Science Associates, SL Ross Environmental Research and Environment Canada

Prepared

April 12, 2013

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Comparison of Differences in Old Harry Oil Spill Fate Modelling Conducted by Applied Science Associates, SL Ross Environmental Research and Environment Canada

1. Background

The original oil fate and behaviour modelling conducted by SL Ross Environmental Research Ltd (SL Ross) for the Corridor Resources Inc. (Corridor) Old Harry prospect was criticized by Environment Canada (EC) (see Appendix I for the latest comments from EC and detailed responses by Corridor). There is a considerable difference of opinion between EC and SL Ross on the likely surface persistence of the Cohasset crude oil that has been selected as the type of oil likely to be encountered at this exploration site.

SL Ross`s modelling indicates that this light oil will persist for a few hours once spilled. This is based on the properties of Cohasset crude oil as measured by EC and the Mackay evaporation model (Mackay et al., 1980) and Audunson's dispersion algorithm (Audunson, 1980) usually employed by SL Ross in its oil spill model. The short surface persistence of this light crude oil is supported by two actual blowout events: the Uniacke blowout off Sable Island in 1984 (Environment Canada, 1984) and the Elgin blowout off Scotland in 2012 (Government of Scotland, 2013). In both of these cases, the light oil from the above-sea blowouts dissipated by evaporation and natural dispersion in less than 24 hours.

An Environment Canada consultant conducted modelling using Applied Science Associate's (ASA) OilMap software products and the Cohasset data set present in the US National Oceanic and Atmospheric Administration's (NOAA's) ADIOS model's database. This modelling resulted in surface persistence of the Cohasset oil in excess of 30 days, in some cases. ASA was commissioned by Corridor Resources to conduct additional modelling of batch spills of diesel and Cohasset crude for comparison purposes due to the significant differences in model results between EC and SL Ross with the goal of identifying the reasons for the major discrepancies.

There are three primary differences in the modelling and interpretation of the modelling results that have been completed by SL Ross, ASA and EC for the Old Harry Environmental Assessment (EA) (Stantec Consulting Ltd, 2013), as described below:

- Whether Cohasset oil will, or will not, form a water-in-oil emulsion if spilled;
- The fundamental principle that light crude oil or diesel slicks will, or will not, naturally disperse permanently in the presence of breaking waves; and
- The belief that light crude oil and diesel spills will, or will not, evaporate and naturally disperse completely within a day in wind speeds that generate breaking wave conditions.

Each of the three differences will be addressed in the sections below. In addition, supplementary modelling completed by SL Ross is presented later in this report (Section 5) to show output from SL Ross Oil Spill Model (SLROSM) using the Delvigne and Sweeney (1988) dispersion algorithm, which is the same as the algorithm used in the ASA and EC modelling work. This modelling was conducted for comparison purposes to illustrate that the original SL Ross modelling is appropriate for the Old Harry environmental assessment process and that the modelling conducted using the Delvigne and Sweeney (1988) dispersion algorithm does not materially affect the zone of influence and therefore it would not change the EA conclusions.

2. Oil Emulsification

The EC modelling assumes that the Cohasset oil will emulsify when spilled in the marine environment. This is not an accurate portrayal of how Cohasset crude oil will behave, based on published spill-related properties from the EC database. EC published data for this light oil shows that it will not form emulsions when evaporated up to 25.6% by volume (See Appendix II). The oil also has 0% asphaltene content at all degrees of weathering, suggesting that it will not form emulsions at any time post-spill. EC's own data does not support the formation of emulsions in spills of Cohasset crude. Therefore, fate modelling of spills of this oil should exclude emulsion formation. The EC modelling also claims that the crude oil (MC 252) released from the Macondo well is very similar to the Cohasset crude. A comparison of the fresh and weathered properties of the two crudes, included in Appendix II, clearly demonstrates that the Cohasset crude is much lighter than the MC 252 crude and the two oils are not similar.

3. Natural Dispersion

EC has stated in its comments on the Old Harry prospect modelling by SL Ross that there is no historical evidence that surface oil slicks will completely evaporate and naturally disperse. EC has also stated that natural dispersion will not occur in winds less than 30 knots (15.4 m/s).

The modelling conducted by ASA and EC utilized a natural dispersion model (Delvigne and Sweeney, 1988) that assumes no natural dispersion will occur at wind speeds less than 5 m/s (approximately 10 knots). It is important to note that this assumption is based on research focused on winds speeds of 5 m/s or greater. In other words, Delvigne and Sweeney (1988) did not study oil entrainment in water for wind speeds less than 5 m/s. For the Old Harry modelling work, SL Ross used a dispersion model developed by Audunson (1980) that predicts natural dispersion will occur at lower wind speeds than those proposed by Delvigne and Sweeney (1988) and suggested by EC. SL Ross believes that its' spill modelling is appropriate for EA purposes

and contends that the 5 m/s cutoff imposed by Delvigne and Sweeney (1988) is likely too constrictive for the Cohasset oil.

It is well known that currents, wind and wave action form a well-defined mixing layer in the upper part of the water column. Oil spilled on the sea surface can be dispersed in the mixing layer by a number of natural processes, including breaking waves. Field observations and laboratory work (Delvigne and Sweeney, 1988; Milgram et. al., 1978; Mackay et al., 1980) have demonstrated that natural dispersion of fluid oils will occur in water as long as breaking waves are present, and these studies have even indicated that dispersion may also occur in non-breaking wave conditions as well.

Tkalich and Chan (2002) developed a mathematical model of oil droplet mixing by breaking waves. Li et al. (2008) used a wave tank to study the dispersed oil particle size. They note that "Under natural conditions, the dispersion of oil slicks is enhanced in the presence of waves. The waves provide mixing energy to break the surface oil film and propel oil droplets into the water column" (Li et al., 2008). Fingas (2011) notes that "…diesel fuel and even light oil crudes can disperse significantly…" The preponderance of evidence clearly indicates that oil dispersion is widely accepted.

A key consideration is the wind speed required to produce a wave of sufficient magnitude to facilitate the mixing of oil and the dispersion of an oil slick. The internationally recognized Beaufort wind scale indicates that breaking waves will occur in winds as low as 3.6 m/s. The NOAA oil spill model ADIOS2 assumes that whitecap formation (breaking waves) and natural dispersion begins at 3 m/sec (W. Lehr, 2001). This supports SL Ross's contention that the 5 m/s cutoff imposed by Delvigne and Sweeney (1988) is likely too constrictive and that EC's assertion that dispersion does not begin until winds reach 30 knots (15.4 m/s) is incorrect.

4. Slick Survival Time

EC has indicated in its reports that the light Cohasset crude oil and diesel oil will persist on the surface for up to 30 days. EC has stated that oil spills do not completely evaporate and disperse from the water surface and there is no historical evidence to support this.

Other respected agencies have different opinions than EC on the possible behaviour of light oil and diesel spills. For example:

- The NOAA's Office of Response and Restoration states on its web site: "Small diesel spills will usually evaporate and disperse naturally within a day or less. This is particularly true for typical spills from a fishing vessel (500-5,000 gallons), even in cold water. Thus, seldom is there any oil on the surface for responders to recover."

(http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html).

- The International Tanker Owners Pollution Federation (ITOPF) states: "Group I oils (non-persistent oils with densities less than 0.8 g/cc) tend to dissipate completely through evaporation within a few hours and do not normally form emulsions." (http://www.itopf.com/marine-spills/fate/models/). The density of Cohasset crude oil is 0.79 g/cc at 15 °C based on EC measurements.
- The French government research group Centre of Documentation, Research and Experimentation on Accidental Water Pollution (Cedre) indicates that "fluid oils can disperse totally within a few days." (http://www.cedre.fr/fr/publication/colloque/obs/1_oil_charater_beha.pdf) .
- The American Petroleum Institute (API, 1999) states that "Following evaporation, natural dispersion is the most important process in the breakup and disappearance of a slick."

The following are a few examples of actual spill events where the complete evaporation and dispersion of oil was documented to have occurred within a day or a few days from the release of the oil.

Uniacke Blowout (Environment Canada, 1984). Environment Canada's own publication describing the fate of oil from the Uniacke blowout off Nova Scotia's shore indicates that the oil completely evaporated and naturally dispersed and was not present on the surface less than 24 hours after the blowout was stopped (Environment Canada, 1984). The oil released in this blowout had a very similar API gravity to that of Cohasset crude and the winds between the well kill and the overflight that could find no oil were approximately 8 knots or 4.2 m/s.

Elgin Blowout (Government of Scotland, 2012). Reports from the Elgin platform blowout off Scotland in 2012 indicate that the oil released during this event evaporated and naturally dispersed within 24 hours (http://www.scotland.gov.uk/Resource/0039/00394137.pdf).

North Cape Spill, east coast US, 1988. Some 828,000 gallons of No. 2 Fuel (home heating oil) escaped into Rhode Island Sound. No. 2 heating oil is a refined product similar to diesel fuel, and because the wind and wave action was so intense on the night of the spill, the oil quickly mixed into the water column.

Arthur J dredge barge, Lake Huron, 2012. 1500 gallons of diesel oil was spilled when the barge sank. Environment Canada was among the agencies that monitored the spill. Environment Canada provided modelling and predictions of the dispersion of diesel fuel. An Environment Canada spokesperson was quoted in a news report as saying "At this point, given local meteorological conditions and the type of pollutant, it is anticipated that much of the pollutant will evaporate."

(http://blogs.windsorstar.com/2012/07/19/diesel-fuel-spill-in-lake-huron-after-barge-sinks/)

F/V Rough Seas, August, 2007. 300 to 1500 gallons of diesel fuel spilled when a fishing boat grounded in Little Egg Inlet N.J. at 1600 EDT on July 31, 2007. An overflight on August 2 found no oil sheen in the vicinity of the spill site. (http://www.incidentnews.gov/incident/7682)

USS New Orleans, August, 2007. 1000 gallons of Navy diesel was spilled from the USS New Orleans. Incident occurred on August 30 at 2000 hours south west of San Clemente Is., CA. The afternoon over-flight at 1815 hours on August 31 was unable to locate the spill. (http://www.incidentnews.gov/incident/7690)

Katsheshuk, April, 2002. The shrimp trawler "Katsheshuk" sank off Cape St. Francis, approximately 20 kilometres north of St. John's, Newfoundland. A spokesperson for the Coast Guard said Wednesday that the fuel was down to a 50 by 100-foot area and was dispersing quickly. At the time of the sinking, there were approximately 430,000 litres of diesel fuel on board the vessel. (Source: CBC News, 3 April 2002) When the vessel sank, the action of the wind and the waves dispersed the oil and its impact on the environment was considered minimal. (http://www.tsb-bst.gc.ca/eng/rapports-reports/marine/2002/m02n0007/m02n0007.asp)

5. New Modelling to Compare SLROSM Results to ASA OilMap Results

The SL Ross Oil Spill Model (SLROSM) was modified to use the Delvigne and Sweeney (1988) natural dispersion algorithm and run using the same EC-measured Cohasset crude oil properties and environmental input parameters as those used by ASA to demonstrate that the dispersion algorithm being used is the same as that in ASA's OilMap product. Figure 1 shows the comparison of the two model's results at various wind speeds. The agreement between the two model results is consistent.

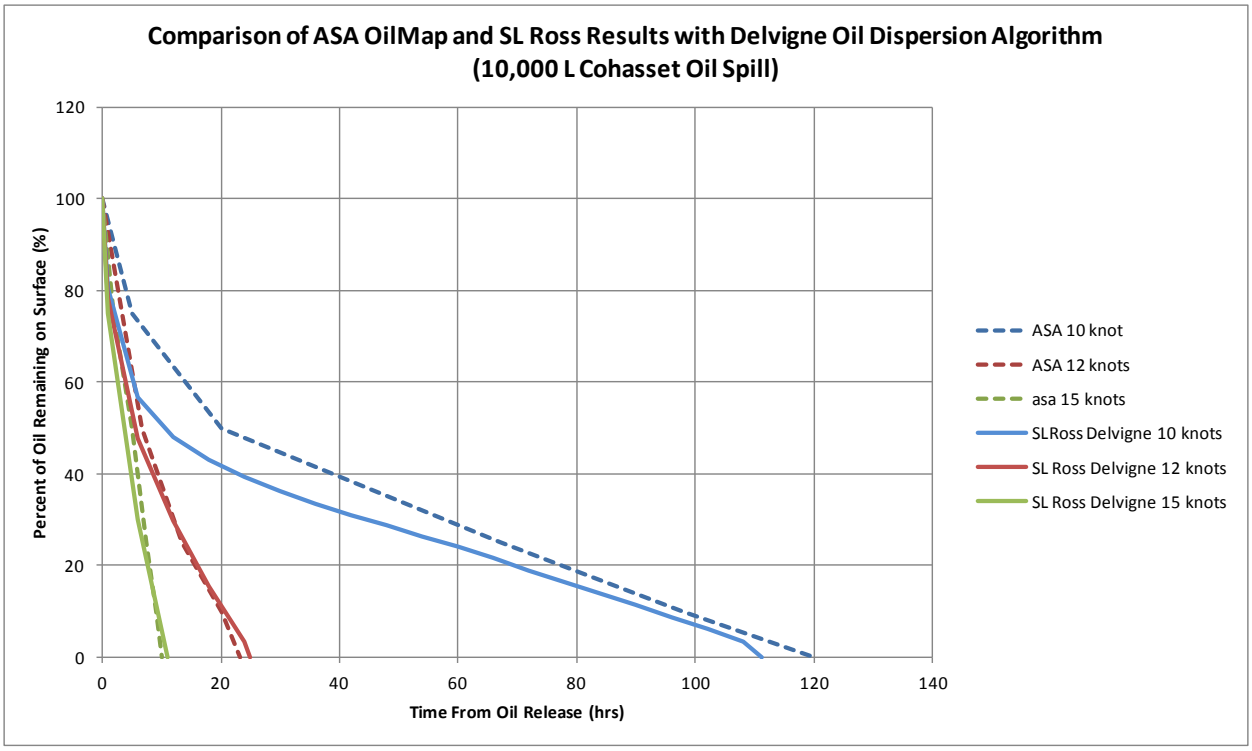

Figure 1: Comparison of OilMap and SLROSM Model Results Using Delvigne and Sweeny (1988) Natural Dispersion

SLROSM was then re-run for surface blowouts from the Old Harry location using the 52 years of MSC50 wind data. A slick, representative of the continuous release of oil from a surface blow out, is selected every 6 hours and its fate and behaviour are determined under the prevailing environmental conditions that follow its time of release using the 52 years of hourly wind data. The trajectories of all of the slicks, for all months, and all 52 years of predictions have been plotted on one image to identify the maximum possible area of effect from a blowout from the Old Harry prospect assuming the same dispersion algorithm as that used in the ASA OilMap software (i.e. Delvigne and Sweeney (1988)). Figure 2 shows the results of this analysis.

Even with the 5 m/s restriction on the onset of dispersion imposed by the Delvigne and Sweeney (1988) algorithm, the maximum likely area that could be affected by a blowout from the operation is still relatively small and would not result in any contact of oil with shorelines.

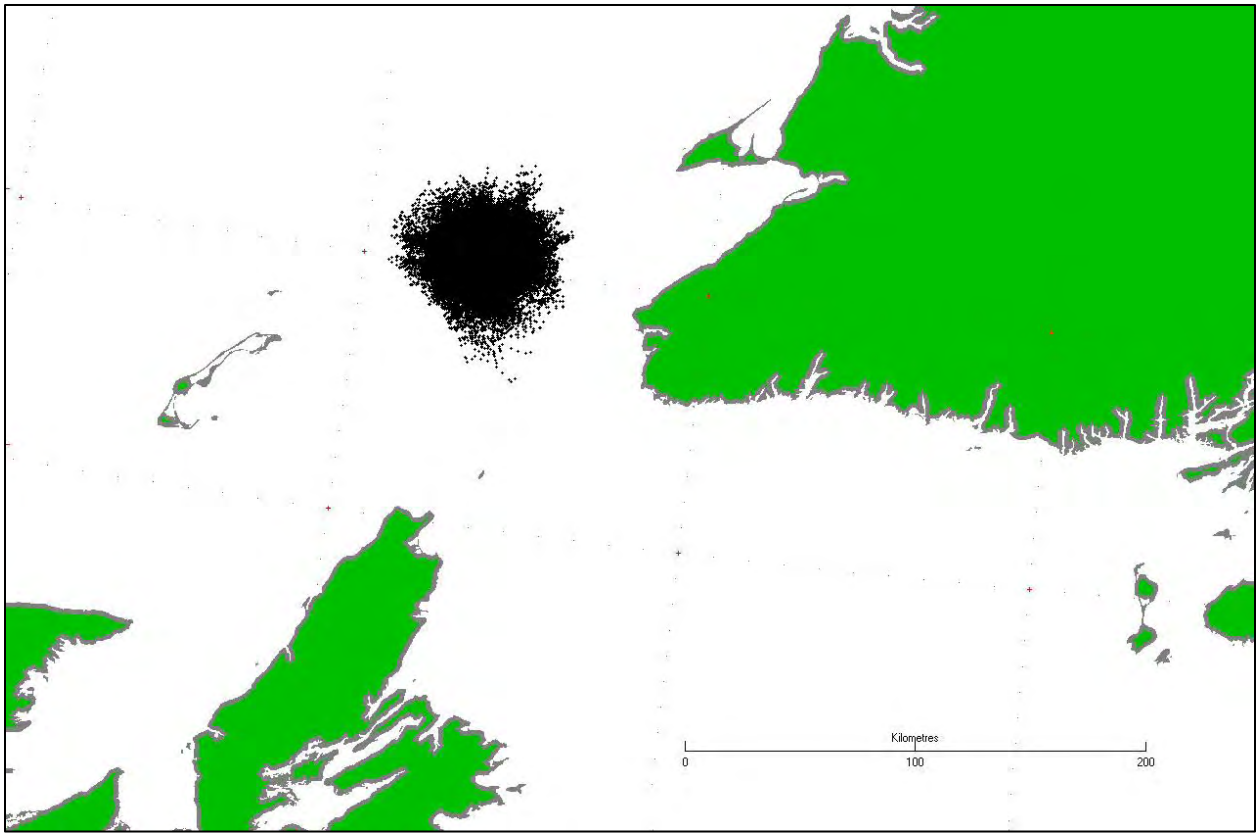

Figure 2: Trajectories of Above-Sea Blowouts: All 52 Years and All Months

A more instructive view is provided in Figure 3. This figure shows all of the trajectories for the months of May, June and July for one year (2004). These months were selected because they have the most calm wind periods of the year based an assessment of 52 years of MSC50 wind data (see Table 1). Three months were selected as this would be the maximum likely time required prior to achieving well control should a blowout occur. As can be seen in Figure 3, most slicks dissipate within 20 to 30 kilometres from the spill site. There are a few cases with longer spill persistence due to prolonged calm periods, but these are few in a given three month period.

The percentage of time that winds are less than 10 knots, between 10 and 12 knots and greater than 12 knots has been extracted from the MSC50 data set for grid point 13347 (located at -60.3° longitude 48.0° latitude, very close to the proposed Old Harry drill site) and are provided in Table 1. It is evident from the historical wind statistics in Table 1 that calmer winds are more prevalent in the summer months. Note that winds greater than 10 knots occur more than 50 percent of the time. Figure 4 shows all of the trajectories for the months of November, December and January (2004). There are fewer instances of longer persistent slicks in these months, as would be expected based on the wind data in Table 1.

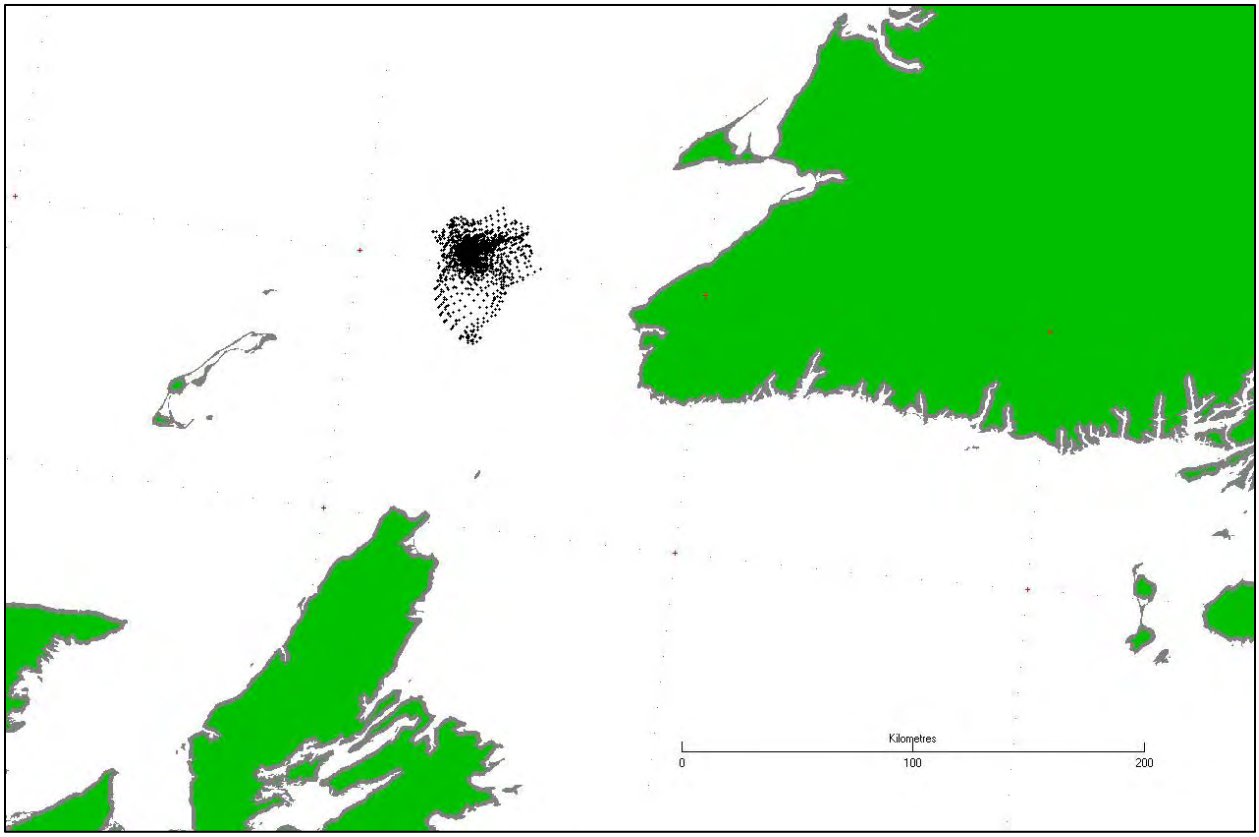

Figure 3: Trajectories of Above-Sea Blowouts: May, June and July of 2004

Table 1: Wind Statistics MSC50 Grid Point 13347

Month	Percentage of Wind Observations (from 1954 TO 2005 data)		
	0 to 10 knots	10 to 12 knots	> 12 knots
January	9.5	6.4	84.1
February	21.5	8.9	69.6
March	24.9	9.1	66.0
April	29.6	10.8	59.5
May	42.0	11.1	46.9
June	46.3	11.6	42.1
July	44.4	13.5	42.1
August	36.4	13.7	49.9
September	24.9	11.3	63.8
October	15.9	8.6	75.5
November	11.3	7.2	81.5
December	9.2	6.0	84.8

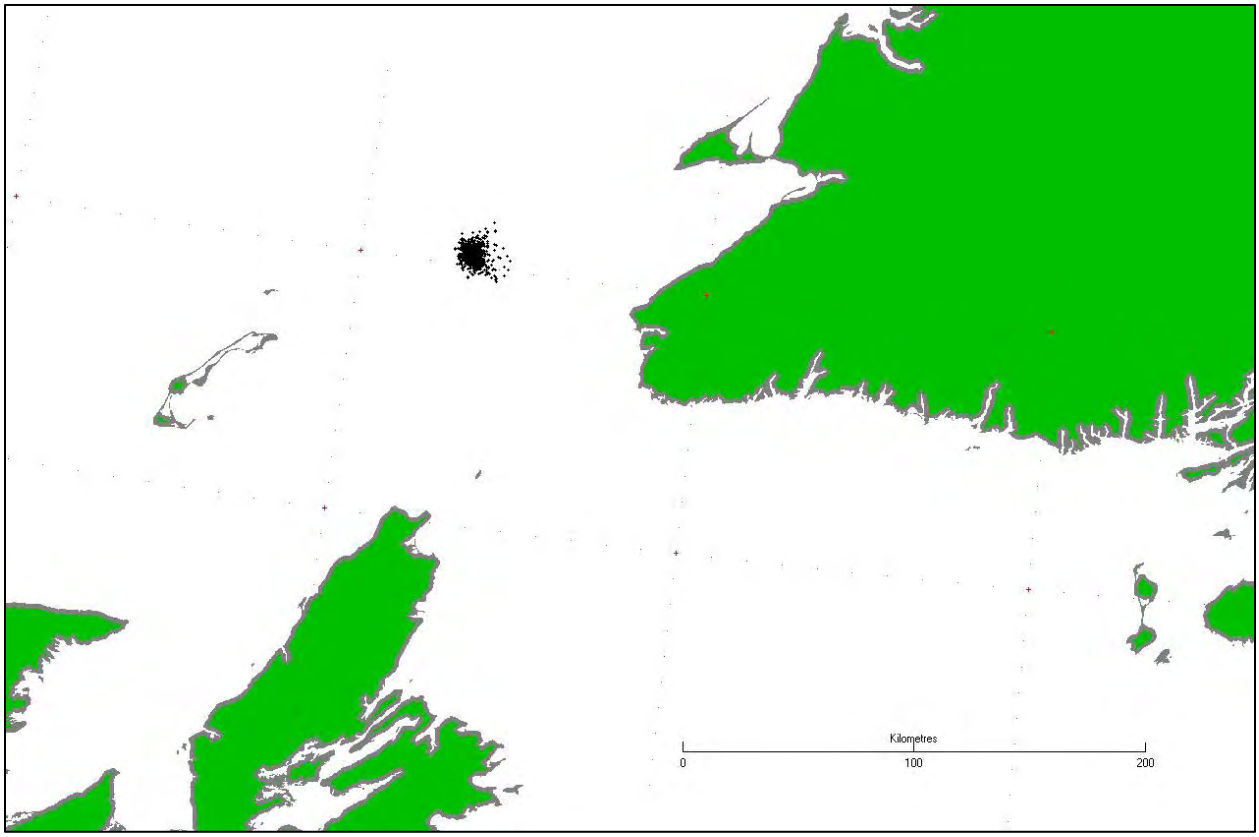

Figure 4: Trajectories of Above-Sea Blowouts: November, December and January of 2004

Figures 2 through 4 can be compared to Figure 12 from the original SL Ross oil fate and behaviour report prepared for the Corridor Resources EA. This figure is reproduced below as Figure 5. The oil footprint from the original modelling effort is smaller than that in Figures 2 and 3, as would be expected due to the different dispersion algorithms used. However, the oil footprint in Figures 2 and 3 is still relatively small, would not interact with any shoreline, and would not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such that it would change EA conclusions). Tables 2 and 3 are provided to allow comparison, between the new and previous modelling results, of the minimum and maximum surface oil slick persistence times for each month. The new work models a surface blowout discharge scenario whereas the original work models batch accumulations of oil released every 6 hours. The minimum slick persistence values were actually longer in the old modelling. The maximum persistence recorded in the new modelling was about 4 times longer than in the original work.

Table 4 shows the percentage of slicks surviving for a given time range. It is instructive to note that over 90% of the slicks released from the blowout in the summer months persisted for less

than 3 days and over 90% of the slicks released in the winter months persisted for less than 1 day.

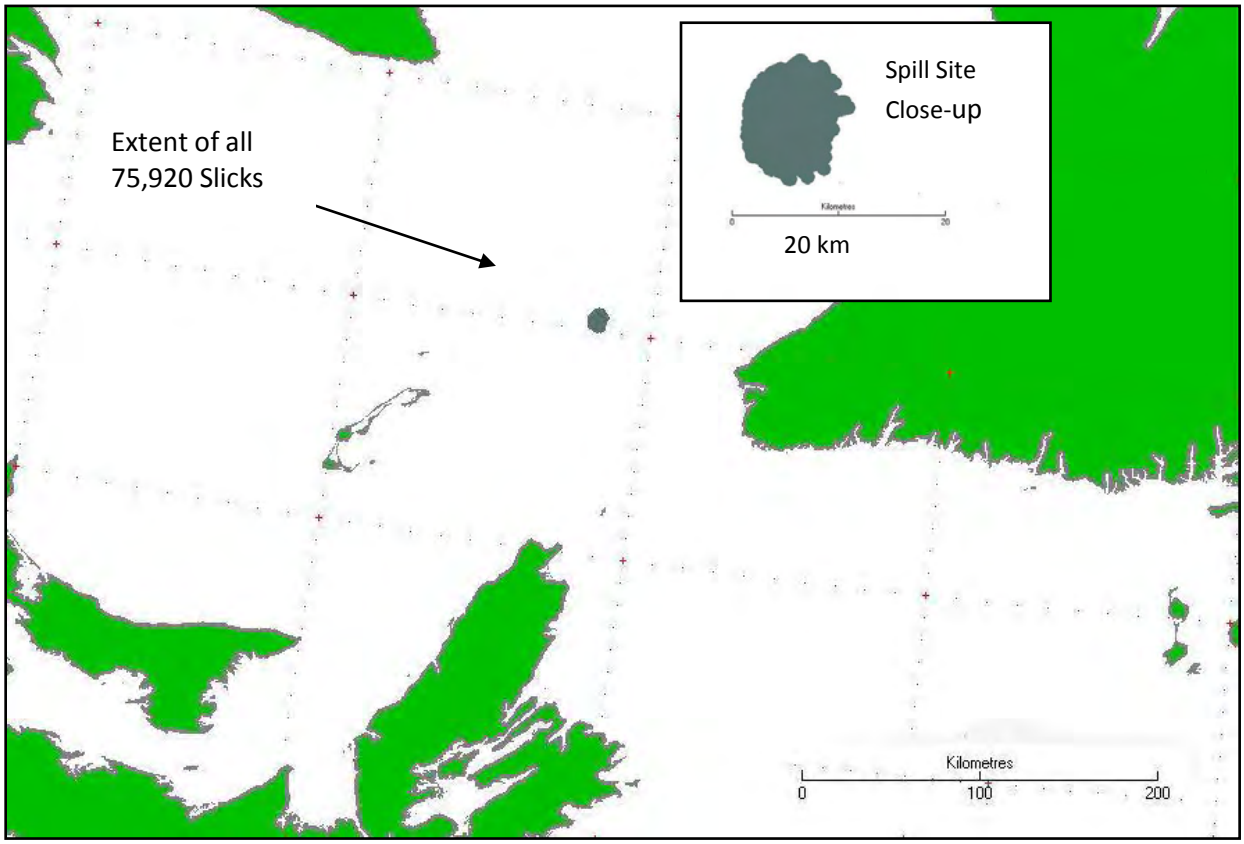

Figure 5: Maximum Area of Ocean Surface Swept by Oil from 52 Years of Simulations Using a Reasonably Conservative Modelling Approach (old Figure 12)

Table 2: Slick Shoreline Contact and Slick Life at Sea: Surface Blowouts (as modeled by SL Ross using the Delvigne and Sweeny (1988) dispersion algorithm)

Month	Number of Slicks Tracked	% of Slicks Tracked Reaching Shore	Minimum Slick Life at Sea (hours)	Maximum Slick Life at Sea (hours)
January	6448	0.0	0.25	91.6
February	5824	0.0	0.31	123.9
March	6448	0.0	0.32	135.0
April	6240	0.0	0.34	223.6
May	6448	0.0	0.39	188.2
June	6240	0.0	0.50	186.6
July	6448	0.0	0.50	211.5
August	6448	0.0	0.42	168.9
September	6240	0.0	0.27	144.7
October	6448	0.0	0.25	116.3
November	6240	0.0	0.24	84.5
December	6448	0.0	0.23	72.0

Table 3: Slick Shoreline Contact and Slick Life at Sea: Reasonable Worst-Case Modelling Approach (from SL Ross's Original Report using Audunson dispersion algorithm – old Table 10)

Month	Number of Slicks Tracked	% of Slicks Tracked Reaching Shore	Minimum Slick Life at Sea (hours)	Maximum Slick Life at Sea (hours)
January	6448	0.0	0.5	18.4
February	5824	0.0	0.6	25.6
March	6448	0.0	0.7	29.5
April	6240	0.0	0.7	34.7
May	6448	0.0	0.8	51.4
June	6240	0.0	0.9	38.3
July	6448	0.0	0.8	36.7
August	6448	0.0	0.7	34.7
September	6240	0.0	0.6	31.5
October	6448	0.0	0.5	24.3
November	6240	0.0	0.6	24.9
December	6448	0.0	0.5	15.3

Table 4: Slick Survival Statistics Using Delvigne and Sweeney Dispersion Algorithm in SL Ross model for Surface Blowout Cohasset Crude

Month	Number of Slicks Tracked	Percentage of Slicks Surviving in Time Range (days)				
		0 to 0.5	0.5 to 1.0	1.0 to 3.0	3.0 to 5.0	5.0 to 10.0
January	6448	84.0	11.6	4.3	0.1	0.0
February	5824	67.0	17.2	14.9	0.9	0.0
March	6448	64.7	17.4	16.1	1.8	0.1
April	6240	57.3	17.6	21.2	3.1	0.8
May	6448	43.5	18.3	29.8	6.8	1.6
June	6240	38.4	17.5	34.0	8.3	1.8
July	6448	38.0	17.6	33.7	8.0	2.7
August	6448	46.5	19.6	28.6	4.9	0.4
September	6240	62.3	17.6	17.8	2.2	0.1
October	6448	75.3	14.8	9.3	0.6	0.0
November	6240	81.0	12.6	6.3	0.1	0.0
December	6448	83.8	11.3	4.9	0.0	0.0
All Months	75800	61.8	16.1	18.4	3.1	0.6

6. Summary

The following points support the validity of the original SL Ross modelling work as appropriate for the Old Harry EA:

- Evidence has been provided from EC's own dataset and actual documented spill examples that the light, Cohasset oil surrogate will **not** emulsify. Therefore only modelling results that exclude emulsion formation are appropriate in this case. Note that the ASA modelling (September 20, 2012) used an emulsification factor only to demonstrate that a model of the Cohasset oil will emulsify if the default values in OILMAP are used. ASA notes that emulsification is not appropriate for a very light oil such as Cohasset;
- Actual spill examples and scientific references are provided as evidence that natural dispersion plays an important role in the fate of diesel and the light, Cohasset crude oil used as a surrogate for the potential Old Harry product;
- Scientific references presented in this report indicate that natural dispersion will occur as long as breaking waves are present and breaking waves are known to begin in offshore waters at wind speeds as low as 7 knots (3.6 m/s);
- It is Corridor's view, in agreement with SL Ross, that spill models appropriate for Old Harry should account for natural dispersion through the full range of wind speeds when breaking waves are present;
- Winds greater than 10 knots (5 m/s) exist in the vicinity of the Old Harry project for more than 50% of the time in all seasons, so wind speeds higher than 10 knots need to be considered when looking at realistic modelling scenarios;
- The full variability of winds in the region has been accounted for in past modelling efforts through the use of the 52 years of hourly MSC 50 time series wind data, which is the most appropriate dataset to use in our view; and
- New modelling by SL Ross using a natural dispersion cut-off at 10 knot (5 m/s) wind speeds shows that the area potentially impacted from the operations is small, would not interact with any shoreline, and would not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such that it would change EA conclusions).

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Appendix I

Corridor Resources Inc. (Corridor's) Detailed Responses to Environment Canada's January 25, 2013 Letter

Environment Canada Comments	Corridor Responses	Reference
In their letter, the proponent refers to a report authored by ASA, proprietor of the Oilmap software used by EC, in its initial review of the proponent's Oil Spill Modelling Report. EC has reviewed the additional information and provides a detailed response in the attached report. The key points within the report are summarized within this letter. Both the ASA modelling presented by the proponent and the EC modelling results show the potential for significant amounts of oil remaining on the water for 20 to 25 days under normally expected conditions.	The 20 to 25 day persistence is only predicted if the oil is assumed to form a water-in-oil emulsion. The oil chosen as a surrogate for the Old Harry Prospect will not form an emulsion based on EC's own analysis of the oil. The SL Ross modelling, and a subset of the ASA modelling, assumed that emulsions would not form, which is in agreement with EC published data. The author of the ASA report (dated September 20, 2012) stated on page 5 of his report that "additional simulations were run with a maximum water content of 0% assuming that the Cohasset oil does not emulsify. This is a reasonable assumption as the Environment Canada data indicate that the Cohasset Crude has a zero emulsion formation tendency up to 25.6 percent volume evaporation." The key issue here is the persistence of slicks of light crude from an exploratory well blowout at the Old Harry Prospect. There have been two actual blowouts from offshore wells involving similar crudes: the Uniacke blowout off the coast of Nova Scotia in 1984 and the Elgin blowout off Scotland in 2012. In both of these actual incidents, the surface slicks generated by the blowouts dissipated in less than 24 hours, which supports the SL Ross view that rapid natural dispersion will occur. • Uniacke Blowout (Environment Canada, 1984). Environment Canada's own publication describing the fate of oil from the Uniacke blowout off Nova Scotia's shore indicates that the oil completely evaporated and naturally dispersed and was not present on the surface less than 24 hours after the blowout was stopped (Environment Canada, 1984). The oil released in this blowout had a very similar API gravity to that of Cohassett crude and the winds between the well kill and the overflight that could find no oil were approximately 8 knots or 4.2 m/s.	File No. 4194-10 letter, Page. 1

	• Elgin Blowout (Government of Scotland, 2012). Reports from the Elgin platform blowout off Scotland in 2012 indicate that the oil released during this event evaporated and naturally dispersed within 24 hours (http://www.scotland.gov.uk/Resource/0039/00394137.pdf).	
The SL Ross modelling, therefore, is the outlier of these three reports. Specifically, using the corrected Cohasset Crude specification (ASA report, Figure 4) at wind speeds of 10 knots or less, encountered 40% of the time in summer, the ASA report indicates 20% of oil remaining on water after 3 days compared to the 25% predicted by EC using Oilmap 4.3, and 0% predicted in the SL Ross model.	The EC report that presently resides on C-NLOPB website (dated 24/05/2012) indicating that 95% of the oil will remain on the surface after 3 days using the OilMap 4.3 is in stark contrast to the 25% identified above. Subsequent reports by Environment Canada (dated March 31, 2012 and July 2012) report 25% remaining with no explanation of the reason for the difference between earlier and more recent EC documents. If the EC report residing on the C-NLOPB website is in error and the 25% value reported above is considered the correct EC result, as previously requested, the old report should be removed from the C-NLOPB website. Unfortunately, the public has reviewed a report that appears to contain inaccurate information.	File No. 4194-10, Page 1
All of the models show that wind speed is a significant factor in the eventual fate of the oil. It is therefore important that the modelling use wind speeds that can reasonably be expected in the area.	The original oil spill modelling completed by SL Ross for Corridor Resources used over 50 years of wind data from the Meteorological Service of Canada (a part of Environment Canada formerly called the Atmospheric Environment Service - AES): the MSC 50 data set. These data are considered very representative of the winds occurring in the vicinity of the proposed exploration site and provide a spatially and temporally varying wind data time series for the region. We strongly believe that this is the best wind data set for offshore oil spill fate and behavior modelling. SL Ross has successfully used this wind data for oil spill modelling in dozens of spill modelling projects on Canada's east coast and a similar MSC wind data set for the Beaufort Sea.	File No. 4194-10, Page 1
The SL Ross cover letter emphasizes this point when it states "The estimated persistence of the Cohasset crude by the two models (Oilmap and SLROSM) is not too different from an offshore spill response and impact perspective, with the exception of 10 knot wind speeds." Yet, as indicated in the screening report, wind speeds of 10	Realistic wind historical time series have been used by SL Ross in the fate and behavior modelling completed for Corridor Resources as described above. These wind histories accurately portray the magnitudes of wind speeds and directions as well as their persistence, including calm wind periods. The issue is not that winds of 10 knots (5 m/s) or less occur. The issue is whether natural dispersion of oil occurs under wind speeds below 10 knots. There is evidence that light oils will disperse as long as breaking waves exist.	File No. 4194-10, Page 1

knots or less occur frequently and are well within the bounds of probability. Even if the average wind speed was higher, any regular occurrence of lower wind speeds would need to be considered if one wants to be conservative when modelling.	The universally accepted Beaufort Wind Scale indicates, in winds from 7 to 10 knots (3.6 to 5.144 m/s), that wave crests break and scattered whitecaps exist in open water areas. Evidence is provided in the main body of this response to support the contention that dispersion of light oils will occur as long as breaking waves exist and that for very light oils, like Cohasset crude, the 5 m/s dispersion cutoff used in the Delvigne and Sweeney (1988) algorithm employed by Environment Canada may be too conservative.	
A further key consideration is the fate of entrained oil. Once dispersed into the water column the droplets remain buoyant and will resurface. The ASA report states that "Under changing wind conditions where wind speed drops below 10 knots the entrained oil could rise to the surface and form a slick." Thus natural dispersion is not a sink of oil but merely a temporary reservoir.	Some portion of naturally dispersed oil (the larger oil drops), but not all (the smaller oil drops), may rise during periods of calm but the re-surfaced oil will be re-entrained during the periods of heavier seas. Natural dispersion is recognized as a potential 'sink' for oil in all oil spill models including ASA's OilMap products.	File No. 4194-10, Page 1
Given that wind speeds below 10 knots are a regular occurrence, especially during the season where drilling is likely to take place, the ultimate fate and potential effects of this oil should be considered.	As identified above, the original modelling completed by SL Ross utilized historical wind time series (MSC50) that included fully representative seasonal winds. A sample of the statistical variation of the wind data used in the modelling is provided in Section 5 of the main body of this report. Winds greater than 10 knots exist in the area in higher regularity than those 10 knots or less throughout all seasons (i.e. greater than 50% of the time).	File No. 4194-10, Page 2
Cohasset oil has been identified as a probable surrogate for modelling purposes only. We should be mindful that the characteristics of any oil occurring at Old Harry are unknown. We therefore recommend that the Assessment take a conservative approach appreciating the limitations of working with surrogates for an unknown crude oil.	A detailed description of the scientific approach undertaken by Corridor to identify a suitable surrogate oil is provided in the EA. In summary, Corridor undertook geochemical studies to identify the types of organic material in the shale rocks; conducted petroleum systems modelling to simulate the type of hydrocarbons that may be generated from the organic material; and compared the geological setting of the basin and the modelled oil to other areas to identify a suitable surrogate. The modelling showed that, based on the organic material in the shale, the hydrocarbons likely to be encountered at Old Harry would be very light oils and natural gas with API gravity between 45 and 56 degrees (Cohassett oil is 47 degrees API). It	File No. 4194-10, Page 2

	should be noted that of the 10 wells drilled in the Gulf of St Lawrence, half of them encountered non-commercial quantities of natural gas and none encountered oil. In addition, the geological formations found at the Old Harry site compare favourably to the geological conditions in the Scotian Basin. That is, both basins are rift type basins, were deposited in fluvial-deltaic environments, and both contain natural gas and light oil prone shale rocks. For these reasons, oil spill modelling that assumes the best available Cohassett oil properties (those from Environment Canada's own analysis) are considered appropriate for the project. Cohasset crude did not form water-in-oil emulsions when tested by Environment Canada and has 0% asphaltene content (another strong indicator that this oil will not form an emulsion). See the Appendix II for published dataset from Environment Canada.	
Finally, the Board should consider that the ASA modelling is limited to batch spills of 10,000 litres. The screening report also includes modelling of a 10-day blow out. Since the ASA model predicts persistence of oil on water longer than a few hours, the proponent should revisit their blow-out modelling as well.	SL Ross has conducted new modelling of surface oil well blowouts using the SL Ross model, recompiled with the Delvigne and Sweeney (1988) dispersion algorithm employed by ASA. The details of this modelling, as well as a comparison of these results with those presented in the original modelling report prepared for Corridor Resources, is provided in Section 5 of the main report. The results show that spills of Cohasset crude from the Old Harry site would not interact with any shoreline, (based on modelling using 52 years of historical wind data), and would not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such that it would change the conclusions of the EA).	File No. 4194-10, Page 2
EC recommends that a more conservative modelling approach should be taken, considering that the type of oil and its characteristics are unknown and wind conditions variable.	As discussed above, due diligence was undertaken by Corridor Resources to identify an appropriate surrogate oil for modelling purposes and industry-recognized, long-term historical wind data was used in the modelling.	File No. 4194-10, Page 2
Furthermore, EC recommends that the C-NLOPB subject the proposed undertaking to a modelling exercise based on conservative scenarios, and base subsequent impact predictions and oil spill	New modelling has been conducted using the more conservative Delvigne and Sweeney dispersion algorithm. The results of this modelling show a slightly larger potential surface oil footprint than that identified in the original modelling, but not anywhere near the size suggested by the Environment Canada modelling. The new	File No. 4194-10, Page 2

readiness on those outcomes.	modelling confirms that a potential spill is not likely to impact any shorelines and these results do not affect the conclusions of the EA Report, which had assumed no shoreline contact.	
The major concern with the proponent's model is that they predict that any oil from the Old Harry release will dissipate within one day. This is quite unrealistic and has never occurred in the history of oil spills.	Environment Canada's own publication (Environment Canada, 1984) describing the fate of oil from the Uniacke blowout off Nova Scotia's shore indicates that slicks extended only a few kilometres from the stricken platform and the oil (actually slightly more dense than Cohassett) was not present on the surface less than 24 hours after the blowout was stopped. Reports from the Elgin platform blowout off Scotland in 2012 also indicate that the light oil released during this event evaporated and dispersed within 24 hours and extended only a short distance from the platform (http://www.scotland.gov.uk/Resource/0039/00394137.pdf). Reports of diesel spills that have dissipated within a day or two of release include the Arthur J Barge in Lake Huron, the F/V Rough Seas off New Jersey, the USS New Orleans off California, and the Katsheshuk off Newfoundland. Additional details on these spills are provided in Section 4 of the main report. Based on these actual examples, SL Ross's modelling is realistic and appropriate. Other respected agencies have different opinions than those of Environment Canada on the possible behaviour of light oil and diesel spills. • For example, the US National Oceanic and Atmospheric Administration's (NOAA's) Office of Response and Restoration states on its website: "Small diesel spills will usually evaporate and disperse naturally within a day or less. This is particularly true for typical spills from a fishing vessel (500-5,000 gallons), even in cold water. Thus, seldom is there any oil on the surface for responders to recover." (http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html). • The International Tanker Owners Pollution Federation (ITOPF) states: "Group I oils (non-persistent oils with densities less than 0.8 g/cc) tend to dissipate completely through evaporation within a few hours and do not normally form emulsions." (http://www.itopf.com/marine-spills/fate/models/). The density of	Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2

	Cohasset crude oil is 0.79 g/cc at 15 °C based on Environment Canada measurements. • The French government research group Centre of Documentation, Research and Experimentation on Accidental Water Pollution (Cedre) indicates that "fluid oils can disperse totally within a few days." (http://www.cedre.fr/fr/publication/colloque/obs/1_oil_charater_beha.pdf). • The American Petroleum Institute (API, 1999) states that "Following evaporation, natural dispersion is the most important process in the breakup and disappearance of a slick."	
Actual evaporation data of Panuke oil a sister of Cohasset oil. What can be better than actual data?	The modelling completed by SL Ross and ASA uses data for Cohasset crude oil prepared by Environment Canada. This includes actual evaporation data for the Cohasset crude oil and is the most appropriate dataset to use.	Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2a
Modelling of Cohasset as that, with the correction that natural dispersion in the models is reduced and then removed, also as a light crude oil in both ADIOS and both ASA models- still all approaches yielded about the same results.	Based on Environment Canada's own published dataset and what is known about the properties of the Cohasset oil, it is unclear as to Environment Canada's justification for modelling the fate of Cohasset with natural dispersion reduced from their own published data or turned off completely in the modelling exercise. Natural dispersion is recognized as an oil spill fate process, especially important for light oils that do not emulsify. In a recent book on oil spill science and technology, it was noted "Depending on oil conditions and the amount of sea energy available, natural dispersion can be insignificant **or it can remove the bulk of the oil (emphasis added)**. Heavy oils such as Bunker C or a heavy crude will not disperse naturally to any significant extent, **whereas diesel fuel and even light crudes can disperse significantly if the saturate content is high and the asphaltene and resin contents are low (emphasis added)** (Fingas, 2011). No results from ADIOS modelling have been presented in any of the reports provided by Environment Canada so we cannot comment on	Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2c

<table>
<tr><td></td><td>the statement comparing the results of ADIOS and OilMap results.</td><td></td></tr>
<tr><td>Modelling of the Cohasset oil using ADIOS II- this is the second-most used model in the world. ADIOS II yields similar results as the OiiMap model.</td><td>No results from ADIOS modelling have been presented in any of the reports provided by Environment Canada so we cannot comment on the validity of the statement.</td><td>Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2d</td></tr>
<tr><td>There was concern that the SL Ross model is not peer-reviewed, used by others and is relatively unknown.</td><td>SL Ross has been responsible for the modelling of the fate and behavior of potential spills for almost all of the exploration and development operations on Canada’s east coast since the early 1980’s. A list of some of the operations for which SL Ross has completed oil spill modelling for EA purposes on Canada’s east coast is included below. These reports have all been reviewed and accepted by the appropriate government agencies, including Environment Canada, over this extensive time period. We respectively submit that the model is well known in the region.

SL Ross has modelled the fate and behavior of hypothetical blowouts and batch spills from various exploration and development projects on Canada's East Coast using their SLROSM software. These modelling efforts include, but are not limited to, the projects outlined in the table below:
<table>
<tr><th>Operator</th><th>Projects</th></tr>
<tr><td>Husky Energy Inc.</td><td>Sydney Basin; White Rose; and White Rose Extension</td></tr>
<tr><td>Canadian Superior</td><td>Mayflower; Marconi and Marauder</td></tr>
<tr><td>Marathon Canada Petroleum LLC</td><td>Cortland and Empire</td></tr>
<tr><td>PanCanadian Ltd</td><td>Deep Panuke</td></tr>
<tr><td>Shell Canada Ltd</td><td>Man-O-War</td></tr>
<tr><td>ExxonMobil</td><td>Hibernia and Cree</td></tr>
<tr><td>Imperial Oil Ltd</td><td>EL 2378/2379</td></tr>
</table></td><td>Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2f</td></tr>
</table>

	PetroCanada: Terra Nova; Flemish Pass; Sweet Bay; Tucamore; and Mizzen Chevron Canada: Orphan Basin Deep Water Conoco Phillips: Laurentian Channel and Labrador SEA	
Corridor Resources hired ASA to model the same spills but only gave them the winds of 10 to 20 knots- in reality too high.	The modelling completed by ASA was designed to provide OilMap model results as prepared by an expert in the use of the model software to compare with the EC results which appeared to be questionable for light oil and diesel spills. It was an exercise to determine if there were errors in EC's use of the OilMap software. The early EC modelling results (dated 25/04/2012, report presently on C-NLOPB website) indicated that 92 % of the volume of a 10,000 litre batch of light non-emulsifying crude oils and 30% of the volume of a 1000 litre batch spill of diesel would persist on the surface after 10 days. The EC reports also indicate that up to 70% of Cohasset crude could evaporate within 10 days. This inconsistency in statements, along with other issues in the web-posted EC modelling results, led to the commissioning of ASA to conduct independent modelling. The EC report dated March 31, 2012 also indicated that Cohasset oil and diesel spills would persist on the surface for over 30 days. Such long-term persistence of light oils and diesel fuel is contrary to actual spill experience and the general understanding of the fate of offshore spills of products of these types. This is supported by the NOAA, ITOPF, Cedre and API descriptions of the general behavior of these products reported above.	Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2f
In fact the winds of 10 knots yielded almost identical result to that produced by Environment Canada, showing that indeed there is a lot of oil remaining on the surface.	The 10 knot modelling results provided by ASA with rapid emulsification to 74% water content yield nearly identical results to those presented by EC for evaporation alone in their March, 2012 data report. The EC results from their April web-posted report are very different from both the ASA results and EC's March data report. None of the ASA modelling results using OilMap are 'nearly identical' to EC's modelling results using the OilMap products. This can be	Comments on Issues Related to the Old Harry Modelling Scenarios, Background #

	seen in the comparison graphs presented in Appendix III. Regardless, it is our contention that the modelling results assuming that the Cohasset oil forms an emulsion should not be considered as reasonable or appropriate.	2f
Further at high winds there still is oil remaining at times of concern.	The ASA modelling identified that at 12 knots all oil would be evaporated and dispersed from a spill of Cohasset crude or diesel fuel within 24 hours and 12 hours, respectively, and at 15 knots within 11 hours and 5.5 hours, respectively.	Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2f
A similar situation arose in the DeepWater Horizon spill. That light oil, not too dissimilar from Cohasset, was predicted to also dissipate within a short time by some individuals. This proved to be more than wrong!	The MC252 crude oil spilled in the Deep Water Horizon incident was very different than Cohasset crude oil as it does form an emulsion after evaporating and thus will have longer on-water persistence. Since the modelling referenced in the comment is not provided nor are any references to support the statement, we cannot comment any further on this statement. Oil property data sets for both the Macondo (MC252) and Cohasset crude oils are provided in Appendix II to show their differences in properties. These two oils are different and they should not be described as being similar.	Comments on Issues Related to the Old Harry Modelling Scenarios, Background # 2g
The main issue is that spilled oil simply does not go away. The use of 'natural dispersion algorithms' in oil spill models is incorrect and in recent years has come under heavy criticism. Many major spills in recent times have been modeled and the models predicted that the oil would go away by natural dispersion. The prime example of this is during the Macondo spill which involved a very light oil not too dissimilar from Cohasset.	The contention that natural dispersion algorithms used in all oil spill models is incorrect is not substantiated. SL Ross has validated its spill model results against actual spill events to ensure that their results are representative. As mentioned earlier, the MC 252 crude oil is very different than Cohasset crude in that it is a heavier product than Cohasset and it has been shown to form water-in-oil emulsions both in laboratory tests and in the field.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue
Several models predicted that the oil would be continually dispersed naturally and that none would come ashore. This proved to be more than wrong. Further even with very	After high wind events during the Macondo event, surface oil was difficult to find away from the spill site. This was experienced by SL Ross personnel on two scientific missions during the Macondo spill event. This behavior suggests that natural dispersion did occur	Comments on Issues Related to the Old Harry

high winds, no natural dispersion was observed.	during the Macondo incident.	Modelling Scenarios, 1. The Main Issue
This same phenomenon has been noted in many spills in the past decade.	There are no references provided to support the claim that natural dispersion does not occur in higher winds. On the contrary, several references are provided in Section 3 of the main body of this report that describe natural dispersion. Diesel spills are often not responded to because they are known to evaporate and disperse naturally. See the comments from NOAA, ITOPF, Cedre and API on dispersion of light crude and diesel products above and in Section 4 of the response document.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue
Natural dispersion should only account for a few percent of the oil at any time, under normal conditions. OiiMap 6.7.1 shows that ASA has reduced natural dispersion since OiiMap 4.3.	SL Ross has had discussions with senior ASA oil spill modeller, Chris Galagan, who verified that OilMap versions 4.3 and 6.7.1 both use the same natural dispersion algorithms by Delvigne and Sweeney (1988). He also indicated that other changes to the maximum oil drop size in natural dispersion and the change in oil viscosity with evaporation in OilMap 6.7.1 would result in slightly higher natural dispersion rates than in the older version 4.3. This is contrary to the EC comment.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue Comments on how natural dispersion should look compared to how it does look in Current Models 1.1
This could still go down further. High natural dispersion is not observed at actual spills. This is a much-discussed topic among modellers today. There are plans in ADIOS to scale natural dispersion way back. Natural dispersion should onset at a higher	The work by Delvigne and Sweeny (1988), Milgram et al. (1978), Mackay et al. (1980) and many others has indicated that natural dispersion will occur as long as breaking waves are present and breaking waves are known to begin in offshore waters at wind speeds as low as 7 knots (3.6 m/s).	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main

wind condition- probably more like 30 knots for a light crude oil.		Issue Comments on how natural dispersion should look compared to how it does look in Current Models 1.1 & 1.2
OilMap onsets at just over 10 knots, too low. The only spill that ever showed a high natural dispersion was the Braer spill where the winds reached as high as 80 knots. Much of the oil was sedimented by the high particulate loading in the area. The Deep Water Horizon showed no natural dispersion despite the fact that it was light crude oil (despite many model predictions that it would).	Environment Canada claims that no spill, other than the Braer, ever showed high natural dispersion is unjustified. Many light crude oil and diesel spills have dissipated naturally. Examples have been provided in Section 4 of this response document.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue Comments on how natural dispersion should look compared to how it does look in Current Models 1.2
Natural dispersion should actually decrease over time. This is because the natural dispersion droplets are not very stable and would return to the surface. Dissolved material leaves at the surface similar to evaporation. OilMap models show this tendency to a certain extent, but probably should have a shorter half live of dispersions (probably about a few hours).	The treatment of natural dispersion in oil spill models is based on laboratory measurements of oil drop size distributions measured in the laboratory (Delvigne and Sweeney (1988) and others) and field measurements of oil drop distributions (Lunel 1993 and others). See Section 3 of this response document for a more complete discussion.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue Comments on how natural

		dispersion should look compared to how it does look in Current Models 1.3
Diesel may show some natural dispersion at higher winds, but all current models overdo this- so much so that models are hard to use for diesel spills. Often this is avoided by turning off natural dispersion or by using a different petroleum product in the modelling exercise.	Readers are directed to the NOAA, ITOPF, Cedre and API discussions of the likely fate of light oil and diesel spills provided in Section 4 in the main body of this report for a different view on the fate of diesel spills.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue Comments on how natural dispersion should look compared to how it does look in Current Models 1.4
Naturally dispersed oil does not go away. Models should record a fate for it. Typically it resurfaces. In high mineral particulate areas, oil can sediment to a degree. Current models need to do more in this regard to be more realistic.	Oil considered naturally dispersed by spill models is in the form of small droplets that are permanently held in open ocean water bodies by natural turbulence. The oil droplets diffuse to lower and lower concentrations and are eventually bio-degraded by naturally occurring bacteria. Oil that is dispersed in small droplets by wave action does not resurface to form new oil slicks.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue Comments on how natural dispersion should look compared to how it does

		look in Current Models 1.5
The ASA results are presented for 10,12,15 and 20 knots of wind for both instantaneous discharges of Cohasset and Diesel fuel. Basically the ASA results for Cohasset and Diesel (at 10 knots) are nearly identical to those presented by Environment Canada. Other results also show that there is oil remaining after a period of time. The relevant wind will be dealt with in the next section, but as will be shown, only the 10 knot winds are appropriate because that fits the region and because the natural dispersion model kicks on in the ASA models after 10 knots. This is known to be a problem.	Winds greater than 10 knots exist in the vicinity of the Old Harry project more that 50% of the time in all seasons, so higher wind speeds also needs to be considered when looking at realistic modelling scenarios. The full variability of winds in the region was accounted for in the original Old Harry modelling efforts by SL Ross. An analysis of historical wind speed in the vicinity of the Old Harry site is provided in Section 5 of the main report.	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue The ASA Results 2
It is no surprise that the ASA results are nearly identical to those of Environment Canada since Environment Canada used the models (as well as others) and also the wind level of knots is about the average of the actual winds in the Old Harry area, using the actual winds for the Magdalen Islands.	Please refer to Appendix III for a complete comparison of equivalent ASA and EC modelling results. Even though OilMap products were used by both ASA and EC, model outputs do differ. Modelling results where water-in-oil emulsification formation occurs should not be considered since the Cohasset oil has been shown to not form water-in-oil emulsions (Appendix II).	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue The ASA Results 2
The prime issue of these discussions has been that SLR predicted no oil level at the one day level for all scenarios. It should be noted that the ASA models and the data submitted by Environment Canada show that significant amounts of oil remain on the surface at the one day mark. This necessitates more extensive model by Corridor Resources to show where the oil would go and what its fate would be.	The only model comparisons that are appropriate for the project include those where water-in-oil emulsification does not occur. If the published Environment Canada property data is honoured (Appendix II), then Cohasset crude oil persistence on the surface is limited to less than 24 hours by ASA's predictions assuming 12 knot winds and 120 hours with steady 10 knot winds. It must be stressed, however, that the 10-knot or less winds must persist for the full five day period for the slick to persist for this time period. The SL Ross model results show a higher dispersion of these light oils when the original dispersion algorithm is used and the slicks are estimated to persist	Comments on Issues Related to the Old Harry Modelling Scenarios, 1. The Main Issue The ASA Results 2

	for a few hours. As noted previously, the dispersion algorithms used by ASA may under predict natural dispersion in wind speeds between 7 and 10 knots (See Section 3 in the main report).	
The results of the ASA modelling at 10 knots wind speed are nearly identical to that of Environment Canada's results using actual winds on the Magdalen Islands.	The 10 knot modelling results provided by ASA with rapid emulsification to 74% water content yield nearly identical results to those presented by EC for evaporation alone in their March, 2012 data report. The EC results from their April report are very different from both the ASA results and EC's March data report. No explanation has been provided by EC for these differences. None of the ASA modelling results using OilMap are 'nearly identical' to EC's modelling results using the OilMap products when equivalent runs are compared. This can be seen in the comparison graphs that are included in Appendix III. Regardless, the modelling results assuming that the Cohasset oil forms an emulsion should not be considered in this application (see Appendix II).	Comments on Issues Related to the Old Harry Modelling Scenarios, 2. The ASA Results Comparison of Results – Cohasset Oil
EC Figure 1 - This diagram clearly shows that under the conditions specified, that the Cohasset oil would persist for at least 4 days as predicted by both models and both assumptions. The assumptions are that either high or low dispersion exists. Only the SLR model shows that the dispersion removes all the oil immediately. The issue of whether high or low dispersion is used should be noted here. The Cohasset oil as in the ADIOS data base contains an emulsification factor of 70% which if left, reduces its dispersion very much in either the ADIOS model or the OilMap model. If removed, natural dispersion is large. ASA ran the Cohasset both ways and so did Environment Canada.	ASA only ran their model with emulsification allowed up to 74% to match what they assumed was modeled by EC based on the ADIOS data set for Cohasset. This was a scenario tested to try to determine how the OilMap software could have been used to arrive at results for diesel and a light crude that are contrary to how they are known to behave. ASA indicates in their report that it is reasonable to assume that emulsification will not occur with this oil and also modeled the fate of oil with 0% emulsification. The ASA results with 0% emulsification are the most applicable to the project. This is a critical point in the interpretation of the ASA work.	Comments on Issues Related to the Old Harry Modelling Scenarios, 2. The ASA Results Comparison of Results – Cohasset Oil
ASA claimed that the inclusion of this factor is a corruption of the data base.	The ASA report states: "When data are missing from the database, both the ADIOS and OilMap model utilize default values or calculations based on proxy oils that can have significant effects on	Comments on Issues Related to the Old

	the fate of the oil". "The Cohasset oil specification in the ADIOS database does not include a value for the maximum allowable water content. In the OilMap model, if the maximum water content is not specified, a default value of 0.74 is used for crude oils and the oil is allowed to emulsify to this limit." This is not appropriate for modelling the Cohasset oil which does not form an oil-in-water emulsion.	Harry Modelling Scenarios, 2. The ASA Results Comparison of Results – Cohasset Oil
A check with NOAA shows that these are deliberately put in to reduce dispersion if there is at all a potential for emulsification. In any case, the models were run both ways, so this is irrelevant. In either case the models show that oil still persists for several days at a realistic wind.	Since the published Environment Canada analysis of Cohasset crude oil (Appendix II) shows that it will not form an emulsion, only those model results where emulsion formation was not allowed should be considered. It is our understanding that EC assumed emulsion formation up to 74% in all of their modelling. We have seen no data in the EC reports showing modelling of Cohasset spills with emulsification turned off.	Comments on Issues Related to the Old Harry Modelling Scenarios, 2. The ASA Results Comparison of Results – Cohasset Oil
The batch spill of diesel oil was modeled using the ASA models as described earlier. The following figure shows the comparison between the three model runs: This graph clearly shows that both the ASA and EC models predict that the diesel would persist for at least 3 to 4 days. The SLR model has the oil entirely gone within hours.	Again, this assumes that only 10 knot winds will exist in the study area and that dispersion will not occur in winds less than 10 knots. Winds greater than 10 knots occur more than 50% of the time, even during summer. Therefore, the full range of wind speeds must be considered and, as discussed in Section 3 of this response document, dispersion does play a role in the fate of the diesel oil.	Comments on Issues Related to the Old Harry Modelling Scenarios, 2. The ASA Results Comparison of Results – Diesel Batch Spill
Thus is both cases, the ASA and Environment Canada's predictions are the same - E.g. That the fuels will at least persist for days spilled under conditions that are	A detailed comparison of the diesel modelling results has not been conducted in this review, as much of the same justification for the modelling approach discussed for the Cohasset model results apply for the diesel spills.	Comments on Issues Related to the Old Harry Modelling

relevant to the area.		Scenarios, 2. The ASA Results Comparison of Results – Diesel Batch Spill
A critical point to these discussions is the wind velocity. A high wind speed should not be used unless it is realistic. The current models have a severe limitation, in that at high winds the dispersion portion of the model kicks in and the oil is predicted to disperse naturally to a high degree. Until further scientific work is carried out to fix this, caution must always be taken to model oil spills at winds below the trigger points (typically over 10 knots) as well as at realistic winds. In this case, the winds at about 10 knots are appropriate as analysis of the Magdalen Island winds shows an average of about 10 knots.	Winds greater than 10 knots exist in the vicinity of the Old Harry project in all seasons, so higher wind speeds also need to be considered when looking at realistic modelling scenarios (See Table 1 in the main report). The full variability of winds in the region has been accounted for in past modelling efforts through the use of the 52 years of hourly MSC 50 time series wind data. Section 5 includes a statistical breakdown of the wind speeds from a 52 year history of hourly winds from a site near the proposed Old Harry drill site. This assessment shows that in all month's winds greater than 10 knots are more likely than winds 10 knots or less.	Comments on Issues Related to the Old Harry Modelling Scenarios, 3. Wind Conditions
This small example shows that the winds in the area are highly variable and that a realistic approach would be to use these actual winds rather than an average. If an average were to be used, 10 knots is appropriate. In Environment Canada's modelling, 13 months of actual data from the Magdalen Islands were used. These were grouped by seasons. Thus there are two reasons a wind speed of about 10 knots is appropriate for this modelling: a) It is realistic compared to the actual winds at the closest weather station	Winds greater than 10 knots exist in the vicinity of the Old Harry project in all seasons, so higher wind speeds also need to be considered when looking at realistic modelling scenarios (See Table 1 in the main report). The full variability of winds in the region has been accounted for in past modelling efforts through the use of the 52 years of hourly MSC 50 time series wind data. Section 5 includes a statistical breakdown of the wind speeds from a 52 year history of hourly winds from a site near the proposed Old Harry drill site. This assessment shows that in all month's winds greater than 10 knots are more likely than winds 10 knots or less.	Comments on Issues Related to the Old Harry Modelling Scenarios, 3. Wind Conditions

b) It is in the region of known model stability.		
A small point is that of temperature. It was noted that ASA modelling was carried out at a sea temperature of 10 °C. The sea temperature in the area is typically below this. It is felt that this would not change results significantly, however might increase the prediction of dispersion somewhat. The following graph shows typical sea temperatures between the Magdalen Islands and the Old Harry site.	Average monthly air and water temperatures were used in the original modelling completed for the project (see section 2.3.4, Table 4 of original SL Ross report to Corridor Resources). A single temperature was chosen to complete the ASA modelling to simplify the comparison to the EC and SL Ross results, not to provide a complete picture of oil behavior under different environmental conditions.	Comments on Issues Related to the Old Harry Modelling Scenarios, 4. Temperature
Another issue that should be raised is that of the blowout scenarios. The modelling discrepancies between the SLR and Environment Canada model were also applicable to those scenarios. ASA did not model these. Since these are quite important, the validity of these scenarios need to be addressed. The basic issue is that SLR had predicted that all the oil would be dispersed in the immediate area of the blowout and thus there were no further trajectories or fate necessary. Since similar results would have been obtained by Environment Canada and ASA, it is suggested that the scenarios similar to that created by Environment Canada would still need to be created.	The ASA modelling was completed on batch spills only to provide a basis for comparison with the EC data presented in tabular form in their initial report dated April 25, 2012 and a previous report dated March 31, 2012. The spill volumes used in the ASA modelling were selected to match those used in the batch scenarios presented by EC for as direct a comparison as possible. The primary goal of the ASA modelling was to determine if the EC modelling using the OilMap software was accurate. It has been shown that there is considerable disagreement between the EC modelling results using the ASA OilMap products and the results presented by the expert modellers of ASA. Most, but not all, of the differences between the ASA results and the more recent EC data relate to whether or not the oil is allowed to emulsify. There are even more significant differences between EC's modelling results posted on the C-NLOPB website in their initial report (dated April 24, 2012) and the ASA results. Section 5 of this report contains new modelling completed by SL Ross using the Delvigne and Sweeney (1988) dispersion algorithm (used by ASA in their model) to replace the original SL Ross dispersion algorithm. The results are compared to the original blowout modelling analysis completed by SL Ross to demonstrate that the ultimate difference in oil behavior using the less aggressive dispersion model does not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such	Comments on Issues Related to the Old Harry Modelling Scenarios, 5. Blowout Scenarios

	that it would change EA conclusions). It is our view that additional modelling is not warranted.	
Since the ASA modelling confirms that oil will still persist after a few days, as Environment Canada has more modelling needs to be carried out. Further the modelling should use: Realistic winds such as the data sets from the Magdalen Islands	Section 5 of this report contains new modelling completed by SL Ross using the Delvigne and Sweeney (1988) dispersion algorithm (used by ASA in their model) to replace the original SL Ross dispersion algorithm. The results are compared to the original blowout modelling analysis completed by SL Ross to demonstrate that the ultimate difference in oil behavior using the less aggressive dispersion model does not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such that it would change EA conclusions). It is our view that additional modelling is not warranted. The 52 year long Meteorological Service of Canada wind data (MSC50 data set) used by SL Ross in the original oil fate and behavior modelling effort is the best wind data available for this application.	Comments on Issues Related to the Old Harry Modelling Scenarios, 6. What Actions are Required
Stochastic models to ensure that all probabilities are accounted for	The original modelling investigated the behavior and trajectory of spills released on every day over a 52 year period. As such, the modelling investigated the widest possible range of oil fate and trajectory.	Comments on Issues Related to the Old Harry Modelling Scenarios, 6. What Actions are Required
Models that do not over-emphasize natural dispersion or with that factor turned down	New modelling has been completed by SL Ross using the Delvigne and Sweeney (1988) dispersion algorithm in use by ASA in their OilMap product and is presented in Section 5 of this report. The fate and trajectory of the surface oil released on a daily basis over a 52 year period from surface oil blowouts has been provided. The results show a somewhat larger footprint than presented in the original SL Ross report to Corridor Resources as would be expected due to the reduced natural dispersion predicted by the Delvigne and Sweeney algorithm with winds between 3.6 and 5 m/s (7 to 10 knots). The area that could be potentially impacted from the operations is still small,	Comments on Issues Related to the Old Harry Modelling Scenarios, 6. What Actions are Required

	would not interact with any shoreline (see Figure 2), and would not result in any material change from an EA perspective (i.e., the zone of influence is not materially affected such that it would change EA conclusions).	
Verification by several models and approaches to ensure that anomalies do not occur	The extensive comparison of model results from ASA and SL Ross that has been completed to date demonstrates a more than adequate effort to ensure that the model results are reasonable for the intended purpose of the modelling, that being environmental impact assessment of a single exploratory well.	Comments on Issues Related to the Old Harry Modelling Scenarios, 6. What Actions are Required
Modelling on all the oil released, without removal by questionable processes	The modelling completed by SL Ross and ASA utilizes common oil fate and behavior process algorithms employed by the industry and no oil is removed "by questionable processes" by these models. Different models may use different process algorithms as is the case with the dispersion algorithms that have been discussed. A case can be made for different dispersion methods based on field and laboratory data. Which model is best for a specific application can only be determined after a spill has occurred and if sufficient data is collected on the oil properties, weather conditions and ultimate fate of the oil to permit a detailed modelling of the event. Such data is rare.	Comments on Issues Related to the Old Harry Modelling Scenarios, 6. What Actions are Required
Environment Canada has carried out this type of modelling and the proponents are welcome to use these scenarios if they wish.	The original EC modelling results (March, 2012) appear to be in error. Corridor is of the opinion that its consultants, SL Ross and ASA, have conducted sufficient modelling for the purposes of environmental assessment for a single exploration well. The additional information contained within this Corridor response, in conjunction with information contained within previous responses, adequately characterize the potential fate of oil for EA purposes, in the unlikely event that a spill or blowout occurs.	Comments on Issues Related to the Old Harry Modelling Scenarios, 6. What Actions are Required

Appendix II

Comparison of Physical Oil Properties of Fresh and Weathered Macondo (MC252) and Cohasset Crude Oil

Oil	Cohasset Crude Oil			MC 252 Crude Oil (BP Macondo Spill)			
Data Source	Whiticar et.al. 1993			Lehr et al. 2010			
Evaporation Loss (Volume %)	0	11.2	25.6	0	34.5	44.7	54.8[1]
Density @ 15 °C	0.7900	0.8046	0.8469	0.839	0.882	0.897	
Kinematic Viscosity (cSt) @ 15 °C	2.06	2.7	4.83	4.8	49	95	
Pour Point (°C)	-30	-18	-12	<-9	6	6	
Emulsion Formation Tendency	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely	Likely
Emulsion Formation Stability	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable	Stable
Emulsion Water Content (%)	0	0	0	0	0	0	57

Notable differences in oils include:

- Lower fresh and weathered densities and viscosities for the Cohasset crude compared to MC252
- Higher pour points for the MC252 crude
- Emulsions formed for the heavily weathered MC252 crude. No emulsions were found to form in tests with the Cohasset crude. Emulsions were observed to have formed during the BP Macondo incident (MC 252 oil), but not during the Shell Uniacke G-72 incident (Environment Canada, 1984, where oil very similar to Cohasset crude was spilled)

References

Environment Canada. 1984. Summary Report of the Regional Environmental Emergencies Team (REET) Involvement in the Uniacke G-72 Blowout Volume 1. Prepared for COGLA-NS by Environmental Emergencies Division, Environmental Protection Service Atlantic Region.

Lehr, B., S. Bristol, A. Possolo. 2010. Oil Budget Calculator Deepwater Horizon TECHNICAL DOCUMENTATION. A Report to the National Incident Command. Appendix B

Whiticar, S., M. Bobra, M. Fingas, P. Jokuty, P. Liuzzo, S. Callaghan, F. Akerman, J. Cao. 1993. A Catalogue of Crude Oil and Oil Product Properties (1992 Edition). Report EE-144, February 1993.

Appendix III

Comparison of ASA OilMap and Environment Canada OilMap Modelling Results for a 10,000 Litre Cohasset Oil Spill

A number of oil spill modelling results and reports have been presented to the C-NLOPB pertaining to the oil spill modelling component of the environmental assessment (EA) for the single well Old Harry Exploratory Drilling Project. In an effort to help the reader develop an understanding of the various modelling results, a comparison of key modelling results as described in the various summary reports is presented herein, namely:

- Environment Canada (EC) OilMap modelling report dated April 24, 2012[1]: This report describes in their Table 1 very low evaporation and dispersion rates for Cohasset oil for a hypothetical 10,000 litre batch spill.
- EC OilMap modelling report dated March, 2012[1]: This report describes in their Table 1 higher and more reasonable evaporation rates, based on EC measured oil properties, than the April report. ASA OilMap modelling report dated September 20, 2012: This report was completed only on 10,000 litre batch spills to provide a basis for direct comparison with the EC data presented in the aforementioned reports. The spill volumes used in the ASA modelling were intentionally selected to match those used in the batch scenarios presented by EC in their April and March, 2012 reports.

Published oil property data from EC is presented in Appendix II for Cohasset crude. The EC spill model results for the 10,000 litre Cohasset spill from their April and March reports are very different (see Figure A-III-1 below) and are not consistent with the published Cohasset oil property data. No explanation has been provided by EC for these differences.

The primary goal of the ASA modelling was to compare the oil mass balance for surface, evaporated and entrained oil for two different specifications of Cohasset crude and one diesel product. However, the focus of this summary document is the Cohasset crude specifications. The modelling was completed by ASA expert modellers under three different constant wind conditions, namely 10, 12 and 15 knots. The ASA modelling results were compared to the EC modelling to better understand the low evaporation and dispersion rates reported by EC in their April and March reports. This comparison is presented in Figures A-III-1 and A-III-2.

As mentioned above, two specifications of Cohasset crude oil were used in the ASA modelling: 1) published oil specification from EC; and 2) the default oil specification from the OilMap software. The default oil specification from the OilMap software database (ASA, 2012) does not include a value for the maximum allowable water content (emulsification).

[1] The EC Reports are presented in this Appendix in the order in which they were received by Corridor (i.e. the April 24, 2012 report was downloaded from the C-NLOPB website after receipt of the April 25, 2012 consolidated comments, and the March, 2012 report was received on July 17, 2012.

In the OilMap software, if the maximum allowable water content is not specified, a default value of 0.74 is used for crude oils. The default oil specification for Cohasset crude in OilMap does not include a value for the maximum allowable water content and, therefore, the default value of 0.74 is used (ASA, 2012). The implications of this are that the default crude specification for Cohasset oil in the OilMap software allows the Cohasset oil to emulsify to 74% water content. This value is appropriate for many crude oils, but it is not appropriate for a very light crude oil such as Cohasset (ASA, 2012), with a zero emulsion formation tendency up to 25.6 percent volume evaporation (Appendix II).

Figures A-III-1 and A-III-2 present a comparison of the various modelling results for the percentage of oil remaining on the surface for a hypothetical batch spill. The presentation of the EC modelling results is the same in both figures. The key difference between the figures is the Cohasset crude oil specification used by ASA (2012). Figure A-III-1 presents a comparison of the EC results with the ASA results for Cohasset oil specification published by EC (without emulsification) and Figure A-III-2 presents a comparison of the EC model results with the ASA modelling results for the default Cohasset oil specification from the OilMap software (with oil emulsification).

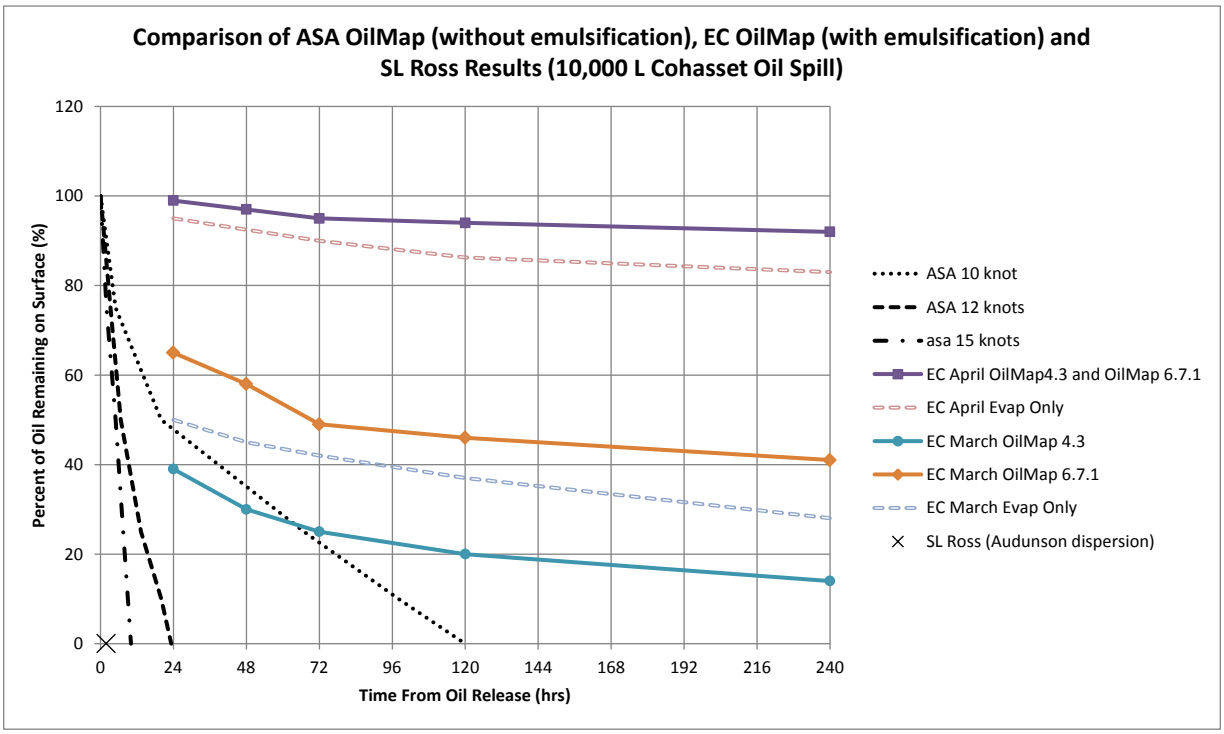

Figure A-III-1: A comparison of the EC results with the ASA (2012) results for Cohasset oil specification published by EC (without emulsification).

The EC results presented in the April, 2012 report are shown in Figures A-III-1 and A-III-2 by the purple solid line and the pink dashed line (see legend at right side of figure). These curves show more than 80% of Cohasset crude oil remaining on the surface for full 240 hours (10 days) presented in the graph. Similarly, the EC results presented in the March, 2012 report are displayed in the figures by blue and orange solid lines and a blue dashed line. These curves show between approximately 40% to 65% of Cohasset crude remaining on the surface at 24 hours and between approximately 15% to 40% remaining on surface after 240 hours.

Although the EC results presented in Figures A-III-1 and A-III-2 are the same, the ASA results are significantly different in the two figures depending on the Cohasset oil specification used. Note that the ASA results are presented according to wind speed. In Figure A-III-1, the ASA model results indicate that all of the Cohasset oil (based on EC published data) will disperse or evaporate within about 10, 24 or 120 hours for wind speeds of 15, 12 or 10 knots, respectively. None of the ASA (2012) model results from OilMap for the Cohasset oil specification published by EC agree with the April or March EC model results from OilMap.

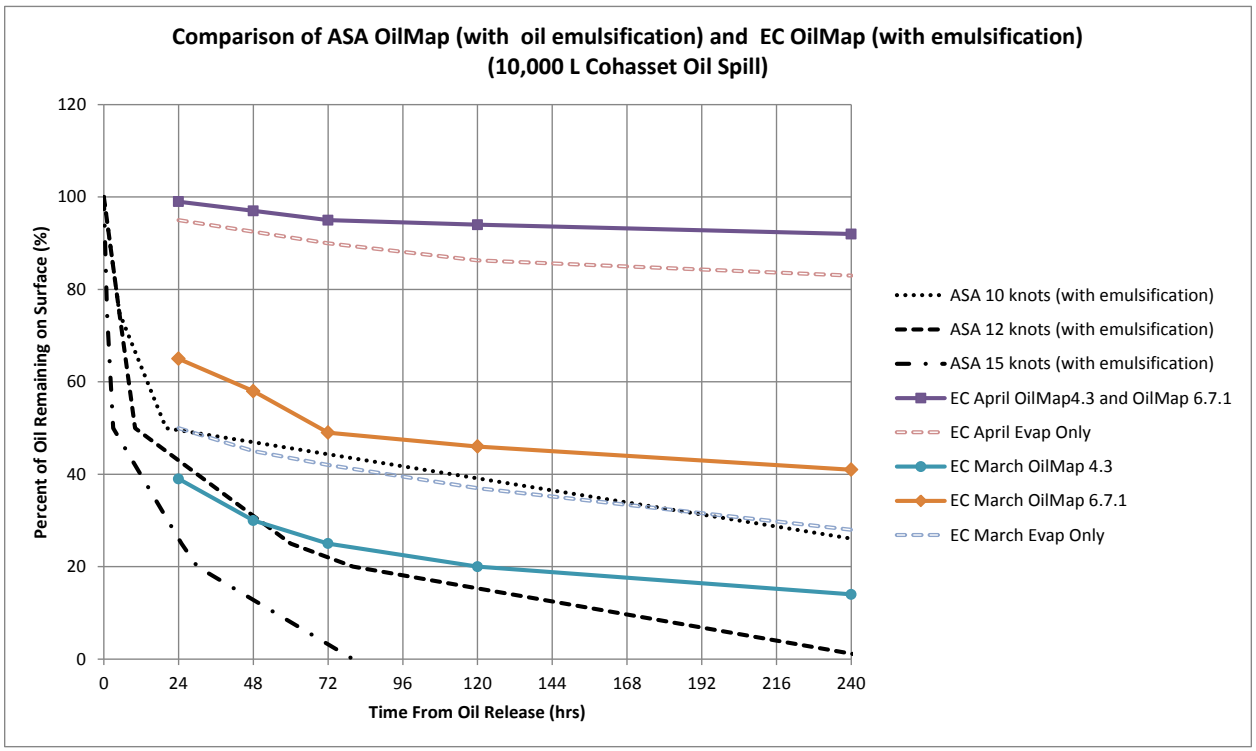

Figure A-III-2: A comparison of EC modelling results with the ASA modelling results for the default Cohasset oil specification from the OilMap software (with oil emulsification).

Figure A-III-2 shows a comparison of the ASA (2012) model results for the default Cohasset oil specification from the OilMap software (i.e. with oil emulsification). The ASA model results show a significant amount of oil remaining on the surface for the three modelled wind speeds, and the curves representing the 10 and 12 knot winds speeds are similar to some of the EC results presented in the March, 2012 report. In fact, the 10 knot curve (black dotted line) for the ASA model results with rapid emulsification to 74% water content for the 10 knot winds speed is nearly identical to the EC curve (blue dashed line) for **evaporation only** from the March, 2012 report. The March EC OilMap 4.3 and 6.7.1 results lie below and above the ASA OilMap 10 knot wind speed results, respectively. This may suggest that the EC modelling work presented in the April and March reports used Cohasset oil specifications that included an emulsification factor rather than the published EC Cohasset oil specification.

Based on the foregoing discussion, it would appear that most, **but not all**, of the differences between the ASA results and the EC model results relate to whether or not the Cohasset oil is allowed to emulsify. We emphasize that **not all** of the difference in results is due to emulsification because none of the EC results using OilMap closely match the ASA OilMap modeling results (ASA, 2012). The closest match exists between the ASA 10 knot wind modelling with oil emulsification and the EC March evaporation only results. ASA (2012) indicates in their report that it is reasonable to assume that emulsification will not occur with the Cohasset oil. Since the published EC analysis of Cohasset crude oil (Appendix II) shows that it will not form an emulsion, only those model results where emulsion formation was not allowed should be considered for spill models involving Cohasset crude oil (i.e. those models that used the published EC Cohasset crude specification).

Reference

ASA, 2012. Results from Model Simulations of Cohasset Crude. Contract Report Submitted to Corridor Resources, September 20, 2012, 14 p.

ATTACHMENT 4

Corridor Responses to Environment Canada and DFO Comments Received on August 20, 2013 from the C-NLOPB (September 11, 2013)

September 11, 2013

Ref: 10-L-0056-13

Ms. Elizabeth Young
Environmental Assessment Officer
Canada-Newfoundland and Labrador Offshore Petroleum Board
5th floor, TD Place, 140 Water Street
St. John's, NL A1S 6H6

RE: Corridor's Response to Comments Received on August 20, 2013, from the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), regarding the Old Harry Environmental Assessment

Dear Ms. Young,

Thank you for forwarding the comments from the regulatory authorities and the Ecojustice letter regarding our Old Harry Environmental Assessment (EA). The final set of comments was received by Corridor on August 20, 2013. Corridor Resources Inc. (Corridor) and its consultants are proud of the tremendous amount of effort we have collectively put into the development of our EA, and we appreciate any science-based feedback that will enhance its quality. Corridor has worked diligently and sincerely in responding to regulatory review comments on the Old Harry EA. This EA process for the drilling of a single exploration well at Old Harry is now in its third year and we look forward to the conclusion of this process and a timely determination on the Old Harry EA.

With respect to the comments, Corridor has consulted with SL Ross Environmental Research (SLR) and Stantec Consulting Ltd. (Stantec) in the preparation of our responses, which are included in attachments to this letter. As you know, our consultants have a depth of experience and have worked for most of the oil and gas companies operating offshore in Eastern Canada. Attachment #1 includes our response to the regulatory agency comments and Attachment #2 includes our response to the Ecojustice comments. This submission will constitute an update to our EA document instead of another full revision of the EA main document, as previously discussed with you.

To put our responses in Attachment #1 in context, although Environment Canada (EC) has noted several remaining issues, they also note that there is little to be gained by further iterations of this exercise. Corridor has provided some comments on the issues and clarifications of the work we have completed, and we agree with EC that there is little to be gained by further iterations of this exercise. The latest comments from Fisheries and Oceans Canada (DFO) have also been addressed in the table in Attachment #1. Corridor does believe that the spill modeling conducted by its consultants provides an appropriate level of scientific rigor. As with any scientists who are studying an issue, there are often variations in scientific opinion on certain aspects of the work or research.

With respect to the Ecojustice comments, Corridor would like to highlight that some of the issues identified by this group are broader in nature than the scope of the Old Harry EA and the review of a single exploration well at Old Harry, and as such are perhaps more appropriate for consideration by the C-NLOPB and other government agencies. Some of the comments, in particular those related to spill modeling that do specifically relate to the drilling of a single exploration well at Old Harry, have already been covered through Corridor's responses to other regulatory agency questions on spill

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Modeling. Therefore, in Attachment #2 Corridor has summarized where appropriate, instead of repeating in detail, responses already provided in previous submissions.

In addition to completing an EA, there are many other elements that comprise an application to drill an offshore exploration well. The Acts and Regulations outline the detailed submissions that must be vetted and approved by the C-NLOPB to ensure that safe and environmentally responsible drilling activities are conducted in the Newfoundland and Labrador offshore area. We are confident that Corridor has filed a thorough EA with the C-NLOPB and that this, together with the other components of the regulatory application process, will demonstrate our capacity to drill an exploratory well safely, and in an environmentally-responsible manner. The drilling of an exploration well is a first step in determining the potential of a geologic structure. If the drilling of the well shows promising results, there is an additional comprehensive regulatory approval process for development projects.

If you have any questions or require any further clarifications, please contact me at 902-429-4511.

Sincerely Yours [redacted]

Dena Murphy, M.Sc., B.Sc., M.M.M.
Health, Safety, Environment and Regulatory Affairs Manager

Attachments

Attachment # 1

Corridor Responses to

Environment Canada

And

Fisheries and Oceans Canada

Comments

Attachment #1: Corridor Response to Consolidated Comments – September 11, 2013

Environment Canada General Comments

Environment Canada General Comments	September 11, 2013 Response
In its reply, the Proponent continues to assert application of best case conditions to an accidental release of hydrocarbons, while EC policy and best practice dictate the application of worst case scenario analysis in preparation for environmental emergencies. As such, our January 25th recommendations remain as stated.	In the modeling conducted by SL Ross, reasonable worst case scenarios were modeled. The oil properties were selected to represent the likely liquid hydrocarbons that could be accidentally released during the Old Harry drilling program and were based on the best available scientific information. The spill rates were based on maximum possible flows determined by Corridor's reservoir experts with knowledge of the reservoir geology. Fate and trajectory runs initiated on every day of the year using 50 years of 6 hourly averaged wind data were modelled to identify the likely possible maximum extent of surface oil from potential spills from the Old Harry location.
The differences between EC and the Proponent's perspectives on this issue are highlighted in three main areas: • Selection of very light Cohasset Crude as surrogate for an unknown reservoir; • Selection of wind speeds; and • The accounting for natural dispersion. Nevertheless, we have addressed several of the Proponent's points below:	A final response is provided below for each individual item.
EC is aware of the geological assumptions regarding the selection of Cohasset crude as surrogate for any hydrocarbons that may be discovered at the Old Harry prospect. Although this selection is based upon reasonable analysis, it is based on limited information including a limited dataset derived from a small number of previously drilled wells, none of which are within proximity of Old Harry. Although the selected surrogate oil may be appropriate it does represent a best case assumption that has powerful influence on the results of the trajectory analysis.	The selection of surrogate is, as EC has stated, based on reasonable analysis. It is also based on the best available scientific information, Corridor's 15 years of study of the geology of the basin and the Old Harry structure and results from source rock studies conducted by a world renowned contractor (Global Geoenergy Research). The selection of surrogate is appropriate and realistic, and as such is the basis for realistic spill modeling.
With respect to wind speeds the revised modelling submitted by the Proponent apparently attempts to capture the full range of wind	There may be some misunderstanding as to what SL Ross did in their revised modeling. Winds averaged over six hour periods for a full 50+ years of MSC50 data were used in the new revised historical spill

Attachment #1: Corridor Response to Consolidated Comments – September 11, 2013

Environment Canada General Comments	September 11, 2013 Response
speeds by applying the average six-hourly wind speed and direction values extracted from the MSC 50 database on a seasonal basis. As such the input values for all seasons are greater than 10 knots (5 m/s) and the Proponent notes in their cover letter that such conditions exist in the vicinity of the Old Harry project for more than 50% of the time. Nevertheless, wind speed is less than 10 knots for significant periods of time. These periods represent a worst case scenario that should reasonably be anticipated, modelled and prepared for.	modelling and not seasonal average wind values. This captured all winds, calm and otherwise, at a 6 hour temporal resolution. Scenarios were run for every day of the year for 50+ years using the MSC50 six hourly averaged data. The oil footprint was not significantly different than the initial modelling results.
EC continues to believe that dispersion is overestimated in the models used but recognizes this is a research gap currently being addressed by NOAA. However, many of the major references on the topic do not appear to have been considered by the proponent. For example, Delvigne, whose work is referenced by SL Ross, clearly states that a companion model is needed to predict resurfacing and furthermore he states possible methods. In the Mackay model this is similarly noted. In the Audunson model, the author himself notes that model is over-stated for the Ekofisk case on which it was based. All these statements on re-surfacing by the authors were ignored in all of the Proponent's modelling work.	Certain aspects of modeling such as resurfacing can be debated by different scientists with different views and it may be difficult get unanimous resolution. For the purpose of the Old Harry EA, the SL Ross revised modelling results provide evidence that the Cohasset oil will not persist on the surface using accepted modelling methods. The mechanisms of oil re-surfacing, oil sheening and re-dispersion or re-coalesence into a slick are not well understood or modelled by anyone with any degree of certainty or validation. NOAA, in its ADIOS documentation, states that “characteristic diffusion times are small compared to rise times” and that “estimates of submerged oil volumes can be made based on experimental results approximating steady conditions”. Both statements minimize the importance of oil re-surfacing once it has been ‘dispersed’ using the model by Delvigne.
The Proponent has cited several cases where they claim oils have seemingly not persisted, as examples of significant natural dispersion. These include the Elgin blowout example off Scotland in 2012 and the Uniacke blowout off Sable Island in 1984, as well as the North Cape barge spill of furnace oil in 1996.	Corridor’s spill modeling consultants have thoroughly reviewed these incidents and believe that they do illustrate that an oil, like the one that could potentially be generated at Old Harry, doesn’t persist. The Uniacke blowout is one the best, real world examples of the type of accidental release that could occur at Old Harry and the oil did not persist by EC’s own observations and records.

Attachment #1: Corridor Response to Consolidated Comments – September 11, 2013

Environment Canada General Comments	September 11, 2013 Response
In the Elgin and Uniacke blowout examples SL Ross indicates the oil dissipates within 24 hours, i.e., "The short surface persistence of this light crude oil is supported by two actual blowout events: the Uniacke blowout off Sable Island in 1984 (Environment Canada, 1984) and the Elgin blowout off Scotland in 2012 (Government of Scotland, 2013). However, they also note that in the Elgin case; "The vast majority of the release was entering the 'atmosphere, but some of the condensate and associated liquid components were impacting the sea surface. This resulted in a silvery sheen with occasional smaller windrow patches of brown weathered material. The brown weathered material also appeared to be dispersing naturally and, during periods when the wind strength and wave height increased, this enhanced dispersion of the condensate and weathered material in the water column, reducing the quantity of material remaining on the sea surface". It could be implied that this oil is not dispersing without this increased wind and wave height. Additionally, if one reviews the remote sensing reports associated with this incident, there is a period of time for many days in late April to early May 2012 where there are slicks from 10 km2 to over 1200 km2 even on days with moderate conditions and winds of 26 knots (Beaufort force 6, larger waves 8-13 feet, whitecaps common, more spray), i.e;, high winds and large slicks still exist on the surface of the ocean (http://www.elgin.total.com/elgin/page.aspx?contentid=721&Ig=en).	
In the case of the North Cape spill, the Proponent has acknowledged that the weather conditions were extreme "the wind and wave action was so intense on the night of the spill, the oil quickly mixed into the water column". In this spill the wind was reported to be as high as 80 km/hr. Even with a light oil, and under these extreme conditions, slicks were observed six days after the initial spill, primarily produced through the resurfacing of oil following the storm. The North Cape spill killed roughly 9 million lobsters, more than 400 loons, and 1600 other marine birds as well as over a million pounds of clams, oysters, amphipods and other species. The spill shut down the lobster industry for five months and reduced the productivity of	EC in earlier responses indicated that **no spills dissipated quickly**. This provided an example of one that did dissipate and SL Ross did note that it was under high winds.

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the area's Piping Plover population.	
There are places in the text of the SL Ross report where sources are misquoted or only partially quoted including Fingas from the 2011 book; "Fingas (2011) notes that "... diesel fuel and even light oil crudes can disperse significantly..."". The actual complete quote from this book provides a clearer and unbiased summary; "Natural dispersion occurs when fine droplets of oil are transferred into the water column by wave action or turbulence. Small oil droplets (less than 2 µm or 0.020 mm) are relatively stable in water and will remain so for long periods of time. Large droplets tend to rise and larger droplets (more than 50 µm) will not stay in the water column for more than a few seconds. Depending on oil conditions and the amount of sea energy available, natural dispersion can be insignificant or it can remove the bulk of the oil. In 1993, the oil from a stricken ship, the Braer, dispersed almost entirely as a result of high seas off Scotland at the time of the spill and the dispersible nature of the oil cargo.11 Natural dispersion is dependent on both the oil properties and the amount of sea energy.12 Heavy oils such as Bunker C or a heavy crude will not disperse naturally to any significant extent, whereas diesel fuel and even light crudes can disperse significantly if the saturate content is high and the asphaltene and resin contents are low. In addition, significant wave action is needed to disperse oil. In 40 years of monitoring spills on the oceans, those spills where oil has dispersed naturally have all occurred in very energetic seas. The long-term fate of dispersed oil is not known, although it may degrade to some extent as it consists primarily of saturate components. Some of the dispersed oil may also rise and form another surface slick or it may become associated with sediment and be precipitated to the bottom." It is interesting to note that the light Gulfaks oil that was spilled in the Braer case was subjected to Beaufort force 8 to 10 winds - very severe weather conditions.	SL Ross has reviewed this comment and maintains that they did not misquote information. The points that SL Ross was illustrating by the reference were as noted by EC in their comments: - *"Depending on oil conditions and the amount of sea energy available, natural dispersion can be insignificant or it can remove the bulk of the oil."* - *"Heavy oils such as Bunker C or a heavy crude will not disperse naturally to any significant extent, whereas diesel fuel and even light crudes can disperse significantly if the saturate content is high and the asphaltene and resin contents are low."* The EC comment below is not supported by any references, but Corridor and its consultants also share the view of EC that there is nothing to be gained from further debating these issues. *"In 40 years of monitoring spills on the oceans, those spills where oil has dispersed naturally have all occurred in very energetic seas."*
It should also be noted that, with respect to emulsification, EC agrees that Cohasset crude does not emulsify and emulsion	No ADIOS modelling results were ever provided to the proponent by EC.

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formation was removed from the ADIOS modelling we provided and emulsion was never included in the Oilmap modelling.	Detailed model outputs (e.g., oil properties and emulsion water contents) from the original EC modelling were requested during initial conversations with EC in August of 2012 to better determine how the graphs presented by EC were derived, but this data was never provided. The OILMAP results provided by EC did not include water content information. Subsequent modeling by ASA indicated that the long persistence of the oil as identified by EC results was possibly due to emulsification of the oil as discussed in earlier submissions.
Finally, EC wishes to point out that the proponent's modelling was carried out using deterministic trajectories rather than the generally accepted stochastic method. Also, the model used by the Proponent has not been subjected to peer review whereas the models used by EC have been peer reviewed and cited many times in the scientific literature.	The SL Ross modelling that used the entire 50+ years of 6 hourly wind data was more detailed than a conventional stochastic modelling exercise that only runs trajectories using a statistical representation of the historical environmental data set, not all of it.

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Responses to Revised EA Submission

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Fisheries and Oceans Canada			
The environmental assessment does not indicate what time of year the project will occur. While the duration is identified, the season of activity is not. This information is particularly important in terms of assessing potential impacts on the ecosystem and its components.	The Environmental Assessment included the possibility of drilling in any month of the year that is ice free. The spud date of the well would likely be no earlier than March and no later than November.	Adequate - However DFO would like to advise that in order to minimize potential impacts, activities should be timed to avoid sensitive periods for fish and marine mammals and species at risk.	Comment noted.
C-NLOPB			
§2.10.4 Well Testing, pg 18 – "*A Well Data Acquisition Program will be submitted to the C-NLOPB in support of the well approval at least 21 days prior to the anticipated spud date. There is no regulatory requirement to test the exploration well.*" Other than declaring a significant discovery, any testing program that involves flowing the well will require its own approval.	Text updated to include the information provided. Other than declaring a significant discovery, any testing program that involves flowing the well will require its own approval.	Text has been updated as noted. The proponent should remove the words "Other than declaring a significant discovery" from the second sentence of the first paragraph of section 2.10.4. For further clarification, a significant discovery is defined in the Accord Acts as "a discovery indicated by the first well on a geological feature that demonstrates by flow testing the existence of hydrocarbons in that feature and, having regard to geological and engineering factors, suggests the existence of an accumulation of hydrocarbons that has potential for sustained production."[1] In other words, any application for a	The second sentence in the first paragraph of Section 2.10.4 Well Testing should read as follows: "~~Other than declaring a significant discovery, a~~Any testing program that involves flowing the well will require its own approval."

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		significant discovery would require that a well test had been completed. 1 Excerpted from http://www.cnlopb.nl.ca/land_issuance.shtml	
§2.10.4 Well Testing, pg 18 – "*If produced water occurs, it will either be flared or treated in accordance with the Offshore Waste Treatment Guidelines (OWTG) (National Energy Board (NEB) et al. 2010) prior to ocean discharge.*" Water brought to the surface as part of reservoir fluids during a testing program, and which is not discharged via the flare, is typically transported to shore.	Text has been updated as noted.	Text has been updated as "If produced water occurs, it will either be treated prior to ocean discharge or transported to shore for disposal in accordance with the Offshore Waste Treatment Guidelines (OWTG) (National Energy Board (NEB) et al. 2010)." This response is acceptable; however, response to 2.10.4 and 2.11.3 must be made consistent within EA report.	Relevant text in Section 2.10.4 and 2.11.3 should read as follows: "Water brought to the surface as part of reservoir fluids during a testing program, and which is not discharged via the flare will either be treated prior to ocean disposal or transported to shore for disposal in accordance with the Offshore Waste Treatment Guidelines (OWTG) (National Energy Board (NEB) et al. 2010)."
§2.11.1 Drill Mud and Cuttings, pg 20 – "*Discharged drill cuttings are required to meet the limits outlined in the OWTG for the disposal of drill solids (no limit for WBM cuttings, 6.9 g of mud or less/100 g of cuttings for SBM cuttings overboard discharge).*" See general comment on discharge	"Corridor will use best available technology to meet the requirements of the OWTG. Corridor will follow the practices established by other operators within the jurisdiction of the CNLOPB if the conditions of the OWTG cannot be met	There is no comment on this within the revised EA Report. This response is not acceptable.	All drilling fluid and solid discharges will be in accordance with the OWTG and subject to approval by C-NLOPB. As per the OWTG, Corridor's EPP will describe the manner in which drilling solids will be managed and discharged to the marine environment.

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limits. A discussion by Corridor regarding their plans if they cannot achieve this concentration of synthetic-on-cuttings is warranted.			
§2.11.1.2 Synthetic-based Muds, pg 22 - "*SBM cuttings may be discharged provided they do not exceed 6.9 g/100 g time weighted average of oil on wet solids (see Section 2.4 of the OWTG)*". See general comment on discharge limits. A discussion by Corridor regarding their plans if they cannot achieve this concentration of synthetic-on-cuttings is warranted.	Corridor will use best available technology to meet the requirements of the OWTG. Corridor will follow the practices established by other operators within the jurisdiction of the CNLOPB if the conditions of the OWTG cannot be met.	There is no comment on this within the revised EA Report. This response is not acceptable.	All drilling fluid and solid discharges will be in accordance with the OWTG and subject to approval by C-NLOPB. As per the OWTG, Corridor's EPP will describe the manner in which drilling solids will be managed and discharged to the marine environment.
§2.11.3 Produced Water, pg 23 –Water brought to the surface as part of reservoir fluids during a testing program, and which is not discharged via the flare, is typically transported to shore.	Text has been updated to remove the reference to ocean disposal.		Refer above to response provided for 2.10.4.
§8.4.5 Calculated Blowout Frequencies for the Old Harry Project, pg 392 – This should probably be reworded. The impression that the reader is left with is that an extremely large spill probably won't occur for 25,000 years. The	Report has since been revised to address this concern.	Report has not been revised. Corridor should review the bulleted list from page 8.6 to 8.7 and then reread the comments already provided.	The bullets in Section 8.4.5 should read as follows: • The likelihood of an extremely large oil spill (>150,000 barrel) from a blowout during drilling of an exploration well, may

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following wording should be considered. • The likelihood of an extremely large oil spill (>150,000 barrel) from a blowout during drilling of an exploration well, may be calculated as (1 well drilled) x (3.97 x 10^{-5} spills/well drilled) = 3.97 x 10^{-5}. • The likelihood of a very large oil spill (>10,000 barrel) from a blowout during drilling of an exploration well is 7.93 x 10^{-5}. • The likelihood of a large oil spill (>1,000 barrel) from a blowout during drilling of an exploration well is 9.91 x 10^{-5}.			be calculated as (1 well drilled) x (3.97 x 10^{-5} spills/well drilled) = 3.97 x 10^{-5}. • The likelihood of a very large oil spill (>10,000 barrel) from a blowout during drilling of an exploration well is 7.93 x 10^{-5}. • The likelihood of a large oil spill (>1,000 barrel) from a blowout during drilling of an exploration well is 9.91 x 10^{-5}.
§8.7.1.2 Marine Bird Species at Risk, pg 402 - Assuming that the risk of spills from supply vessels is consistent with other shipping, it is still an incremental increase in risk. In addition, since no risk statistics have been provided for marine shipping activity in the Gulf, this statement cannot	Although an incremental risk is acknowledged, it remains a low risk and a quantitative analysis is not considered necessary for this discussion.	no change The EA report does not acknowledge an incremental risk and provides no context in which to assess such an incremental change. The proponent should refer to Alexander et al.[2] and Pelot & Wootton[3] for a quantitative description of commercial vessel transits in the Gulf of St. Lawrence. 2 Alexander, D.W., Sooley, D.R., Mullins,	The following discussion can be used to supplement the last paragraph in Section 8.7.1.2, Marine Bird Species at Risk, p. 8.18. It is anticipated that the Project will involve two to three support vessels trips per week during the

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be assessed in a quantitative manner.		C.C., Chiasson, M.I., Cabana, A.M., Klvana, I., and J.A. Brennan 2010. Gulf of St. Lawrence: Human Systems Overview Report. Oceans, Habitat and Species at Risk Publication Series, Newfoundland and Labrador Region. Pages v and 60. Available at www.dfo-mpo.gc.ca/Library/340113.pdf 3 Pelot, Ronald & Wootton, David, Merchant traffic through Eastern Canadian waters: Canadian port of call versus transient shipping traffic, MARIN Report # 2004-09, available at http://www.marin-research.ca/english/research/publications/reports.php	proposed drilling program (20 to 50 days). It is recognized that an accidental spill could occur from a supply vessel and that the mortality of an individual bird species at risk would be significant. However, given the high vessel volume occurring in the region, risk of a spill from a Project support vessel is considered to be incidental. To put the volume of Project vessel traffic in perspective, it is helpful to review traffic volume data in the Gulf of St. Lawrence. Pelot and Wootton (2004) analyzed vessel traffic through Eastern Canada using 2001 for merchant shipping and cruise ship traffic and 1999 for fishing traffic for various regions in Eastern Canada. Including cruise ship traffic, fishing vessels and merchant shipping, monthly traffic volumes in the Gulf of St. Lawrence ranged from a minimum of 376 (February) to a maximum of

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			59,897 (May) with fishing vessels making up the majority of these volumes (Pelot and Wootton 2004). Annual volumes of fishing vessels amounted to 190,024 (96.5% of annual totals), (Pelot and Wootton 2004). This is consistent with data on commercial vessel transits through the Cabot Strait, the major point of entry to the Gulf of St. Lawrence, which is reported to accommodate approximately 6,400 commercial vessel transits annually (Coffen-Smout et al. 2001, cited in Alexander et al. 2010). Given this context, the Project vessel traffic and potential risk of spills to marine bird species at risk is considered minimally incremental to the risk that exists from other non-Project related traffic.
§8.7.2 Marine Ecosystems, pg 405 - Since no risk	Corridor refers to the previous comment in its response	no change This comment was made in reference	Refer to the response provided immediately above

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statistics have been provided for marine shipping activity in the Gulf, this statement cannot be assessed in a quantitative manner. Also, "low" has not been defined.		to the proponent's statement, in the last paragraph of section 8.7.2, now on page 8.22, that "The risk of any diesel spill in association with this Project is low and no greater than from any other marine shipping activity in this region." The proponent should refer to Alexander et al. and Pelot & Wootton for a quantitative description of commercial vessel transits in the Gulf of St. Lawrence. In addition the word "low" is used as a qualifier of risk and has not been defined. The proponent must define what is meant by low.	which puts Project related vessel traffic in context with other marine vessel traffic in the Gulf of St. Lawrence. Low would be considered to be within natural variation of existing activities.
§8.7.7 Commercial Fisheries and Other Users, pg 410 - "low" has not been defined.	"Low" in this case is referring to the low level of commercial harvesting activities within the Project Area which was defined in Section 5.8.1 by the following text - "there is minimal fishing effort within and surrounding the Project. No harvesting locations were recorded within EL 1105. The closest harvest location to the Project is located just less than 10 km to the southwest of EL 1105, and was recorded for redfish. Between 10 and 12 km from the EL 1105, a couple of harvest locations were recorded for redfish and one for each cod and white hake. However, in general,	no change. This comment was in reference to the sentence "However, the likelihood of such an event is extremely low" on what is now page 8.26. The proponent must define what is meant by low or extremely low.	"Low" refers to the low likelihood of an accidental spill occurring as per the calculated frequencies presented in Section 8.4.9 in combination with the understanding that there is minimal fishing effort within 10 km of the Project.

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	the fishing effort can be summarized in the immediate vicinity of the Project as low".		
§12.1 Potential Effects of the Physical Environment on the Project, para. 1, pg 422 – "These effects will be mitigated by using… state-of-the-art forecasting." Details should be provided on the "state-of-the-art" forecasting.	Text has been revised to "monitoring government and industry24-hour forecasts".	revised as indicated Grand Banks operators are required to provide site specific forecasts and this requirement will likely extend to this Gulf of St. Lawrence location.	Comment noted.
§13.0 Environmental Management, 7th Bullet, pg 425 - The *Drilling and Production Regulations* require an Operator to submit a Safety Plan and an Environmental Protection Plan with the application for an authorization. One document may be used to satisfy the requirements if it meets the requirements laid out in Sections 8 and 9, of the regulation.	Comment noted.	This section has been edited but not in relation to the comment. This comment required acknowledgement but no particular action as the proponent's proposed document will be acceptable if it meets the requirements for an EPP as described in the regulations.	Comment noted.
Environment Canada			
§ 4.1.10, Storm Tracks in the Gulf of St. Lawrence - This section contains 3 figures that inadequately describe the intended subject. Figures 4.21 and 4.22 barely cover the Gulf of St Lawrence and thus	Tropical cyclones/transitioning tropical cyclones need to be considered (ref. below) Figures 4.21 and 4.22 were replaced with 4 figures more relevant to storm tracks in the Gulf of St. Lawrence. Figure 4.23 was separated into	This section shows confusion between tropical and extratropical cyclones. It seems the text was not updated when the figures from extratropical storm tracks in the previous EA Report were replaced. The captions for Figures 4.21 and 4.24 are incorrect: they say	Figures 4.21 to 4.24 should be labelled as "Tropical Storm Tracks" instead of "Extratropical Storm Tracks". Section 4.2.5 should read as follows:

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cannot show. Figure 4.23 is very hard to read. It is missing the panel for the winter season (DJF); the summer panel (JJA) is repeated twice. Major storm tracks for both extra-tropical and tropical cyclones that approach from the south or southwest and track northeastwards over the Gulf of St Lawrence and the Atlantic Provinces.	four figures for readability with the winter panel being corrected to show the proper season.	extratropical instead of tropical storm tracks. EC recommends revision of this section to correct errors.	Weather systems tend to move along preferred paths over Canadian waters. Major tracks pass through the St. Lawrence Lowlands, with storms developing and moving out to sea in a northeasterly direction over the Grand Banks of Newfoundland and the Labrador Sea. In the Gulf of St. Lawrence, a cyclone season occurs from June to November, peaking in August through September. ~~Major polar storm tracks during the summer months from 2008 to 2011 are shown in Figure 4.21 to 4.24.~~ Figures 4.21 to 4.24 show tracks of tropical storms in Atlantic Canada waters between 2008 and 2011. The frequency of extratropical storm tracks during 1998 are illustrated in Figures 4.25 to 4.28.
§ 4.2.2, Wind Climate - The wind climate was described solely from the MSC50 dataset for a single point in the Project area. This is insufficient to	The MSC50 Data point gives a central data point with regards to unimpeded wind conditions. As such this point was chosen to give an overall picture of the wind	This section only uses hindcast (modelled) mean winds at a single point in the open Gulf of St. Lawrence. Additional data that would help to describe the hazardous local effects are	Table 4.6 should be updated as per Attachment 4.2.2 which includes normal and extremes for wind at Port-aux-Basques.

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give a full picture of the conditions over the entire Project and Study Area. The analysis should include hourly mean and gust wind speeds from land/island stations in the surrounding area. Local effects and elevation differences need to be considered.	characteristics in the Project and Study Area.	readily available from EC archives by request. EC recommends that the EA includes analysis of measured hourly sustained and gust wind speeds from exposed stations including Wreckhouse and St. Paul Island (Auto). EC recommends that Table 4.6 for Port-aux-Basques include climate normals and extremes for wind (available from EC online).	
§ 4.3 Climate Change: This section includes discussion only of sea-level change. This section should describe changes in ice frequency that have occurred over the last few decades, and the effect of reductions in ice cover (longer fetch allowing higher waves to build, and more frequent occurrence of adverse weather)	Observations over the last few decades show an increase in ice cover in the Gulf, and has not supported predictions that the area will be ice free year round. "Observations of the past decades do not support this prediction, with sea ice getting more severe in the Gulf" (Dufour and Ouelette 2007). As a result, it would not be justified to say that the Gulf has seen reductions in ice cover, allowing for increased fetch for wave propagation.	The response cited a paper by Dufour and Ouellet (2007) that said that ice cover was increasing. However that paper refers to a study by Parkinson (2000) based on 1979 to 1996 data only. The Historical Total Accumulated Ice Cover (TAC) for the Gulf of St Lawrence for 1968/69 to 2012113 shows an overall decreasing trend as well as considerable interdecadal variability. [This plot can be generated online at the Canadian Ice Service website http://www.ec.gc.ca/glacesice/default.asp?lang=En&n=7E34FF80-1 using IceGraph Tool 2.0). The revised section on ice, 4.2.6, also mentions a reduction in ice cover in the last few decades. Variability and trend in ice cover (while related to temporal variability on a larger scale) would contribute to variations in climate elements such as wave height and	Comment noted.

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		visibility. Statistics based on low ice cover years would be expected to differ from those based on the long term record. This could be of interest for future studies, if recent trends in ice cover continue.	
§ 4.1.11 Ice, Page 103, 1st paragraph, sentence 6: *"All sea ice in EL 1105 is first-year ice, ranging in its un-deformed thickness from 30 to 120 cm (SLGO 2011; Figure 4.20*). Not all sea ice in EL1105 is greater than 30cm (first-year ice), especially at the start of the winter season. Also, your reference to Figure 4.20 is in error … Figure 4.20 in the EA report is a tide map. Rephrase this sentence. Say something like "All sea ice in EL 1105 is seasonal ice, with un-deformed thicknesses normally not reaching the thin first-year ice category (30-70cm) until March. Predominant ice thicknesses greater than 70cm are generally not observed until mid-April, towards the very end of the ice season in the Gulf." Also – cite the 1981-2010 CIS Atlas for the	The paragraph was updated to reflect the updated Figure 4.24 (now Figure 4.29) with information from the 1981-2010 CIS Atlas and referenced accordingly.	The description of the sea ice in the text has been adequately corrected. However; the incorrect tide map has been replaced with an ice chart, but the chosen ice chart is just a random example from a single date in a single year towards the beginning of the ice season (at a time when the ice extent has not even reached the Old Harry area yet). It is not a climatological chart representative of the median conditions throughout the past 30 years for the peak of the ice season when sea ice is most likely to affect the Old Harry area. *Recommendation:* This chart should be replaced with a median predominant ice type chart from the CIS Atlas for the time of peak ice extent in the Gulf (mid-February to mid-March), and the requested citation for the information given (CIS 1981-2010 Atlas) has NOT been added. *Recommendation:* Add a reference to the CIS 1981-2010 Atlas for the sea ice information.	Figure 4.29 should be replaced with Attachment 4.1.11 which represents the Median of Predominant Ice Type When Ice is Present from the CIS Atlas (Environment Canada 2011). It is acknowledged that the CIS Atlas is the source of ice data in Section 4.2.6 of the EA Report, referenced therein as Environment Canada 2011.

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information. See your own description at the bottom of p.108, where this is correctly described.			
§ 4.1.11 Ice: Insert a new figure to replace the erroneous reference to Figure 4.20. Use a figure from the CIS online atlas, for example: http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=AE4A459A-1&wsdoc=C3DAE7C6-0C7E-11E0-9694-185EF62D62D6	The Figure 4.20 reference now refers to Figure 4.24 (now Figure 4.29) as intended which has been updated in accordance with EC-367.	The Figure was replaced as requested, but not with a Figure from the CIS Atlas. *Recommendation:* Add a reference to the CIS 1981-2010 Atlas for the sea ice information.	Refer to response provided above and Attachment 4.1.11.
§ 4.1.11 Ice, Page 103, 1st paragraph, sentence 7 - "*Daily graphs such as depicted in Figure 4.24 are available as a seasonal service from http://slgo.ca/en/ocean/data/ice-concentration.html, starting in December / January through May / June."Comment: The charts (not graphs, unless you meant to say graphics) published on the SLGO website are forecasts produced by a computer model. This computer model uses CIS analysis data for input. Real CIS analysis charts, NOT*	Figure 4.24 (now Figure 4.29) has been changed to the Ice Stage chart for 31 Jan 2011 from the CIS Online Atlas. References have been updated to reflect this.	Here, the figure was replaced correctly with one for 31 Jan 2011 as requested and the correct source was added. However, the sentence originally associated with this figure appears to have been removed from the present version of the text. Additionally, an attempt was made to now use this figure to address the comment above, which is not appropriate. The requested citation for the information given (CIS 1981-2010 Atlas) has NOT been added. *Recommendation:* Add a reference to the CIS 1981-2010 Atlas for the sea ice information.	Note that the citation "Environment Canada 2011" which is used throughout the text and accompanies figures, refers to the CIS 1981-2010 Atlas. The full citation for Environment Canada 2011 as written in Section 15 is: Environment Canada. 2011. Sea Ice Climatic Atlas for the East Coast 1981-2010: The Ice Regime. Available at: http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=AE4A459A-1&offset=2&toc=show.

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model forecast graphics, should be used here, where describing climatological sea ice conditions in the Gulf of St. Lawrence *• Replace Figure 4.24. Use either the corresponding Ice Stage chart for 31 Jan 2011, found on the CIS web site archive:* *http://ice-glaces.ec.gc.ca/www_archive/AOI_12/Charts/sc_a12_20110131_WIS57SD.gif* *Or the one for 07 Feb 2011:* *http://ice-glaces.ec.gc.ca/www_archive/AOI_12/Charts/sc_a12_20110207_WIS57SD.gif* *• In these charts, note that ice stage relates to ice thickness according to last (bottom) table on the following webpage:* *http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=4FF82CBD-1&wsdoc=19CDA64E-10E4-4BFFB188-D69A612A0322* *• Also - Replace the reference to SLGO with the appropriate reference to the CIS web page.*			
§ 4.1.11 Ice - Comment: The	Paragraphs have been paraphrased	Most of the paragraphs have been	The last paragraph on p.

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paragraphs on these pages were copied nearly verbatim from the CIS 1971-2000 sea ice climatic Atlas. Passages and phrases copied word-for-word should be in quotation marks, followed by the appropriate reference. No quotation marks are used and no references are given for the copied sentences until the end of each paragraph, making it appear that the information was paraphrased from this source or that only the last sentence is from this source. The above is plagiarism and needs to be corrected. Simply changing a word in the copied sentence (e.g. replacing significant with substantive so that the sentence has not been copied verbatim in its entirety) is not sufficient.	where necessary and referenced correctly.	paraphrased and correctly referenced. However, the bulk of the last paragraph on page 4.39 is still nearly verbatim from the CIS Atlas, except for a few words changed here and there to keep the text from being exactly word-for-word. A reference to the Atlas is only given in two places, after the second sentence and after the last sentence. *Recommendation:* • The Atlas reference, in brackets, should be given after each of the first 6 sentences of this paragraph to clearly indicate where the information came from. No quotation marks are necessary since a few of the words were changed, but the text is still nearly identical to that of the source; • The last 3 sentences should be separated into a new paragraph. • Rephrase the first two of the last 3 sentences as: "Based on the Canadian Ice Service's Sea Ice Climatic Atlas for the East Coast 1981-2010 (Environment Canada, 2011), for the period 1981 to 2010, the most ice encountered in a single season in the Gulf occurred in 1989/1990 with the least amount of ice occurred in 2009/2010. Time series of	4.39 should read as follows: At the beginning of February, grey-white and grey ice predominates with thin first year ice gradually developing over the course of the month (Environment Canada 2011). By the end of the third week of February, thin first year ice is found in Northumberland Strait, along the northwest coast of Cape Breton, along the north coast of the Magdalen Islands, along the west coast of Newfoundland as well as along the south shores of Chaleur Bay and the Estuary (Environment Canada 2011). Over the northern portions of the St. Lawrence Estuary and Gulf, the predominant ice type remains new and grey because offshore winds push the ice southward (Environment Canada 2011). From the later part of February until the middle of March, the ice in the Gulf will have reached its maximum extent and much of the ice continues to grow to the first-year stage of

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		Historical Total Accumulated Ice Coverage found in this Atlas indicate that the ice coverage varies considerably from year to year but, in general, there were *above* normal conditions from 1980/1981 to 1994/1995 and then below normal conditions from 1995/1996 to 2009/2010." • In the last sentence, indicate that the charts shown are for **mid**-February, **mid**-March and **mid**-April, since no dates for the charts are given in the Figure captions.	development (Environment Canada 2011). As a result of the continuous southward drift of the pack ice in the Gulf, the ice remains at the grey-white stage over the northwestern portions of the Gulf. The lead along the Western Newfoundland coast, particularly north of the Port-au-Port Peninsula, is closed and there can be ice drifting into the Cabot Strait. Based on the Canadian Ice Service's Sea Ice Climatic Atlas for the East Coast 1981-2010 (Environment Canada, 2011), for the period 1981 to 2010, the most ice encountered in a single season in the Gulf occurred in 1989/1990 with the least amount of ice occurred in 2009/2010. Time series of Historical Total Accumulated Ice Coverage found in this Atlas indicate that the ice coverage varies considerably from year to year but, in general, there were *above* normal

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			conditions from 1980/1981 to 1994/1995 and then below normal conditions from 1995/1996 to 2009/2010. The maximum pack ice extent in the Gulf in mid-February, mid-March and mid-April, based on a 30-year median of ice concentration, is displayed in Figures 4.30, 4.31 and 4.32, respectively (Environment Canada 2011).
Original Comment: § 4.1.11 Ice P.108, 1st paragraph, sentence 5 reads*: "EL 1105 is located in the area that has an average ice freeze up date of January 29 (Figure 4.31)." Comment: From the Freeze-up chart, the average freeze-up date is February 12, not January 29. Correct the date given in sentence 5 from January 29 to February 12.*	The sentence was updated to include the correct February 12th date.	The table of concordance indicates that the date of freeze-up was corrected from Jan 29 to Feb 12, but inspection of the text shows that this correction was NOT made.	Text in Section 4.2.6, p. 4.41 should read as follows: "EL 1105 is located in the area that has an average ice freeze up date of February 12th (Figure 4.35)".
New CIS Comments			
		As a result of the EA authors having to paraphrase the information they had originally copied verbatim from the CIS Atlas (to avoid plagiarism), some errors in interpretation were noted.	
		§ 4.2.6 Ice, Page 4.38, paragraph 2,	4.2.6 Ice, Page 4.38,

Original Comment	Proponent Response	Revised EA Report Check	September 11, 2013 Response
		sentence 2 - The text in the Atlas clearly states that tidal influences LIMIT fast ice formation, they do not enhance it. *Recommendation:* Revise this sentence to read "As a result of the shallowness of these areas, large areas of fast ice can form. However, tidal influences in certain locations can also limit the fast ice formation (Environment Canada 2011)."	paragraph 2, sentence 2 should read as follows: "As a result of the shallowness of these areas, large areas of fast ice can form. However, tidal influences in certain locations can also limit the fast ice formation (Environment Canada 2011)."
		§ 4.2.6 Ice, Page 4.39, paragraph 1, sentence 1 - The directions given in the second half of the sentence are incorrect. *Please correct to:* "Winter winds from the west to north directions are generally cold and dry while those from the southwest to northeast are mild and moist (Environment Canada 2011)."	4.2.6 Ice, Page 4.39, paragraph 1, sentence 1 should read as follows: "Winter winds from the west to north directions are generally cold and dry while those from the southwest to northeast are mild and moist (Environment Canada 2011)."
Fisheries and Oceans			
§ 2.6 - While the anticipated duration of work is indicated (20-50 days) the season is not. This is information is particularly important in terms of assessing potential impacts on the ecosystem and its components (i.e. fish, marine mammals etc…).	The Environmental Assessment included the possibility of drilling in any month of the year that is ice free. The spud date of the well would likely be no earlier than March and no later than November.	Adequate - However DFO would like to advise that in order to minimize potential impacts, activities should be timed to avoid sensitive periods for fish and marine mammals and species at risk.	Comment noted.

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§ 2.6 - It is advised that the proponent should plan the activity around important and sensitive time periods for fish, marine mammals and species at risk.	Drilling will not occur earlier than March or later than November. Specific timing will depend on a variety of variables including but not limited to rig availability and regulatory approvals. Mitigation measures, including wildlife observers and adherence to regulatory guidelines (e.g., Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment, Offshore Waste Treatment Guidelines) will reduce effects on marine species.	Adequate - However DFO would like to advise that in order to minimize potential impacts, activities should be timed to avoid sensitive periods for fish and marine mammals and species at risk.	Comment noted.
§ 5.2.1.10 - The paragraph on Striped bass should be re-edited to reduce confusion. It starts by speaking about extirpated estuary population, and then it states the harvest restrictions put in place in 2000 seem to have assisted in recovery. Confusion exists between Estuary and Gulf populations. Please consult the recovery strategy on the SARA public registry. COSEWIC's (2004) assessment for striped bass is not a good reference nor is it used properly.	The Striped Bass section has been reworded to reduce confusion and update its relevance with the Project area.	Adequate - However the paragraph now conflicts with Table 5.2	Both Section 5.2.10 and Table 5.2 indicate a low potential for occurrence in relation to EL 1105. However, Table 5.2 and Section 5.2.1.10 should be updated to acknowledge that the Southern Gulf of St. Lawrence population has been downgraded from "Threatened" to "Special Concern" by COSEWIC. The St. Lawrence Estuary Population (also referred to as the St. Lawrence River population) is designated as "Endangered" by COSEWIC (COSEWIC

Original Comment	Proponent Response	Revised EA Report Check	September 11, 2013 Response
			designation not previously noted in the EA Report for this population) and "Extirpated" by SARA.
§ 7.1.5.3 - Ketten and Bartol (2005) and other more recent references included in the topic of sea turtle hearing would be useful inclusions in this assessment.	Ketten and Bartol 2005 has been added to the EA Report to provide a reference on the hearing range of sea turtles.	Adequate response however the reference could not be found in the EA Report.	The first sentence in the second paragraph under the Sea Turtles heading (Section 7.1.5.3, p. 7.47) should read as follows: "Available information indicates that turtles hear at low frequency range similarly to seals (e.g., 100-900 Hz (Office of Naval Research website 2002; Environment Australia 2003; Ketton and Bartol 2005), with measureable age and species variations in response to underwater sound (Ketton and Bartol 2005). Ketton and Bartol (2005) observed a size/age difference in hearing range for loggerhead and green sea turtles, with smaller younger individuals having a greater hearing range than larger, older individuals. Kemp's Ridleys had a more restricted hearing range

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			(100-500 Hz).“
§ 7.2.4 - Table 7.8 – Suggests that mortality resulting in collision with vessel is reversible? Please be advised that it is unlawful to kill harm, harass, capture or take an individual of a species that is listed as Endangered or Threatened under SARA unless permitted. This measure assists in protecting species, as the loss of an individual could be significant for a certain species (e.g. blue whale).	The results of mortality from a vessel collision have been changed to irreversible due to the fact that the loss of an individual from certain species could lead to negative population level effects.	Adequate response, however Section 7.2.2.4 or Table 7.8 was not updated in the EA Report.	Table 7.8 Potential Environmental Effects Summary - Species at Risk should read “I” for irreversible in the Reversibility column to indicate a potential irreversible effect of mortality of species at risk from a collision with a vessel. However, text in Section 7.2.4 Residual Environmental Effects remains unchanged as the predicted residual adverse environmental effects of the Project on Species at Risk remains not significant as defined by significance criteria in Section 7.2.1.

References Cited

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Ketten, D.R. and Bartol, S.M. 2005. Functional Measures of Sea Turtle Hearing. Woods Hole Oceanographic Institution: ONR Award No: N00014-02-1-0510.

Office of Naval Research. 2002. Science and Technology Focus, Oceanography, Ocean Life: Green Sea Turtle – Current Research. http://www.onr.navy.mil/focus/ocean/life/turtle4.htm. Last update not indicated. Accessed 3 March 2009.

Pelot, Ronald & Wootton, David, Merchant traffic through Eastern Canadian waters: Canadian port of call versus transient shipping traffic, MARIN Report # 2004-09, available at http://www.marin-research.ca/english/research/publications/reports.php.

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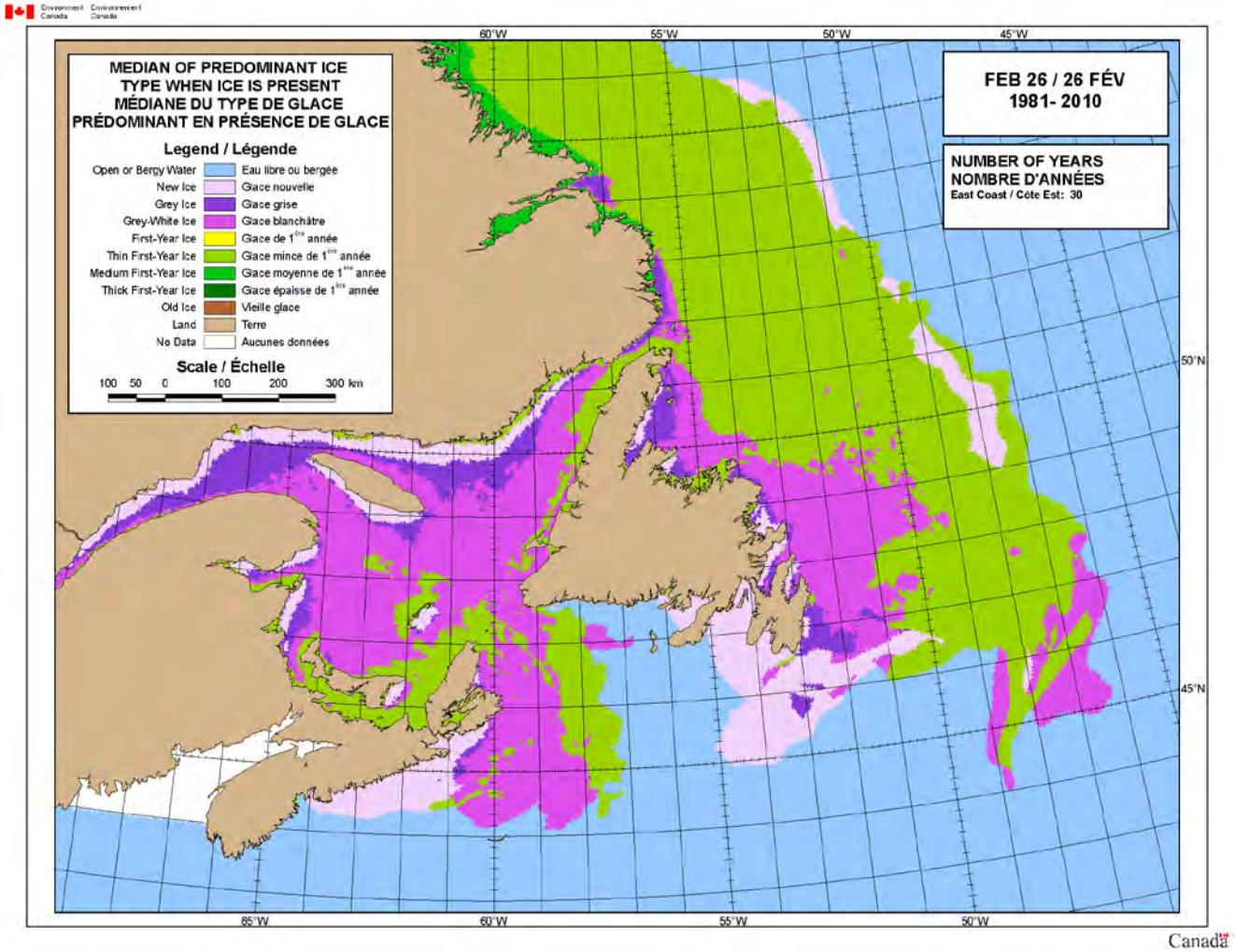
Attachment 4.2.2 (Revised Table 4.6)

Table 1 Temperature and Precipitation Climate Data, 1971 to 2000, Port Aux Basques, Newfoundland

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)												
Daily Average	-5.2	-6.4	-3.5	1	5.2	9.5	13.7	15	11.6	7	2.6	-2.2
Daily Maximum	-1.9	-3	-0.4	3.7	8.3	12.8	16.7	18.3	15	10	5.2	0.8
Daily Minimum	-8.4	-9.8	-6.6	-1.7	2.1	6.2	10.6	11.7	8.2	3.9	-0.1	-5.1
Extreme Maximum	9.9	8.9	11.2	18.2	22.2	25.3	27.8	27.2	30	25	15	10.7
Extreme Minimum	-23.3	-26.1	-24.1	-13.3	-6.7	-1.1	3.5	2.8	0	-4	-11.3	-21.2
Precipitation (mm)												
Rainfall	52.8	39.2	61	101.8	124.2	114.1	115.3	114.1	123.1	147	126.2	97
Snowfall (cm)	93.5	75	51.7	21.5	3.4	0	0	0	0	3.4	19.6	75.3
Precipitation	146.4	115.1	113.9	126.5	128.2	114.1	115.3	114.2	123.1	150.5	147.6	174.7
Extreme Daily Rainfall	74.2	67.3	60	89.9	85.9	66.8	111.4	83.8	96.6	65.3	101.1	88.9
Extreme Daily Snowfall (cm)	57.4	45.7	36.8	31	11.4	0.5	0	0	2.8	14.7	30.5	43
Days with Precipitation												
>= 0.2 mm	24.9	20.8	18.9	16.1	15.4	15	15.8	14.7	16.2	17.7	19.5	8.6
>= 5 mm	8.9	6.5	6.6	6.7	6.7	6.3	6.2	6	7.1	8.3	8.6	4.7
>= 10 mm	4.6	3.7	3.7	4	4.4	4	3.6	3.7	4	4.8	4.9	3.3
>= 25 mm	0.96	0.74	0.78	1.1	1.2	1.1	1.1	1.1	1.2	1.6	1.4	0.92
Wind												
Speed (km/h)	32.3	29.6	26.7	24.5	21.3	20.2	18.5	17.5	19.7	23.6	27.4	31.5
Most frequent direction	W	W	E	E	E	E	E	E	W	W	W	W
Maximum hourly speed (km/h)	116	120	109	100	87	74	74	74	106	115	106	115
Date (yyyy/dd)	1968/05	1995/13	1992/22	2001/03	2002/04	1993/07	1979/05	1986/25	1999/23	1999/15	1998/16	2000/10
Maximum gust speed (km/h)	152	161	148	141	126	104	111	111	120	153	151	157
Date (yyyy/dd)	1982/18	1967/22	1976/17	1988/20	1988/03	1986/10	1979/05	1986/25	1986/27	1974/20	1976/06	1985/19
Source: Environment Canada 2010a.												

Attachment 4.1.11 Median of Predominant Ice Type when Ice is Present (replaces Figure 4.29)



Source: Canadian Ice Services 1981-2010 Atlas (http://dynaweb.cis.ec.gc.ca/30Atlas10/page1.xhtml?region=ec&lang=en)

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41	3	DFO	General	The environmental assessment does not indicate what time of year the project will occur. While the duration is identified, the season of activity is not. This information is particularly important in terms of assessing potential impacts on the ecosystem and its components.	The Environmental Assessment included the possibility of drilling in any month of the year that is ice free. The spud date of the well would likely be no earlier than March and no later than November.	Adequate - However DFO would like to advise that in order to minimize potential impacts, activities should be timed to avoid sensitive periods for fish and marine mammals and species at risk.	Comment acknowledged
46	8	DFO	2.6	While the anticipated duration of work is indicated (20-50 days) the season is not. This is information is particularly important in terms of assessing potential impacts on the ecosystem and its components (i.e. fish, marine mammals etc…).	The Environmental Assessment included the possibility of drilling in any month of the year that is ice free. The spud date of the well would likely be no earlier than March and no later than November.	Adequate - However DFO would like to advise that in order to minimize potential impacts, activities should be timed to avoid sensitive periods for fish and marine mammals and species at risk.	Comment acknowledged
47	9	DFO	Section 2.6	It is advised that the proponent should plan the activity around important and sensitive time periods for fish, marine mammals and species at risk.	Drilling will not occur earlier than March or later than November. Specific timing will depend on a variety of variables including but not limited to rig availability and regulatory approvals. Mitigation measures, including wildlife observers and adherence to regulatory guidelines (e.g., Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment, Offshore Waste Treatment Guidelines) will reduce effects on marine species.	Adequate - However DFO would like to advise that in order to minimize potential impacts, activities should be timed to avoid sensitive periods for fish and marine mammals and species at risk.	Comment Acknowledged
53	15	DFO	4.1.7	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 modeling).	The section on ocean currents properly describes the currents of the Gulf. The currents are shown in Figures 4.13, 4.14, and 4.16-4.19 with citations (SLGO 2011; Galbraith et al. 2011; LGL 2005b). Tang et al. 2008 was not referenced in Section 4.1.7. For more information on oil spill modeling, trajectories and the currents used to create these, please refer to the stand alone report conducted by SL Ross.	The section on ocean currents adequately describes long-term averages, but not sporadic wind-driven currents that can be much larger. The point was that the report acknowledges this by using a completely different source of currents in the modelling section, yet it is not presented.	The water currents used in the modelling (Tang et al. 2008) were not presented in hardcopy in the spill document. Detailed digital data was provided to SL Ross by DFO scientists for use in the project. The Tang et al 2008 report "atlas Of Ocean Currents Eastern Canada.pdf "referenced in the report shows only a coarse representation of these currents. The report can be provided if required.
58	20	DFO	4.1.8	It is not evident that tides were used in spill trajectory modeling within the EA. If this is the case, why not?	Tides were not used in the modelling because their inclusion would not have significantly altered the overall spatial footprint of the oil from the spill scenarios modelled.	The authors could have compared the predicted tidal displacement in the area to the modelled results. The very small footprint of 6 km (Fig 2.12-2.15) is based on the assumption that only 6 hours are required to completely disperse or evaporate the oil, otherwise	The model predicts the survival time of the oil slick based on the prevailing environmental conditions and does not assume that the oil will be completely dispersed or evaporated in 6 hours. As per table 2.25 in the EA, oil slicks survived for up to 56 hours under some

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						they would have to factor in accumulation over longer times. At that point precise maximal instantaneous currents would be important to know. As it is, Figs. 2.12-2.15 do not show a month-long release (as stated), but a series of independent 6-hour releases, with no accumulation between them (resetting conditions to pristine after each one).	conditions. Maximum tidal currents at the drill site are about 0.3 m/s (see section 4.2.3 page 4.29 of submission). Over a 6 hour tidal cycle, this could possibly result in a maximum additional translation of oil of approximately 3 km if the tidal current direction were aligned with the wind driven and residual current vector and an average speed of 0.15 m/s is used over the 6 hours. The direction of the tidal current also varies during the 6 hour period so this will not be the case over the full 6 hour cycle. The surface oil movement identified in Figures 2.12 and 2.15 show maximum travels on the order of 10 km. The addition of tidal currents could possibly increase this travel distance to 13 km.
91	61	DFO	5.2.1.2	The 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; Summer sentinel trawl surveys in both areas). Migration routes and timing and overwintering distributions should also be described.	Seasonal movements and migrations of each of the Atlantic Cod populations has now been described and incorporated into the EA.	See general comment #1	Comment acknowledged
92	62	DFO	5.2.1.2	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.	Information on the Laurentian South Cod migration movements has been updated.	See general comment #1	Comment acknowledged
96	66	DFO	5.2.1.2	Some key sources of information include: Swain et al. (1998); Chouinard & Hurlbut (2011); Comeau et al. (2002); Benoît et al. (2003); Darbyson & Benoît (2003); and recent CSAS Science Advisory Reports and Research Documents coming from stock assessments.	Up to date Canadian Science Advisory Reports and research documents coming from stock assessments have been reviewed and incorporated into the EA where deemed appropriate.	See general comment #1	Comment acknowledged
98	68	DFO	5.2.1.3	Only general information is presented in this section; not information focused on winter skate in the Gulf. Information is available from Swain et al. (1998); Chouinard & Hurlbut (2011); Comeau et al. (2002); Benoît	Up to date Canadian Science Advisory Reports and research documents coming from stock assessments have been reviewed and incorporated into the EA where deemed	See general comment #1	Comment acknowledged

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				et al. (2003); Darbyson & Benoît (2003); and recent CSAS Science Advisory Reports and Research Documents coming from stock assessments, as well as CSAS Res Docs 2006/003; 2006/004; Swain et al. 2009 (and the associated supplementary material).	appropriate.		
110	80	DFO	5.2.1.9	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.	The seasonal distribution of American plaice has been added to the EA.	See general comment #1	Comment acknowledged
111	81	DFO	5.2.1.10	The paragraph on Striped bass should be re-edited to reduce confusion. It starts by speaking about extirpated estuary population, and then it states the harvest restrictions put in place in 2000 seem to have assisted in recovery. Confusion exists between Estuary and Gulf populations. Please consult the recovery strategy on the SARA public registry. COSEWIC's (2004) assessment for striped bass is not a good reference nor is it used properly.	The Striped Bass section has been reworded to reduce confusion and update its relevance with the Project area.	Adequate - However the paragraph now conflicts with Table 5.2	Both Section 5.2.10 and Table 5.2 indicate a low potential for occurrence in relation to EL 1105. However, Table 5.2 and Section 5.2.1.10 should be updated to acknowledge that the Southern Gulf of St. Lawrence population has been downgraded from "Threatened" to "Special Concern" by COSEWIC. The St. Lawrence Estuary Population (also referred to as the St. Lawrence River population) is designated as "Endangered" by COSEWIC (COSEWIC designation not previously noted in the EA Report for this population) and "Extirpated" by SARA.
348	284	DFO	7.1.5.3	Ketten and Bartol (2005) and other more recent references included in the topic of sea turtle hearing would be useful inclusions in this assessment.	Ketten and Bartol 2005 has been added to the EA Report to provide a reference on the hearing range of sea turtles.	The reference could not be found	The first sentence in the second paragraph under the Sea Turtles heading (Section 7.1.5.3, p. 7.47) should read as follows: "Available information indicates that turtles hear at low frequency range similarly to seals (e.g., 100-900 Hz (Office of Naval Research website 2002; Environment Australia 2003; Ketton and Bartol 2005), with measureable age and species variations in response to underwater sound (Ketton and Bartol 2005). Ketton and Bartol (2005) observed a size/age difference in hearing range for loggerhead and green sea turtles, with smaller younger individuals having a greater hearing

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							range than larger, older individuals. Kemp's Ridleys had a more restricted hearing range (100-500 Hz)." Environment Australia. 2003. Recovery Plan for Marine Turtles in Australia. Prepared by the Marine Species Section Approvals and Wildlife Division, Environment Australia in consultation with the Marine Turtle Recovery Team Canberra, viewed 7 March 2011, Available at: www.environment.gov.au/coasts/publications/turtle-recovery/index.html Ketten, D.R. and Bartol, S.M. 2005. Functional Measures of Sea Turtle Hearing. Woods Hole Oceanographic Institution: ONR Award No: N00014-02-1-0510. Office of Naval Research. 2002. Science and Technology Focus, Oceanography, Ocean Life: Green Sea Turtle – Current Research. http://www.onr.navy.mil/focus/ocean/life/turtle4.htm. Last update not indicated. Accessed 3 March 2009.
351	288	DFO	7.2.4	Table 7.8 – Suggests that mortality resulting in collision with vessel is reversible? Please be advised that it is unlawful to kill harm, harass, capture or take an individual of a species that is listed as Endangered or Threatened under SARA unless permitted. This measure assists in protecting species, as the loss of an individual could be significant for a certain species (e.g. blue whale).	The results of mortality from a vessel collision have been changed to irreversible due to the fact that the loss of an individual from certain species could lead to negative population level effects.	Section 7.2.2.4 was not updated. Neither was Table 7.8	Table 7.8 Potential Environmental Effects Summary - Species at Risk should read "I" for irreversible in the Reversibility column to indicate a potential irreversible effect of mortality of species at risk from a collision with a vessel. However, text in Section 7.2.4 Residual Environmental Effects remains unchanged as the predicted residual adverse environmental effects of the Project on Species at Risk remains not significant as defined by significance criteria in Section 7.2.1.
362	301	DFO	8.7.1.1	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)."	A reference has been added to support the redfish larval extrusion area.	Adequate - However the reference provided was from another consultants EA report (i.e., LGL Limited. 2007. Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment amendment. Prepared for the Canada-Newfoundland and Labrador Offshore Petroleum Board.) This is not	The Old Harry EA (Section 8.7.1.1 and Figure 5.65) references a potential redfish mating area, attributing this information to LGL 2007. LGL (2007) depicts this potential redfish mating area on Figure 3.1 indicating "likely areas of redfish mating and larval extrusion within the Amendment Area based on

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				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.		an original citation; it is the original citation that should have been provided.	published DFO documents" (Section 3.3.1.1 p. 9). No specific reference is provided. A review of relevant references listed in the LGL (2007) text (e.g., Ollerhead et al. 2004; Sevigny et al. 2007) did not reveal any documentation of a specific mating area, hence LGL 2007 is cited in the Old Harry EA as the source. Ollerhead, L.M.N., M.J. Morgan, D.A. Scruton, and B. Marrie. 2004. Mapping spawning times and locations for 10 commercially important fish species found on the Grand Banks of Newfoundland. Canadian Technical Report of Fisheries and Aquatic Sciences 2522:iv + 45 p. Sévigny, J.-M., R. Méthot, H. Bourdages, D. Power, and P. Comeau, 2007. Review of the structure, the abundance and distribution of Sebastes mentella and S. fasciatus in Atlantic Canada in a species-at-risk context: an update. Canadian Science Advisory Secretariat Research Document 2007/085.
371	309	DFO	Supporting Document - Modeling in Support of Corridor Resources Old Harry Exploratory Drilling Environmental Assessment	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.	See Section 2.1.2 in the SL Ross report (SL Ross 2011a, updated 2012) for a description of the behaviour of the oil and gas from a shallow water subsea blowout. In general, significant entrainment of oil in the water column is unlikely during its rise to the surface in the gas bubble driven plume. The behaviour of a shallow water blowout (minimal hydrate formation) will be different from a deep water event (extensive hydrate formation) such as the Deep Water Horizon event in the Gulf of Mexico. The formation of gas hydrates depletes the hydrocarbon plume of the high energy natural gas and the driving buoyancy of the plume is essentially lost. In the case of a shallow water blowout, the gas is preserved in the plume and the high	The use of the top 30 meters of the surface waters to dilute the oil is not warranted by observations: 1. Based on a report from United States Coast Guard (2005) fact sheet on small diesel fuel spills, the authors extended the conclusions to open ocean crude oil spill conditions (see Sec. 8.5 of revised EA); 2. The authors used the mixed layer of the surface waters in the Gulf of St. Lawrence to conclude that the oil would mix over the whole mixing layer. It is true that the surface mixed layer is 30 meters (Drinkwater and Gilbert 2004), but there are two conditions that are not met in case of oil spill. The difference of density of the observed waters over 30 meters is very small. It ranges typically	Oil spill model dispersion algorithms have been developed based on field and laboratory collected data to identify the quantity of oil that would be held in the water column by turbulent mixing caused by breaking waves and other oceanographic processes. The small oil drops that are generated by breaking waves remain in the water column once dispersed and oil concentrations are diluted as they mix with additional water at depth and laterally. Density is an important factor in this process but once the droplets become small enough the buoyant force on them is reduced due to the small oil volume. Ocean turbulence then dominates and the oil is more readily mixed to depth. Choice of

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				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.	energy bouyancy effect is maintained. The overall impact is that the hydrocarbon plume travels very rapidly to the sea surface with little or no oil dispersed into the water column during its rise to the surface. The expected oil to be encountered at Old Harry is a very light 45-56 degree API oil/condensate (see response for DFO-06), in contrast to the much heavier oil encountered at Macondo (~35 degree API oil). The Old Harry site is located in 470 m water depth, which is much shallower that the 1520 m of water depth at the Macondo site. A subsea blowout at the Old Harry site is expected to behave like a shallow water event with minimal hydrate formation whereas hydrate formation at Macondo was likely extensive.	from 1.023 to 1.025 (g/cm3) (SGDO), while the density of oil ranges from 0.790 to 0.837 (g/cm3) (Table 2.14 of revised EA). It is much more difficult to mix a larger difference in density. Mixing oil of density 0.8 (g/cm3) with water of density of 1.023 (g/cm3) would not occur under a typical storm and the oil would reach a shoreline before it would mix thoroughly over 30 meters; 3. The second condition that is not met is that the mixed layer is the result of a number of storms over a season. It is not instantaneous. The top layer of the waters stays on the top until a storm mixes the waters.	the 30 m mixing depth used in the modelling was based on published reports. The oil cloud was tracked until the concentration reached 0.1 ppm over this depth. If a 10 m mixing depth is assumed, the oil cloud footprints identified in the report would represent the extent of 0.3 ppm oil concentrations. Most offshore resources are not impacted by dispersed oil concentrations less than a few ppm so the cloud dimensions are appropriate for EA purposes. The modelling does not include any biodegradation component so loss of oil concentration through this potential sink is not included in the analysis of oil concentration and cloud size. Within Section 8.5 of the Old Harry EA document, on p. 8.13, to avoid any confusion, the following statement should be considered removed: “The oil from Old Harry is anticipated to be light (45 to 56 API)”. The rest of the section focuses on diesel so the reference to Old Harry light oil is irrelevant.
372	310	DFO	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 are 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, a blow out from the surface is illustrated. However, a blowout from the bottom is not illustrated. The Gulf of Mexico spill did not behave as a text book spill as the blow out was from the bottom; it was	The surface water current data utilized provides the seasonal average trends in water movement in the region. When this is combined with the 52 years of MSC50 wind data used in the trajectory assessments the variation in trajectories possible from the drilling location are well represented for the purposes of environmental impact assessment, especially for a spill of non-persistent light oil/condensate. Tidal variations would also not significantly alter the probable footprint of the oil spills. With respect to the wind data used, the MSC50 hind cast wind set used in the modeling is a long term data set with good spatial resolution over the entire Atlantic region. The data was developed by the Climate Research Division of Environment Canada and the Federal Program of Energy	The trajectories of the oil spill are not calculated under realistic conditions. The main forces are tidal currents and hourly observed winds. Neither was used - only Seasonal mean surface water velocity and climate averaged surface winds (Sec. 2.3.3 (Water Current) and Sec. 2.3.5 (Wind) of Oil Spill Fate Report Update). The assessment that: Tidal currents were not considered in the assessment since their oscillatory movement results in little long-term net movement of surface oil is unrealistic. It is the interaction of hourly winds and tidal currents on the surface oil that provides a realistic trajectory.	See comments on significance of tidal currents in response to item 58. The MSC50 wind data set used in the modelling is not a seasonal averaged wind data set and provides an accurate representation of spatially varying hourly offshore winds. See the March 3013 response to this concern in column 6 of this table to the left.

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				not at the surface. Some of the oil did not reach the surface, and a good portion of it stayed near the bottom. There is a need to determine 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.	Research and Development. In the research paper describing the data set, the authors state that "The wind and wave data are considered to be of sufficiently high quality to be used in the analysis of long return period statistics, and other engineering applications". As such, we contend that this data set is the best available for offshore spill trajectory and behavior modeling. The use of land-based weather data from a single weather station, suggested by the reviewer, does not necessarily accurately portray the winds offshore. Sub-surface water currents were not considered in the subsea oil release because the strong, buoyant gas-bubble plume that would result from a shallow subsea release (see response to DFO-309) would overwhelm such currents and result in minimal deflection of the developed plume (see page 8 and 9 of full spill modeling report for additional description of the models used). For example, a sea bottom current of 3 kts (~0.15 m/s) is significantly weaker than the vertical velocities that can be acheived in a gas bubble plume (2-10 m/s).A description of the likely behaviour of the oil and gas from a subsea blowout from this project is provided in section 2.1.2 of the SL Ross oil fate modelling report ((SL Ross 2011a, updated 2012) (see also response to Comment #371). A shallow water blowout from the seabed is illustrated in Figure 3 of the report. Due to the strong buoyancy effect of the natural gas in the hydrocarbon plume for a shallow water subsea blowout, all of the oil is predicted to reach the surface.		
373	311	DFO	2.12 Subsea Blowouts 5	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 processes 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 Deep Blow by SINTEF, OILMAPDEEP by ASA, or CDOG by Clarkson University). It is important to	SLROSM utilizes the algorithms developed by Fannelop and Sjoen for shallow subsea blowouts as identified in the report on page 10. These are the same algorithms used by SINTEF in their shallow water discharge model and this approach has been validated against the IXTOC blowout event, a more representative blowout for this spill scenario than the Deep Water Horizon	While the Table provides a brief description of the oil spill model (SLROSM), the related content was not included in the revised document. Regarding the justification for selecting the SLROSM model instead of SINTEF, OILMAPDEEP, and CDOG it is noted that the other models were used for deep waters, whereas the SLROSM is	The development of subsea blowouts models is an ongoing process that has seen a resurgence of interest since the BP Macondo spill. Most of this effort is being expended to study the fate of releases in deep water environments where gas loss through hydrate formation is an issue and a bubble plume does not form. The shallow water

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				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.	event. Supplementary modelling completed by ASA (submitted to C-NLOPB on September 21, 2012) to compare the oil mass balance for surface, evaporated and entrained oil for two different oil specifications (Cohasset crude and diesel) shows that oils with similar properties have similar on-water persistence predictions when using SLROSM and OILMAP. With respect to Figure 3, because of the strong gas bubble plume, the oil would rise to the surface very quickly, and there would be minimal deflection of the plume by subsea cross-currents. Any potential minimal deflection would not result in a significant change in the surface oil footprint (a few hundreds of metres at most).	validated in shallow water cases. The authors should point out any limits of the model due to water depth as the water depth at the area is 400-500 m.	conditions (with respect to hydrate formation.. see discussion in section 2.12.2.1) present in this drilling location are more similar to the Ixtoc blowout as described previously in column 6 of this table. The algorithm used by SLROSM (developed by Fannelop and Sjoen) is the same algorithm used by SINTEF and others for shallow gas releases. This algorithm was validated using IXTOC data (approximately 50m water depth) and various other small scale gas release experiments. Additional validation of this or other models at greater depths has not been completed to our knowledge.
375	313	DFO	2.3.3 Water Currents	It was stated that surface water current was used in the modeling. The surface only case is fine for the surface spill scenarios, but it is insufficient in modeling subsurface blowout. Although the 470m depth was classified as shallow in terms of hydrate formation it is deep 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.	The extensive experience of SL Ross with oil spill modelling over 25 years indicates that the strong gas bubble plume will bring oil to the surface quickly and there would be minimal deflection of the plume by subsea cross-currents (a few hundreds of metres at most). Any minor deflection of the gas bubble plume by cross-currents will result in only minor changes in the surface foot print of oil. Because of the strong gas bubble plume, the oil would rise to the surface very quickly and there would be little loss of oil to the surrounding waters.	The original comment was that using only the surface current is not sufficient to describe the spill behavior in the water column. The deep current is important as well especially considering the drill site is in a channel. The model calculation should include the current in the subsurface layer. The authors responded that the gas bubble would rise to surface very quickly and there would be little loss of oil to the surrounding waters according to 25-year modelling experience. The response did not answer the velocity, magnitude and implications of ignoring the subsurface current at this study site. The subsurface current may be important because the direction of the surface current is opposite to that at the deep layer at the study site of the report according to numerical results of Wu and Tang (2011). It is recommended that the authors recalculate the model using the deep layer current field.	We reiterate that the presence of a strong gas bubble plume will generate a hydraulic condition that will override the influence of relatively small subsurface water currents. Please refer to the descriptions in the EA on the bottom of page 2.34 and page 2.35. Oil will be brought to the surface quickly with minimal shedding of droplets in the water column on the rise to the surface. To illustrate the impact of subsurface currents on the distribution of surface slicks from a subsea bow-out, the figures attached to this table show two subsea blow-out scenarios: Figure (a) shows a subsea blow-out where the upward velocity of fluids (gas, oil and water) in the center of the plume is 5 m/s; and Figure (b) shows the upward velocity of fluids in the center of the plume is 1 m/s. The magnitude of subsea currents was estimated from Figures 4.18 and 4.19 of Corridor's EA document. These figures show the subsurface currents in the vicinity of

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							Old Harry are variable, but the strongest subsurface currents are in the order of 25 cm/s along the southern edge of the Laurentian Channel. For the purposes of discussion, Corridor has selected a subsurface current of 50 cm/s (0.5 m/s), which is double the strongest subsurface current in the area. That water depth in both examples is assumed to be 450 m. The time for the fluids in the plume to rise from the seabed to the surface at a velocity of 5 m/s for the example in Figure (a) is 90 seconds. During that time, a single droplet of oil rising from the seabed to the surface would experience a horizontal movement of 45 m. The rise time for a drop of oil at a velocity of 1 m/s is 450 s (about 7 minutes). During that time, a single droplet of oil rising from the seabed to the surface as shown in figure (b) would experience a horizontal movement of 225 m. Given that distance from the source where the modeled dispersed oil plumes from a subsurface blow-out drops to 0.1 ppm varies from approximately 5 to 8 km, it is Corridor's view that a horizontal translation of the surface slick / plume by subsea currents of a few hundred meters is immaterial for the purposes of environmental assessment. See figures at the end of this document that accompany Corridor's response.
376	314	DFO	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.	The reviewers indicated that the choice to stop the trajectories at a given level of concentration in the water column was not documented. The extent of the sub-surface dispersed oil plumes was stopped at 0.1 ppm (the concentration considered no longer harmful to marine life) as indicated on page 24 along with references for justification. For the batch diesel spills of fixed volume (1000 and 10,000 litres), the dispersed oil in the upper 30 m of the water column was	See previous comment #371 re: Supporting Document - Modeling in Support of Corridor Resources Old Harry Exploratory Drilling Environmental Assessment	See response to 371

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					tracked until the oil concentration dropped to 0.1 ppm. For the subsea and surface blowouts, the models were run for one month (30 days) and the dispersed oil in the upper 30 m of the water column was tracked until the oil concentration dropped to 0.1 ppm. The light Cohasset crude oil/condensate will evaporate or disperse to a concentration of 0.1 ppm before impacting any coastline no matter how long the models are run.		
377	315	DFO	3.1 Batch Diesel Spill Fate Modeling	The modeling was conducted in average wind conditions, what 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 overestimate of concentration in some areas and underestimations in other areas.	Statistical wind data was used for Environmental Assessment purposes. Average weather conditions were modelled to provide the most likely behavior of these small diesel spills to meet the requirements of the EA. As the dispersed oil cloud moves with the prevailing currents, it also diffuses and dilutes as it moves with the water body. The 30 m mixing depth provides a reasonable estimate of in-water oil concentration for Environmental Assessment purposes.	See previous comment #372 re: Oil Spill Scenarios and Modelling Inputs	See response to comment 372.
381	319	DFO	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 the water column will be entirely different and are not covered here.	As described in the response to DFO-311, all oil released at the seabed for a shallow water, subsea blowout will travel quickly to the surface with the strong gas/water/oil plume (that is driven by the rising gas bubbles) to the surface (i.e. it is likely that no oil would trapped near the bottom or in the water column). All of the oil would rise to the surface and either evaporate or disperse. The dispersed plume trajectories were tracked until the concentration dropped to 0.1 ppm.	The behaviours of the spill near the bottom and even over the whole water column has not been addressed.	See response to comment #375. Also refer to Figure 2.9 of EA and supporting text on the bottom of page 2.34 and page 2.35 of the EA.
382	320	DFO	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 estimates based on a completely mixed, upper ocean mixing region provide adequate estimates of in-water oil concentration for Environmental Assessment purposes. Any additional resolution, either temporally or spatially, would be of limited use given the spatial and temporal knowledge of the resources	Information to support using surface water currents to represent the whole water column was not included.	The surface water currents were used to translate the location of the dispersed oil cloud in the upper mixed water layer only. Oil is not likely to be present in the water column at greater depths.

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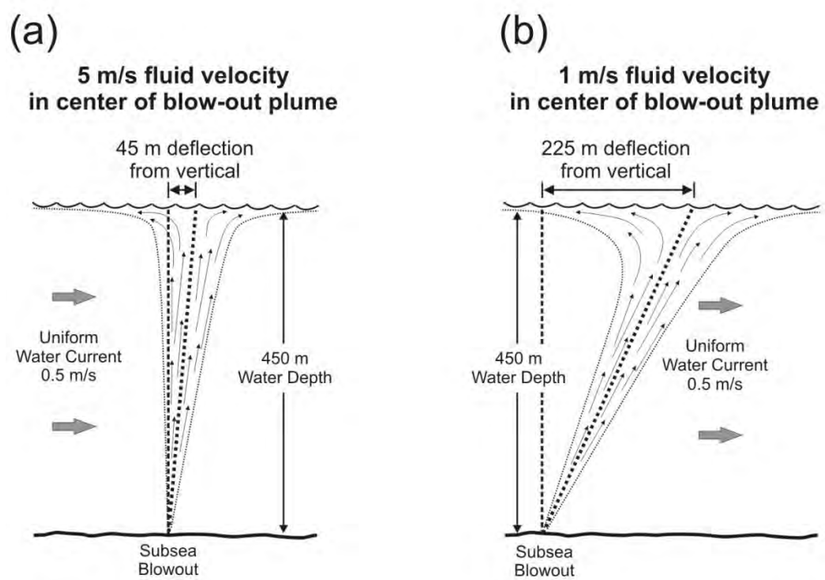
				oil concentration.	that the dispersed oil could impact.		

Response to Total Comment #375 Agency/Company Comment # 313 - DFO 2.3.3. Water currents



Attachment # 2

Corridor Responses to

Ecojustice Comments

Attachment #2: Corridor Response to the Ecojustice Comments

Introduction

Corridor Resources Inc. (Corridor) has included in the table below the science-based issues raised in the Ecojustice letter to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and a summary response to these issues for the C-NLOPB consideration. It is important to note that all of these issues have been addressed in either the updated Environmental Assessment (EA) document or Corridor's responses to regulatory agency comments. Several of the issues identified are typically addressed, as is appropriate through other aspects of the C-NLOPB regulatory approval process and Corridor will make submissions to the C-NLOPB to meet the other aspects of the approval process once a determination on the EA is made. The EA is one of many rigorous requirements that must be met before operators receive the regulatory authorization to drill an offshore exploration well.

Corridor is confident that it has filed a thorough EA with the C-NLOPB, and that the EA, together with the other aspects of the regulatory application, will demonstrate that the Old Harry exploration well can be drilled in a safe and environmentally-responsible manner.

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1	The model's parameters regarding the type and behaviour of the oil that would be encountered, the weather and the likely dispersion and extent of oil in case of a spill are unrealistic.	Corridor has included the scientific basis for the oil that could potentially be generated from the Oil Harry structure in Appendix A to the original oil spill report document that was prepared by SL Ross Environmental Research Ltd. (SL Ross) and submitted by Corridor to the C-NLOPB. It is based on the best available scientific information, Corridor's 15 years of study of the geology of the basin and the Old Harry structure and results from source rock studies conducted by a world renowned contractor (Global Geoenergy Research). Due to the present stage of thermal maturation of the source rocks, the hydrocarbons with the Old Harry structure, if present, are likely to be a very light, 45° to 56° API gravity oil. The selection of surrogate is appropriate and realistic, and as such is the basis for realistic spill modeling. With respect to the weather inputs, the SL Ross oil spill model used 50 years of historical wind data developed by the Meteorological Service of Canada (MSC 50 database), which is recognized as the best available spatial and temporal wind data set for offshore engineering project evaluation. This database takes into account all winds recorded over the past 50 years, including periods when the winds are less than 10 knots. The database includes wind information specific for the Old Harry site, and as such, it is the most appropriate source of wind information for environmental assessment purposes. The water current data used was the most up-to-date product developed by the Department of Fisheries and Oceans. With respect to oil dispersion, SL Ross re-evaluated their modeling using the Delvigne dispersion algorithm and the results were found to be not significantly different from the initial modeling results. The Delvigne algorithm does not allow for oil dispersion for wind speeds of 10 knots or less which, in our consultant's view, is not appropriate based on observation of actual oils spills documented in the scientific literature. A full discussion is presented in Corridor's September 21, 2012 response to the C-NLOPB.
2	Further, the spill scenarios that are modelled are too modest to allow for appropriate precautionary decision-making and planning.	SL Ross modeled reasonable worst case scenarios. The oil properties selected represent the likely liquid hydrocarbons that could be discovered in the Old Harry prospect. As noted above, the selection of oil type and properties was based on the best available scientific information. The spill rates were based on maximum possible flows determined by Corridor's reservoir experts with knowledge of the reservoir geology. This information was included in Appendix B of the SL Ross original modeling report. The fate and trajectory runs initiated on every day of the year using 50 years of 6 hourly averaged wind data were modelled to identify

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		the likely possible maximum extent of surface oil from potential spills from the Old Harry location.
3	As a result of the modelling, risk assessment and mitigation options are presented too optimistically as a result: the options discussed are based in the very limited risks that Corridor believes to be possible.	As is standard practice, the Old Harry EA is based on the spill risk and trajectory modeling conducted for the Project. Modeling is conducted to inform Project planning and assessment and proposed mitigation. The EA is only one of the ways in which risk is assessed early in project planning. Risk assessment continues throughout project planning, the regulatory application phase, and throughout the operations period on a daily basis. See response #30.
4	The most recent Draft EA still contains serious flaws related to the assessment of the biological environment and the potential impacts of exploration. These flaws include the omission of some VECs that would likely be affected by any serious spill, particularly coastal environments.	The Old Harry EA was prepared in accordance with the Scoping Document (August 2011) released by the C-NLOPB. This Scoping Document, which was finalized following a 30-day public review and comment period, outlines the scope of the Project, factors to be considered, and scope of the factors to be considered in the EA. The Scoping Document provided guidance on defining appropriate spatial boundaries which included consideration of potential areas of effects as determined by modeling (spill trajectory and cuttings dispersion), scientific literature, and project-environment interactions (e.g., transportation corridors). The Study Area used in the EA was defined using spill trajectory modeling results and transportation corridors to identify an appropriate area within which potential environmental effects could be realized ("Affected Area" as specified in the Scoping Document). The assessment of environmental effects of a spill is based on the spill trajectory modeling which predicts that the spilled product would not reach any coastlines. Given this finding, a detailed assessment of effects on coastal features and species is not warranted. However, the Marine Environment VEC does consider coastal features (e.g., eel grass) and an assessment of diesel spills from vessels is presented in Section 8.7.2. The Scoping Document outlined potential issues to be addressed which formed the basis for the selection of Valued Environmental Components (VECs) for the EA, and encouraged use of existing environmental assessment reports and the updating of new information where available (e.g., fisheries data). The Old Harry EA relied heavily, although not exclusively, on the Western NL SEA (LGL 2005) and the 2007 Amendment (LGL 2007). The current Western NL SEA Update (AMEC 2013), for which a draft document was released in June 2013 for public review, was not available for reference during the preparation of the Old Harry EA. However, a review of the current draft Western NL SEA Update (AMEC 2013) indicates, in the view of Corridor, that there is nothing presented in the current Western NL SEA Update (AMEC 2013) that would suggest any material changes should be made to the findings of the

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		Old Harry EA.
5	The Draft EA also contains an occasionally misleading or outdated presentation of biological information, which does not fully respond to reviewers' concerns.	The Old Harry EA has been updated, based on two technical reviews by the expert regulatory authorities. Any additional comments from the technical review will be incorporated as appropriate. As noted above in response to 4, a review of the current draft Western NL SEA Update indicates, in the opinion of Corridor and its consultants, that there is nothing presented in the 2013 Western NL SEA Update that would suggest any material changes should be made to the findings of the Old Harry EA.
6	It is essential that the time and effort be invested to conduct a truly comprehensive and independent assessment based on the best scientific information and modelling. Corridor's submissions to date do not meet this standard.	Corridor and its consultants are currently into year 3 of this EA process. The Project Description for the Old Harry exploration well was filed in February 2011. Since the filing of the Project Description, Corridor and its consultants have worked diligently to develop a thorough EA document. The draft EA has been reviewed by the expert regulatory agencies twice with Corridor making updates and modifications to the EA document. Corridor's response to the latest round of comments includes a review of the SEA draft document and modifications to the EA document have been made where appropriate. Corridor and its consultants are of the view that this EA document for a single well at Old Harry is one of the most comprehensive EA documents put together for a single exploration well offshore Newfoundland.
7	The extent of consultations is overstated in the Draft EA – while there were open houses, insufficient information was provided regarding the scope of the project and the broader issues of Gulf oil and gas development. No further information on these "open house" sessions is presented for the C-NLOPB to consider, and certainly there is no evidence to suggest that high levels of public concern have been attenuated.	Consultation activities undertaken for the Old Harry EA were undertaken prior to consultation sessions for the Western NL SEA Update. Consultation for the Old Harry EA consisted of: open houses in Port aux Basques, Stephenville, and Corner Brook; meetings with local municipal governments and economic development agencies on the west coast of Newfoundland and on the Magdalen Islands; meetings with various fisheries groups in Newfoundland and the Magadalen Islands; meetings with provincial (NL and Québec) and federal government agencies and departments; and media communication and a project website. A sample of presentation materials is included as an attachment to this table. The scope of Corridor's project involves the drilling of a single exploration well at the Old Harry structure to determine its hydrocarbon production potential. This is a short term, temporary activity for which the potential environmental impacts are largely understood. As of July 2013, there have been 389 wells drilled offshore Newfoundland. If a successful well at Old Harry lead to a development project, further public consultation will be required to support the EA of the development project. Furthermore, the broader issues of oil and gas development in the Gulf of St. Lawrence are beyond the scope of the Old Harry EA.
8	Corridor should account for this discrepancy by providing details on the consultations, including: the identity of any institutional representatives	See Response to #7. Copies of communication materials are attached to this table.

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	consulted (e.g. representatives of First Nations groups), the nature of participants' opinions and concerns, and the nature of the contact (via telephone, in person, letter, etc.). The information that was made available to consultation participants should also be attached to the EA documentation, to demonstrate that Corridor disclosed all of the relevant details of the project and provided unbiased information.	
9	The Old Harry EA must respond to the priorities identified in the final Strategic Environmental Assessment report.	A review of the current draft Western NL SEA Update by Corridor and its consultants indicates that there is nothing presented in the 2013 Western NL SEA Update that would suggest any material changes should be made to the findings of the Old Harry EA. As with all regulatory approval processes, Corridor will comply with its authorizations from the C-NLOPB and any associated conditions.
10	While Corridor has made certain revisions to its original EA submission, its updated Draft EA documents still do not meet an acceptable standard in terms of accurately modelling potential oil spills, planning appropriate disaster response, and discussing the potential impacts of the project on species in the region.	Corridor is of the view that it has provided sufficient information in this response and previous submissions to the C-NLOPB to demonstrate that the Old Harry EA is thorough, based on best available science and acceptable for the application to drill a single exploratory well. Corridor appreciates all of the comments received to date that have resulted in an enhanced EA document. With regard to response planning, detailed plans will be presented to the C-NLOPB for approval. In the offshore jurisdiction in Eastern Canada, the legislation governing the oil and gas industry establishes a comprehensive and rigorous set of requirements that an operator must meet to obtain an Operations Authorization (OA) and an Approval to Drill a Well (ADW) within the C-NLOPB regulatory framework. Although a project-specific EA like the one developed for Old Harry includes reference to some of these other requirements, an EA document cannot possibly include all of the detailed plans that govern offshore operations. It is part of the normal regulatory process to submit these detailed plans, including comprehensive contingency and response plans in order to obtain an OA and ADW.
11	The EA Scoping Document for Old Harry states that "defining the spatial boundaries should take into consideration the potential for project activities, including accidental hydrocarbon spill events, which could affect sensitive areas, including coastlines".	See Response #4. Section 5.1 of the Scoping Document explains how temporal and spatial boundaries should be defined. Corridor and its consultants have taken this into account.

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12	The oil spill dispersion model provided in an acceptable EA must be based on realistic inputs and on conservative assumptions about the kinds of incidents that could take place. Relying on an artificially optimistic model will negatively affect the capacity of the environmental assessment exercise to account for and plan for responses to potential incidents.	See Response #1. Corridor maintains that realistic inputs were used in the oil spill modeling and that the science-based modeling work completed by Corridor and its consultants is appropriate for the EA application. Recognizing the importance of spill modeling early in the planning process, Corridor spent considerable time and effort on: determining the type of hydrocarbon likely to be encountered; reservoir studies to estimate potential hydrocarbon flow rates; and the spill modeling work, where Corridor hired two professional modeling companies to conduct the spill modeling.
13	Corridor's research suggests that the oil discovered will be between 45 and 56 degrees API gravity. The same estimate appears in the company's project description to investors. However, there is no way of knowing for certain what quality of oil would be found. Executing modelling for a heavier grade of oil would be an appropriate precaution to take in the face of this uncertainty. While we do not have the resources to engage our own independent petroleum geology expertise, we submit that it is Corridor's responsibility to subject to independent scrutiny the research backing their assessment of the grade of the oil that may be found at Old Harry.	See Response # 1. Corridor hired an independent expert, Global Geoenergy Research, who is world renowned, to study the type of oil that could be generated from Old Harry. The work of Global Geoenergy Research is highly respected in the scientific community. The research backing Corridor's assessment of the grade of oil that may be found at Old Harry is presented in Section 2.3 of the EA report and is available for public scrutiny. Corridor applied a sequential scientific approach to identify the grade of potential hydrocarbon. First, Corridor undertook geochemical studies to identify the types and relative abundance of organic material that is preserved in the shale source rocks in the vicinity of Old Harry. This work revealed that the organic material is fluvial-deltaic in origin with type II to III kerogen, which generally produces natural gas or light oil. Second, petroleum systems modelling was completed to simulate the burial, maturation and generation of hydrocarbons from the organic material and migration and trapping of hydrocarbons at Old Harry. This work shows that a light oil between 45 and 56 degrees API gravity is likely.
14	While the Draft EA mentions the potential impact of sea ice, the model runs do not appear to account for the potential for sea ice to affect the spread of oil in case of a spill or blowout.	SL Ross, in Section 2.2 of its original report, did examine the general influence of ice on oil fate and behaviour. It is important to note that Corridor intends to drill the well within an ice-free period, as stated in the EA and in other responses to the regulatory authorities' technical review of the EA.
15	The model also fails to account for the possibility and impact of a sub-surface plume of oil, such as that which developed during the Deepwater Horizon blowout.	Based on SL Ross's 30 years of experience with oil spill fate and behaviour and their experience with the Deep Water Horizon incident, it is their expert opinion that a subsea blowout in water at the depth encountered at Old Harry will not behave in the same way as the Deep Water Horizon incident. Instead, in the unlikely event of a release at the Old Harry site, oil would be carried to the surface in a gas bubble driven plume more similar to the Ixtoc blowout.
16	The SL Ross model for being unrealistic in its assumption that oil will dissipate throughout the	The 30 m mixing depth is based on a reference (Drinkwater and Gilbert 2004) that identified the upper mixing zone to be on the order of 30+ m. A conservative estimate of in-water oil

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	first 30 m of the water column.	concentration has been made based on this mixing depth and is, in SL Ross's opinion, a reasonable approach for the purposes of an EA.
17	Further, they criticize the simulation's use of mean currents rather than instantaneous currents.	See Response #1 relating to currents used by SL Ross in its modeling.
18	The comparison of the SL Ross and ASA models does not include winds below 10 knots, though these are possible in the area, especially in summer when the proposed drilling would take place. For instance, in June, the weather data set Corridor used shows that 46.3% of the time, winds will be between 0 and 10 knots, hampering the natural dispersion that Corridor believes would occur.	The model outputs from the two models (SL Ross and ASA) were compared at wind speeds other than 10 knots and found to be in agreement. Since the same Delvigne algorithms for natural dispersion were used in both models, the results at the lower winds speeds will also be the same. The SL Ross model was then used with the 50 year MSC data set (that includes the calm winds noted by the Ecojustice reviewers) in the revised modelling with results not significantly different from the original modelling, as previous described.
19	While Cohassett-type crude may have a limited life at the sea's surface, Corridor's assertion that it will evaporate rapidly is based on the density of this oil at 15°C, apparently unadjusted for the likely water temperature it would encounter in the Gulf. Depending on the temperature of the water and air around the oil at the time of release, the oil's fresh and weathered density could be affected. The average air temperature in vicinity, during the warmest month of the year, is 15°C. The sea temperature is much cooler, apparently dropping to 1°C 50 m below the surface.	The spill modelling accounts for oil property change with water temperature variation so this comment is incorrect.
20	SL Ross' description of their model states that the behaviour of each "slicklet" is modelled separately as if the slick were composed of batch releases at six-hour intervals. It is unclear how this affects the amount and fate of oil accumulating in the water surrounding the modelled spill or blowout.	The original modelling was done using initial oil volumes equivalent to 6 hour accumulations of oil from the blowout to provide a conservative estimate of oil persistence. The full quantity of oil from the blowout was accounted for in the modelling.
21	While SL Ross has introduced a new dispersion algorithm for the purposes of comparison, the model still does not provide a realistic worst-case scenario.	See Response #2 with respect to realistic worst case scenarios.
22	The size, duration, and origin of the spill should be	SL Ross did take these items into account in their spill modeling. See Responses #1 and 2 and

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	planned to provide a realistic appraisal of the potential area affected by a worst-case incident.	note that the fate and trajectory runs initiated on every day of the year using 50 years of 6 hourly averaged wind data were modelled to identify the likely possible maximum extent of surface oil from potential spills from the Old Harry location.
23	Currently, the flow rate of the spill is too small compared to some other blowouts (only 13,225 bpd compared to 53,000 to 62,000 in the Deepwater Horizon spill).	Corridor's reservoir engineer studied the potential flow rates that could be generated from Old Harry and the potential flow rates from the Old Harry structure are very different from the flow rates from the Deepwater Horizon. Flow rates are controlled by pressure, permeability, viscosity and density, with the largest differences usually being pressure and permeability. A calculation of the predicted hydrocarbon flow from the Old Harry structure was included in Appendix B of the SL Ross original modeling report. The depth of the Deepwater Horizon Miocene M56 reservoir is approximately 5,500 m (18,000 feet) below sea level (BSL) with a reservoir pressure 11,850 psi. Permeabilities are typically in the hundreds of milliDarcys (mD) for the very young (5 to 25 million year old) Miocene sandstones. The Deepwater Horizon well encountered some of the highest productivity reservoirs ever encountered in the Gulf of Mexico. In contrast, Old Harry is drilling into much older Carboniferous (300 million years old) potential reservoirs. Older reservoirs are more cemented and thus have less porosity and permeability (flow capacity) is at best in the 10s of mD. In addition, the depth of the Old Harry reservoir is expected to be about 2,000 m (6,500 feet) BSF. At this shallow depth, the pressure of formation is expected to be approximately 2350 psi (normally pressured), based on the numerous normal or near-normally pressured wells drilled in the Maritimes Basin. The highest rate modeled was based upon an average 50 mD sandstone. There are two wells in the northern part of the basin where Old Harry is being drilled. Both wells show sandstones with an average of 30 mD in the best intervals. A 50 mD sandstone is considered in the high range of expected permeabilities.
24	The spill modelled is also not lengthy enough, only 30 days, when it took nearly three times that long to kill the Deepwater Horizon blowout and there is no reason to believe the conditions or emergency response capabilities in the Gulf would enable a	Corridor asserts that SL Ross used an appropriate duration for spill modeling.

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	faster response to any similar incident.	
25	Some statements by Corridor suggest the company may be less interested than the public is in gaining a complete picture of the potential magnitude of damage resulting from a spill: "Which model is best for a specific application can only be determined after a spill has occurred and if sufficient data is collected on the oil properties, weather conditions and ultimate fate of the oil to permit a detailed modelling of the event. Such data is rare." Waiting until after a spill to respond to the issues about the spill modelling is not an approach that permits appropriate scenario planning, nor does it live up to *CEAA*'s precautionary approach.	The main point being made in the statement in quotations at left is that models are only an estimate of what may happen based on predictive models that have been based on testing or experience with a limited number of oils under a limited number of conditions. What model best simulates what has happened in a specific spill can only be determined after the event. This is just stating an obvious fact. Corridor is committed to safe and responsible offshore exploration in the Gulf of St. Lawrence and is in no way less interested than the public in gaining a complete picture of a potential spill for EA purposes. Corridor, in collaboration with its expert consultants, has completed a thorough and reasonably conservative evaluation of realistic spill scenarios based on scientifically defensible arguments.
26	Corridor cites the Uniacke and Elgin blowouts as examples of oil evaporating rapidly after a blowout. This is an untrue description of these spills. The Uniacke blowout released approximately "two million cubic meters/day of gas and upwards of 48 cubic meters/day of condensate", and apparently little to no crude oil. The Elgin blowout released mainly "methane gas, with associated higher alkane gases (e.g., ethane, propane and butane), natural gas liquids, condensate, and small quantities of waxes", according to the document referred to by Corridor. Neither was a major oil spill. SL Ross's own description of its model refers to the Uniacke incident as a "condensate blowout".	Corridor and its consultants maintain that these two blowouts are relevant comparable incidents. SL Ross has studied both incidents in detail. The Uniacke release, in particular, provides an example of the fate of a blowout release of a very similar oil to that expected from Old Harry. The short persistence of the oil on the surface from the Uniacke blowout, as documented by Environment Canada, validates the persistence results from the spill modeling conducted by SL Ross for Old Harry. From item 6 in the conclusions on page 49 of the EC report EPS-8-AR-84-1… "as a rule slicks dissipated within 5 n.mi. (approximately 9 km) of the Vinland rig." From page 75 of EPS-8-AR-84-2 the REET account for March 5 at 8:10 states "Environmental monitoring indicated no visible condensate slick in the area and no evidence of impact to Sable Island." The well flow was stopped at about 17:00 hours on March 3rd.
27	Dispersion of oil through the water column has deleterious effects as well. It is toxic to many organisms, and the longitudinal marine biological studies being conducted in the wake of the Deepwater Horizon disaster will provide ample	Effects of spilled oil on fish, birds, mammals, and sea turtles (including species at risk) as well as effects on the marine ecosystem, sensitive areas, and fisheries were considered. Existing literature was cited to characterize predicted effects on these VECs, with the conclusion that with the exception of marine birds (as a result of an accidental spill), there are not predicted to be significant adverse residual effects on any other VECs. Data presented to reach these

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	evidence in support of this assertion, in the course of time.	conclusions are compatible with those presented in other exploration drilling EAs in the NL offshore, including the SEA and subsequent updates for the Western NL Offshore Area (LGL 2005, 2007; AMEC 2013).
28	According to the Draft EA, "[t]he estimated project time is from 20 to 50 days. The 20 days refers to drilling time for a 2000 m well. The 20 days does not include rig mobilization and demobilization, non-productive time or any time associated with waiting on weather. The time for well testing has not been included in the 20 to 50 day time period. Currently, testing is not planned to be completed during the drilling of the well; however, depending on approval times and rig availability, testing may be completed immediately after drilling or at a later date." This timeframe is very optimistic, as it does not explicitly exclude the sea ice season or specify that enough time would be built in to allow the drilling of a relief well even under poor weather conditions or with other setbacks**.**	With respect to the timeframe required for drilling operations, Corridor's technical team composed of experienced drilling engineers, geologists and reservoir specialists have identified the amount of time needed to conduct the drilling program and this timeframe was outlined in the EA document and reinforced in Corridor's responses to regulatory agency comments. Of course, the timeframe will be refined as detailed planning continues and the spud date for the well approaches. Drilling is expected to proceed quickly, given the nature of the rocks. The Old Harry well is a shallow well (2,000 to 2,200m below sea floor) with carboniferous age sandstone, siltstone and shale rocks. Corridor and others have drilled a number of wells in the Upper Carboniferous rock of the Maritimes Basin and can use the drilling rates from these wells to provide a very good estimation of the time required to drill the 2000 to 2,200 m of Carboniferous rock in the Old Harry well. As noted in the EA document, Corridor intends to drill the well during an ice-free period.
29	Again, Corridor must provide assurances that its drilling operation would not take place during that portion of the year when conditions are not optimal. The Board should not approve the project if this basic assurance is not supplied.	See Response #28. It is stated in the EA document that Corridor intends to drill during an ice-free period.
30	The Coalition believes that risk mitigation as that are currently planned for this project is not adequate to reduce the risk and potential impact of accidents and malfunctions to a level consistent with the C-NLOPB's environmental and safety responsibilities.	In the offshore in Eastern Canada, the legislation governing the oil and gas industry establishes a comprehensive and rigorous set of requirements that an operator must meet to obtain an Operations Authorization and an Approval to Drill a Well within the C-NLOPB regulatory framework. Although a project-specific EA like the one developed for Old Harry includes reference to some of these other requirements, an EA document cannot possibly include all of the detailed plans that govern offshore operations and support risk identification and mitigation. These detailed plans will be presented to the regulator for approval subsequent to an EA determination. In addition, exploration and development companies as a matter of course and following best

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		industry practice develop their own internal planning process before operations are undertaken. Corridor has in place a Management System that governs how the company conducts its business and associated operations. Risk assessment and mitigation is the fundamental component of the management system and is central to the planning of all operations. A detailed risk assessment is conducted in advance of operations to ensure that any potential risks are appropriately mitigated. Other plans or procedures that will be in place in advance of operations (either due to requirements of Corridor's own internal management system or the detailed regulatory approval process) include, but are not limited to, the following: hazard identification and risk management processes; training and competency assessment of all involved personnel and contractors; audit process; integrity management procedure for all facilities (rig, support craft and equipment necessary to ensure safety, environmental protection and waste prevention); environmental protection plan; contingency plans to prevent, mitigate and respond to emergencies including detailed emergency response plans, spill response plans, search and rescue arrangements, resources sharing and mutual aid agreements, relief well drilling and subsea control arrangements; safety plan; waste management plan; and many more. The regulatory requirements are outlined in Acts, Regulations and Guidelines on the C-NLOPB website www.cnlopb.nl.ca. In addition, the major contractors (drilling, supply vessels, helicopters) are required to maintain updated and current health, safety, environmental plans including emergency response and other contingency plans. All of this information is submitted to the C-NLOPB for review and approval prior to any offshore operations as part of the regulatory approval process.
31	The disaster response section of Corridor's Draft EA document lists methods for cleanup and recovery, including mechanical recovery, in situ burning, mechanical dispersion, chemical dispersants, and natural dispersion. However, this section discussing spill response technologies does not discuss the magnitude of response gaps in actual conditions, due to weather, visibility, darkness, or equipment or personnel availability that can restrict the usefulness of these technologies and techniques.	See Response #30. The EA contains a high level summary, but the detailed contingency plans will be submitted to the C-NLOPB for approval once an EA determination is made as part of the Operations Authorization application.
32	In the same vein, chemical dispersants are	See Response #30, 31. As noted in our EA and in this Ecojustice comment, Corridor would

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	mentioned as an appropriate response technique, and Corridor proposes that they may only be used when authorized by the C-NLOPB. As a result, it is not clear whether all of the chemical components of dispersants anticipated by Corridor for effective spill response have been approved for use in Canada. Furthermore, recent research shows that a combination of oil and dispersants can be more toxic, to a variety of species, than oil alone.	only use chemicals approved by the C-NLOPB.
33	The 2013 Draft EA simply promises that a more detailed Oil Spill Response Plan (OSRP) will be worked out later on, when an Operation Authorization is being sought. Ironically, Corridor's Draft EA subsequently cites this as-yet-unprepared Spill Response Plan as a mitigation measure against damage to the VECs assessed for the exploration program. This is simply unacceptable.	Corridor is following the regulatory approval process for obtaining authorizations for drilling offshore Newfoundland. Corridor will not receive an authorization to drill a well from the C-NLOPB, unless the C-NLOPB deems the contingency plans acceptable. There is sufficient experience with the development of oil spill response, emergency response and other contingency plans in the Newfoundland offshore that Corridor is confident its detailed plans will meet or exceed regulatory requirements.
34	Corridor's Draft EA assures readers that the company will have access to the same quality of well caps and other equipment to control a blowout as the rest of the industry operating in the Grand Banks. This is a manifestly insufficient response to concerns about the adequacy of even the industry's best efforts at responding to spills and blowouts. There are ongoing and high-profile technical challenges in the application of these devices (e.g. Shell's containment dome being "crushed like a beer can" in 2012 testing in Bellingham, WA), so Corridor must be prepared to demonstrate that the project is very likely to be successful in the use of well capping technologies should the need arise.	With respect to blowout prevention and well capping, Corridor is committed to continuous improvement that builds upon lessons learned from industry wide experience. It is important to note that wells are designed with multiple barriers and are capable of being shut-in with a full column of hydrocarbons. During the drilling phase, the primary well control barrier is typically provided by the overbalance of the drilling fluid. Blowout preventers (BOPs) would be used for controlling pressure in the well only if required due to the loss of a primary barrier. Redundant systems are also in place to activate the subsea BOPs. BOPs are monitored during operations, inspected and tested at regular intervals. Personnel are trained in well control and exercises are conducted. Corridor is a member of the Canadian Association of Petroleum Producers (CAPP), an organization that is participating in the evaluation of global capping and containment solutions. The global efforts by the oil and gas industry on well capping and containment and the resultant technology that is available for worldwide use is mainly being developed by the Subsea Well Response Project and is accessible to companies like Corridor through membership in Oil Spill Response Ltd. (OSRL) and a supplementary agreement. As noted in previous submissions, Corridor will have the same access to capping devices and deployment

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		capacity as the other Newfoundland and Labrador offshore operators. Of course, the key focus for Corridor and other operators is prevention.
35	Although the 2013 Draft EA contains more information on the anticipated amount of vessel traffic that would result from exploration at Old Harry, the risk of spills from supply vessels is not presented quantitatively. The discussion of shipping does not address the incremental increase in risk or in cumulative impacts that may result from the combination of Old Harry-related vessel traffic and existing marine transport in the Gulf.	The assessment of cumulative effects in the EA considered environmental effects of the Project in combination with other projects or activities that have been or will be carried out (including fishing activities), as outlined in the Scoping Document. With specific regard to the comment that the cumulative effects assessment did not consider the incremental risk that may result from the combination of Old Harry-related vessel traffic and existing marine transport in the Gulf, it is helpful to put the incremental risk in context. It is anticipated that the Project will involve two to three support vessels trips per week during the proposed drilling program (20 to 50 days). Monthly vessel traffic volumes (including merchant traffic, cruise ships, and fishing vessels) in the Gulf of St. Lawrence vary throughout the year from less than 400 vessels per month to nearly 60,000 vessels per month (Pelot and Wootton 2004). Given this context, a detailed quantitative analysis is not required to determine that vessel traffic from the Project is minimal and would not result in a measureable cumulative environmental effect.
36	Further, determinations about the full cumulative impact of Old Harry should reflect the findings of the Western Newfoundland SEA.	The Western NL SEA was not publicly available at the time of writing the Old Harry EA. However, a review of the SEA was undertaken prior to submission of the latest comments to the C-NLOPB and there are no findings reported in the SEA that would affect the conclusions of the cumulative effects assessment of the Old Harry EA. It is recognized in the various cumulative effects sections (throughout Section 5) in the Western NL SEA that overlap between offshore petroleum projects and/or unrelated activities in the Gulf would be considered in planning and review of applications and that spatial and temporal overlap of petroleum exploration activities would be limited in the Western NL Offshore Area given the anticipated level of exploration in the region and the limited spatial and temporal extents of most programs.
37	Corridor should not downplay the importance of the Old Harry study area, or the possibility of species' occurrence nearby.	The Old Harry EA recognizes the ecological and socio-economic value of the Gulf of St. Lawrence and includes exhaustive descriptions of relevant biophysical and socio-economic features, which in many cases, extend beyond the predicted "affected area". This includes descriptions of species and important habitats which occur in the Gulf region but may or may not be predicted to interact with the Project.
38	As stated above, although Corridor's model treats dissipated oil as a problem that has been solved, oil dispersed into the water column can still have significant adverse effects on biota. The dispersed oil becomes available to phytoplankton, and through this pathway can contaminate species that	Due to the present stage of thermal maturation of the source rocks, the hydrocarbons with the Old Harry structure, if present, are likely to be a very light, 45° to 56° API gravity oil. The selection of surrogate is appropriate and realistic, and as such is the basis for realistic spill modeling. The effects assessment is based on the predicted characteristics and behavior of the hydrocarbons expected to be encountered in the well. Spill modelling results indicate a short-term exposure of dispersed oil and therefore bioaccumulation is not considered to be an issue

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	use the phytoplankton as a food source. The discussion should reflect these effects, particularly as a new oil spill model could demonstrate that the effects of a spill could expose phytoplankton to "chronic" levels of oil which may then make their way up the food chain. Corridor erroneously asserts that the shorter-term exposure it has modelled will not bioaccumulate.	of concern for this Project. See also Response to #16.
39	In some places, outdated information persists in the EA's discussion of the effects of the operation on marine life. Where more recent scientific information is available, it should be incorporated.	The updating of information in the EA document has been addressed through the revised EA document and Corridor's responses to the technical review conducted by the C-NLOPB and other federal agencies. The latest 2013 Western NL SEA document was also reviewed prior to submitting this response to the C-NLOPB. Data presented to reach the conclusions in the Old Harry EA are compatible with those presented in other exploration drilling EAs in the NL offshore, including the SEA and subsequent updates for the Western NL Offshore Area (LGL 2005, 2007; AMEC 2013).
40	For example, a 1990 study is cited to demonstrate that no significant whale and dolphin mortality results from oil spills. This discussion should be updated with more recent information based on mortality from other major spills, as (unfortunately) there have been several large oil spills that have provided opportunities for further scientific research in this area since 1990.	See Response #39.
41	In addition, more complete information should be provided regarding the effects of seismic noise.	As indicated in Section 2.10.3 of the Old Harry EA, vertical seismic profiling may be conducted as part of the exploration drilling program. This involves placing a string of geophones down the drilled well with an air-source array suspended from the drilling unit. Peak output pressure is usually in the range of 240 to 250 dB and the duration of the survey would be in the order of hours to days. A separate EA conducted for Corridor's geohazard program (Stantec 2010) assessed effects of seismic noise from these types of activities on EL 1105 and predicted no significant adverse environmental effects would occur.
42	Corridor's assessment also does not extensively discuss the potential for damage to sensitive and productive eelgrass beds and salt marshes, either resulting from small spills from vessels, or more	Section 8.7.2 of the Old Harry EA assesses effects of spills on coastal environments. Although spill modelling did not indicate any interaction with coastline, Corridor recognizes the potential risk of a diesel spill from supply vessels that could potentially interact with coastal habitats. Section 8.7.2 therefore focuses on effects from diesel spills on sensitive coastal

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	major harm from a large spill or blowout.	habitats including, but not limited to, eelgrass beds.
43	The restrictions on the modelling of the oil spill zone also affect the assessment of spills' effects on species in the Gulf. The use of a very light surrogate crude oil leads Corridor to conclude that impacts on VECs are minimal or reversible. The inadequacies identified in the current model have the effect of artificially restricting the study area and excluding the potential shoreline impacts shown in models that are less favourable to Corridor's proposal. The smaller study area contributes to an impression that there is little likelihood of effects on, for instance, commercial fisheries that are 10 to 12 km outside the project area.	See Response #4. As indicated above, the effects assessment, including delineation of a Study Area, selection of VECs, and identification of potential interactions, and analysis of effects, is based on the predictive spill modeling undertaken by SL Ross. For reasons stated above, Corridor and its consultants stand by the modelling that was undertaken and the outcome of this modelling.
44	The comments document notes that provincial lists of species (e.g., Magdalen Islands seabirds under Québec's legislation) are not included.	The Scoping Document requires the EA to include a description of marine and/or migratory birds using the "Affected Area" (defined by Corridor as the Study Area in the EA) and Species at Risk listed in Schedule 1 of the *Species at Risk Act* (SARA) and those under consideration by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in the "Affected Area". Species of highest conservation concern would fall under either SARA or COSEWIC listings. Although there is no predicted interaction with the Magdalen Islands, data on seabird colonies on the Magdalen Islands, in addition to Western Newfoundland, Southern Newfoundland, Cape Breton Island and the southern portion of Anticosti Island was included in the revised EA in response to comments from Environment Canada. In addition, detailed seasonal distribution data from the Eastern Canadian Seabirds at Sea (ECSAS) and the Programme Intégré de Recherches sur les Oixeaux Pélagiques (PIROP) for the Gulf of St. Lawrence (outside the "affected area") was presented in the February 2013 EA. Magdalen Islands seabirds are therefore given comprehensive treatment in the February 2013 EA.

Supporting Documentation

For

Responses to Questions 7 and 8

Of

Attachment #2

Corridor Response to the Ecojustice Comments

About Corridor Resources Inc.

Bringing energy to *life*

Corridor Resources is an Eastern Canadian energy company that has been engaged in the exploration, development and production of oil and natural gas onshore in New Brunswick, Prince Edward Island, Quebec, and offshore in the Gulf of St. Lawrence in Newfoundland and Labrador and Quebec for more than 14 years. We are dedicated to the discovery of new oil and gas resources, the safety of our employees, the environment and the community around us, as we continue to explore and develop these resources in Eastern Canada.

Established in 1995, Corridor Resources is headquartered in Halifax, Nova Scotia, and has a production office and gas plant in Penobsquis, New Brunswick, near Sussex.

ABOUT OUR COMPANY

PRODUCTION:

- McCully Gas Plant operational – June 2007
- Production of sweet gas (no acid gases, e.g., no hydrogen sulphide or carbon dioxide)
- Gas plant capacity – 50 million cubic feet of gas per day
- Current rate of gas production – 15 million cubic feet of gas per day
- Number of producing wells – 30
- Length of gathering system pipeline – 14.1 km
- Length of transmission pipeline – 48.7 km
- Gas plant designed for low emissions/noise and minimal visual impact
- Fully automated safety systems
- Gas plant remote monitoring capability
- High gas plant reliability (greater than 98%)

Corridor Resources drilled its first onshore natural gas discovery well at the McCully Field in September 2000. Since that time, Corridor has drilled more than 40 wells in the area which have encountered natural gas. In June 2007, the McCully Gas Plant became operational. Corridor currently produces gas from the McCully Field to markets in the Maritimes, and to New England through the Maritimes and Northeast Pipeline. Corridor continues to connect wells to the system as new resources are found.

The oil and natural gas industry is contributing to a strong Eastern Canadian economy. The potential exists for this industry to continue to grow and prosper in the future – creating jobs, opportunities for local people and businesses, and growth in research and development, education, and training. At Corridor Resources, we are passionate about what the future holds and hope to use our expertise to uncover nature's potential in Eastern Canada.

DRILLING & COMPLETIONS:

- Total number of wells drilled – 39 in Penobsquis area (McCully Field) and 3 in Elgin area in New Brunswick
- Deepest well drilled – 4130 m
- Total length of holes drilled in New Brunswick (for all wells) approximately 130 km

SEISMIC:

- Land (2-D) seismic data – 15 programs – 997 km total
- Land (3-D) seismic data coverage – 4 programs – 132 km^2 total
- Marine (2-D) seismic data – 3 programs in the Gulf of St. Lawrence – 1880 km total
- Marine geohazard survey on Old Harry – 1 program –130 km

For further information:
#301-5475 Spring Garden Road, Halifax, NS, B3J 3T2
Telephone: 1-888-429-4511 / Facsimile: 1-902-429-0209
Email: info@corridor.ca
www.corridor.ca

March 2011

Consultation Meeting Comment Card

Were all of your questions answered during the meeting?

□ Yes □ Most were answered □ Some were answered □ No questions were answered

If no, what additional questions about the information Corridor Resources presented do you feel still need to be addressed?

What is your main concern with regard to Corridor Resources' proposed exploration well offshore Newfoundland and Labrador?

Do you support Corridor Resources' proposed exploration well? Please explain your position.

Other comments:

Optional: If you wish to be contacted directly, please complete the section below.

Name: _____

Email:_____ Phone number: ( ) _____ - _____

May we contact you with information? □ Yes □ No

Please leave this at the front table, fax to (902) 429-0209, email to HSE@corridor.ca
Or mail to: #301-5475 Spring Garden Road, Halifax, NS B3J 3T2
Thank You. We appreciate your feedback.

This is an example of presentations given as part of our public engagement strategy.

Proposed Drilling of an Exploration Well on the Old Harry Prospect within Exploration Licence 1105

March 2011

Disclaimer

Forward Looking Statements

This presentation contains certain forward-looking statements and forward-looking information (collectively referred to herein as "forward-looking statements"). All statements other than statements of historical fact are forward-looking statements. Forward-looking information typically contains statements with words such as "anticipate", "believe", "plan", "continuous", "estimate", "expect", "may", "will", "project", "should", or similar words suggesting future outcomes. In particular, this presentation contains forward-looking statements pertaining to the following: characteristics and potential of Old Harry; next steps to be undertaken by Corridor, including holding public consultations, preparing and filing with C-NLOPB an environmental assessment, timing of the assessment; regulatory approval of the exploration program; and the proposed exploration program at Old Harry, including well location, well design, type of drilling rigs to be used, logistical support, timing of drilling, practices to be followed, and potential issues associated with the program and potential mitigation of such issues. Forward-looking statements are based on Corridor's current beliefs as well as assumptions made by, and information currently available to, Corridor concerning business prospects, strategies, regulatory developments, future natural gas and oil commodity prices, exchange rates, the ability to obtain equipment in a timely manner to carry out development activities, the impact of increasing competition, the ability to obtain financing on acceptable terms. Although management considers these assumptions to be reasonable based on information currently available to it, they may prove to be incorrect. Undue reliance should not be placed on forward-looking statements, which are inherently uncertain, are based on estimates and assumptions, and are subject to known and unknown risks and uncertainties (both general and specific) that contribute to the possibility that the future events or circumstances contemplated by the forward-looking statements will not occur. There can be no assurance that the plans, intentions or expectations upon which forward-looking statements are based will in fact be realized. Actual results will differ, and the difference may be material and adverse to Corridor and its shareholders. These factors include, but are not limited to risks associated with oil and gas exploration, financial risks, substantial capital requirements, bank financing, government regulation, environmental, prices, risks may not be insurable and reserves estimates. Further information regarding these factors and additional factors may be found under the heading "Risk Factors" in Corridor's Annual Information Form for the year ended December 31, 2009 and its most recent management's discussion and analysis, *copies of which is available at www.sedar.com. The forward-looking statements contained in this presentation are made as of the date hereof and Corridor does not undertake any obligation to update publicly or to revise any of the included forward-looking statements, except as required by applicable law. The forward-looking statements contained herein are expressly qualified by this cautionary statement.*

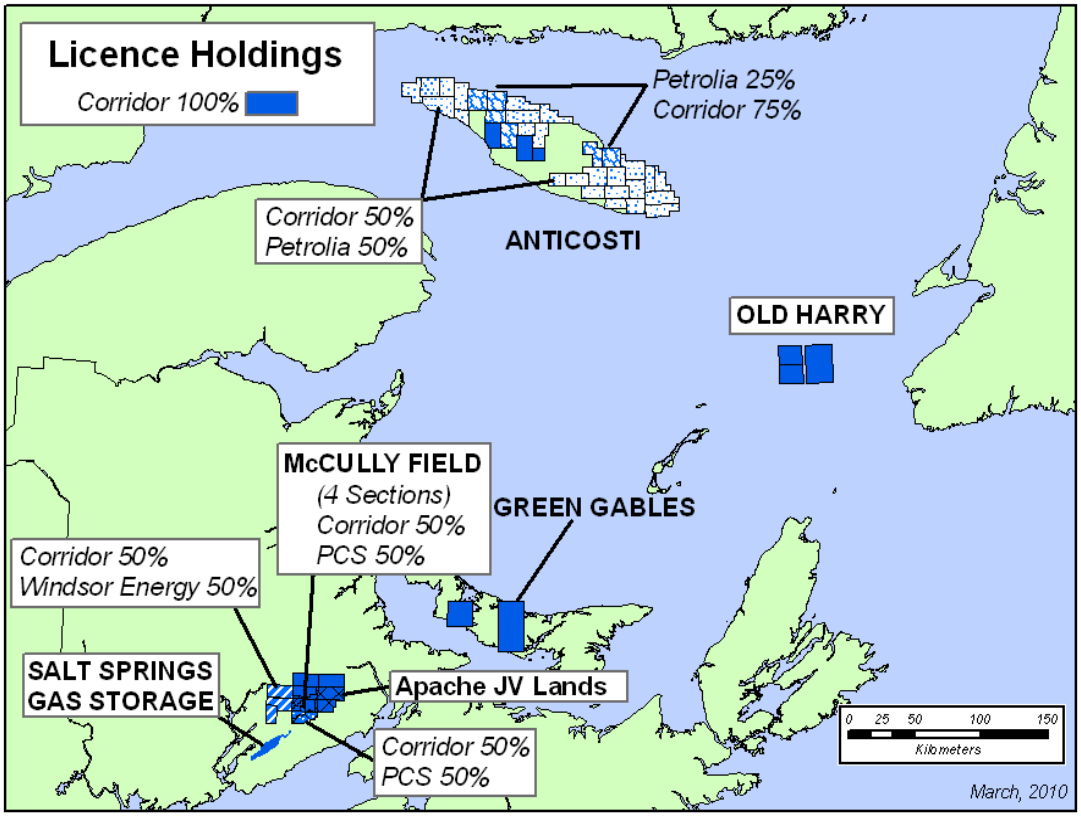
Presentation Outline

- Meeting goals and objectives.
- Who is Corridor Resources.
- Long history of oil and gas exploration in the Gulf of St. Lawrence.
- Update on Corridor's 2010 Geohazard Site Survey.
- Overview of Corridor's proposed exploration well within EL1105.
- C-NLOPB regulatory process to obtain approval to drill a well.
- Next steps.

Meeting Goals and Objectives

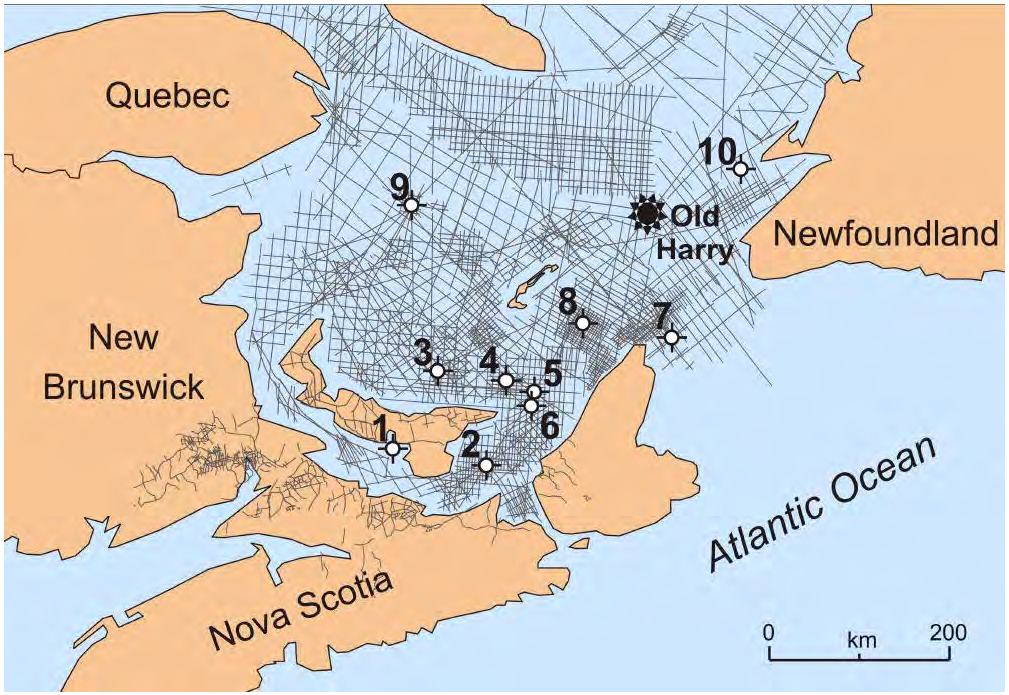
- We are here to listen to your questions, record your issues and describe the project – a proposed well within EL 1105.
- Responses to questions and concerns will be addressed scientifically through the Environmental Assessment and regulatory process.
- We want to design the best possible exploration project with input from stakeholders.
- This information will be incorporated into the Environmental Assessment that is underway.
- We are confident the proposed well can be drilled in a safe and environmentally responsible manner.
- The Environmental Assessment will be available for review on the C-NLOPB website.

Who is Corridor Resources?



- Leading independent natural gas producer in Eastern Canada.
- Main Project Areas
  - Natural gas production, New Brunswick
  - Petroleum exploration, New Brunswick
  - Oil exploration, Anticosti Island, Quebec
  - Natural gas potential, Prince Edward island
  - Old Harry exploration, Gulf of St. Lawrence
- Strong team with onshore and offshore experience.

Long History of Exploration in the Gulf of St. Lawrence

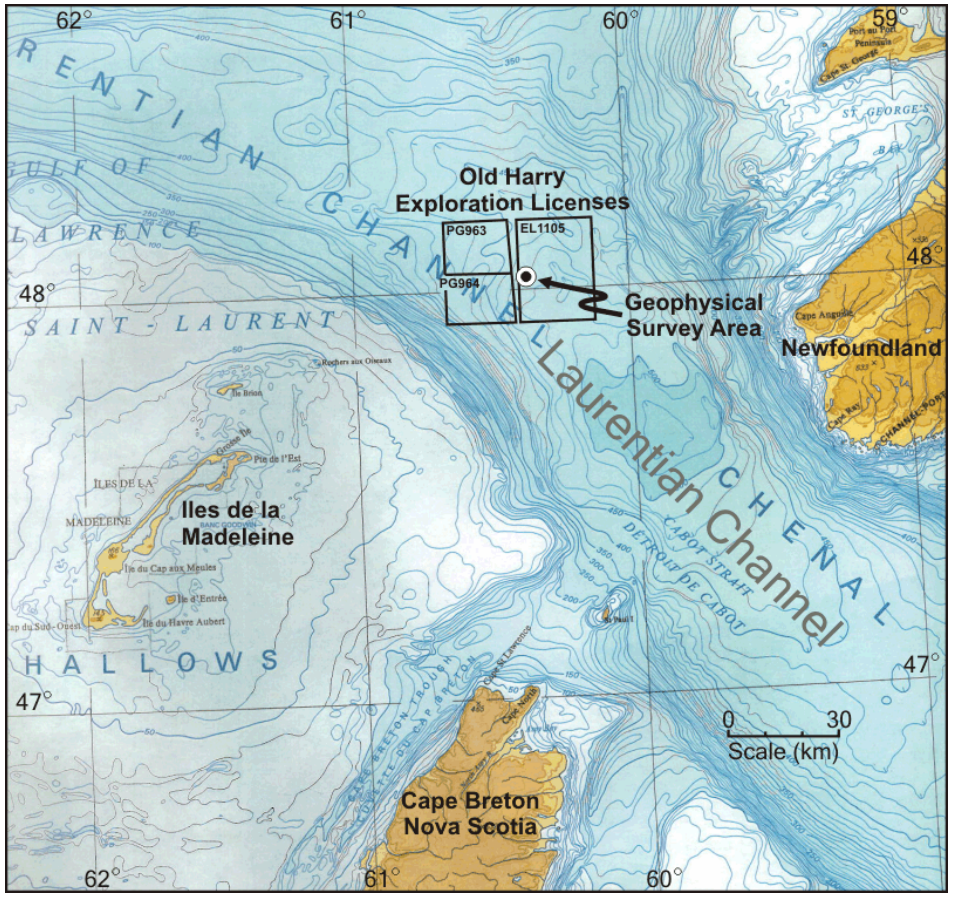


#	Well	Year Drilled	Total Depth (m)
1	Hillsborough No.1	1944	4479
2	Northumberland Strait F-25	1970	3001
3	Cable Head E-95	1983	3235
4	Beaton Point F-70	1980	1734
5	East Point E-49	1974	3526
6	East Point E-47	1980	2662
7	St. Paul P-91	1983	2885
8	Cap Rouge F-52	1973	5059
9	Bradelle L-49	1973	4421
10	St. George's Bay A-36	1996	3240

- 10 offshore wells drilled and many kilometers of seismic collected by other operators.
- Most wells drilled in 1970-80's were looking for oil
  - 5 - no hydrocarbon shows
  - 4 - minor shows
  - 1 - significant gas discovery.
- Old Harry was first identified in the early 1970s
- Corridor Old Harry activities
  - 1996 - acquired Old Harry exploration licences
  - 1998 / 2002 - new seismic
  - 2010 - geohazard survey.

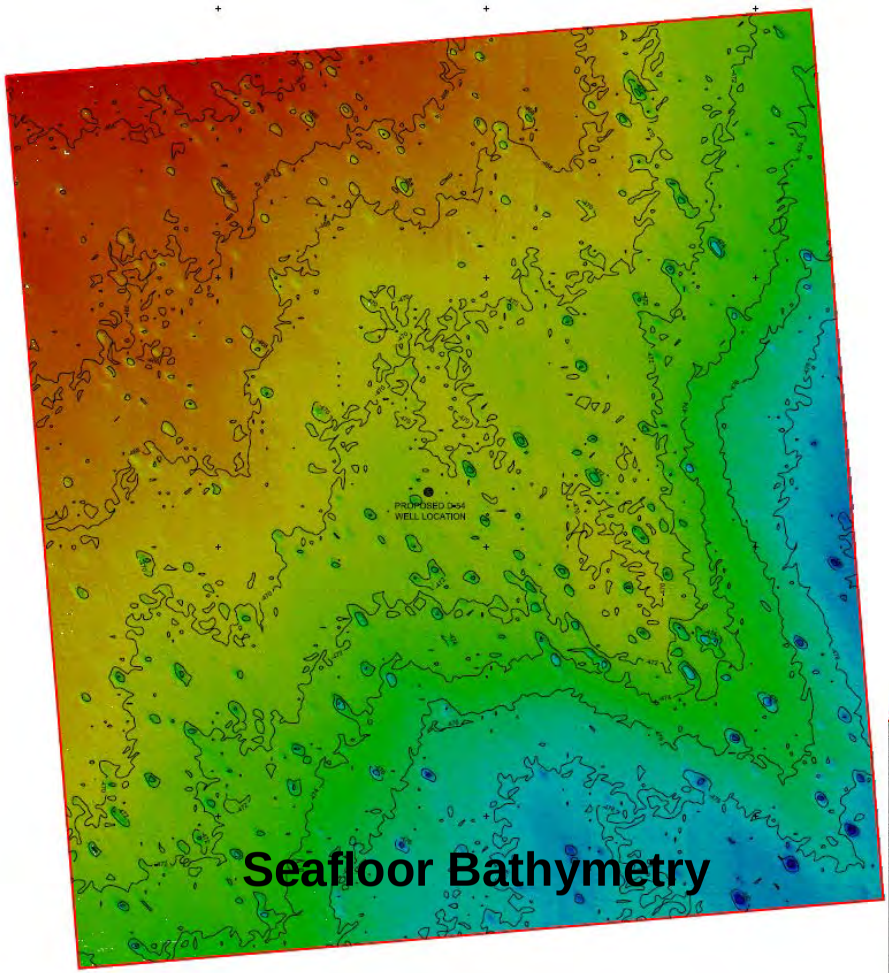
Update on Corridor's
2010 Geohazard Site Survey

Geohazard Survey Conducted Safely



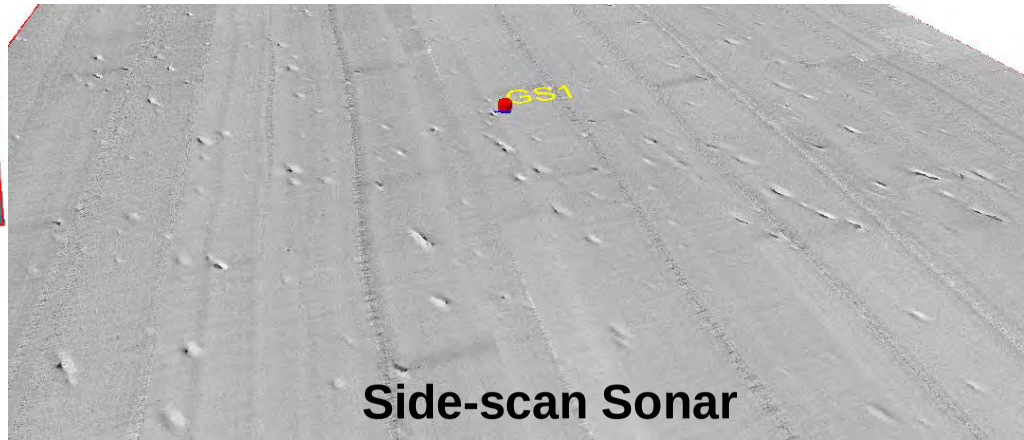
- Conducted October 12-15, 2010.
- Employed a marine mammal observer and a fisheries observer.
- No fishing activity was observed.
- No marine mammals or sea turtles were observed in the 500 m safety zone. Some observed at a distance.
- Collected 63 hours of geophysical data, including low intensity seismic.
- Collected side-scan sonar data.
- Seabed photography at 5 sites.
- Sediment samples at 3 sites.

Seafloor Characteristics at Old Harry



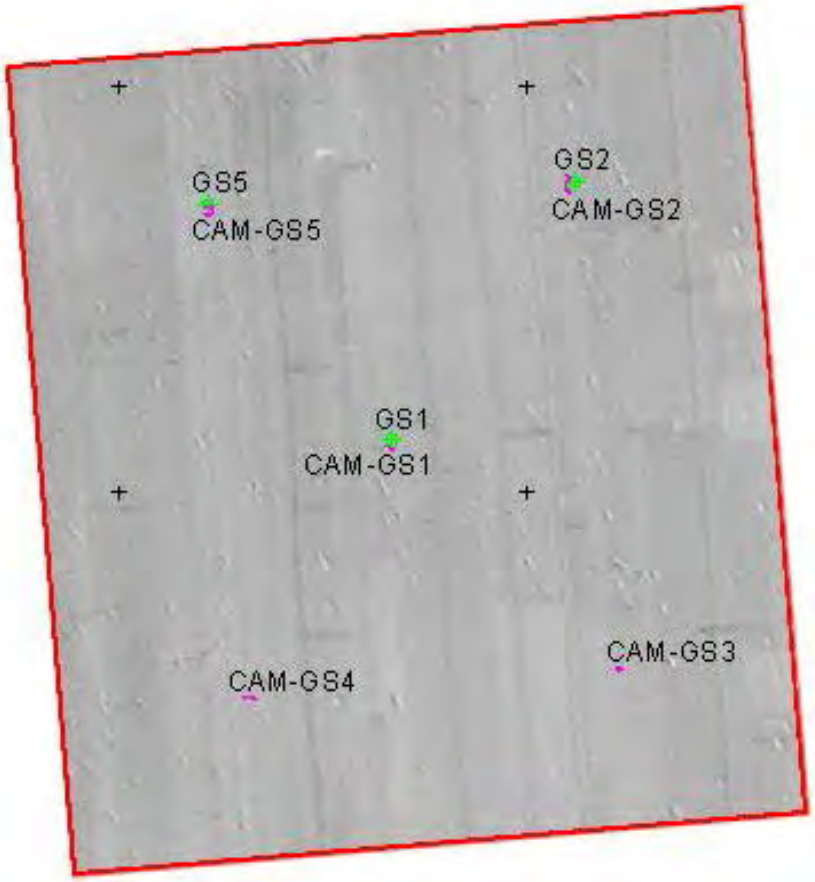
Seafloor Bathymetry

- Water depth is 464 m in the northwest and 478 m in the southeast.
- The small depressions in seafloor are interpreted as pockmarks.
  - 1-3 m deep; 15-20 m across; 30-40 m in length.
  - The well will be located to avoid pockmarks.



Side-scan Sonar

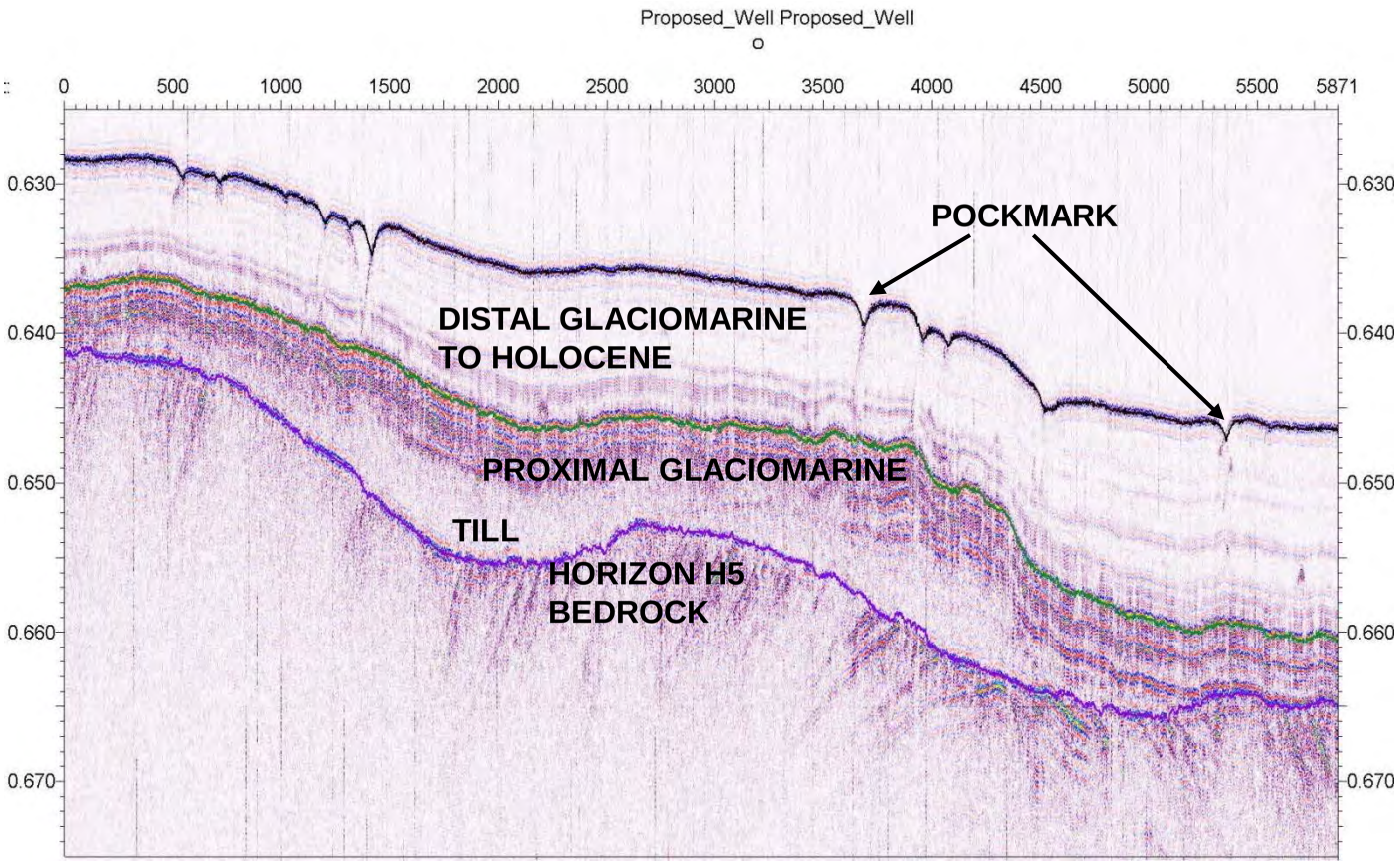
Sediment Samples and Photos Show a Soft Muddy Sea Bottom

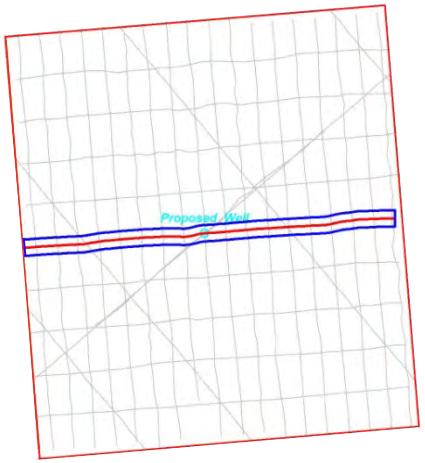


- 5 Camera stations.
- 3 Sediment sample stations.

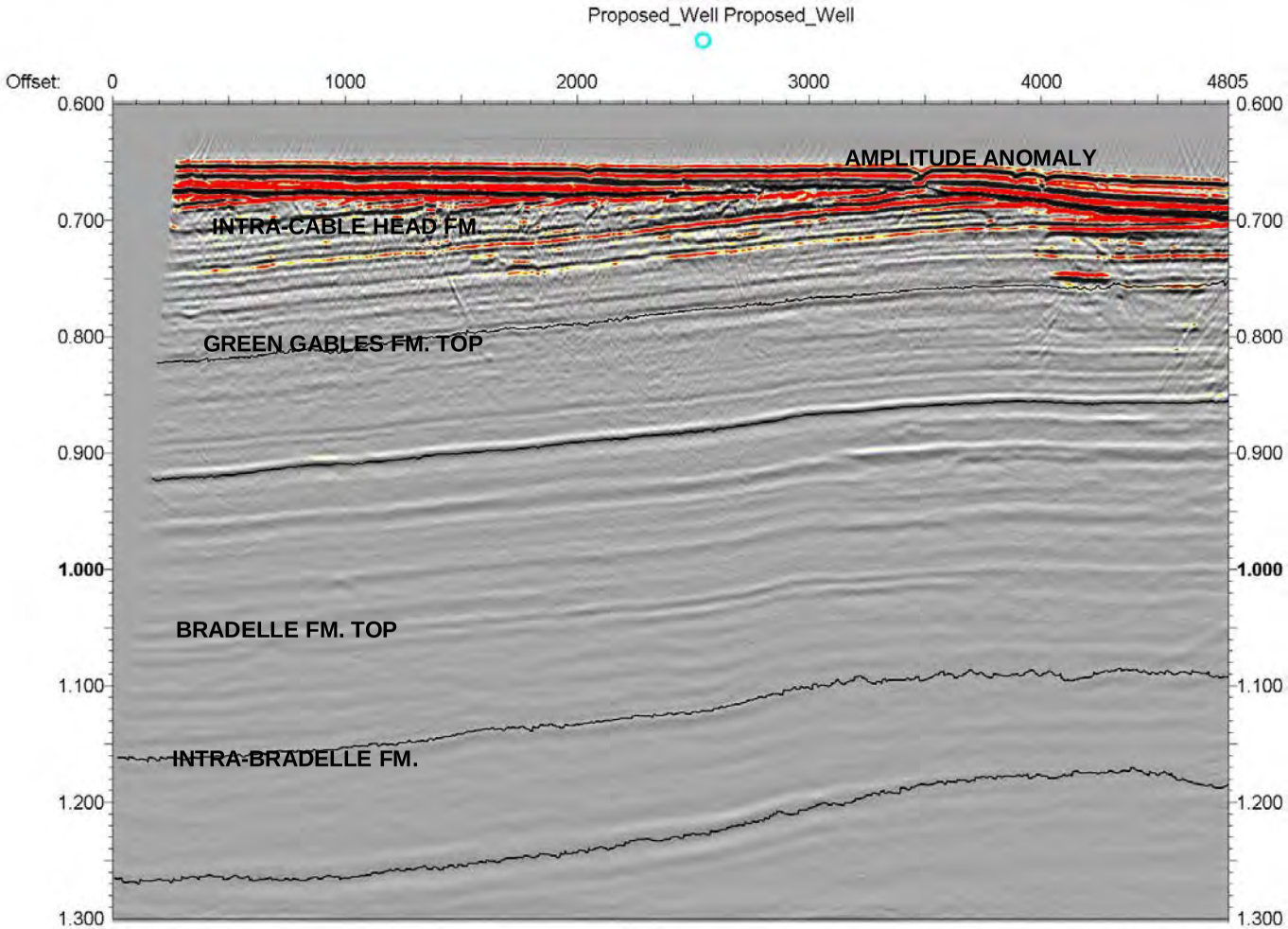
Seabed Photograph – GS4

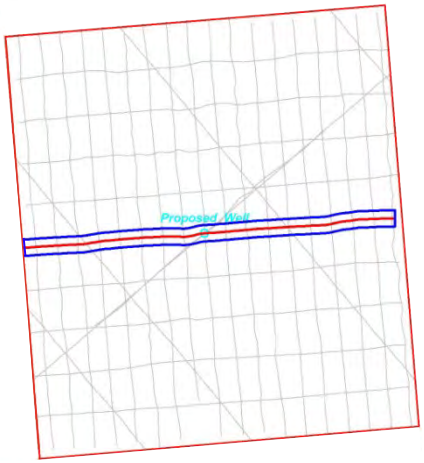
Sub-bottom Profile: Characteristics of Seabed Sediments



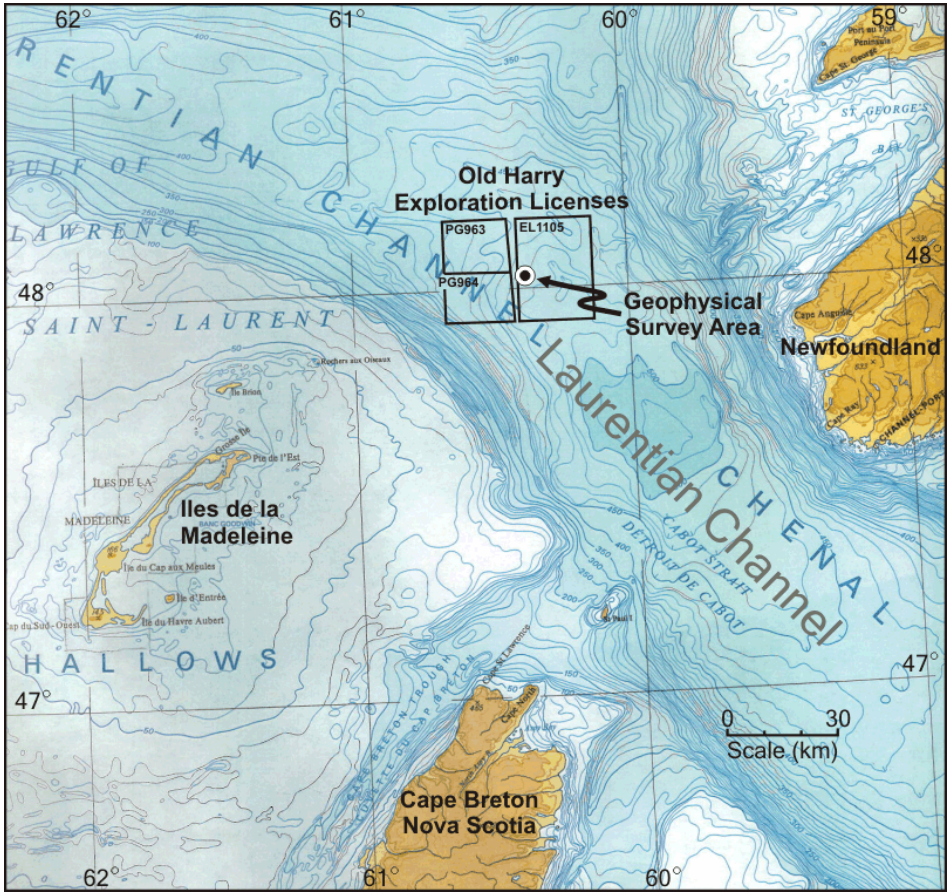


Seismic Line:
Well Location avoids Potential Drilling Hazards





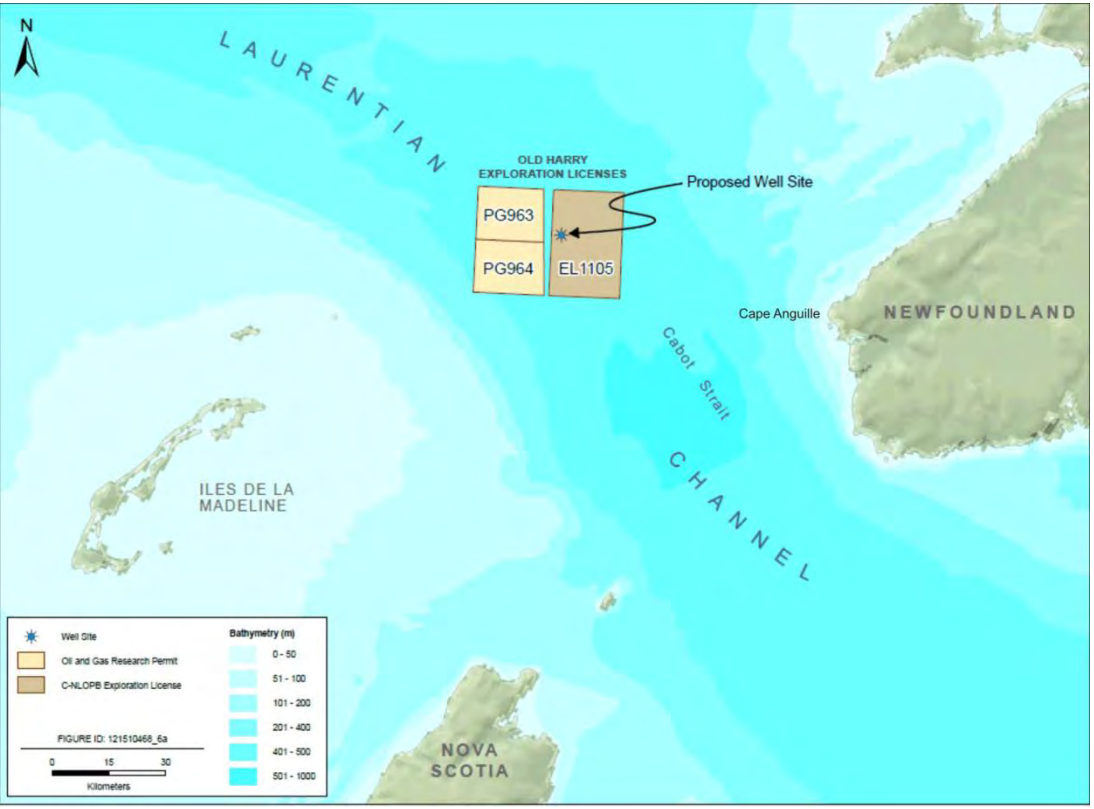
Geohazard Survey Indicates Safe Location for Drilling



- Bathymetry, sidescan sonar, and sub-bottom profiler results were delivered in December 2010.
- Seismic data and sea bottom photography were delivered on February 4, 2011.
- Geohazard survey results showed:
  - Good quality data were collected;
  - The seafloor was free of shipwrecks or hazardous debris; and
  - A potential well location that is safe for drilling could be identified.
- A decision was made to submit a Project Description to start the regulatory approval process for an exploration well.

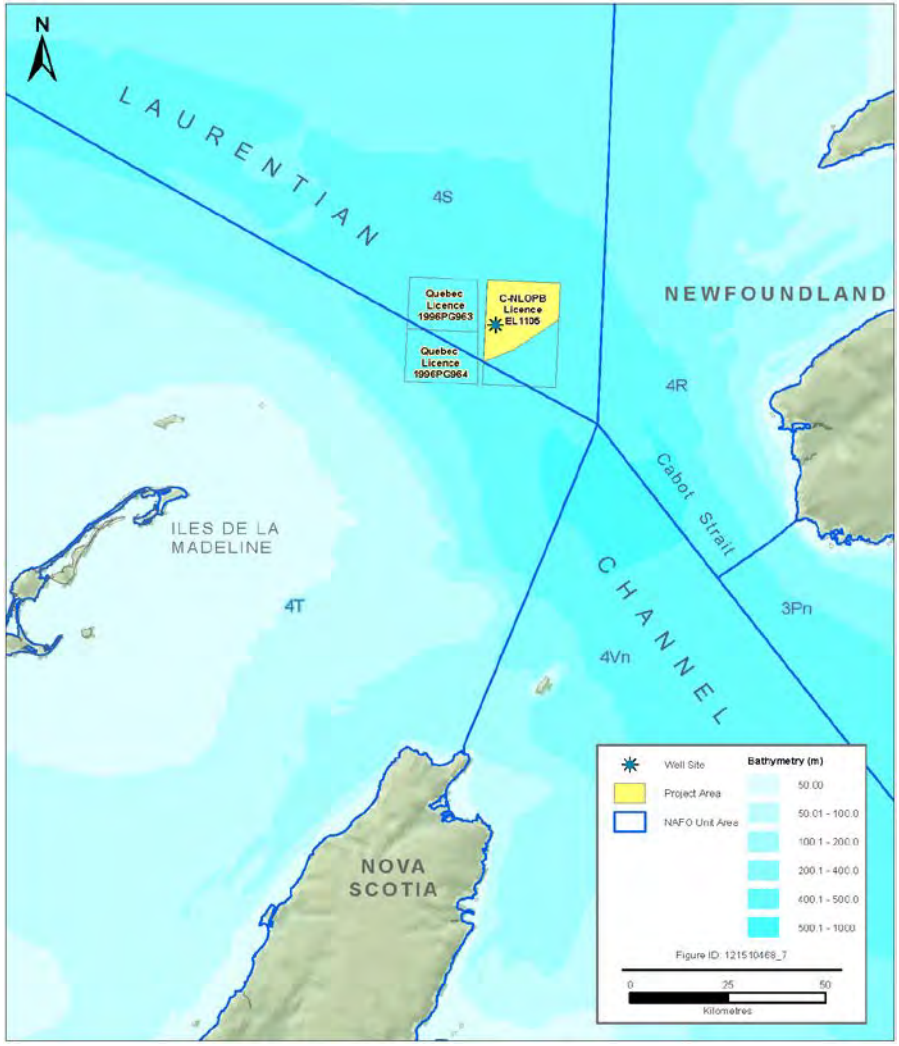
Overview of Corridor's Proposed Exploration Well within EL 1105

Planning for a Safe and Environmentally Responsible Drilling Program



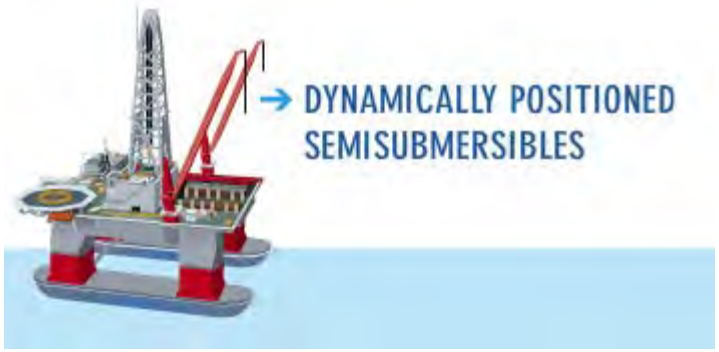
- Project Description filed with the C-NLOPB on February 21, outlining Corridor's intention to drill 1 well within EL 1105.
- Next Steps
  - Complete a thorough Environmental Assessment (EA)
  - Conduct Public Consultation
  - Incorporate science-based issues in EA
  - File EA with C-NLOPB in June, 2011.
- Details of potential impacts and associated mitigation cannot be provided until EA is complete.

Project Area for the Exploration Well



- The proposed Project is for the drilling of one well solely within EL 1105.
- The Project area is approximately 304 km^2, located within the Laurentian Channel about 80 km WNW from Cape Anguille, NL.
- The approximate water depth is 470m.
- The proposed well coordinates are in the vicinity of Latitude 48°03’05.294” and Longitude 60°23’39.385” (NAD83 datum, geographic coordinates).
- Drilling is anticipated to take place between mid-2012 and early 2014, depending on rig availability and regulatory approvals.

Drill Rig Options for Proposed Exploratory Well



Mobile Offshore Drilling Unit

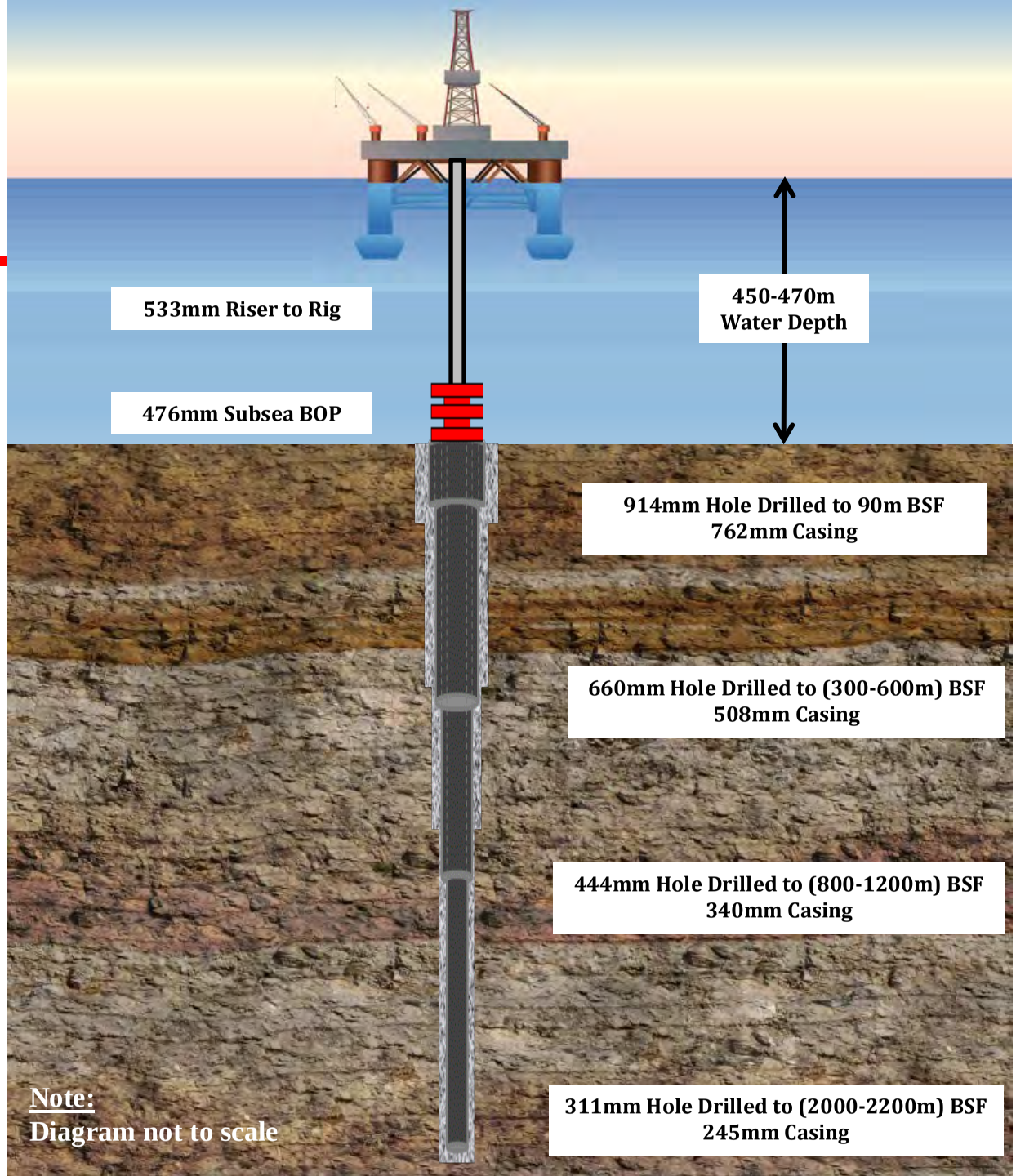
- Three possible options:
  - Semisubmersible (moored) such as Henry Goodrich.
  - Semisubmersible (Dynamically Positioned) such as Eirik Raude.
  - Drill ship (Dynamically Positioned) such as the Stena Carron.

Logistical Support for Drill Rig

- 2-3 Supply Vessels
  - 1 at the rig at all times.
- Several helicopter flights to the rig each week.
- Search and rescue helicopter on standby.

Example of Well Design

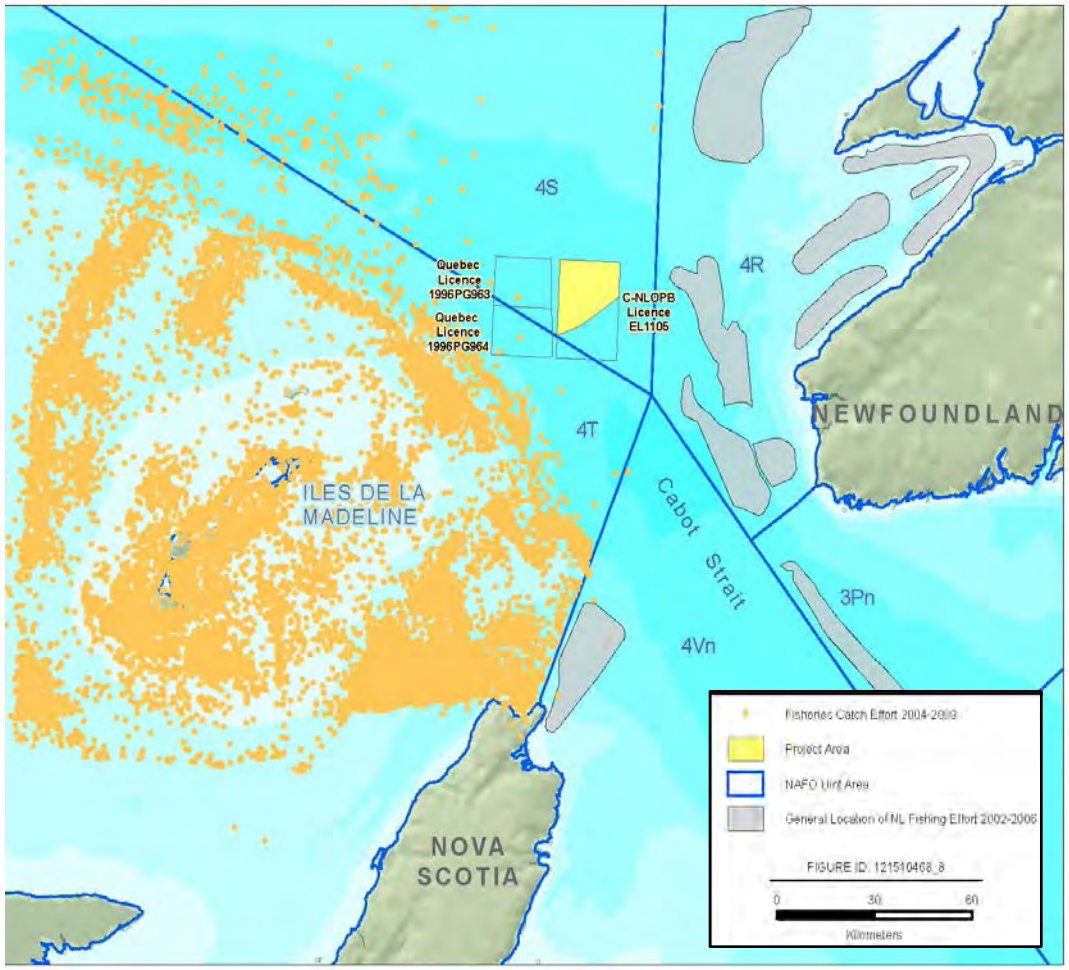
- Diagram is not to scale.
- Similar well design to wells currently drilled on Grand Banks.
- Shallow vertical well with a total depth planned of approximately 2570m RKB.



Examples of Issues Assessed for Exploratory Drilling Projects

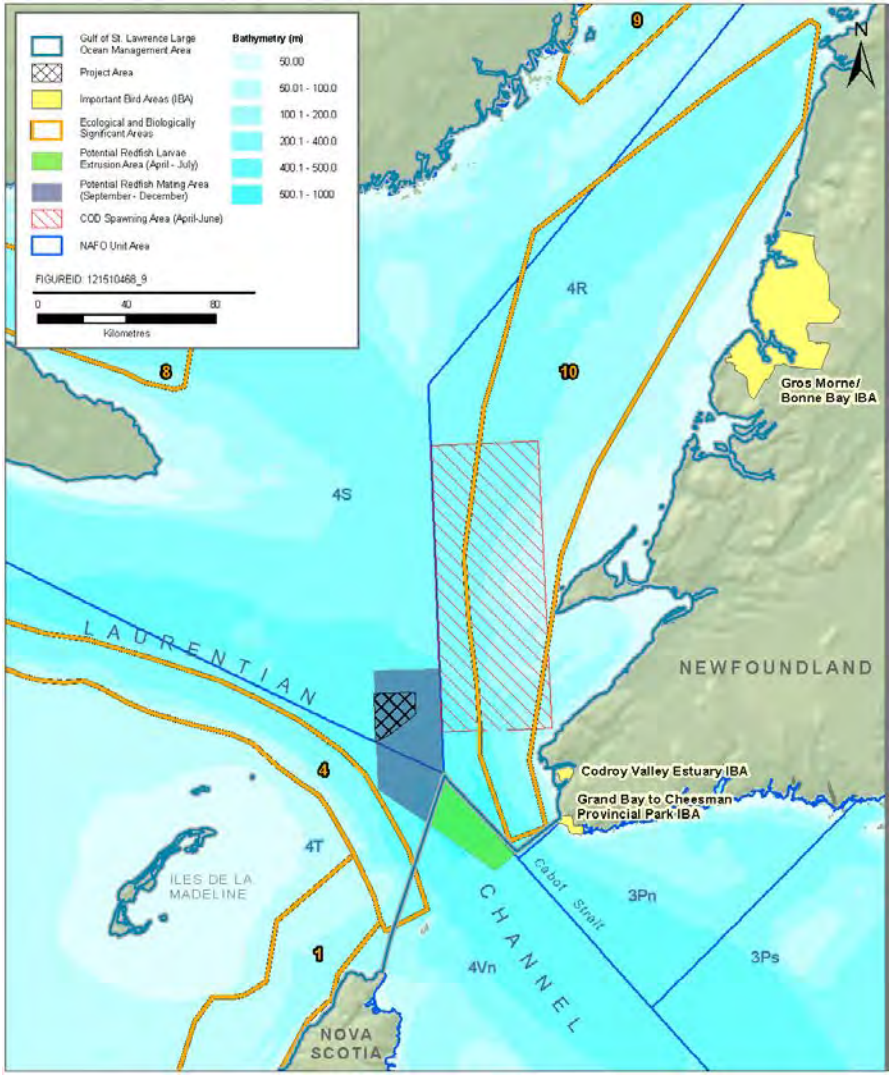
Project Activities	Issues	Potential Mitigation
Presence of Drill Rig	Navigation interference; attraction of birds and mammals; acoustic disturbance	Safety zones; communication; release of stranded birds; bird and mammal monitoring
Drill Muds and Cuttings	Sediment and water quality	Nontoxic muds; maximize use of WBMs; fluid treatment and management; adhere to Offshore Waste Treatment Guidelines; minimize discharge
Flaring	Air emissions; attraction of birds and mammals	Release of stranded birds; investigate use of reduced emission technology
Lights	Attraction of birds and mammals	Release of stranded birds
Vessel and Helicopter Traffic	Air emissions; navigation interference; collisions with mammals; disturbance	Equipment design and maintenance; minimize number of trips; damage compensation programs; release of stranded birds; bird and mammal monitoring; avoidance
Well Testing	Acoustic and sea bottom disturbance	Equipment design and maintenance; minimize activity time; temporal and spatial avoidance; communication
Well Abandonment	Acoustic and sea bottom disturbance	Equipment design and maintenance; minimize time; communication
Accidental Events	Seafood tainting, health effects of fish, birds and mammals	Environmental protection planning; spill response protocols; contingency planning

Fishing Effort in the Vicinity of the Project Area



- Data shown are 2004-2009.
- Updated information and more details will be provided in the Environmental Assessment.

Environmentally Sensitive Areas Near the Project Area



- The Project Area is within the Gulf of St. Lawrence Large Ocean Management Area.
- Within the Estuary and Gulf, 10 areas have been designated/nominated as ecologically and biologically significant areas (ESBAs).
- None of the ESBAs are within the Project Area.
- Project Area is within a potential redfish mating area.
- The Environmental Assessment will consider these areas.

Comprehensive Spill Modeling

- Petroleum System modeling has been conducted to determine the composition of hydrocarbons that could be produced from the reservoir
  - Results indicate that the reservoir could generate natural gas and/or a light oil ranging from 45-55 API.
- SL Ross, a specialist spill modeling company, will conduct comprehensive work for this Project
  - Task 1. Spill Risk Assessment
  - Task 2. Spill Behavior and Fate Modeling
  - Task 3. Detailed Trajectory Modeling.

Comprehensive Drill Mud and Cuttings Dispersion Modeling

- AMEC Earth & Environmental, an environmental engineering firm, will conduct comprehensive drill mud and cuttings dispersion modeling for this Project.
- AMEC will draw from several modeling software resources to complete the work.
- Scenario 1: seafloor return of mud and cuttings during open circuit (i.e., riser not yet in place) drilling of the initial conductor and surface well sections.
- Scenario 2: rig or surface release of mud and cuttings from drilling of the remaining well sections.
- Comments received from regulatory agencies on similar modeling work conducted for other operators will be incorporated.

C-NLOPB Regulatory Process to Obtain Approval to Drill a Well

Robust Canadian Regulatory Regime

- More than 350 wells have been drilled under the robust Canadian regulations in Newfoundland, with more than 500 in total in Atlantic Canada.

- Canadian regulators have effectively managed the exploration and development process while protecting the environment and the safety of workers. Three major offshore projects (Hibernia, White Rose and Terra Nova) have moved safely and smoothly into the production phase.

- There is a detailed and involved process that operators must follow to obtain approvals.

Legislative Requirements to Drill a Well

- Acts
  - Canada-Newfoundland Atlantic Accord Implementation Act
  - Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act
  - Canadian Environmental Assessment Act
  - Oceans Act
  - Fisheries Act
  - Navigable Waters Protection Act
  - Canada Shipping Act
  - Species at Risk Act
  - Migratory Birds Convention Act
  - Canadian Environmental Protection Act

Legislative Requirements to Drill a Well

- Key C-NLOPB Regulations
  - Drilling and Production Regulations
  - Certificate of Fitness Regulations
  - Oil and Gas Debris and Spills Liability Regulations
  - Petroleum Installation Regulations
- Key C-NLOPB Guidance Documents
  - Drilling and Production Guidelines
  - Safety Plan Guidelines
  - Environmental Protection Plan Guidelines
  - Selection of Chemicals Guidelines
  - Physical Environmental Program Guidelines
  - Offshore Waste Treatment Guidelines
  - Incident Reporting and Investigation Guidelines
  - Data Acquisition and Reporting Guidelines
  - Financial Responsibility Requirements Guidelines
  - Compensation for Damages Guidelines

Operators Authorization (OA) Requirements

- Information for the C-NLOPB Safety Assessment
  - Operator Safety Management System and Safety Plan
  - Safety reviews of contractors
  - Training and competency information for key individuals and proof that requisite training requirements have been met
  - Risk Assessment
  - Contingency Plans
    - Offshore and Onshore Emergency Response Plans
    - Oil Spill Response Plan
    - Ice Management Plan
    - Relief Wells
  - Drilling Operations Manual
  - Well Control and Blowout Prevention Manual
  - Rig, supply vessel, helicopter and other major contractor Operations and HSE policies, programs, manuals

Operators Authorization (OA) Requirements

- Environmental Assessment
  - Estimates of types and quantities of substances to be discharged and a description of procedures and equipment to treat discharges
  - Arrangements for measurement, observation and forecasting of environmental conditions
  - Spill Response Plan and qualifications of spill response personnel
- Environmental Protection Plan
- Certificate of Fitness
- Operator's Declaration of Fitness
- Letter of Compliance for the MODU and each standby vessel
- Evidence of Financial Responsibility
- Canada - Newfoundland Benefits Plan

Approval to Drill a Well (ADW) Requirements

- Seabed Survey Report
- Detailed geological prognosis
- Detailed drilling program
- Formation pressure and fracture gradient evaluation
- Barrier analysis to confirm two barriers at all times
- Casing Program
- Cementing Program
- Drilling Fluids Program
- Casing and Wellhead Pressure Testing
- Formation Leak-Off Tests
- BOP Configuration
- BOP Pressure and Function Testing

Preparation of a Project Specific Environmental Assessment Document

- Conducted in accordance with Canadian Environmental Assessment Act and the C-NLOPB Scoping Document.
- Documents published on C-NLOPB Website in near-real time.
- Environmental Assessment documents reviewed by C-NLOPB, other regulatory authorities and the public.
- Note: C-NLOPB conducted a Strategic Environmental Assessment (LGL, 2005) and its Amendment (LGL, 2007), prior to issuing EL 1105 to Corridor.

Project Specific Environmental Assessment Timeline

Project Component	Responsibility	Estimated Timeline
Submit Project Description (PD) and initiate Stakeholder consultation	Corridor Resources	Initiated on February 21
Release of draft Scoping Document for Public and Stakeholder review	C-NLOPB	Released February 25 4 weeks for review
Release of Final Scoping Document	C-NLOPB	2 weeks
Preparation of EA (Screening) Document	Corridor Resources	6 – 10 weeks
Submission of Draft EA	Corridor Resources	Target June
Draft EA Review	C-NLOPB, Government Agencies, Public	6 weeks
Compile comments on EA	C-NLOPB	2 weeks
Release of EA review comments	C-NLOPB	-
Respond to comments and submit EA Addendum/Final EA Document	Corridor Resources	4 weeks
Review of EA Addendum/Response Document	C-NLOPB, Government Agencies	3 weeks
Release Screening Report (Determination of significance of Project Effects)	C-NLOPB	4-6 weeks

Examples of Timelines from Exploration to Development

Hibernia

- First exploration well in 1979
- First production occurred in 1997

Terra Nova

- Discovered in 1984
- First production occurred in 2002

White Rose

- First exploration well in mid-80s
- First production occurred in 2005

Newfoundland and Labrador Benefits

- At the end of 2009, more than 3,500 people were working in jobs directly linked to the petroleum sector.
- Total cumulative offshore oil production to the end of 2009 was 1.09 billion barrels with an estimated value of $65.6 billion.
- By 2008, the petroleum sector represented about 40% of the provincial economy or GDP.

Next Steps

- Progress the regulatory application towards achieving approval to drill the well.
- Continue work on the Environmental Assessment and the associated public consultation.
- Detailed well planning, including securing an appropriate rig, supply vessels, helicopters, shorebase, etc.
- Drilling is anticipated to take place between mid-2012 and early 2014, depending on rig availability and regulatory approvals.

Summary and Conclusions

- Corridor has submitted a Project Description to start the regulatory process to drill a proposed well within EL 1105.
- A large number of applications and approvals are required to obtain an approval to drill a well within Canada's rigorous offshore regulatory regime.
- We are confident the proposed well can be drilled in a safe and environmentally responsible manner.
- We want to design the best possible exploration project with input from stakeholders.
- Responses to questions and concerns will be addressed scientifically in the Environmental Assessment and through the regulatory process.
- The Environmental Assessment will be available for review on the C-NLOPB website.

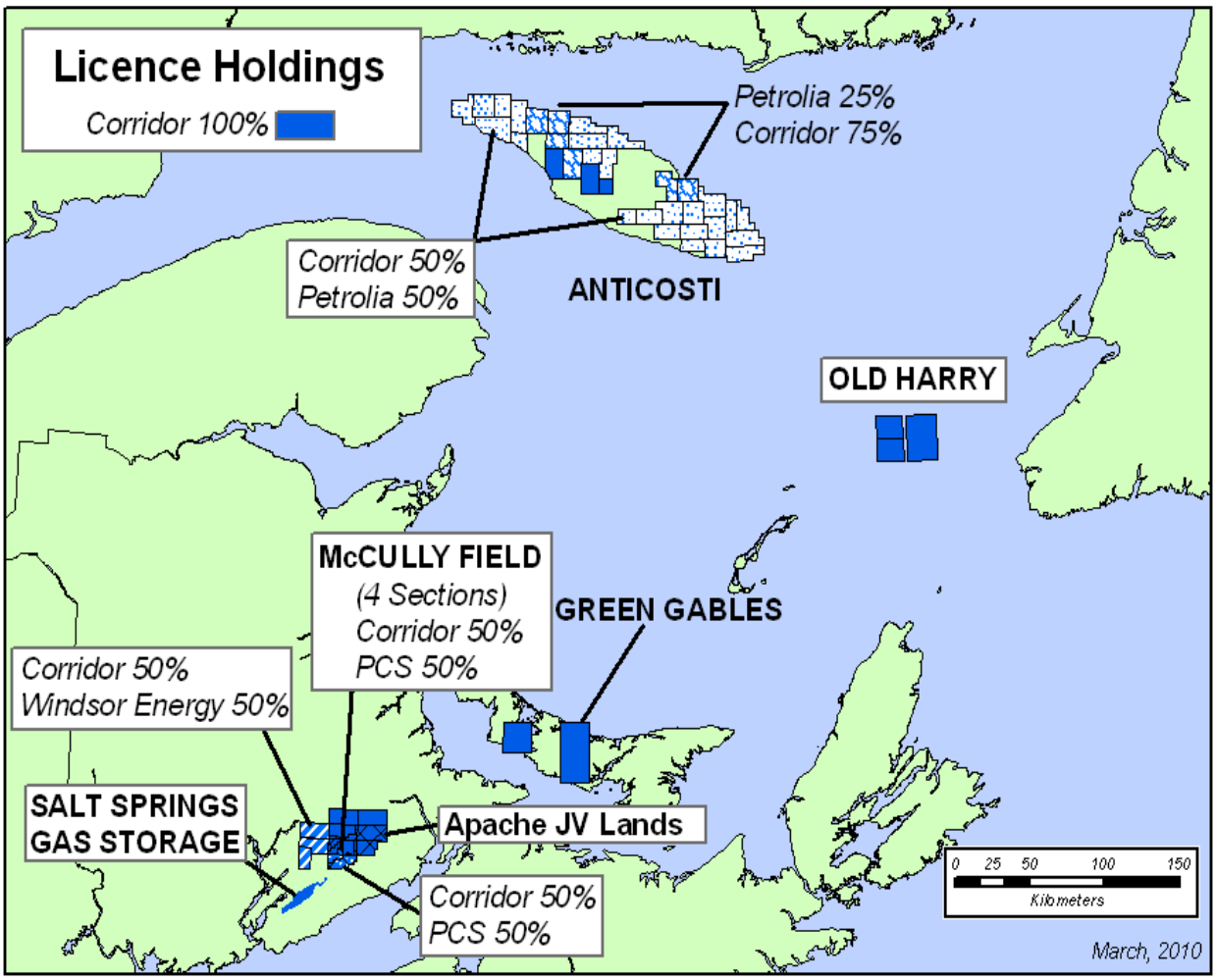
Questions or Comments

Thank You.

Toll Free: 1-888-429-4511

Website: www.corridor.ca

Who is Corridor Resources?



- Natural gas production from the McCully Field, Penobsquis, New Brunswick
- Petroleum exploration, New Brunswick
- Oil exploration, Anticosti Island, Quebec
- Natural gas exploration, Prince Edward Island
- Old Harry exploration, Gulf of St. Lawrence

Corridor Resources Operations

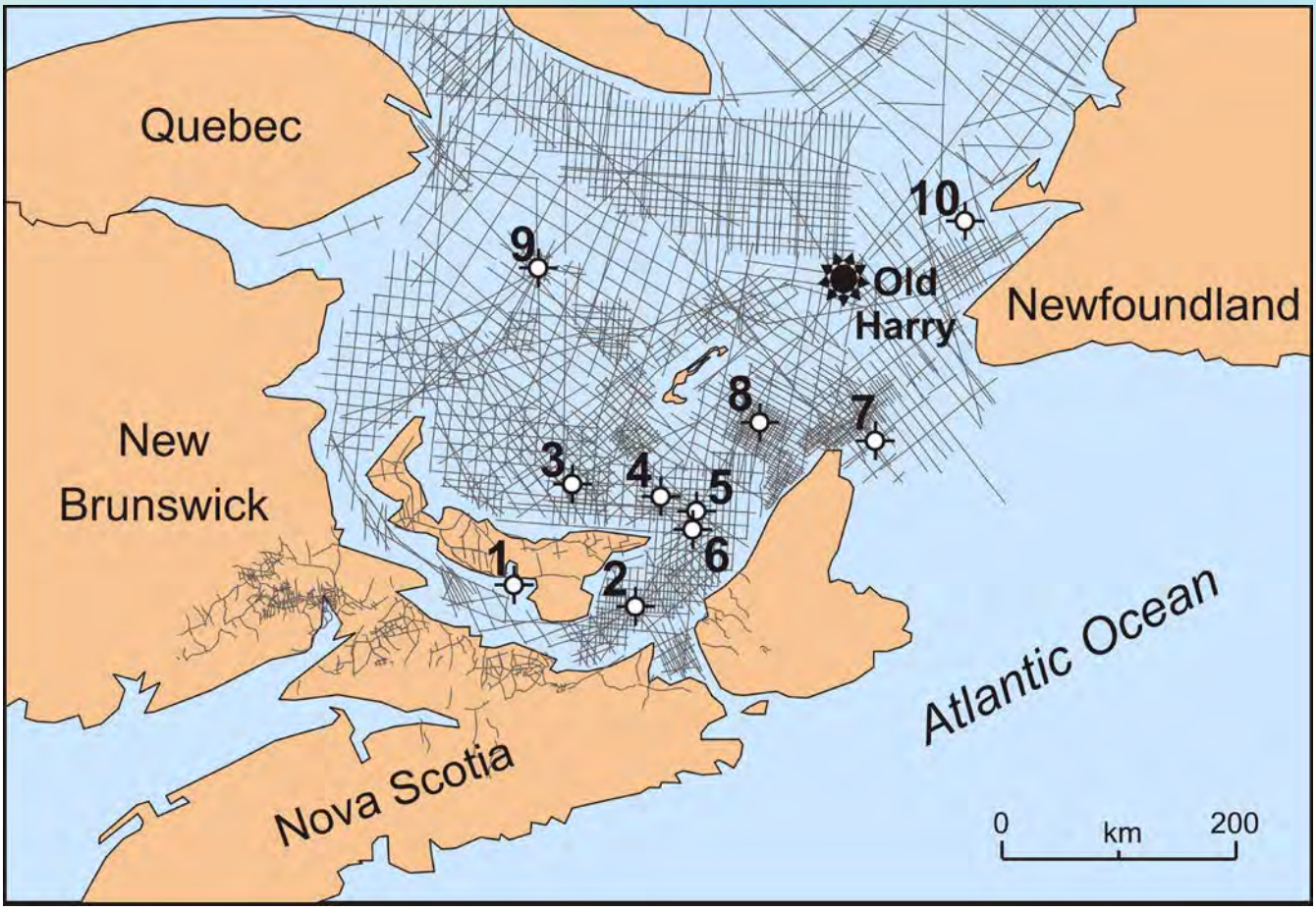
McCully Gas Plant – Penobsquis, New Brunswick

Nabors Drilling Rig 112 - Anticosti Island, Quebec
2010 Drilling Program

MV Anticosti – Geohazard Survey 2010
Newfoundland and Labrador Offshore

Shale Gas Exploration – Elgin, New Brunswick

Long History of Exploration in the Gulf of St. Lawrence



History

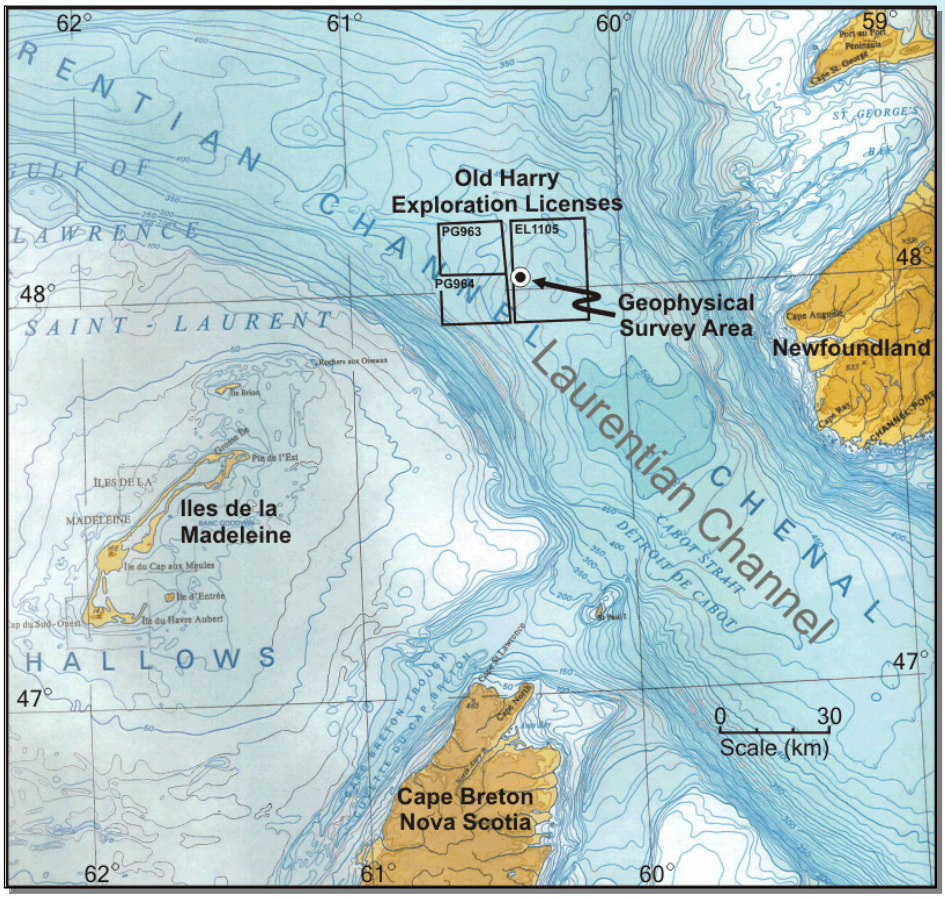
10 offshore wells were drilled and many kilometers of seismic were collected by other operators.

- Most wells drilled in 1970-80's were looking for oil
- 5 - no hydrocarbon shows
- 4 - minor shows
- 1 - significant gas discovery
- Old Harry Prospect first identified in 1970's

Corridor's Old Harry Activities

- **1996** - acquired Old Harry exploration licences
- **1998 / 2002** – collected new seismic data
- **2010** - conducted geohazard site survey

Geohazard Survey Conducted Safely

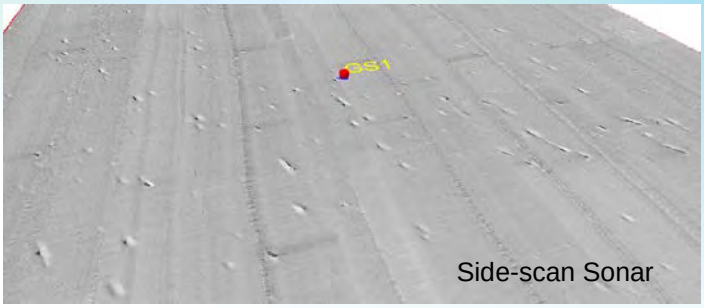


- Geohazard Survey was conducted from October 12 to October 15, 2010.
- Employed a marine mammal observer and a fisheries observer for the duration of the survey.
- 63 hours of geophysical data were collected, including:
  - low intensity seismic
  - side-scan sonar
  - seabed photography
  - sediment samples

Results

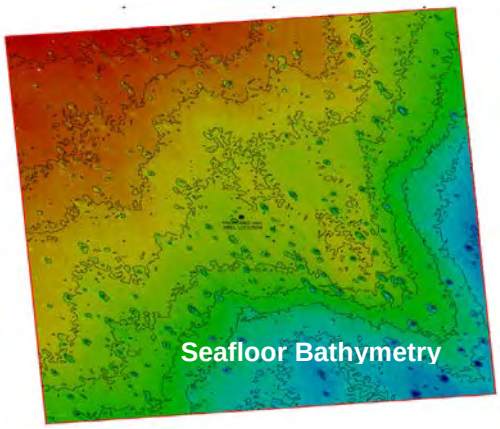
- The geohazard survey results indicated that good quality data were collected.
- The seafloor was determined to be free of shipwrecks or hazardous debris.
- A potential well location that is safe for drilling was identified.
- A decision was made to submit a Project Description to the C-NLOPB to start the regulatory approval process for an exploration well.

Examples of Old Harry Geohazard Survey Data

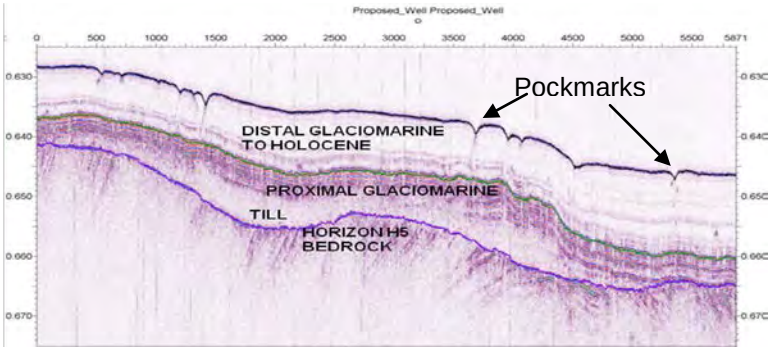


Side-scan Sonar

- The small depressions in seafloor are interpreted as pockmarks
- 1-3 m deep; 15-20 m across; 30-40 m in length
- The well will be located to avoid pockmarks


Seafloor Bathymetry

- Water depth is 464 m in the northwest and 478 m in the southeast

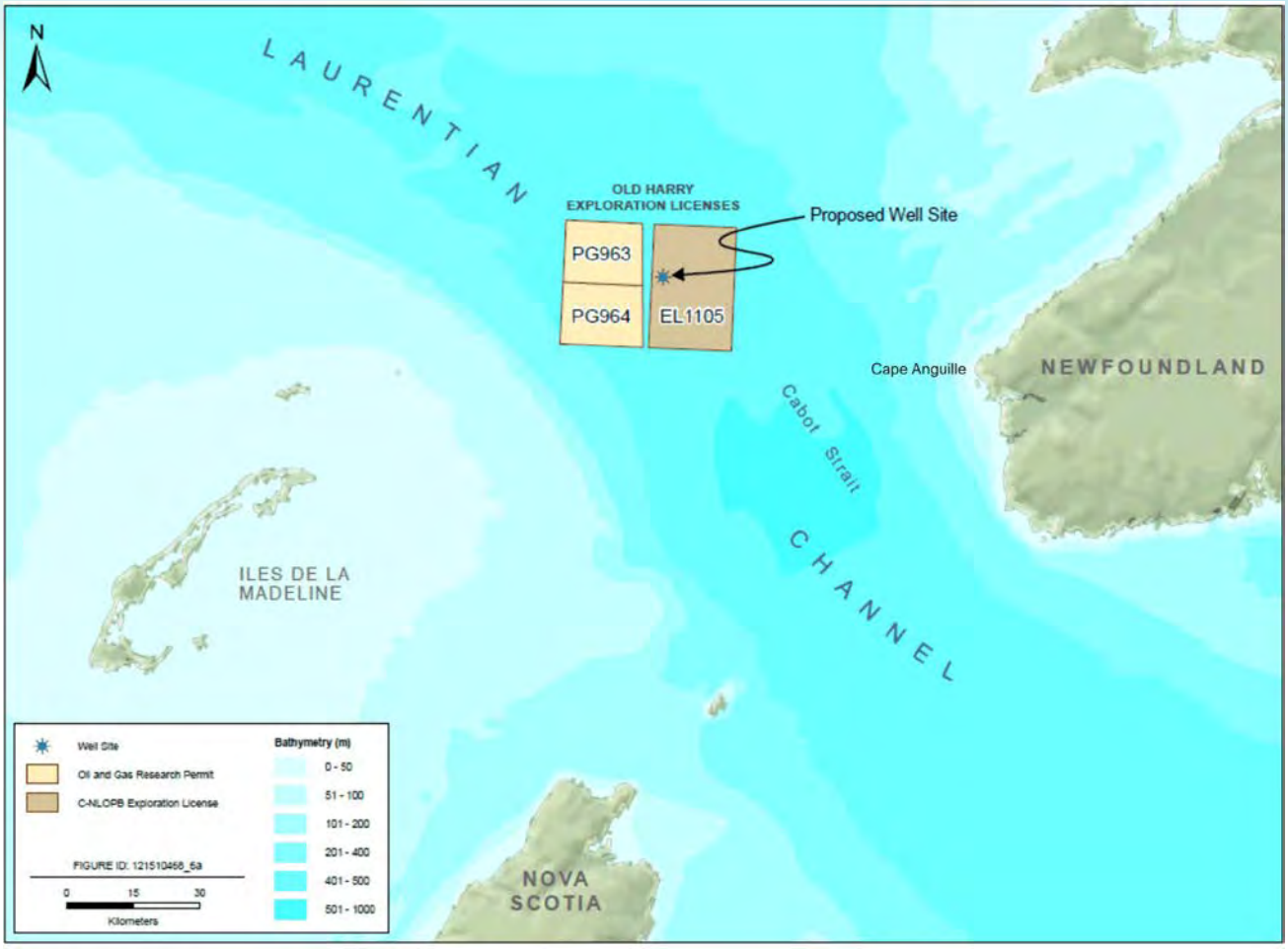


- Seismic data show characteristics of seabed sediments

Seabed Photograph – GS4

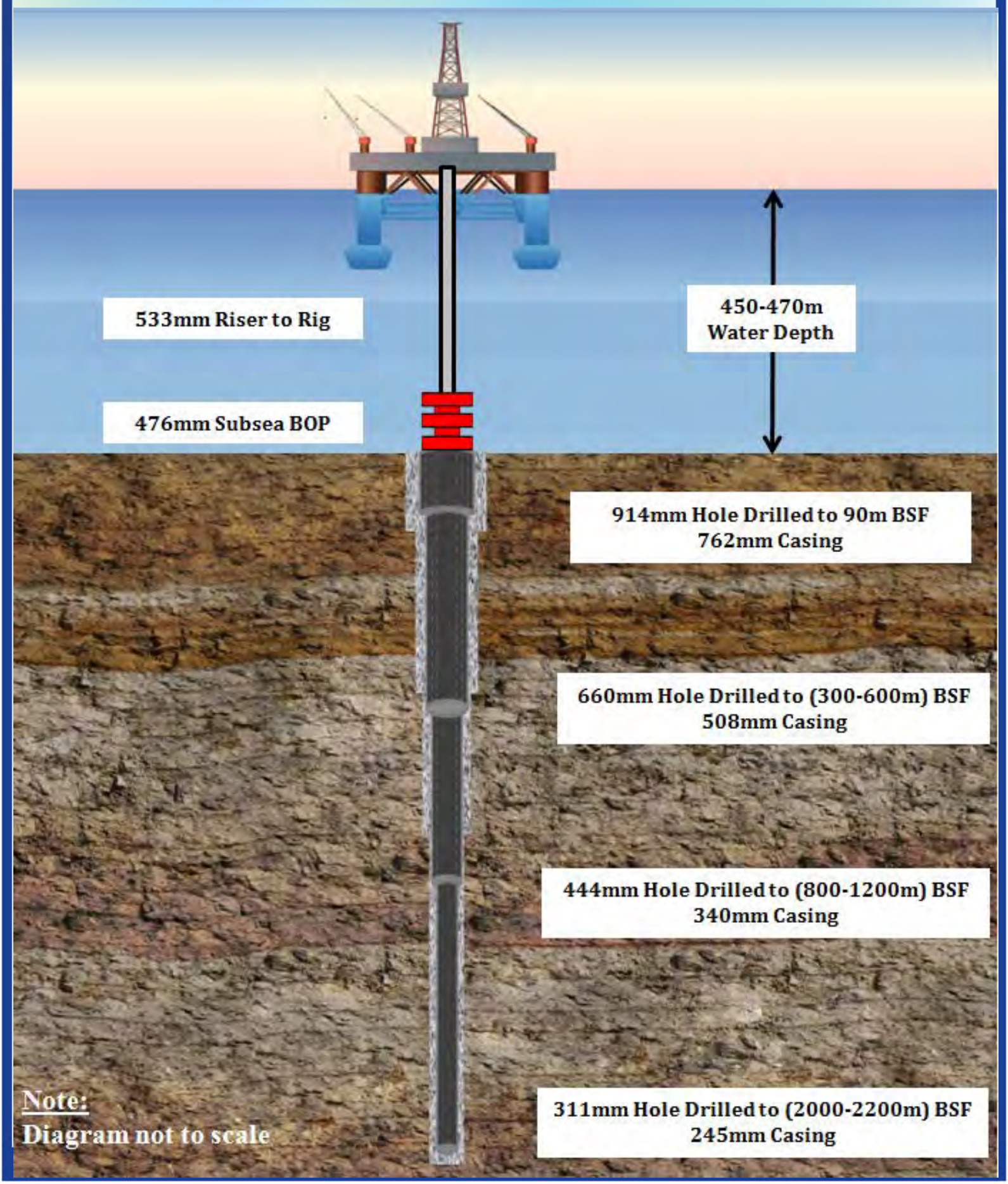
- 5 camera stations
- 3 sediment sample stations

Planning for a Safe and Environmentally Responsible Drilling Program

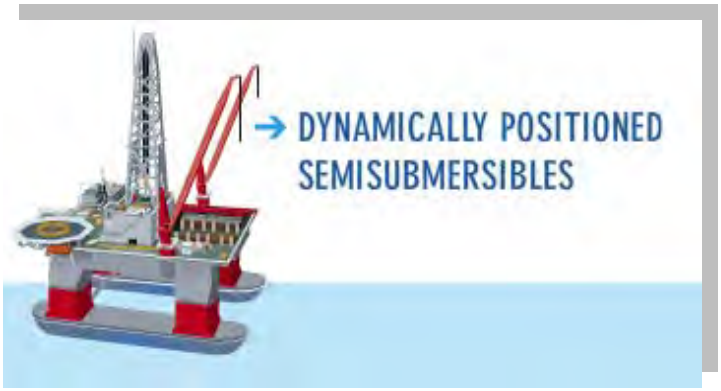


- Project Description filed with C-NLOPB on February 21, 2011
- One exploration well within EL1105 proposed
- Project Area located within the Laurentian Channel approximately 80 km WNW from Cape Anguille, NL
- Approximate water depth is approximately 470 meters
- Next Steps:
  - Complete a thorough Environmental Assessment (EA)
  - Conduct public consultation
  - Incorporate science-based issues in EA
  - File EA with C-NLOPB in June 2011

Well Design Example



Drill Rig Options for Proposed Exploratory Well



Preparation of Project Specific Environmental Assessment Document

Project Component	Responsibility	Estimated Timeline
Submit Project Description (PD) and initiate Stakeholder consultation	Corridor Resources	Initiated on February 21
Release of draft Scoping Document for Public and Stakeholder review	C-NLOPB	Released February 25 4 weeks for review
Release of Final Scoping Document	C-NLOPB	2 weeks
Preparation of EA (Screening) Document	Corridor Resources	6 – 10 weeks
Submission of Draft EA	Corridor Resources	Target June
Draft EA Review	C-NLOPB, Government Agencies, Public	6 weeks
Compile comments on EA	C-NLOPB	2 weeks
Release of EA review comments	C-NLOPB	-
Respond to comments and submit EA Addendum/Final EA Document	Corridor Resources	4 weeks
Review of EA Addendum/Response Document	C-NLOPB, Government Agencies	3 weeks
Release Screening Report (Determination of significance of Project Effects)	C-NLOPB	4-6 weeks

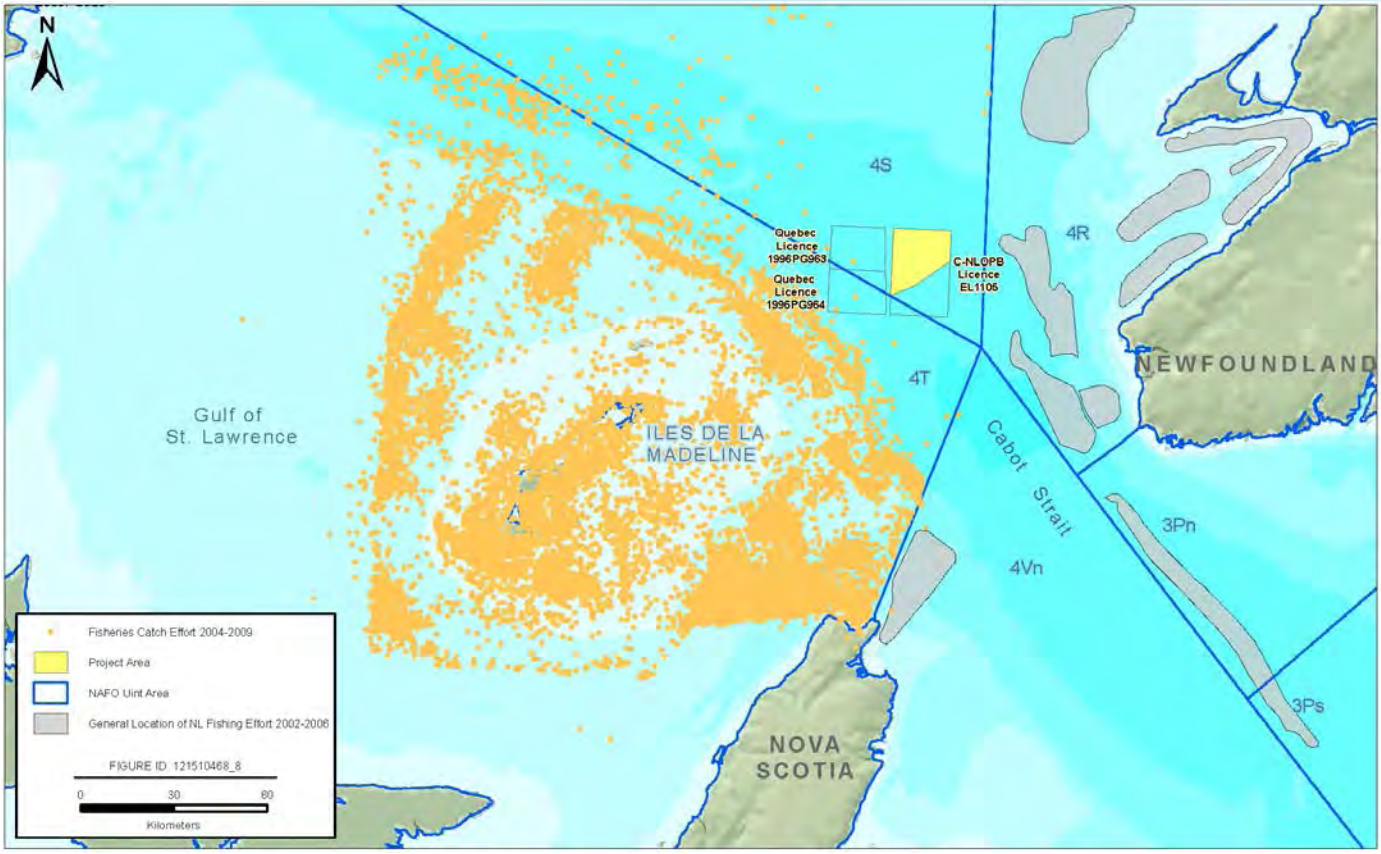
- Conducted in accordance with the Canadian Environmental Assessment Act and the C-NLOPB Scoping Document
- Documents published on C-NLOPB website in near-real time
- Environmental Assessment documents reviewed by C-NLOPB, other regulatory authorities and the public

Robust Canadian Regulatory Regime

- More than 350 wells drilled under robust Canadian regulations in Newfoundland and Labrador, with more than 500 in total in Atlantic Canada.
- Numerous legislative requirements to be met (Acts, Regulations, Guidelines)
- Operations Authorization (OA) and Approval to Drill a Well (ADW) to be obtained from the Canadian-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB)

Operations Authorization (OA)	Approval to Drill a Well (ADW)
Safety Management System / Safety Plan	Seabed Survey Report
Safety reviews of contractors	Detailed geological prognosis
Training and Competency information for key individuals	Detailed drilling program
Risk Assessment	Formation pressure and fracture gradient evaluation
Contingency Plans *(Emergency Response Plan, Oil Spill Response Plan, Relief Wells, etc.)*	Barrier analysis to confirm two barriers at all times
Drilling Operations Manual	Casing Program
Well Control and Blowout Prevention Manual	Cementing Program
Contractor operations and HSE policies, programs, manuals	Drilling Fluids Program
Environmental Assessment	Casing and Wellhead Pressure Testing
Environmental Protection Plan	Formation Leak-Off Tests
Certificate of Fitness	BOP Configuration
Operator's Declaration of Fitness	BOP Pressure and Function Testing
Letter of Compliance for the MODU and each standby vessel	
Evidence of Financial Responsibility	
Benefits Plan	

Fishing Effort in the Vicinity of the Project Area



- Data shown are 2004-2009.
- Updated information and more details will be provided in the Environmental Assessment.

ATTACHMENT 5

Corridor Response to Ecojustice Comments
(November 29, 2013)

November 29, 2013

Ref: 10-L-0069-13

Ms. Elizabeth Young
Environmental Assessment Officer
Canada-Newfoundland and Labrador Offshore Petroleum Board
Fifth Floor, TD Place, 140 Water Street
St. John's, NL
A1C 6H6

RE: Corridor's Response to Comments Received on November 5, 2013, from the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), regarding the Old Harry Assessment

Dear Ms. Young,

Please see below Corridor's response to the comments received on November 5, 2013. If you have any questions or require and additional information, please let us know.

St. Lawrence Coalition/Ecojustice Comment # 1

Corridor is requested to provide a complete explanation, with supporting documents, for their reliance upon the (probabilistic) calculated blowout frequencies (see s. 8.4.5). We do not have confidence in the bases for conclusions that the likelihood of an extremely large oil spill (>150,000 barrels) is equivalent to 1 in 25,189 for each well drilled, a very large oil spill (>10,000 barrels) is equivalent to 1 in 12,610 for each well drilled, and a large oil spill (>1000 barrels) is equivalent to 1 in 10,091 for each well drilled. Obviously, the probability of a blowout increases significantly with each additional exploratory well drilled, and must be clearly incorporated into risk calculations. In addition, these probabilities are inconsistent with those presented by Mr. David Pryce (see below). Finally it is critical that uncertainties inherent in such probabilistic assertions be articulated plainly with a view to enabling public comprehension.

It is obviously true that not every well results in a serious "loss of control" incident. Statistics about the unlikelihood of an accident may seem reassuring to some, at least in the abstract: only four blowouts out of 647 Canadian wells drilled by 2010 (one blowout every 16 years), one pipeline spill over 1,000 litres in Canada between 2003 and 2012, and 3.3 tanker spills over 7 tonnes per year worldwide from 2000 to 2009.

Corridor Response

The complete explanation, with references to supporting documentation, for Corridor's reliance on (probabilistic) calculated blow-out frequencies is provided in Sections 8.4.2 to 8.4.4 in the Environmental Assessment and is summarized herein. As of May 2010, approximately 50,433 offshore exploration and delineation wells have been drilled world-wide (Deloitte Petroleum Services, 2010). Since 1955, only two extremely large spills have ever occurred from offshore drilling. In other words, two offshore wells out of 50,433 wells drilled resulted in extremely large spills, including the Macondo spill (Deepwater Horizon event). The probability, therefore, is one extremely large spill for

every 25,216 wells drilled (or 1 divided by 25,433 = 3.97 X 10^{-5} spills per well drilled). If there were one well drilled in the Gulf of St. Lawrence every year, the likelihood of an extremely large spill would be one large spill every 25,216 years.

The probabilities stated in the Corridor EA are not inconsistent with the statistics presented by Mr. David Pryce (Vice-President, Canadian Association of Petroleum Producers). In his presentation to the Standing Committee on Natural Resources, Mr. Pryce indicated that there have been four blowouts in Canadian waters out of 647 wells drilled (to 2010). None of these incidents resulted in a large oil spill, which is the context of the stated Corridor/SL Ross numbers. The four incidents include two in the Nova Scotia Offshore Area in the 1980s during the drilling of Shell's Uniacke G-72 and Mobil's West Venture N-91 wells (both gas). There were two significant blowouts in the north. The first was Panarctic's Drake Point N-67 well, drilled in 1969 to 2577m on the Sabine Peninsula of Melville Island. A well drilled in 1970 on King Christian Island resulted in another blowout. The King Christian D-18 blowout continued for 91 days and may have been emitting as much as 200 million cubic feet (5,700,000 m^3 of gas per day).

St. Lawrence Coalition/Ecojustice Comment # 2

Corridor is requested to explain their "low risk" characterization in relation to potential spill impacts on commercial fisheries, based on the assertion of limited fishing activity within 10-12km of the proposed drill site. Furthermore, this characterization is based on Corridor's spill simulation that has been heavily criticized by DFO and EC. We further submit that Corridor has failed to account for the prospect of future stigma risks to regional fisheries interests, should a spill occur. Thus, the negative impacts on the fisheries sector related to a spill would occur even if the oil did not physically reach areas of the Gulf that are subject to fisheries operations.

Corridor Response

The "low-risk" characterization in relation to potential spill impacts on commercial fisheries is based on a variety of components. The first of these is the fact that the probability of any spill occurring (and thus potentially commercial fisheries) is 0.18% for a non-blowout spill (50-999 barrels), with the next possible spill type affecting commercial fisheries (subsea blowout) occurring 0.02% of the time. These probabilities are extremely low and thus can be classified as "low risk". This fact, combined with the fact that the closest fisheries, which are located 10 to 12 km outside of the project area, include redfish, cod, and white hake. Redfish, cod, and white hake are mobile fish, and, in the event of a major spill or blow-out of hydrocarbons, these species are likely to leave the impacted area for more favourable conditions. The majority of the closest invertebrate fisheries, which are less mobile, are located over 25 km away from the edges of the project area and are located outside of the "Predicted Maximum Extent of Oil Plume Trajectory in Relation to Exploratory License 1105". With respect to the prospect of future stigma risks to regional fisheries interests, fishing and harvesting restrictions can be imposed after an oil spill in order to prevent and minimize contamination of fishing gear and to protect and reassure consumers. Fishing can resume after the appearance of surface and subsurface oil has subsided. In the unlikely event of a spill, affected parties will be compensated in accordance with the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2002).

Reference: C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board) and CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2002. Compensation Guidelines for Respecting Damages Relating to Offshore Petroleum Activity.

St. Lawrence Coalition/Ecojustice Comment # 3

Corridor still does not address the fact that a 23-year old reference is provided to show no significant mortality to marine mammals, while recent oil spills have shown the contrary.

Corridor Response

As described in Section 8.7.1.3, it has been stated that oil spills can negatively affect marine mammals. Some species of whales avoid oil slicks and thus negate any negative consequences of a spill. Based on a comparison of sperm whale acoustic activity from pre-spill (2007) and post-spill (2010) conditions, Ackleh et al. (2012) suggested that sperm whales may have relocated farther away from the Deepwater Horizon oil spill site in the Gulf of Mexico, as there was a statistically significant reduction in acoustic activity and abundance at a site 40 km (25 miles) compared with 14.5 km (9 miles) from the spill in 2010. Humpback whales may have shown temporary avoidance during the *Exxon Valdez* spill in Prince William Sound (von Ziegesar et al. 1994). The potential for a major oil spill or blowout occurring during exploratory drilling is extremely unlikely. The size of a worst case scenario oil spill will measure approximately 25 km x 50 km, with less major spills taking up much less area. Due to the fact that the likelihood of a major oil spill is extremely low, and in the event of a spill, the affected area is expected to be confined to a small area of the Gulf based on spill trajectory modeling, there is unlikely to be a significant adverse environmental effect on marine mammals (i.e., not likely to result in a decline or change in abundance and/or distribution of a marine mammal population over one or more generations and/or where natural recruitment may not re-establish the population to its pre-project level within several generations and/or where avoidance of the area becomes permanent).

References:

Ackleh, A.S., G.E. Ioup, J.W. Ioup, B.Ma, J.J. Newcomb, N. Pal, N.A. Sidorovskaia and C. Tiemann. 2012. Assessing the *Deepwater Horizon* oil spill impact on marine mammal population through acoustics: Endangered sperm whales. *Journal of the Acoustical Society of America*, 131: 2306-2314.

von Ziegesar, O., E. Miller and M.E. Dahlheim. 1994. Impacts on humpback whales in Prince William Sound. Pp. 173-191. In: T.R. Loughlin (ed.). *Marine Mammals and the Exxon Valdez*. Academic Press, Inc., San Diego, CA.

If you have any questions, please do not hesitate to call me at 902-406-8011.

Sincerely,

[redacted]

Health, Safety, Environment and Regulatory Affairs Manager
Corridor Resources Inc.