White Rose Extension Project

Response to Review Comments on the White Rose Extension Project Environmental Assessment

WH-DWH-RP-0031

April 2013

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1.1 Chapter 2 Project Description

2.3.2.2 Evaluation of Material Disposal Options

Will there be any discharges of deleterious substances to receiving waters?

> **Husky Response:**
> No deleterious substances will be discharged into the marine environment.

2.6.2 On-Land Construction

What will be the standards used for sewage treatment?

> **Husky Response:**
> Sewage treatment will be discharged according to the Newfoundland and Labrador *Environmental Control Water and Sewage Regulations, 2003*

2.6.3.1 Excavation

Quote: "Site surface water and groundwater from any dewatering of the graving dock will be collected, assessed and, if necessary, held in an engineered lined settling pond onsite to satisfy all regulatory requirements before being discharged into the marine environment."

Are the regulatory standards both federal and provincial?

> **Husky Response:**
> All discharges from on land project activities will be according to the Newfoundland and Labrador *Environmental Control Water and Sewage Regulations, 2003*

2.6.3.4 Site Dewatering and Disposal

Quote: "Water will be treated with a mobile treatment unit as required prior to discharge to ensure compliance with provincial and federal requirements."

Confirm that these standards will be used for site surface water and groundwater as above.

> **Husky Response:**
> All discharges from on land project activities will be according to the Newfoundland and Labrador *Environmental Control Water and Sewage Regulations, 2003*.

1.2 Chapter 3 Summary of White Rose Extension Project Specific Models

General:
The document did not reference the regular tanker traffic associated with the Come-by-Chance refinery. Nearshore Project Area will transect the shipping lanes for these oil tankers. What protocols will be developed to allow the safe coordination of project activities with tanker traffic in the dredging, module mating, and transportation to White Rose drilling site phases? Given weather conditions, navigational challenges, length of time required for project phases and the nature of all the vessels involved, there could be potential for close manoeuvring between vessels, which should be considered in the context of the assessment.

Husky Response:
Husky will work with marine stakeholders such as FFAW, Marine Atlantic, NTL, Argentia Port Authority, Atlantic Pilotage Authority, the North Atlantic Refinery and the Placentia Bay Traffic Committee to determine high traffic periods and get a detailed vessel schedule for coordination of project activities. Project specific marine procedures will be reviewed with stakeholders to ensure awareness. All vessels contracted on Husky's behalf are vetted to ensure they meet Husky's requirements for reliability, redundancy, crew competency and vessel condition.

Closer to planned operations, a Notice of Shipping will be broadcast twice per day to ensure vessel traffic is aware of planned marine-related project activity. The speed for transit of project related vessels into and out of Argentia will be determined by the Port and Pilot authorities at time of navigation, given the current weather conditions.

Nearshore work could involve the use of heavy lift vessels, supply vessels, tugs, as well as on-shore large construction equipment. The nearshore spill modeling considered fuel spills ranging from 100 to 350 m^3. Supply vessels can have a capacity of over 1100 m^3 of fuel and, in the event of collision, could lose more than 350 m^3. It may be useful to run nearshore scenarios with expanded fuel capacity reflecting what is carried in larger vessels.

Husky Response:
350 m^3 is the estimated volume of fuel to be carried by supply vessels operating in the nearshore in support of the wellhead platform construction project.

Again, for nearshore work, it may be useful to examine the potential for spills in the land-water interface (e.g., heavy equipment upset into a water body; puncturing of an onshore fuel tank that could spill into a water body). Planning could include placing in local inventory the material and equipment needed to deploy a boom from land to contain a water-borne slick, as well as having appropriately trained personnel.

Husky Response:
Husky will ensure a local inventory of spill response equipment at Argentia to respond to on-land and nearshore spills. On site personnel will receive appropriate training in spill response.

3.6 Hydrocarbon Spill Probabilities

In general, this section is difficult to follow. Some of the sources and information used are fairly dated (e.g., NAS 2000; Scandpower 2000). It might also be useful to change the format of the section so that calculations are done in an equation format with corresponding data tables reflecting the results of those calculations. In the discussion, it would also be useful to indicate which calculations were used to derive the spill probability for the White Rose Expansion Project.

Husky Response:
NAS 2000 and Scandpower 2000 are mentioned in the report but are not used as primary sources for the spill frequency predictions. The primary references used for spill frequency predictions are Deloitte 2012, IAOGP 2010 and C-NLOPB 2012.

References;

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2012. *Spill Statistics and Well Statistics*. Available at: www.cnlopb.nl.ca/ env_stat.shtml,/well_chrono.shtml.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2012. *Spill Information by Operator: Spills Greater than 1 Litre (1997-2012)*. Available at: http://www.cnlopb.nl.ca/env_stat.shtml

Deloitte Petroleum Services. 2012. *List of Offshore Petroleum Wells to December 31, 2011*. Report generated on request from Deloitte LLP. London, England.

IAOGP (International Association of Oil & Gas Producers). 2010. *Risk Assessment Data Directory: Blowout Frequencies*. International Association of Oil & Gas Producers. London, UK, Report No. 434-2. Available at: http://www.ogp.org.uk

3.6.1.1 Blowouts During Drilling

Quote: "Up to 2011, four development-drilling blowouts have produced spills in the very large spill category (Table 3-48, including the recent incident in Australia, and including the spill in the extremely large category)."

Unclear. The description could be reworded to something like, "From Table 3-48, there are four large spills from development well blowouts, giving a spill frequency of (4/67,703) x 5.9 x 10^{-5} */ well drilled = 1 spill / 17,000 wells drilled."*

Husky Response:
Comment noted. Thank you.

3.6.1.2 Blowouts During Production and Workovers

Quote: "…it is estimated that the total oil produced offshore on a worldwide basis up to 2011 has been approximately 210 billion bbl, and that the total producing oil well-years has been 350,000 well-years… On this basis, the world-wide frequency of extremely large hydrocarbon spills from oil-well blowouts that occurred during production or workovers is 5.7 X 10^{-6} *blowouts/well-year. For very large, the number is 1.4X*10^{-5} *blowouts/well-year."*

In recent decades, there has been an increasing move to explore and exploit hydrocarbon reserves that had been previously less accessible, or even inaccessible, given technologies available at the time. With the move to exploration in less hospitable frontiers, there would seem to be greater risk for spills from blowouts posed by environmental and geological conditions. These differences could be statistically smoothed by looking at the longer term drilling record. Perhaps the reference cited (Deloitte Petroleum Services. 2012. List of Offshore Petroleum Wells to December 31, 2011. Report generated on request from Deloitte LLP. London, England) discussed this aspect -- it would be informative if this was addressed in looking at exploration that has occurred in more challenging environments, which could have an impact on the calculated probabilities.

Husky Response:
Unfortunately, Deloitte (2012) does not contain the detail necessary to separately identify those wells drilled in "challenging environments". If it is indeed true that recent decades have had more wells in challenging environments, it is not reflected in the spill record noted in Table 3-3 (Historical Large Spills from Offshore Oil Well Blowouts); until the Montara blowout (2009) and the Macondo blowout (2010), there had been no blowout spills of greater than 10,000 barrels since 1992.

It should be noted that deep-water exploration and production has occurred since the 1980s; production from wells in depths greater than 305 m (1,000 feet) in the Gulf of Mexico surpassed that of shallow-water production in the year 2001.

3.6.1.3 Summary of Extremely Large and Very Large Oil Spills from Blowouts

Quote: "…the Ixtoc l oil-well blowout ... was caused by drilling procedures (used by PEMEX, …) that are not practised in US or Canadian waters and that are contrary to US or Canadian regulations and to the accepted practices within the international oil and gas industry. Therefore, extremely large spill frequencies in North America are expected to be even lower."

A few points to consider:

- *Mexico is part of North America;*
- *the Macondo blow-out in the Gulf of Mexico occurred partly due to "… BP, Transocean, and Halliburton's conduct violated federal offshore safety regulations under BOEMRE's jurisdiction… " and poor risk management (Oil and Gas Journal, Sept. 14, 2011);*
- *there are different regulations in the US and Canada (e.g., 3.6.2.1 Shallow Gas versus Deep-well Blowout, Page 3-63 indicates that Canada requires two barriers in exploration and development, while only one is required in the US); and*
- *Quote: "…extremely large spill frequencies in North America are expected to be even lower" is a conclusion that could be modified based on the above.*

Husky Response:
Thank you for noting this: the text should be changed as follows:

> *"…the Ixtoc l oil-well blowout ... was caused by drilling procedures (used by PEMEX, …)* that are not practised in Canadian waters and that are contrary to Canadian regulations and to the accepted practices within the international oil and gas industry. Therefore, extremely large spill frequencies in Canada are expected to be even lower."

3.6.2.1 Shallow Gas versus Deep-well Blowout

Blowout stats are derived from Scandpower (Scandpower A/S 2000. Blowout Frequencies 2000, BlowFAM Edition. Report No. 27.20.01/R3.). While very informative, it would be good to have stats up to 2013, given the significant blowouts that have occurred since 2000 (e.g., Deep Water Horizon in the Gulf of Mexico (2010) and the Montara spill off the west coast of Australia (2009)). These occurrences would not have been included in the other document cited (IAOGP 2010) since statistics quoted are up to 2005.

Quote: "Finally, it is worth noting (Table 3-52) that shallow gas blowout frequencies in the North Sea and in the US GOM have been on the decline in the most recent years of the record."

This is based on a period up to 1997 – 16 years ago. It would be good to determine if data are available to the present to indicate whether that trend has changed.

Husky Response:
A search for other similarly detailed and more recent studies did not reveal any other studies. It should be noted that Scandpower (2000) data were not used for any predictive purposes, simply for illustrative purposes.

3.6.3 Large Platform Spills

Quote (P. 3-65, para. 2): "BOEMRE statisticians … have decreased the estimate gradually over the past 15 years, mostly in recognition of a statistical trend towards a lower spill frequency."

What is the lower value? For what year?

Quote (P. 3-65, para. 4): "Note that the above statistic for spills >10,000 bbl (i.e. 5.5 x 10^{-6} spills/well-year) is almost four times smaller than the statistic derived earlier for production blowout spills >10,000 bbl (i.e. 2.0 x 10^{-5}). This is impossible because the first category includes blowout spills. The reason for the anomaly is that the US record was used for the former and the world-wide record was used for the latter. The world-wide statistic is higher than the US-derived one because the former was developed on a very conservative basis, which considered an exposure of only oil wells and not gas wells."

This paragraph is unclear, please clarify which probability is going to be used and why.

Quote: "It is noted that there has been … Given the limited statistical database of Newfoundland and Labrador production operations, the US statistics are used in this frequency calculation."

Is it because of similar geologic and marine conditions? Are there greater similarities with North Sea operations?

Husky Response:

The lower value is the stated, "*1.5 x 10^{-5} spills/well-year for spills equal or greater than 1,000 bbl and 5.5 x 10^{-6} spills/well-year for spills equal or greater than 10,000 bbl Anderson and LaBelle (2000)*". Again, although BOEMRE has updated the spill record (Table 3-9), they have not updated the predictor rates. Based on the fact there is only one recorded 10,000 barrel spill (Macondo) and two recorded 1,000 barrel spills (including Macondo) in the period 2000 to present, the T rates would be similar if the predictor rates were updated,

The fourth paragraph on page 3-65 is included to point out what is an anomaly (based on different exposure variable, total wells) between the number predicted from the raw data for production/workover blowouts and the reported platform rates by Anderson and Labelle.

If Newfoundland and Labrador statistics had been used, the frequency of spills would have been calculated based on zero spills greater than 1,000 barrels and one spill greater than 10,000 barrels; this did not seem to be a reasonable approach. No comparison is made between Newfoundland and Labrador and US waters based on geologic or marine conditions; US data were used simply because there is a reasonable and accessible data base.

3.6.6 Summary of Blowout and Spill Frequencies

Quote (P. 3-68, last para.): "…0.5 and 0.2, respectively."
Are those values percentages?

Husky Response:

Correct, those should be stated as percentages.

3.7 Fate and Behavior of Hydrocarbon Spills in the Nearshore Study Area (Trajectory Modelling) and 3.8 Fate and Behavior of Hydrocarbon Spills from a Platform or Seafloor Blow-out in the Offshore Study Area (Trajectory Modelling)

Please see the attached report "Review of Husky Energy Proposal for The White Rose Extension Project Oil Spill Aspects" by Dr. Merv Fingas.

In general, Environment Canada is in agreement with the proponent's findings with some differences in direction due to differences in winds and currents utilized (the EC modelling was done in stochastic mode with winds from CMC and currents from DFO). The persistence of the oils differed somewhat, with the proponent overestimating dispersion. In the EC modelling, there were a few cases where oil impacted the shorelines in Placentia Bay and the movement was consistently to the south, driven by NE winds. In contrast, the proponent had the oil moving further into the bay.

Husky Response:
Thank you very much for endorsement and the detailed review.

With regard to the comments on page 8 of the Fingas report regarding dispersed oil modelling: The oil shown to be lost from the surface in Table 3.6 is dispersed (as noted by Dr. Fingas) beneath the surface slick, mixed to a 10 m depth and diffused laterally. The characteristics of the dispersed oil cloud are provided in Table 3.6. All of these assumptions result in a conservative estimate of the possible dispersed oil cloud concentration and zone of influence. Figures 3.6 and 3.7 identify the locations along the spill trajectory where the dispersed oil concentration drops to 0.1 ppm.

Upon review of the Fingas report, Husky has determined that any differences, if they exist, would not significantly alter the outcome of the modelling exercise or the environmental assessment. The different winds and water currents used in the two assessments will result in differences in movement as Environment Canada has identified.

3.7.1 Model Inputs and Scenarios

Quote (P. 3-69, para. 1): "The only potential sources of marine spills from the WREP nearshore operations are batch spills of fuel as a result of ship accidents or groundings during tow-out activities from the graving dock to the deep-water mating site and the support vessel activities during the topsides installation."

Could add dredging operations here.

Husky Response:
Comment Noted. Thank you. The sentence could be reworded as follows:

The only potential sources of marine spills from the WREP nearshore operations are batch spills of fuel as a result of ship accidents or groundings during dredging, tow-out activities from the graving dock to the deep-water mating site and the support vessel activities during the topsides installation.

P. 3-69, para. 2:
If supply vessels are in the nearshore, they can have fuel capacities of around 1150 m^3, so the batch spills could range from 100 to 1150 m^3 rather than the 350 m^3 suggested.

Husky Response:
350 m^3 is the estimated volume of fuel to be carried by supply vessels operating in the nearshore in support of the WHP construction project.

P. 3-69, para. 3:
Why not include current maps for the autumn (Oct – Dec) as well?

Husky Response:
Spill trajectories were completed in the months of March, April, May, June and July as these are the months when marine-based activities are most likely to occur in the nearshore. For this reason, the summer water current mapping is most appropriate to show.

3.8.22 Surface (Platform) Spill
Quote (last para.): "…the oil will be broken into small tar-balls spread over a large area, with the oil particles separated by large expanses of water."

Where would the tar-balls end up? Are there potential impacts for Greenland, Iceland and further east?

Husky Response:
Oil spill fate prediction models do not use a mechanism for the final breakup of heavily weathered small oil particles. There is no literature or data available to our knowledge that would permit the development of such an algorithm. The present understanding of spilled oil behaviour does not permit the confident modelling of the behaviour of oil over such long durations and presentation of such trajectory results can be misleading. The time required to break down small particles of heavily weathered oil is currently unknown.

1.3 Chapter 4 Socio-economic, Terrestrial and Physical Environment Setting

4.2.1.1 Climate Overview and 4.2.1.3 Wind Climatology
The stations used to describe the nearshore climate of Placentia Bay did not include St. Lawrence, located near the mouth of the bay on the west side, with a record of hourly and daily weather reports nearly as long as that of Argentia. It is more exposed to open water conditions than the other three land stations with hourly data.

EC recommends that hourly wind reports from St Lawrence be analyzed to improve the wind climatology near the mouth of the bay, and could be compared to the southernmost MSC50 grid point.

Husky Response:
Thank you. We have updated the Placentia Bay nearshore winds with measurements from St. Lawrence (Environment Canada 2013). The key edits are:

- new columns in tables of monthly and annual mean and max wind (Tables 4-13, 4-14) and companion figure 4-16 (see response to **Comment 4.2.1.3 Wind Climatology**).
- added St. Lawrence as a row in Table 4-2 (see Table 1) in Figure 4-3 (see Figure 1) for Site Location and Years of Record

Eleven Environment Canada weather stations (Environment Canada 2012) were used for determining air temperature, wind and precipitation statistics for the nearshore climatology of Placentia Bay. Hourly wind reports from St. Lawrence were also included (as a twelfth station) for wind characterization near the mouth of the bay.

Table 1 Revised Table 4-2 List of Environment Canada Hourly Weather Observation Sites

Site Location	Years of Record
Argentia-Placentia	1953-2011 (Staffed Visibility/Precipitation through 1986)
Marticot Island	1994-2010
St. Lawrence	1994-1996; 1998-2013
Winterland	1999-2011
Source: Environment Canada 2012a, 2013.	

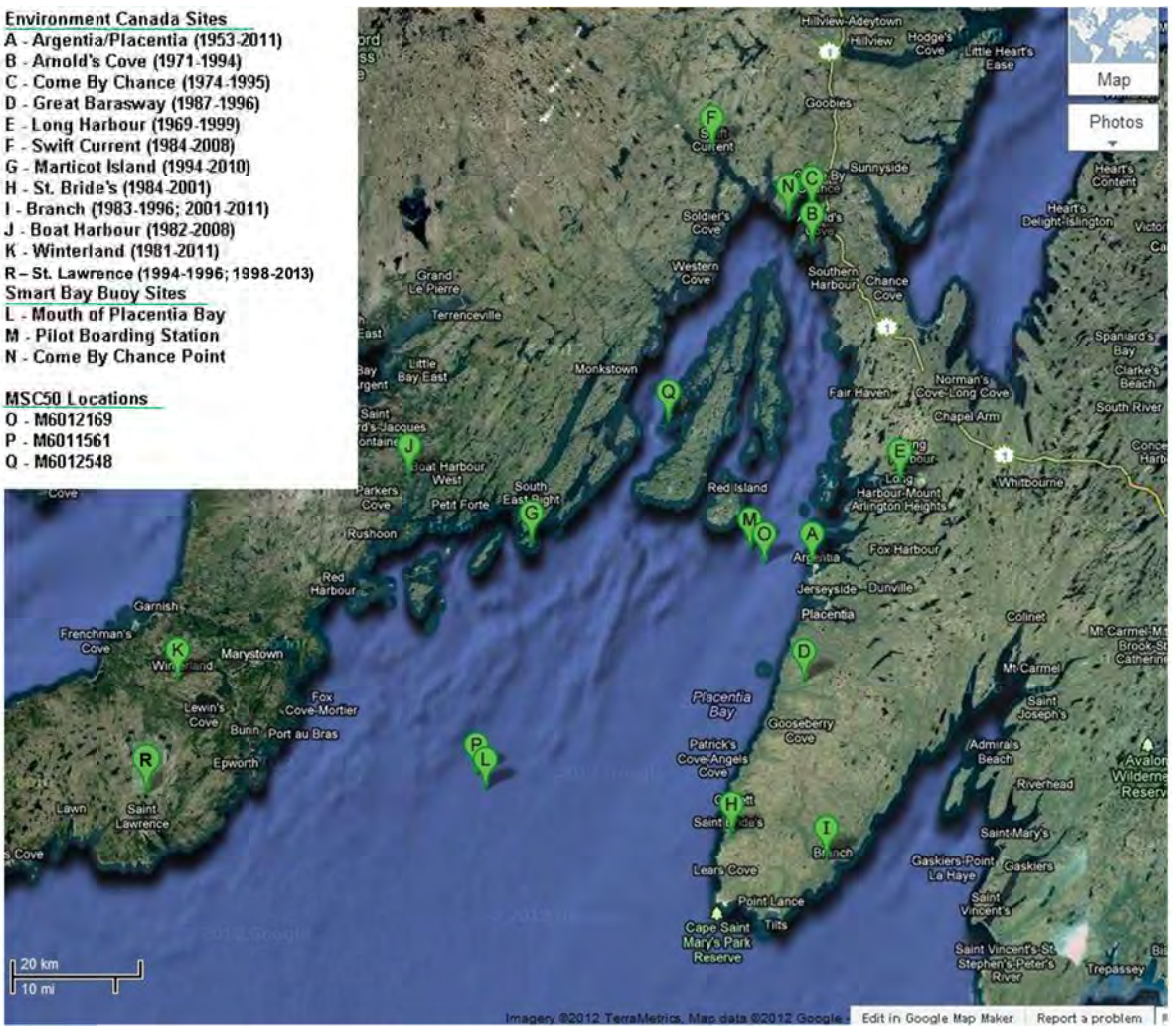


Figure 1 Revised Figure 4-3 Location of Nearshore Weather Stations

4.2.1.3 Wind Climatology

Winds from the MSC50 grid point locations and the SmartBay buoys are compared in Tables 4-8 and 4-9. The differences in wind statistics are attributed to the much shorter record of the buoys, but the low buoy anemometer heights, compared to the 10 m MSC50 winds, would also contribute to an apparent low bias.

The wind climatology describes only the hourly-reported sustained (mean) wind speeds. Analysis of gust wind speeds, available from the hourly automatic stations, would be important for planning and design.

Husky Response:
Wind gusts have been included.

Hourly observations from four Environment Canada weather stations (Marticot Island, Argentia-Placentia, Winterland and St. Lawrence) were used to assess the typical wind conditions nearshore Placentia Bay. These four sites provide a broad regional summary of winds surrounding the region as they encompass the west, east, and southwest sides of Placentia Bay. The lowest mean wind speeds are expected during the summer months (June-July), while the maximum occurs in the winter (January-February). The monthly and annual mean and maximum wind speeds for nearshore Placentia Bay are presented in Table 4-13 (Table 2) and Table 4-14 (Table 3) and plotted in Figure 4-16 (Figure 2).

Recognizing the relevance of wind gusts for planning, design, and operations activities, wind gust measurements measured at automatic climate stations for coastal sites Argentia-Placentia, Marticot Island and St. Lawrence were also analyzed. The maximum monthly wind gust speeds are also reported in Table 4-14 (Table 3), and plotted in Figure 4-16a (Figure 3).

Table 2 Revised Table 4-13 Monthly and Annual Mean Wind Speed nearshore Placentia Bay

Month	Argentia-Placentia (m/s)	Marticot Island (m/s)	Winterland (m/s)	St. Lawrence (m/s)
Jan	8.2	6.6	6.9	7.9
Feb	7.8	6.7	7.2	8.1
Mar	7.4	6.5	6.7	7.3
Apr	6.6	5.3	6.2	6.6
May	5.8	4.2	5.5	5.7
Jun	5.6	3.8	5.2	5.2
Jul	5.4	3.7	4.5	4.4
Aug	5.6	3.9	4.4	4.8
Sep	6.0	4.6	5.2	5.4
Oct	6.9	5.5	5.8	6.5
Nov	7.4	6.1	5.4	6.7
Dec	8.0	6.3	6.6	7.7
Annual	6.7	5.3	5.8	6.4
Source: Environment Canada 2012a, 2013.				

Table 3 Revised Table 4-14 Monthly and Annual Maximum Hourly Wind Speed and Wind Gust Nearshore Placentia Bay

Month	Argentia-Placentia		Marticot Island		Winterland	St. Lawrence	
	Maximum Wind Speed (m/s)	Maximum Gust Speed (m/s)	Maximum Wind Speed (m/s)	Maximum Gust Speed (m/s)	Maximum Wind Speed (m/s)	Maximum Wind Speed (m/s)	Maximum Gust Speed (m/s)
Jan	30.3	36.7	26.4	30.3	25.3	29.7	42.2
Feb	30.8	39.2	28.3	33.9	27.2	35.0	44.2
Mar	24.2	36.7	31.9	38.6	22.2	27.2	39.7
Apr	25.8	29.4	27.2	35.0	22.2	26.7	36.7
May	23.3	27.8	25.8	31.9	23.6	25.8	35.5
Jun	20.6	25.3	18.6	22.8	18.1	20.6	29.4
Jul	21.7	26.7	20.6	22.2	19.4	19.2	25.8
Aug	22.2	24.2	22.2	30.8	20.6	20.6	26.7
Sep	26.4	36.7	29.7	35.0	25.3	24.7	38.6
Oct	28.6	29.7	27.8	33.9	22.8	29.4	38.0
Nov	28.1	30.8	25.8	29.7	20.6	24.7	36.9
Dec	30.0	35.5	27.2	33.9	25.8	29.4	42.2
Annual	30.8	39.2	31.9	38.6	27.2	35.0	44.2
Source: Environment Canada 2012a, 2013							

Reference:

Environment Canada, 2013. *Wind Data, Placentia Bay, Newfoundland*. St. Lawrence, Argentia-Placentia. Marticot Island, hourly wind speed and wind gust speed data. Climate Services, Atlantic Climate Centre. MSC Atlantic Operations, Dartmouth, NS, 26 March 2013.

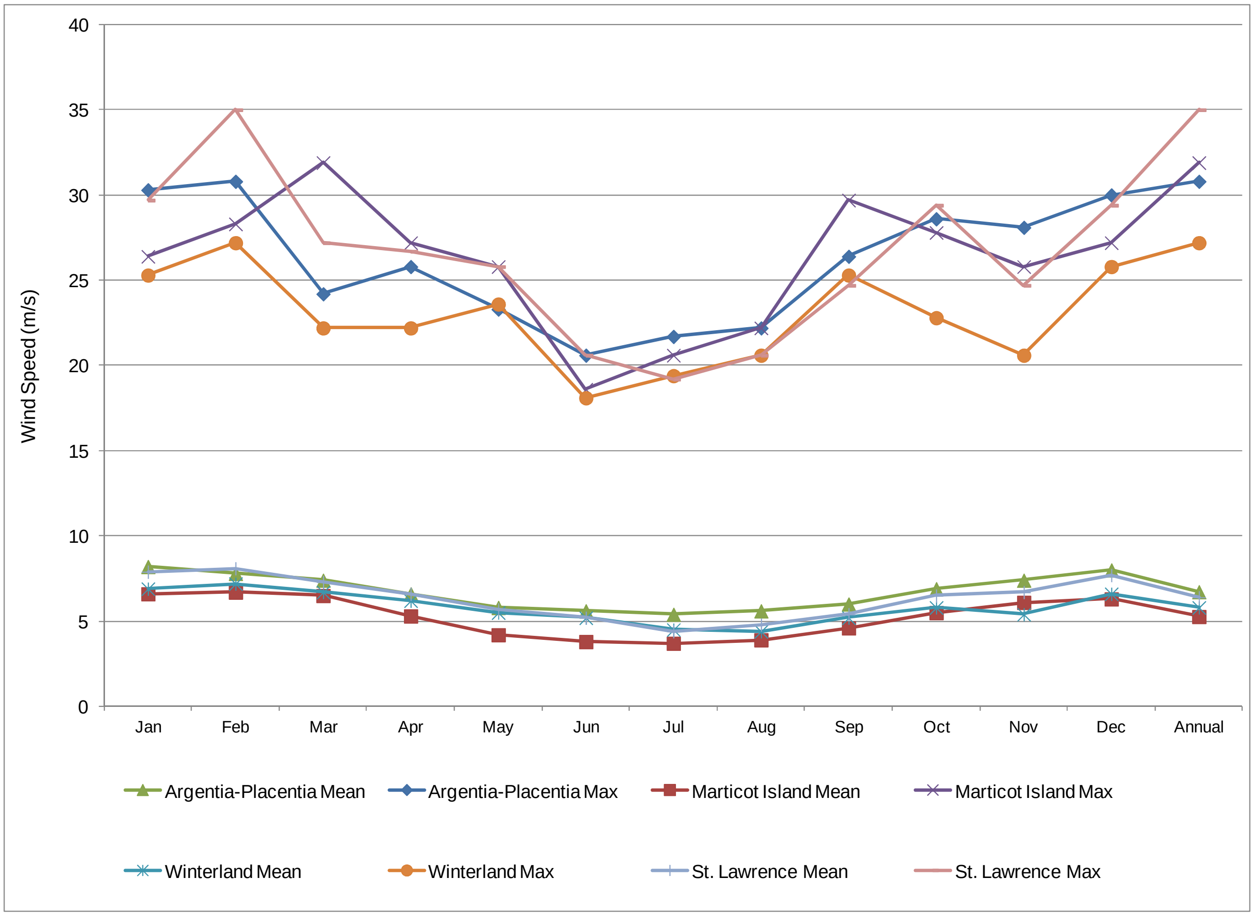


Figure 2 **Revised Figure 4-16 Monthly Average and Maximum Wind Speed for Nearshore Placentia Bay**

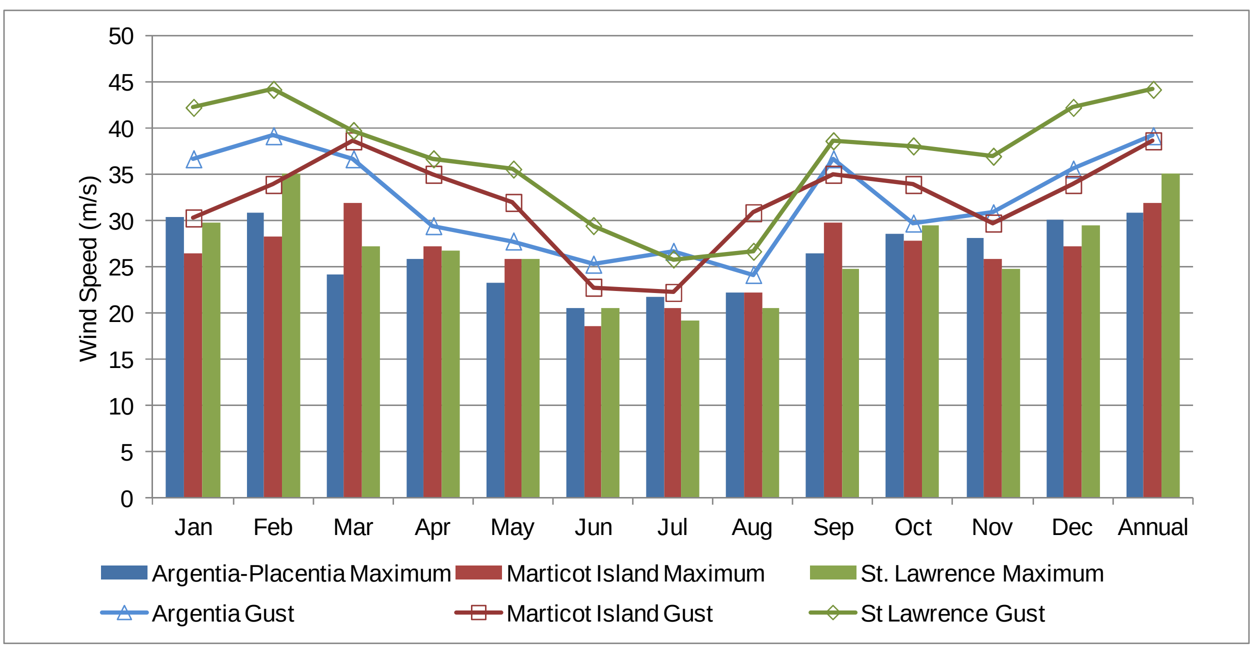


Figure 3 **Figure 4 16a Monthly Maximum and Gust Wind Speed for Nearshore Placentia Bay**

4.2.2.2 Waves

The MSC50 dataset was not intended for use very nearshore. The model resolution, representation of the coastline and islands, and the bathymetry, are not optimized for nearshore applications, such as well into the Placentia Bay. EC suggests that this limitation be acknowledged.

Husky Response:
Husky acknowledges the limitation of the MSC50 data set in its use in the nearshore.

4.2.2.5 Tides, Storm Surges

The text gives an estimate of 0.8 m for probable maximum storm surge from 40-year return period hindcast values (from Bernier and Thompson (2006), Figure 4-64), however the storm surge model used by Bernier and Thompson does not include wave set-up or wave run-up or seiche effects, which can contribute significantly to extreme water levels. EC recommends that the EIS include an extremal analysis of water levels based on long time series tide gauge data at Argentia.

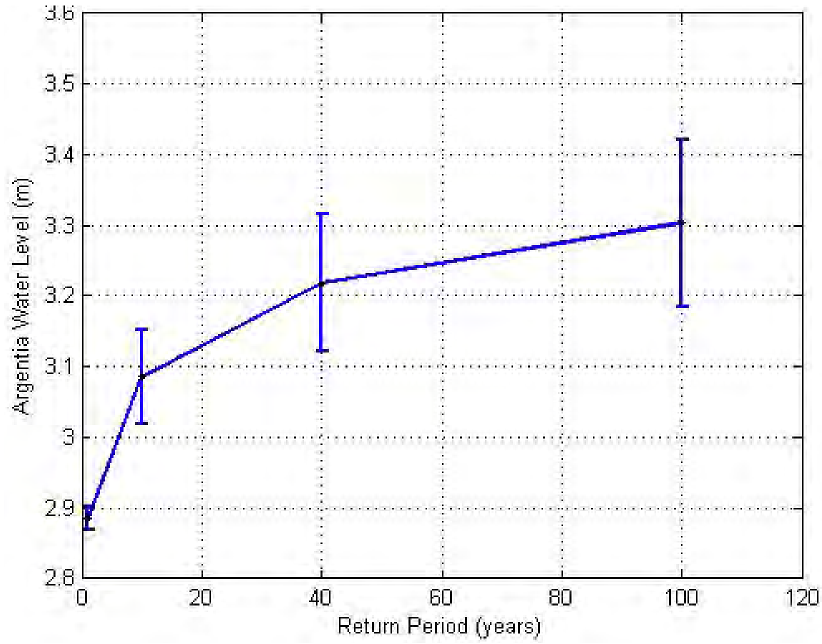
Husky Response:
We have performed an extreme value analysis on the Argentia tide/water level historical data.

The following is added to the end of Section 4.2.2.5.

Extremal analysis was performed on the February 1971 to March 2011 historical 1-hourly water level measurements at Argentia (DFO 2012b) by fitting them to a Gumbel distribution using the maximum likelihood method. By analysing the water level measurements themselves, this approach includes any wave set-up or seiche effects which may occur. The results are shown in revised Table 4-34 (Table 4) and revised Figure 4-66 (Figure 4), which indicate a 100-year water level value of 3.3 m. This is again consistent with the HHW value of 3.4 m reported in Table 4-33.

Table 4 Revised Table 4-34 Argentia Water Level Annual Extremes

	1-yr Return (m)	10-yr Return (m)	40-yr Return (m)	100-yr Return (m)
Argentia Water Level	2.89 +/- 0.02	3.09 +/- 0.07	3.22 +/- 0.10	3.30 +/- 0.12



Source: DFO 2012b

Figure 4 Revised Figure 4-66 Extreme Water Level Values, Argentia

4.2.4 Sea Ice and Icebergs

Page 4-112, Figure 4-75:

Typo – The x and y axes are labelled identically as "Annual Total Number of Icebergs Observed South of 48N". The label is correct for the x-axis, but the y-axis should simply be labelled "Year".

Husky Response:

Comment noted. Thank you.

4.2.4.1 Sea Ice Conditions in Placentia Bay

Page 4-112, Sentence 3:

Two errors

The ice that enters the Bay in February is generally grey or grey-white ice (less than 30cm thick), and is not first-year ice (>30cm thick). First-year ice incursions into Placentia Bay only take place from March onwards.

- *First-year ice is >30 cm thick. Contrary to indicated, it can be >120cm thick. First-year ice that is >120 cm is called "thick first-year" ice. Ice that is 30-70cm is thin first-year ice, and ice that is 70-120cm is medium first-year ice.*

Page 4-114, Paragraph 2, Sentence 2 and *Page 4-115, Figure 4-78*:

Error with respect to the upper limit for the standard ice types – In Figure 4-78, the thickness of thin first-year ice (e.g., Mar 19, Mar 26, Apr 02) is given as 50 cm. This is the average thickness for this ice type, not the upper limit as indicated. The upper limit for this ice type is 70 cm.

Husky Response:

Comment noted. Thank you.

Page 4-115, Sentence 1:
Typo – It appears that "(Figure 4-4)" should be "(Figure 4-78)".

Husky Response:
The reviewer is correct. The in-text figure reference should be Figure 4-78.

4.3 Offshore
Page 4-201:
Figure caption is missing – The sea ice chart on this page has no figure number (it should be Figure 4-121). There should also be a reference to the Canadian Ice Service in the caption, as the chart was obtained from its archives.

Husky Response:
Comment noted. Thank you.

4.3.1.2 Wind Climatology
The caption for Table 4-44 has the word "anemometer", which should be replaced by MSC50.

Husky Response:
Comment noted. Thank you.

4.3.1.5 Icing
This section includes only potential sea spray icing. EC recommends that the EIS include analysis of observed freezing spray and icing accumulation measured on the platforms.

Husky Response:
Ice accumulation on stationary offshore platforms is a rare event. Freezing spray is more common on ships transiting rough seas. Data on ice accumulation are not recorded in either case.

4.3.4.1 Sea Ice
Spatial Distribution:
Page 4-204, Paragraph 3, last sentence:
*Clarity – This sentence could easily be misunderstood as written. To make it clearer, it is suggested that it be rewritten as two sentences: "**Thin** first-year or white ice becomes the dominant ice form in areas off Newfoundland beginning in March, just before water temperatures rise above the freezing level. **In April and May, during years when ice lingers in the area, medium to thick first-year ice are the dominant ice forms.**"*

Husky Response:
Comment noted. Thank you.

Page 4-204, Paragraph 4, first sentence:
*Clarity + Typo – For clarity, it is suggested that this sentence be rewritten as: "By the end of July, the ice pack **has retreated** northward, with substantial ice concentrations confined north of Labrador."*

Husky Response:
Comment noted. Thank you.

Page 4-205, Paragraph 1, Sentence 1 and Figure 4-122:
Slight error – In the first sentence, it says the mid-month Frequency of Presence of Sea Ice charts (taken from the CIS atlas) are shown January through May. All the charts shown are indeed for the middle of the months, except for the one for January. The chart shown for January is that of the week of January 08, when really, to be consistent with the statement and the other months, it should be that for January 15.

Husky Response:
Comment noted. Thank you.

Page 4-209, Paragraph 1, Sentence 1:
Clarity – For greater clarity, it is suggested that the phrase "annual timing of all ice incursions" in the first sentence of this paragraph be replaced, since that is not exactly what the bar graph in Figure 4-127 shows. The sentence should rewritten as: "The ***average ice coverage during the initial period of*** *ice incursions near the White Rose field,* ***between end of November and mid-February****, from 1980 to 2012, is shown in Figure 4-127."*

Husky Response:
Comment noted. Thank you.

Page 4-209, Paragraph 1, Sentence 2:
Clarity, as in Sentence 1 – Suggested revision of this sentence: "These data show the years of higher-than-average ***ice coverage during the initial period of ice*** *incursions (1983 to 1995, 2000 and 2008)."*

Husky Response:
Comment noted. Thank you.

Page 4-209, Paragraph 1, Sentence 3:
Clarity – as in Sentences 1 and 2
Inconsistency – The incursion period shown in Figure 4-127 spans Nov 26 – Feb 19. But the representative chart shown for 1993 is for March 01.

Suggested revision of sentence 3: "The maximum recorded ***amount of ice during the initial period of*** *incursion of sea ice for east Newfoundland waters occurred in 1993* ***(Figure 4-127). The 1993 ice coverage chart for the second week following the incursion period*** *is illustrated in Figure 4-128."*

Husky Response:
Comment noted. Thank you.

Concentrations:
Page 4-212, Paragraph 2, Sentence 1:
Illustration or example required – When talking about the "seasonal ice tongue", it would be helpful if the reader were pointed to a visual example of this. A bracket could be added to the end of the first sentence, such as "(e.g. see Figure 4-124)".

Husky Response:
Comment noted. Thank you.

4.3.4.2 Icebergs
Origins and Controlling Factors:
Page 4-217, Paragraph 1, Sentence 4:
Correction – Since the Humboldt Glacier and Jacobshavn Isbrae are two of the major sources of icebergs, the sentence should read, "…primarily from 20 major glaciers between **and including** the Jacobshavn and Humboldt glaciers". Also, note that there is no "e" in Jacobshaven.

Husky Response:
Comment noted. Thank you.

Page 4-217, Paragraph 4:
Additional explanation could be added here – It could be explained that the reason why there is a positive correlation between iceberg numbers and pack ice extent is that the pack ice protects the icebergs from melt and wave-induced deterioration during their trip southwards. Because of this, many more bergs survive the trip to Newfoundland during winters with extensive pack ice.

Husky Response:
Comment noted. Thank you.

Page 4-217, Paragraph 5, Sentence 1:
Inconsistency – It is stated that according to the data (Figure 4-133) ***iceberg counts of zero occurred in 1966****, 2006 and 2011,* ***however the bar chart in Figure 4-133 only goes back to 1981****. If a low of zero bergs did occur in 1966, a bracket after this year saying "(not shown)" should be added to the sentence.*

Husky Response:
Comment noted. Thank you.

Variations in Local and Regional Iceberg Numbers:
Page 4-219, Paragraph 1, Sentence 2:
Inconsistency – Here it is stated that iceberg distributions between March and May of 2009 and 2010 are illustrated in Figures 4-134 and 4-135. However, the two charts shown for 2009 are for March and April, while those shown for 2010 are for March and May. While April does fall "between March and May", it would be better to compare the same months for the two years (i.e., either use a May chart for 2009 or an April chart for 2010).

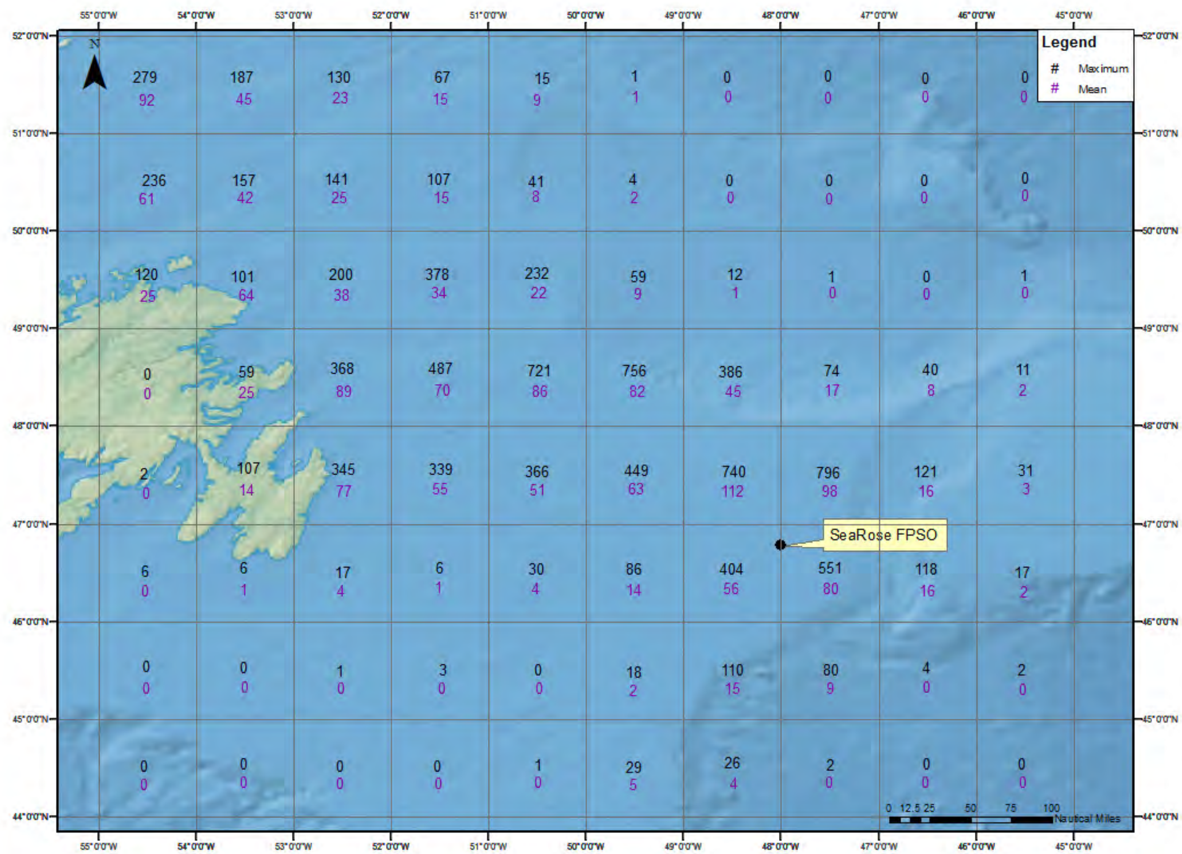
Husky Response:
It is stated in the first paragraph on Page 4-219, under the section "Variations in Local and Regional Numbers", as do accompanying captions for each iceberg distribution image, that these plots are meant to provide the extremes (maximum and minimum extent of iceberg distribution) during the 2009 and 2010 ice seasons. Those two seasons were chosen due to the significant difference in the number of icebergs observed off the East Coast of Canada. Only iceberg analysis charts between March 1 and May 31 of both years were analyzed to determine the minimum and maximum iceberg distribution during these three months, which is the typical iceberg season on the Grand Banks.

During the March 1 to May 31 timeframe of both the 2009 and 2010 ice seasons, the lowest number of icebergs analyzed off Eastern Canada occurred on March 1. The 2009 ice season was particularly heavy for icebergs and the highest number of analyzed icebergs during March, April and May occurred on April 17. The 2010 season was a light year for icebergs off Eastern Canada, particularly south of the 48° North latitude where no icebergs were observed. The majority of 2010 icebergs were observed off the coast of Labrador and the north coast of Newfoundland and the highest number of icebergs analyzed during March, April and May occurred on May 31.

Page 4-223, Figure 4-137:
Chart does not make sense and needs more explanation – According to this chart, which is said to be based on the PAL database, zero bergs were sighted everywhere over the last decade except in the vicinity of the White Rose platform (smack in the middle of the highest observation densities) and along the Northern Peninsula of Newfoundland. Clearly this is not the case (see Figures 4-134 and 4-135). I suspect that what this chart is showing is a subset of the PAL sightings, based around or made from either the White Rose or Hibernia platforms. What exactly this chart is showing needs to be better explained here.

Husky Response:
The reviewers' assumption is correct. Figure 4-137 used archived information from PAL's iceberg sighting database and concentrated the plot on the region around the White Rose oil field by filtering the records. The iceberg density around the Northern Peninsula, depicted in Figure 4-137, is not indicative of the actual concentration typically seen in that region, but these sparse densities were obtained from beacons that were placed on ice island fragments in the past couple of years. Since most iceberg observations are recorded by vessels servicing oil and gas operators on the Grand Banks and from surveillance flights, the majority of sighting data would be recorded near the offshore facilities and close to shorelines of Newfoundland and Labrador, therefore the true density of iceberg locations would not be completely known based on recorded data.

To correct the issue, PAL retrieved all known iceberg sightings from its expansive database, containing over 58,000 records, and produced an updated iceberg observation density plot, for a more condensed domain centred on the White Rose oil field and providing information for areas to the north and west of the Grand Banks. The iceberg density information for the period 1995 to 2012 with the annual mean and maximum (largest number of icebergs recorded in each block in one year) values for each square degree (1 degree latitude by 1 degree longitude) are provided as Figure 5.



Maximum and Mean Iceberg Density on the Grand Banks from 1995 to 2012

Figure 5 Maximum and Mean Iceberg Density on the Grand Banks from 1995 to 2012

Size Distributions:

Page 4-226, Table 4-80:

<u>*Slight errors in quoted height and length values, and in quoted mass values*</u>

- *Height / Length – The ranges of heights and lengths for each category should begin one increment higher than that of the previous category. So if a Bergy Bit has a length range of 5-15 m, then a Small Iceberg has a length range of 16-60 m (not 15-60 m). Ditto for height. This needs to be corrected for the small, medium and large iceberg categories in the table. See MANICE, Tables 2.3 and 4.8.*
- *Approximate Mass – Although ranges for the masses of medium and large icebergs are given in Table 4-80, the cited source of information does not give ranges for these categories. According to MANICE (Table 2.3), a Medium berg has an approximate mass of 2,000,000 tons and a Large berg has a mass of 10,000,000 tons.*

Husky Response:

Comment noted. Thank you.

Iceberg Length:

Pages 4-227 to 4-228, Figure 4-140:

<u>Figure is split across 2 pages</u> – This is a little confusing because the Figure has two panels. The panels should either be labelled "a)" and "b)" with descriptions of these in the Figure caption so that it is clear these panels both belong to "Figure 4-140", or the Figure should be published on a single page and not split across pages.

Husky Response:

Comment noted. Thank you.

Page 4-227, Paragraph 3, Last Sentence:

<u>Clarification</u> – It should be stated that the Petermann Glacier is in northwest Greenland, north of the 20 greatest sources of icebergs noted earlier, which lie between and include Jacobshavn Isbrae and the Humboldt Glacier. It could also be noted that the Petermann Glacier has a history of calving large tabular ice islands as opposed to hundreds of smaller bergs, the way the other glaciers do.

Husky Response:

Comment noted. Thank you.

Iceberg Draft:

Pages 4-228 to 4-229, Figure 4-141:

<u>Figure is split across 2 pages</u> – This is a little confusing because the Figure has two panels. The panels should either be labelled "a)" and "b)" with descriptions of these in the Figure caption so that it is clear these panels both belong to "Figure 4-141", or the Figure should be published on a single page and not split across pages.

Husky Response:

Comment noted. Thank you.

Page 4-227, Paragraph 4, First Sentence:

*<u>Inconsistency</u> – It is stated here that the data used in Figure 4-141 were derived from observations and measurements made from **2000 to 2012**, but the source under Figure 4-141 says the PAL data span **2000-2011**. According to our iceberg expert here at CIS, the 2012 data are not yet available.*

Husky Response:

Comment noted. Thank you.

Iceberg Height:

Page 4-229, Paragraph 2:

<u>Reference to Figure 4-141 missing</u> – The reader should be directed to Figure 4-142 somewhere in this paragraph.

Husky Response:

Reference to Figure 4-141 is provided in the last paragraph on Page 4-227. Reference to Figure 4-142 is provided in the first paragraph on page 4-229.

4.3.9 Climate Change,

The proponents discuss the impacts of NAO on climate and storminess of the region as well as on the path of hurricanes over the 20th century. Although confidence in projections is generally low (see IPCC SREX), they should provide some general discussion of projected future changes in these climate phenomena as well as extratropical storm tracks, frequency and intensity.

Husky Response:

According to the IPCC AR4 (IPCC 2007), "*extratropical storm tracks are projected to move poleward, with consequent changes in wind, precipitation and temperature patterns…*" A number of studies have been done to project future changes in extratropical storm tracks, as well as extratropical storm frequency and intensity.

Ulbrich et al. (2008) computed winter storm-track activity from an ensemble of 23 runs from 16 coupled global climate models for the control period of 1960 to 1999 and for the period of 2081 to 2100. The Special Report on Emission Scenarios (SRES) A1B scenario was used for the climate forcing of the 2081 to 2100 period. The results of the 1960 to 1999 period were validated against the National Centres for Environmental Prediction (NCEP) – NCAR reanalysis (Kalnay et al. 1996) and found to perform well in reproducing the observed climatological pattern.

Ulbrich et al.'s findings show an increase in storm-track activity in the North Atlantic region extending from southern Newfoundland to Western Europe with the largest increase of 5 to 8 percent occurring over the Eastern North Atlantic.

In 2005, Yin (2005) analyzed storm tracks from an ensemble of 15 coupled climate models and found a consistent poleward and upward shift and intensification of the storm tracks in the Northern Hemisphere for the 21st century. This shift was associated with enhanced warming in the tropics. Yin also found this poleward shift is accompanied by a poleward shift in surface wind stress and precipitation.

References

IPCC (Intergovernmental Panel on Climate Change). 2007. *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Kalnay, E., M. Kanamitsu, R. Kistler, W. Collins, D. Deaven, L. Gandin, M. Iredell, S. Saha, G. White, J. Woollen, Y. Zhu, M. Chelliah, W. Ebisuzaki, W. Higgins, J. Janowiak, K.C. Mao, C. Ropelewski, J. Wang, A. Keetmaa, R. Reynolds, R. Jenne and D. Joseph. 1996. The NCEP/NCAR 40-Year Reanalysis Project. *Bulletin of the American Meteorological Society*, 77: 437-471.

Ulbrich, U., J.G. Pinto, H. Kupfer, G.C. Leckebusch, T. Spangehl and M. Reyers. 2008. Changing northern hemisphere storm tracks in an ensemble of IPCC climate change simulations. *Journal of Climate*, 21(8): 1669-1679.

Yin, J.H. 2005. A consistent poleward shift of the storm tracks in simulations of 21st century climate, Geophysical Research Letters, 32: L18701.

Page 4-264:
MSC50 is mistakenly used in the sentence citing Swail et al 1999. It should be AES40, the earlier hindcast.

Husky Response:
Comment noted. Thank you.

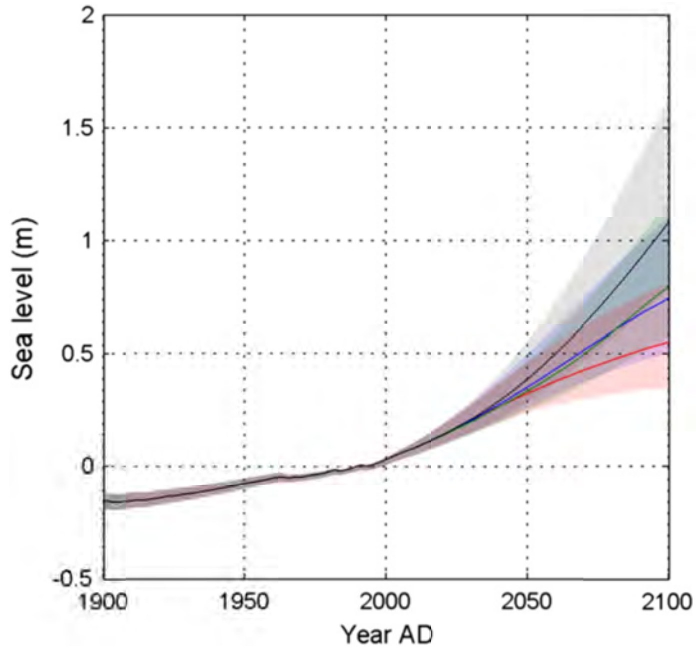
4.3.9.1 Sea Level Rise

The proponents cite the IPCC AR4 which gives projections of global sea level rise of 18-59 cm by 2100 across the range of scenarios and models (the proponents cite an increase of 22-44 cm for the A1B scenario). These estimates are derived from process-based models and exclude possible effects of accelerated ice sheet dynamics. More recent studies based on process-based models give an estimated rise of 20-80 cm by 2100 (e.g. Church et al., 2011). Semi-empirical models yield estimates in excess of 100 cm. As such, the proponents may want to consider a wider range of possible change than they have presented here and discuss local (as opposed to global) sea level changes.

Husky Response:
A study by Church et al. (2011) notes that the projected sea-level rise predicted by Solomon et al. (IPCC 2007) failed to take into consideration rapid dynamic ice sheet response since methods for quantifying it were unavailable at the time. Church et al. (2011) suggests an additional sea level rise of 10 to 20 cm or more, resulting in a range in global average projections of about 20 to 80 cm by 2100.

More recently, semi-empirical models have been used to model rapid dynamic ice sheet response. Since the IPCC Fourth Assessment Report new Representative Concentration Pathways (RCPs) scenarios have been developed. Jevrejeva et al. (2012) used a sea-level model forced with four new RCPs to project median global sea level rises of 0.57m for the lowest forcing and 1.10m for the highest forcing by 2100 (Figure 6). Unlike in the AR4, these projections include a contribution from changes in ice-sheet outflow.

Sea level changes are the result of local, hemispheric and global changes. Coastal areas respond differently and the change in sea level along different coasts is not identical, even along the coasts of Newfoundland. Little research has been done on the rate of sea-level change due to climate change on the Grand Banks and predictions of sea level changes along the coast of Newfoundland may not be representative of what will happen offshore. A study by Batterson (2010) shows projections of sea-level rise of 100+ mm by 2099 for the Avalon Peninsula of Newfoundland. This estimate was based on the IPCC A1F1 emissions scenario, which produces the greatest sea level rises of all the emissions scenarios. These estimates do not take into consideration rapid dynamic ice sheet response. A literature search for the Grand Banks and Newfoundland did not provide any estimates of sea-level rise using the Representative Concentration Pathways and therefore estimates based on the new emissions scenarios cannot be provided locally.



Source: Jevrejeva et al. 2012
Note: Shadows with similar colour around sea level projections represent the upper (95%) and lower (5%) confidence levels.

Figure 6 Sea Level Projections by 2100 with RCP Scenarios

References:

Batterson, M. and D. Liverman. 2010. Past and future sea-level change in Newfoundland and Labrador: Guidelines for policy and planning. Pp. 129-141. In: *Current Research. Newfoundland and Labrador Department of Natural Resources, Geological Survey*, Report 10-1.

Church, J.A., J.M. Gregory, N.J. White, S.M. Platten and J.X. Mitrovica. 2011. Understanding and projecting sea level change. *Oceanography*, 24(2): 130-143, doi:10.5670/oceanog.2011.33.

IPCC (Intergovernmental Panel on Climate Change). 2007. *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Jevrejeva, S., J.C. Moore and A. Grinstead. 2012. Sea level projections to AD2500 with a new generation of climate change scenarios. *Global and Planetary Change*, 80-81: 14-20. 10.1016/j.gloplacha.2011.09.006

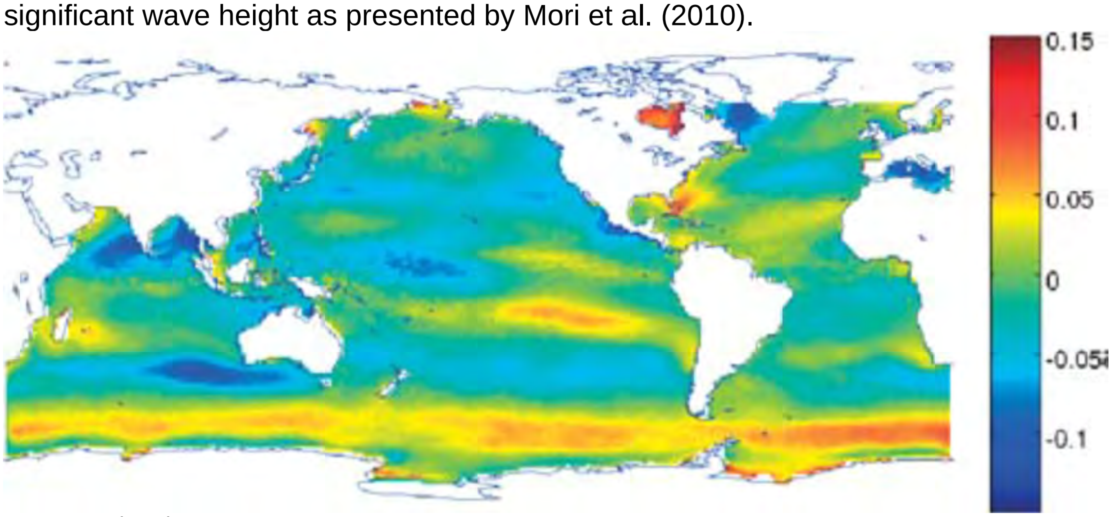
4.3.9.2 Waves

Projections of wind-driven ocean wave heights are not available from current global climate models. As such, future projections of wave height have been based on either: (1) dynamical models that use wind speed projections to drive wave models, or (2) statistical downscaling based on relationships with variables related to wave height (e.g., sea level pressure projections). Wave height projections are considered uncertain (see IPCC SREX) in part *because there are few studies but also because of limitations with GCM estimates of wind speed (used to drive wave models). The proponents rely on wind speed projections from a single scenario from a single climate model (CGCM2, B2) to make inferences about changes in wave height. This approach is inadequate to capture the range of uncertainty. They note increased wind speed is projected from this run. Recent studies project decreased wave height in this area (e.g., Hemer et al. 2012).*

Husky Response:

Projections of significant wave heights are not available from current global climate models. Therefore, two methods have primarily been used to project changes in mean significant wave height; dynamical models and statistical downscaling. Dynamical models use wind speed projections to drive wave models while statistical models develop statistical relationships between other variables (e.g., wind speed, mean sea level pressure) to generate empirical formulae. Both the dynamical model approach and the statistical model approach have their problems. Dynamical models show a bias with the corresponding current climate. Bias corrections are normally made to account for this however it is uncertain whether these corrections will be valid in future climates. Statistical models have the advantage of being less computationally intense than dynamical models however neglect factors such as wave dispersion, fetch and swell and therefore, have difficulty in reproducing the observed wave fields in areas dominated by swell (Hemer et al. 2012)

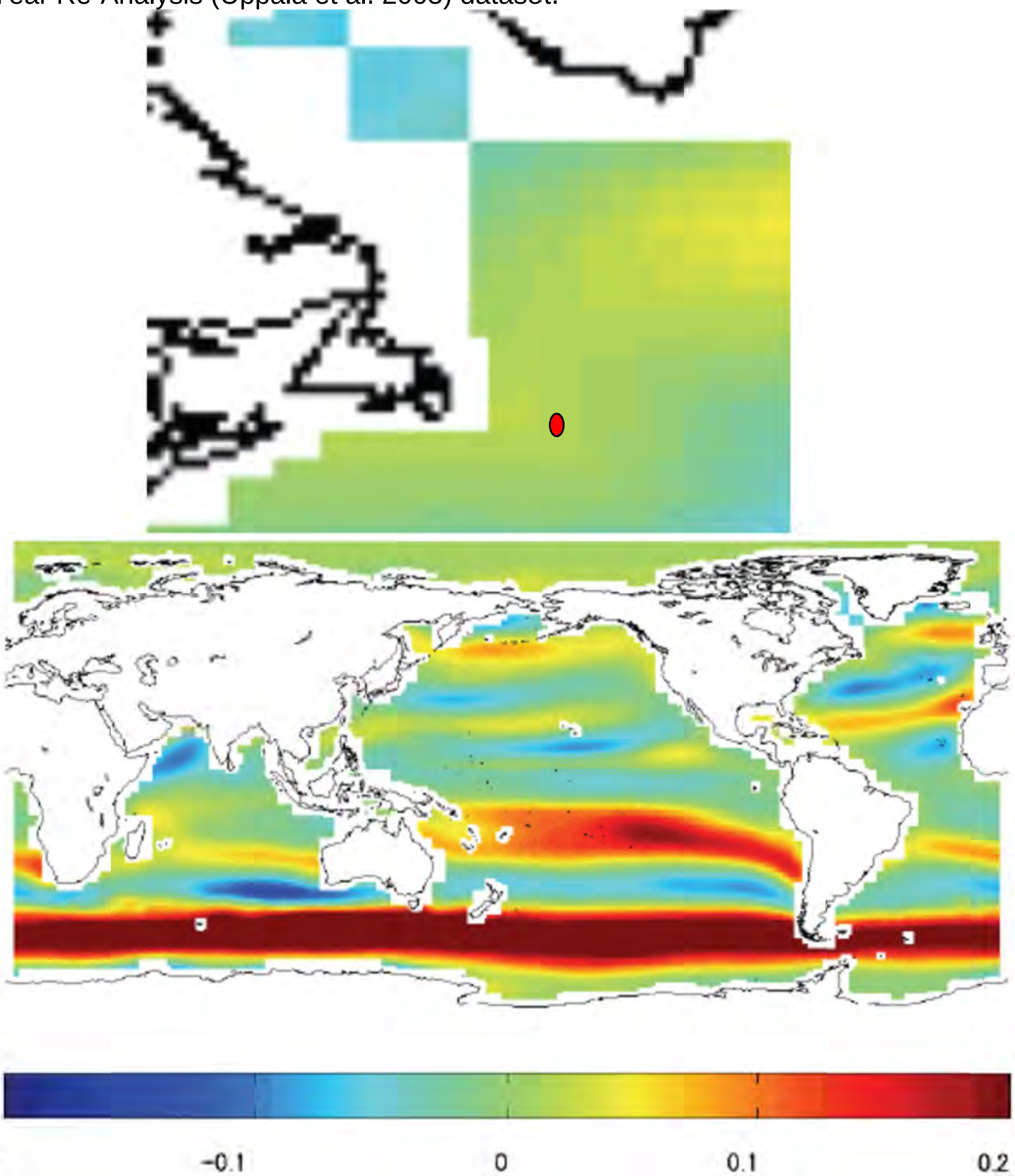
In a study by Mori et al. (2010), future climate predictions were produced using the MRI-JMA global climate model following the A1B scenario. The present climate is for the period of 1979 to 2005 and climate predictions were generated for the period of 2075 to 2100. The global wave climate was then simulated by the SWAN model using 10 m winds from the climate model. This study determined that in the North Atlantic Ocean between the latitude range of 30°N to 45°N there will be a decrease in mean significant wave height of approximately 7 percent, corresponding to a decrease of 0.15 m. An analysis of Figure 7 suggests a smaller decrease for the Grand Banks region of somewhere between 0.0 and 0.05 m. Figure 7 presents the global normalized difference between the future and present climate mean significant wave height as presented by Mori et al. (2010).



Source: Mori et al. 2010

Figure 7 Difference of Mean Significant Wave Height between Future (2075 to 2100) Minus Present (1979 to 2005) Climate Normalized by Present Climate

Additional work by Mori et al. (2012) using statistical analysis techniques projects a small increase in significant wave height for the 2070 to 2100 period (Figure 8 (top)). This study analyzed future change of ocean wave height using the CMIP3 ensemble with the SRES A1B forcing scenario. Wave heights were then statistically projected using an empirical formula based on wind speed and wave height from the ECMWF 40 Year Re-Analysis (Uppala et al. 2005) dataset.

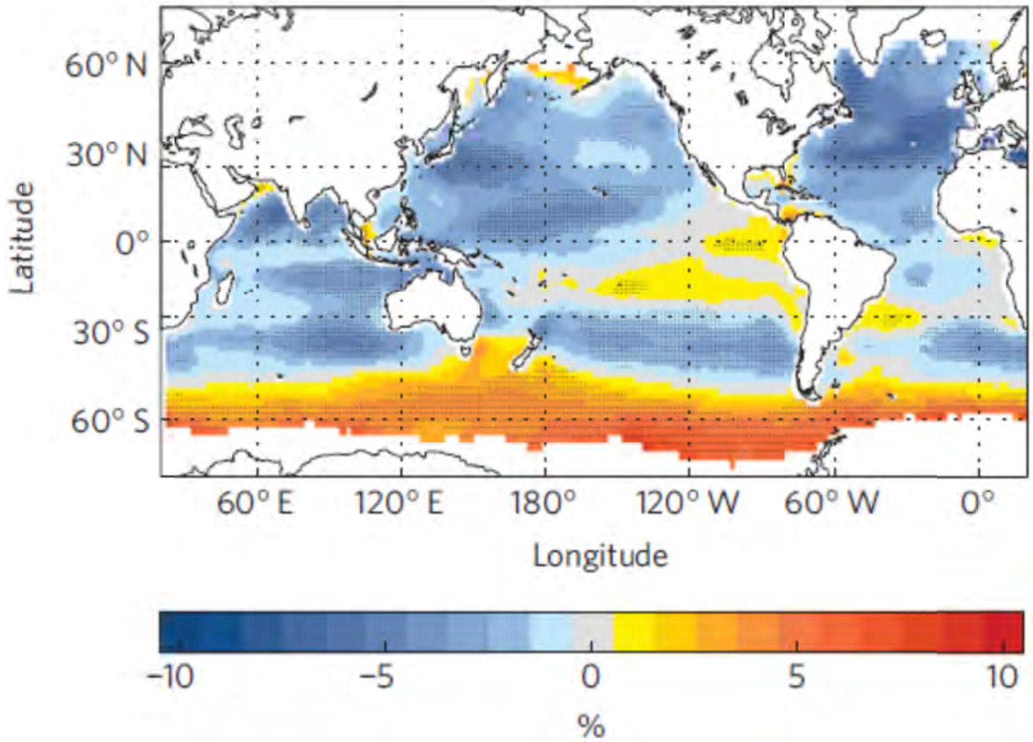


Source: Mori et al, 2012

Note: Red dot in top graphic depicts the approximate location of the White Rose field.

Figure 8 Future Change of Significant Wave Height at year 2100 using the SRES A1B scenario: top) Close-up of Offshore Newfoundland Region; and bottom) Global Projections

In 2013, Hemer et al. (2013) compared the results of five independent studies to determine the level of agreement between available wave climate projections. In their analysis, they found a decrease in annual mean significant wave height over 25.8 percent of the global ocean area and an annual mean significant wave height increase over 7.1 percent of the global ocean area. In the North Atlantic, Hemer et al. (2013) found an agreed decrease in mean significant wave height across all models and all seasons. An analysis of Figure 9 shows a decrease in mean significant wave height of approximately 5 to 6 percent for the Northern Grand Banks.



Source: Hemer et al. 2013

Figure 9 Projected Future Changes in Multi-model Averaged Annual Significant Wave Height for Future Climate (2070 to 2100) Relative to the Present Climate (1979 to 2009)

References

Hemer, M.A., X.L. Wang, R. Weisse and V.R. Swail. 2012. Advancing wind-waves climate science. *Bulletin of the American Meteorological Society*, 93: 791-796.

Hemer, M.A., Y. Fan, N. Mori, A. Semedo and X.L. Wang. 2013. Projected changes in wave climate from a multi-model ensemble. Nature Climate Change, doi:10.1038/nclimate1791

Mori N, T. Yasuda, H. Mase, T. Tom and Y. Oku. 2010. Projection of extreme wave climate change under global warming. *Hydrological Research Letters*, 4: 15-19

Mori, N., T. Shimura, S. Nakajo, T. Yasuda and H. Mase. 2012. Multi-model ensemble projection of future coastal climate change. *Coastal Engineering Proceedings*, 1(33), management.25.

S.M. Uppala, P.W. KÅllberg, A.J. Simmons, U. Andrae, V. Da Costa Bechtold, M. Fiorino, J.K. Gibson, J. Haseler, A. Hernandez, G.A. Kelly, X. Li, K. Onogi, S. Saarinen, N. Sokka, R.P. Allan, E. Andersson, K. Arpe, M.A. Balmaseda, A.C.M.

Beljaars, L. Van De Berg, J. Bidlot, N. Bormann, S. Caires, F. Chevallier, A. Dethof, M. Dragosavac, M. Fisher, M. Fuentes, S. Hagemann, E. Hólm, B.J. Hoskins, L. Isaksen, P.A.E. M. Janssen, R. Jenne, A.P. Mcnally, J.-F. Mahfouf, J.-J. Morcrette, N.A. Rayner, R.W. Saunders, P. Simon, A. Sterl, K.E. Trenberth, A. Untch, D. Vasiljevic, P. Viterbo, J. Woollen. 2005. The ERA-40 re-analysis. *Quarterly Journal of the Royal Meteorological Society*, 131(612): 2961-3012

4.3.9.3 Sea Surface Temperatures

It is not clear exactly which gridpoints the SST anomalies plotted in Figures 4-163 and 4-165 are from.

Husky Response:
SST anomalies were calculated from the ICOADS dataset as stated in Paragraph 1 of Section 4.3.9.3. The ICOADS region is defined in Section 4.3.1.1

Why are trends in SSTs only discussed over the period 1981-2010? Much longer records are available and would be more appropriate for trend analysis

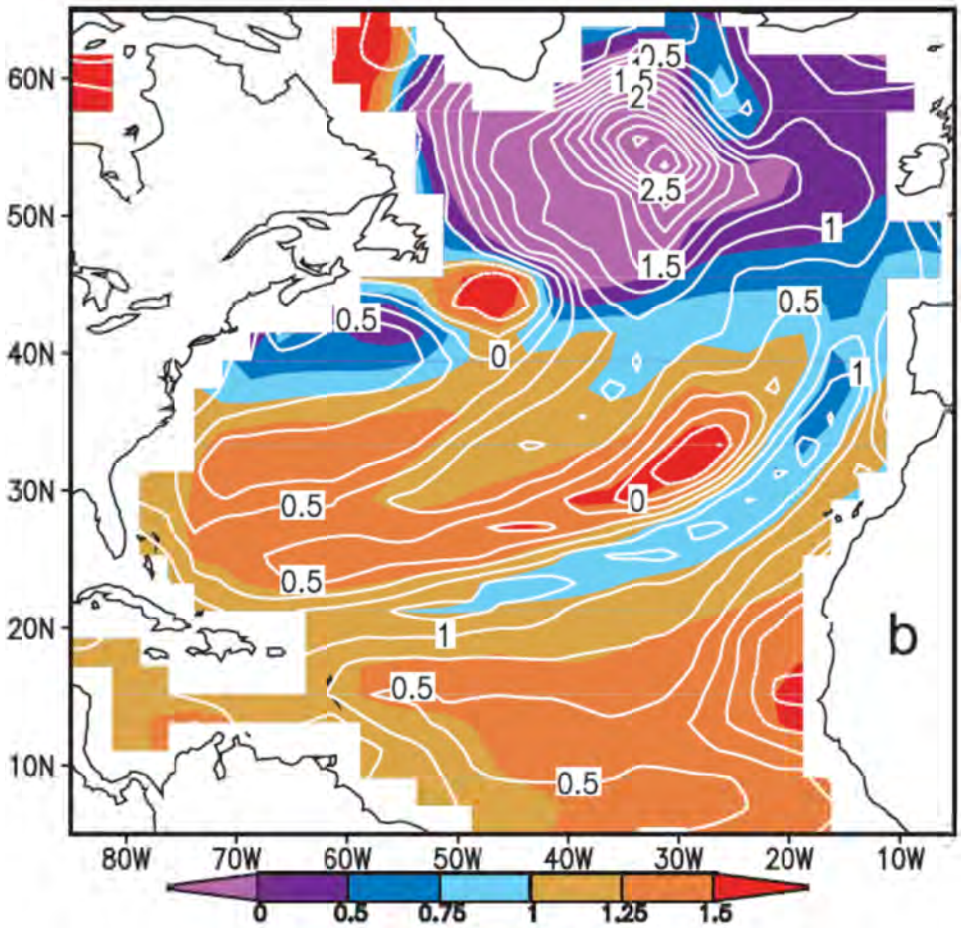
Husky Response:
A 30 year period was chosen in part because of the number of errors in the data prior to this period.

What are future SST projections for the region?

Husky Response:
Xie et al. (2009) investigated sea surface temperature changes based on ensemble simulations for the first half of the twenty-first century using the A1B emissions scenario with the Geophysical Fluid Dynamics Laboratory (GFDL) Climate Model, version 2.1 (CM2.1) and the National Center for Atmospheric Research (NCAR) Community Climate System Model, version 3 (CCSM3). As seen from Figure 10, the CM2.1 model predicts an annual mean sea surface temperature change of greater than 1.5°C for the White Rose area. The changes in the CM2.1 model were calculated by subtracting the 1996 to 2000 period from the 2046 to 2050 period.

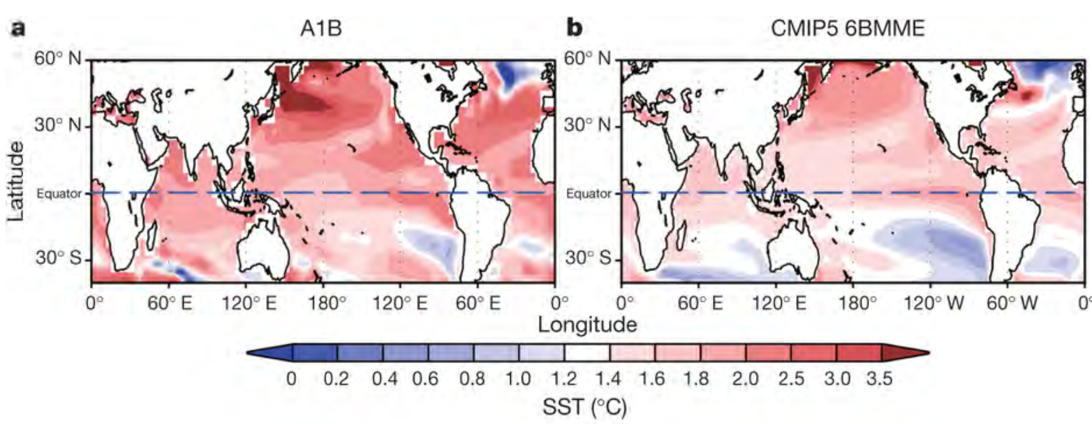
A similar warming increase of near 1.5°C was predicted by the CCSM3 for the White Rose area. The CCSM3 values were calculated by finding the difference between the 2001 to 2010 and 2051 to 2060 periods.

More recently Liu et al. (2013) used the ECHO-G climate model forced with the A1B scenario to produce global sea surface temperature estimates relative to the period of 1990 to 2019. These data were then compared with the Coupled Model Intercomparison Project Phase 5 (CMIP5) multi-model mean projection of the 6 best (6BMME) CMIP5 models forced according to the Representative Concentration Pathway 4.5. The CMIP5 model results are relative to the period of 1980 to 2005. Similar to the Xie et al. (2009) projections, the projections presented by Liu et al. (2013) indicate an increase in sea surface temperature for the White Rose area for the period of 2070 to 2099 (Figure 11).



Source: Xie et al. 2009

Figure 10 Annual Mean Changes in CM2.1 A1B: SST (colored, °C) and Surface RH (white, CI 0.25%)



Source: Liu et al. 2013

Figure 11 Comparison of the Changes in Annual Mean Sea Surface Temperature

References

Xie, S-P., C. Deser, G.A. Vecchi, J. Ma, H. Teng and A.T. Wittenberg. 2010. Global warming pattern formation: Sea surface temperature and rainfall. *Journal of Climate*, 23, 966-986. doi: http://dx.doi.org/10.1175/2009JCLI3329.1

Liu, Jian, B. Wang, M.A. Cane, S-Y. Yim and J-Y. Lee. 2013. Divergent global precipitation changes induced by natural versus anthropogenic forcing. *Nature*, 493.7434 (2013): 656-659. doi:10.1038/nature11784

1.4 Chapter 10 Marine Birds

General:
The species "Greater Shearwater" should be changed to updated common name of "Great Shearwater" throughout the text.

Husky Response:
Comment noted. Thank you.

10.3.1 Nearshore Overview
Quote: "It contains the largest Northern Gannet nesting colony (14,696 pairs (2011) (CWS unpublished data)), the largest Thick-billed Murre colony and third largest Common Murre colony (14,789 pairs (2009) (CWS unpublished data)) in Newfoundland and Labrador (Table 10-2)."

The largest Thick-billed Murre colonies are located in Labrador. The colony mentioned above is the largest colony on the Island of Newfoundland, but is also the most southerly colony of the Thick-billed Murre's breeding range.

Husky Response:
Comment noted. Thank you.

Quote: "The only sustained breeding site for Manx Shearwater in eastern North America is located at the Middle Lawn Islands, Burin Peninsula (Figure 10-1) (Roul 2011)."

It should be noted here that Middle Lawn Island, along with two adjacent islands, which are collectively known as the Lawn Islands Archipelago, are now established as a Provisional Ecological Reserve by the Government of Newfoundland and Labrador, Parks and Natural Areas Division.

Husky Response:
Comment noted. Thank you.

Figure 10-1 Locations of Seabird Nesting Colonies at Important Bird Areas in Relation to the Study Areas

The Cape Freels Important Bird Area (IBA) should highlight Cabot Island as an important nesting area for migratory birds. Cabot Island supports approximately 10,000 pairs of nesting Common Murre (Canadian Wildlife Service, unpublished data). Gull Island should be removed from the list of important bird areas. This information should be updated in this section and in subsequent maps.

Husky Response:
See Figure 12 (revised Figure 10-1).

Table 10-2 Numbers of Pairs of Marine Birds Nesting at Marine Bird Colonies in Eastern Newfoundland

Cabot Island should be added to this table.

Husky Response:
No revisions to Table 10-2 were necessary, as the table already included Cabot Island in the column: "Cape Freels and Cabot Island".

10.3.5 Marine Bird Nesting Colonies Along Southeastern Newfoundland

Quote: "More than 4.6 million pairs nest at these three locations alone (Table 10-2; Figure 10-1). This number includes the largest Atlantic Canada colonies of Leach's Storm-Petrel (3,336,000 pairs on Baccalieu Island), Black-legged Kittiwake (23,606 pairs on Witless Bay Islands), Thick-billed Murre (1,000 pairs at Cape St. Mary's) and Atlantic Puffin (272,729 pairs on Witless Bay Islands) (Cairns et al. 1989; Rodway et al. 2003; Robertson et al. 2004)."

It should be noted here that two of the three Northern Gannet colonies in the province of Newfoundland and Labrador are on the Avalon Peninsula.

Husky Response:
Comment noted. Thank you.

Quote: "The Offshore Study Area is well beyond the foraging range of breeding birds during the breeding season (approximately May to August)."

Murres will feed close to their breeding colonies when spawning inshore capelin are available (late June/early July), but prior to the capelin spawning period will feed further from the colonies. Gannets and storm-petrels are known to feed considerable distances away from the colonies and may forage within the offshore study area (as noted on page 10-28 of the EIS).

Husky Response:
Comment noted. Thank you.

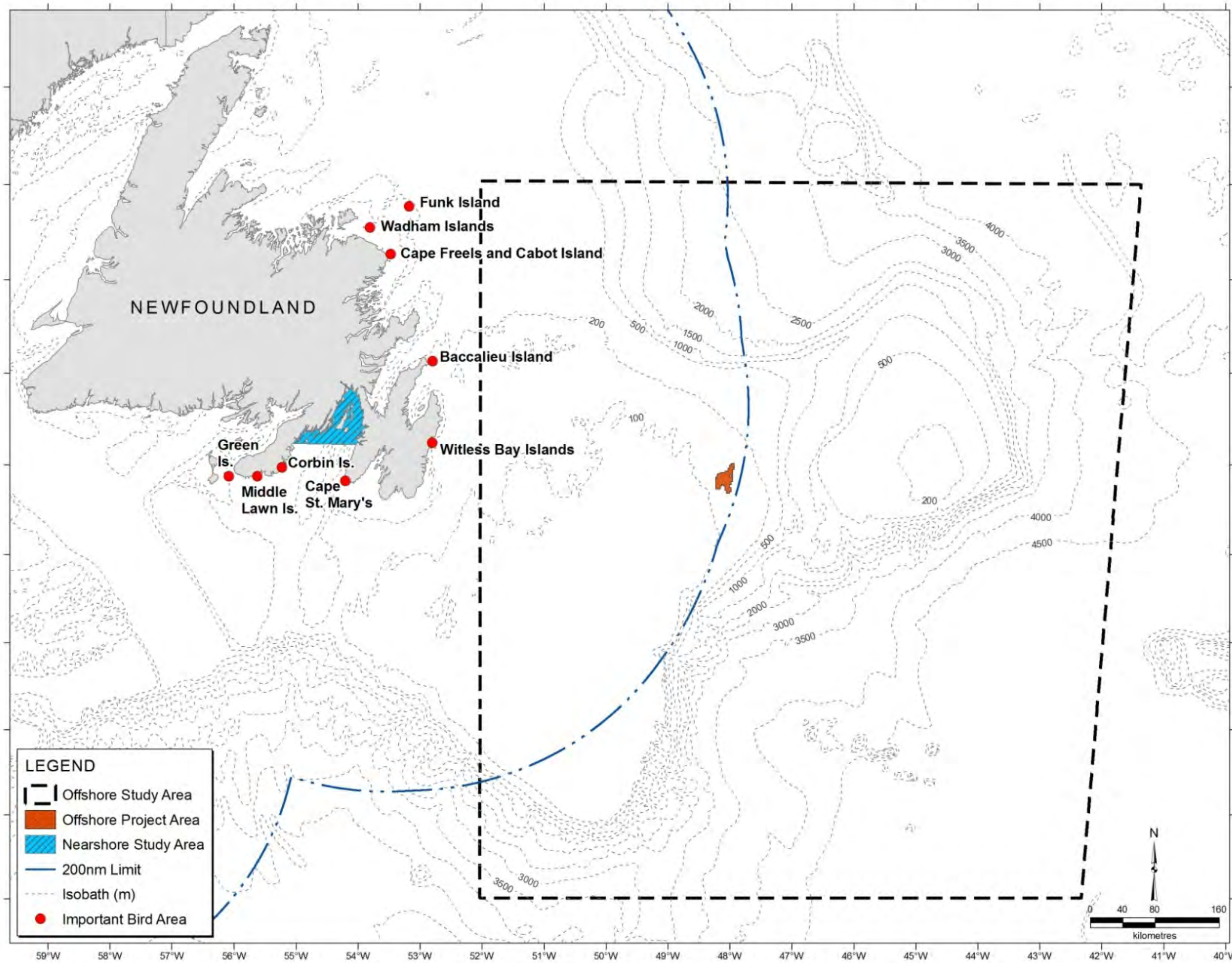


Figure 12 **Revised Figure 10-1 Locations of Seabird Nesting Colonies at Important Bird Areas in Relation to the Study Areas**

10.3.6.8 Alcidae (Atlantic Puffin)
Quote: "Grand Colombier in St. Pierre et Miquelon is the only breeding colony near Placentia Bay; approximately 400 pairs nest there."

The number of pairs breeding at the Grand Colombier colony should be updated to 9,543 pairs breeding pairs (Lormee et al. unpublished data).

Husky Response:
Comment noted. Thank you.

1.5 Chapter 13 Sensitive Areas

Figure 13-3 Ecological Reserves and Special Places Identified in Placentia Bay
The Lawn Islands Archipelago Provisional Ecological Reserve should be added to this section. The Lawn Islands Archipelago Provisional Ecological Reserve is also an Important Bird Area, and should be identified as such where Important Bird Areas are discussed.

Husky Response:
Comment Noted. Thank you. The figure is from DFO 2008 and cannot be revised. Note that the Lawn Islands Archipelago Provincial Ecological Reserve/IBA is outside the Nearshore Study Area.

Table 13-2 Number of Pairs of Marine Birds Characteristic of Placentia Bay Colonies
Columns should be added here regarding the Lawn Islands Archipelago IBA and the Corbin Island IBA.

Additionally, data for population numbers of Northern Gannet and Common Murre at the Cape St. Mary's IBA are incorrect. Numbers reported in Chapter 10 of this EIS should instead be used.

Husky Response:
Please see Table 5 (revised Table 13-2) with new text underlined. Note that the Lawn Islands Archipelago IBA and the Corbin Island IBA are outside the Nearshore Study Area.

Figure 13-4 Areas Identified as Important for Birds and Whales in Placentia Bay
The Lawn Islands Archipelago IBA and the Corbin Island IBA should be identified on this map.

Husky Response:
Comment Noted. Thank you. The figure is from DFO 2008 and cannot be revised. Note that the Lawn Islands Archipelago IBA and the Corbin Island IBA are outside the Nearshore Study Area.

Table 5 Revised Table 13-2 Number of Pairs of Marine Birds Characteristic of Placentia Bay Colonies

Common Name	Species Name	Cape St. Mary's	Middle Lawn Island (1985)	Corbin Island (1974)
Northern Fulmar	*Fulmarus glacialis*	12	--	--
Manx Shearwater	*Puffinus puffinus*	--	360	30
Leach's Storm-petrel	*Oceanodroma leucorhoa*	--	26,313	100,000
Northern Gannet	*Mora bassanus*	14,.696	--	--
Herring Gull	*Larus argentatus*	Present	--	5,000
Great Black-backed Gull	*Larus marinus*	Present	--	25
Black-legged Kittiwake	*Rissa tridactyla*	10,000	--	50
Common Murre	*Uria aalge*	14,789	--	--
Thick-billed Murre	*Uria lomvia*	1,000	--	--
Razorbill	*Alca torda*	100	--	--
Black Guillemot	*Cepphus grylle*	Present	--	--
Colonial Waterbirds/ Seabirds		--	26,327	105,107

Sources: Stenhouse and Montevecchi (1999), Cairns et al. (1989), and Chardine (2000) [adapted from VBNC 2008]; Middle Lawn Island IBA: http://www.bsc-eoc.org/iba/site.jsp?siteID=NF031; Corbin Island IBA: http://www.bsc-eoc.org/iba/site.jsp?siteID=NF030

13.3.1.5 Bird Habitat

The Lawn Islands Archipelago IBA and the Corbin Island IBA should be added to this list.

Husky Response:

Comment Noted. Thank you. Note that the Lawn Islands Archipelago IBA and the Corbin Island IBA are outside the Nearshore Study Area.

13.5.1 Effects Analysis and Mitigation – Nearshore

It should be noted that eelgrass beds are wetlands.

The proponent should be aware that as part of its commitment to wetlands conservation, the Federal Government has adopted The Federal Policy on Wetland Conservation (FPWC) with its objective to "promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future." In support of this objective, the Federal Government strives for the goal of No Net Loss of wetland function on federal lands or when federal funding is provided. EC-CWS therefore recommends that the goals of the policy be considered in wetland areas, and EC-CWS recommends that that the hierarchical sequence of mitigation alternatives (avoidance, minimization, and as a last resort, compensation) recommended in FPWC is followed. Avoidance refers to elimination of adverse effects on wetland functions, by altering the siting or modifying the design of a project, and is the preferred option. In the event that avoidance is not possible, the reasons why elimination of adverse effects on wetland functions were not possible should be clearly demonstrated in environmental assessment documents, and EC-CWS should be contacted for advice on next steps to follow for compliance with the FPWC.

A copy of the FPWC can be found at: http://dsp-psd.communication.gc.ca/Collection/CW66-116-1991E.pdf

Husky Response:
Husky is currently discussing the unavoidable loss of 692 m^2 of eelgrass habitat at water depths between 2.5 and 7.5 m with DFO to obtain a *Fisheries Act* Authorization for the harmful alteration, disruption or destruction of fish habitat (HADD). EC-CWS will be contacted for advice on next steps to follow for compliance with the FPWC.

13.5.2.1 Nearshore (Important Bird Areas)
The Lawn Islands Archipelago IBA and the Corbin Island IBA should be added to this list.

Husky Response:
Comment Noted. Thank you. Note that the Lawn Islands Archipelago IBA and the Corbin Island IBA are outside the Nearshore Study Area.

1.6 Chapter 14 Effects of the Environment on the White Rose Extension Project

14.4 Nearshore Potential Marine Effects
The text gives an estimate of an extreme storm surge of 0.8 m occurring at the time of a large high tide, based on a model that does not include wave run up or set up, or seiche effects. As noted on the comments in 4.2.2.5, EC recommends an extremal analysis of water levels of long term tide gauge at Argentia would give better results for this location.

Husky Response:
Please see 4.2.2.5 Tides, Storm Surges comment and response.

14.4.6 Sea Ice and Iceberg
Sentence 2:
Same comments as in Section 4.2.4.1
Two errors

- *The ice that enters the Bay in February is generally grey or greywhite ice (less than 30cm thick), and is not first-year ice (>30cm thick). First-year ice incursions into Placentia Bay only take place from March onwards.*
- *First-year ice is >30 cm thick. Contrary to indicated, it can be >120cm thick. First-year ice that is >120 cm is called "thick first-year" ice. Ice that is 30-70cm is thin first-year ice, and ice that is 70-120cm is medium first-year ice.*

Husky Response:
Comments noted. Thank you.

1.7 Chapter 16 Environmental Management

16.8 Emergency Response

As emergency response is covered in the Incident Coordination Plan (EC-M-99-X-PR-00003-001), which is a pre-existing plan for operations, EC is not providing comments. Likewise for the OSR Procedure – East Coast Oil Spill Response Plan (EC-M-99-X-PR-00125-001).

Husky Response:
Comments noted. Thank you.

16.11.2 Single vessel Side Sweep System

It would be beneficial to have a brief description on how equipment would be retrieved and cleaned, and how waste oil and sorbents would be handled

Husky Response:
The SVSS equipment is deployed and retrieved through strict adherence to the above mentioned procedures and work instructions. SVSS equipment retrieval will be limited to specified areas of the vessel that have been protected by plastic sheeting and sorbents. Equipment that comes in contact with any spilled oil will be cleaned in the field with sorbent materials upon recovery.

The equipment cleaning process requires arrangements for collecting all oil and cleaning fluids after use and will likely involve steam cleaning and/or pressure washing after gross oil removal. All liquid and solid waste collected through the oil response spill recovery process will be handled through a contracted and approved waste management company. Husky will work with its waste management contractor to determine the most appropriate waste disposal option. All waste management activities will be undertaken in accordance with provincial and federal legislation, where applicable.

16.13.3 Dispersants

It would be beneficial to indicate dispersant (Corexit 9500) availability, and whether quantities would meet the requirements at various levels of possible response.

Husky Response:
Husky is a member of Oil Spill Response Limited (OSRL). This international oil spill response cooperative specializes in providing global oil spill response services from their bases in Southampton, England, and Singapore. Through its agreement with OSRL, Husky has access to inventory maintained at OSRL facilities which currently consists a stockpile of approximately 670 m^3 of dispersant. This stockpile consists of various types of dispersant including Corexit, Finasol and Slickgone products.

In addition to the dispersant volumes available through the standard OSRL member agreement, additional volumes may be available through;

- Members of the Global response Network
- Dispersant manufacturer inventory

- The Global Dispersant Stockpile being compiled through OSRL which will consist of a standing inventory of 5,000 m^3.

The actual volume of dispersant required for a response would depend on a number of factors including, but not limited to;

- Type of spill (batch vs. continuous)
- Application method
- Environmental conditions (wind, sea state, visibility etc.)
- Approved dispersant application program.

16.14 Offshore Training – Spill Response Operations

It would be beneficial to indicate the types of exercises undertaken that would test crew and equipment under real conditions. Associated with these exercises could be the testing of communications and response management structures that combines the efforts of on-scene and on-shore emergency management. The communications hierarchy would also include communications to regulators and 24/7 pollution reporting (CCG-EC).

Husky Response:
Husky's east coast oil spill response program has been structured to support any of Husky's operations offshore Newfoundland. The program is comprehensive and consists of two components – operational response and response management.

Husky has established an operational response capability to respond to offshore oil spills. Equipment has been staged to allow prompt response to small spills with resources at site and an efficient response to larger spills using equipment stored at ECRC's facility in Mount Pearl. The response management process is described in the Incident Coordination Plan and is an integrated and coordinated approach to a spill incident that includes:

- Immediate reaction to the incident controlled by the Person In Charge in the Emergency Command Centre or bridge of the offshore facility;
- Prompt and direct support for the offshore emergency response by Husky's onshore Incident Command Centre (ICC);
- Escalation of the onshore response to include long term management of post-emergency clean-up activities through Husky's onshore ERT response management team;
- Activation of ECRC in all spill events requiring mobilization of Husky's ICC, and;
- Activation of Oil Spill Response (OSR).

On an annual basis Husky completes a number of activities related to spill response operations this include;

- Annual training for contracted Supply Vessel with training completed one per year with each crew (28 day on / 28 day off rotation) The training program includes training on:
  - o Sorbent side sweep system, tracker buoys, sampling equipment, oil observation, and bird recovery equipment

  - o Annual training for SVSS equipped Supply Vessel with training completed one per year with each crew (28 day on / 28 day off rotation)
- Train 10 ECRC responders per year to maintain a pool of 20 responders

In addition to training noted above Husky completes frequent emergency response exercises and is a participant in the Annual Oil on Water exercise, known locally as synergy. Synergy 2012 was hosted by Husky with support from ECRC. It was designed to demonstrate selected elements of the combined oil spill response capabilities currently available to operators on the east coast of Canada. Objectives of the exercise were to:

- Demonstrate the ability of the Grand Banks Operators to work cooperatively with vessel crews, industry, and their response organization in responding to an oil spill incident.
- Demonstrate the safe and effective activation, deployment and operation of the I-Sphere™ Oil spill tracking buoy system.
- Demonstrate the safe and effective deployment, operation and recovery of a sorbent boom side sweep system.
- Demonstrate the safe and effective deployment, operation, and recovery of a single vessel side sweep system using an exercise vessel.
- Demonstrate the safe and effective deployment, operation (simulated spill containment) and recovery of the NorLense 1200-R containment system.
- Demonstrate the safe and effective deployment, operation, and recovery of the TransRec 150 skimmer system in concert with the NorLense 1200-R containment system. This demonstration is to include collection of simulated product into vessel internal tanks.
- Demonstrate the ability to offload simulated product from primary vessel tank to secondary storage.

In addition to the on water exercise activities noted above Husky holds emergency response exercises with the following objectives to;

- Provide an opportunity for Husky Emergency Response Team personnel to practice their Emergency response roles
- Raise the general level of awareness of Husky's Atlantic Region oil spill response program
- Provide the Husky onshore ERT and the crew of the *SeaRose FPSO* with hands-on experience in oil spill response operations and management
- Confirm the role of ECRC as Husky's principal oil spill response contractor in offshore spill response operations and onshore spill management activities
- Confirm the role of Oil Spill Response Limited (OSRL) as a contractor that can provide specialized services in a major oil spill incident
- Confirm communications links between offshore vessels, the SeaRose, a standby vessel, the Husky ERT and the ECRC Spill Management Team (SMT).

16.17.3 Physical Management

Quote (Page 16-30): "The effectiveness of operational iceberg towing conducted during the 1980s has been studied (Bishop 1989). The conclusions were that, of 354 iceberg towing operations considered, 277 were successful with no difficulties, 74 were successful but required several attempts and 49 were unsuccessful. This translates into an effectiveness of 86 percent. Recently, much has been made of the criteria used in this study to define successful tows. However, since in most cases it is unknown what the free-drifting track would have been if the iceberg were not towed, tow success can only be evaluated on one simple criterion: did the offshore facility have to move? If not, the tow was successful".

Since the WHP is not mobile, how would this affect the required design of the CGS?

Husky Response:
Whereas the Wellhead Platform (WHP) is not mobile, Husky will put sufficient measures into practice based on the predictability of iceberg encounters, forecasts for abnormal events to occur, and time required for implementation of a predefined emergency response plan. The emergency response plan will ensure life safety of personnel through evacuation and limit the risk to the environment by providing sufficient time to depressurize and shut in the production system.

WHP is being designed in compliance with the *Atlantic Accord Implementation Acts* and the Certificate of Fitness Regulations. Transport Canada Marine Safety's assistance will be sought as required for marine matters.

WHP must have a valid Certificate of Fitness issued by Det Norske Veritas (DNV), a recognized Certifying Authority, before it is used to conduct any activity in the offshore area. DNV will provide an independent third party assurance and verification that the installation, during the term of the Certificate of Fitness, is fit for purpose, functions as intended, and remains in compliance with the regulations.

1.8 Oil Spill Fate and Behaviour Modelling Supporting Document

See Attached Document
Review of Husky Energy Proposal for The White Rose Extension Project Oil Spill Aspects, Merv Fingas Spill Science Edmonton, Alberta (For Environment Canada (February 2013)).

Husky Response.
Thank you for this in-depth review and comments.

2.0 Department of National Defence

The Department of National Defence is likely to be operating in the vicinity of the study area in a non-interference manner during the project timeframe. A search of the unexploded ordinates (UXO) records was conducte3d and those records indicate that there are two wrecks within the study area. There are two sunken U-Boats dating from 1942. The approximate locations of the U-Boats are 47.78N, 49.83E and 50.00N, 46.53E. Due to the limits of technology at the time of the sinking, the location information is considered inaccurate.

Given DND's understanding of the survey activities to be conducted, the associated UXO risk is assessed as negligible. Nonetheless, due to the inherent dangers associated with UXO and the fact that the Atlantic Ocean was exposed to many naval engagements during WWII, should any suspected UXO be encountered during the course of the proponent's operations it should not be disturbed/manipulated. The proponent should mark the location and immediately inform the Coast Guard. Additional information is available in the 2012 Annual Edition - Notices to Mariners. Section F, No.37. In the event of activities which may have contact with the seabed (such as drilling or mooring), it is strongly advised that operational aids, such as remote operated vehicles, be used to conduct seabed surveys in order to prevent unintentional contact with harmful UXO items that may have gone unreported or undetected. General information regarding UXO is available at our website at www.uxocanada.forces.gc.ca.

Husky Response:
Comment noted. Thank you. Husky will conduct seabed surveys prior to activities that require contact with the seabed.

3.0 Natural Resources Canada

Coastal and Marine Geology:
NRCan's Conclusions:

The proponent has properly referenced and described both nearshore and offshore Grand Bank geology (surface and shallow subsurface). The Final design criteria for the potential gravity-based structure will be based on a detailed geotechnical investigation and proper engineering design and installation details are not provided in the EA document. NRCan does not have expertise to advise on those aspects.

NRCan has not identified any issues or information gaps on aspects related to coastal and marine geology.

Husky Response:
Comment noted. Thank you.

Seismicity:
NRCan's Conclusion:
Based on NRCan's review of section 4.3.8, the seismicity and seismic hazard review analysis is reasonably comprehensive. The proposed 1/2500 year hazard values appear to be considerably higher than previous industry assessments and, if they are used in the design process, should be adequate.

Husky Response:
Comment noted. Thank you.

Using the average of the values from Model A and B is a little un-conservative relative to using a model that gives each a 50% weight. NRCan confirms that the estimated "GSC model" entries in Table 4-83 are approximately the same as when NRCan's Geological Survey of Canada (GSC) runs its NBCC2005 model for the White Rose site. The GSC values are median values, but it is uncertain whether the URS seismic hazard values in Table 4-83 of the EA document are mean or median values and should be clarified before they are used in design. The GSC is currently working on a revised model for NBCC2015 that gives lesser weight to "Model 2". Indications are that the mean hazard that the full model gives at the White Rose site will not exceed the "URS" values in Table 4-83. Note that the NBCC seismic source models are national in scope and of necessity very general for specific locations, so the values from the model are only suitable for screening purposes. Site-specific studies are recommended where safety or cost implications justify them.

NRCan Recommendation:
The proponent should clarify whether the URS seismic hazard values in Table 4-83 (chapter 4) are mean or median values before they are used in design.

Husky Response:
The limitations of the NBCC seismic source models are appreciated and site-specific studies have been conducted for facility design.

4.0 Transport Canada

Specific Comment / Request for Additional Information:
The Proponent is advised to assess all proposed works, including dredging operations, against the Minor Works and Waters Order.

The Proponent is advised to submit a completed 'Request for Work Approval' for all works and activities that do not meet the criteria outlined in the Minor Works and Waters Orders. Completed requests can be submitted to:

Navigable Waters Protection Program
Transport Canada – Marine Safety
PO Box 1013
Dartmouth, NS B2Y 4K2
P: (902) 426-2726
F: (902) 426-7585
E: nwpdar@tc.gc.ca

The Minor Works and Waters Order, 'Request for Work Approval' application, and other relevant information are available from the following website:

http://www.tc.gc.ca/eng/marinesafety/oep-nwpp-menu-1978.htm

Husky Response:
Husky will assess all proposed works, including dredging operations, against the Minor Works and Waters Order and submit a completed 'Request for Work Approval' for all works and activities that do not meet the criteria outlined in the Minor Works and Waters Orders

Specific Comment / Request for Additional Information:
In addition to the applicable regulations under the Canada Shipping Act, all international project vessels must apply for a Coasting Trade Permit issued under the Coasting Trade Act. This means that the vessel would comply with all applicable regulations under International Maritime Organization (IMO) Conventions, including but not limited to;
- International Convention for the Safety of Life at Sea (SOLAS)
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW)
- International Convention on Load Lines (LL)
- International Convention on Tonnage Measurement of Ships (TONNAGE)
- International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS)
- International Convention on Civil Liability Damage for Oil Pollution Damage (CLC).

Husky Response:
Comment noted. Thank you.

The Coasting Trade Permit is actually issued by Canadian Customs in consultation with Canadian Transportation Agency and Transport Canada.
Page 17-15 of the EA Report states that project-related vessels will use designated routes during construction activities to help mitigate interactions with project vessels and other vessels. Transport Canada – Marine Safety would like an opportunity to review the proposed designated routes. Plans on the designated routes can be forwarded to:

Compliance and Enforcement
Transport Canada – Marine Safety
John Cabot Building, 10 Barter's Hill
PO Box 1300
St. John's, NL A1C 6H8
Tel: (709) 772-5167

Husky Response:
With the exception of vessel traffic to and from the deep-water mating site, Husky will use existing navigation channels for regular traffic. Husky will communicate proposed traffic route for vessels to and from the deep-water mating site once selected.

Section 15.2.1 *- The Proponent is advised that Transport Canada may conduct compliance monitoring in relation to conditions listed on any Part 1, Section 5 Approval issued under the Navigable Waters Protection Act. The potential environmental effects associated with any NWPA approvals may also be evaluated by Transport Canada.*

Husky Response:
Comment noted. Thank you.

Page 2-22 of the EA Report *- The Proponent is advised to communicate the final design of the graving dock to Transport Canada should the graving dock remain flooded and accessible to the navigating public once construction activities are complete.*

Husky Response:
Comment noted. Thank you.

5.0 Canada-Newfoundland and Labrador Offshore Petroleum Board

5.1 Executive Summary

Page v of xxix - says "*Husky has an Environmental Protection and Compliance Monitoring Plan for its existing activities in the White Rose field. The Environmental Protection and Compliance Monitoring Plan will be modified to include the offshore activities associated with the WREP...*"

- *The WHP, if the option selected, will require an installation specific EPP.*

Husky Response:
Comment noted. Thank you.

Page v of xxix – says "*On June 19, 2012, the Newfoundland and Labrador Department of Environment and Conservation (NLDEC) advised Husky of its determination that the WREP is an undertaking requiring environmental review pursuant to the Environmental Protection Act and that registration was therefore required. Husky formally submitted the Registration to the Province of Newfoundland and Labrador on August 3, 2012.*"

- *[only] the construction site for the WHP is a provincial undertaking ?*

Husky Response:
Correct. Only the construction site (and deep-water mating site) for the WHP is a provincial undertaking

Page vi of xxix** – the subsection **Assessment Scope and Approach

- *needs more clarity around the geographic and temporal scope of the assessment*

Husky Response:
In accordance with the Scoping Document, the following spatial boundaries have been used in this environmental assessment for nearshore and offshore WREP activities:

- Project Area is defined as the area within which WREP activities will occur;
- Affected Area is defined as the area which could potentially be affected by WREP works or activities within or beyond the Project Area;
- Study Area has been defined by modelling WREP-environment interactions, such as accidental events, and considers all WREP-environment interactions. This is the area within which significance will be determined and it represents a compilation of the various Affected Areas for all WREP works, activities and accidental events.

The WREP schedule has been revised since the environmental assessment was prepared. The changes to the schedule do not affect the environmental assessment significance predictions nor the mitigations planned for the WREP. The following summary is the current schedule for nearshore and offshore activities:

- Nearshore (applies to Wellhead Platform option only) - In the case of the WHP development option, site preparation, graving dock construction, construction of CGS, dredging, topsides mating and tow out will occur over an estimated maximum 45 months from 2013 to 2017. Various activities will occur at all times of year until completion. In the case of the subsea drill centre development option, no nearshore activities will occur.

- Offshore - In the case of the WHP development option, site preparation, installation of the WHP and initial production/maintenance will occur in 2017. The WHP will be decommissioned and abandoned in accordance with standard practices at the end of its production life, which is anticipated to be 25 years. The subsea drill centre option is scheduled to begin construction in 2014, with first oil expected in 2016. Under this option, the wells will be plugged and abandoned at the end of its production life (anticipated to be 20 years), and the subsea infrastructure removed or abandoned in accordance with relevant regulations.

***Page vi of xxix** – says "This environmental assessment meets these requirements, as well as the requirements of the C-NLOPB Development Plan Guidelines (C-NLOPB 2006)."*

- *It would be more appropriate to preface the word "meets" with the words "is intended to"*

Husky Response:
Comment noted. Thank you.

***Page x of xxix** – says "The environmental effects of hydrocarbon spills could be significant if spills are large and persistent enough to affect more than one generation."*

- *Is this intended to mean that the on-water slick or shoreline fouling would persist for longer than one generation [which I read as one year but which could be longer], or that the population effect from a large and persistent spill will endure for longer than one generation. Some improvement in sentence construction would be appropriate here.*

Husky Response:
The sentence is revised to read:

The environmental effects of hydrocarbon spills could be significant if spills are large and persistent enough to cause population effects that endure for more than one generation (see Section 10.2 - Determination of Significance).

***Page xi of xxix** – the sections after the header **Species at Risk** should be designated as **SAR Marine Fish, SAR Marine Mammals and Sea Turtles, and SAR Birds** since there is no other way to distinguish between these headers and the same headings for non-SAR fauna on preceding pages.*

Husky Response:
Comment noted. Thank you.

Page xiv of xxix – says "*WREP design and planning will benefit from the years of physical data collection in the White Rose field. The WREP design and operations planning incorporates metocean criteria for specific nearshore and offshore conditions. Physical metocean data collection will continue during the WREP*."

- *Check against development plan for inclusion of modern metocean data.*

Husky Response:
Both the WREP Environmental Assessment and the WREP Development Plan Amendment present metocean data provided by Oceans Ltd. in 2011. This is the most up to date metocean data available.

Reference:
Oceans Ltd. 2011. *Summary of White Rose Physical Environmental Data for Production System*. Prepared for Husky Energy, St. John's, NL.

5.2 Chapter 1 Introduction

Page 1-9 - says "*This environmental assessment meets these requirements, as well as the requirements of the C-NLOPB Development Plan Guidelines (C-NLOPB 2006).*"

- *Replace "meets" with "is intended to meet".*

Husky Response:
Comment noted. Thank you.

Page 1-10, Section 1.5.1

- *Need temporal scope*

Husky Response:
The WREP schedule has been revised since the environmental assessment was prepared. The changes to the schedule do not affect the environmental assessment significance predictions nor the mitigations planned for the project. The current schedule for nearshore activities can be summarized as site preparation, graving dock construction, construction of CGS, dredging, topsides mating and tow out will occur over an estimated maximum 45 months from 2013 to 2017. Various activities will occur at all times of year until completion.

Page 1-11, Section 1.5.2

- *Need temporal scope*

Husky Response:
The WREP schedule has been revised since the environmental assessment was prepared. The changes to the schedule do not affect the environmental assessment significance predictions nor the mitigations planned for the project. In the case of the WHP development option, site preparation, installation of the WHP and initial production/maintenance will occur in 2017. The WHP will be decommissioned and abandoned in accordance with standard practices at the end of its production life, which is anticipated to be 25 years. The subsea drill centre option is scheduled to begin construction in 2014, with first oil expected in 2016. Under this option, the wells will be plugged and abandoned at the end of its production life (anticipated to be 20 years), and the subsea infrastructure removed or abandoned in accordance with relevant regulations.

5.3 Chapter 2 Project Description

Page 2-7 says "*AMA would also have to take ownership of the material post-excavation, as material handling is not part of Husky's business*." But page 2-9 says "*In an effort to minimize the environmental footprint and disturbance to all stakeholders as much as possible, Husky has committed to ensuring proper disposal and use of the excavated and dredged material within the Argentia Peninsula. Husky has assumed environmental responsibility for the material from the AMA, and will test and treat the material as required, for the designated use.*"

- *Are these statements coherent? If not, make them coherent.*

  Husky Response:
  These statements are referring to different disposal options. If the material was to be stored on the Argentia Peninsula for a future use that was not associated with the WREP, a third party would have to assume ownership of the material. Husky has assumed environmental responsibility for the material within the Husky lease area that is intended to be disposed of in The Pond.

Page 2-9, Table 2-4*: WHP Life of Field/Structure is up to 25 Years and Subsea Drill centre productive life is up to 20 years.*

- *Is this consistent with the original White Rose Environmental Assessment? Is it the proponent's intent to revise the project temporal scope?*

  Husky Response:
  The original White Rose Environmental Assessment (Husky Energy 2001) contemplated 3 to 4 subsea drill centres being constructed within the White Rose field. Three drill centres (Centre, Southern and Northern), were constructed prior to an assessment of five additional drill centres in the Husky White Rose Development Project: New Drill Centre Construction and Operations Program Environmental Assessment - EA Addendum (LGL 2007). To date, only the North Amethyst and South White Rose Extension drill centres have been constructed of the five assessed during the period from 2007 to 2015.

  The current WREP Environmental Assessment re-assessed the effects of construction and operation of up to three drill centres during the life of the project. The productive life of the subsea infrastructure is estimated at 20 years, the productive life of the WHP is estimated at 25 years. The potential environmental effects of the operation of the *SeaRose FPSO* have not been assessed past 2020, the original projected life of the White Rose field.

  Husky Energy will complete environmental assessments as required to review potential effects and mitigation opportunities prior to the expiry of current approvals.

Page 2-10, Table 2-4*: Well Treatment fluids attribute is described as "≤ 30 mg/L…"*

- *Insert OIW before ≤ 30 mg/L*

  Husky Response:
  Comment noted. Thank you.

Page 2-11, Section 2.4.2 *lists "Seawater systems including cooling water and firewater" and Table 2-4 shows "No discharge limit" for "Fire Control Systems Test Water."*

- *The SeaRose FPSO has [in the past] required continuous discharge from the firewater ringmain to prevent freezing and that this water is expected to meet discharge limits for chlorine concentration. This potential discharge should be considered for the WHP as well.*

Husky Response:
Comment noted. Thank you.

Page 2-11 and elsewhere *– references to OWTG*

- *References to the OWTG (National Energy Board et al. 2010) should include the phrase "as amended."*

Husky Response:
Comment noted. Thank you.

Page 2-11 and 2-12 – Discussion of water based mud and cuttings

- *This discussion of WBM and Table 2-5 should be moved to a separate section for discussion of mud and cuttings since it is not a discussion of wellhead platform systems and the associated systems are already listed in the preceding list.*

Husky Response:
Comment noted. Thank you.

Page 2-12 – Discussion of Subsea Drill Centre

- *The MODU and its subsystems have been omitted and should be included here*

Husky Response:
Comment noted. Thank you.

Page 2-13 – Discussion of WBM and SBM cuttings

- *This discussion of WBM and SBM cuttings and Table 2-6 should be moved to a separate section for discussion of mud and cuttings since it is not a discussion of subsea drill centre equipment.*

Husky Response:
Comment noted. Thank you.

Page 2-13 Section 2.5

- *The phrase "life of the White Rose field" should be clarified with respect to assessed temporal scope.*

Husky Response:
The original White Rose Environmental Assessment (Husky Energy 2001) contemplated three to four subsea drill centres being constructed within the White Rose field. Three drill centres (Centre, Southern and Northern), were constructed

prior to an assessment of five additional drill centres in the Husky White Rose Development Project: New Drill Centre Construction and Operations Program Environmental Assessment - EA Addendum (LGL 2007). To date, only the North Amethyst and South White Rose Extension drill centres have been constructed of the five assessed during the period from 2007 to 2015.

The current WREP Environmental Assessment re-assessed the effects of construction and operation of up to three drill centres during the life of the project. The productive life of the subsea infrastructure is estimated at 20 years, the productive life of the WHP is estimated at 25 years. The potential environmental effects of the operation of the *SeaRose FPSO* have not been assessed past 2020, the original projected life of the White Rose field.

Husky Energy will complete environmental assessments as required to review potential effects and mitigation opportunities prior to the expiry of current approvals.

Page 2-16

- *What is meant by the term "industrial-sized road"?*

Husky Response:
The term 'industrial sized road' was stated in error. Route NL S 100 is a regional road that varies in provincial Highway Classification from RLU 100 to RLU 60 in areas where the road passes through communities along the way.

***Page 2-20 On-Land Construction Section 2.6.2** – does the emergency generator have a capacity of 750 kilowatts per hour as well? If not, then what is the hourly kilowatt number? Kilowatts per hour is the much more common and useful value.*

Husky Response:
Yes, when the generator is operated at its rated full real power capacity for 1 hour it will deliver 750 kilowatt hours of energy. When continuing to supply the same load for 10 hours it will have delivered 7,500 kilowatt hours of energy. Electrical generators designed for industrial applications will have the following three parameters on its nameplate and specification sheet.

- Watts
- Volt x Amperes
- Power Factor

***Page 2-23, Section 2.6.3.2** says "As part of PWGSC's site-wide environmental site assessments (ESAs) completed in 1993/1994 and 1995, 64 test pits, 62 monitor wells, and 15 boreholes with related soil and groundwater sampling were completed at the NFSA site, with the primary emphasis on petroleum hydrocarbon contamination in the area of petroleum hydrocarbon product tank storage, located immediately east of the current site (Figure 2-7)" and Page 2-24, Figure 2.7:*

- *Are the test pits, boreholes and wells referred to above shown on figure 2-7 since this drawing is titled "Casting Basin Geotechnical Borehole Location Plan" and the notes are somewhat cryptic. Are the existing boreholes locations completed as wells or filled and abandoned? Are the test pits in place or filled and abandoned? Are the proposed* *observation wells to be installed by Husky or were these proposed and installed some time ago by PWGSC. Please provide additional clarity in relation to figure 2-7.*

Husky Response:
The test pits, boreholes and wells referred to in Section 2.6.3.2 are not shown in Figure 2-7.

A summary of the historical environmental site assessment information acquired in close proximity to the Graving Dock site is illustrated in the 2011 NFSA (Northside Fuel Storage Area) Closure Report by Dillon Consulting Ltd.
Existing boreholes have been abandoned. Existing boreholes located inside the area of construction will be removed during excavation of the graving dock.

Existing Test Pits have been filled and abandoned.

Proposed observation wells have been installed by Husky as a component of the planned hydrogeological site investigation. Observation wells will be removed during excavation of the graving dock.

- *If figure 2.7 is to be used for reference then the quality of the figure needs improvement*

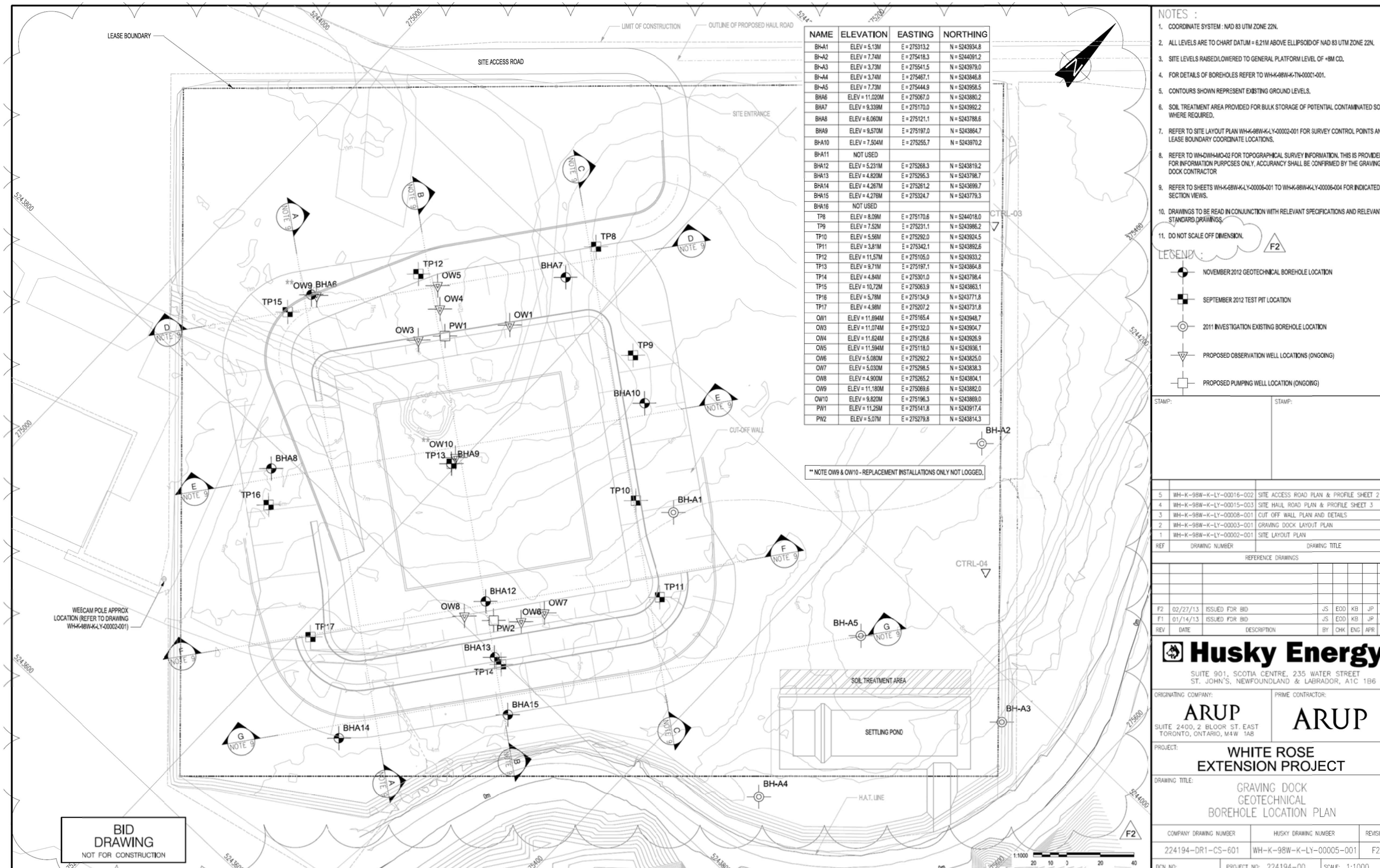
Husky Response:
See Figure 13 (revised Figure 2-7 (Drawing # WH-K-98W-K-LY-00005-001).

Page 2-45, Section Wellhead Platform – *Flowlines are discussed in Section 2.8.2 Subsea Drill Centre but not here. Are they proposed for the Wellhead Platform? If so, details with regard to installation (e.g. buried, rock covered) should be provided*

Husky Response:
Comment noted. The text from Section 2.8.2 regarding flowlines would also apply to the WHP option. Specifically, "*Flowlines will be laid directly on the seafloor, similar to installation methods used for flowlines currently in the White Rose field. The need for additional flowline tie-in modules and associated valves will be evaluated during engineering. Flowline tie-in modules will sit on the seafloor and range between an estimated 20 and 40 m^2. Dropped object protection on the flowline near the subsea drill centres is also being evaluated and maybe composed of rock berms, as for SCD and NADC, or concrete mats or sleeves.*"

Page 2-46 Section 2.8.2 Subsea Drill Centre – *The particulars of the drill centres should be compared to the previously assessed drill centres, such as size, depth, amount of seabed sediment to be removed per drill centre, etc. If different then it must be addressed.*

Husky Response:
The size of subsea drill centres associated with the WREP are not anticipated to be different than the drill centres previously constructed in the White Rose field.



NAME	ELEVATION	EASTING	NORTHING
BH-A1	ELEV = 5.13M	E = 275313.2	N = 5243934.8
BH-A2	ELEV = 7.74M	E = 275418.3	N = 5244091.2
BH-A3	ELEV = 3.73M	E = 275541.5	N = 5243979.0
BH-A4	ELEV = 3.74M	E = 275467.1	N = 5243846.8
BH-A5	ELEV = 7.73M	E = 275444.9	N = 5243958.5
BHA6	ELEV = 11.020M	E = 275067.0	N = 5243880.2
BHA7	ELEV = 9.339M	E = 275170.0	N = 5243992.2
BHA8	ELEV = 6.060M	E = 275121.1	N = 5243788.6
BHA9	ELEV = 9.570M	E = 275197.0	N = 5243864.7
BHA10	ELEV = 7.504M	E = 275255.7	N = 5243970.2
BHA11	NOT USED		
BHA12	ELEV = 5.231M	E = 275268.3	N = 5243819.2
BHA13	ELEV = 4.820M	E = 275295.3	N = 5243798.7
BHA14	ELEV = 4.267M	E = 275261.2	N = 5243699.7
BHA15	ELEV = 4.276M	E = 275324.7	N = 5243779.3
BHA16	NOT USED		
TP8	ELEV = 8.09M	E = 275170.6	N = 5244018.0
TP9	ELEV = 7.52M	E = 275231.1	N = 5243986.2
TP10	ELEV = 5.56M	E = 275292.0	N = 5243924.5
TP11	ELEV = 3.81M	E = 275342.1	N = 5243892.6
TP12	ELEV = 11.57M	E = 275105.0	N = 5243933.2
TP13	ELEV = 9.71M	E = 275197.1	N = 5243864.8
TP14	ELEV = 4.84M	E = 275301.0	N = 5243798.4
TP15	ELEV = 10.72M	E = 275063.9	N = 5243863.1
TP16	ELEV = 5.78M	E = 275134.9	N = 5243771.8
TP17	ELEV = 4.98M	E = 275207.2	N = 5243731.8
OW1	ELEV = 11.694M	E = 275165.4	N = 5243948.7
OW3	ELEV = 11.074M	E = 275132.0	N = 5243904.7
OW4	ELEV = 11.624M	E = 275128.6	N = 5243926.9
OW5	ELEV = 11.594M	E = 275118.0	N = 5243936.1
OW6	ELEV = 5.080M	E = 275292.2	N = 5243825.0
OW7	ELEV = 5.030M	E = 275298.5	N = 5243838.3
OW8	ELEV = 4.900M	E = 275265.2	N = 5243804.1
OW9	ELEV = 11.180M	E = 275069.6	N = 5243882.0
OW10	ELEV = 9.820M	E = 275196.3	N = 5243869.0
PW1	ELEV = 11.25M	E = 275141.8	N = 5243917.4
PW2	ELEV = 5.07M	E = 275279.8	N = 5243814.3

Figure 13 Revised Figure 2-7 Environmental Site Assessment Site Plan (Drawing # WH-K-98W-K-LY-00005-001)

***Page 2-49 White Rose Extension Project Operation Section 2.9** – it is stated that if the WHP development option is selected, then SBM cuttings will be reinjected. How will the SBM cuttings be dealt with before the cuttings reinjection well is drilled?*

Husky Response:
The base plan is to drill two cuttings reinjection wells for cuttings disposal purposes. In addition, the WHP design currently envisions a secondary cuttings dryer system to lower synthetic based mud on cuttings (SOC) to a target level of 6.9 percent SOC. This is consistent with technology currently employed by MODUs operating in the area. This secondary dryer would be employed until the cuttings reinjection (CRI) system is functional. This secondary system would also be employed in the event of difficulties with the CRI system. Prior to having a CRI system in place, and in the event of CRI system failure, following processing with the secondary dryer, cuttings would be discharged overboard.

Current drilling authorizations allow for the discharge of cuttings while drilling with an SBM fluid, at discharge limits specified in the facilities Environmental Protection Plan. The discharge of mud and cuttings and their limits for the WREP will be described in the WREP Environmental Protection Compliance and Monitoring Plan and submitted as part of the authorization application. While using an SBM fluid system, the WHP intends to handle cuttings in a similar manner as a MODU until the CRI system is operable, as well as in the event the CRI system experiences a failure. Once the CRI system is operable, these cuttings will be reinjected downhole.

***Page 2-51, Section 2.9.2** says "SBM cuttings will be treated and discharged from the MODU in accordance with the OWTG (NEB et al. 2010)."*

- *References to the OWTG (National Energy Board et al. 2010) should include the phrase "as amended."*

Husky Response:
Comment noted. Thank you

***Page 2-47 Subsea Drill Centre Section 2.8.2** – "Dropped object proection", assume it is supposed to be "protection."*

Husky Response:
The assumption is correct.

***Page 2-52 Shipping/Transportation Section 2.12** – "Oil will <u>be</u> stored on the ..."*

Husky Response:
Comment noted. Thank you

***Page 2-53 Offshore Section 2.14.2**– "... in accordance with standard oil field practices AND <u>approved by the C-NLOPB</u>, then..."*

Husky Response:
Comment noted. Thank you

Page 2-53, Section 2.14.2 says" *Under the WHP development option, the WHP will be decommissioned and abandoned by first abandoning the wells in accordance with standard oil field practices, then decommissioning the topsides, followed by decommissioning and abandonment of the CGS. All infrastructure will be abandoned in accordance with the relevant regulations. The topsides will be removed from the CGS in a manner evaluated to be most effective at the time of decommissioning. The WHP will not be abandoned and disposed of offshore, nor converted to another use on site.*"

- *How does this compare to statements in the 2000 ES*
- *Should we require a surety for removal costs?*

Husky Response:
First bullet - please see response to review comment **Page 2-53, Section 2.14.2**.

Second bullet - Husky provides Proof of Financial Security as a condition for all operations authorizations issued by the CNLOPB. This documentation establishes that Husky has the financial ability to meet its obligations regarding the scope of activities as defined under the authorizations. Prior to start of production on the WHP, an operations authorization will be required, including Proof of Financial Security. The authorization will include the requirement for Husky to adhere to the commitments made in the WREP Development Plan Amendment and the environmental assessment, including commitments related to decommissioning.

Page 2-53, Section 2.14.2, says" *Under the WHP development option, the WHP will be decommissioned and abandoned by first abandoning the wells in accordance with standard oil field practices, then decommissioning the topsides, followed by decommissioning and abandonment of the CGS. All infrastructure will be abandoned in accordance with the relevant regulations. The topsides will be removed from the CGS in a manner evaluated to be most effective at the time of decommissioning. The WHP will not be abandoned and disposed of offshore, nor converted to another use on site.*"

Under the subsea drill centre development option, the wells will be plugged and abandoned and the subsea infrastructure will be removed or abandoned in accordance with the relevant regulations."

- *The text regarding decommissioning should be consistent with the 2001 Comprehensive Study Report…*

  [Husky 2001] Page 24, Section 2.5 says "At the end of the production life of the White Rose oilfield development, the operator will decommission and abandon the site according to C-NOPB requirements and Newfoundland Offshore Area Production and Conservation Regulations. The floating production facility will be removed from the oilfield. Subsea infrastructure will be removed and the wells will be plugged and abandoned."

  [Husky 2001] Page 38, Section 4.1.2.3 says "The White Rose site will be abandoned at the end of the production life and will be restored to minimize residual effects on the environment…conditions should revert to those before development and overall there will

be no adverse effect. If some structures remain projecting above the seabed, there will be a positive, very localized effect on fish populations due to the reef effect, provided these structures are protected from trawlers."

[Husky 2001] Page 47, Section 4.2.2.3 says "The White Rose site will be abandoned and restored to near pre-development conditions at the end of its production life to minimize potential residual effects on the environment…"

[Husky 2001] Page 53, Section 4.3.2.3 says "The White Rose site will be abandoned and restored at the end of production to minimize permanent effects on the environment…"

Husky Response:
The apparent inconsistency with the White Rose Comprehensive Study Report (Husky Energy 2001) may arise from the statement "*If some structures remain projecting above the seabed, there will be a positive, very localized effect on fish populations due to the reef effect, provided these structures are protected from trawlers.*"

As stated in the White Rose Decision Report (2001.01) s. 4.8.5.2 "…all subsea facilities, including flowlines, that are located on or above the undisturbed sea floor, will be removed during field abandonment."

Regarding the flowline rock berms, the White Rose Decommissioning and Abandonment Plan (Husky Energy 2012) states that "Flowline sections that have been rock-dumped will not be recovered, and will be cut by divers at the locations where rock dumping ceases."

Rock berms were approved by DFO as compensation for fish habitat loss and removal may constitute a harmful destruction of fish habitat and as such could require a *Fisheries Act* Authorization.

Page 2-53, Section 2.15 says "*Regardless of the development drilling option selected, potential future activities include excavating and installing up to two additional drill centres within the White Rose field. Note that these drill centres have been previously assessed (LGL 2007a), but are included in this environmental assessment in order to extend the temporal scope of these activities.*"

- *Is this consistent with the original White Rose Environmental Assessment? The production project temporal scope extends only to 2020. Is it the proponent's intent to revise the project temporal scope?*

Husky Response:
The original White Rose Environmental Assessment (Husky Energy 2001) contemplated three to four subsea drill centres being constructed within the White Rose field. Three drill centres (Centre, Southern and Northern), were constructed prior to an assessment of five additional drill centres in the Husky White Rose Development Project: New Drill Centre Construction and Operations Program Environmental Assessment - EA Addendum (LGL 2007). To date, only the North Amethyst and South White Rose Extension drill centres have been constructed of the five assessed during the period from 2007 to 2015.

The current WREP Environmental Assessment re-assessed the effects of construction and operation of up to three drill centres during the life of the project. The productive life of the subsea infrastructure is estimated at 20 years, the productive life of the WHP is estimated at 25 years. The potential environmental effects of the operation of the *SeaRose FPSO* have not been assessed past 2020, the original projected life of the White Rose field.

Husky will complete environmental assessments as required to review potential effects and mitigation opportunities prior to the expiry of current approvals.

5.4 Chapter 3 Summary of White Rose Extension Project-specific Models

Page 3-2, Section 3.1.1 says "*…receptor height was set to sea level… the height of the platforms was set at 30 m above sea level to represent the first deck…*"

- *Since human exposure to air emissions is one of the primary concerns for air quality, is the meaning of the text noted above for the three discrete receptors [adjacent structures]? The air quality is modeled at the height of the [human] receptors.*

Husky Response:
The receptor height of all the receptors (discrete, sampling grids, nested grids) was set to sea level. This includes the three receptors that were included to represent each of the existing offshore oil operations (Hibernia, Terra Nova and *SeaRose FPSO*). The 30 m height refers to the physical height of the base of the source of platform emissions. The typical terminology is ground level; however, where the proposed Project is located offshore, the term "sea level" was also used. Tests using AERSCREEN show a difference for the contribution of the turbines at 1.5 m versus 30 m above sea level to be approximately 4 percent at 500 m distance decreasing to 2 percent at 10,000 m. Setting the receptor height to sea level (or ground level) is common practice to all dispersion modelling where conformance with standards must be tested, as this represents the "breathing zone", typically 1.5 m above the surface. As shown in the subsequent test, there would be negligible vertical variation in concentration to persons exposed on fishing or supply boats at low speed and at low elevation, to those exposed briefly on the higher decks of transient large vessels; however, the duration of exposure at low elevation would favour the placement of the receptor grid at the lower level because these persons would likely be in the vicinity longer. At distances corresponding to the separation of offshore facilities, the exhaust plumes are virtually uniform in the vertical.

Page 3-3, Section 3.1.1 says" *Ground level concentrations have been predicted for all these listed air contaminants*."

- *Do you mean sea level or deck level?*

Husky Response:
Ground level and sea level are used interchangeably.

Page 3-3, Section 3.1.2.1 *says" The maximum predicted 1-hour ground level concentrations at each of the three discrete installations for CO, NO_2, SO_2, total particulate matter (TPM), PM_{10} and $PM_{2.5}$ during normal operation of the proposed WHP are listed in Table 3-1." The term "ground level is used repeatedly in this section.*

- *Do you mean deck level concentrations?*

  Husky Response:
  Maximum predicted ground level (or sea level) concentrations were predicted for each of the three discrete receptors. Setting the receptor height to ground level (or sea level) is common practice to all dispersion modelling and represents the "breathing zone", typically 1.5 m above the surface. As noted in the previous reply, the vertical variation in concentration was assessed for the maximum impact on receptors at 1.5 m and 30 m heights and found to be less than 4 percent at 500 m and 2 percent at 10,000 m.

Page 3-5, Section3.1.2.2
Page 3-9, Section 3.1.2.3
Page 3-10, Section 3.1.2.4
Page 3.14, Section 3.1.2.5

- *Do you mean deck level where the term "ground level" occurs?*

  Husky Response:
  Ground level is referring to sea level in all cases.

Page 3-17, Table 3-26 and 3-27

- *In the total column in Table 3-7 the WHP carries over the total burden of operations as described in Table 3-26 while the MODU carries over only the MODU specific emissions. Make these consistent.*
- *Can the proponent verify that the GHG emissions obtained from Environment Canada are calculated in the same manner as those presented for the WHP and MODU operations?*
- *Please provide details on what activities at the WHP account for the large difference between WHP Operations, specifically power generation, and MODU Operations.*

  Husky Response:
  Table 3-27 has been revised and is provided as Table 6.

Table 6 Revised Table 3-27 2010 Greenhouse Gas Emissions data by Platform

Facility	GHG Emissions (tonnes CO_{2eq}/year)			
	CO_2	CH_4	N_2O	Total
Terra Nova (A)	569,634	22,976	11,616	604,227
Hibernia (A)	491,117	31,121	4,644	526,882
SeaRose FPSO(A)	394,690	27,691	9,405	431,786
WHP Operation	148,672	137	719	149,529
MODU Operation	62,688	17.6	326	63,033

Husky cannot verify that the GHG emissions obtained from Environment Canada have been calculated in the same manner as those calculations produced for the WREP, as they have been computed by other operators or a third party; however, we can confirm that our calculations are according to accepted principles for the major sources. There is no reason to expect that other sources were calculated differently.

The activities at the WHP that account for the difference between GHG emissions from the WHP operations and the MODU operations include that of power generation and flaring. In terms of power generation, the requirements for power will be lower on the MODU versus that of the WHP. As well, the GHG emissions data used for the MODU were based on data from operating a MODU in a typical year in the White Rose field (2011) during which no flaring occurred.

Page 3-18, Section 3.2 and subsections

- *Some reference to the sections where impacts of underwater noise are assessed would make this information relevant. It might be useful to include something very brief regarding the sound level magnitude where effects would be detected in identified receptors [or even to say where this information is in the report].*

Husky Response:
Effects of underwater noise are assessed in the following sections in the WREP environmental assessment:

- Page 8-46, Section 8.5.1.1 – Change in Habitat Quality – Noise
- Page 8-60, Section 8.5.2.1 – Change in Habitat Quality
- Page 11-31, Section 11.4
- Page 11-34, Section 11.4.1.1
- Page 11-35, Section 11.4.1.2 – Effects of Dredging and Effects of Vessel Traffic
- Page 11-66, Section 11.5.1.2 – Change in Habitat Quality - Dredging
- Pages 12-96 to 12-101, Section 12.5.1.1

Page 3-33 Model Inputs Section 3.3.1- *"... that a 160 m-wide <u>swath</u> is required to..."*

Husky Response:
Comment noted. Thank you

Page 3-39, Section 3.4 and subsections:

- *Page 3-40 lists a number of assumptions about cuttings size distributions…Husky has been drilling in the Jeanne d'Arc basin for some time now and should be able to provide an average particle size distribution from SBM drilling operations.*

Husky Response:
Neither Husky nor its drilling contractor records particle size distribution from SBM drilling operations. AMEC used sieve analysis results from modeling of the Hibernia well K-18 (AGAT Laboratories 1993), which is the same information used for the Hibernia, Terra Nova and White Rose cuttings modeling (Hodgins 1993; Hodgins and Hodgins 1998, 2000). Hebron drill cutting models also used these grain size data as inputs (AMEC 2010). These estimates of percentage pebbles, coarse sand, medium sand and fines are the best available source of information.

Page 3-40 Drill Cuttings Deposition Section 3.4 & Table 3-36 – *"These times <u>do</u> not include..."*

Husky Response:
Comment noted. Thank you

Page 3-56, Section 3.6 refers to a "recent study"

- *(NAS 2002) is not recent even if it is the last iteration from NAS and the most appropriate reference.*

  Husky response:
  Comment noted. Thank you, the word "recent" should be removed.

  This is the most recent iteration from NAS. Note that it is not used in the analysis, only for illustrative purposes of the overall sources of petroleum in the environment.

Page 3-57 *says "Other sources used, notably Scandpower (2000), and NAS (2002), have not been updated."*

- *The proponent is directed to two studies referenced in the Hebron Comprehensive Study*
  - *Scandpower Risk Management AS. 2006. Blow-out and Well Release Frequencies – based on SINTEF Offshore Blow-out Database, 2006. Report No. 90.005.001/R2*
  - *IAOGP (International Association of Oil & Gas Producers). 2010. Blow-out Frequencies. Report No. 434-2.*

  Husky Response:
  IAOGP (2010) is referenced in this report, and is used as a primary source for data. Scandpower (2000) is not used as a primary source of data so the 2006 update was not included.

Page 3-57 says "*Each drill centre will have 16 wells. Based on this, the total number of wells could range from 48 under the subsea drill centre option and 72 wells under the WHP option. For calculation purposes, the number of wells to be drilled will be assumed to be 60 (average of the range of 48 to 72) and the production well-years assumed to be 300 (60 wells, half of which assumed to be producers, each with a producing life of 10 years).*"

- *It would be more appropriate to calculate separate exposures for each scenario rather than to pool them.*

  Husky Response:
  The mean number of wells was considered a reasonable approach to calculate exposure because of the uncertainty in the number of wells for the WREP. There is a simple linear relationship between the number of wells and spill exposure. An increase in the number of wells from 60 to 72 would increase exposure proportionally, or by 20 percent in this example.

  Unfortunately, an error was made in editing and 70 was used as the number of wells when it should have been 60, the average in the possible range. Corrected text is provided in the response to comment "**Page 3-60… the section is inserted below in its entirety**".

Page 3-57 Hydrocarbon Spill Probabilities Section 3.6 *– "... using an exposure variable <u>based</u> on the number..."*

Husky Response:
Comment noted. Thank you.

Page 3.58, Table 3-48 *- It is stated that the Australia spill is under investigation.*

- *This spill investigation has been completed. Spill volume estimate remains "best estimate".*

Husky Response:
Comment notes. Thank you

Page 3-58 to 3-59, Section 3.6.1.1…

- *If Deloitte (2012) says there are 85,796 development wells to end 2011, why is the frequency of an extremely large blowout calculated as [1/67,703] not [1/85,796]? Please explain or correct.*
- *The same calculation error is repeated for very large spills and should be corrected. In addition the statistic being calculated is actually frequency of "Spills >10,000 bbl Volume" which includes very large and extremely large spills.*

Husky Response:
The comment is correct: the number should be 1/85,796, or 1.2×10^{-5}, and 4/85,796, or 4.7×10^{-5}, respectively.

Page 3-59 Blowouts During Production and Workovers Section 3.6.1.2

- *The frequency of very large spills (including extremely large) should be [8/350,000] or 2.28×10^{-5} blowouts/well-year.*

Husky Response:
The comment seems to assume that the two extremely large spills were not included in the large category, but they were. The correct number for very large spills is 6/350,000, or 1.7×10^{-5} blowouts per well year.

Page 3-60 says "*With respect to the WREP, there will be approximately 70 development wells drilled, and an estimated 300 well-years of production" but page 3-57 says "For calculation purposes, the number of wells to be drilled will be assumed to be 60*"

- Make these numbers agree

Husky Response:
As noted above, an error was made in editing and 70 was used as the number of wells when it should have been 60, the average in the possible range. Corrected text is provided in the response to the comment that immediately follows (**Page 3-60… the section is inserted below in its entirety**).

***Page 3-60**… the section is inserted below in its entirety:*

> *With respect to the WREP, there will be approximately 70 development wells drilled, and an estimated 300 well-years of production. Using the above world-wide spill frequency statistics as a basis for prediction, the spill frequencies estimated for the WREP would be as follows:*
>
> - *Predicted frequency of extremely large hydrocarbon spills from blowouts during a drilling operation, based on an exposure of wells drilled: 70 x 1.5 x 10^{-5} = 1.1 x 10^{-3}, or a 0.11 percent chance over the life of the WREP.*
> - *Predicted frequency of very large hydrocarbon spills from drilling blowouts based on an exposure of wells drilled: 70 x 5.9 x 10^{-5} = 4.1 x 10^{-3} or a 0.41 percent chance over the life of the WREP.*
> - *Predicted frequency of extremely large hydrocarbon spills from production/ workover blowouts, based on an exposure of well-years = 300 x 5.7 x 10^{-6} = 1.7 x 10^{-3} or a 0.17 percent chance over the life of the WREP.*
> - *Predicted frequency of very large hydrocarbon spills from production/workover blowouts, based on an exposure of well-years = 300 x 1.4 x 10^{-5} = 4.2 x 10^{-3} or a 0.42 percent chance over the life of the WREP.*

The content above is wrong, the following corrections are provided

With respect to the WREP, there will be approximately 70 development wells drilled, and an estimated 300 well-years of production. Using the above world-wide spill frequency statistics as a basis for prediction, the spill frequencies estimated for the WREP would be as follows:

- *The frequency of an extremely large hydrocarbon spill from a blowout during development drilling operations is 1/85,796 = 1.16 x 10^{-5} spills/well*
- *The predicted number of extremely large hydrocarbon spills from blowouts during a drilling operation, based on an exposure of wells drilled: 70 wells x1.16x 10^{-5} spills/well = 8.2 x 10^{-4} spills*
- *The frequency of very large hydrocarbon spills (including the extremely large category) from a blowout during development drilling operations is (4/85,796) = 4.66 x 10^{-5} spills/well*
- *The predicted number of very large hydrocarbon spills from blowouts during a drilling operation, based on exposure of wells drilled: 70 wells x 4.66 x 10^{-5} spills/well= 3.26 x 10^{-3} spills*
- *The frequency of extremely large hydrocarbon spills from production/workover blowouts is 2/350,000 = 5.71 x 10^{-6} spills/well-year*
- *The predicted number of extremely large hydrocarbon spills from the WREP based on well-years is calculated as 300 well-year x 5.71 x 10^{-6} spills/well-year=1.7 x 10^{-3} spills*
- *The frequency of very large hydrocarbon spills (including extremely large) from production/workover blowouts is 8/350,000 = 2.28 x 10^{-5} blowouts/well-year*
- *The predicted number of very large hydrocarbon spills (including extremely large) based on an exposure of well-years = 300 well-years x 2.28 x 10^{-5} blowouts/well-year = 6.8 x 10^{-3} spills*

The following text is to provide background to comments
Of course you can't have 6.8 x 10^{-3} spills, which is what makes someone who didn't carry units through their equation think that they've calculated a probability. However, the problem is that the calculation of a probability for such an event is more complex.

Having a blow-out is a yes or no event (i.e. you either have one or you don't) and events of this type are typically viewed as being binomially distributed. If you model blow-outs as binomially distributed data using historical frequencies you find that you can use the Binomial Probability Formula to generate probabilities of x number of events occurring (where x has a value from 1 to n, and n is the total number of trials: 70 wells-drilled or 300 well-years as appropriate. If you do that and take the sum of probabilities for potential x (1,2,3,4,5...n) as the "probability of at least one event"; then for low probability events that sum is very close to (i.e. the same as) the number calculated using the formula used by the proponent, but, as the likelihood of the event increases, the numbers become increasingly different.

*For example, to model the likelihood of a very large blowout spill during development drilling where the frequency is 4.66x10^{-5} spills/well. The binomial probability of any discrete number of spills **k (**1 to 70) in **n** trials (70) can be modeled using the binomial probability function*

$$P = \binom{n}{k} p^k q^{n-k}$$

Where n = number of trials (wells)
k = number of successes (spills)
p =probability of success in one trial (spills per well)
q =1-p

k	***P***
1	*0.00325153*
2	0.00000523
3	0.00000001
4	0.00000000
Sum	0.00325

One can see that the value of P is vanishingly small with larger k (i.e. the probability of 4 [or more] very large spills in 70 wells is very small). The probability of at least one very large spill in 70 wells is the sum of the calculated values ≈ 0.00325.

Or you could use $P_{k\geq 1} = 1-(1-p)^n$ *to directly calculate a P value for probability that there will be at least one very large spill in n=70 wells. Which, for the example above, yields P =0.00325.*

The formula used by the proponent to calculate "frequency over the life of the project" is both mathematically incorrect (as it does not preserve units) and will fail to produce a "statistically reasonable" answer for higher frequency events since the calculated probability will be greater than 100 percent.

Husky Response:
The above bullet list provided by the reviewer is correct, however, the following edits are made to reflect 60 wells rather than 70:

With respect to the WREP, there will be approximately ~~70~~ 60 development wells drilled, and an estimated 300 well-years of production. Using the above world-wide spill frequency statistics as a basis for prediction, the spill frequencies estimated for the WREP would be as follows:

- The frequency of an extremely large hydrocarbon spill from a blowout during development drilling operations is 1/85,796 = 1.16 x 10^{-5} spills/well
- The predicted number of extremely large hydrocarbon spills from blowouts during a drilling operation, based on an exposure of wells drilled: ~~70~~ 60 wells x1.16 x 10^{-5} spills/well = ~~8.2~~ 7.0 x 10^{-4} spills
- The frequency of very large hydrocarbon spills (including the extremely large category) from a blowout during development drilling operations is (4/85,796) = 4.66 x 10^{-5} spills/well
- The predicted number of very large hydrocarbon spills from blowouts during a drilling operation, based on exposure of wells drilled: ~~70~~ 60 wells x 4.66 x 10^{-5} spills/well= ~~3.26~~ 2.8 x 10^{-3} spills
- The frequency of extremely large hydrocarbon spills from production/workover blowouts is 2/350,000 = 5.71 x 10^{-6} spills/well-year
- The predicted number of extremely large hydrocarbon spills from the WREP based on well-years is calculated as 300 well-year x 5.71 x 10^{-6} spills/well-year=1.7 x 10^{-3} spills
- The frequency of very large hydrocarbon spills (including extremely large) from production/workover blowouts is 6~~8~~/350,000 = ~~2.28~~ 1.71x 10^{-5} blowouts/well-year
- The predicted number of very large hydrocarbon spills (including extremely large) based on an exposure of well-years = 300 well-years x ~~2.28~~ 1.71 x 10^{-5} blowouts/well-year = ~~6.8~~ 5.1 x 10^{-3} spills

Indeed, binomial probability could be used as an alternate method to make the calculations, but we believe that the calculation of spill frequency is an acceptable quantification of the risk of blowouts and spills, as required in the WREP Scoping Document (C-NLOPB 2012), and as previously deemed acceptable. We acknowledge there were inconsistencies in the well count used and that there is some confusion in the presentation of results. The probabilities in Table 3-60 have been corrected to reflect re-calculation using the binomial probability proposed by the reviewer. Revised Table 3-60 is provided as Table 7.

Page 3-62 says "*The probabilities of the various blowout categories are shown in Table 3-50, abstracted from Scandpower (2000).*"

- *This table actually contains the incident counts for various blowout categories and should be labeled as such.*

Husky Response:
Comment noted. Thank you.

Table 7 Revised Table 3-60 Predicted Probability of Blowouts and Spills for the White Rose Extension Project

Event	Historical Frequency	White Rose Exposure (a)	Probability over the Project Life
Blowouts			
1. Deep blowout during development	4.8×10^{-5} / wells drilled	60 wells drilled	0.29%
2. Blowout during production involving some hydrocarbon discharge >1 bbl	2.8×10^{-5} / well-years	300 well-years	0.83%
3. Development drilling blowout with hydrocarbon spill >10,000	4.7×10^{-5} / wells drilled	60 wells drilled	0.28%
4. Development drilling blowout with hydrocarbon spill >150,000 bbl	1.2×10^{-5} / wells drilled	60 wells drilled	0.072%
5. Production / workover blowout with hydrocarbon spill >10,000	1.7×10^{-5} / well-year	300 well-years	0.51%
6. Production / workover blowout with hydrocarbons pill >150,000	5.7×10^{-6} / well-year	300 well-years	0.17%
Platform Spills (b) (including blowouts)			
7. Hydrocarbon spill >10,000 bbl	5.5×10^{-6} / well-year	300 well-years	0.17%
8. Hydrocarbon spill >1,000 bbl	1.5×10^{-5} / well-year	300 well-years	0.45%
9. Hydrocarbon spill 50 to 999 bbl	4.8×10^{-4} / well-year	300 well-years	13%
10. Hydrocarbon spill 1 to 49 bbl	1.2×10^{-2} / well-year	300 well-years	3.6 spills over the life of the Project
11. Hydrocarbon spill 1 L to 1 bbl (159 L)	0.23/well-year	300 well-years	69 spills over the life of the Project
12. Hydrocarbon spill less than 1 L	0.46/well-year	300 well-years	140 spills over the life of the Project

(A) White Rose Exposure is the number of events over the life of the Project. This is either defined as number of well-years for production-related activities, or number of wells drilled for drilling-related activities.
(B) Platform spills greater than 150,000 bbl are not included on the table as it would simply duplicate the statistic for blowouts greater than 150,000 bbl.
(C) Probabilities estimated using binomial probability

Page 3-64, table 3-53

- *Note that the blowout frequency has the units "Blowout per Well-year"*

Husky Response:
Comment noted. Thank you.

Page 3-64 Section 3.6.2.3 *says "There are an estimated 70 wells to be drilled for the WREP, so the calculated number of deep blowouts during development drilling becomes 70 [wells] x 4.8 x 10^{-5} [blowouts/well]= 3.4 x 10^{-3}[blowouts]'*

- *Insert "using the deep-blowout frequency from OGP (2010)" and the units as indicated above*

It then says "For gas blowouts occurring during production and workovers, the statistic for the WREP becomes 300 well-years x 1.17 x 10^{-4} blowouts/well-year, or approximately 3.5 percent probability over the 20-year life of the WREP.

- *The quantity calculated is the number of events predicted. However, it is very close to the "probability of at least one spill" which may be calculated in the manner described in the note above as 0.0345*

It also says "For gas blowouts that occur during production and workovers that involve some hydrocarbon discharge (>1 bbl), the statistic for White Rose becomes 300 well-years x 2.8 x 10^{-5} blowouts/well-year, or approximately 0.84 percent probability over the 20-year life of the WREP.

- *The quantity calculated is the number of events predicted. However, it is very close to the "probability of at least one spill" which may be calculated in the manner described in the note above 0.0084.*

Husky Response:
Comment noted, thank you. This should be restated as "number of events predicted" rather than probability. As noted in the comments, for low frequency events, the results are identical to the two significant digits presented in the report. The probabilities in revised Table 3-60 (Table 7) have been corrected to reflect re-calculation using binomial probability proposed by the reviewer.

Page 3-65 Section 3.6.3 *says" The number of production well-years for WREP is 300; therefore, the probability over the WREP period would be 4.5 x 10^{-3} for a 1,000 bbl spill and 1.7 x 10^{-3} for a 10,000 bbl spill."*

- *These are the "probability of at least one spill" of the given size*

Husky Response:
Comment noted. Thank you

Page 3-68, Table 3.6.6

- *The proponent should review the contents of the table in relation to the notes above*
- *If "Platform Spills" includes blowouts the probability for platform spill >10,000 bbl should be larger than the probability of a production/workover blowout > 10,000 bbl. Please review the contents of the "Probability over the WREP Life" column.*

Husky Response:
Revised Table 3-60 is provided as Table 7. This anomaly was noted in the text.

Page 3-68*, says "Over the 20-year life of the WREP, the probability of having a large or very large spill as a result of an accident on a platform is 0.5 and 0.2, respectively. This is calculated on the basis of US OCS experience."*

- *Is the word "percent" missing?*

Husky Response:
Comment noted. Thank you. The word "percent" is missing.

Page 3-78 Subsea (seafloor) Blow-out Spill Section 3.8.2.1– Figure 3-47 and Figure 3-48 – *these figures need to be redrawn to fit the results of the oil spill trajectory model results. The author has erroneously placed the results of the oil spill model into a fixed diagram. This error is also present in the supporting oil spill trajectory model document. The author is advised to redraw any other figures that have the oil spill modelling results truncated by the fixed diagram.*

Husky Response:
The southern and eastern extents of the oil spill trajectory study area were defined by the extent of the water current data available from DFO, which are the best available water current data for the WREP. Since the water current data were not available to the east or south of this area, we could not model the movement of oil beyond these boundaries. The spill trajectories have been run for maximum duration of 120 days, which is the estimated time required to drill a relief well. As we demonstrate below, the 120 day trajectory predictions are conservative and if durations reflective of estimated spill surface slick persistence were presented, then all trajectories would terminate prior to the outer bounds of the figures provided.

From page 3-89 of the WREP environmental assessment:

> "It cannot be stressed enough that our confidence in accurately modelling the fate of crude oil on the open ocean past a few weeks is not high. Very little data has ever been collected on the long-term fate of different oil types in the offshore (past even one-week of exposure). A study completed for the US Minerals Management Service reviewed the worldwide data on the persistence of crude oil spills on open water (SL Ross et al. 2003). The study found that the persistence of large spills (>1,000 barrels) was predicted best with the following equation:
>
> PD= 0.0001S-1.32T+33.1
>
> Where: PD= spill persistence in days
> S= spill size in barrels
> T = Water temperature in degrees Celsius
>
> If the single day's release of oil is considered as a unique slick with a volume of 40,500 barrels then its long term persistence would be approximately 34 days in the winter and approximately 20 days in the summer. These estimated surface slick persistence values (based on the equation above) are somewhat shorter than those predicted in the detailed spill modelling prepared for this report and are presented only to provide additional insight into the possible survival time of surface slicks based on historical records."

5.5 Chapter 4 Socio-economic, Terrestrial and Physical Environment Setting

***Page 4-213 Sea Ice Floe Size Section 4.3.4.1** – the author has identified "melting" as a reason why floe sizes are smaller south of 49^oN. What about warmer air? Also, why is it necessary to include "higher water temperatures" when you have stated "melting", which implies higher temperatures, overall? Please clarify.*

Husky Response:

Comment noted. The points explaining the reasons for floe sizes being smaller south of 49° North should read:

- Fracturing
- Warmer air
- Warmer water temperatures
- Sea states.

Page 4-262, Figure 4-159

- *The chart should include a note as to why (0) is set at the sea-level elevation corresponding to year 1990.*

  Husky Response:
  All series are set to have the same average value over 1960 to 1990 and the reconstructions are set to zero in 1990.

5.6 Chapter 5 Effects Assessment Method

Page 5-2, Section 5.2

- *Temporal scope is not discussed and needs to be included. The time of year for activities should be included.*

  Husky Response:
  Section 5.3.2.2 Temporal Boundaries, refers the reader to Chapter 2, which provides a description of the activities that will occur during each phase of the WREP. The text in Chapter 2 along with Figures 2-1 and 2-2 provide the time of year and duration for each activity.

Page 5-12, Section 5.3.2.2 Temporal Boundaries, and
Page 7-6, Table 7-2
Page 8-2, Table 8-1
Page 9-5, Table 9-1
Page 10-2, Table 10-1

- *The temporal boundaries of the WHP and subsea option are not consistent with the temporal boundaries for the original White Rose Project, including the operation of the SeaRose FPSO.*

Husky Response:
The original White Rose Environmental Assessment (Husky Energy 2001) contemplated three to four subsea drill centres being constructed within the White Rose field. Three drill centres (Centre, Southern and Northern), were constructed prior to an assessment of five additional drill centres in the Husky White Rose Development Project: New Drill Centre Construction and Operations Program Environmental Assessment - EA Addendum (LGL 2007). To date, only the North Amethyst and South White Rose Extension drill centres have been constructed of the five assessed during the period from 2007 to 2015.

The current WREP Environmental Assessment re-assessed the effects of construction and operation of up to three drill centres during the life of the project. The productive life of the subsea infrastructure is estimated at 20 years, the productive life of the WHP is estimated at 25 years. The potential environmental effects of the operation of the *SeaRose FPSO* have not been assessed past 2020, the original projected life of the White Rose field.

Husky Energy will complete environmental assessments as required to review potential effects and mitigation opportunities prior to the expiry of current approvals.

***Page 5-23 Step 7 – Cumulative Environmental Effects Section 5.3.7, Table 5-3** – The information presented in this table is out of date. Please revise.*

Husky Response:
See Table 8 (Revised Table 5-3) with new text in underline.

Table 8 Revised Table 5-3 Past, Present and Likely Future Projects and Activities in the Nearshore Area Considered in the Environmental Assessment

Project / Activity Name	Project/Activity Description
Marine Transportation and Vessel Traffic	Marine transportation in Placentia Bay is predominantly comprised of fishing vessels and tanker/nickel plant traffic and other vessels both commercial and recreational. <u>Tanker traffic associated with the oil and gas industry traverse Placentia Bay to the North Atlantic Refining Limited refinery and Newfoundland Transshipment Limited terminal. Ore carriers will also traverse Placentia Bay to the Vale nickel processing plant in Long Harbour</u>.
Commercial Fisheries	Commercial fishing is an activity in Placentia Bay. Commercial fisheries include snow crab, cod, lobster and lumpfish roe. A more detailed description of commercial fisheries is outlined in Chapter 9 of this environmental assessment

5.7 Chapter 8 Fish and Fish Habitat

Page 8-42 Summary of Potential Environmental Effects Section 8.4.4 – Table 8-5 – if the *"x" is to indicate interaction, what does the "+" mean?*

Husky Response:
"+" means a positive interaction

Page 8-48 Concrete Graving Structure Construction and Installation *Sedimentation* – Section 8.5.1.2 – "...(*Van Dalfsen et. al. 2000), while <u>other</u> species such..."*

Husky Response:
Comment noted. Thank you.

Page 8-64 Production/Operation and Maintenance - Table 8-8 – Section 8.5.2.2 – *Explain how the potential mortality of fish in the Safety Zone is a positive effect?*

Husky Response:
A Safety Zone prohibits fishing, thus reducing the mortality of fish.

Page 8-66 Production/Operation and Maintenance – O*perational Discharges* – Section 8.5.2.2 – *there is no such thing as OWTG Regulations. The OWTG are Guidelines, the Drilling and Production Regulations are Regulations*.

Husky Response:
Comment noted. Thank you.

Page 8-68 Production/Operation and Maintenance – O*perational Discharges* – Section 8.5.2.2 – "*...and/or discharging <u>SBM</u> and WBMs...*"

Husky Response:
Comment noted. Thank you.

5.8 Chapter 9 Fisheries

9 Page 9-44 Study Area Value of Harvest by Year, All Species, 2005 to 2010 Figure 9-25 – *Upon analysis of the Study Area and the affected NAFO zones, these two areas do not overlap in a symmetrical way so how can the author extrapolate anything, let alone dollar value of harvest, based on this approach? Explain your methodology of attaining dollar value for harvested species when the Study Area overlaps sections of NAFO zones.*

Husky Response:
As the sub-caption for this Figure notes, the source of the data used is "DFO Geo-referenced Catch and Effort Data 2005 to 2010", not NAFO data. The methodology for establishing the data used for the offshore is explained in detail in Section 9.3.1, pages 9-5 to 9.7. Catch and effort data were obtained from DFO and are geo-referenced records of the quantity and value of any species harvested at a particular longitude and latitude (by degree and minute) located within the Study Area (or Project Area). Thus, the dollar value (or the total weight in tonnes) of all species harvested within the Study Area is calculated (using a GIS) by summing the value of all the individual catch records that fall inside the boundaries of the Study Area. The data coordinates are those recorded in the vessel's fishing log and in the DFO database by degree and minute of latitude and longitude: thus the position is accurate within approximately 925 m (0.5 nm) of the reported coordinates.

Figure 9-26 Project Area Quantity of Harvest by Year, All Species (Snow Crab), 2005 to 2010 – *is this all species, all species of crab or just Snow Crab?*

Husky Response:
Within the Offshore Project Area, the harvest has been exclusively for snow crab since 2005. In the title text for Figure 9-26, the bracketed words (Snow Crab) after "All Species" were included to alert the reader to this fact, but should have also been included in the text.

Figure 9-27 Project Area Value of Harvest by Year, All Species (Snow Crab), 2005 to 2010 *– Again, is this all species, all species of crab or just Snow Crab? Also, was the value of the harvest for 2007, 2009 and 2010 below $100,000 each year? This seems low, clarify.*

Husky Response:
Again, in the title text for Figure 9-27 indicates Snow Crab after "All Species", but should have also been included in the text. With respect to the value of the harvest in the Project Area in recent years, and as noted on page 9-45, the DFO data show that "harvesting within the Offshore Project Area has been irregular, with no catch recorded there in three of the five years shown, and only relatively small quantities during 2009 and 2010." As Figure 9-55, page 9-75, illustrates, the Offshore Project Area is situated outside the main snow crab fishing grounds.

***General comment** – The Project and Study Areas are not symmetrical with NAFO Zones, therefore, how can the author determine the Quantity of Harvest or the Value of Harvests?*

Husky Response:
See response above regarding comment Page 9-44 Study Area Value of Harvest by Year, All Species, 2005 to 2010 Figure 9-25

9.4.1.1 Graving Dock and Concrete Gravity Structure Construction – *the proponent appears to be assuming first rights to traditional and commercial fishing grounds. The proponent is reminded to work constructively with other users of the marine environment. Also, the author has written that "Fishing gear set to close to planned dredging operations..." This may be incorrect because if fishing gear is already in the water before dredging operations commence then the proponent will have to work constructively with fish harvesters to remove fishing gear with the use of an approved compensation plan.*

Husky Response:
As explained in Section 9.5.1.2 (page 9-94), prior to the start of marine activities, Husky will establish a Fisheries Liaison Committee (FLC) to ensure good working relations and cooperation between the WREP, fishers and fisheries harvesting activities during the life of the Project. The Proponent will also be an active member of the Placentia Bay Traffic Committee (PBTC) and, though its participation in this Committee, will work constructively with all users of the marine environment in the Bay.

9.5.1.2 Concrete Gravity Structure Tow-out and mating at the Deep-water Site – Access to Fishing Grounds – page 9-92 – *"Dredging vessel(s) will <u>need</u> a 500 m safety zone,..."*

..."there will also <u>need to</u> be a temporary..."

Husky Response:
Comment Noted. Thank you

General comment – *this type of presumptive language continues up to, and including page 9-98. Please revisit this and rewrite to remove presumptive language.*

Husky Response:
Presumptive language was not the intent of the Fisheries chapter, rather the need for safety zones will be assessed in consultation with stakeholders, authorities and Transport Canada.

5.9 Chapter 10 Marine Birds

10.3.3 Data Sources and Survey Effort for Marine Birds in the Study Areas – *the author has used the word "Tasker" in a number of places. The reviewer is assuming that the intention was to use the word "Tanker", clarify.*

Husky Response:

Tasker survey is the correct terminology. A Tasker survey is a standardized method for counting seabirds at sea developed by Tasker et al. (1984). For counting seabirds from a moving vessel, a transect 300 m in width is used so that their density can be calculated. All birds on the surface within this transect are identified to species and age and counted. Because flying birds pass through this transect more quickly than birds on the surface, counting all flying birds in the transect would result in an overestimation of their density. To avoid this bias, flying birds within the transect are identified and counted in a series of instantaneous counts ("snapshots") performed at 300 m intervals as the vessel moves along the transect. The Eastern Canadian Seabirds at Sea program and more recent industry programs used the Tasker method, modified by the incorporation of a technique called distance sampling (Fifield et al. 2009; Gjerdrum et al. 2012).

Fifield, D.A., K.P. Lewis, C. Gjerdrum, G.J. Robertson and R. Wells. 2009. Offshore seabird monitoring program. *Environmental Studies Research Funds Report*, 183: 68 pp.

Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. *Canadian Wildlife Service Atlantic Region Technical Report Series*, 515: vi + 36 pp.

Tasker, M. L., P. H. Jones, T. Dixon, and B. F. Blake. 1984. Counting seabirds at sea from ships: A review of methods employed and a suggestion for a standardized approach. *Auk*, 101:567-577.

10.3.6.8 Alcidae (Murres, Razorbill, Puffins, Guillemots and Dovekie) page 10-27 Alcids either eat fish or feed on fish, they do not feed on eat fish.

Husky Response:

Comment noted. Thank you

Page 10-38 Operation and Maintenance Section 10.4.2.2 - *says "Cooling water will be chlorinated and discharged overboard at an approximate temperature of 30°C, with a residual chlorine level <0.5 ppm."*

- *This is not consistent with current chlorine residual on the SeaRose FPSO and conflicts with Table 2-4 on page 2-9 of the Environmental Assessment.*

Husky Response:

Comment noted. Thank you. The discharge of cooling water associated with the WREP will be consistent with the *SeaRose FPSO* at chlorine residual concentration of 1.0 ppm, as stated in Table 2-4.

5.10 Chapter 11 Marine Mammals and Sea Turtles

Table 11-1 Temporal Boundaries of Nearshore and Offshore Study Areas - *... decommissioned and abandoned in accordance with standard practices, as approved by the C-NLOPB, at the end...”*

Husky Response:
Comment noted. Thank you

11.3.1 Marine Mammal Monitoring in the Jeanne d’Arc and Orphan Basins in the Past Decade – *There have been more recent surveys, see http://www.cnlopb.nl.ca/exp_stat.shtml for recent executed geophysical activity and incorporate the results of the respective marine mammal monitoring programs.*

Husky Response:
Reports for other more recent monitoring programs are not publically available and are not posted on the C-NLOPB website. Only monitoring reports that were publically available were used in the summary. The data that were presented provide an accurate summary of the types of marine mammals that could occur in the area.

11.3.1.3 Fisheries and Oceans Canada Cetacean Sighting Database page 11-11 – *the personal communication with J. Lawson is somewhat dated. When wad the last time the author communicated with DFO on the cetacean sighting database?*

Husky Response:
LGL communicated with Jack Lawson at DFO in February 2013 regarding the cetacean sightings database. It is their understanding that there have been no updates to the sightings database since 2009, and records within the database for the study areas still cover 1945 to 2007.

11.4.1.1 Graving Dock Construction – Effects of Pile Driving – page 11-35 – *this section/paragraph requires explanation or support from analysis of actual data or peer-reviewed research. The author simply cannot make statements that downplay the effects without scientific support or is this a non-qualitative assumption? Explain.*

Husky Response:
Few studies compare underwater received levels between on-land and in-water pile driving. In one study at the Stockton Regional Wastewater Control Facility in California, in-water received rms SPLs from on-land impact pile driving operations were 4 and 12 dB lower than from in-water pile driving at 10 and 12 m from the pile, respectively (Illingworth & Rodkin, Inc. 2006, 2007). The pile is assumed to have been less than 10 m inland from the shoreline; however, the exact distance is unknown.

In another study, Jenkerson et al. (2012) present measured underwater rms SPLs less than 135 dB re 1 µPa at 2 km from impact pile driving operation approximately 800 m from the shoreline, at the Odoptu-North construction site on Sakhalin Island, Russia.

The results of Illingworth & Rodkin, Inc. (2006, 2007) suggest that in-water rms SPLs from the WREP on-land pile driving operations may be 12 dB less or lower than from similar in-water operations. Results from Jenkerson et al. (2012) suggest that levels may be well below injury criteria (based on Southall et al. 2007) at short distance from the shoreline.

There is little risk for hearing impairment to marine mammals and sea turtles during pile driving activities, given that sound levels typically recorded during pile driving activities do not exceed 180 dB re 1 µPa (rms) beyond several hundred metres from the source. JASCO (2010) acoustic modelling for the Hebron Project estimated that 180 dB re 1 µPa (rms) levels would extend to 260 m and 150 m from two locations in Trinity Bay. Sound levels of 190 dB re 1 µPa (rms) occurred at 60 and 20 m from these locations. 180 and 190 dB re 1 µPa (rms) sound levels are commonly used to assess physiological effects on marine mammals. Thus, available information suggests that there is little risk for hearing impairment to marine mammals or sea turtles beyond 300 m from pile driving in water. There would be even less risk of hearing impairment during the WREP pre-construction and installation phase, as pile driving would occur onshore, if required (JASCO, pers. comm.).

Literature Cited:

Illingworth & Rodkin, Inc. 2006. *Results of Underwater Sound Measurements for the Construction of Utility Crossing at Stockton Regional Wastewater Control Facility*. Report to CH2M Hill dated April 17.

Illingworth and Rodkin, Inc. 2007. *Compendium of Pile Driving Sound Data (Appendix I)*. Prepared for The California Department of Transportation. 129 pp. Available at: http://www.dot.ca.gov/hq/env/bio/files/pile_driving_snd_comp9_27_07.pdf

JASCO Applied Sciences. 2010. *Hebron Project: Modelling of underwater noise at the Bull Arm Construction Site*. Prepared for Stantec Consulting Ltd. 32 pp.

Jenkerson, M.R., S. Rutenko, J.M. Dupont, H.R. Melton and D.E. Egging. 2012. Sound levels associated with pile installation in waters offshore from Piltun Bay, Northeast Sakhalin Island. *International Whaling Commission Scientific Committee Document*, SC/63/BRG4: 16 pp. Available at: http://iwc.int/index.php?cID=499&cType=document&download=1

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R.G. Jr., D. Kastak and D.R. Ketten. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals*, 33:411-521.

11.5.1.1 Graving Dock Construction – *Pile Driving* – page 11-64 *– provide evidence to support "it is very unlikely that on-land pile driving..." See comment **11.4.1.1 Graving Dock Construction – Effects of Pile Driving – page 11-35** above.*

Husky Response:
Please see response to comment 11.4.1.1 Graving Dock Construction – Effects of Pile Driving – page 11-35.

11.5.1.2 Concrete Gravity Structure Construction and Installation – Change in Habitat Quality – page 11-65 – *the author's concluding statement that effects are negligible does not coincide with the "Medium" effects in Table 11-10. Rewrite this conclusion to better reflect the actual magnitude of effect.*

Husky Response:
It was concluded that increased turbidity associated with dredging would have negligible effects on marine mammals and sea turtles. However, increased noise from dredging activities could have medium-magnitude effects on habitat quality, which in turn may affect marine mammals and sea turtles if they avoid the area where dredging is proposed to occur. The "Medium" rating in Table 11-10 reflects the most conservative rating for this activity.

11.5.1.2 Concrete Gravity Structure Construction and Installation – Change in Habitat Quality – Dredging - page 11-66 – *change the "negative effects language" to coincide with the medium magnitude effect in Table 11-10.*

Husky Response:
In nearshore shallow water regions, dredges can be strong sources of low frequency underwater noise; underwater sound produced by dredging may be detectable at ranges up to 25 km (Richardson et al. 1995; JASCO 2012). Thus, noise from dredging may have medium-magnitude effects on the habitat quality, which in turn may affect marine mammals and sea turtles if they avoid the area where dredging is proposed to occur. Sound levels of 160 dB re 1 μPa (rms) occur within 248 m (R95%) of the dredging site, depending on dredge type and season (JASCO 2012). Thus, marine mammals and sea turtles may show behavioural changes from dredging activities within at least 248 m of the dredging site.

Literature cited:

JASCO Applied Sciences. 2012. *Underwater Sound Propagation Assessment for the Environmental Assessment of the White Rose Extension Project*. Report P001162-001 by JASCO Applied Sciences, Dartmouth, NS, for Stantec Consulting Ltd., St. John's, NL.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme and D.H. Thomson. 1995. *Marine Mammals and Noise*. Academic Press, San Diego, CA. 576 pp.

11.5.1.3 Accidental Effects in the Nearshore – Change in Habitat Quantity – page 11-71 *"... in habitat quality, because of an accidental hydrocarbon spill, may directly reduce..." An accidental spill does not have an indirect effect on habitat, it is a direct effect of an accidental event.*

Husky Response:
Comment noted. Thank you.

11.5.2.2 Production/Operations and Maintenance – Change in Habitat Quality – *Other Activities* – page 11-80 – *it is not necessary to write out the reference to the OWTG (NEB et al. 2010) after it has been repeatedly abbreviated.*

> **Husky Response:**
> Comment noted. Thank you

5.11 Chapter 13 Sensitive Areas

13.0 Sensitive Areas – page 13-1 – *"... stakeholder and regulatory requirements about the..."*

> **Husky Response:**
> Comment noted. Thank you.

Figure 13-2 – Sensitive Areas Identified Within or Near to the Offshore Study Area – *the Placentia Bay/Grand Banks LOMA does not have a land component, redraw the Figure with this correction.*

> **Husky Response:**
> Please see Figure 14 (revised Figure 13-2), indicating the boundary of the PBGB-LOMA.

Page 13-10 Eelgrass Beds – *remove the very first sentence in this section as it is not necessary. The third sentence is referenced and is better placed after the second sentence, which introduces the idea of eelgrass beds.*

> **Husky Response:**
> Comment noted. Thank you.

5.12 Chapter 16 Environmental Management

Page 16-4, Section 16.4

- *Should include a reference to the Environmental Protection Plan Guidelines (National Energy Board, et al. 2011) to be consistent with other similar sections.*

> **Husky Response:**
> Comment noted. Thank you.

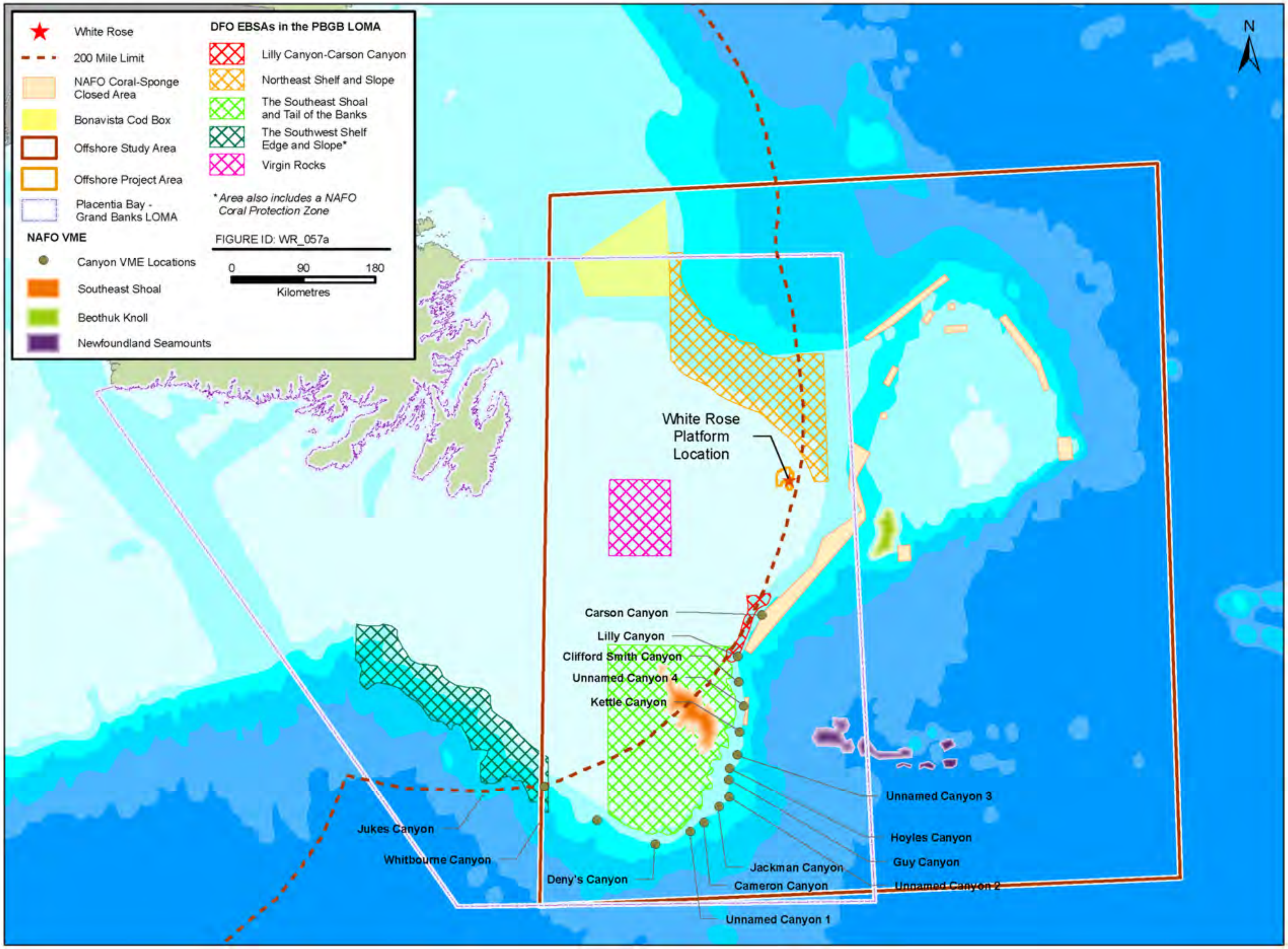


Figure 14 Revised Figure 13-2 Offshore Sensitive Areas

Page 16-22, Section 16.13.2

- *Husky has not indicated how they avail of the GRN.*

  Husky Response:
  The mission of the GRN is to maximize the knowledge, expertise, and preparedness that each spill response organization has individually, and share such information with other GRN members for the purposes of enabling each organization to provide a better response to their respective members or customers. The GRN does not, as a coalition, provide direct spill response resources such as equipment or personnel to a spilling entity.

  Husky has agreements for personnel and equipment support with both ECRC and OSRL who are members of the GRN. In the event of a spill requiring Tier 3 support, beyond the combined capability of Husky, OSRL and ECRC, Husky would establish contracts with other agencies / response organizations that have equipment and personnel suitable for response in the operating area.

5.13 Chapter 17 Summary and Conclusions

Page 17-1 Summary and Conclusions Section 17.0 – *"All production from the potential future drill centres will be processed through the SeaRose FPSO currently operating at White Rose. The effects of production have been previously assessed (Husky Oil 2000; LGL 2007a), and are not addressed in this document." Again, the temporal scope for the previous EAs for operation of the SeaRose FPSO will have to be considered in relation to the temporal scope for the operation of this proposed project.*

Husky Response:
The original White Rose Environmental Assessment (Husky Energy 2001) contemplated three to four subsea drill centres being constructed within the White Rose field. Three drill centres (Centre, Southern and Northern), were constructed prior to an assessment of five additional drill centres in the Husky White Rose Development Project: New Drill Centre Construction and Operations Program Environmental Assessment - EA Addendum (LGL 2007). To date, only the North Amethyst and South White Rose Extension drill centres have been constructed of the five assessed during the period from 2007 to 2015.

The current WREP Environmental Assessment re-assessed the effects of construction and operation of up to three drill centres during the life of the project. The productive life of the subsea infrastructure is estimated at 20 years, the productive life of the WHP is estimated at 25 years. The potential environmental effects of the operation of the *SeaRose FPSO* have not been assessed past 2020, the original projected life of the White Rose field.

Husky will complete environmental assessments as required to review potential effects and mitigation opportunities prior to the expiry of current approvals.

Page 17-2 Results of White Rose Extension Project Modelling Section 17.2.1 – *See specific comments on Supporting Document below.*

Husky Response:
Responses to specific comments are provided in Sections 6 and 7.

Page 17-4 Air Quality Section 17.2.2 – *See specific comments on Supporting Document below.*

Husky Response:
Responses to specific comments are provided in Section 8.

Canada-Newfoundland and Labrador Offshore Petroleum Board
SUPPORTING DOCUMENT COMMENTS

6.0 Drill Cuttings and WBM Operational Release Modelling (AMEC June 2012)

6.1 General Comments

G1 Throughout the document it is stated that the release of mud and cuttings will be in accordance with the Offshore Waste Treatment Guidelines (OWTG). The OWTG outline: " …the goals, objectives and requirements of the applicable acts and regulations, and to explain the expectations of the Boards regarding the management of waste material …". For an operator, the governing document with respect to management of discharges to the natural environment is the Environmental Protection Plan (EPP) submitted as part of the authorization application (OWTG page 2). The document should describe the discharge of cuttings and mud expected for the project (e.g. mud types, discharge locations, oil on cuttings).

Husky Response:
A description of expected mud and cuttings volume and release locations are provided on the tables 2-2 and 2-3 of the Drill Cuttings and WBM Operational Release Modelling (AMEC 2012). The discharge of mud and cuttings and their limits for the WREP will be described in the WREP Environmental Protection Compliance and Monitoring Plan and submitted as part of the authorization application.

G2 There are a number of assumptions made, such as particle size and distribution, well depths and aggregation of cuttings. It is difficult to say if the assumption is valid. The basis on which all model assumptions are based should be provided.

Husky Response:
Cuttings particle size, distribution and the aggregations used are presented in Section 3.2.2, including the basis for their selection and corresponding references. For well depths, please see comment "Section 2 Drilling Program, pg 3 – "Well lengths assumed …".

G3 It is not clear from the report that the modeling accounts for the effect the WHP and its orientation may have on local currents and the dispersion of cuttings. An explanation of how the WHP would affect currents and dispersion should be provided.

Husky Response:
The modelling does not account for the presence of the WHP nor does it attempt to predict any potential effect on local currents and the dispersion of cuttings. The effect of turbulences generated by a GBS-type platform on sediment deposition would not be substantive, as indicated by discharge modeling conducted for Hibernia (Hodgins 1993).

Furthermore, in previous work AMEC carried out for the Hebron Project, a 1D model was established considering the symmetrical characteristics of the sediment deposition distribution. The model considered variation in current patterns in each of the 16 direction quadrants. The model adopted a radial modelling grid system, with the origin at the sediment discharge point. The model considered sedimentation by gravity in the vertical direction and movement with the current in the horizontal direction. Hydrodynamics and turbulences caused by the GBS were not considered. However, the Hibernia model was used to calibrate the Hebron model with respect to the effects of hydrodynamics and turbulences generated by the GBS, and they were found to be comparable.

It appears that the hydrodynamics and turbulences generated by the GBS have little effect on sediment deposition around a GBS. Several factors may have contributed to this observation. The current in the area generally has a low velocity, which causes the turbulences generated by the GBS to be low. The particles deposited around the GBS are typically coarse materials, which are less influenced by turbulences than fine particles. With distance from the GBS, where finer particles tend to settle, the turbulence generated by the GBS diminishes.

Settling and transport by the current of sediment particles is the primary mechanism in determining sediment deposition. The effect of turbulences generated by a GBS on sediment deposition was found to be not substantive.

Reference:

Hodgins, D.O. 1993. *Hibernia Effluent Fate and Effects Modelling*. Report prepared for Hibernia Management and Development Company Ltd., St. John's, NL.

G4 Husky has completed a number of Environmental Effects Monitoring (EEM) Programs which give an indication of the extent of area affected by cuttings discharge from a MODU. There is no indication that the model has been calibrated or compared to the results of the EEM Programs. Such a comparison would demonstrate the accuracy of the model to predict the deposition of cuttings discharged.

Husky Response:
A comparison of hydrocarbon concentrations measured in situ during the White Rose EEM program and those estimated by the SBM cuttings dispersion model (AMEC 2012) can be used to demonstrate the accuracy of the model. Although the EEM stations are not precisely at the distances from drill centres used in the model predictions, estimates of hydrocarbon concentrations may be compared at a scale of within 100 m.

Figure 5-7 from the 2010 White Rose EEM program displays the spatial distribution of hydrocarbon concentrations (>C_{10}-C_{21}) in sediment samples from around the four drill centers at White Rose (Figure 15). The figure illustrates that hydrocarbon concentration in sediment at EEM stations within 900 m of a drill centre as generally greater than 5 mg/kg. EEM sediment stations further than 900 m from a drill centre generally have concentrations less than 5 mg/kg.

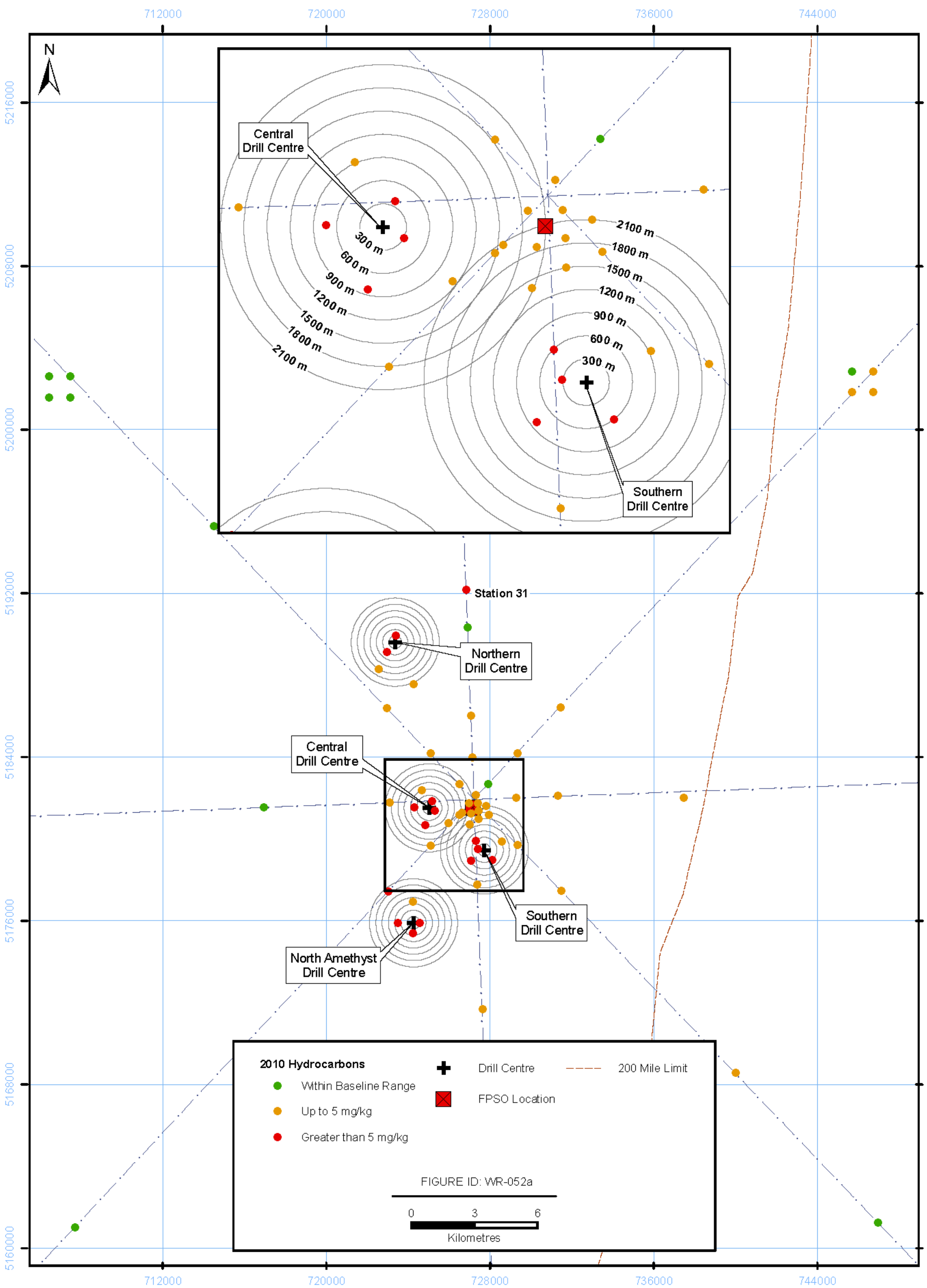


Figure 15 2010 White Rose EEM Figure 5-7 White Rose 2010 EEM Stations with Hydrocarbon (>C_{10}-C_{21}) Concentrations up to 5 mg/kg and Greater than 5 mg/kg

Table 3-12 in the Drill Cuttings and WBM Operational Release Model report (AMEC 2012) estimates hydrocarbon concentrations from SBM cutting discharge by distance from origin (see Table 9). Estimates from the SBM cutting dispersion model generally agree with the White Rose EEM results in that concentrations at distances less than 500 m from a drill centre are predicted to be greater than 5 mg/kg and concentrations at distances greater than 1,000 m from a drill centre are predicted to be less than 5 mg/kg. Hydrocarbon concentrations between 500 and 1,000 m from a drill centre are estimated to be slightly above and below 5 mg/kg.

Table 9 AMEC 2012 Table 3-12 Mean Synthetic-based Mud Cuttings Oil Concentration (mg/kg)

Scenario	Distance from Origin (m)					
	100 to 200	200 to 500	500 to 1,000	1,000 to 1,500	1,500 to 2,500	2,500 to 25,000
WHP Development Option; 40 Wells at WWRX1	no SBM cuttings released to sea					
Subsea Development Option; 16 Wells at WWRX1	1,122.9	7.7	3.2	2.6	2.6	1.9
New Subsea Drill Centre; 16 Wells at SWRX	1,350.7	22.2	1.9	2.2	3.7	1.7
New Subsea Drill Centre; 16 Wells at WWRX2	1,092.1	22.6	7.1	4.9	4.4	1.5
New Subsea Drill Centre; 16 Wells at NWRX	1,394.0	17.8	4.0	1.9	2.7	1.9

6.2 Specific Comments

Executive Summary, pgs i-ii – "*These will be almost exclusively the fast-settling pebbles and coarse sand (a very small percentage of the fines will drift for a time and ultimately settle near the WHP…". Please provide the reference for the grain sizing.*

Husky Response:
Neither Husky nor its drilling contractor records particle size distribution from SBM drilling operations. AMEC used sieve analysis results from modeling of the Hibernia well K-18 (AGAT Laboratories 1993) . Which is the same information used for the Hibernia, Terra Nova and White Rose cuttings modeling (Hodgins 1993; Hodgins and Hodgins 1998, 2000). Hebron drill cutting models also used these grain size data as model inputs (AMEC 2010). These estimates of percentage pebbles, coarse sand, medium sand and fines is the best available source of information.

Executive Summary, pg ii – "*Under the subsea scenario, the footprint of WBM cuttings is smaller than that for the WHP option, with a range generally restricted to within 2 km. The primary difference factor is the reduced number of wells drilled (16 as opposed to 40) and the reduced volume of cuttings material released (267 m^3 per well as opposed to 295 m^3) for the subsea option". This statement should be reviewed, as the settling rate would be the main determining factor for the area affected and to a much lesser extent the volume of material discharged.*

Husky Response:

The paragraph talks about WBM footprints resulting from WHP and subsea options. For both options, WBM cuttings are released near the sea floor (20 m above for WHP; 10 m above for subsea, see Table 2-2). The WBM drill cuttings characterizations including settling rates are the same under either option (Tables 3-3 and 3-4).

On review, yes, it's possible the slightly higher release location for the WHP option would result in a greater time (settling time) to reach the seabed and hence a greater horizontal distance travelled. This and the smaller cuttings volume are the primary differences.

Executive Summary, pg ii – "*Under the subsea drill centre option, the majority of SBM cuttings are deposited quite close to the drill centre, due to the large percentage of large cuttings pieces having fast settling speeds." Please provide the reference for both the grain sizes expected for cutting and settling rates, and how they were determined.*

Husky Response:

Neither Husky nor its drilling contractor records particle size distribution from SBM drilling operations. AMEC used sieve analysis results from modeling of the Hibernia well K-18 (AGAT Laboratories 1993) . Which is the same information used for the Hibernia, Terra Nova and White Rose cuttings modeling (Hodgins 1993; Hodgins and Hodgins 1998, 2000). Hebron drill cutting models also used these grain size data as inputs (AMEC 2010). These estimates of percentage pebbles, coarse sand, medium sand and fines is the best available source of information.

Please see Section 3.2.2 of the AMEC for an explanation of settling rates used.

Executive Summary, pg ii – "*The environmental effects of released WBMs are generally associated with the potential physical toxicity of fine particulate matter, either barite or bentonite, which are sometimes used to increase the density of the mud mixture, and these additives have greater potential to affect filter feeding organisms as they remain suspended in the bottom boundary layer." Barite and bentonite should sink to the ocean floor and not remain suspended in the bottom boundary layer. Explain what is meant by the bottom boundary layer and provide a reference for the assertion that WBM are generally associated.*

Husky Response:
The benthic boundary layer is the layer of water in the first few metres directly above the seabed. It is relevant for study of the oceanographic processes that affect the fate of drilling waste release. Drilling mud particles have settling velocities on the order of a few mm/s to a cm/s, which are high enough to allow them to settle to the bottom. Hodgins and Hodgins (2000) concludes sediment transport of parent sand and flocculated mud and cuttings (fall velocity >1 mm/s) in the boundary layer is not expected at White Rose. In any case, Husky is not planning to use barite or bentonite as components of WBM, so suspension in the benthic boundary layer is not an issue.

Reference:
Hodgins, D.O. and S.L.M. Hodgins. 2000. *Modelled Predictions of Well Cuttings Deposition and Produced Water Dispersion for the Proposed White Rose Development*. Prepared for Husky Oil Operations Limited by Seaconsult Marine Research Ltd.

Executive Summary, pg ii - *"The most likely composition of the WBM planned for use during the WREP does not include these weighting agents". Either the WBM contains or does not contain weighting agents. The authors need to consult with the proponent regarding the types and general composition of muds to be used.*

Husky Response:
The WBM planned for use does not contain these weighting agents.

Executive Summary, pg ii – "*No component of the WBM has been identified as potentially toxic; therefore…". Please define toxic and identify the generic composition of the mud and the toxicity of its components. Provide references for the toxicity of the mud components.*

Husky Response:
The WBM that Husky will use is comprised of primarily of brine, with the possible addition of sodium acid pyrophosphate (125 kg per hole section per well).

The WBM systems currently planned for use for the first two hole sections (i.e., conductor and surface) contain components as follows, with notional concentrations provided:

- Drilling Fluid: Seawater
- Mud Sweeps: Seawater + 6 to 10 kg/m³ Guar Gum
- SAPP Sweeps: Seawater + 3 to 7 kg/m³ SAPP
- Kill Mud: NaCl Brine (24%) + 4 kg/m³ Kelzan XCD + 5 kg/m³ Guar Gum + 35 kg/m³ Salt 805

Acute toxicity of sodium acid pyrophosphate to marine algae and animals is summarized in Neff (2010), who listed the range of LC50 for different species (in) (using the GESAMP (2002) toxicity classification, where >1,000 mg/L is non-toxic and >100 to ≤1,000 mg/L is practically non-toxic). Sodium acid pyrophosphate had a range of 870 mg/L (freshwater species used in test; salt water species expected to much more tolerant) to >100,000 mg/L. Testing the toxicity of WBMs to marine organisms from the Gulf of Mexico, Atlantic and Pacific Oceans and Beaufort Sea

(NRC 1983, in Melton et al. 2000) indicated that WBM discharged to the marine environment will be low in toxicity (Melton et al. 2000).

Section 2 Drilling Program, pg 2 – "*For drilling of the deeper intermediate and main hole sections - for both WHP and MODU drilling - SBM will be used. Under the WHP option the base case is to use two cuttings reinjection wells into which treated SBM and cuttings will be re-injected (i.e., no return of materials to the sea)". The discharge of SBM cuttings will not be permitted until the cutting reinjection system is operative. This would mean no drilling with SBM.*

Husky Response:
The base plan is to drill two cuttings reinjection wells for cuttings disposal purposes. In addition, the WHP design currently envisions a secondary cuttings dryer system to lower synthetic-based mud on cuttings (SOC) to a target level of 6.9 percent SOC. This is consistent with technology currently employed by MODUs operating in the area. This secondary dryer would be employed until the cuttings reinjection (CRI) system is functional. This secondary system would also be employed in the event of difficulties with the CRI system. Prior to having a CRI system in place, and in the event of CRI system failure, following processing with the secondary dryer, cuttings would be discharged overboard.

Current drilling authorizations allow for the discharge of cuttings while drilling with an SBM fluid, at discharge limits specified in the facilities Environmental Protection Plan. The discharge of mud and cuttings and their limits for the WREP will be described in the WREP Environmental Protection Compliance and Monitoring Plan and submitted as part of the authorization application. While utilizing an SBM fluid system, the WHP intends to handle cuttings in a similar manner as a MODU until the CRI system is operable, as well as in the event the CRI system experiences a failure. Once the CRI system is operable, these cuttings will be reinjected downhole.

Section 2 Drilling Program, pg 3 – "*Well lengths assumed are for a typical producing well from a MODU, which is approximately 5,500 m (mKB)." Well length should be typical to what is being drilled and what the proponent expects to be drilling and not typical to a MODU.*

Husky Response:
At the time of environmental assessment submission, the mean average measured length of planned wellbores to be drilled from the WHP was 5,513 mMDbrt, consistent with the information provided. This is also consistent with what would be expected to be drilled from a MODU.

Subsequent to the environmental assessment submission, the most recent wellbore trajectory planning scope undertaken by Husky for the WHP project indicates a mean average wellbore length of 5,644 mMDbrt, which would not introduce significant deviation from what has been modelled for the environmental assessment.

§3.1.1 Advection Dispersion Model Description, pg 6 - *"For the purposes of predicting their physical deposition on the seabed, the cuttings are considered as a composition of particle types or sizes; typically larger cuttings pieces pebbles coarse sand, medium sand and fines. These particle sizes are assumed to be generally representative of the materials likely to be encountered in the area and generated using WBM or WBM." Please provide the percentage of each particle size and reference the source of the composition. It is inappropriate to make assumptions and where assumptions are made the rational for that assumption needs to be described.*

Husky Response:
Neither Husky nor its drilling contractor records particle size distribution from SBM drilling operations. AMEC used sieve analysis results from modeling of the Hibernia well K-18 (AGAT Laboratories 1993) . Which is the same information used for the Hibernia, Terra Nova and White Rose cuttings modeling (Hodgins 1993; Hodgins and Hodgins 1998, 2000). Hebron drill cutting models also used these grain size data as inputs (AMEC 2010). These estimates of percentage pebbles, coarse sand, medium sand and fines is the best available source of information.

SBM are proposed to be discharged from the MODU for subsea development but according to the statement only WBM are modeled. SBM are to also be modeled.

Husky Response:
The second WBM ("…using WBM or WBM") in the above paragraph is an error and should be SBM. SBM were also modelled as per the report.

§3.1.1 Advection Dispersion Model Description, pg 6 - *"After completion of a model run, when all particles have settled, or have reached the model grid boundaries (in which case, they are taken to have drifted outside the domain and are tabulated as 'lost')…". If particles reach the boundary then the boundary will need to be extended. Otherwise, no conclusion can be reached as to the extent of the affected area. State if the particles exceed the boundary.*

Husky Response:
This is a general description of the model. The model output listing reports the weight of cuttings settled and lost, and is routinely checked. Settled cuttings are those that reach the sea bottom within the horizontal extent of the model grid. Lost cuttings are those that do not reach the sea bottom while settling within the model grid and continue to drift horizontally outside the (model) domain. The grid sizes employed are noted at the bottom of page 13. There were no 'lost' cuttings for the scenarios modelled: no particles exceed (or drift outside of) the boundary.

§3.1.1 Advection Dispersion Model Description, pg 7– "*All cuttings are assumed to be adequately treated to reclaim oil as required by present regulations. Oil content on cuttings produced during drilling with SBM, $OC_{initial}$ was set to 7.4 g / 100 g, equal to 6.9 g / 100 g oil on wet solids, as per the OWTG (NEB et al. 2010)." The use of oil on cuttings data from the proponent's current operation would be more appropriate for modeling purposes.*

Husky Response:
Actual mean SOC discharge for the past five Husky wells is 6.4 percent. So the use of 6.9 percent in the model is accurate and will not change model or impact assessment predictions.

§3.2.1 Scenarios, Well Sequences, Well Types, Table 3-1, pg 8 – *Please provide the information on the duration for drilling each well section. Duration should be based on actual time to drill a well in the White Rose field.*

Husky Response:
Average durations are as follows, based upon average duration for seven recent Husky subsea wells, and used as the basis for WHP time estimations. Durations are inclusive of skidding, drilling, casing, cementing, completions and associated ancillary operations:

- Conductor section (1,067 mm hole OD) = 5.0 days
- Surface section (406 mm hole OD) = 12.5 days
- Production section (311 mm hole OD) = 22.2 days
- Production liner section/completion (216 mm hole OD) = 43.5 days

Considering only durations in which cuttings are being generated, the following average times apply. Note that there are periods within these times provided that cuttings are not returned;

- Conductor section (1,067 mm hole OD) = 2.0 days
- Surface section (406 mm hole OD) = 8.9 days
- Production section (311 mm hole OD) = 17.3 days
- Production liner section/completion (216 mm hole OD) = 22.1 days

§3.2.2 Cuttings Particle Characterization, pg 9 - *"Information for the Hibernia K-18 well is available from a sieve analysis performed by AGAT Laboratories (1993) and details depths of 900 to 5,010 m. This has been employed in the previous cuttings modelling for Hibernia, Terra Nova and White Rose (Hodgins 1993; Hodgins and Hodgins 1998, 2000), and Hebron (AMEC 2010), with estimates of percentage pebbles, coarse sand, medium sand and fines, and is the best available source of information." Information on particle size could be obtained through Husky's current drilling program and would be more representative of particles sizes while drilling with SBM.*

Husky Response:
Neither Husky nor its drilling contractor records particle size distribution from drilling operations. The quoted sources are currently the best available data for modelling inputs.

§3.2.2 Cuttings Particle Characterization, pg 9 – "*Experience with both SBM and WBM has shown that SBM systems are not dispersive; cuttings are large, and they remain intact until deposited on the seabed." Whose experience and what is the basis of that experience? For SBM cuttings, the more the cuttings are processed the more the particle size decreases and remain suspended in the water column. This increases the affected area. In addition, as cuttings get drier, the amount of oil decreases. Please see Brandsma, 1996 which states that "The explanation for this apparent conundrum is that while treatments other than centrifugation also reduce oil content (from an untreated level of 15.8% [w/w] to a range of 0.3% to 5.1%, these treatments also generate cuttings with finer particle sizes. Thus, according to the model, the untreated and centrifuged OBF-cuttings would not reach the 1000 m mark to the same extent that the treated OBF-cuttings would because the finer particles created by the treatment have lower settling velocities and are transported farther in the water column."*

US EPA. 2000. Environmental Assessment Of Final Effluent Limitations Guidelines And Standards For Synthetic-Based Drilling Fluids And Other Non-Aqueous Drilling Fluids In The Oil And Gas Extraction Point Source Category, December 2000, report number EPA-821-00-014 Page 4-4.

Brandsma, M.G. 1996. Computer simulations of oil based mud cuttings discharge in the North Sea. In: The Physical and Biological Effects of Processed Oily Frill Cuttings. E&P Forum Report No.2.61/202. April 1996. Pages 25-40.

Husky Response:

a) In response to the question "Whose experience and what is the basis of that experience?", as noted with the personal communication reference at end of that paragraph it is the experience of Chris Mazerolle, Drilling Engineer Advisor, Chevron Canada Resources, Calgary, AB.

b) In response to "Please see Brandsma, 1996 ..." Comment noted. Thank you.

§3.2.2 Cuttings Particle Characterization, pg 9 – *"Cuttings drilled with SBM will be large, on the order of 2.5" in length, 1" wide, and 1/8" thick. To characterize these large cuttings as spherical particles for the model, their volume corresponds to a particle diameter of about 1 to 3 cm. This large cutting size type was added to the pebbles, coarse sand, medium sand and fines types used to characterize the WBM-cuttings noted above. It was assumed that most (approximately 70 percent) of the cuttings will be large, approximately 20 percent 0.5 to 1 cm, 5 percent 0.1 cm, with the remaining 5 percent being very fine particles, with diameters of 0.01 cm (Table 3-3)." Provide the reference for the data source.*

Husky Response:

Reference for cuttings drilled with SBM (first sentence, paragraph before Table 3-2) is (pers. comm. with Suncor drilling superintendent and MI Swaco personnel, January 2011).

§3.2.2 Cuttings Particle Characterization, pg 10 – "*It is assumed that the cuttings will enter the sea in a disaggregated form". There are a lot of assumptions made for this modeling however no basis for the assumptions is given. Provide the basis on which this assumption is made.*

Husky Response:
This is a reasonable assumption. Drill cuttings (solids) will be separated from the drilling fluid with shale shakers (solids separation) and during this process will, by nature, become disaggregated.

§3.2.2 Cuttings Particle Characterization, pg 11 – *Reference the source of the data provided in Table 3-4.*

Husky Response:
The source of the data in Table 3-4 is the equations presented in the report text immediately prior to Table 3-4.

§3.2.3 Ocean Currents, pg 12 – "*It was assumed that drilling would commence in the fall, for either the WHP or subsea". Drilling can occur at any time of the year. Will the timing of drilling activities affect the outcome of the modeling? Please confirm the timing of drilling activities.*

Husky Response:
In order to select a time series of currents for the modelling, a drilling start date of fall (e.g., October 1 as a calendar date), was based on the proposed project schedule at the time of modelling (ref. WREP Project Description). See also Section 3.2.1 bottom of page 7.

Drilling activities are assumed to take place year round (e.g., for the 40 wells under a WHP option, 10 wells are drilled each season), over periods of approximately 15 (subsea option) to 21 years (WHP option), so the season in which they commence will not affect the outcome of the modelling

§3.2.4 Model Geometry, pg 14 - *"The subsea development option differed from the WHP option only in that West White Rose was drilled with a MODU rather than from the WHP; and 16 wells as opposed to 40 were drilled with the subsea option. For visualizations of combined scenario results (e.g., for the WHP option, 40 wells at the WHP, plus 16 wells at the SWRX, for a total of 56 wells".*

It is stated in the Introduction that "*Two development options are being considered for the West White Rose component of the WREP: a WHP, which essentially is a fixed drilling platform; or a subsea drill centre with wells drilled by a mobile offshore drilling unit (MODU). Also as part of the WREP are up to three additional drill centres in other areas of the White Rose field. If a WHP is used in the West, the total number of wells could be up to 88: 40 wells from the WHP, plus up to three additional subsea drill centres, each with up to16 wells (Husky 2012). For the subsea drill centre option, the total number of wells could be up to 64: 16 wells each for West White Rose plus up to three additional drill centres (Husky 2012). These wells will be a combination of producing, water injection, gas injection and (WHP option only) cuttings reinjection.*"

Modeling 56 wells when there is potentially 88 wells is not adequate to show the extent of the area that may be affected by cuttings. Modeling is to be done for the project scenarios described in the environmental assessment report. The proposal for the WHP and subsea development is 40 platform wells and 48 subsea wells, and the subsea option of 64 wells.

Husky Response:
At the time of writing the modelling report, the WREP was to include up to 88 wells. Since then, the South White Rose Extension Drill Centre has proceeded under existing approvals, so was removed from the environmental assessment of the WREP. The number of wells for the WREP is now estimated between 48 (subsea) and 72 (WHP). Discharges from the maximum number of wells (40) at one location (WHP) were modelled and can be considered the worst case scenario for WBM cuttings deposition. As illustrated in Figure 3-9 and 3-10 of the report, SBM deposition was modelled for 64 wells, and the deposition is very similar between drill centres. The inclusion of another eight wells in the model will not affect the model results to a degree to change any impact predictions in the WREP environmental assessment.

The reference to 56 wells in the first paragraph on page 14 is simply mentioned in an example of how the results of two separate scenarios could be combined and visualized.

The modelling results of 64 wells for the subsea option are shown in Figure 3.10 (and three new zoomed-in views of the same figure as Figures 3-10a,b,c; see Figures 16 to 18).

A new set of four figures, Figure 3-10d,e,f,g (see Figures 19 to 22) have been prepared to illustrate deposition of the 88 well scenario, although not a potential scenario for the WREP. Figure 3-10d shows the 28 km view following the WHP 88 well option, a similar extent as shown in Figure 3-10. Figure 3-10e (Figure 20) shows near NWRX after 88 wells; essentially the same as Figure 3-10a view near NWRX after 64 wells for the subsea option. Figure 3-10g (Figure 22) shows near SWRX after 88 wells; essentially the same as Figure 3-10c view near SWRX after 64 wells for the subsea option.

Figure 3-10f (Figure 21) shows a WWRX1/WWRX2 view, which shows a similar cuttings thickness footprint to that in Figure 3-1 for the 40 WHP wells at WRX1 with two additional observations. With another 16 wells drilled (WWRX2) the amount of cuttings materials released is increased because of reinjection at the WHP. Near WWRX2, an increase of approximately 73 percent is predicted compared to the results from the 40 WHP wells and the areas of thickness between approximately 1 and 10 mm are larger by approximately 50 percent.

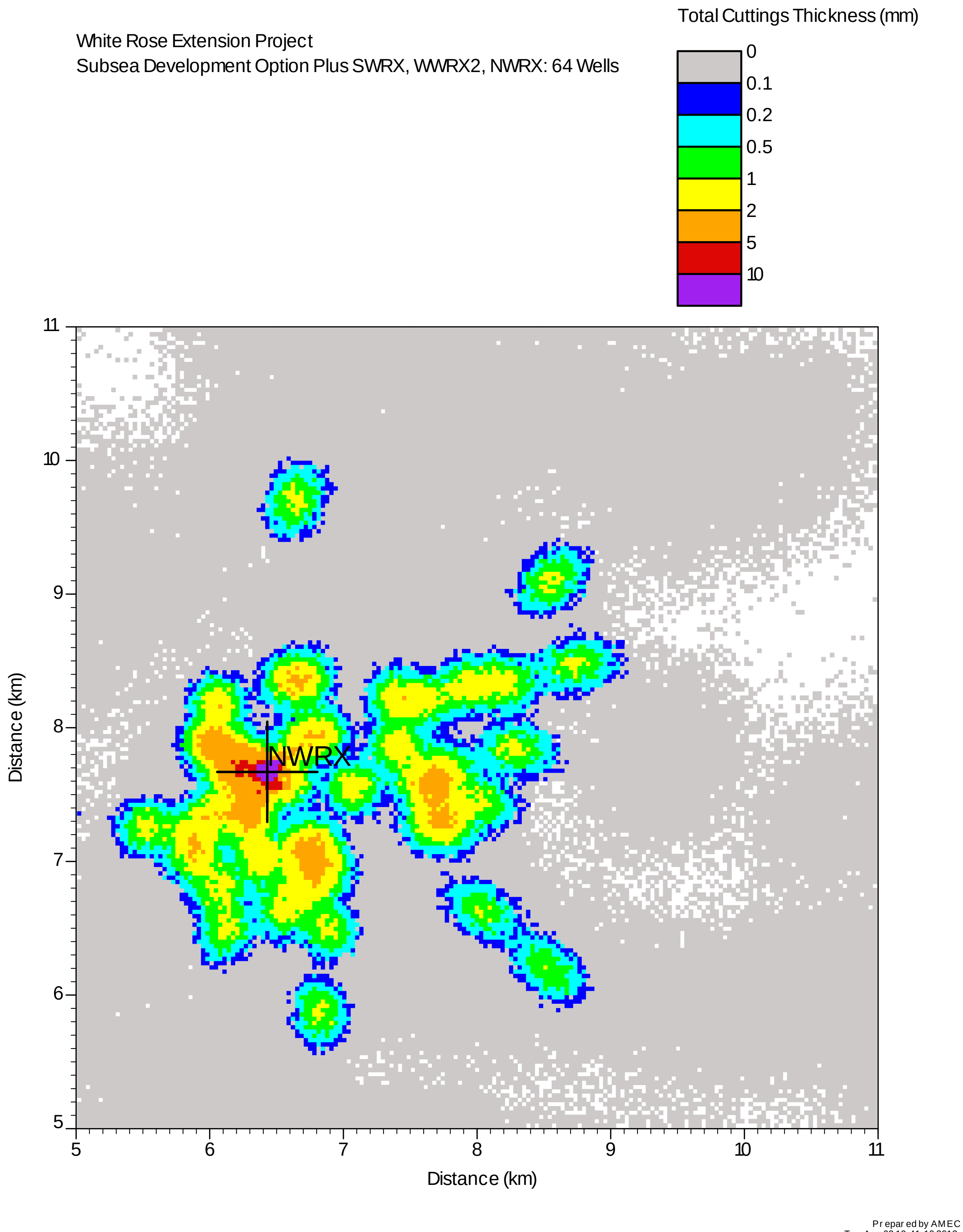


Figure 16 Figure 3-10a Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for Subsea Option with 64 Wells, NWRX View

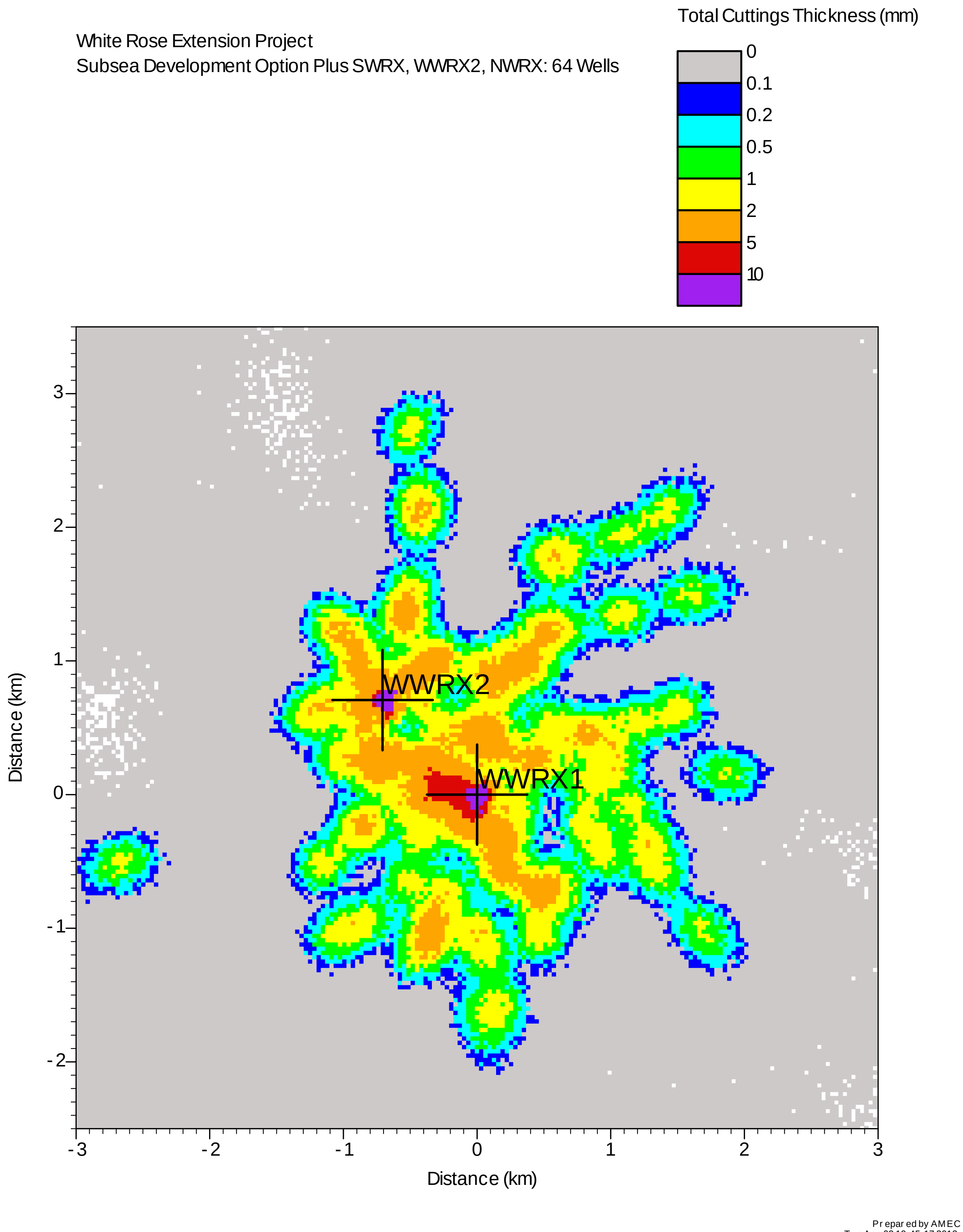


Figure 17 **Figure 3-10b Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for the Subsea Option with 64 Wells, WWRX View**

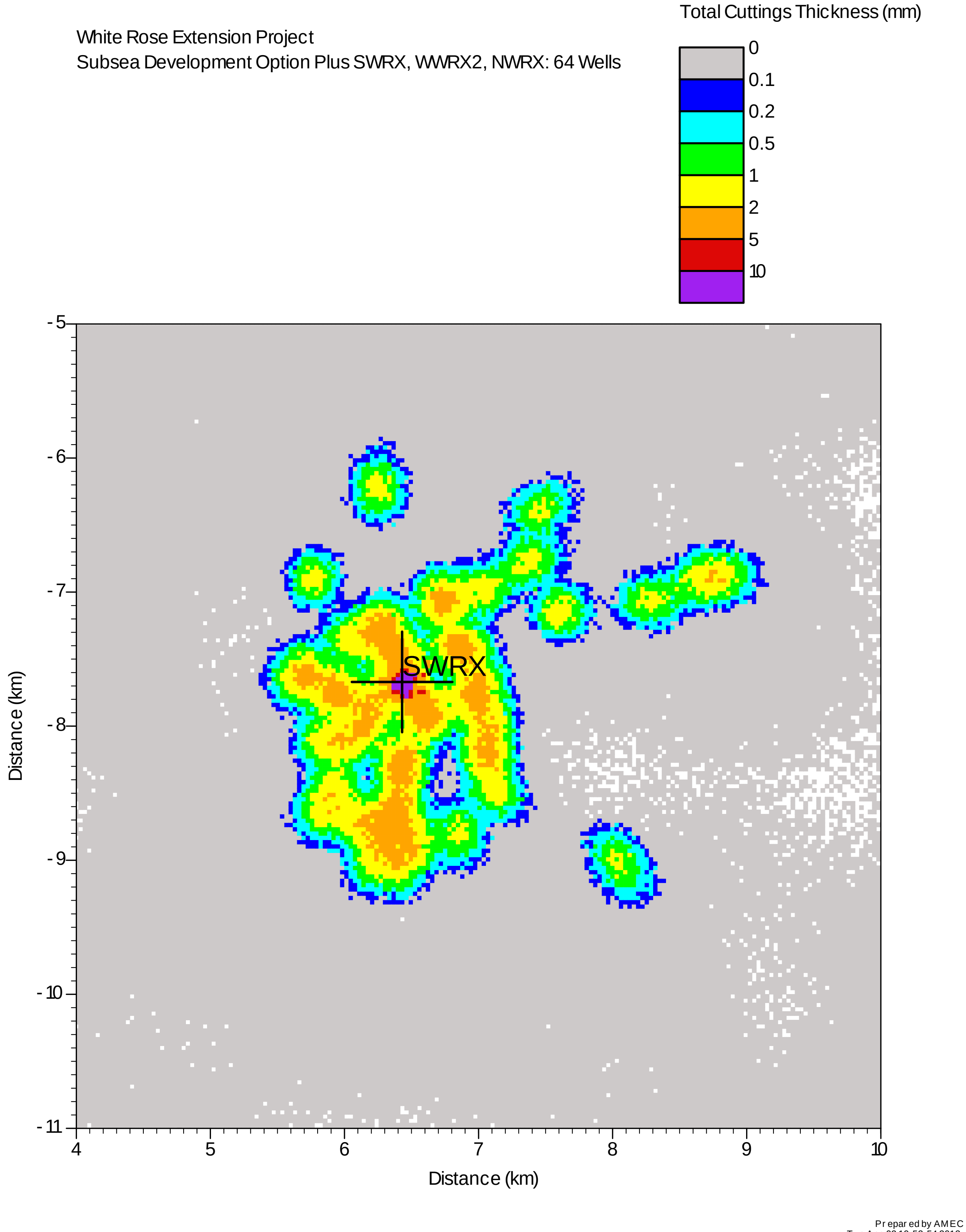


Figure 18 **Figure 3-10c Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for Subsea Option with 64 Wells, SWRX View**

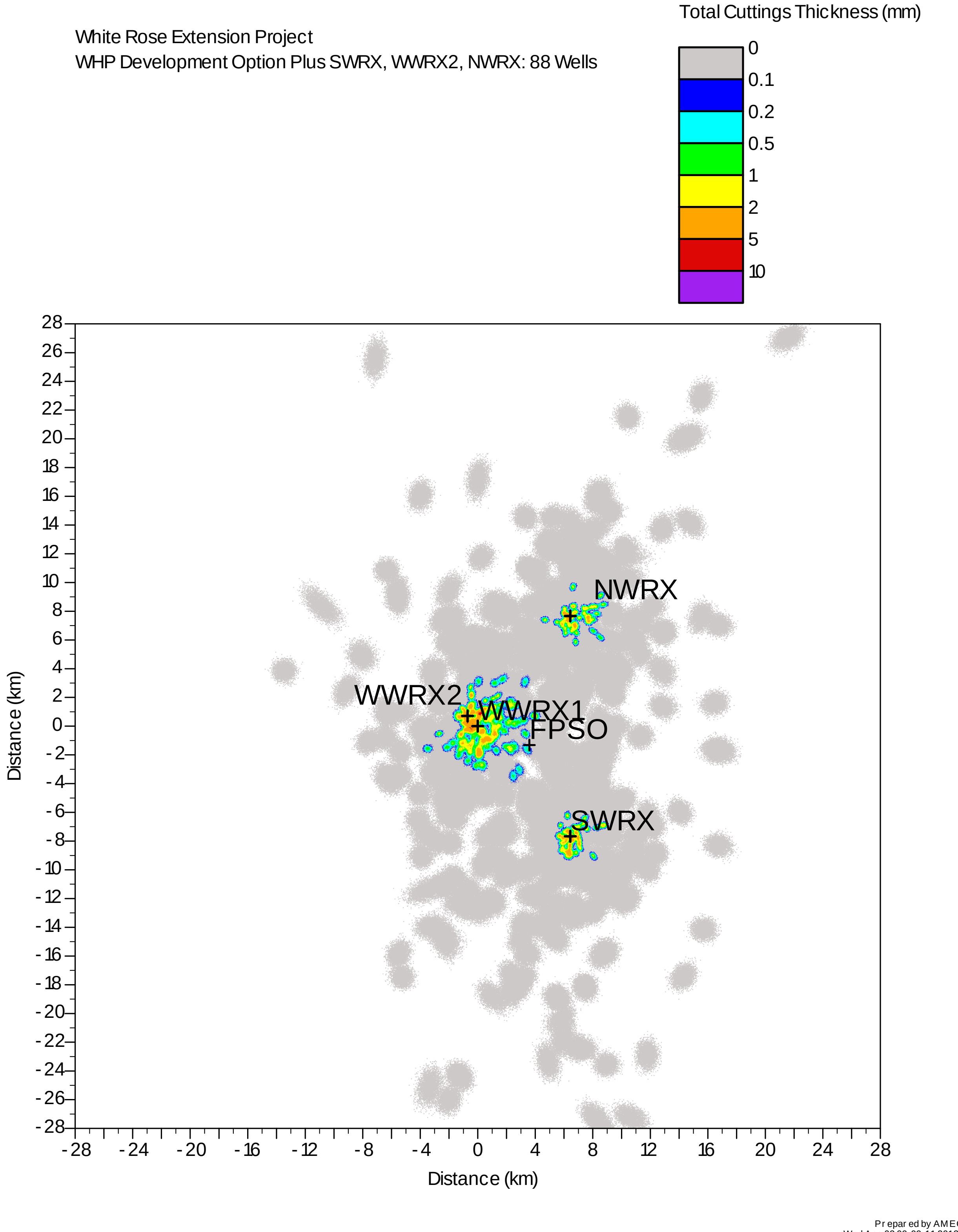


Figure 19 **Figure 3-10d Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for WHP Option (40 Wells) plus 48 Drill Centre Wells**

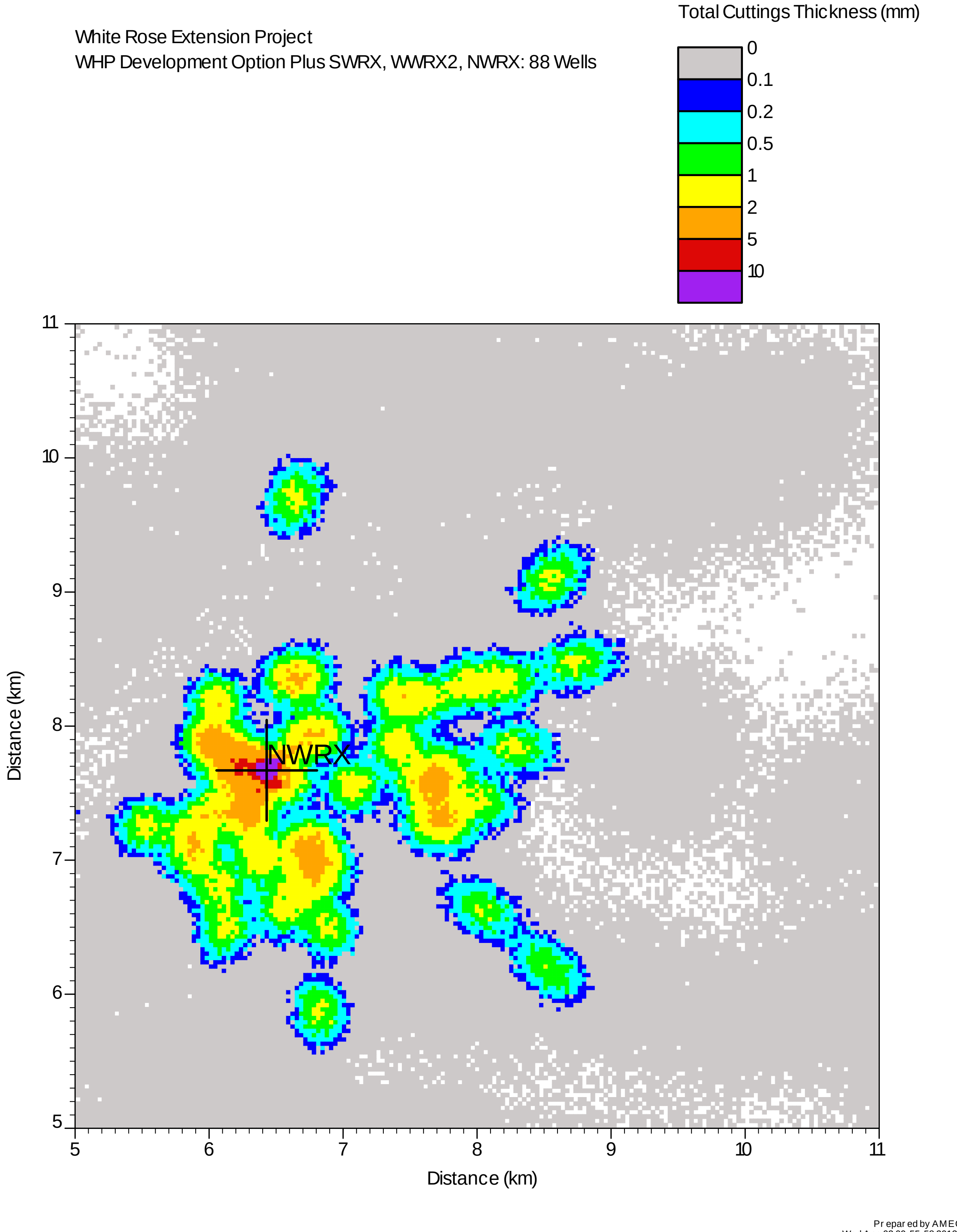


Figure 20 Figure 3-10e Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for WHP Option (40 Wells) plus 48 Drill Centre Wells, NWRX View

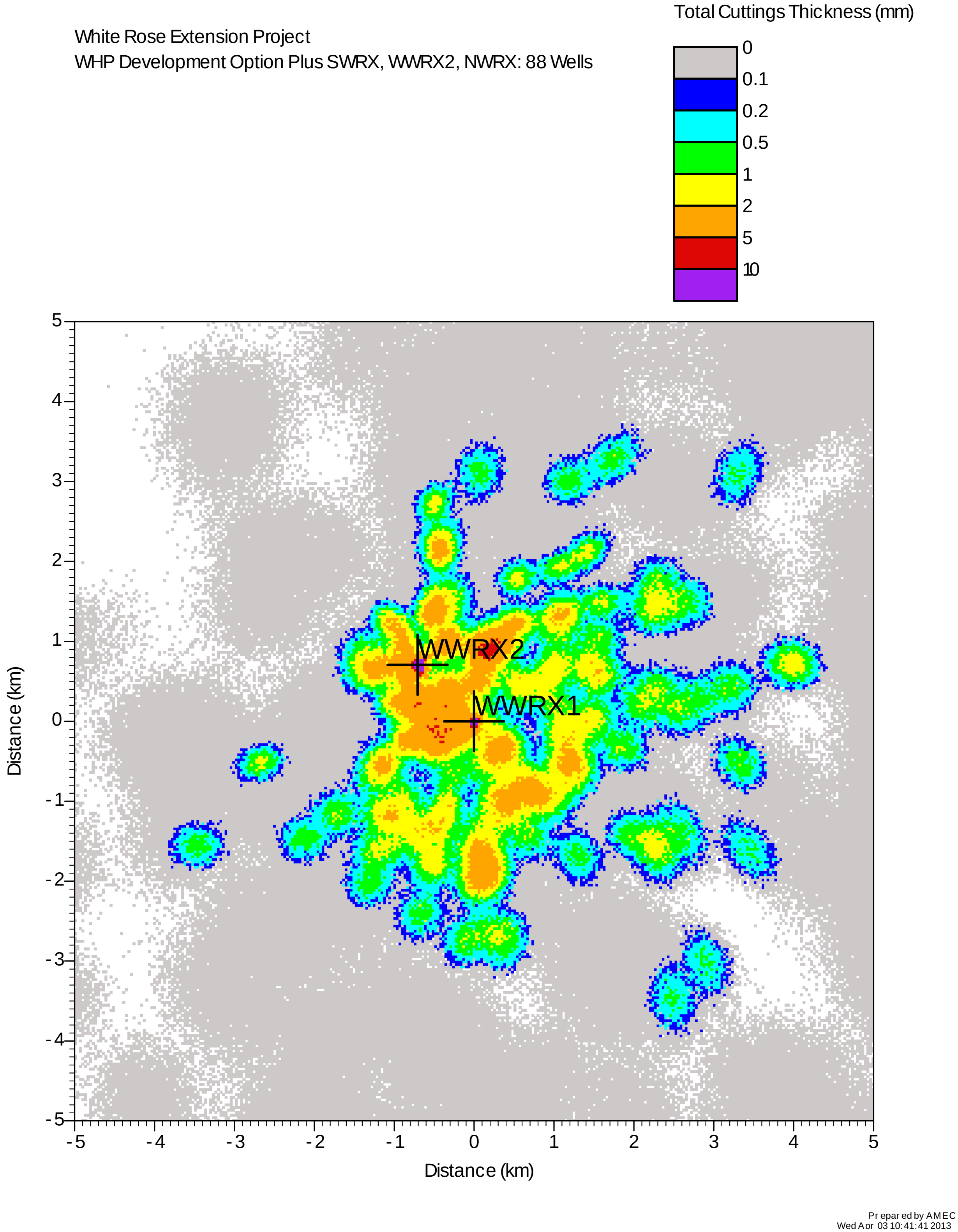


Figure 21 Figure 3-10f Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for WHP Option (40 Wells) plus 48 Drill Centre Wells, WWRX View

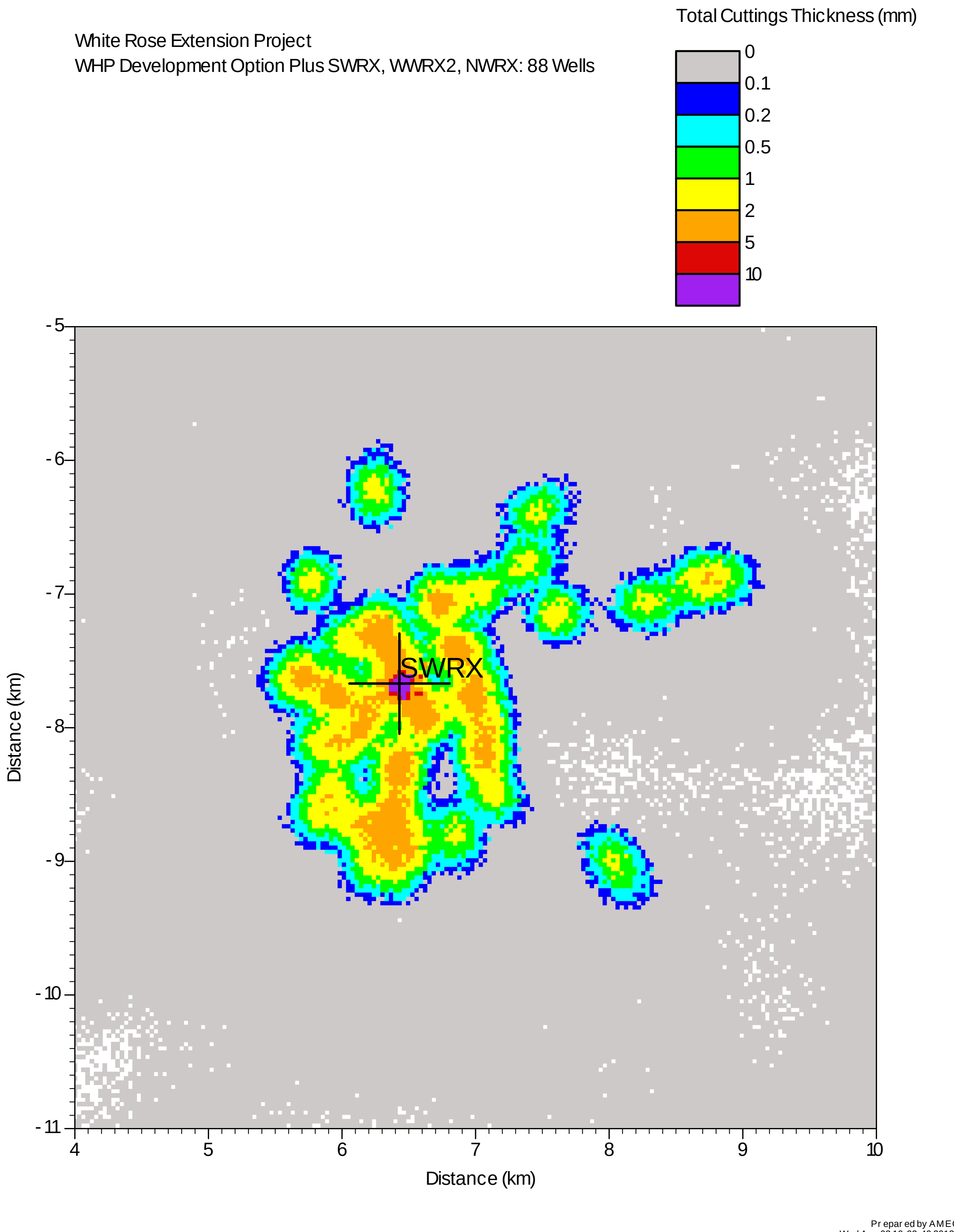


Figure 22 Figure 3-10g Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for WHP Option (40 Wells) plus 48 Drill Centre Wells, SWRX View

§3.3.1 Water-based Mud Cuttings, pg 15 – "*Cuttings from drilling the upper two well sections with WBM will all be released as per the OWTG (2012) close to the seafloor, under either the WHP option with chute release, or under the subsea option with MODU riserless drilling. Therefore, there is little time for the cuttings to be transported large distances by the ambient currents.". The Cuttings are not being released as per the OWTG, they are being released based on the design of the facilities and drilling practices. Also, the MODU discharges WBM at the sea floor while the wellhead platform will release discharges above the sea floor. The paragraph should be reworded to reflect that cuttings are being released based on facility design and practice and that the release of WBM from the platform and MODU are different but simplified for the purposes of the modeling.*

> **Husky Response:**
> Correct, the model is based on facility design and drilling practices. WBM cuttings are released near the sea floor (20 m above for WHP; 10 m above for subsea, see Table 2-2; the elevations of 20 m and 10 m are used in the model).

§3.3.1 Water-based Mud Cuttings, pgs 16-17 - *There is no figure showing the combined deposition of WBM and cuttings for either the WHP option or the Subsea option. There is also no figure showing the disposition of WBM cuttings discharged from all of the subsea wells. The only figure presented is for 16 wells and not the 88 wells for the wellhead platform or the 64 with the subsea option.*

> **Husky Response:**
> WBM cuttings deposition was modelled to assist in the environmental assessment of potential effects of the WREP. Potential physical smothering of fish and fish habitat from cutting deposition is considered more of an environmental risk than the discharge of water-based muds.
>
> For the subsea option, the WBM+SBM (total) cuttings are shown in Figure 3-10 (plus the new three zoom-in views of the same figure for NWRX, WWRX1/2, SWRX) (see Figures 16 to 18).
>
> Please see nearby comment "§3.2.4 Model Geometry, pg 14 - "The subsea..." for discussion and new figures for 88 wells with the WHP option.

§3.3.2 Synthetic-based Jud Cuttings, pg 21 – "*For MODU drilling, SBM cuttings will be treated and released in accordance with the Offshore Waste Treatment Guidelines (OWTG) (National Energy Board (NEB) et al. 2010)*".

See previous comments.

> **Husky Response:**
> Comment noted. Thank you.

§3.3.2 Synthetic-based Jud Cuttings, pg 28 - *A smaller scale figure would be useful to distinguish the near field deposition.*

Husky Response:
Three finer scale versions of Figure 3-10 are provided as Figures 16 to 18, focusing on WWRX, NWRX and SWRX locations.

§3.4 Sensitivity Discussion, pg 31 - *"Sensitivity to the amount of cuttings material is straightforward; in general, the cuttings weights, densities and thicknesses seen over a given area are directly proportional to the volume of materials released." Provide the reference as to the source of the statement or more detail as to how the conclusion that densities and thicknesses are proportional to the volume of material released.*

Husky Response:
1. The volume of materials released, V, defines the weight (W=V * specific weight of the cuttings)
2. In turn, as shown in equation (1), p.7, the weight, W, and model grid cell area, A, define the cuttings density, C
3. In turn, as shown in equation (2), p.7, the thickness, T, is directly proportional to cuttings density, C, and in situ bulk density, γ

§3.4 Sensitivity Discussion, pg 32 – "*For the present modelling, one settling velocity is employed for each particle type. For a faster fines settling velocity sensitivity, the value of 0.005 m/s from Tedford et al. (2003) was selected and applied for the scenario of drilling one of the potential future subsea drill centres." A more detailed explanation as to why this velocity was selected and the others excluded is required. Also, Tedford et al. only studied water based muds so an explanation as to the application of the settling velocities for WBM is comparable to SBM cuttings.*

Husky Response:
For the particle settling velocity sensitivity model run, to consider the effect of faster settling of the fines, AMEC selected a settling rate (w in equation 8) of 0.005 m/s used by Tedford; this is a larger value than the model 'base case' value of w=0.0012 m/s for the fines fall velocity (Table 3-4).

The w=0.005 m/s is a sensitivity to the base case particle settling velocity for fines. It applies to the fines particle whether they are associated with WBM or SBM cuttings (amounts of the different particles are given in Table 3-3). The objective of the sensitivity run is to consider possible change in range of the footprint. The outcome was that cutting thickness increased slightly as a result of faster settling velocities.

Section 4 Drilling Mud Properties and Discharge characteristics, pg 38 – "*The use and disposal of water-based muds are subject to the Offshore Waste Treatment Guidelines (OWTG) (NEB et al. 2010)*".

Previous comments

Husky Response:
Comment noted. Thank you.

Section 4 Drilling Mud Properties and Discharge characteristics, pg 38 – "*The most likely composition of the WBM planned for use during the WREP does not include these weighting agents, therefore no amount of particulate matter is expected to be introduced to the environment due to the release of WBM during any stage of the drilling process. The anticipated composition of WBM (Table 4-1) constitutes primarily of brine, with the possible addition of Sodium Acid Pyrophosphate (SAPP). SAPP is a white powder that is water soluble. It is used as a mud thinner and dispersant, and is especially effective for treating cement contamination (MiSwaco 2006)." Confirm with the proponent what the composition of WBM will be.*

Husky Response:
The WBM systems currently planned for use for the first two hole sections (i.e., conductor and surface) contain components as follows, with notional concentrations provided:

- Drilling Fluid: Seawater
- Mud Sweeps: Seawater + 6 to 10 kg/m³ Guar Gum
- SAPP Sweeps: Seawater + 3 to 7 kg/m³ SAPP
- Kill Mud: NaCl Brine (24%) + 4 kg/m³ Kelzan XCD + 5 kg/m³ Guar Gum + 35 kg/m³ Salt 805

Subsequent hole sections, once the BOP has been installed, will employ SBM fluid systems.

Section 4 Drilling Mud Properties and Discharge characteristics, pg 38 – "*No component of the WBM has been identified as potentially toxic; therefore the dispersion of WBM following the discharges has not been treated in further detail." A reference of other information to support this conclusion is required otherwise it is an unfounded assumption.*

Husky Response:
The WBM that Husky will use is comprised of primarily of brine, with the possible addition of sodium acid pyrophosphate (125 kg per hole section per well).

Acute toxicity of sodium acid pyrophosphate to marine algae and animals is summarized in Neff (2010), who listed the range of LC50 for different species (in) (using the GESAMP (2002) toxicity classification, where >1,000 mg/L is non-toxic and >100 to ≤1,000 mg/L is practically non-toxic). Sodium acid pyrophosphate had a range of 870 mg/L (freshwater species used in test; salt water species expected to much more tolerant) to >100,000 mg/L. Testing the toxicity of WBMs to marine organisms from the Gulf of Mexico, Atlantic and Pacific Oceans and Beaufort Sea (NRC 1983, in Melton et al. 2000) indicated that WBM discharged to the marine environment will be low in toxicity (Melton et al. 2000).
Reference:

GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). 2002. *The Revised GESAMP Hazard Evaluation Procedure for Chemical Substances Carried by Ships*. Reports and Studies No. 64, International Maritime Organization, London, UK. 120 pp.

Melton, H.R., J.P. Smith, C.R. Martin, T.J. Nedwed, H.L. Mairs and D.L. Raught. 2000. *Offshore Discharge of Drilling Fluids and Cuttings – A Scientific Perspective on Public Policy*. Brazilian Petroleum Institute – IBP. Paper prepared for presentation at the Rio Oil and Gas Conference held in Rio de Janeiro, Brazil, October 16-19, 2000.

Neff, J.M. 2010. *Fate and Effects of Water-based Drilling Muds and Cuttings in Cold-water Environment*. A scientific review prepared for Shell Exploration and Production Company, Houston, TX.

Section 4 Drilling Mud Properties and Discharge characteristics, pg 39 – "*Drilling operations involving SBMs will be conducted in accordance with the OWTG (NEB et al. 2010), which dictate the following:*

> *Where there is technical justification (e.g., requirements for enhanced lubricity or for gas hydrate mitigation), operators may use synthetic based mud (SBM) or enhanced mineral oil based mud (EMOBM) in the drilling of wells and well sections. Other than the residual base fluid retained on cuttings as described in the operator's EPP, no whole SBM or EMOBM base fluid, or any whole mud containing these constituents as a base fluid, should be discharged to the sea."*

See previous comments

Husky Response:
Comment noted. Thank you.

7.0 SBM Accidental Release and Dispersion Modelling (AMEC June 2012)

7.1 General Comment

The proponent does not understand the current regulatory environment and should familiarize themselves with the difference between regulation and guidance. The OWTG is not regulation, it is guidance. The OWTG states "…*the goals, objectives and requirements of the applicable acts and regulations, and to explain the expectations of the Boards regarding the management of waste material…" For an operator, the governing document with respect to management of discharges to the natural environment is the Environmental Protection Plan (EPP) submitted as part of the authorization application*." *(OWTG page 2). The document should describe the discharge of cuttings and mud for the project which would include, mud types, discharge locations, and oil on cuttings as expected for the project.*

Husky Response:
The discharge of mud and cuttings and their limits for the WREP will be described in the WREP Environmental Protection Compliance and Monitoring Plan and submitted as part of the authorization application.

7.2 Specific Comments

Executive Summary, pg I – "*The development of the White Rose Extension Project (WREP) will involve the use of synthetic-based muds (SBMs), due to their unique performance characteristics, as well as their low toxicity and relatively low environmental effects compared to oil-based muds (OBMs). "Low toxicity" and "relatively low environmental effects" need to be defined to put the intended meaning in perspective. Information to support the assertion that SBM have low toxicity and relatively low environmental effects compared to OBM is required.*

Husky Response:
Oil-based muds are characterized by much higher toxicity (LC_{50} as low as 0.1 g/kg) in comparison to SBMs (Patin 1999).

Husky Energy's Chemical Management System will continue to adhere to the *Offshore Chemical Selection Guidelines* (OCSG) (NEB et al. 2009), in its assessment of toxicity and biodegradability of discharges for the WREP. The OCSG requires that discharges are initially evaluated against the OSPAR Pose Little or No Risk to the Environment (PLONOR) List. The PLONOR List contains a list of substances that will pose little or no risk to the environment. If one or more of the constituents of a discharge are not on the PLONOR List, the PARCOM OCNS hazard rating system is used.

The Centre for Environment, Fisheries and Aquaculture Science (Cefas), on behalf of the UK government, assigns product ratings for the petroleum industry based on the OCNS. These ratings are based on the physical, chemical and ecotoxicological properties of products. Cefas publishes a list of ranked products and their hazard classifications. The assigned hazard groups vary from category A (most hazardous) through E (least hazardous), and hazard quotient colour bands from purple (most hazardous), through orange, blue, white, and silver, to gold (least hazardous).

As reported annually to the C-NLOPB, Husky only discharges substances on the PLONOR List or class chemicals rated C through E, or colour band silver or gold. Discharge of any substances not on these lists requires justification and pre-approval from the C-NLOPB. The OCNS rating for the constituents of the WBM (listed in the response to the comment Section 4 Drilling Mud Properties and Discharge characteristics, pg 38) are provided in Table 10.

Table 10 Offshore Chemical Notification Scheme Rating for White Rose Extension Project Water-based Mud Constituents

Product Name	OCNS/Charm Rating Class
Sodium Chloride	E
Guar Gum	E
Ketzan XCD Polymer	E
Sifto 100 (sodium chloride)	E
SAPP	E

Reference:

Patin, S. 1999. *Environmental Impact of the Offshore Oil and Gas Industry*. EcoMonitor Publishing, East Northport, NY.

Executive Summary, pgs i – "*The interpretation of the predicted footprint areas and thicknesses should take into account that these are only preliminary dimensions of the projected landing area for the SBM droplets,…". What is meant by Preliminary Dimensions?*

Husky Response:
The current state of knowledge of SBM spill behaviour in the ocean allows for the calculation of the approximate landing area, or footprint, within which SBM droplets of a certain size would fall if they were released within a given period of time. It is not currently possible to predict the extent of spreading of SBM at the sea bottom following the initial landing. Therefore, the modelled footprint dimensions only reflect the spatial spreading of SBM droplets by ocean currents as they fall through the water column, up to the point where they reach the bottom.

Executive Summary, pgs i-ii – "*The subsequent fate and the footprint are likely to evolve in a less predictable fashion, as the negatively buoyant SBM droplets are expected to coalesce into streams or pools, and flow under the influence of gravity and the local bathymetric features.". How does the unpredictability of the settling of SMB affect the model results and the extent of the area affected? This should be better explained in the report.*

Husky Response:
The spreading of SBM after it drops to the sea bottom will likely depend on the SBM droplet interaction with bottom sediments. These processes will likely be specific to the conditions at the landing site, including the site-specific sediment properties, bottom morphology, near-bottom currents and SBM weathering processes. SBM behaviour at the seafloor has not been characterized or quantified by basic research studies to date and is very site and scenario specific..

Executive Summary, pg ii – *"As there is a trade off between the area covered by the spill and the thickness of the spill,…". What is the trade off? Provide more explanation as to the relationship between the area covered and spill thickness, and how this affects the outcome of the model.*

Husky Response:
The SBM model grid consists of cells measuring 30 m by 30 m, and the thickness of SBM in each cell is computed from the total volume of SBM that falls in each cell if that volume was distributed uniformly within the cell. The total volume of spilled SBM is conserved in the model; therefore, the spill thickness and area covered are inversely proportional. In other words, if the spill is spread over a larger number of cells (over a larger area), the spill amount per cell (or spill thickness) would be smaller than if the same amount of SBM landed within a smaller area.

Executive Summary, pg ii – "**…***it is expected that the biodegradation of the SBM on the seafloor would take place over periods on the order of several weeks." A reference and information to support this conclusion is required. Not all of the components of the mud will degrade. The synthetic-based fluid is the component that will degrade faster than remaining components, some of which will not degrade. The assumption that the SBM will degrade is not entirely accurate. Revise the statement to reflect this.*

Husky Response:
SBM biodegradation itself is highly variable, as the various constituents. However, biodegradation of unused SBMs over several weeks is supported by Centre for Offshore Oil, Gas and Energy Research and Lee (2009).

Reference:

Centre for Offshore Oil, Gas and Energy Research and K. Lee. 2009. Environmental persistence of drilling muds and fluid discharges and potential impacts. *Environmental Studies Research Funds Report*, No. 176: 35 pp. http://www.esrfunds.org/pdf/176.pdf

§1.1 Project Background, pg 1 – *"1 Under the wellhead platform (WHP) development option (the alternative to the subsea drill centre option), for both intermediate and main well sections, all SBM will be treated and reinjected or stored/ transferred to the next well." The proponent has neglected to consider that it is possible to spill SBM from the platform. For example on January 28, 2003 Hibernia spilled 23.7 m^3 of SBM when gates were not properly aligned to direct SBM to cuttings reinjection. There have also been instances where SBM was spilled due to breakages of bunkering hoses. The proponent should review the possibilities of SBM being lost from the WHP and, as appropriate, model those situations.*

Husky Response:
Please see nearby comment §2.2 Potential Synthetic-based Mud Accidental Release Scenarios for the White Rose Extension Project, pg 6 – "The most …"

The surface/platform release scenario (initially 60 m^3, now 175 m^3) is the most severe, but reasonable, hypothetical scenario that can be anticipated for the WREP (WHP). In the report we've classified the releases as surface/mid-depth/near bottom based on the literature review (following SwRI 2007), and picked the most common mode of failure for each, and used the most severe spill amount for each of those modes in the modelling. The 175 m^3 is more severe than the 23.7 m^3 cited by the reviewer.

§1.1 Project Background, pg 1 – *"The use of SBMs in offshore drilling operations is regulated in accordance with the Offshore Waste Treatment Guidelines (OWTG) (NEB et al. 2010), which dictate the following:…". The OWTG are not regulation they are guidance. Please refer to general comment above on the difference between guidance and regulation.*

Husky Response:
Comment Noted. Thank you.

§1.1 Project Background, pg 1 – "…*as the synthetic fluids that comprise the continuous phase exhibit low toxicity to aquatic life and are more biodegradable in marine sediments than OBMs.". The statement "low toxicity and more biodegradable" needs to be put in context. Define what is meant by low toxicity and explain (and reference) how SBM is more biodegradable than OBM.*

Husky Response:
Unlike the base oils in OBMs (diesel and mineral oil), which are refined from crude oil, the base fluids in SBMs are synthesized organic compounds so are less toxic and biodegrade faster than OBMs (Patin 1999).

§1.1 Project Background, pg 1 –*At the end of page 1 Burke and Veil (1995) is cited; however no such reference appears in the "Literature Cited" section. The reference can not be checked to verify that it supports the statements made in the paragraph.*

Husky Response:
Reference was indeed missing, thank you.

Burke, C.A., and Veil, J.A. 1995. Synthetic-based drilling fluids have many environmental pulses. *Oil and Gas Journal*, 93(48): 59-71.

§1.2 Objectives, pg 2 – "*It is noted that these studies are preliminary and the information will be updated as design progresses through FEED and detailed engineering." MODU are not dependent on the FEED analysis. They are not a specific design for the Project. There should be sufficient information regarding accidental releases of SBM from these facilities. The design of the WHP should be at a stage where losses of SBM can be identified.*

Husky Response:
While MODU design is not associated with FEED analysis, there is variation amongst capacity and design of current MODUs in use and newer MODUs that may be operating in the area.

As WHP design progresses through FEED and detailed design, further optimizations will occur to validate and potentially improve the overall design with the goal of safe and efficient operations. This would include mitigations against spills. In this context, the information would be considered preliminary.

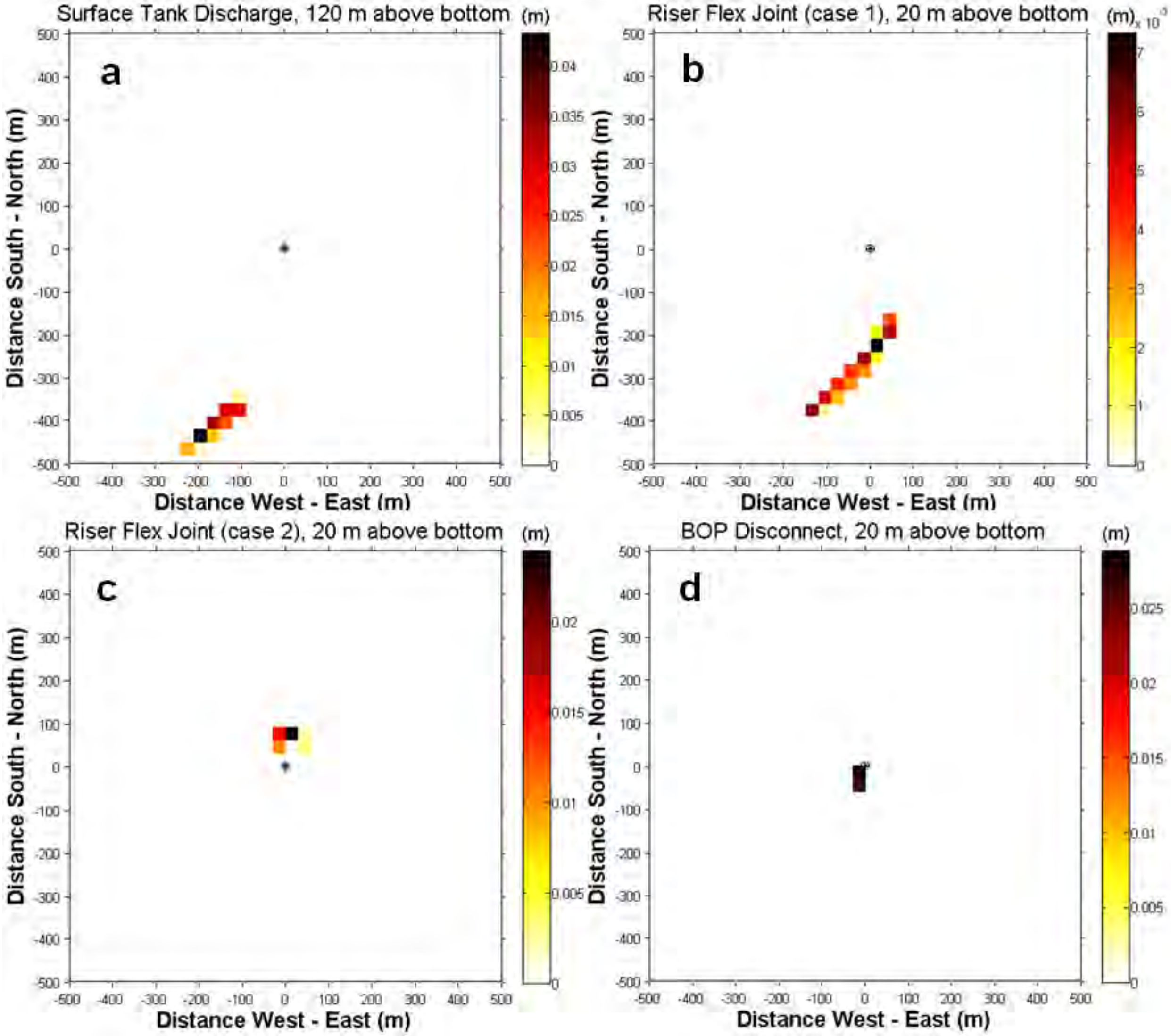
§2.2 Potential Synthetic-based Mud Accidental Release Scenarios for the White Rose Extension Project, pg 6 – "*The most severe hypothetical scenario that can be anticipated for the WREP involves the inadvertent discharge of the entire volume of a mud tank, resulting in 60 m3 of SBM being discharged through a 25 cm (10 inch) (internal diameter) pipe a few metres below the sea surface.". An explanation as to how this hypothetical case was arrived at is needed considering that this is not the worst case in the C-NLOPB jurisdiction. The worst case was on October 24, 2004 when Husky spilled 96.7 m^3 from the GSF Grand Banks through the diverter line.*

Husky Response:
The most severe, but reasonable hypothetical scenario that can be anticipated for the WREP (WHP) remains the inadvertent discharge of the entire volume of a reserve mud tank, resulting in 175 m^3 of SBM being discharged through a 25 cm (10 inch) (internal diameter) pipe a few metres below the sea surface. This volume has been updated since initial EA submission to reflect latest design.

An updated amount for the Surface Tank Discharge (STD) (mud tank) scenario is 175 m^3, almost three times the original volume of 60 m^3. The release time for this scenario has also been extended to 1.5 h (three times the original 0.5 h) to reflect the larger amount of SBM spilled. The updated results indicate that tripling the amount of SBM spilled from the surface would approximately triple the maximum footprint lengths and areas, but the median footprint length and areas would only double compared to the original results. The lengths and areas of the footprints from this scenario would still be smaller than those expected for the Riser Flex Joint (case 1), due to the fact that this mode of release is expected to produce SBM droplets with low fall velocities that can spread further over a shorter period of time.

See also Figure 23 (revised Figure 3-3) of results as response to comment §3.4 Synthetic-based Mud Dispersion Model Results, Figure 3-3. pg 17.

Another result of the updated surface release scenario is the increase in layer thickness. Thus, the STD scenario would result in the highest maximum layer thicknesses (19.4 cm in limited areas), and the highest average layer thicknesses (5.1 to 6.1 cm) that are most closely comparable to the average layer thicknesses of the BOP disconnect scenario (4.8 to 4.9 cm). It should be noted that the BOP disconnect scenario results in footprints that are approximately four to five times smaller in area than those from the STD scenario.



Note: a) surface low-speed jet release; b) subsea high-speed jet – low fall velocity; c) subsea high-speed jet – high fall velocity; d) subsea low-speed jet (BOP disconnect). The colour-contoured heights (z-value) is SBM layer thickness (m).

Figure 23 Revised Figure 3-3 Example Realizations for the Four Modelled Release Scenarios in Winter

Section3.0 Synthetic-Based Mud Spill Dispersion Modelling, pg 9 – "*A literature review of the current state of scientific knowledge of the behaviour of SBM in the marine environment, as well as reports of observations of actual SBM spill events, revealed that SBMs exhibit a unique behaviour in the marine environment due to the fact that they are immiscible in water (i.e., cannot be mixed with), and are negatively buoyant.". A reference is required to support this conclusion.*

Husky Response:

We agree that the reference to the study describing the SBM behaviour should appear in the text sooner than it does.

The behaviour of spilled SBM in the ocean has been studied and quantified in laboratory conditions by the Southwest Research Institute, as discussed on page 10 of the report and thereafter (reference below). The same study included a review of spill incident reports as well as interviews with operators in the Gulf of Mexico, which indicate that SBM is negatively buoyant and immiscible in water. This behaviour of SBM can be expected based on the composition of commonly used SBM.

Reference:

SwRI (Southwest Research Institute). 2007. *Fall Velocity of Synthetic-Based Drilling Fluids in Seawater*. Final Report, prepared for Minerals Management Service.

Section3.0 Synthetic-Based Mud Spill Dispersion Modelling, pg 9 – "*Unlike water-based fluids, they tend to form distinct jets and droplets that fall relatively rapidly through the water column, and they are prone to form visible and clearly-defined streams and pools at the seafloor, where their dispersion is in large part driven by gravity in conjunction with the local seafloor features.". A reference is required to support this conclusion*

Husky Response:
Same as previous comment: We agree that the reference to the study describing the SBM behaviour should appear in the text sooner than it does (page 10).

Section3.0 Synthetic-Based Mud Spill Dispersion Modelling, pg 9 – "*To date, there have been no systematic field observations of SBM dispersion in the marine environment that could be used to quantify their dispersion properties in a real world scenario.". The Proponent's EEM programs would provide an indication of the extent of SBM dispersion to verify the model.*

Husky Response:
The White Rose EEM program monitors the potential effects of field operations. An accidental SBM spill would require a site specific incident monitoring program to verify the model.

A comparison of the drill cuttings dispersion model and White Rose EEM results is provided above in response to comment G4 . Husky has completed a number of Environmental Effects Monitoring (EEM) Programs which give an indication of the extent of area affected by cuttings discharge from a MODU. There is no indication that the model has been calibrated or compared to the results of the EEM Programs. Such a comparison would demonstrate the accuracy of the model to predict the deposition of cuttings discharged.

§3.1 Synthetic-based Mud Properties and Behaviour, pg 9 – "…*the continuous phase is comprised of Puredrill IA-35LV, a non-toxic and readily biodegradable synthetic fluid…". A reference is required to support this conclusion. The terms "low toxicity" and "readily biodegradable" need to be defined.*

Husky Response:
Exposure trials of PureDrill IA-35 on *Artemia* nauplii, capelin larvae, marine copepods, juvenile yellowtail flounder and ctenophores indicated that the potential for acute toxicity was very low (Payne et al. 2001). The MSDS for PureDrill IA-35 indicates that the product is readily biodegradable based on the results of the OECD Guideline for Testing of Chemicals (301b), which describes methods that permit the screening of chemicals for ready biodegradability in an aerobic aqueous medium. It was also found to be readily biodegradable in laboratory tests (Centre for Offshore Oil, Gas and Energy Research and Lee 2009).

References:

Centre for Offshore Oil, Gas and Energy Research and K. Lee. 2009. Environmental persistence of drilling muds and fluid discharges and potential impacts. *Environmental Studies Research Funds Report*, No. 176: 35 pp.

Payne, J., L. Fancey, C. Andrews, J. Meade, F. Power, K. Lee, G. Veinott and A. Cook. 2001. Laboratory exposures of invertebrate and vertebrate species to concentrations of IA-35 (Petro-Canada) drill mud fluid, production water and Hibernia drill mud cuttings. *Canadian Manuscript Report of Fisheries and Aquatic Sciences*, No. 2560: iv + 27 pp.

§3.1 Synthetic-based Mud Properties and Behaviour, pg 9 – "*The overall density of the SBM will be 1,350 kg/m3.". Density of a drilling mud varies depending on the specific conditions of well section being drilled. For the purpose of this modeling, it is best to use a generic mud formulation which would produce a worst case result.*

Husky Response:
A drilling fluid density of 1,350 kg/m^3 represents a generic fluid density for the WHP application, based on anticipated drilling fluid densities and offset well history.

§3.4 Synthetic-based Mud Dispersion Model Results, Figure 3-3. pg 17 - *The graphical presentation in Figure 3-3 is rather crude and small. It should be revised in finer resolution. Please indicate what each axis represents and where the release originated.*

Husky Response:
Please see Figure 23 (revised Figure 3-3). The axes are the distances in the south-north (y-axis) and west-east (x-axis) directions, about the origin, or point of release, at (x,y) = (0,0) shown as a small symbol.

§3.5 Synthetic-based Mud Dispersion Model Sensitivity Tests, pg 19 – "*However, the tradeoff is that the larger footprint will result in a lower average SBM layer thickness at the seafloor, compared to the case where a smaller area receives a larger portion of the SBM.". Is this a trade off or an outcome of the model?*

Husky Response:
This is considered a trade-off because a larger footprint would result in thinner layer of SBM and vise-versa, but is also a result of the model.

The SBM model grid consists of cells measuring 30 m by 30 m, and the thickness of SBM in each cell is computed from the total volume of SBM that falls in each cell if that volume was distributed uniformly within the cell. The total volume of spilled SBM is conserved in the model; therefore, the spill thickness and area covered are inversely proportional. In other words, if the spill is spread over a larger number of cells (over a larger area), the spill amount per cell (or spill thickness) would be smaller than if the same amount of SBM landed within a smaller area.

Section 4.0 Summary, pg 22 – *"The interpretation of the predicted footprint areas and thicknesses should take into account that these are only preliminary dimensions of the projected landing area for the SBM droplets, and the estimated SBM layer thickness if the full spill volume landing in each model cell were to be equally distributed within that cell.". Saying that these are preliminary results implies that the information provided is not finalized and that there is more work to be done to calibrate the model or to collect additional data so the model's output represents the actual dispersion of mud. The Proponent needs to complete this work, submit a new report and revise the environmental assessment report, as appropriate.*

Husky Response:
The quoted statement by AMEC reflects the current state of scientific knowledge of SBM behaviour in the ocean environment, which is still in the early stages of development. AMEC acknowledges that further basic research is required to fully characterize SBM behaviour on the seafloor. The current SBM dispersion modelling study by AMEC represents a first effort (to the best knowledge of the authors) to model SBM spill behaviour on the Grand Banks based on the quantitative laboratory study by SwRI (2007), which treated SBM dispersion through the water column, but not the subsequent spreading on the sea bottom.

The current state of knowledge of SBM spill behaviour in the ocean allows for the calculation of the approximate landing area, or footprint, within which SBM droplets of a certain size would fall if they were released within a given period of time. It is not currently possible to predict the extent of spreading of SBM at the sea bottom following the initial landing.

8.0 Air Emissions Study – White Rose Extension Project (Stantec June 21, 2012) Revised Draft Report

8.1 General Comments

G1 The "Air Emissions Study" report submitted is a revised draft report. Is it Husky Energy's intention to submit a final report?

Husky Response:
Husky does not intend to submit another copy of this report. The submitted report was intended to be the final.

G2 Section 5.3.6.2 of the Scoping Document directs the proponent to describe the potential means for reduction and reporting of air emissions. This report only deals with ambient air quality and does not examine the potential to reduce emissions from equipment or the facilities (i.e., WHP or MODU). The proponent should provide details with regard to plans to reduce and report air emissions. The proponent should also consider the future direction the federal government will take in achieving reductions of greenhouse gases in its evaluation.

Husky Response:
Husky appreciates that energy efficiency is important to the WREP. That is why the detailed design and the tender documents will place value on the energy efficiency and emissions level of the selected units. It is Husky's intent to incorporate into their tender documents requests for emission reduction identification from the facility. Bidders will be directed to prepare bids reflecting these priorities. As well, any future policies or guidelines issued by the federal government during WREP design will be taken into consideration during final design.

G3 The report has not mentioned gas dehydration for the WHP. If gas is to be dried for use on WHP it should be included in the report along with emissions estimates.

Husky Response:
Gas dehydration will be conducted on the FPSO, not the WHP.

8.2 Specific Comments

§3.2.2.1 Option 1 – Wellhead Platform, pg 12 – "*During normal operations of the WHP, a support vessel will be on stand-by for the Platform 365 days/year and at least one supply vessel will also be in operation 365 days/year, travelling between the east coast of…". The estimated number of vessels, two, appears to be low. The number of vessels to be used should be confirmed and compared to the number of vessels associated with other similar operations.*

Husky Response:
The estimated number of vessels used to calculate the emissions from the operation of the support vessels has been confirmed and remains at two, the number used within the Environmental Assessment and Air Emissions Study. If, once the WREP becomes operational, the number of support vessels differs, the additive emissions will be reported to the C-NLOPB and Federal Government through various reporting systems.

§3.2.2.1 Option 1 – Wellhead Platform, pg 12 – "*Helicopters will also routinely travel between the east coast of Newfoundland and the offshore WREP site to transport employees to and from work, approximately three round trip flights per week." This estimate is for rotation of employees and does not account for other flights that may occur such as adhoc or medivacs. Such flights should also be included.*

Husky Response:
The estimate of approximately three round trip helicopter flights will occur per week, weather depending, has been confirmed and is valid. The additional number of flights, such as *ad hoc* or medevacs, is currently unknown, and will likely not add up to the number of routine flights cancelled due to incremental weather.

§3.2.2.1 Option 1 – Wellhead Platform, pg 14 – "*The fuel gas composition analysis, as presented in Table 3-8, indicates that there is no hydrogen sulphide (H_2S) present in the gas;…". This is the composition of the gas now, however, as the field ages it is possible that the field may sour and H_2S present in the gas. The proponent needs to examine this possibility and, if possible, account for souring in the modeling.*

Husky Response:
Husky is not expecting sour gas at a particular time but, consistent with the *SeaRose FPSO* topsides design, the WHP will be designed to handle 200 ppm H_2S in topsides piping.

§3.2.2.1 Option 1 – Wellhead Platform, pg 14 – "*Emissions related to the operation of the two 10 MW dual-fueled turbine generators were calculated using emission factors acquired from the US EPA AP-42 Chapter 3.1 Stationary Gas Turbines (US EPA 2000) and assuming a 34 percent efficiency (shaft plus electrical) for normal operations." Information on the efficiency of turbine generators is assumed but should be available and used in the modeling. The basis of the assumption used needs to be stated along with how the assumptions affect the outcome of the modeling.*

Husky Response:
As currently planned, the proposed WREP will use Siemens SGT-400 12.9 MW turbine generators for power generation on the WHP. The performance spec sheet for this unit states that the gross efficiency of the unit ranges from 33 to 36 percent, depending on the gross power. Therefore, the estimate of 34 percent used in the modelling conducted for the WREP environmental assessment is consistent with design specifications.

§3.2.2.2 Option 2 – Subsea Drill Centre, pg 15 - *Only total quantities of air emission are presented. This section should include a list of the emission sources and their contribution to the total emissions. If flaring is to occur with MODU, flare emission from the MODU will need to be included.*

Husky Response:

The emission estimates for the MODU were based on the operation of a MODU in the White Rose Field during a typical operating year. The emissions are representative of the combustion of diesel fuel in boilers and turbines. Flaring is an unpredictable and rare event and has not occurred from a MODU in the White Rose field since 2008.

Note that a transposition error was discovered following submission of the WREP Environmental Assessment and the Air Emissions Study. This error affects predicted concentrations of SO_2 from the operation of the MODU. The emission rate for SO_2 from the operation of the MODU is stated as being 0.008 g/s in the Environmental Assessment and Air Emissions Study; however, this value is 0.146 g/s. The corrected concentration predictions for SO_2 is still far below the regulatory limit for all modelling scenarios considered and are provided in Tables 11 and 12.

Table 11 Maximum Predicted Ground Level Concentrations of Sulphur Dioxide for Normal Operation of the Mobile Offshore Drilling Unit

Receptor	UTM		1-hour (µg/m^3)	3-hour (µg/m^3)	24-hour (µg/m^3)	Annual (µg/m^3)
	Easting (m)	Northing (m)				
White Rose	727708	5186021	22.7	17.6	7.56	0.522
Hibernia	669419	5179807	0.756	0.468	0.144	0.005
Terra Nova	693372	5149964	1.044	0.882	0.252	0.009
NL Regulatory Limit	-	-	900	600	300	60

Table 12 Maximum Predicted Ground Level Concentrations of Sulphur Dioxide for Cumulative Mobile Offshore Drilling Unit Operation

Receptor	UTM		1-hour (µg/m^3)	3-hour (µg/m^3)	24-hour (µg/m^3)	Annual (µg/m^3)
	Easting (m)	Northing (m)				
White Rose	727708	5186021	28.6	21.6	9.72	0.666
Hibernia	669419	5179807	1.01	0.612	0.198	0.007
Terra Nova	693372	5149964	1.37	1.17	0.324	0.011
NL Regulatory Limit	-	-	900	600	300	60

§4.5.3 Source Inputs, pg 23 – "*As discussed in Section 3.2.2, there is potential for approximately 12 blowdowns to occur per year. During a single blowdown event approximately 7,400 m^3 of gas is released from the flare. This type of flaring usually occurs over a short period of time and for calculation purposes a 10-minute release rate has been assumed for this study.". What are the source of the 12 blowdowns and 7,400 m^3 of gas? Why is an assumption made? The Proponent currently operates a FPSO and should be able to provide the duration of a blowdown. Please provide the basis of this assumption.*

Husky Response:
The duration of one blowdown event was an assumption used by Stantec to reflect an emergency reduction to half-pressure that must be complete within a 10 minute period, a condition that has been applied to other facilities. This information has since been updated based on further design of the WHP and therefore, modelling of a revised flare blowdown event was conducted and the results are provided in Table 13. A revised estimate of approximately 1,727 kg (or 2,409 m^3 (4.01 m^3/s)) of gas will be released during a blowdown event, based on the latest WHP design. The number of blowdown events per year is expected to be infrequent and not likely amounting to 12 in any given year.

§5.6 Greenhouse Gas Emissions (Wellhead Platform and Subsea Drill Centre), pg 36 - *The summary only deals with air quality objectives. It does not deal with emissions from equipment and how their emissions can be minimized. The report also does not consider future emission reduction targets being considered by the federal government. The Proponent should address these issues as they are more relevant to the proposed operation than achieving air quality objectives. Air Quality objectives are not relevant as the proposed operation is in flat terrain with good dispersion and distant receptors.*

Husky Response:
As the proposed WREP has not undergone final design or tendering, plans pertaining to equipment and emission reductions are not currently available. The requirement for such consideration will be included in Husky's tender documents for final WREP design. During the final WREP design, consideration will also be given to any emission reduction targets identified by the federal government.

Table 13 Summary of Model Predictions - Maximum Predicted Ground-level Concentration for a Wellhead Platform Flare Blowdown Event

Contaminant	Averaging Period	Receptor	Location (UTM) Easting (m)	Location (UTM) Northing (m)	Maximum Predicted GLC (μg/m^3)	NL *Air Pollution Control Regulations* (μg/m^3)
NO_2	1-hour	Hibernia	669419	5179807	6.96E-01	400
		Terra Nova	693372	5149964	7.84E-01	
		White Rose (*SeaRose FSPO*)	727708	5186021	7.48	
	24-hour	Hibernia	669419	5179807	1.09E-01	200
		Terra Nova	693372	5149964	1.69E-01	
		White Rose (*SeaRose FSPO*)	727708	5186021	3.70	
	Annual	Hibernia	669419	5179807	3.82E-03	100
		Terra Nova	693372	5149964	5.12E-03	
		White Rose (*SeaRose FSPO*)	727708	5186021	2.02E-01	
SO_2	1-hour	Hibernia	669419	5179807	9.59E-03	900
		Terra Nova	693372	5149964	1.10E-02	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.05E-01	
	3-hour	Hibernia	669419	5179807	6.59E-03	600
		Terra Nova	693372	5149964	5.25E-03	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.03E-01	
	24-hour	Hibernia	669419	5179807	1.47E-03	300
		Terra Nova	693372	5149964	2.31E-03	
		White Rose (*SeaRose FSPO*)	727708	5186021	5.20E-02	
	Annual	Hibernia	669419	5179807	5.24E-05	60
		Terra Nova	693372	5149964	6.99E-05	
		White Rose (*SeaRose FSPO*)	727708	5186021	2.82E-03	
CO	1-hour	Hibernia	669419	5179807	1.53E-01	35,000
		Terra Nova	693372	5149964	1.76E-01	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.67	
	8-hour	Hibernia	669419	5179807	7.03E-02	15,000
		Terra Nova	693372	5149964	5.88E-02	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.46	
TPM	1-hour	Hibernia	669419	5179807	1.51E-02	-
		Terra Nova	693372	5149964	1.55E-02	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.50E-01	
	24-hour	Hibernia	669419	5179807	2.63E-03	120
		Terra Nova	693372	5149964	3.79E-03	
		White Rose (*SeaRose FSPO*)	727708	5186021	7.40E-02	
	Annual	Hibernia	669419	5179807	8.39E-05	60
		Terra Nova	693372	5149964	1.15E-04	
		White Rose (*SeaRose FSPO*)	727708	5186021	4.08E-03	

Contaminant	Averaging Period	Receptor	Location (UTM)		Maximum Predicted GLC (µg/m^3)	NL *Air Pollution Control Regulations* (µg/m^3)
			Easting (m)	Northing (m)		
PM_{10}	1-hour	Hibernia	669419	5179807	1.45E-02	-
		Terra Nova	693372	5149964	1.48E-02	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.43E-01	
	24-hour	Hibernia	669419	5179807	2.53E-03	50
		Terra Nova	693372	5149964	3.64E-03	
		White Rose (*SeaRose FSPO*)	727708	5186021	7.06E-02	
$PM_{2.5}$	1-hour	Hibernia	669419	5179807	1.38E-02	-
		Terra Nova	693372	5149964	1.39E-02	
		White Rose (*SeaRose FSPO*)	727708	5186021	1.35E-01	
	24-hour	Hibernia	669419	5179807	2.41E-03	25
		Terra Nova	693372	5149964	3.46E-03	
		White Rose (*SeaRose FSPO*)	727708	5186021	6.64E-02	

9.0 Government of Newfoundland and Labrador

9.1 Department of Advanced Education and Skills

The Labour Market Development Division and the Skills Development Division of the Department of Advanced Education and Skills have reviewed the environmental assessment report provided for EA Registration #1665 by the proponent (Husky Energy). We are satisfied that the information provided in this report meets our requirements as outlined in the EA Guidelines for this project, and have no further comments on this report. In our opinion, the project may proceed.

Husky Response:
Comment noted. Thank you. For the information of the Department of Advanced Skills and Education, an updated estimate of the person hours and corresponding full-time equivalents required for graving dock construction and concrete gravity structure construction at Argentia is provided as Table 14 (revised Table 4-2). The revised numbers are based on further project definition following completion of FEED.

As the project moves closer to commencement, we are requesting copies of any HR, Benefits, Diversity and/or Women's Employment plans prepared for this project, as well as quarterly employment reports as outlined in the guidelines document.

Husky Response:
Comment noted. Thank you. The *White Rose Extension Project Diversity Plan* is provided with this WREP EA Addendum as Attachment 1. No revisions have been made to this report since it was provided to DOEC on April 3, 2013.

9.2 Department of Environment and Conservation

9.2.1 Environmental Assessment Division

Adequate justification provided on the need for a labour camp.

Husky Response:
Comment noted. Thank you.

Regarding site decommissioning see Water Resources Management Division comments below.

9.2.2 Pollution Prevention Division

Further Information Required during EA:

1. *Information related to all potential discharges from the activity should be provided. This includes, but is not limited to details regarding the discharge locations, expected quality, duration, monitoring and receiving areas.*

Table 14 Revised Table 4-2 Estimated Person-hours (Full-time Equivalents) to Design Graving Dock and Construct Graving Dock and Concrete Gravity Structure by Quarter

NOC Code	Role	Qtr 3, 2013	Qtr 4, 2013	Qtr 1, 2014	Qtr2, 2014	Qtr 3, 2014	Qtr 4, 2014	Qtr 1, 2015	Qtr2, 2015	Qtr 3, 2015	Qtr 4, 2015	Qtr 1, 2016	Qtr2, 2016	Qtr 3, 2016	Qtr 4, 2016	Qtr 1, 2017	Qtr2, 2017	Qtr 3, 2017
Graving Dock Construction																		
NOC-0113	Purchasing managers	890(2)	811(1)	834(1)	891(1)	413(1)												
NOC-0211	Engineering managers	3561(6)	3246(4)	3337(4)	3566(5)	1650(4)												
NOC-1221	Administrative officers	890(2)	811(1)	834(1)	891(1)	413(1)												
NOC-1241	Administrative assistants	2671(5)	2434(3)	2503(3)	2674(3)	1238(3)												
NOC-2131	Civil engineers	13354(24)	12171(15)	12514(16)	13371(17)	6189(15)												
NOC-2234	Construction estimators	2671(5)	2434(3)	2503(3)	2674(3)	1238(3)												
NOC-7205	Contractors and supervisors, other construction trades, installers, repairers and servicers	2644(5)	1983(3)	1574(2)	1077(1)	410(1)												
NOC-7302	Contractors and supervisors, heavy equipment operator crews	7046(13)	5289(7)	4199(5)	2872(4)	1095(3)												
NOC-7521	Heavy equipment operators (except crane)	59023(107)	44298(56)	35164(46)	24053(31)	9177(22)												
NOC-7611	Construction trades helpers and labourers	21161(38)	16169(20)	13215(17)	9681(12)	3839(9)												
CGS Construction																		
NOC-0211	Engineering managers					3904(5)	5530(7)	5799(8)	6136(8)	6204(8)	5462(7)	5934(8)	6136(8)	6204(8)	6204(8)	6069(8)	4997(6)	0 (0)
NOC-1221	Administrative officers					1301(2)	1843(2)	1933(3)	2045(3)	2068(3)	1821(2)	1978(3)	2045(3)	2068(3)	2068(3)	2023(3)	1666(2)	0 (0)
NOC-1225	Purchasing agents and officers					1735(2)	2458(3)	2577(3)	2727(3)	2757(3)	2428(3)	2637(3)	2727(3)	2757(3)	2757(3)	2697(4)	2221(3)	0 (0)
NOC-1241	Administrative assistants					8676(11)	12288(16)	12887(17)	13637(17)	13786(17)	12138(15)	13187(17)	13637(17)	13786(17)	13786(17)	13487(18)	11104(14)	0 (0)
NOC-2131	Civil engineers					19625(25)	27793(35)	29149(38)	30843(40)	31182(39)	27454(35)	29827(38)	30843(40)	31182(39)	31182(39)	30504(40)	25115(32)	0 (0)
NOC-2132	Mechanical engineers					5496(7)	7784(10)	8164(11)	8638(11)	8733(11)	7689(10)	8354(11)	8638(11)	8733(11)	8733(11)	8543(11)	7034(9)	0 (0)
NOC-2231	Civil engineering technologists and technicians					8468(11)	11993(15)	12578(16)	13309(17)	13455(17)	11847(15)	12870(17)	13309(17)	13455(17)	13455(17)	13163(17)	10837(14)	0 (0)
NOC-2234	Construction estimators					2077(3)	2941(4)	3085(4)	3264(4)	3300(4)	2905(4)	3157(4)	3264(4)	3300(4)	3300(4)	3228(4)	2658(3)	0 (0)
NOC-7201	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations					0 (0)	0 (0)	1076(1)	7492(7)	14257(13)	10101(10)	11552(11)	15819(15)	11549(11)	2950(2)	1268(1)	1317(2)	4(0)
NOC-7203	Contractors and supervisors, pipefitting trades					0 (0)	0 (0)	36(0)	151(0)	763(1)	680(1)	690(1)	683(1)	655(1)	654(1)	289(0)	0 (0)	0 (0)
NOC-7204	Contractors and supervisors, carpentry trades					0 (0)	0 (0)	21(0)	2053(2)	2785(3)	1906(2)	2250(2)	2481(2)	2122(2)	698(1)	189(0)	0 (0)	0 (0)
NOC-7205	Contractors and supervisors, other construction trades, installers, repairers and servicers					836(1)	1772(2)	2555(2)	8490(8)	13798(13)	10415(10)	13596(13)	18473(17)	11945(11)	4644(4)	1879(2)	851(1)	0 (0)
NOC-7236	Ironworkers					93(0)	11959(19)	48940(74)	112236(134)	153917(156)	105105(105)	119680(120)	160178(158)	122712(124)	33836(36)	16671(19)	13833(23)	38(0)
NOC-7252	Steamfitters, pipefitters and sprinkler system installers					0 (0)	0 (0)	341(0)	1417(1)	7153(11)	6377(10)	6469(10)	6395(10)	6133(10)	6119(10)	2701(5)	0 (0)	0 (0)
NOC-7271	Carpenters					0 (0)	0 (0)	242(0)	23950(22)	32490(29)	22236(20)	26254(24)	28940(27)	24757(22)	8144(7)	2197(2)	0 (0)	0 (0)
NOC-7302	Contractors and supervisors, heavy equipment operator crews					1649(2)	2335(3)	2449(3)	2591(3)	2619(3)	2306(3)	2506(3)	2591(3)	2619(3)	2619(3)	2562(3)	2110(3)	0 (0)
NOC-7521	Heavy equipment operators (except crane)					11790(15)	16698(21)	17512(23)	18530(24)	18734(24)	16494(21)	17919(23)	18530(24)	18734(24)	18734(24)	18327(24)	15089(19)	0 (0)
NOC-7611	Construction trades helpers and labourers					13550(17)	22322(27)	27130(32)	59567(61)	88032(87)	68265(68)	86324(86)	112809(110)	78150(78)	39211(42)	24132(29)	16170(21)	0 (0)

Husky Response:
Information regarding all planned discharges related to construction of the CGS is provided in the EPP. The EPP is provided as Attachment 2.

2. *It is stated that water removed from the graving dock will be pumped into a lined 2,700 m^2 settling pond, where it will be aerated and tested against applicable regulations prior to ocean disposal. Details should be provided on how the water flow into the settling pond will be managed, and how this water will then be discharged into the ocean. Is it known that the proposed settling pond will be able to hold a large enough volume of water to avoid overflow and potential ground contamination?*

Husky Response:
The settling pond, weirs, ditches, and culverts within the construction site have been designed to avoid overflow, based on current knowledge of groundwater flow rates and 1/100 year storm event. Aeration has been considered further and determined to be counter-productive to the purpose of the settling pond in that aeration would prevent effective settlement of suspended particles. Aeration was considered to treat potential hydrocarbon contamination, but data from the soil and groundwater testing indicate little risk of water contamination. The primary purpose of the settling pond is to remove suspended particulate, which in turn will remove any contamination associated with particulate from being released to the marine environment. Additional information attained during detailed design process will be considered in the final design of the settling pond. Please refer to the Draft Settling Pond Plan and sections in Figure 24 for the most recent design detail.

The dewatering water will be pumped from the dewatering wells and treated by a silt fence at the pipe outfall (one silt fence per pump outfall) before being transported in the impermeable ditch (lined with 20 mm clean crushed stone) to the settling pond. The runoff water generated from the working platform will also be carried in an impermeable ditch lined with 20 mm clean crushed stone to the settling pond. After going through the settling pond, the water will be released through a 10 m wide weir at the outfall of the settling pond. The weir is protected by large-diameter crushed stones (100 to 200 mm) and a soakaway has been provided to facilitate water infiltration in the ground at the weir outfall.

3. *Section 2.3.2.2 indicates the material volume proposed to be disposed of in the pond would exceed the water volume but would not exceed the volume of the natural topography of the pond. If this is the case, would additional soil be brought to the site to completely level the area? Please provide further information.*

Husky Response:
All material being transported to The Pond during the graving dock construction will come from the Husky lease boundary. Additional material is not expected to be required to completely level the area. The area around the eastern edge of The Pond, adjacent to the Haul Road will be raised to +4m before tipping of material will commence but this will be done using material from the graving dock excavation. Some engineered rock fill may be placed and compacted along the Pond side of the berm between the Pond and the Ocean to reduce permeability of the berm.

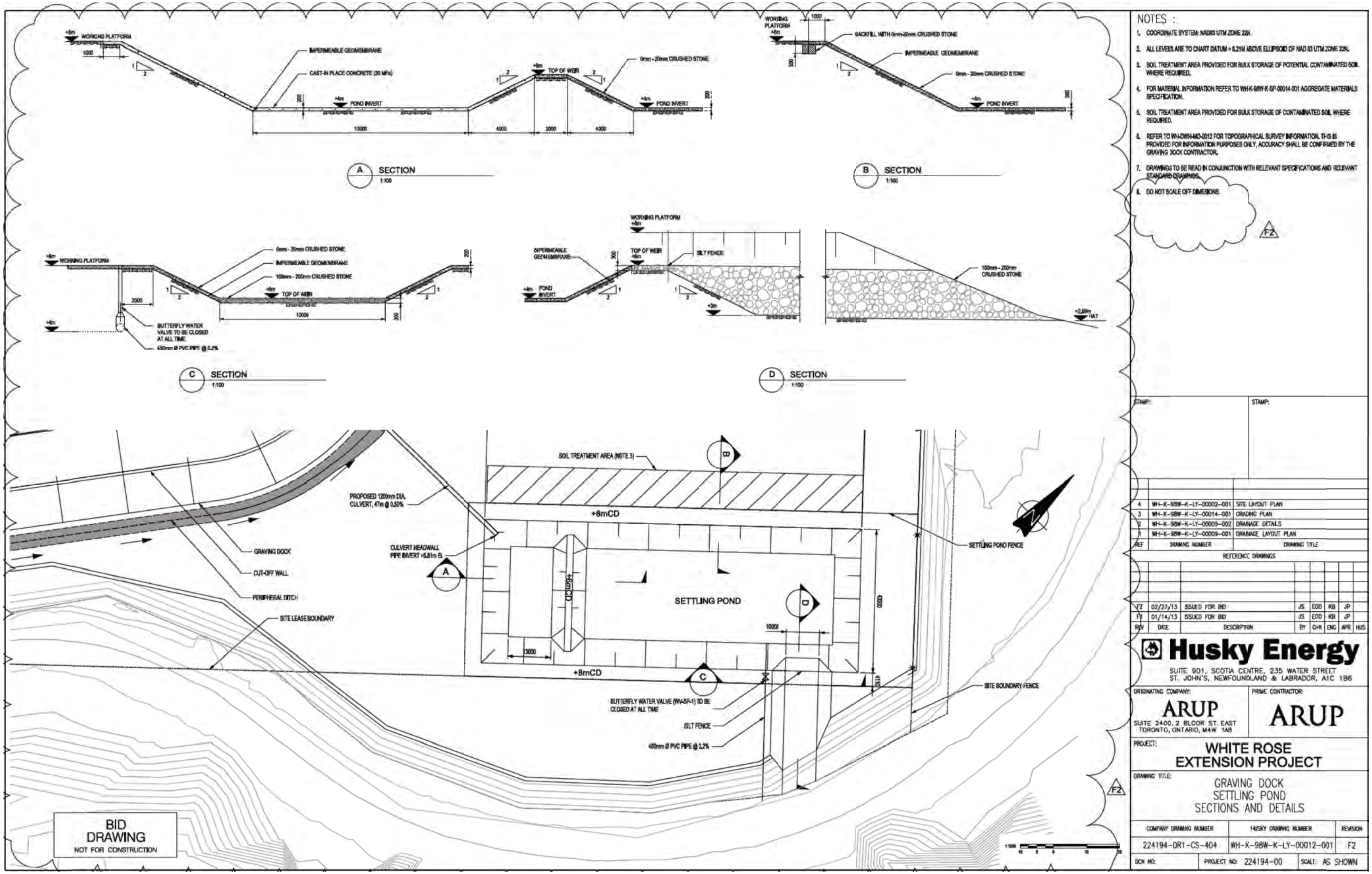


Figure 24 **Draft Settling Pond Plan (Drawing # WH-K-98W-K-LY-00012-001)**

4. *In order for material to be disposed in the Pond, it must be demonstrated that this is a beneficial use. This has not been demonstrated thus far. It is stated that "Sediments within the pond are contaminated and capping the contaminated sediments with cleaner sediments is a method of remediation that has previously been proposed" The ERA completed in 1998 indicated potential for unacceptable risks from PAHs in The Pond. However, in closure documentation provided to the Department by PWGSC, it is stated that a Risk Management Objectives (RMOs) were developed by Cantox in 2005 which concluded that further remediation was not required at the Pond. This same conclusion is referenced on page 2-33. It is therefore not evident that remediation/risk management is actually required at the Pond. In addition, based on the sediment samples collected during the recent sampling programs conducted by Husky, the pond sediment chemistry does not appear to be significantly different than that of the dredged materials and soil, with the exception of some slight PCB exceedances. The PCB results appear to be fairly consistent with those from 1997. Based on this, in order to determine if disposal in the pond is a beneficial use for excavated materials, an updated risk assessment would be required to demonstrate that risk management/capping is warranted.*

Husky Response:
Table 15 summaries the Risk Management Objectives (RMOs) applied previously to determine the need for remediation of The Pond. If we use the same criteria against the more recent data Husky has collected, these risks appear to have decreased, and remediation would not be warranted on this basis.

Table 15 Risk Management Objectives Previously Applied to Determine the Need for Remediation of The Pond

Parameter (ppm)	RMO	The Pond Sediment		Graving Dock Solis	
		1997	2012	Test Pits	Boreholes
Lead	187	<1 to 71	17 to 55	14 to 60	15 to 29
TPH	1900	<30.2 to 1600	170 to 500	20 to 64	27 to 38
Total PAH	11.4	0 to 18.9	1.18 to 8.33	0.01 to 0.18	0
PCBs	1.7	<0.05 to 1.7	<0.05 to 0.38	0.05 to 0.07	0

As Husky has pointed out in the WREP environmental assessment, The Pond is not a natural water body, it is man-made. DFO has concluded that The Pond is not productive fish habitat (DFO letter to Husky 01/10/12) and the sediments in The Pond are contaminated. However, by filling in The Pond, we are reducing contaminant exposure because soils from graving dock and sediments from the dredge areas pose less risk than sediments of The Pond.

As the excavation of the graving dock proceeds from the surface to deeper soils, there is less and less risk of contamination. Material from near the surface of the graving dock will be placed in the Pond initially and subsequently covered by deeper soils as the excavation proceeds, thereby reducing the risk of exposed contamination.

The process of material disposal in The Pond is to have bulldozers push material into The Pond that has been dumped alongside. This process will compact the material as the infill progresses from east to west within The Pond. Subsequent layers will be placed following a similar progression and compaction will result.

Husky will work with the AMA to reclaim The Pond for suitable future industrial/ commercial use.

5. *Should dredged material be permitted to be placed in the Pond, what measures will be in place to prevent fines in the material from becoming airborne?*

Husky Response:
Water content within the dredge materials will prevent fines from becoming airborne. Once the disposal of dredge material is complete, Husky will mitigate airborne particulate from the surface of the disposed material, as required.

6. *In the assessment of disposal alternatives for excavated materials, it is noted that out of area disposal is the environmentally preferred option. Clarification should be provided as to whether there is sufficient demand in the region for the excavated materials to be used as landfill cover. Section 2.3.2.3 refers to recent informal correspondence with Eastern Waste Management regarding the demand for cover material at nearby landfills. Husky should consult with the Department of Municipal Affairs to ascertain this demand, as that Department is the lead agency for the closure of landfills in this province.*

Husky Response:
In the third-party assessment of disposal options, out of area disposal was the environmentally preferred option, but just marginally better than disposal in The Pond. We must consider the socio-economic implications of trucking the material offsite at the rate of an estimated 764 truck-trips per day. Furthermore, the economic implication of offsite disposal to Husky is estimated at $150.5 million. This estimate has been calculated as the difference in cost between trucking materials to The Pond and trucking to a location 150 km offsite.

Nonetheless, Husky has investigated the demand for landfill cover though the Newfoundland and Labrador Department of Municipal Affairs, as requested. The information obtained reveals that most of the landfills on the Avalon Peninsula and Isthmus area have been decommissioned, so there is very little demand for landfill cover.

The disposal options analysis has demonstrated that disposal in The Pond is the only socially, economically and technically responsible option.

9.2.2.1 Department Requirements

7. *It has been suggested that Husky would like to treat any petroleum hydrocarbon and metals impacted soil on site. Note that prior to this, approvals from Service NL and Department of Environment and Conservation would be required and there may be further sampling requirements.*

Husky Response:
Comment noted. Thank you.

8. *The operation of diesel generators at the site may require a Certificate of Approval from the Pollution Prevention Division, as per the Department's Guidance Document GD-PPD-061.1 (Approval of Diesel Generators).*

   Husky Response:
   Comment noted. Thank you.

9. *Pending a review of the additional information to be provided by the proponent, a Certificate of Approval may be required from the Pollution Prevention Division for this project.*

   Husky Response:
   Comment noted. Thank you.

10. *Any use of regulated substances, for example in cooling systems and fire suppression systems, associated with this proposed activity is subject to Halocarbon Regulations.*

    Husky Response:
    Comment noted. Thank you.

11. *Any discharge from the proposed site is subject to compliance with the Environmental Control Water and Sewage Regulations. Analyses completed for the purposes of compliance will be subject to the Accredited Laboratory Policy (PD:PP2001-01.2).*

    Husky Response:
    Comment noted. Thank you.

12. *White Rose has an Environmental Effects Monitoring (EEM) program in place for the offshore operations and this program will be re scoped to include the expansion. If there is a federal requirement for EEM at the Argentia site during construction, copies of the study designs and reports should be provided to the Department.*

    Husky Response:
    Comment noted. Thank you.

9.2.2.2 Other Comments

13. *As a condition of release from Environmental Assessment, the Proponent should be required to prepare an acceptable Environmental Protection Plan that includes proposed effluent monitoring programs.*

    Husky Response:
    Comment noted. Thank you. Husky has provided a copy of the *Environmental Protection Plan - White Rose Extension Project - Argentia Site* as part of this environmental assessment Addendum as Attachment 2.

14. *During a site visit by Department officials in the fall of 2012, several coils of razor wire were noted just to the east of The Pond. These should be removed and disposed of safely.*

Husky Response:
Comment noted. Thank you. Husky will remove and dispose of the razor wire prior to construction, as a part of a site safety inspection.

15. There is indication of groundwater monitoring at the site to determine site suitability. The groundwater monitoring should continue throughout the proposed activity to ensure that there are no impacts as a result of the activity.

Husky Response:
Comment noted. Thank you. Groundwater monitoring will continue throughout the proposed activity. For details on the groundwater monitoring, the *Baseline Hydrogeological Characterization Concrete Gravity Structure Graving Dock Site Argentia, NL* (Stantec (2013)) is provided as part of this Environmental Assessment Addendum as Attachment 3.

9.2.3 Water Resources Management Division

9.2.3.1 General Comments

1. The requested information on groundwater flow and groundwater quality monitoring and treatment has not been provided in sufficient detail for WRMD to provide any recommendation. The proponent should provide the requested information.

Husky Response:
Details on the groundwater flow and quality monitoring are contained in the attached Stantec (2013) report (Attachment 3). This information is supplemented by Section 5.2 of the EPP (Attachment 2), which addresses the plan for discharge monitoring. Should the groundwater require treatment for contamination, a mobile water treatment unit with the required specifications will be used to ensure compliance with applicable water discharge regulations.

2. As per information provided, the Pond has been contaminated by previous users, does not have any fish, has no surface connections to other water bodies and is not accessible to the public because it is surrounded by private land. As such, the proponent must obtain a permit under Section 48 of the Water Resources Act prior to infilling the Pond and ensure that water discharged from the Pond meets all regulatory requirements.

Husky Response:
Comment noted. Thank you.

3. Pg2-2: the proponent indicates that the graving dock could be constructed as a permanent facility with gates or single-use facility that will be left flooded. The EA document does not confirm whether the proponent has chosen an option or not at this time.

Husky Response:
No decision has been made at this time with regard to the construction of the graving dock gates.

9.2.3.2 Permitting Requirements

The proponent must apply for a non-domestic drilled well permit under Section 58 of the Water Resources Act for the proposed drilled well(s)
Contact: Manager, Groundwater Section, (709) 729-2539.

Husky Response:
Comment noted. Thank you.

The proponent must obtain a Water Use License from this Division for the use of any volume of water from any water source. As part of this licence the proponent will be required to provide a water use or diversion monitoring and reporting plan for all groundwater and surface water sources.
Contact: Manager, Water Rights Section (709) 729-4795

Husky Response:
Comment noted. Thank you.

The proponent will require approval from this Division under Section 48 of the Water Resources Act before starting construction activities within 15 metres of any water body (including wetlands). Construction activities include all stream crossings, dams, drainage works, fording and any other work such as landscaping, clearing or cutting of any natural vegetation within 15 metres of a body of water.
Contact: Manager, Water Investigations Section, (709) 729-5713

Husky Response:
Comment noted. Thank you.

Any effluent or runoff leaving the site will be required to conform to the requirements of the Environmental Control Water and Sewage Regulations, 2003.

Husky Response:
Comment noted. Thank you.

9.3 Executive Council, Women's Policy Office

The Women's Policy Office is in agreement with the assessment provided by Natural Resources.

Husky Response:
Comment noted. Thank you.

The Operator failed to include comments requested by WPO in the Guidelines and we reiterate the need for the Operator to include in the EPR document the following commitment:

- *All benefit amendment components including Gender Equity and Diversity Plans (including Business Access Strategies) with the Province for the construction, operations and decommissioning phases of the project will be finalized and approved by the Minister of Natural Resources, and for Gender Equity and Diversity, the Minister responsible for the Status of Women prior to the start of construction.*

Husky Response:
Comment noted. Thank you. The *White Rose Extension Project Diversity Plan* is provided with this WREP Environmental Assessment Addendum as Attachment 1. No revisions have been made to this report since it was provided to DOEC on April 3, 2013.

9.4 Department of Natural Resources

On behalf of Natural Resources (Mines and Energy), we have reviewed the EPR report for the Argentia Wellhead Platform Project and have found that the Operator failed to include comments requested in the Guideline.

Thus, we reiterate the need for the Operator to include in the EPR document the following commitments:

- *All benefit amendment components including local benefit capture, and Gender Equity and Diversity Plans (including Business Access Strategies) with the Province for the construction, operations and decommissioning phases of the project will be finalized and approved by the Minister of Natural Resources, and for Gender Equity and Diversity, the Minister responsible for the Status of Women prior to the start of construction,*

  Husky Response:
  Comment noted. Thank you. The White Rose Extension Project Diversity Plan is provided with this EA Addendum (Attachment 1). No revisions have been made to this report since it was provided to DOEC on April 3, 2013.

- *The Operator must agree to address any additional benefit concerns identified by the province arising from the Wellhead project, and*

  Husky Response:
  Husky will submit a White Rose Canada-NL Benefits Plan Amendment to the C-NLOPB as part of its development application for the wellhead platform. This document will reflect the project benefits as agreed with the province.

- *Any Benefit Amendments will be submitted to the CNLOPB as an amendment to the Benefits Plan, and will also be amended in the overall White Rose Benefit Framework if deemed necessary by the Province.*

  Husky Response:
  Comment noted. Thank you.

10.0 Fish, Food and Allied Workers

While the FFAW is generally supportive of the proposed project we have to balance that support with our responsibility to protect the interests of our fish harvester and plant worker membership and the health of our ocean for future generations.

Fundamentally, the overall project will impact fish harvesters both in Placentia Bay and the offshore. The near-shore component of the project will result in some loss of fishing grounds to harvesters in Placentia Bay. It needs to be noted that accessing alternate fishing grounds can be problematic when considering the traditional nature of the fishery in Newfoundland & Labrador. Fishing alternate grounds generally means that they are infringing on another harvester's "territory". As well, commercial species are not distributed equally in bays and coves. Therefore, the impacts of project-related activities in the next few years will have an impact on many harvesters in Placentia Bay, that is, not just those in the communities adjacent to the construction activities. All Placentia Bay harvesters will be subjected to increased risk of gear/vessel loss and damage, accidental spills, as well as reduced safety on the water, access to fishing grounds, and catch rates as a result of this project. As well, similar impacts will be faced by offshore harvesters with quotas to fish in NAFO Division 3L as offshore development begins.

Husky Response:
Husky has included an extensive list of mitigations to minimize potential impact to fish harvesters in Section 9.5 of the WREP environmental assessment.

Specific Comments

1. Establishing a Fisheries Liaison Committee with adequate fish harvester representation will be key in the coming months to enable appropriate consultation with the affected harvesters as the project proceeds (Section 6.2.1.3 and 9.5.1.2). Involving harvesters in the development of a near-shore Environmental Effects Monitoring program prior to the start of construction at the site will also provide opportunity for collaboration (Section 15.2.1). The FFAW and the harvesters whom it represents are looking forward to future consultations regarding the deepwater mating location as committed to by the Partners (Section 2.7.5)

Husky Response:
Husky agrees that the Fisheries Liaison Committee (FLC) is key to successful cooperation between marine users. The FLC will be established prior to the start of marine construction activities. For clarification, Section 15.2.1 discusses an Environmental Protection Plan (EPP) to be implemented during construction activities at Argentia. The EPP will outline the testing requirements to ensure compliance with regulations and guidelines. The EPP will be prepared and submitted to the provincial Department of Environment and Conservation for review and approval. Husky is committed to holding further consultations with the FFAW once the deep-water site has been confirmed.

2. In the discussion on planning for the development of the White Rose Expansion Project involving the western expansion in Section 2.4 there the acronym for the Wellhead Platform (WHP) is used on page 2-14, yet in Figure 2-1 said acronym is not involved in the depiction.

Husky Response:
Comment noted. Thank you. The legend for Figure 2-1 should indicate that the WHP is comprised of the CGS and the topsides.

3. Possible construction of the proposed Wellhead Platform structure in Placentia Bay will have an impact on the environment in the bay and more specifically fish habitat. Concerns from fish harvesters have been noted in the report with respect to dredging, debris, discharges, dumping, accidental spills, construction related noise and lighting. It needs to be reiterated however that construction activity will also impact catchability, and therefore profitability, for fish harvesters.

Husky Response:
The WREP EA assesses the potential impact of all project activities on fish and fish habitat in Chapter 8. Potential impacts to Fisheries, including catchability, are assessed in Chapter 9. Husky has included an extensive list of mitigations to minimize potential impact to fish harvesters in Section 9.5.

4. The future fisheries were nominally encountered in this Environmental Assessment. With significant environmental changes it is anticipated that there will be a change in the biomass composition in Newfoundland & Labrador waters. With the environment readjusting to more stable/normal state there is an expectance of an increased presence of finfish (such as Cod). Therefore, although Figure 9-23 shows a drastic decrease around 1990 and since stability, there are indicators that this is about to change again. The likelihood is that harvesting patterns will change and there will be a significantly increased level of fishing activity throughout the Grand Banks. Potentially that activity could rival the time prior to the cod moratorium. The White Rose Partners should consult with the fishing industry on a regular basis to keep up to date with the fishing trends for the various species.

Husky Response:
Husky intends to continue regular consultation with fishery representatives and the FFAW through One Ocean to remain current knowledge of trends and changes in both the nearshore and offshore fisheries environment. Husky provides annual updates to the FFAW and One Ocean on planned future activities. There is also ongoing liaison with the fishing industry through regular meetings of the One Ocean Technical Working Group. The C-NLOPB requires that all active environmental assessments are updated annually with the most current fisheries data available. Consultation with One Ocean and the FFAW are conducted as part of those environmental assessment updates.

5. Also with respect to future fisheries, information presented at RAP meetings in 2009 and 2010 indicated that there are increasing signs of cod in the offshore with scope for more recovery, with indication of a low natural mortality. The 2011 Assessment of Northern (2J3KL) Cod (Science Advisory Report) noted that the annual DFO trawl surveys indicated an eight-fold increase in the spawning stock biomass from 2004 to 2008. A commercial fishery for Atlantic cod on the Flemish Cap (an adjacent, NAFO-regulated stock) opened in 2010. For Southern Grand Banks cod (3NO) it is expected that the spawning stock biomass will surpass the conservation limit reference point set by DFO in 1999 at 60,OOOt.The resumption of offshore groundfish fisheries would significantly alter fishing patterns and activities within the Jean d'Arc

Basin of the Grand Banks and have an impact on fishing enterprises. Again, the fishing industry should be regularly consulted to keep apprised of fishing trends.

Husky Response:
Husky intends to continue regular consultation with fishery representatives and the FFAW through One Ocean to remain current knowledge of trends and changes in both the nearshore and offshore fisheries environment. Husky provides annual updates to the FFAW and One Ocean on planned future activities. There is also ongoing liaison with the fishing industry through regular meetings of the One Ocean Technical Working Group. The C-NLOPB requires that all active environmental assessments are updated annually with the most current fisheries data available. Consultation with One Ocean and the FFAW are conducted as part of those environmental assessment updates.

6. The FFAW feels that the fisheries statistics contained in the Environmental Assessment are insufficient in that they do not give any reflection of the historical harvest for groundfish on the Grand Banks. With the changing environment it would be pertinent for the Environmental Assessment to contain indicators of where and how groundfish harvest was pursued on the Grand Banks, especially the formerly important codfish. Effectively, a five year horizon for past fisheries is not sufficient and does not provide a good enough perspective of the activities for the members of the FFAW.

Husky Response:
WREP EA Section 9.3.2.1 - Historical Overview of Regional Fisheries (Placentia Bay) provides a broad overview of historical trends in the nearshore fisheries in Placentia Bay during the past 20 to 25 years. Section 9.3.3.1 - Historical Overview of Regional Fisheries (Eastern Grand Banks) provides a 20-year perspective of fisheries harvesting trends in NAFO 3LMN. As noted above, Husky will continue to consult on a regular basis with offshore fisher representatives, FFAW managers and One Ocean in order to keep apprised of future trends and changes in the offshore fisheries environment.

7. Looking at the various discussions on habitat through out the Environmental Assessment there are some mishaps, such as a subheading in Section 8.5.2.1 being Change of Habitat Quality, the lead sentence then reads. "Habitat quantity may be reduced as a result of lighting, discharges, sedimentation and increased noise occurring due to the above activities." There obviously is a disconnect between what is written and what was intended written. It is further worth to note that the final paragraph of Section 8.5.1.3 suggests that in a worst case scenario of an accidental event the impact would be such to only affect abundance or distribution of one generation of fish, and to be re-established to previous levels within several generations. This is a significant statement as with the state of the Newfoundland & Labrador fisheries any impact on the biomass or resource availability is significant.

Husky Response:
Comment noted. Thank you. The heading for Section 8.5.2.1 should read Change in Habitat Quantity. Section 8.5.1.3 assesses the effect of an accidental event on fish and fish habitat.

9. The establishment of a Safety Zone (Section 9.5.1.1 and 9.5.1.2) at the locations in Placentia Bay will result in a loss of fishing grounds to harvesters in Placentia Bay. This is significant for inshore harvesters in Placentia Bay as previously discussed.

Husky Response:
While the establishment of a deep-water mating site safety zone will create a temporary loss of access to fishing grounds within these areas, it will serve as a key mitigation to avoid or prevent interaction and to help ensure the safety of workers, fishers and other marine users.

Husky has committed to several mitigation measures in Section 9.5.1.2 to mitigate the impact of the WREP on fish harvesters. Details of these mitigations will be further discussed during the Fisheries Liaison Committee meetings.

10. The Husky Energy Extension Project Environmental Assessment presents an untenable spin on an unfortunate situation in the Gulf of Mexico, making light of an environmental disaster (Section 9.5.3). There are now cases of species in the Gulf of Mexico that are experiencing changes in gender composition, directly affecting the species recruitment. The FFAW does not appreciate a suggestion of a potential better economic return per volume harvested, due to diminished resource availability on the market as a result of an environmental disaster. Section 9.5.3 leads with the indication that the "...effects from a spill or blowout will be not significant. However, economic impacts might still occur if a spill prevented or impeded a harvester's ability to access fishing grounds, caused damage to fishing gear or resulted in a negative effect on the marketability of fish products."

Husky Response:
Husky in no way intended to make light of the Deepwater Horizon accident in the Gulf of Mexico. The context of the discussion was simply to state the potential effects of an accidental event. We agree that the effects of the incident are still being realized.

The context of quote regarding significant effects from Section 9.5.3 is:

> "Chapter 8 concludes that biophysical effects on fish from a spill or blowout will be not significant. However, economic impacts might still occur if a spill prevented or impeded a harvester's ability to access fishing grounds (because of areas temporarily excluded during the spill or spill clean-up), caused damage to fishing gear (through oiling) or resulted in a negative effect on the marketability of fish products (because of market perception resulting in lower prices)."

We thereby acknowledge that a non-significant effect on fish may still impact fish harvesters.

11. With regards to socio-economic considerations there is a mention that "90 percent of the nickel processing plant's construction workforce live outside of the Argentia area and commute to the WREP site on a daily basis, and a similar situation is expected with the WREP." It is unfortunate that this was not caught before the document was sent out for review. In addition who is to say that the WREP will have access to the potential labour supply surplus resulting from the completion of the nickel processing plant, there are two other major industrial projects *taking place in the province at the same time that the Wellhead Platform is expected to be constructed.*

Husky Response:
Husky will work with its contractors, who will work directly with the appropriate trade unions, to offer a competitive wage and benefits package to attract and retain the required workers for the Project. A competitive wage and benefits package, in addition to the location of the project site, will support recruitment of qualified persons from the local area, throughout Newfoundland and Labrador, as well as nationally and internationally as required.

12. In the consultation session with the Offshore Harvesters, one fisherman raised an issue with regards to the possibility of the petroleum activity within the White Rose Field expanding to the Northeast. If this were to take place it would have a direct impact on some of the most fruitful snow crab harvesting grounds. This was brought up as the diagrams showing the White Rose field with new drilling centres had one listed to the Northeast of the current North Drill Centre (Figure 2-15 and/or Figure 2-16). At a subsequent meeting on October 9th, 2012 between the Husky Energy and the FFAW (One Ocean was also present) Husky was indicating that any expansion towards the Northeast was not within the horizon, and there are currently no plans to pursue anything in this area. Nevertheless, when the Environmental Assessment was sent out for review this is still listed in the figures listed above. Further to this, it is mentioned that offshore harvesters were concerned that the extension into the west of the White Rose field would go into snow crab grounds (Section 6.2.2.2). This is factually inaccurate, the concern raised by the harvesters was about extending to the north, there is very limited harvest taking place to the west of the White Rose field as evident from the (limited) information presented in Figure 9-28.

Husky Response:
Comment Noted. Thank you.

13. With regards to the concerns that were raised in the context of the SWRX (Page 6-10), the issue at hand was that the Safety Zone depicted in the consultation slide differed from that which is in place out in the field. The map which was used included a zonal change, which Husky subsequently went on to apply to get implemented. At the September 20th, 2012 consultation meeting the submission to change the Safety Zone had not been made. However, at the follow-up meeting on October s". 2012 Husky indicated that the application for changing the Safety Zone had been submitted. The issue was not that the FFAW and One Ocean were not consulted on the SWRX, but rather that said consultation had not had any mention of a change to the White Rose Safety Zone. This approach was not conducive to the enhancement of mutual trust between the two industries. The FFAW does realize that at the time of submitting the original Environmental Assessment for the subsea drill centres Husky did not know the exact location where they would be drilling. But when the proponent knows where the drill centres will be, there needs to be further consultation if there is going to be an impact on the fishing vessels that use the area.

Husky Response:
Husky makes every effort to inform stakeholders of planned activities once schedules have been confirmed. We continue to ensure that consultation meetings are held with the FFAW and One Ocean in a timely manner.

14. The FFAW and its members are very concerned about the potential of aquatic invasive species, such as green crab, infesting our bays and coastal waters. The additional vessel traffic associated with the construction of the Wellhead Platform in Placentia Bay may potentially lead to the introduction or proliferation of unwanted aquatic invasive species. The green crab that has become resident in areas of Placentia Bay for example has destroyed eel grass beds and competes with native crab and lobster species for food. The potential for the introduction of aquatic invasive species in the area was merely mentioned in passing (Section 12.4.2.3) in the White Rose Extension Project Environmental Assessment document. The FFAW strongly encourages the Partners to consider and detail the mitigation strategies that the contracting marine vessel companies will need to follow to prevent the introduction and/or proliferation of aquatic invasive species in Placentia Bay. Furthermore, the FFAW calls upon the various regulatory bodies to be very stringent regarding any ballast water exchange plans proposed by the Partners and ensure vessels follow proper ballast water management practices. As well, aquatic invasive species should be incorporated into the near-shore Environmental Effects Monitoring program.

Husky Response:
There is very little non-domestic marine traffic expected from the WREP. The *Ballast Water Control and Management Regulations*, *Canada Shipping Act* will be applied as necessary to WREP vessels to ensure vessels follow proper ballast water management practices to mitigate the risk of the introduction of aquatic invasive species.

11.0 Fisheries and Oceans Canada

11.1 White Rose Extension Project Environmental Assessment

No.	Sector	Reviewer Initial	Section / Page No.	Comment / Information Request
GENERAL COMMENTS				
1	*HPD*	*SL*		*DFO has recently reviewed the post-construction survey for the South White Rose Extension. It has been determined that the authorized footprint for excavation of the South White Rose drill center and associated spoils disposal has been significantly exceeded.* *Throughout the document, Husky states there is sufficient capacity within the existing authorization for all works and undertakings proposed for the offshore component. DFO would like to highlight the fact that although Husky Energy has a valid authorization (Authorization No. 07-01-002) until December 31, 2015 for the White Rose Extension Project, an amendment may be required if Husky Energy plans to carry out any further excavation activities at the West White Rose other than that required for installation of the CGS and/or develop the North White Rose drill center as originally authorized.*
Husky Response:				Comment noted. Thank you.
2	*HPD*	*SL*		*Based on recent ROV surveys of a nearby oil development, it appears that accumulation of drill cuttings in proximity to offshore oil drilling sites may be greater than predicted during the environmental assessment (EA). As such, DFO will be requesting that all oil developments (existing and future) conduct additional monitoring to determine the magnitude and extent of deposition of drill cuttings closer to the drill centers where current monitoring has not been carried out (i.e., within 250-500 m). This will require further discussions with DFO.*

No.	Sector	Reviewer Initial	Section / Page No.	Comment / Information Request
Husky Response:				Comment noted. Thank you.
3	*HPD*	*SL*		*There is no mention in the EA of subsea cables occurring within the nearshore dredging/excavation areas. The proponent should contact Canadian Hydrographic Service, NL Region to ensure that there are no cables or other impediments within the proposed route prior to commencement of dredging activities and CGS tow-out.*
Husky Response:				Comment noted. Thank you.
4	*DFO (Sci.)*			*Species descriptions should include the most up-to-date, relevant information available. For example, many of the distribution maps, particularly those for marine fish and SAR, are based on data prior to 2001 and need to be updated accordingly. Significant changes have occurred over the past 10 to 20 years for many marine species, as well as the marine environment.*
Husky Response:				To our knowledge the maps are the most recent available. The text is more current.
<u>SPECIFIC COMMENTS</u>				
1	*HPD*	*SL*	*2.4.1 White Rose Extension Project Design Criteria Table 2-4, P. 2-10*	*Please provide the correct dimensions of the CGS as the table reports the diameter in* m^2*. The exact footprint of the CGS is not specifically reported, which is needed to confirm that the authorized area under the current Fisheries Act Authorization has not been exceeded.*
Husky Response:				The current CGS footprint is 111 m x 111 m.
2	*HPD*	*SL*	*2.6.3.1 Excavation, P. 2-20*	*The proponent should ensure that the cut-off wall is constructed using appropriate mitigations, such as sedimentation and erosion control measures as outlined in DFO's Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador. Please note that mitigation measures as described in this document are applicable in both the freshwater and marine environments. Also, please confirm that there will be no in-water works during construction of the cut-off wall.*

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Husky Response:				In-water works will not be required during construction of the cut-off wall. Sedimentation and erosion control measures as outlined in DFO's *Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador* are included in the EPP, as appropriate.
3	*DFO (Sci.)*		*Section 2.6.3.3, P. 2-25 to 2-29*	*Baseline data on the health of fish in Argentia Harbor would be useful. Data is presented on levels of contaminants in sediment, but information on contaminant levels alone is of very limited value in assessing any potential risks to aquatic organisms. It is also noted that levels of contaminants in some sediment samples are above Canadian Council of the Ministers of the Environment (CCME) guidelines.*
Husky Response:				Sediment contaminant data were collected by Husky as part of the graving dock site selection and dredge materials disposal options analysis. Baseline fish health data were not considered necessary for the assessment of planned activities associated with construction of the CGS.
4	*HPD*	*SL*	*2.6.4 The Pond, P. 2-30*	*During water withdrawal at The Pond, ensure adherence to DFO guidelines as described above, including the use of appropriately sized screens as described in DFO's Freshwater Intake End-of-Pipe Fish Screen Guidelines (1995).*
Husky Response:				Comment Noted. Thank you. For clarification, water is not planned to be actively withdrawn from The Pond.
5	*HPD*	*SL*	*P. 2-32*	*Please confirm that activities within The Pond will not compromise the integrity of the bar sway/berm, which could result in a breach of the structure and a resultant release of sediment into the marine environment.*
Husky Response:				The berm will be inspected for integrity/permeability prior to activities within the Pond. If necessary, engineered material will be placed and compacted along the Pond side of the berm.

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6	*HPD*	*SL*	*2.7.2 Shoreline Dredging, P. 2-37*	*During shoreline dredging, please ensure appropriate mitigations are implemented, particularly erosion and sedimentation control measures. Dimensions of the graving dock entrance are unclear. Please clarify whether the excavated/dredged area will be 18-20 m deep across the entire 180 m channel.*
Husky Response:				The current estimate of the graving dock entrance is approximately 151 m wide and 18 m deep, relative to chart datum. Husky will install rip-rap along the entrance of the graving dock to mitigate shoreline erosion, post construction.
7	*HPD*	*SL*	*2.7.3 Tow-out Channel Dredging, P. 2-38*	*The overall size of the dredging footprint appears to be different than that reported in the Marine Habitat Characterization Report, dated September 2012 (i.e., decreased from 223,800 to 215,000 m^2). Prior to the start of construction, a final estimate of the dredging footprint should be provided to DFO.*
Husky Response:				A final estimate of the dredging footprint will be provided to DFO once finalized.
8	*HPD*	*SL*	*2.7.6 Topsides Mating and Commissioning, P. 2-42*	*Please provide more detailed information on the proposed mooring systems, including anchor dimensions, water depth and substrate type at anchoring points, timing and duration of deployment, etc.*
Husky Response:				The topsides mating operation is scheduled to take place no earlier than the summer of 2016. Husky continues to evaluate the specifications required for the deep water mating site. Once a site has been selected, the associated detailed information on the proposed mooring system will be submitted to DFO.
9	*HPD*	*SL*	*2.8.1 Wellhead Platform, Figures 2-15 and 2-16, P. 2-45 & 2-48, respectively*	*The drill center SWRX should be included in the figures as it has been excavated and will be developed in 2013 with completion of the site prior to the offshore component of this project.*
Husky Response:				Figures 2-15 and 2-16 have been revised as suggested and are provided as Figures 25 and 26 at the end of the DFO comment tables.

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10	*HPD*	*SL*	*2.8 White Rose Extension Project: Installation, Table 2-12, P. 2-46*	*The table indicates that rock berms could be installed offshore. It is DFO's understanding that there would not be extensive use of rock berms in the offshore. Please confirm in writing that concrete sleeves will be used instead of berms for flowline protection (phone conversation between S. Lewis and D. Pinsent, February 8, 2013), as this could have implications under s.35(2) of the Fisheries Act.*
Husky Response:				For clarification, concrete sleeves will be used instead of berms for flowlines associated with the SWRX Drill Centre. As discussed in the WREP EA, "Flowlines will be laid directly on the seafloor, similar to installation methods used for flowlines currently in the White Rose field. The need for additional flowline tie-in modules and associated valves will be evaluated during engineering. Flowline tie-in modules will sit on the seafloor and range between an estimated 20 and 40 m^2. Dropped object protection on the flowline near the subsea drill centres is also being evaluated and maybe composed of rock berms, as for SCD and NADC, or concrete mats or sleeves." Husky will continue to consult with DFO on planned offshore activities associated with the WREP.
11	*HPD*	*SL*	*2.8.2 Subsea Drill Centre, Table 2-13, P. 2-49*	*Maintenance of drill centers and flowlines, including the removal of excess drilling muds should be included in the list of activities as there could be implications under s. 35(2) of the Fisheries Act depending on the scale of activities required.*
Husky Response:				Husky will contact DFO prior to the undertaking of such activities.
12	*HPD*	*SL*	*2.9.1 Wellhead Platform Operation and Maintenance, P. 2-51*	*This section indicates that SBMs will be re-injected if a suitable formation can be found. Please provide a contingency plan if this is not possible.*

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Husky Response:				The base plan is to drill two cuttings reinjection wells for cuttings disposal purposes. In addition, the WHP design currently envisions a secondary cuttings dryer system to lower synthetic based mud on cuttings (SOC) to a target level of 6.9% SOC. This is consistent with technology currently employed by MODUs operating in the area. This secondary dryer would be employed until the cuttings reinjection (CRI) system is functional. This secondary system would also be employed in the event of difficulties with the CRI system. Prior to having a CRI system in place, and in the event of CRI system failure, following processing with the secondary dryer, cuttings would be discharged overboard. Current drilling authorizations allow for the discharge of cuttings while drilling with an SBM fluid, at discharge limits specified in the facilities Environmental Protection Plan. The discharge of mud and cuttings and their limits for the WREP will be described in the WREP Environmental Protection Compliance and Monitoring Plan and submitted as part of the authorization application. While using an SBM fluid system, the WHP intends to handle cuttings in a similar manner as a MODU until the CRI system is operable, as well as in the event the CRI system experiences a failure. Once the CRI system is operable, these cuttings will be reinjected downhole.
13	*HPD*	*SL*	*2.14 Decommissioning and Abandonment, P. 2-53*	*As part of the decommissioning plan for the graving dock, stabilization and erosion control measures should be implemented to ensure the conservation and protection of fish habitat. The long term plans of the graving dock should also be discussed with DFO to ensure whether there is any potential for fish habitat restoration measures.* *It is important to note that during offshore decommissioning, any structures currently considered as fish habitat (i.e. existing rock berms) should not be removed without prior consultation and approval with DFO.*

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Husky Response:				Husky will install rip-rap along the entrance of the graving dock to mitigate shoreline erosion, post construction. Husky will contact DFO prior to the undertaking of offshore decommissioning.
14	*HPD*	*SL*	*2.15 Potential Future Activities, P. 2-53*	*See comment G-1.*
Husky Response:				Comment noted. Thank you.
15	*HPD*	*SL*	*3.4 Drill Cuttings Deposition, P. 3-39*	*Figures in this section should include finer scale images such as 0-1 km scale. As described in the general comment (G-2), based on recent ROV surveys at a nearby oil development, it appears that accumulation of drill cuttings in proximity to offshore oil drilling sites may be greater than predicted during the EA. As such, DFO may require Husky Energy, as well as operators of other existing and future oil developments, to provide additional monitoring adjacent to the drill centers in order to verify these predictions. It should be noted that in the past, DFO has recognized that drill cuttings deposition with thicknesses of greater than 10 cm are considered harmful to benthic organisms. Predictions provided in this section suggest that maximum thicknesses could reach approximately 8.6 cm within 100 m from the deposition area.*
Husky Response:				The four cuttings plan view figures in this section consist of base case and fast settling of fines sensitivity runs for two views: a 28-km view, and a 5-km view. A new pair of “1.5 km” views have been prepared. An additional figure shows the model run over a finer scale is presented in Figure 3-16a and is provided as Figure 27 at the end of the DFO comment tables.
16	*HPD*	*SL*	*3.5 Synthetic-based Whole Mud Spill Trajectory Modelling, P. 3-52*	*The EA indicates that the SBM would biodegrade over several weeks; however, the properties are unknown. Please provide references or evidence to support this claim.*

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Husky Response:				SBM biodegradation is highly variable; however, biodegradation of unused SBMs over several weeks is supported by Centre for Offshore Oil, Gas and Energy Research and Lee (2009). Reference: Centre for Offshore Oil, Gas and Energy Research and K. Lee. 2009. Environmental persistence of drilling muds and fluid discharges and potential impacts. *Environmental Studies Research Funds Report*, No. 176: 35 pp.
17	*HPD*	*SL*	*Tables 3-50 to 3-52, P. 3-62 to 3-63*	*Oil spill information presented in these tables is based on data from 1987 to 1997. Although, previous EAs have also used the same data, it may be useful to incorporate more recent information as available.*
Husky Response:				Note that these were not primary data sources, more recent data were used for spill frequency calculations.
18	*HPD*	*SL*	*5.2 Scope of Environmental Assessment, P. 5-2*	*See comment G-1.*
Husky Response:				Comment noted. Thank you
19		*DFO (Sci.)*	*5.3.1 Step 1 - Scoping Issues and Selecting Valued Environmental Components, P. 5-7*	*The EA states "Populations of marine mammals and some sea turtle species migrate to the Offshore Study Area primarily to forage for food". It should be noted that some marine mammal species and the Leatherback Sea Turtle also migrate to the nearshore study area to feed in the summer and fall. The draft Critical Habitat for the Leatherback Sea Turtle may encompass part of the southern Placentia Bay area so this may require further mitigation and monitoring.*
Husky Response:				Comment noted. Thank you

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21		*DFO (Sci.)*	*8.3.1.5 Fish and Shellfish – Capelin, P. 8-22*	*The statement: "…migrate to deeper waters to spawn offshore at depths up to 125 m (likely when conditions for beach spawning are not ideal" is incorrect. Nakashima and Wheeler (2002) indicate that spawning occurs subtidally when water temperatures at the beach are too warm. Furthermore, this redirected spawning occurs in coastal waters generally at depths considerably less than 125m. Please adjust the statement appropriately.* *The statement that eggs "…remain in the sediment for 14 to 52 days…" is not supported by Scott and Scott (1988) as indicated in the document. Scott and Scott (1988) indicate that eggs hatched in the beach from 9 to 24 days depending on where they were in the intertidal zone. If this statement is in reference to demersal spawning on the Southeast Shoal where water temperatures are much cooler, 52 days may be acceptable.*
Husky Response:				Comments noted. Thank you.
22		*DFO (Sci.)*	*8.3.1.5 Fish and Shellfish – Capelin, P. 8-23*	*The statement that juvenile Capelin in the nearshore prefer eelgrass habitat should be supported with a reference. Most juvenile Capelin are found offshore where eelgrass does not occur. The following statement "….except in autumn, when they have a reverse vertical migration (migrate to the surface during the day)" that is attributed to Mowbray (2002) is incorrect.*
Husky Response:				In support of the first statement regarding juvenile capelin and eelgrass the following reference is provided: Grant, S.M. and C.G. Grant. 2013. Habitat requirements and life history characteristics of selected marine finfish species occurring in the Newfoundland and Labrador Region. *Canadian Manuscript Report of Fisheries and Aquatic Sciences*. (in progress). Second Comment noted. Thank you.

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<tr><td>23</td><td></td><td>DFO (Sci.)</td><td>8.3.1.5 Fish and Shellfish – Herring, P. 8-23</td><td>The description for Herring should be updated using DFO (2012).</td></tr>
<tr><td colspan="4">Husky Response:</td><td>The paragraphs on herring have been revised with the insertion of underlined text as provided below.

“Herring in Placentia Bay are part of the St. Mary’s Bay-Placentia Bay stock and are commercially fished during spring and fall (DFO 2005a; Wheeler 2010). Herring move into the bays during spring to spawn and feed, and generally migrate to deeper water to over-winter. Herring are demersal spawners, depositing their eggs on stable substrates in shallow, coastal waters (Stevenson and Scott 2005), although some spawning can occur on offshore banks at depths of 40 to 80 m. Masses of herring eggs attach to the hard bottom substrate nearshore or to kelp fronds. Eelgrass has been associated with spawning in some areas (DFO 2005a). Herring have been known to spawn north of the Argentia peninsula in previous years (John O’Rourke, pers. comm.).

Hatching of larvae occurs after approximately 10 to 30 days and is temperature dependent (Scott and Scott 1988). Spring recruits will remain in the water column during spring and summer, but fall recruits may be pelagic until the following spring. Tides may cause retention of eggs and larvae near the spawning ground, or eggs and larvae may passively drift with dominant currents (DFO 1984, in EMCP 2011). Herring primarily feed on euphausiids (DFO 2005a) and this species is an important prey item for other fish, seabirds and marine mammals.

<u>Herring in Newfoundland are at the northernmost part of their range. As a result, ideal conditions rarely occur, resulting in rare years of strong recruitment (DFO 2012). Survival of young-of-the-year is influenced by environmental conditions, with ideal conditions consisting of warm overwintering water temperatures and high salinities prior to spawning. Large year classes of herring produced in 1968 and 1969 supported stocks throughout the 1970s (DFO 2012).</u></td></tr>
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				The moderate to large stock of 1982 allowed stocks to rebuild in the 1980s, with moderate stock sizes occurring in 1987 and 1996. Assessments of the St. Mary's Bay-Placentia Bay stock suggest a decline occurred from 2001 to 2004, remained stable from 2005 to 2010, and increased slightly in 2011 (DFO 2012). The 2003 and 2006 year classes account for 20 percent each of the catch. Autumn spawners comprised 43 percent of the catch from 2010-2011, which is an increase of 8 percent from 2009. Short-term prospects for herring stocks in St. Mary's Bay-Placentia Bay remain uncertain, with the 2006 stock above average. All year classes since 1982 are weak when compared to historical levels (DFO 2012). A survey of local knowledge identified three known herring aggregation sites in Placentia Bay: coastal waters between Lamaline and St. Lawrence (southern Burin Peninsula); near Boat Harbour/Brookside/Little Harbour (west side of Placentia Bay); and on northeast and northwest Merasheen Island and southwest Long Island (refer to Section 13.3.1.4; Figure 13-5)."
24	*HPD*	*SL*	*8.4.1.2 Concrete Gravity Structure Construction and Installation, P. 8-41*	*The EA states that a gated structure could be installed at the entrance of the graving dock post-flooding. Installation of the gate should be included in the assessment as an activity resulting in potential impacts to fish and fish habitat.*
Husky Response:				*The following underlined insertions have been made to Section 8.4 to include the addition of a potential gated structure installed at the entrance of the graving dock post-flooding.* **Summary of Potential Environmental Effects** The potential environmental effects that could result from WREP-VEC interactions for fish and fish habitat are provided in revised Table 8-5, including planned future activities and potential accidental events, which is provided as Table 16 at the end of the DFO comment tables. **8.4.1 Nearshore** The activities assessed in the Nearshore Project Area include graving dock construction and CGS construction and installation. There are no nearshore activities associated with the subsea drill centre option.

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				Project-related accidental events could also occur in the Nearshore Study Area. **8.4.1.1 Graving Dock Construction** During construction of the graving dock (see Section 2.6.3), the nearshore activities that have the potential to interact with marine fish and fish habitat include discharge of water from The Pond, dewatering of the graving dock, noise from construction activities (i.e., sheet pile driving and potential grouting) and lighting. **8.4.1.2 Concrete Gravity Structure Construction and Installation** During CGS construction and installation, the nearshore activities that have the potential to interact with marine fish and fish habitat includes lighting, operation of vessels, nearshore surveys (i.e., multibeam, sonar, environmental), dredging and dredge spoils disposal, ballasting/deballasting of the CGS; towing to the deep-water mating site; noise from topsides mating; and the establishment of a no-fishing safety zone. **8.4.1.3 Operation and Maintenance of Permanent Graving Dock** Under the WHP development option, consideration will be given during the design phase to developing the CGS construction facility as a permanent graving dock, which could be used for the construction of future CGSs or for other industrial applications. Design of the graving dock for future use could include provision for a gated system, allowing the graving dock to be flooded and drained as required. During operation and maintenance of the permanent graving dock, nearshore activities that have the potential to interact with marine fish and fish habitat include dewatering and flooding of the graving dock. *The following underlined insertions have been made to Section 8.5 to include the addition of a potential gated structure installed at the entrance of the graving dock post-flooding.* **8.5.1 Nearshore** In the Nearshore Study Area, the WREP activities that could affect marine fish and fish habitat include those associated with graving dock

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				excavation, CGS construction, CGS tow-out, topsides mating and permanent graving dock operations and maintenance. The potential environmental effects from these activities include change in habitat quality, change in habitat quantity and potential mortality. **8.5.1.1 Graving Dock Construction** **Change in Habitat Quality** The potential change in marine fish and fish habitat quality in the Nearshore Study Area during graving dock construction include lighting, discharges from The Pond, dewatering of the graving dock and noise from pile driving and graving dock gate installation. The potential environmental effects include increased light, sedimentation and underwater noise. **8.5.1.3 Operation and Maintenance of Permanent Graving Dock** **Change in Habitat Quality** The potential change in marine fish and fish habitat quality in the Nearshore Study Area during the operation and maintenance of a permanent graving dock include discharges during dewatering of the graving dock and flooding of the graving dock. The potential environmental effects to the marine environment are primarily associated with the discharge during the dewatering of the graving dock. These environmental effects may include changes in the water quality of the ambient environment with respect to salinity, dissolved oxygen, and sedimentation. Flooding of the graving dock will have minimal environmental effects, except for the potential introduction of fish in the graving dock, but they will be able to move freely back to the marine environment. ***Salinity*** The operation of the permanent graving dock with a gated system could lead to the intrusion of hypersaline or hyposaline water from discharges during dewatering of the graving dock into the marine environment. Saline water trapped inside the gated graving dock system could be subject to evaporation (intense during the summer

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				months), resulting in increased salinity of graving dock water. Water trapped inside the gated graving dock system could be subject to freshwater input from precipitation or groundwater intrusions resulting in hypo-saline water. If this hypersaline or hyposaline water is discharged to the marine environment, it could lead to stress on marine species present in the immediate area, especially benthic sessile species that do not have the ability to avoid contact with this water. Osmoregulation in marine species depends on the relationship between solute and solvent concentrations of internal body fluids and the outside medium that surrounds the animal (Hammerschlag 2006). Unless the species' internal body fluids are equal to those of the water surrounding it, water will enter the body when fluids in the body contain higher concentrations of ions, and will leave the body when the surrounding environment contains higher concentrations of ions. Electrolytes (ions) will also diffuse across concentration gradients in a similar fashion (Hammerschlag 2006; Genz et al. 2011). Marine teleosts are slightly hypo-osmotic compared to the surrounding seawater and experience water loss and an influx of salts (Sardella et al. 2004; Gonzalez et al. 2005; Genz et al. 2011). Exposure to hypersaline water poses increased challenges for osmoregulators and stresses physiological and biochemical systems. In hypersaline situations, marine species experience a greater osmotic gradient and greater water loss than normal. To maintain a constant cellular volume, species must actively ingest ambient water and excrete salts. Most marine species are unable to maintain long-term osmotic balance in salinity greater than concentrations found in seawater (Sardella et al. 2004; Gonzalez et al. 2005; Genz et al. 2011). Hyposaline environments can also put stress on marine organisms. When salinity decreases marine organisms will have an influx of water due to passive diffusion. To maintain a constant volume they will have to actively pump water out via the kidney in the form of dilute urine (Hammerschlag 2006). Low salinity can also put stress on marine algae. Marine algae in low saline environments will have a lower

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				photosynthetic rate and growth rate (Kim and Garbary 2006). ***Dissolved Oxygen*** Water kept in the graving dock for extended periods of time could result in lower dissolved oxygen levels than circulated marine water. Lower dissolved oxygen water could be introduced to the marine environment upon dewatering of the graving dock. If a large amount of water with low dissolved oxygen enters the marine environment, mortality of some organisms could occur and stress induced to surviving organisms (Vanquer-Sunyer and Duarte 2008). Benthic organisms are more vulnerable to coastal hypoxia due to the fact that they are far from the atmospheric oxygen supply and sediments are often depleted in oxygen (Vanquer-Sunyer and Duarte 2008). Differences in oxygen thresholds for hypoxia across different species reflect the broad range of adaptations to low oxygen conditions. Mobile organisms have the ability to migrate and avoid oxygen-deficient water and have relatively high sub-lethal and lethal thresholds for oxygen concentrations. Organisms which are sessile or slow-moving have higher thresholds for sub-lethal and lethal oxygen concentrations due to the fact they cannot quickly escape oxygen-deficient water. Median lethal dissolved oxygen concentrations range from 8.6 mg O_2/L for the larval crab, *Cancer irroratus,* to 0 mg O_2/L for the oyster, *Crassostrea virginica*. Median sub-lethal dissolved oxygen concentrations range from 10.2 mg O_2/L for cod, *Gadus morhua*, to 0.085 mg O_2/L for the burrowing shrimp, *Calocaris macandreae* (Vanquer-Sunyer and Duarte 2008). ***Sedimentation*** Water discharges from the graving dock during dewatering may result in a change in marine habitat quality due to sedimentation or the increase in suspended sediment concentrations in the ambient environment. Potential environmental effects of sedimentation on organisms include direct effects such as smothering (decreased gas exchange), toxicity (exposure to anaerobic sediment layers or contaminated sediment), reduced light intensity, and physical

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				abrasion, as well as indirect effects such as changes in substrate characteristics (Wilber et al. 2005). The WREP will comply with the total suspended solids discharge limit of 30 mg/L (Newfoundland and Labrador *Environmental Control Water and Sewage Regulations, 2003*) and, therefore, water discharges are not expected to result in any smothering effects. The discharge of water at these levels is also not expected to create a suspended solids level that would exceed the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002). The CCME guidelines specify that during clear flow periods, anthropogenic activities should not increase suspended sediment concentrations by more than 25 mg/L over background levels during any short-term exposure period (24 hours). Since these levels are not expected to be exceeded during dredging operations (see Section 8.5.1.2), then CCME suspended solids levels would not be exceeded while discharging water within regulated limits. Increased levels of suspended sediment can reduce the availability of light in the photic zone and may reduce local primary production, particularly if sediment loading occurs just prior to, or during, a phytoplankton bloom. This could have effects on higher trophic levels including fish and shellfish if the sediment is suspended over large areas for extended duration. Benthic primary production can also be reduced due to decreased light attenuation caused by sediment loading over extended periods (Aumack et al. 2007). Plankton and sessile invertebrates are unable to actively avoid areas with high sediment loads. Mechanical damage has been observed in herring larvae at TSS levels of 1,000 mg/L (Boehlert and Yoklavich 1984). Further harm to fish and invertebrates may result from respiratory and feeding problems associated with high sediment levels. The severity of environmental effects of the suspended sediment increases as the volume and duration of exposure increase. Mobile fish and invertebrates may avoid an area completely during the period of physical activity (Robinson and Cuthbert 1996). Shellfish are typically more likely to experience adverse effects of increased

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				sediment load than fish because they are often sessile and filter feeders, and may reduce or stop feeding until sediment loading decreases to suitable levels (Peddicord 1980). Eventually, suspended sediment will settle on the seafloor, and the rate at which this occurs is dependent on sediment grain size and the water currents in the area. Fine sediment such as silt and mud will drift over longer distances in the water column than coarser sediments. Water discharges from the graving dock during dewatering will be treated, if necessary, to comply with applicable federal and provincial water quality standards. The discharge will be tested routinely for TSS and to be in compliance with the Newfoundland and Labrador *Environmental Control Water and Sewage Regulations, 2003*. If there is indication that the water is close to the discharge limit of 30 mg/L, the water will be diverted to a settling pond or through a filter to ensure compliance before discharge. Contact of graving dock water by marine organisms, however, would be temporary and localized and which would be further reduced in severity as a result of mixing with the surrounding waters and attributed to physical factors such as the tides, waves and current flows in Argentia Harbour. Therefore, these discharges are likely to result in a short-term change in marine habitat quality due to the potential input of hypersaline or hyposaline water, of lower dissolved oxygen water, or high suspended solids in the water. Large volumes of water will be discharged over the course of several tidal cycles to ensure adequate mixing. The environmental effects on the marine environment from the potential discharge of hypersaline or hyposaline water, low dissolved oxygen, or high suspended solids during the dewatering of the graving dock is therefore expected to be short in duration, low in magnitude, of limited geographic extent and reversible. Further, with the proposed mitigation measures noted above, adverse residual environmental effects on fish and fish habitat from the dewatering and flooding of the graving dock are predicted to be not significant.

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				New References: Genz, J., M.D. McDonald and M. Grosell. 2011. Concentration of $MgSO_4$ in the intestinal lumen of *Ospanus beta* limits osmoregulation in response to acute hypersalinity stress. *American Journal of Physiology - Regulatory, Integrative and Comparative Physiology*, 300: R895-909. Gonzalez, R.J., J. Cooper and D. Head. 2005. Physiological responses to hyper-saline waters in sailfin mollies (*Poecilia latipinal*). *Comparative Biochemistry and Physiology, Part A*, 142: 397-403. Hammerschlag, N. 2006. Osmoregulation in elasmobranchs: a review for fish biologists, behaviorists and ecologists. *Marine and Freshwater Behaviour and Physiology*, 39 (3): 209-228. Kim, Y.K. and D.J. Garbary. 2006. Photosynthesis in *Codium fragile* (Chlorophyta) from a Nova Scotia estuary: responses to desiccation and hyposalinity. *Marine Biology*, 151: 99-107. Sardella, B.A., V. Matey, J. Cooper, R.J. Gonzalez and C.J. Brauner. 2004. Physiological, biochemical, and morphological indicators of osmoregulaotry stress in 'California' Mozambique tilapia (*Oreochromis mossambicus X O. urolepis hornorum*) exposed to hypersaline water. *The Journal of Experimental Biology*, 207: 1399-1413. Vaquer-Sunyer, R., and C.M. Duarte, 2008. Thresholds of hypoxia for marine biodiversity. *Proceedings of the National Academy of Sciences*, 105 (40):15452-15457.

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25	*EAMP*	*LN*	*8.4.4 Summary of Potential Environmental Effects, Table 8-5, P. 8-43*	*i. Under Subsea Drill Center Installation, installation of subsea equipment: "x/+" should be depicted under Change in Habitat Quantity, as habitat is being lost as a result of the placement of equipment on the seafloor.* *ii. Under Potential Future Activities, excavation of drill centers: "-" should be depicted under Potential Mortality, as there will likely be loss of benthic organisms as a result of the excavation and disposal of dredge spoils.* *iii. Under Wellhead Platform Installation/Commissioning, Dredging and disposal of dredge material should have "X" for Potential Mortality* *iv. Under Potential Future Activities, Installation of Pipeline(s) and Testing from Drill Centres to FPSO, including Flowline Protection should have an "X" for Potential Mortality.*
Husky Response:				All comments are noted. Thank you.
26	*HPD*	*SL*	*8.5.1.1 Graving Dock Construction, P. 8-46*	*As discussed in the EA, The Pond will be drained prior to disposal of the graving dock and dredge spoils. However, given the permeable nature of the berm/barasway, please provide justification/evidence to illustrate that there will be no contamination or sedimentation from The Pond into the marine environment.* *Also, it should be noted that appropriately sized screens should be employed during the draining of The Pond as noted above (S-4).*
Husky Response:				Please note that the water in The Pond will be displaced as soil from the graving dock is deposited. Water from The Pond will be tested for compliance according to the Newfoundland and Labrador *Environmental Control Water and Sewage Regulations, 2003*, prior to discharge to the marine environment.

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27	*HPD*	*SL*	*8.5.1.2 Concrete Graving Structure Construction and Installation, P. 8-50*	*The proposed Dredging Area nearshore was originally proposed to be 24,150 m^2 (as stated in the Marine Habitat Characterization Report, 2012), whereas the EA indicates that a significantly smaller area will be dredged/excavated (55 m x 200 m). Please confirm the actual amount of habitat that will be potentially affected. Also, depending on the final design of the graving dock entrance (i.e. gated or left open), additional habitat protection measures may be required. Measures to offset the impacts to fish habitat as a result of dredging/excavation of eelgrass beds and other productive nearshore habitats should be included. The EA should demonstrate that there are sufficient mitigation measures in place to ensure there are no significant adverse environmental effects.* *As discussed above (S-8), please confirm there will be no change in the quantity of fish habitat at the deep-water mooring points.*
Husky Response:				Husky submitted a habitat quantification report to DFO on March13th, 2013 which clarifies nearshore dredging area to be affected. The topsides mating operation is scheduled to take place no earlier than the summer of 2016. Husky continues to evaluate the specifications required for the deep water mating site. Once a site has been selected, the associated detailed information on the proposed mooring system will be submitted to DFO.
28	*EAMP*	*LN*	*8.5.1.2 Concrete Graving Structure Construction and Installation* *Table 8-6 /P 8-52*	*The Ecological/Social/Cultural/Economic Significance should be rated "2 (Evidence of existing adverse activity)".*
Husky Response:				Comment noted. Thank you.
29	*HPD*	*SL*	*8.5.1.3 Accidental Events in the Nearshore, P. 8-54*	*The potential collapse of the settling pond at The Pond and a breach at the berm/barasway resulting in a sedimentation event in the marine environment are potential accidental events that should be included in this section.*

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Husky Response:				The following underlined insertions have been made to Section 8.5.1.3 to include the accidental event for the potential collapse of the settling pond at The Pond and a breach at the berm/barasway, resulting in a sedimentation event in the marine environment. **8.5.1.3 Accidental Events in the Nearshore** There is the possibility of an accidental event occurring in the Nearshore Study Area during graving dock construction or CGS construction and installation phases. The scenarios with the greatest potential environmental risk considered in this section are a breach in the graving dock, <u>collapse of the settling pond at The Pond and breach at the berm/barasway,</u> or an accidental release of marine diesel fuel from a vessel as a result of a collision or other incident. The collapse of the bund wall could result in a sudden increase in sedimentation in the immediate vicinity of the breach. A breach in the bund wall surrounding the graving dock would result in an influx of water into the dry graving dock. Water could become contaminated with cement, lube oils and other chemicals contained within the graving dock. <u>The collapse of the settling pond at The Pond or a breach at the berm/barasway could also result in a sudden increase in sedimentation in the immediate vicinity of the collapse. Water containing fines could exit The Pond and enter the marine environment, potentially causing adverse environmental effects to habitat quality and mortality within the immediate vicinity. The berm dividing The Pond from the marine environment is reinforced with armour stone on the sea side and is unlikely to give way. In the event of a breach, wind, wave, and current action will disperse these fines into a dilute layer that is not expected to result in significant adverse environmental effects. A breach would quickly be repaired by the earth works equipment on site. In an extreme failure event, there may be a small, localized area of smothering within the immediate area of the breach, which could potentially increase direct mortality of sessile</u>

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				<u>benthic organisms. The potential environmental effects of sedimentation are discussed above in Sections 8.5.1.1 and 8.5.1.2. Potential direct mortality in this case is expected to be very low and not significant.</u> In the unlikely event there is a spill of marine diesel fuel in the nearshore, oil spill response plans will be initiated to contain and clean-up the spill to mitigate potential environmental effects. Nearshore oil spill modelling (Section 3.7) suggests that in the unlikely worst-case scenario, the maximum possible volume of a batch fuel spill (350 m^3) would be released. The tug boats, accommodation vessel and supply vessels that will be used in the Nearshore Study Area will use marine gas oil, which is similar in composition and spill behaviour to diesel fuel. Modelling of an unmitigated nearshore oil spill scenarios found that a high proportion (55 to 94 percent) of the modelled slicks reach the shoreline due to the close proximity of the spill sites modelled to shore (near Argentia and the two possible deep-water mating sites) and due to the prevailing westerly and southwesterly winds in Placentia Bay. The minimum time to shore ranged from two to five hours if there was no spill response (SL Ross 2012). During the months of March and July, over 55 percent of the modelled spills (diesel slick) reached the shore within less than 24 hours, and more than 75 percent of the modelled spills reached the shoreline within 48 hours. Survival time of the diesel fuel that did not reach the shoreline ranged from a minimum of 0.5 days to 8 days (SL Ross 2012). The average summer and winter conditions were modelled based on wind speed and water temperature. There are few differences in the fate of the spills between the two seasons. The nearshore oil spill model is discussed in detail in Section 3.7 and SL Ross (2012). The potential effects of diesel fuel reaching the identified Sensitive Areas in the Nearshore Study Area (e.g., coastal habitats) are discussed in Section 13.5.2.1. Marine fish species at risk and the potential effects of the accidental release of diesel fuel are discussed in Section 12.4.2.1. The majority of information summarized below is

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				from studies on crude oil spills, but may be relevant to marine diesel spills in the nearshore, and is also applicable to the Offshore Study Area. **Summary of Nearshore Environmental Effects Assessment from Accidental Events** The environmental effects resulting from an accidental event in the Nearshore Study Area and the mitigations to be implemented are summarized in revised Table 8-7, which is provided as Table 17 at the end of the DFO comment tables.).
30	*EAMP*	*LN*	*8.5.1.3 Accidental Events in the Nearshore P 8-59*	*In the nearshore, another accidental event that could potentially have an adverse effect on fish and fish habitat is a oil spill near a capelin spawning beach during a sensitive time of the year.*
Husky Response:				Please refer to Section 13.5.2.1, which discussed the environmental effects of an oil spill in the vicinity of a capelin spawning beach
31	*EAMP*	*LN*	*8.5.2.2 Production/Operation and Maintenance Table 8-8 / P. 8-64*	*i) The Ecological/Socio/Cultural/Economic Significance should be given a lower rating of 2 = evidence of existing adverse activity. In fact, this would apply for any of the potential effects assessment summary tables.* *ii) The change in habitat quantity for flowline rock berms is Negative as well as Positive.*
Husky Response:				Both comments are noted. Thank you.
32	*HPD*	*SL*	*8.5.2.2 Production/Operation and Maintenance, P. 8-67*	*It is important to note that even though Husky Energy has already been previously authorized for the footprint of the CGS, this will cause a change in fish habitat quantity and therefore should be included. Although a "reef effect" may occur at the installation site, it is temporary in nature as the CGS will be removed during decommissioning.*
Husky Response:				Comment noted. Thank you.

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33	*HPD*	*SL*	*8.5.2.3 Offshore Decommissioning and Abandonment, P. 8-69, 8-72*	*As stated above (S-10), the removal of rock berms and flowlines which were approved as compensation for fish habitat loss may constitute a harmful destruction of fish habitat and as such could require a Fisheries Act Authorization.*
Husky Response:				Husky will contact DFO prior to the undertaking of such activities.
34	*HPD*	*SL*	*8.5.2.4 Potential Future Activities, P. 8-72*	*Future maintenance of drill centers could result in further harmful alteration and/or destruction of fish habitat depending on the magnitude and extent of operations. For large-scale maintenance projects and extensive installations of new equipment, Husky is advised to consult DFO to determine whether there are any Fisheries Act implications.*
Husky Response:				Husky will contact DFO prior to the undertaking of such activities.
35	*EAMP*	*LN*	*8.5.2.4 Potential Future Activities* *Table 8-11 / P 8-74*	*i) The intentions surrounding the potential future activities should be clarified as the potential effects associated with activities or components outside of the current project description would be subject to regulatory view and may require additional EA.* *ii) The Ecological/Socio/Cultural/Economic Significance should be given a lower rating of 2 = evidence of existing adverse activity.* *iii) Please provide clarification on the mitigation measure referring to s.32 Fisheries Act Authorization. The issuance of a s.35(2) Fisheries Act Authorization is more accurate.*
Husky Response:				All comments noted. Thank you
36	*HPD*	*SL*	*8.5.3.1 Nearshore, P. 8-80*	*As described in the general comments (S-4), submarine cables and other obstacles may be present in the coastal environment which could pose a risk during dredging activities.*
Husky Response:				Comment noted. Thank you

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37	*HPD*	*SL*	*8.5.5 Follow-up and Monitoring, P. 8-83*	*Fish habitat compensation monitoring will be required as a condition of the s. 35(2) Fisheries Act Authorization to be issued for the harmful alteration or destruction of fish habitat associated with the dredging/excavation activities within the immediate vicinity of the graving dock.*
Husky Response:				Comment noted. Thank you.
38	*EAMP*	*LN*	*11.4.4 Summary Table 11-9 / Pg 11-57* *12.4.1.5 Summary Table 12-4 / Pg 12-61*	*i) Avoidance should be considered a Change in Habitat Quantity associated with seismic activities.* *ii) Collisions should be considered as Potential Mortality associated with Cumulative Effects.*
Husky Response:				Comment noted. Thank you.
39	*EAMP*	*LN*	*11.5.1.1 Graving Dock Construction, Table 11-10, P. 11-61*	*Avoiding mammal concentrations, maintaining a steady course and safe speed (identify limit, i.e., less than 26 km/hr) should be mandatory rather than "when possible", otherwise, conditions not likely to implement a safe speed should be identified.*
Husky Response:				A safe speed for transit into and out of Argentia will be determined by the Port and Pilot authorities at time of navigation, with consideration for weather and visibility.
40	*EAMP*	*LN*	*11.5.2.5 Accidental Events, P. 11-87*	*Please provide additional rationale why the Killer Whale population-level effects conclude "no population-level effects."*
Husky Response:				Because killer whales are uncommon in the study areas and are widely distributed throughout their range in the Northwest Atlantic and eastern Arctic, population-level effects would appear to be unlikely. However, it is noted that if the population size is small (although population size is currently unknown), loss of one or two individuals could represent a population-level effect.
41	*EAMP*	*LN*	*12.2 Definition of Significance, P. 12-2*	*The qualifying statement, "…if a population is vulnerable to extinction" should be removed from the definition.* *This also applies to inclusion of "vulnerable to extinction" in the summary on page 12-71.*

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Husky Response:				Comment noted. Thank you.
42	*DFO (Sci.)*		*12.3 Existing Environment, Table 12-3, P. 12-5*	*For Smooth Skate, Table 12-3 should also state "Southern NF population has moderate potential for occurrence in Nearshore Study Area". This addition also applies to **Page 12-25 (para. 4)**.* *The second most common skate species caught in the inshore NF/Subdiv. 3Ps skate fishery is Smooth Skate (Malacoraja senta), all discarded at sea; albeit not SAR population of the Funk Island Deep DU.*
Husky Response:				Both comments noted. Thank you.
43	*DFO (Sci.)*		*12.3 Existing Environment, Table 12-3, P. 12-6*	*For Blue Shark, Table 12-3 should read "Prio**n**ace glauca"; not "Priomace glauca". Also should read "Cape Hatt**e**ras"; not "Cape Hattaras" for Spiny Dogfish (Squalus acanthias) and elsewhere.* *The EA statement, "Most abundant along the coast of Nova Scotia and offshore Scotian Shelf" is irrelevant to this Newfoundland EA study; however, Blue Sharks (Prionace glauca) are an abundant regular seasonal visitor to Newfoundland waters.*
Husky Response:				Both comments noted. Thank you.
44	*DFO (Sci.)*		*12.3 Existing Environment, Table 12-3, P. 12-7*	*For Basking Shark, Table 12-3 should read "Low to moderate potential for occurrence in Nearshore Study Area during summer"; not "Low". Also, the table should read "Usually present in surface waters of Newfoundland bays feeding on plankton from May to September." This correction also applies to **Page 12-40 (para. 2)**.*
Husky Response:				Comment noted. Thank you.
45	*DFO (Sci.)*		*12.3 Existing Environment, Table 12-3, P. 12-7*	*For Thorny Skate, Table 12-3 should read "Moderate to high potential for occurrence in Nearshore Study Area; not "Moderate" as suggested. This correction also applies to **Page 12-44 (para. 2)**.*
Husky Response:				Comment noted. Thank you.

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46	*DFO (Sci.)*		*12.3.1.2 Wolffish, P. 12-9*	*Regarding the following statement, "No wolffish were observed during the nearshore ROV habitat survey of Argentia and area", any conclusions are dependent upon the date(s), time of day, survey depth(s), and remotely operated vehicle (ROV) proximity to bottom topographic features. The ROV survey was conducted "outside" of the Atlantic Wolffish (Anarhichas lupus) spawning/nesting season; therefore, it is not unexpected to find low/no observations of adults "near shore". If this ROV survey was conducted "within" the wolffish spawning/nesting season, this conclusion may change. Therefore, the specifics of the ROV survey are crucial for the validation of conclusions in regard to wolffish in the proposed Argentia Peninsula (i.e., Nearshore) development.*
Husky Response:				Comment noted. Thank you.
47	*DFO (Sci.)*		*12.3.1.2 Wolffish, P. 12-11*	*The following statement, "Females guard the nests", is incorrect and the cited references do not support those statements. For all three wolffish species, the adult male of each mated pair guards and aerates the resultant egg mass (i.e., "nest") until hatching.*
Husky Response:				Comment noted. Thank you.
48	*DFO (Sci.)*		*12.3.1 Marine Fish Species at Risk, Figures 12-1 to 12-7, 12-9 to12-12, 12-14 to 12-16, and 12-18*	*Please update the figures as more recent data is available.*
Husky Response:				Figures 12-1, 12-2, 12-3, 12-6, 12-7, 12-12, 12-14, 12-15 and 12-18 have been updated and are provided as Figures 28 to 36 at the end of the DFO comment tables. Figures 12-5, 12-9, 12-10, 12-11 and 12-16 are up to date.
49	*DFO (Sci.)*		*12.3.1.3 Atlantic Cod, P. 12-15*	*The distribution plots for Atlantic Cod (and other species using Kulka et al. 2003) are based on data from 2000 and should be updated, particularly in relation to baseline information for the project.*
Husky Response:				Figure 12-4 has been updated and is provided as Figure 37 at the end of the DFO comment tables.

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50	*DFO (Sci.)*		*12.3.1.5 Porbeagle Shark, P. 12-22*	*The statement, "Porbeagle are also caught as bycatch in other fisheries…of the 57 mt of discards annually" (based on Campana et al. 2011), underestimates fishing bycatch mortality for this species. A more realistic estimate/fisheries overview can be obtained from Benjamins et al. (2010). This paper also considers several other SAR shark species including Shortfin Mako, Spiny Dogfish, Blue Shark, and Basking Shark.*
Husky Response:				Comment noted. Thank you.
51	*DFO (Sci.)*		*12.3.1.8 Redfish, Figure 12-9, P. 12-27*	*The distribution plots for redfish indicate very low relative abundance except for an occasional hot spot. This was not expected and should be reviewed for accuracy. In addition, the low abundance of the distribution plots for redfish appear to contradict the results of the DFO RV survey in Div. 3L for 2010 and 2011 where Deepwater Redfish (Sebastes mentella) is the dominant species by weight both years (**Page 8-34**).*
Husky Response:				The figure is from Kulka et al. (2003). Comment noted. Thank you.
52	*DFO (Sci.)*		*12.3.1.12 Atlantic Salmon, P. 12.32*	*For the south coast of Newfoundland, Atlantic salmon (Salmo salar) remain in the river until <u>age three or four</u>, not "age two". The species is no longer valued as "commercial fisheries" (also delete sentence 2 of **para. 6**). The third sentence of para. 2 should be revised because salmon breed in other areas besides the southeast tip. In **para. 5,** the last sentence should state "20 percent for <u>small salmon</u> and by 11 percent for <u>large salmon</u>." Note that the small salmon are adults. In Figure 12-13, "post-smelt" should be <u>post-smolt</u>.*
Husky Response:				Comment noted. Thank you.

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53	*DFO (Sci.)*		*12.3.1.18 Thorny Skate, P. 12-44*	*The statement, "Simon and Frank (2000) found that in the skate fishery on the eastern Scotian Shelf…majority was Winter Skate", is irrelevant to this EA study. Instead, scientific papers reporting on the annual Newfoundland skate fishery - in which 95% of the skate catch is Thorny Skate (Amblyraja radiata) - should have been used.* *This fact, "95% of the skate catch is Thorny Skate", also applies to the skate fishery in Placentia Bay; rather than the ambiguous EA statement, "is thought to be Thorny Skate". (Simpson and Miri, 2012).*
Husky Response:				Comment noted. Thank you.
54	*DFO (Sci.)*		*12.5.1.1 Nearshore, P. 12-97 and 12-98*	*Previous published studies of the possible effects of pile driving are discussed, but not in relation to the pile driving activities proposed in the EA. In addition, there is no mention of sound output into the marine environment from pile driving in* ***Section 17.2.1****.*
Husky Response:				Effects of pile driving activities as they relate to the proposed project are addressed in the Effects Analysis Section 12.5.2.1 of the environmental assessment. They were also addressed in Section 11.5.1.1. Few studies compare underwater received levels between on-land and in-water pile driving. In one study at the Stockton Regional Wastewater Control Facility in California, in-water received rms SPLs from on-land impact pile driving operations were 4 and 12 dB lower than from in-water pile driving at 10 and 12 m from the pile, respectively (Illingworth & Rodkin, Inc. 2006, 2007). The pile is assumed to have been less than 10 m inland from the shoreline; however, the exact distance is unknown. In another study, Jenkerson et al. (2012) present measured underwater rms SPLs less than 135 dB re 1 µPa at 2 km from impact pile driving operation approximately 800 m from the shoreline, at the Odoptu-North construction site on Sakhalin Island, Russia. The results of Illingworth & Rodkin, Inc. (2006, 2007) suggest that in-water rms SPLs from the WREP on-land pile driving operations may

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				be 12 dB less or lower than from similar in-water operations. Results from Jenkerson et al. (2012) suggest that levels may be well below injury criteria (based on Southall et al. 2007) at short distance from the shoreline. There is little risk for hearing impairment to marine mammals and sea turtles during pile driving activities, given that sound levels typically recorded during pile driving activities do not exceed 180 dB re 1 µPa (rms) beyond several hundred metres from the source. JASCO (2010) acoustic modelling for the Hebron Project estimated that 180 dB re 1 µPa (rms) levels would extend to 260 m and 150 m from two locations in Trinity Bay. Sound levels of 190 dB re 1 µPa (rms) occurred at 60 and 20 m from these locations. 180 and 190 dB re 1 µPa (rms) sound levels are commonly used to assess physiological effects on marine mammals. Thus, available information suggests that there is little risk for hearing impairment to marine mammals or sea turtles beyond 300 m from pile driving in water. There would be even less risk of hearing impairment during the WREP pre-construction and installation phase, as pile driving would occur onshore, if required (JASCO, pers. comm.).
55	*DFO (Sci.)*		*12.5.1.1 Nearshore, P. 12-120*	*The EA states that "Although effects of the Exxon Valdez oil spill were substantial on killer whales, killer whales are uncommon in Placentia Bay, and no population-level effects would be expected." This conclusion may be incorrect based on the apparent small size of the Northwest (NW) Atlantic Killer Whale population. Even if the number of known individuals reaches 100, loss of one or two animals would represent a "population-level effect".*
Husky Response:				Comment noted. Thank you.
56			*12.5.2.2 Offshore, P. 12-126*	*Please specify a "safe speed" for project vessels. To ensure no mortality to listed marine mammals or sea turtles the safe speed would be (an unrealistic) zero knots. And it is unlikely that vessels transiting in night, fog, or high wave height conditions will be able to detect, much less, avoid a sea turtle or beaked whale.*

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Husky Response:				A safe speed for transit into and out of Argentia will be determined by the Port and Pilot authorities at time of navigation, with consideration for weather and visibility.
57	*DFO Oceans*		*13.0 Sensitive Areas, P. 13-1*	*The definition for sensitive areas quoted from the Scoping Document differs from the sensitive areas definition that has been used for other recent strategic and project based EAs (ex. Western Newfoundland SEA Update). In addition, in some assessments, sensitive areas are grouped with "special areas" (Western Newfoundland SEA), referred to as "potentially sensitive areas" (Southern Newfoundland SEA) or simply referred to as "special areas" (Laurentian Sub-Basin SEA). In the interest of clarity and consistency, it is suggested that the C-NLOPB identify a common, comprehensive definition and use common terminology for all SEAs and project based EAs when referring to special and sensitive areas.*
Husky Response:				Comment noted. Thank you.
58	*DFO Oceans*		*13.3 Existing Environment, P. 13-5*	*Please provide consistency in reference to the CPAWS Special Marine Areas. There are three areas not two areas, as specified in the EA. These three Special Marine Areas should be depicted on a map as they are currently not shown in the document.*
Husky Response:				Revised Figure 13-1, with the three CPAWS special Marine Areas identified is provided in Attachment 2.
59	*DFO Oceans*		*13.3.1 Nearshore, P. 13-6*	*The EA states: "…The Placentia Bay Extension EBSA (which includes all of Placentia Bay) is ranked second by DFO (2007b) in priority among the 11 identified EBSAs within the PBGB LOMA as candidate sites for designation as an MPA…". The Placentia Bay Extension EBSA was not ranked second in relation to priority for Marine Protected Area designation. The area scored second out of the 11 EBSAs in relation to the criteria evaluated to determine the ecological or biological significance of the areas examined by DFO Science. The EA document refers to these criteria on p.13-16 in Section 13.3.2.1.*

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				The identification of EBSAs is not restricted to considerations for MPA designation. While portions of EBSAs may be potentially considered for MPA designation, there are a suite of potential management measures that may be established for EBSAs, not just strict protection. It is suggested that the proponent refer to Appendix 1 of the Southern Newfoundland Strategic Environmental Assessment http://www.cnlopb.nl.ca/pdfs/snsea/snseaapp1.pdf where DFO submitted a clarification of the purpose for identifying EBSAs. *References framing EBSAs solely in the context of MPA designation should be corrected (ex. P. 13-6 and third paragraph P. 13-16).*
Husky Response:				Both comments are noted. Thank you.
60	*DFO Oceans*		*13.3.1.2 Eelgrass Beds, P. 13-10*	*The location of eelgrass beds should be depicted in a map as per the statement "…Extensive eelgrass beds have been identified in Placentia Bay (Catto et al. 1999; CPAWS 2009)…".*
Husky Response:				Neither CPAWS (2009) nor Catto et al. (1999) provide mapping of eelgrass bed locations in Placentia Bay. Eelgrass beds are known to occur within most shallow, sandy, sheltered areas of Placentia Bay with freshwater input (CPAWS 2009; Catto et al. 1999), forming in areas with energy levels low enough to allow for the accumulation and maintenance of sand, but with sufficient water circulation to limit accumulation of mud. Catto et al. (1999) conducted a preliminary biological and geomorphological classification of Placentia Bay and found that eelgrass beds in Placentia Bay are associated with "*estuarine areas (shore class 23), and are also found in association with ponds and inlets present along the landward sides of narrow sand flats (shore class20), gravel and sand flats (shore classes 16 and 17), on the lower energy, low shore zones of gravel flats (shore classes 13 and 14), and in the Come-by-Chance area (shore class 24)*".

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				Within the Cape Shore region, defined by Catto et al. (1999) as the region extending from Cape St. Mary's to the northern tip of the Argentia Peninsula, and within Northeast Placentia Bay, defined as Argentia Harbour to North Harbour, eelgrass shores were identified as one of the most commonly encountered subregions. Within the Swift Current Estuarine Region or northwest portion of Placentia Bay, defined as the area between North Harbour Point and Prowsetown, including Soundy Island, Woody Island, and Bar Haven Island, eelgrass beds were identified as the most characteristic feature. At Swift Current, eelgrass beds start just above the low tide level and extend almost to the upper reaches of the Swift Current estuary, associated with the presence of suitable sheltered sandy substrate (Catto et al. 199). Within the northwest Placentia Bay region, which is defined by Catto et al. (1999) to include Merasheen Island, Long Island, the Ragged Islands archipelago, Isle Valen, Presque Harbour, Paradise Sound, and the adjacent mainland shores of Newfoundland, eelgrass communities were not identified as a common subregion. Within the Burin Peninsula region, from Marystown to Point May, eelgrass communities are also less common, although present in some areas. This is due to the lack of deep embayments in this region (Catto et al. 1999).
61	*HPD*	*SL*	*13.5.1 Nearshore Pre-construction and Construction, Table 13-4, P. 13-24*	*The reversibility eelgrass bed destruction is not accurate as presented in the table. The cut-off wall will be excavated to 18-20 m depth making it too deep for eelgrass re-colonization. Therefore, the effects would be irreversible. Please clarify.*

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Husky Response:				Comment noted. It is acknowledged that some eelgrass located within the proposed dredge area will be permanently lost (refer to Figure 8-2). As this loss of habitat will be compensated for (under HADD compensation) and it is a small percentage of the eelgrass present in Placentia Bay, the residual adverse effects are still predicted to be not significant.
62	*HPD*	*SL*	*15.1 Existing White Rose Offshore Environmental Effects Monitoring Program, P. 15.1*	*While it is acknowledged that the WHP requires inclusion into the existing EEM, DFO has not reviewed any plans for the insertion of the SWRX into the EEM design. Prior to the commencement of the next iteration of the EEM program (2014), it is advised that the proposed design be submitted to DFO for review.*
Husky Response:				Husky will update the design of the EEM to include SWRX prior to the next scheduled sampling program in 2014. DFO will be consulted during the EEM re-design.
63	*HPD*	*SL*	*15.1.2 Environment Effects Monitoring Sampling Design, P. 15-3*	*Additional sampling will likely be required to verify predictions made during the EA regarding dispersion and subsequent accumulation of drill cuttings and therefore should be included in the monitoring program.*
Husky Response:				Comment noted. Thank you.
64	*HPD*	*SL*	*15.2.1 Nearshore Environmental Compliance Monitoring, P. 15-4*	*The proponent should also specify that a Section 35(2) Fisheries Act Authorization will likely be required for the nearshore dredging component.*
Husky Response:				Comment noted. Thank you.
65	*HPD*	*SL*	*15.2.2 Offshore Environmental Compliance Monitoring, P. 15-5*	*See comment G-1.*
Husky Response:				Comment noted. Thank you.

No.	Sector	Reviewer Initial	Section / Page No.	Comment / Information Request
66	*HPD*	*SL*	*15.3 Other Required Programs, P. 15-5*	*It is important to note that although there will be upcoming changes to the Fisheries Act, the current requirements of the Fisheries Act and DFO's Policy for the Management of Fish Habitat (1986) are still in effect for on-going projects.*
Husky Response:				Comment noted. Thank you.
67	*DFO (Sci.)*		*15.3*	*Dynamic positioned rigs and vessels will produce significant and long-duration underwater noise through propeller cavitation and thruster operations displacing marine mammals, or in the case of Northern Bottlenose Whales (Hyperoodon ampullatus), may attract them to such operations. Regular monitoring before, during, and after the onset of such activities would help to determine if there were distributional or behaviour responses to such noise sources.*
Husky Response:				Comment noted. Thank you.
68	*HPD*	*SL*	*17.4 Summary of Monitoring and Follow-up, P. 17-11*	*There is an indication that the EEM will be updated to incorporate the West White Rose development; however, the SWRX also needs to be included into the existing EEM program as described above (S-62).*
Husky Response:				Baseline information was collected around SWRX during White Rose 2012 EEM, prior to excavation. Husky will update the design of the EEM to include SWRX prior to the next scheduled sampling program in 2014.
69	*Oceans*		*17.5 Conclusions, Table 17-2, P. 17-12*	*Please be consistent in referring to "Special Areas" or "Sensitive Areas" throughout the EA.*
Husky Response:				Comment noted. Thank you.

11.2 Drill Cuttings and WBM Operational Release Modelling

No.	Sector	Reviewer Initial	Section / Page No.	Comment / Information Request
GENERAL COMMENTS				
1	*HPD*	*SL*	*Executive Summary, P. ii*	*The statement "Nor is account made of the possibility of cuttings near the cuttings deposits directly about the excavated drill centre(s) being cleared by a seafloor cutting transportation system and moved to another seafloor location" is concerning to DFO. The transportation of drill cuttings outside the authorized area could have Fisheries Act implications and therefore DFO should be contacted prior to the relocation of drill cuttings.*
Husky Response:				Husky will contact DFO prior to the undertaking of such activities.
2	*HPD*	*SL*	*2.0 Drilling Program, P. 2*	*The document suggests there could be three additional subsea drill centers at the White Rose field as well as the WHP. This is inconsistent with the EA and other documentation. Regardless, as stated in DFO's comment G-1 of the EA, the post-construction survey results from the SWRX have indicated Husky Energy may require amendments to existing authorizations to enable the excavation of anymore drill centers beyond the installation of the WHP.*
Husky Response:				For clarification, the WHP option includes two additional subsea drill centres, since SWRX was excavated in 2012. Husky will consult DFO regarding requirements for amendments to existing authorizations prior to the excavation of any additional subsea drill centres.
3	*HPD*	*SL*	*Figure 2-1, P. 3*	*The drill center SWRX is not depicted on the figure. Similar to S-9, please include it in the figure.*
Husky Response:				Please see response to comment S-9.
4	*HPD*	*SL*	*3.3.2 Synthetic Based Muds, P. 31*	*As discussed above, relocation of drill cuttings could have implications to fish and fish habitat, therefore contact DFO prior to the undertaking such activities.*
Husky Response:				Husky will contact DFO prior to the undertaking of such activities.

No.	Sector	Reviewer Initial	Section / Page No.	Comment / Information Request
5	*HPD*	*SL*	*4.0 Drilling Mud Properties and Discharge Characteristics, P. 38*	*It should be noted that another environmental effect of released WBMs is the smothering of benthic organisms that should be included.*
Husky Response:				Comment noted. Thank you.

11.3 Underwater Sound Propagation

No.	Sector	Reviewer Initial	Section / Page No.	Comment / Information Request
GENERAL COMMENTS				
1	*DFO (Sci.)*		*Table 1-2, P. 4*	*While the injury criteria in Southall et al. (2007) are accepted by many reviewers, the behavioural criteria are not generally accepted. For some cetaceans, reactions to sound appear to be highly dependent on context and their behavioural state. Based on the modelled sound propagation the area ensonified to a level that would result in behavioural reactions by cetaceans could be quite large.*
Husky Response:				Comment noted. Thank you.
2	*DFO (Sci.)*		*Table 2-2, Section 2.2.2 and elsewhere*	*Given that sounds from propeller cavitation and dynamic positioning using thrusters can be substantial – it would have been useful to review these models separately as they might be significant.*
Husky Response:				Comment noted. Thank you.
3	*DFO (Sci.)*		*Section 3.0*	*Provide a rationale for the exclusion of 5% of the furthest distance values to a given sound level; it does not seem useful to present this reduced dataset.*
Husky Response:				Using R95% to define an omnidirectional safety region (i.e., affected area, as defined in Section 5.3.2.1 of the environmental assessment) avoids inflating its size to encompass a large area that is mostly below the threshold. This radius is especially relevant where the source directivity or the environment lead to acoustic footprints that are highly irregular and include perimeter features that extend far beyond the circumference of the main ensonified area. Where the shape of a modelled isopleth is compact and has a featureless boundary, on the other hand, it may be advisable to use Rmax in determining the boundaries of the affected area, which will result in the inclusion of more than 100% of the ensonified area. The choice of which radius to use may ultimately depend on considerations of the shape of the region and the specific circumstances of each exposure scenario.

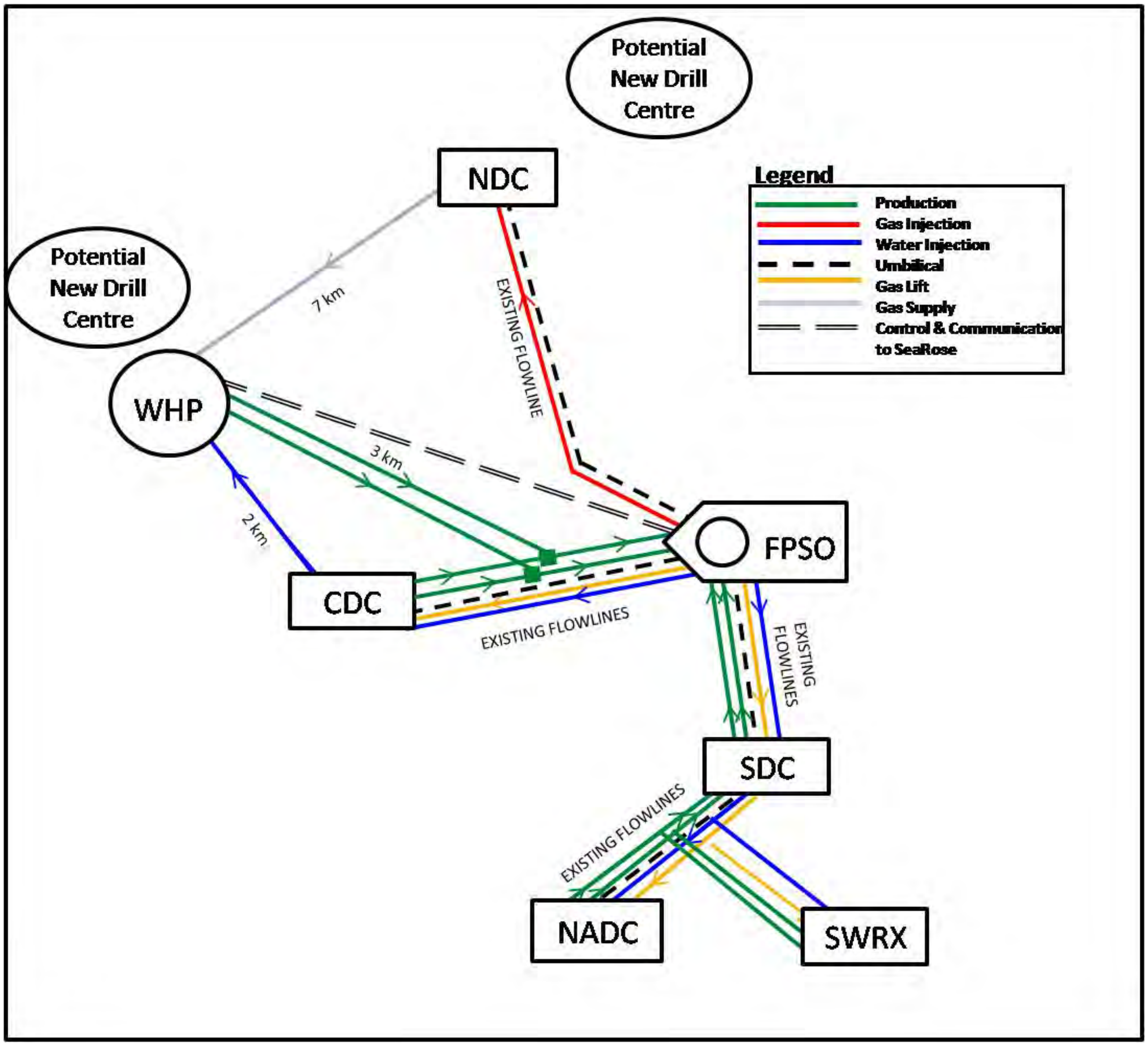


Figure 25 **Revised Figure 2-15 Potential Wellhead Platform Concept Integration into Existing White Rose Facilities**

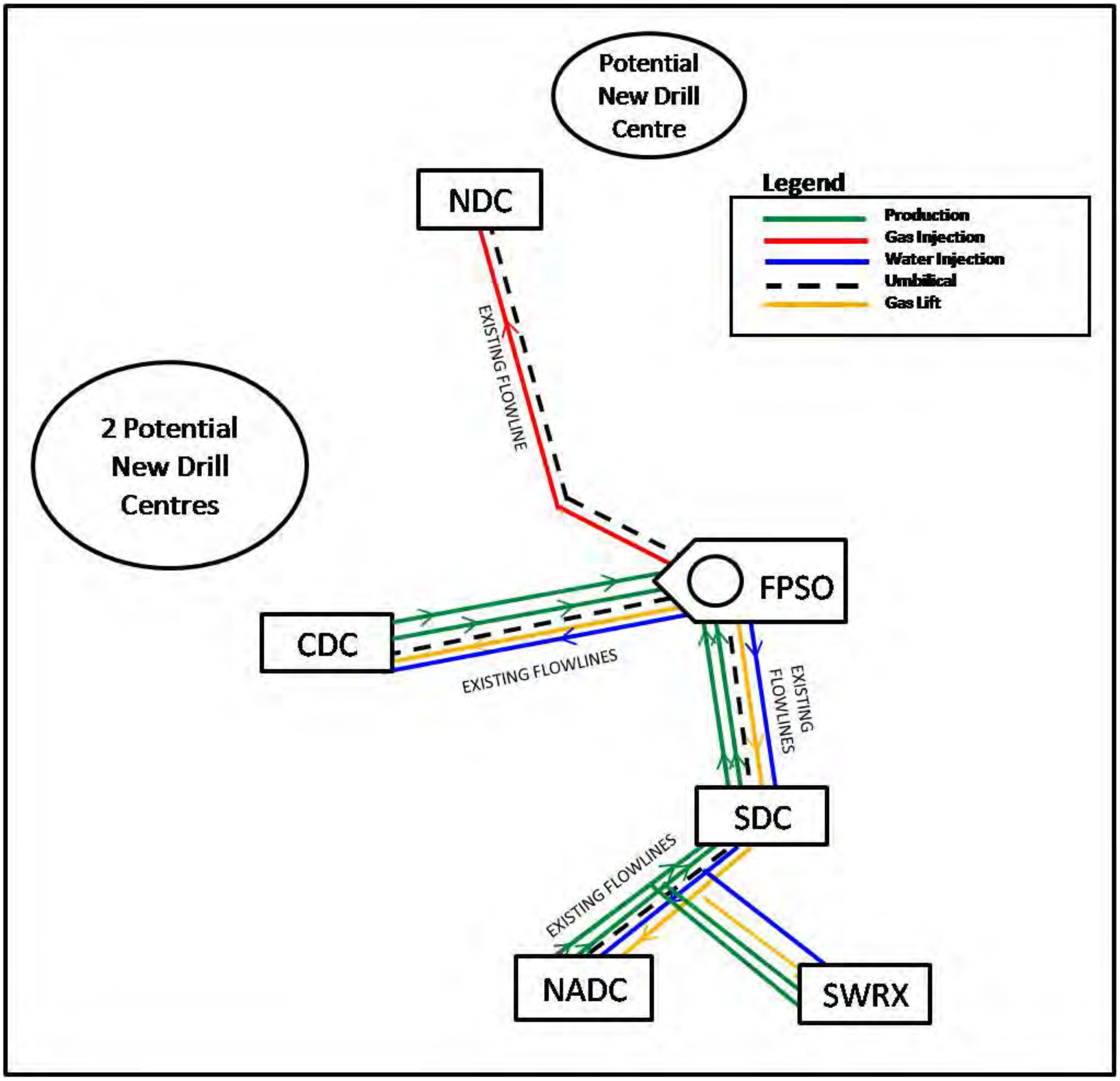


Figure 26 **Revised Figure 2-16 Potential New Subsea Drill Centres Location in Relation to the Existing White Rose Facilities**

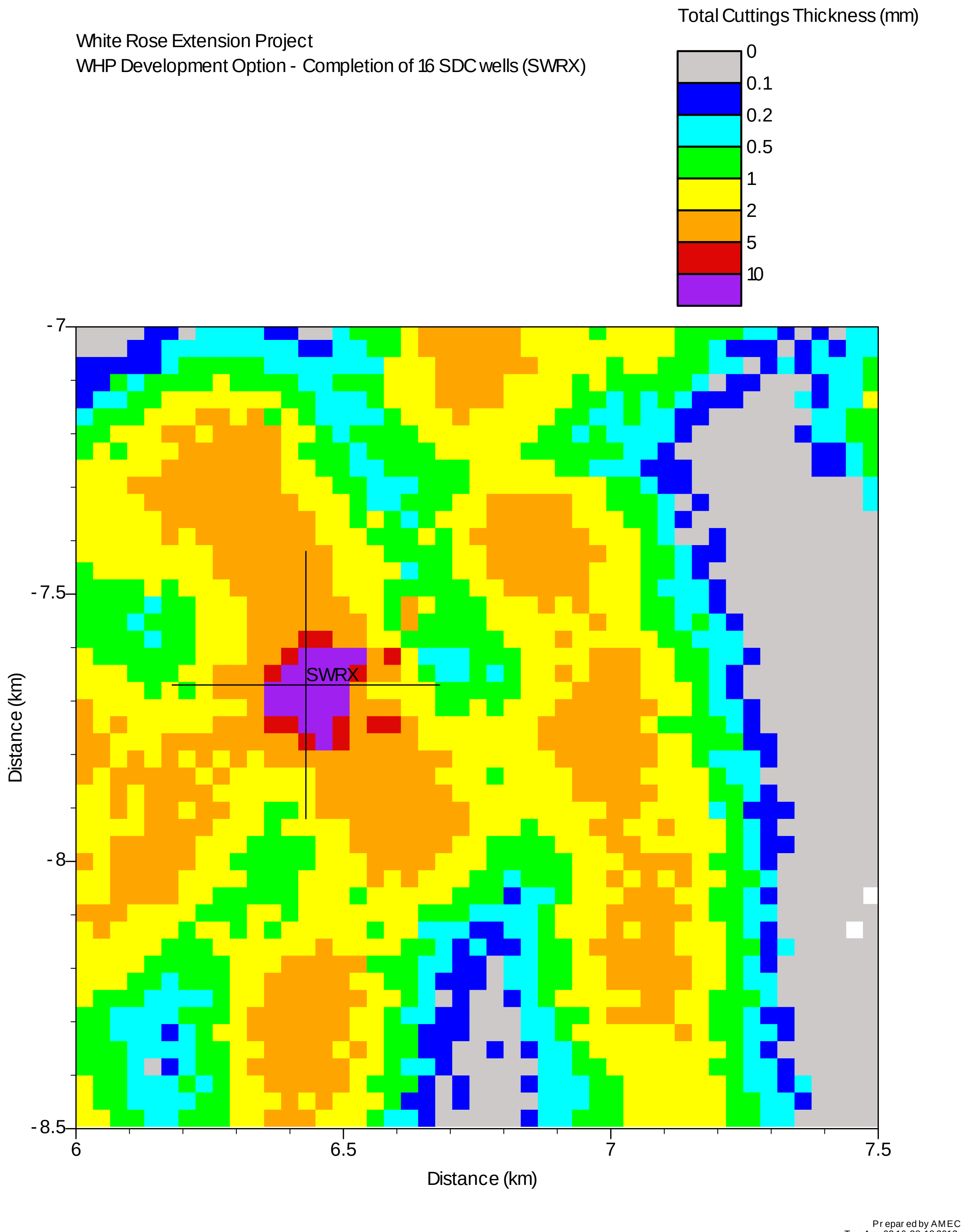


Figure 27 Figure 3-16a Total Water-based Mud and Synthetic-based Mud Cuttings Deposition for South White Rose Extension Drilling of 16 Wells, 'Base Case', 1.5-km View

Table 16 Revised Table 8-5 Potential White Rose Extension Project-Related Interactions – Fish and Fish Habitat

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Nearshore (WHP only)			
Graving Dock Construction			
Lighting	x		
Water discharge from The Pond	x		
Construction of graving dock (include sheet pile driving, potential grouting, <u>potential gate</u>)	x		
Dewater graving dock	x		
CGS Construction and Installation			
Onshore (Argentia Construction Site)			
Lighting	x		
Marine (Argentia and Deep-water Mating Site)			
Operation of vessels	x		
Additional nearshore surveys (e.g., multibeam, sonar, environmental)	x		
Dredging	x	x	x
CGS solid ballasting (which may include disposal of water containing fine material)	x		
CGS water ballasting and de-ballasting	x		
CGS towing to deep-water mating site	x		
Noise from topsides mating	x		
Lighting	x		
Safety zone			+
<u>Operation and Maintenance of Permanent Graving Dock</u>			
<u>Dewatering of graving dock</u>	x		
<u>Flooding of graving dock</u>	x		
Offshore			
Wellhead Platform Installation/Commissioning			
Clearance surveys (e.g., sidescan sonar) prior to installation of WHP or pipelines/ flowlines	x		
Operation of helicopters and vessels/barges	x		
Installation of flowlines and pipelines between WHP, subsea drill centre(s) and existing infrastructure	x		
Potential rock berms for flowline protection		x/+	
Lighting	x		
Safety zone			+
Drilling-associated seismic (VSPs and wellsite surveys)	x		
Subsea Drill Centre Installation/Commissioning **(Previously assessed; LGL 2007a)**			
Dredging and disposal of dredge material	x	x	
Clearance surveys (e.g., sidescan sonar) prior to installation of pipelines/flowlines	x		
Operation of helicopters and supply, support, standby and tow vessels/barges	x		
Lighting	x		
Safety zone			+
Installation of subsea equipment, flowlines and tie-in modules to existing subsea infrastructure	x		
Drilling-associated seismic (VSPs and wellsite surveys)	x		x
Production/Operation and Maintenance (Wellhead or Subsea Drill Centre)			
Presence of structure	x	x/+	
Safety zone			+
Noise from drilling from a MODU and WHP	x		
WBM (from either WHP or MODU) and SBM (from MODU only) cuttings [(A)]	x	x	x
Lighting	x		
Operation of seawater systems (cooling, firewater)	x		
Operation of helicopters, supply, support, standby and tow vessels/barges/ROVs	x		
Surveys (geotechnical, geophysical and environmental)	x		x
Cementing and completing wells	x		

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Oily water treatment [B]	x		
Decommissioning and Abandonment (WHP or Subsea Drill Centre)			
Removal of WHP		x/+	
Plugging and Abandoning Wells	x		
Operation of Vessels (supply/support/standby/tow vessels/barges/diving/ROVs	x		
Lighting	x		
Safety zone			x
Surveys (geotechnical, geophysical and environmental)	x		x
Potential Future Activities			
Surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving)	x		
Excavation of drill centres (including disposal of dredge spoils)	x	x	
Noise from drilling from MODU at potential future subsea drill centres	x	x	
WBM and SBM Cuttings	x	x	x
Installation of Pipeline(s)/Flowline(s) and Testing from Drill Centres to FPSO, including Flowline Protection	x	x	
Chemical Use and management (e.g., BOP fluids, well treatment fluids, corrosion inhibitors [C])	x		
Accidental Events			
Marine diesel fuel spill from support vessel	x		x
Graving dock breach	x	x	
SBM whole mud spill	x		
Subsea hydrocarbon blowout	x		x
Hydrocarbon surface spill	x		x
Other spills (e.g., fuel, waste materials)	x		x
Marine vessel incident including collisions (i.e., marine diesel fuel spill)	x		x
Cumulative Environmental Effects			
Commercial fisheries (nearshore and offshore)	x		x
Marine traffic (nearshore and offshore)	x		
White Rose Oilfield Development (including North Amethyst and the South White Rose extension drill centre)	x	x	x
Terra Nova Development	x	x	x
Hibernia Oil Development	x	x	x
Hibernia Southern Extension Project	x	x	x
Hebron Oil Development	x	x	x
Offshore Exploration Seismic Activity	x		x
Offshore Exploration Drilling Activity	x	x	

Notes:

(A) Water-based drilling fluids and cuttings will be discharged overboard. Husky will evaluate best available cuttings management technology and practices to identify a waste management strategy for spent non-aqueous fluid and non-aqueous fluid cuttings from the MODU. SBM cuttings will be re-injected into a dedicated well from the WHP, pending confirmation of a suitable disposal formation

(B) Water (including from open drains) will be treated prior to being discharged to the sea in accordance with the *Offshore Waste Treatment Guidelines* (OWTG) (National Energy Board (NEB) et al. 2010)

(C) Husky will evaluate the use of biocides other than chlorine. The discharge from the hypochlorite system will be treated to meet a limit approved by the C-NLOPB's Chief Conservation Officer

Table 17 Revised Table 8-7 Potential Environmental Effects Assessment Summary for Fish and Fish Habitat – Accidental Events in the Nearshore

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance	Significance Rating	Level of Confidence
Hydrocarbon spill from vessel (marine diesel) due to collision or accidental release	Change in habitat quality (N) Potential mortality (N)	• Training, preparation, equipment inventory, prevention, and emergency response drills • Oil Spill Response Plan • Vessels will not be re-fueled in the Nearshore Project Area • Adhere to MARPOL	H	3	1	2	R	3	NS	M
Graving dock breach	Change in habitat quality (N) Potential mortality (N)	• Design • Use of best practices and continual improvement programs	L	1	1	1	R	3	NS	H
Collapse of Settling Pond or Breach of Berm at The Pond	Change in habitat quality (N) Potential mortality (N)	• Design • Monitoring • Use of best practices and continual improvement programs	L	1	1	1	R	3	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

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

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

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

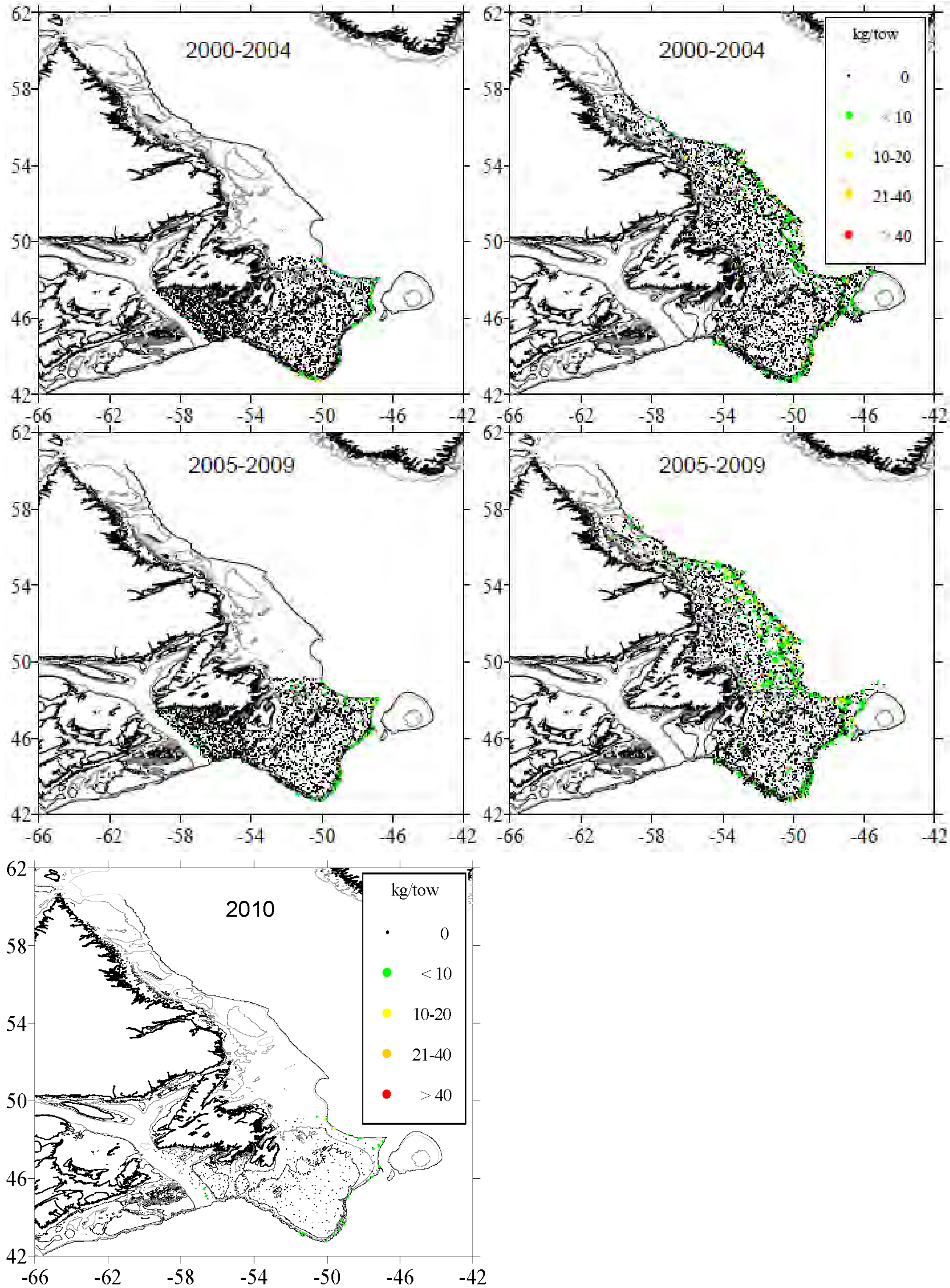
Reversibility (population level):
R = Reversible
I = Irreversible

Ecological/Socio-cultural/Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

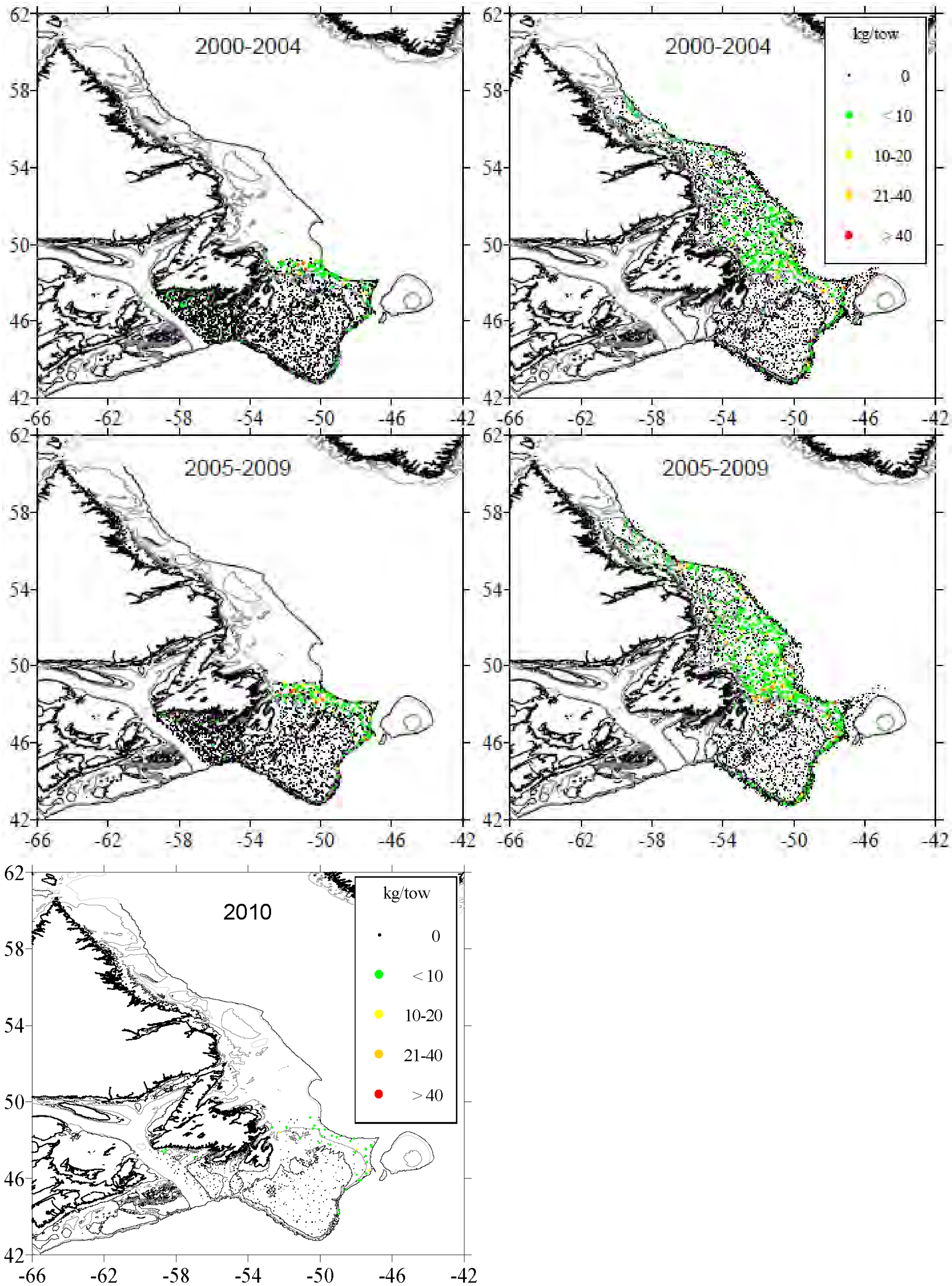
Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm



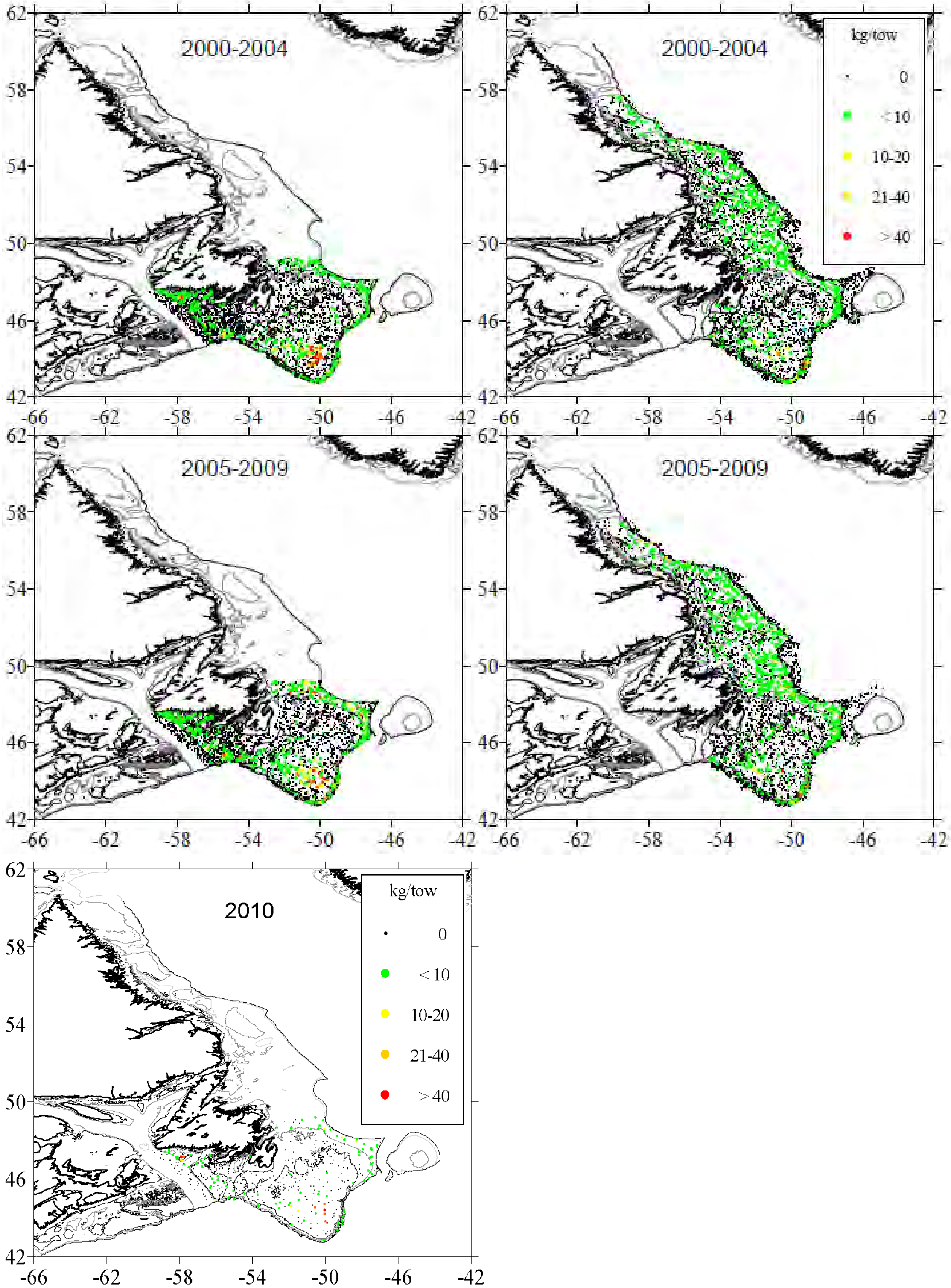
Source: Simpson et al. 2012

Figure 28 Revised Figure 12-1 Geographic Distribution of Spring (left panel) and Fall (right panel) Research Survey Catch Rates (kg/tow) of Northern Wolffish in the Newfoundland and Labrador Region, 2000 to 2010



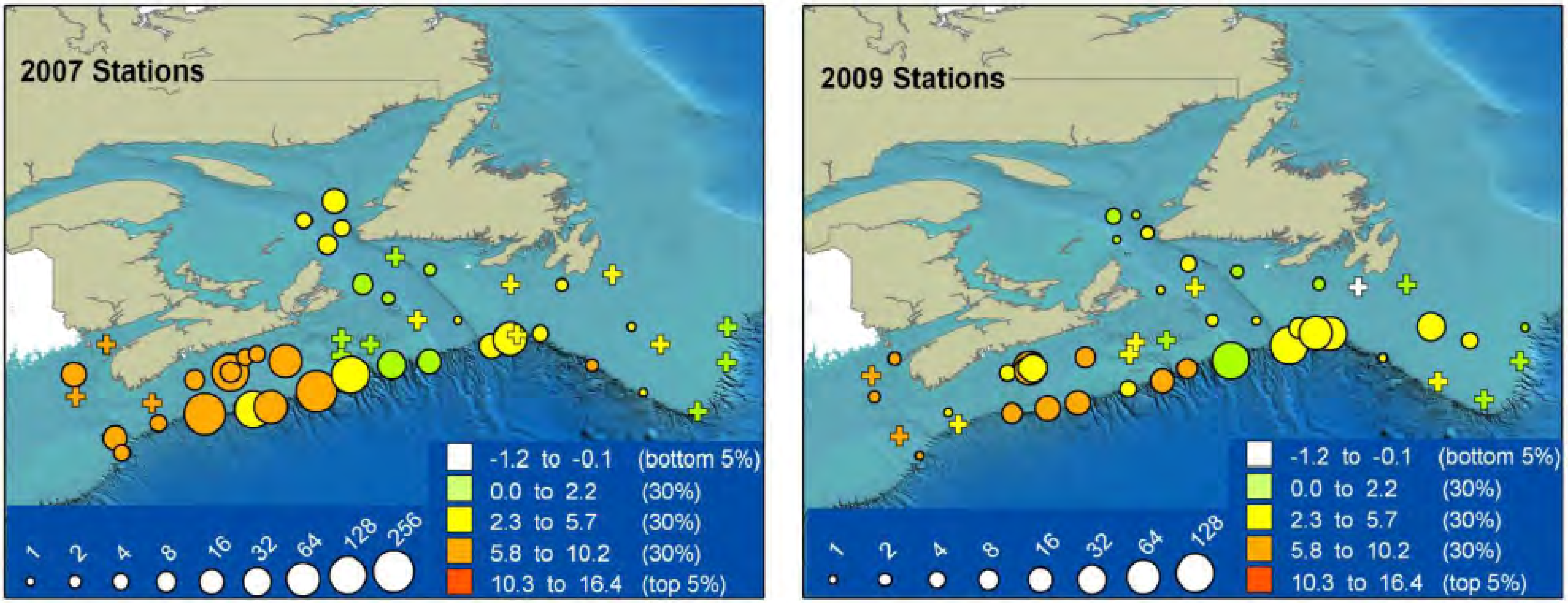
Source: Simpson et al. 2012

Figure 29 Revised Figure 12-2 Geographic Distribution of Spring (left panel) and Fall (right panel) Research Survey Catch Rates (kg/tow) of Spotted Wolffish in the Newfoundland and Labrador Region, 2000 to 2010



Source: Simpson et al. 2012

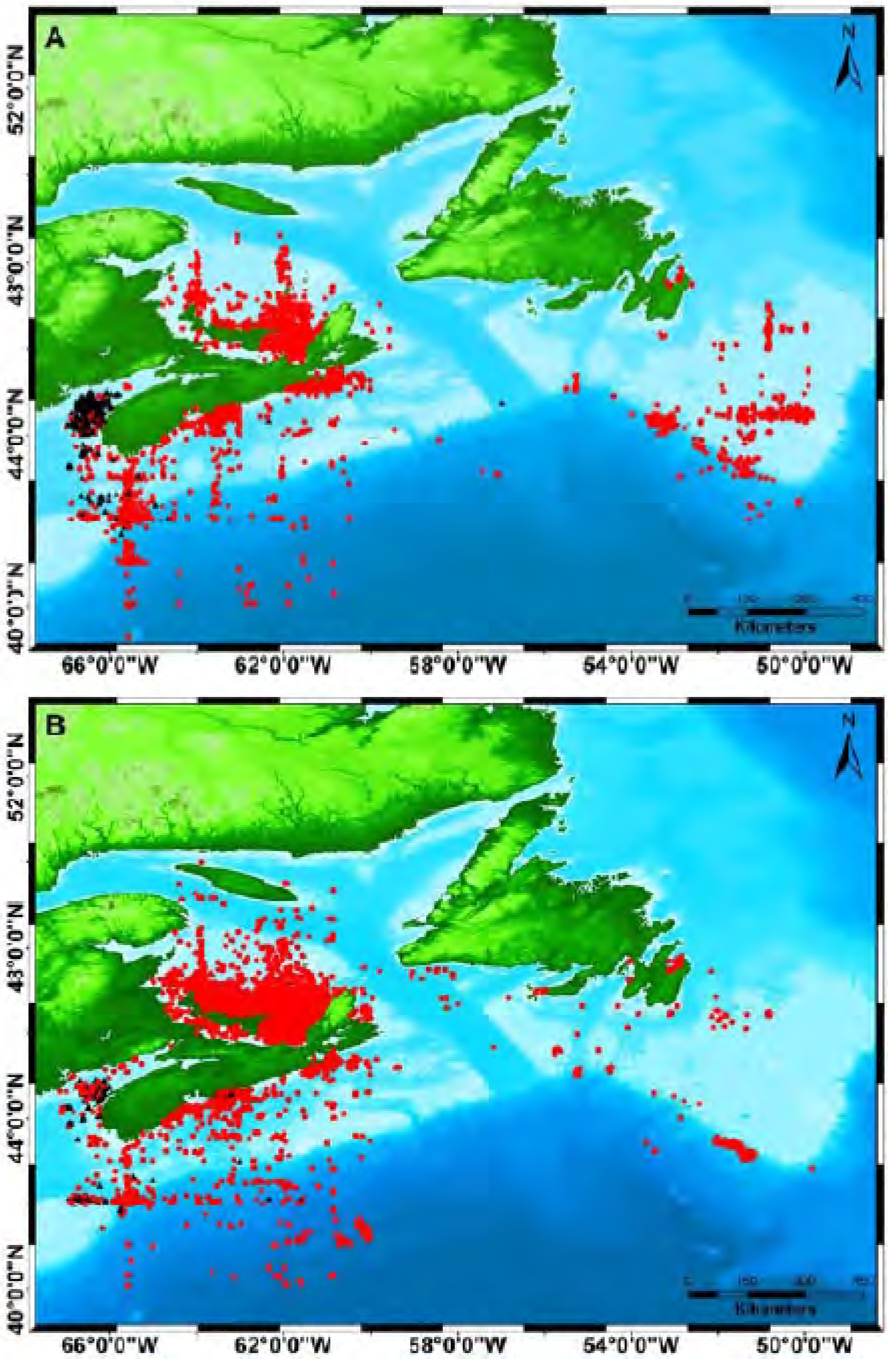
Figure 30 Revised Figure 12-3 Geographic Distribution of Spring (left panel) and Fall (right panel) Research Survey Catch Rates (kg/tow) of Atlantic Wolffish in the Newfoundland and Labrador Region, 2000 to 2010



Source: Campana et al. 2012

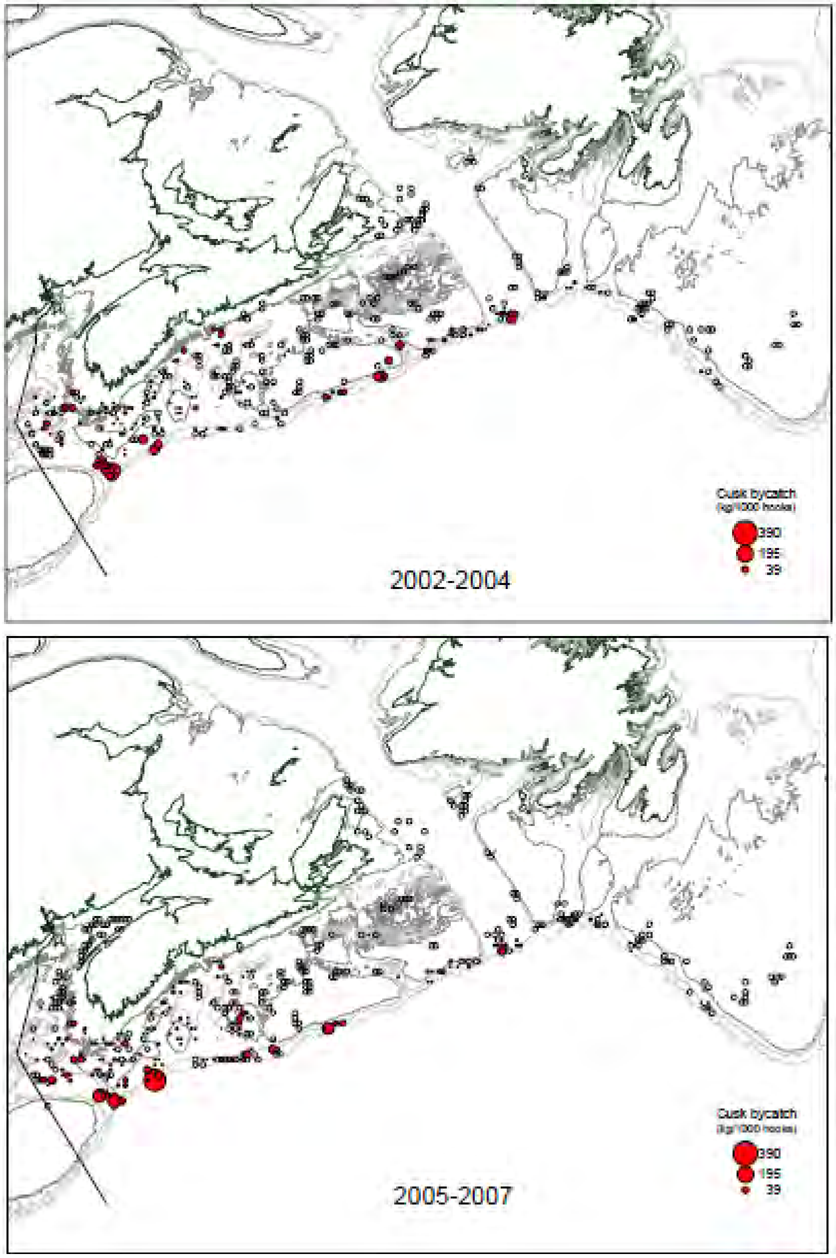
Note: Abundance per survey station is represented by graduated symbology, and average temperature and depth of gear is represented by a colour ramp. Null catches are represented by crosses.

Figure 31 Revised Figure 12-6 Porbeagle Shark Survey Abundance in 2007 and 2009



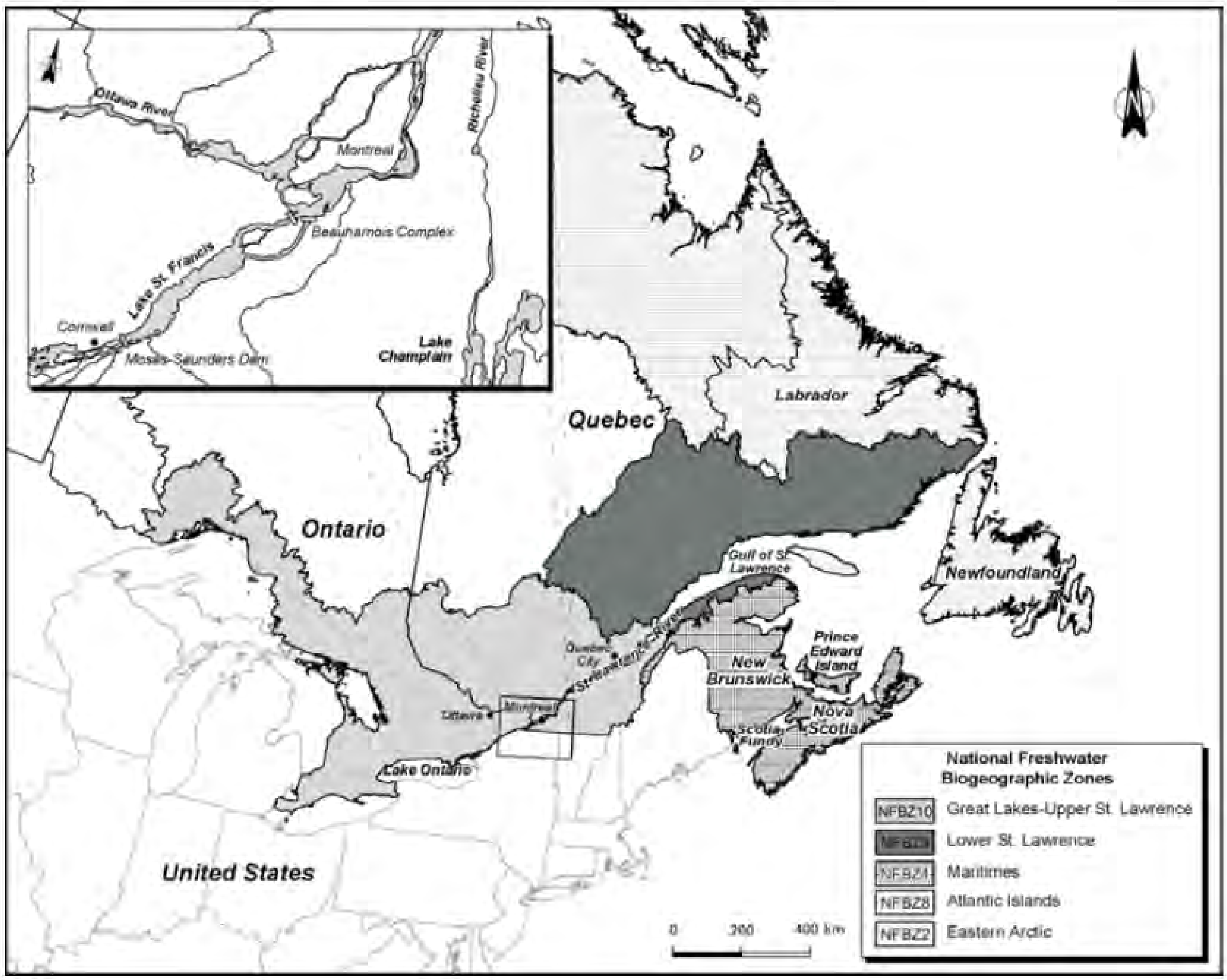
Source: Maguire et al. 2012

Figure 32 Revised Figure 12-7 Location of Canadian Atlantic Bluefin Tuna Catches from Logbook Records from 1990-1999 (A) and 2000-2009 (B)



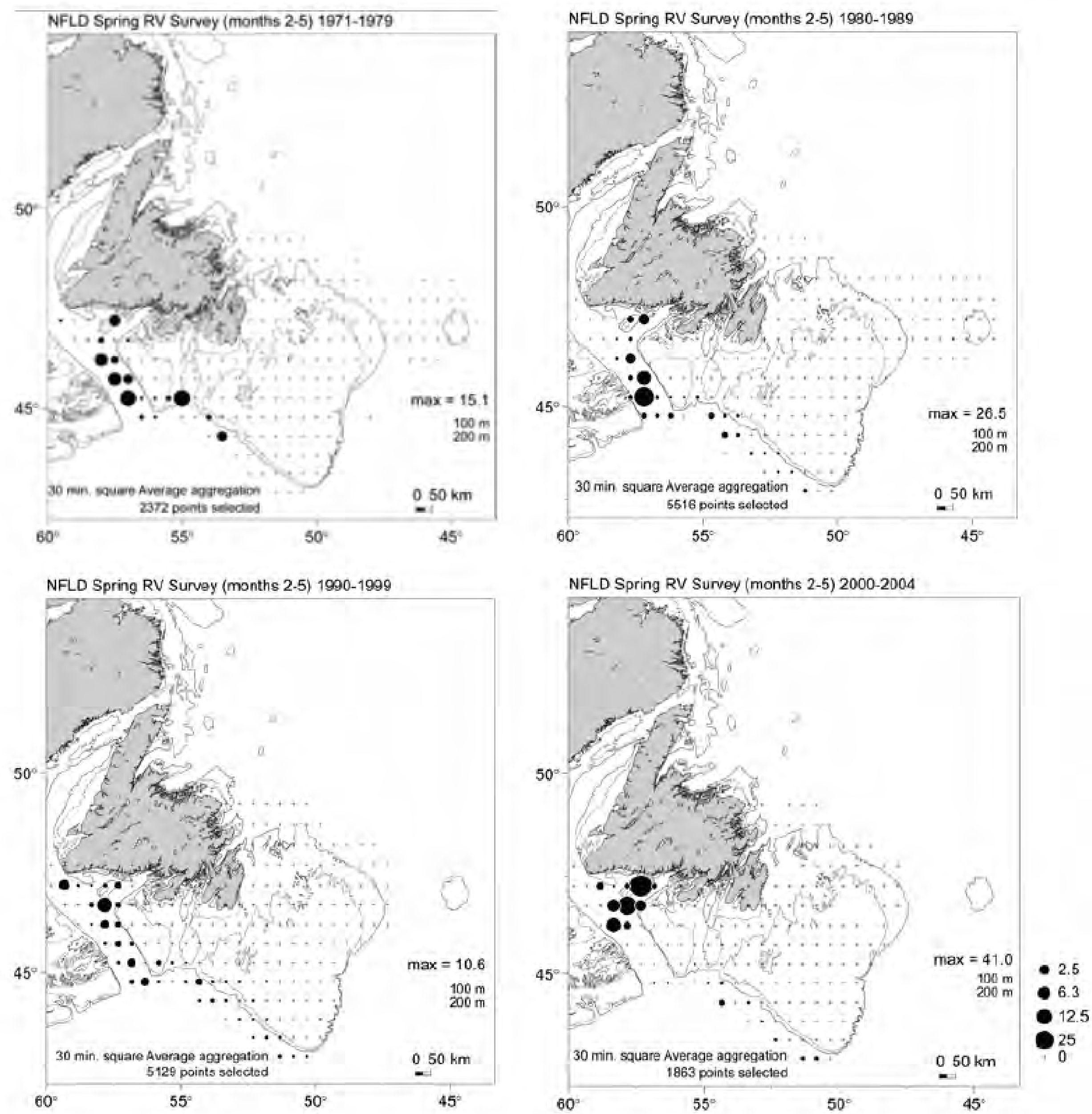
Source: Harris and Hanke 2010

Figure 33 Revised Figure 12-12 Distribution of Cusk Catches in the Halibut Industry, 2002-2004 and 2005-2007



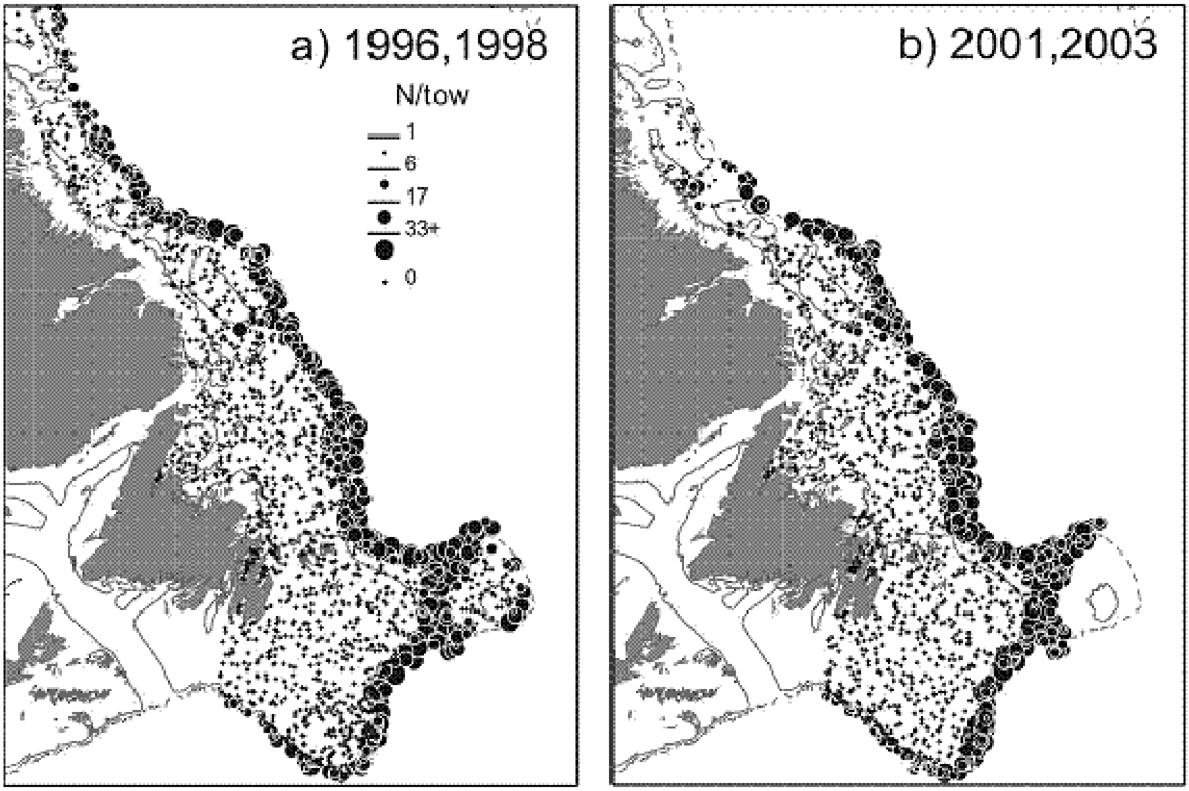
Source: COSEWIC 2012

Figure 34 Revised Figure 12-14 Canadian Geographic Range of the American Eel



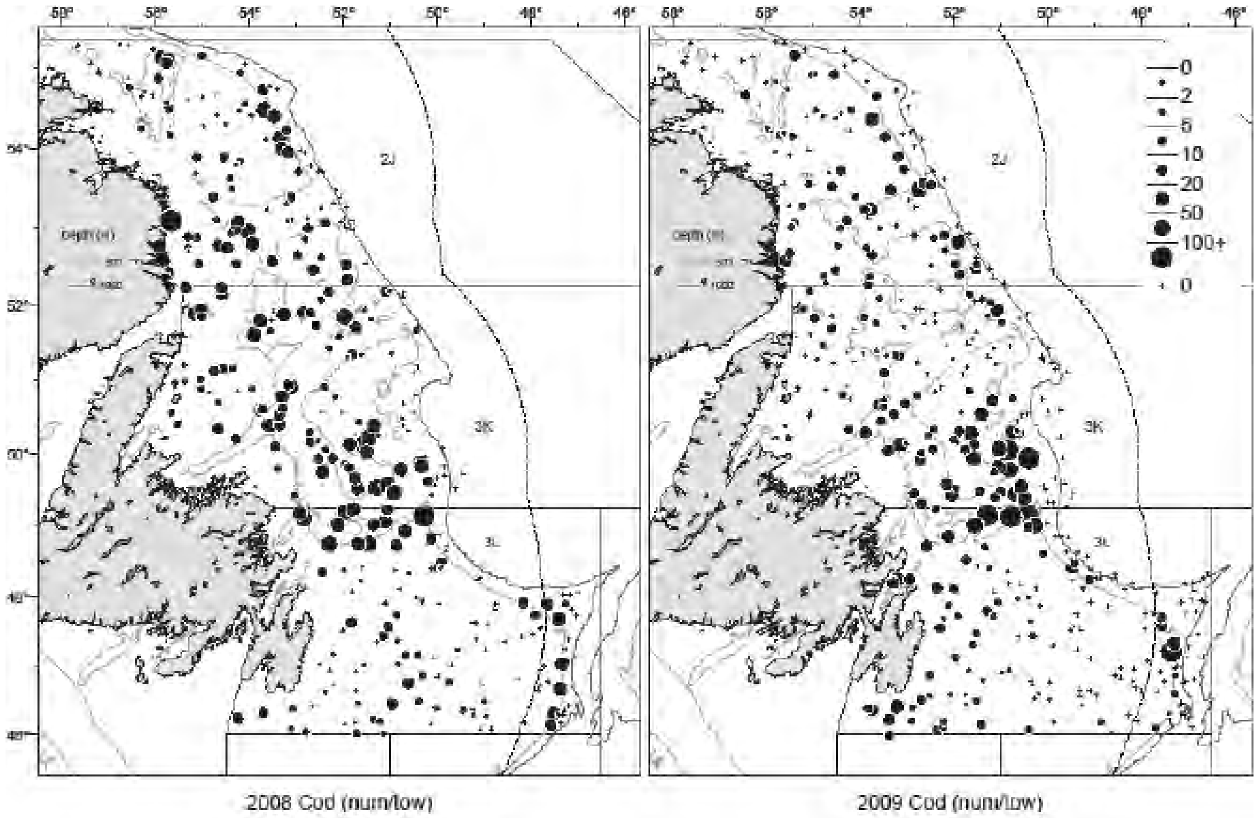
Source: Campana et al. 2007

Figure 35 Revised Figure 12-15 Distribution of Spiny Dogfish in the Spring Research Vessel Surveys of Southern Newfoundland, 1972-2005



Source: COSEWIC 2007

Figure 36 Revised Figure 12-17 Geographic Distribution of Roughhead Grenadier Catches in the Fall Survey of the Labrador and Northeastern Newfoundland Shelves and the Grand Bank for Selected Years between 1995 and 2000 (Campelen surveys)



Source: Brattey et al. 2010

Figure 37 Revised Figure 12-4 Cod Distribution (number per standard tow) during the Autumn Research Survey, 2008 and 2009

References for Revised Chapter 12 Figures (Figures 28 to 37)

Brattey, J., N.G. Cadigan, K. Dwyer, B.P. Healey, M.J. Morgan, E.F. Murphy, D. Maddock Parsons and D. Power. 2011. Assessment of the cod (*Gadus morhua*) stock in NAFO Divisions 2J+3KL in 2010. *DFO Canadian Science Advisory Secretariat Research Document*, 2010/103: viii + 108 pp.

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Simpson, M.R., L.G.S. Mello, C.M. Miri and M. Treble. 2012. A pre-COSEWIC assessment of three species of Wolffish (*Anarhichas denticulatus, A. minor,* and *A. lupus*) in Canadian waters of the Northwest Atlantic Ocean. *DFO Canadian Science Advisory Secretariat Research Document*, 2011/122: iv + 69 pp.

White Rose Extension Project

Diversity Plan

March 2013

ACKNOWLEDGEMENT

Husky Energy gratefully acknowledges the contribution of Stantec Consulting Ltd. in the preparation of this diversity plan.

Table of Contents

LIST OF APPENDICES

List of Acronyms

Acronym	Definition
CGS	Concrete gravity structure
C-NLOPB	Canada-Newfoundland Offshore Petroleum Board
FEED	Front-end Engineering and Design
FPSO	Floating production, storage and offloading vessel
Husky	Husky Oil Operations Limited, operator of the White Rose field
MODU	Mobile drilling units
NLOWE	Newfoundland and Labrador Association of Women Entrepreneurs
NOC	National Occupational Classification
WHP	Wellhead platform
WREP	White Rose Extension Project

1.0 INTRODUCTION

1.1 Diversity Commitment and Principles

Husky Energy (Husky) understands that the contribution the White Rose Extension Project (WREP) will make to the Province's economic development is important to the people of Newfoundland and Labrador. Husky is committed to providing employment, business and other benefits to the Province as a whole, and especially to women and other under-represented groups (as designated in the federal *Employment Equity Act*), including members of Aboriginal groups, persons with disabilities and visible minorities. In doing so, Husky will build on its current practice of promoting and supporting diversity in Newfoundland and Labrador's offshore oil industry.

Note: This Diversity Plan assumes that the WREP will be developed using a wellhead platform (WHP). However, should it be determined that the WREP will be developed using a subsea drill centre, the White Rose Diversity Plan, approved by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) in 2003, will apply to the WREP.In its 2003 White Rose Benefits Plan, Husky committed that its White Rose project contractors operating or hiring in Canada would be required to act in a manner consistent with Husky's corporate diversity policy. As revised in August 2012, the Diversity & Respectful Workplace Policy states that every employee has the right to work in an environment that is free of harassment and violence and where respectful treatment is the norm and that Husky is committed to:

- Building a work environment that is free of discrimination, harassment and violence by ensuring its employment policies are implemented in a fair and equitable manner and are free of discrimination;
- The principle of fair representation of the designated target groups (women, aboriginals, visible minorities, and people with disabilities) at all levels of the organization; and
- Creating an environment which enables all employees to contribute to their full potential, thereby increasing our business effectiveness and competitive advantage and providing employees with a positive and valued work environment.

The White Rose Diversity Plan identifies six principles that guide Husky's processes and initiatives for addressing diversity goals during the development and operation of White Rose, which will also apply to WREP:

Diversity, not just Equal Opportunity

Consistent with the *Atlantic Accord Implementation Acts* and the federal *Employment Equity Act,* the White Rose Diversity Plan is about more than just removing discrimination and bias in employment and contracting policies and practices. It is a proactive initiative that seeks to use a range of interventions to increase the representation of designated groups in the White Rose labour force and the involvement of corporations owned or co-operatives operated by them in White Rose-related business.

A Diversity Culture

Just as it has been seen that occupational safety can only be achieved when the companies involved have a safety culture, so it is recognized that diversity can only be achieved if it is encouraged and supported at all levels of the different companies involved. This requires that they develop a 'diversity culture', whereby diversity is the responsibility of all their personnel. For example, diversity and respectful workplace training is mandatory for all Husky employees. The aim is to make diversity a normal part of doing business for project companies.

Small Steps/Large Results

It makes sense to concentrate the effort in areas where the potential for change, measured quantitatively (for instance, in terms of the numbers of jobs or value of contracts), is greatest. However, implicit to the concept of a diversity culture is the idea that it has effects throughout an organization. This is very desirable, because even small initiatives can yield major benefits. For example, a small increment in any designated group's representation in all or part of a company can provide role models that can have significant long-term effects.

Diversity throughout the Value Chain

The White Rose Diversity Plan applies to companies contracted by Husky to provide services to the White Rose project. This includes Husky itself and its contractors, whether involved in development or operations activities. Husky has the lead responsibility for developing and implementing the Diversity Plan. However, this responsibility is shared with Husky's main contractors, who must meet the requirements of the Plan, and seek to have their subcontractors meet them.

Working Together

Many of the companies involved in the White Rose project can contribute experience in addressing diversity. Some are registered under the Federal Contractors Program and they and others have adopted employment equity or other diversity initiatives locally, nationally and globally. Other companies may be relatively small and inexperienced in addressing diversity concerns. Accordingly, the White Rose Diversity Plan includes a number of initiatives that facilitate an exchange of information among companies working on White Rose, such that they can learn from each other.

Working with the Community

A range of community groups and government agencies represent the employment and business interests of the four designated groups (women, Aboriginal persons, persons with disabilities and visible minorities). The specialized information and networks of these groups and agencies allow them to advise and assist Husky and its contractors in achieving diversity. They contributed to development of the Plan and to its implementation, and will be critical partners in future diversity initiatives.

The last decade has seen Husky implement a wide range of initiatives under the 2003 White Rose Diversity Plan. They include:

- Hosting Diversity Workshops/Forums, which provide an opportunity for Husky, its major contractors, community groups and government to review the diversity record for the White Rose project and discuss future plans;

- Providing long-term financial and in-kind support of Women in Science and Engineering and the Women in Resource Development Corporation;

- Carrying out a gender-based analysis of workterm students at Husky, including comparison of the participation rates among work term students at Husky with the rates in the workterm program and among Memorial University students generally;

- Developing and implementing a female apprenticeship program in cooperation with Newfoundland Service Alliance, with one candidate spending several hitches offshore on the *SeaRose* floating production, storage and offloading *(FPSO)*vessel;

- Implementing an Aboriginal training program that allowed four Nunatisiavut beneficiaries to job shadow Marine Mammal Observers and Fisheries Liaison Officers during Husky's 2010 2D seismic survey offshore Labrador;

- Providing an internship for a female beneficiary of Miawpukek First Nation to allow her to get employment experience; this person subsequently became a full-time Husky employee;

- Establishing a diversity advisory group focused on persons with disabilities, to provide Husky with advice on potential initiatives directed at achieving its overall diversity goals, to help Husky reach the right target audience for participants for its outreach programs, and to assist Husky in mobilizing resources from the community organizations on joint initiatives which may result from the work of the advisory group; and

- Helping to initiate and plan, as well as sponsoring, the *Fueling the Future: Women in Oil and Gas* conference. Held in St. John's in March 2011, this international event shared information and experiences among employers, policy-makers, educators and industry participants in order to celebrate the contributions and increase the participation of women in the petroleum industry.

Experience in implementing the White Rose Diversity Plan has demonstrated that there is a limited pool of diversity group members within the industry, the current labour pool and potential new entrants in training institutions and programs. This problem is being exacerbated by the growing labour demand from other industries, given proposed new hydro-electric, mining and other mega-projects in Newfoundland and Labrador and by the C-NLOPB and Government of Newfoundland and Labrador diversity requirements. Accordingly, Husky and its contractors have placed an increased emphasis on collective efforts to increase the size of the pool of diversity group members through support of conferences, career fairs and scholarship programs.

This Diversity Plan builds on the White Rose Diversity Plan and its principles and initiatives to facilitate the provision of WREP employment and business to women, members of other designated groups and businesses majority owned, managed and controlled by individuals from designated groups. It incorporates input from a review of other plans and initiatives, and from consultation with a range of government agencies and community groups with diversity-related responsibilities.

1.2 Plan Format

The rest of this WREP Diversity Plan has three main sections:

- Section 2.0 provides an overview of the WREP and its employment and goods and services requirements, based on a description of the WREP components and other materials;
- Section 3.0 establishes ambitious but realistic targets for the employment of women during the construction and the operations phases; and
- Section 4.0 describes the actions that Husky will take to fully satisfy its diversity commitments and to achieve the established targets, drawing on Husky's human resources, contracting and other policies and initiatives. This includes actions related to: managing, recruitment and selection, employee development, work environment and equipment, work/family balance, business access, information and communications, community outreach, and monitoring and reporting.

There is also, throughout this WREP Diversity Plan, a description of the means by which Husky will encourage comparable diversity actions are taken by its WREP contractors and sub-contractors. Appendices provide additional information about WREP requirements and Plan targets.

2.0 The White Rose Extension Project

2.1 Project Overview

Husky, on behalf of the WREP co-venturers, Suncor Energy Inc. and Nalcor Energy - Oil and Gas Inc., is leading the development of the WREP. It will develop the West White Rose pool using either a WHP or a subsea drill centre. The WREP also includes the potential future construction and installation of up to three drill centres elsewhere in the White Rose field.

If the WHP development option is selected, there will be an on-land and nearshore component to the project. The WHP would be constructed on the Argentia Peninsula, which is located in Placentia Bay, on the southern Avalon Peninsula, 130 km south west of St. John's, Newfoundland and Labrador. The activities associated with the WHP option include the excavation and construction of a graving dock, the construction of a concrete gravity structure (CGS), the mating of the topsides to the CGS at a deep-water site in Placentia Bay, and tow-out and installation in the White Rose field.

2.2 Employment Requirements

This section provides a high-level description of the anticipated WREP labour requirements during the construction and operations phases.

2.2.1 Construction Phase

It is estimated that a total of over 4.0 million hours of employment will take place in Newfoundland and Labrador during the construction phase for the WHP option. This includes Front-End Engineering and Design (FEED) and detailed design, graving dock construction, CGS construction, but does not include employment associated with the subsea tie-in and marine works. The location of engineering and project management in the Province will provide employment for engineers, technicians and other office support staff. Table A.1 (Appendix A) provides an estimate of the Newfoundland and Labrador hours (by four-digit National Occupational Classification or NOC code associated with completion of the WREP (excluding FEED) for the WHP option. This estimate of requirements is preliminary, and will be refined over the course of project planning and especially with the completion of FEED.

Project construction will require a wide range of skills. For graving dock construction, this includes the following major types of skills:

- Electrical trades;
- Machinery and transportation equipment mechanics;
- Crane operators, drillers and blasters;
- Motor vehicle and transit drivers;
- Heavy equipment operators; and
- Trades helpers and labourers.

Construction of the CGS will mostly require the following:

- Ironworkers;
- Concrete finishers;
- Electrical tradespeople;
- Plumbers, pipefitters and gas fitters;
- Carpenters and cabinetmakers;
- Machinery and transportation equipment mechanics;
- Other mechanics and related repairers;
- Crane operators, drillers and blasters;
- Motor vehicle and transit drivers;
- Heavy equipment operators; and

- Trades helpers and labourers.

Other skills required to support the WREP construction phase include:

- Contract analysts;
- Procurement specialists;
- Accountants;
- Health, Safety and Environment specialists;
- Document control specialists
- Medics;
- Security personnel;
- Project controls specialists;
- Estimators;
- Project planners;
- Administrative assistants;
- Engineers (electrical, chemical, geological, civil, mechanical, petroleum); and
- Architects.

2.2.2 Operations Phase

Production from the WHP will be tied back directly to the *SeaRose FPSO*. New employment associated with WREP operations will relate primarily to additional personnel required for operations on the WHP, as well as subsea inspection and maintenance associated with subsea lines. The WHP will have between 100 and 130 persons onboard at any time, providing new employment for a total of between 200 and 260 persons. It is anticipated that the WHP will use a rotation scheme similar to the three weeks on/three weeks off pattern that is currently used on the *SeaRose FPSO* and mobile drilling units (MODUs). Operations on the WHP are estimated to require over 5 million hours of labour. Logistical support including Husky logistical staff, helicopter services, vessel support (standby and supply), marine base support, weather forecasting, survival suit maintenance and waste management is anticipated to add a further over 2.4 million hours of labour during operations.

In addition, extension of the production plateau on the *SeaRose FPSO* due to the WREP will result in a continuation of operations employment levels at peak for an additional five or more years. There are currently around 1,000 steady-state positions, the majority of them onshore, associated with White Rose operations, including employees of Husky and its contractors and subcontractors. The additional operations phase employment associated with the WREP forms part of, and is largely indistinguishable from, the ongoing *SeaRose FPSO* operations employment.

While the number of operations phase positions will be smaller than that required for construction, they will be of much longer duration and represent career opportunities. Following is a listing of the main anticipated positions on the WHP during operations:

- Offshore installation manager
- Drilling supervisor
- Toolpusher
- Driller
- Assistant driller
- Derrickperson
- Roughneck
- Deck coordinator
- Roustabout
- Maintenance supervisor
- Senior mechanic
- Rig mechanic
- Electrical technician
- Assistant engineer/clerk
- Motorperson
- Materials manager
- Crane operator
- Radio operator
- Medic
- Quality health safety and environment specialist
- Logistics technician
- Geologist
- Drilling engineer
- Completions engineer
- Completions equipment supervisor
- Completions equipment technician
- Cement pump operator
- Well intervention supervisor
- Datalogger
- Mudlogger
- Chef
- Steward
- Well test supervisor
- Well test surface technician
- Flare boom technician
- Well tester
- Electric line logging engineer
- Electric line winch operator
- Operations assistant/clerk
- Wellhead/tree technician
- Production supervisor
- Production operator
- Instrumentation technician

2.3 Goods and Services Requirements

This section provides a high-level description of the anticipated requirements for goods and services during the construction and operations phases of the WREP.

2.3.1 Construction Phase

A wide range of construction phase goods and services will be provided by Newfoundland and Labrador-based companies, particularly during graving dock construction, CGS construction, and activities related to topsides integration and offshore installation. The opportunities available to local companies include the provision of earth-moving equipment to build the graving dock, fencing and on-site infrastructure and on-site security. For the construction of the CGS, opportunities include the provision of concrete, aggregate and rebar. During topsides mating, support of personnel at the deep-water site, including catering, medical services and fuel for support vessels, will be required.

Detailed goods and services requirements information is provided in Table B.1 (Appendix B). As with the employment information, goods and services requirements will be refined over the course of project planning and especially with the completion of FEED. Accordingly, this information will be subject to periodic revision as plans evolve.

2.3.2 Operations Phase

The goods and services required on the WHP during operations will be similar to those needed on MODUs currently operating in the Jeanne d'Arc Basin. They will be generally additional to those of current operations because it is expected that a MODU will still be required for substantial periods in the field to support the development and maintenance of existing and any future subsea drill centres, as well as for drilling of exploration wells.

The WREP will allow the *SeaRose FPSO* to maintain production for additional years and thereby ensure that the present demand for the goods and services it requires will continue. The WREP will provide continued opportunities for companies that currently provide services as well as for new companies entering the marketplace. The following goods and services are anticipated to be required during WHP operations:

- Drilling contractor;
- Drilling services (coring, tubulars, casing, slickline, solids control and well fluids, well bore cleanout, cementing and drilling tools);
- Engineering, procurement and construction and maintenance campaign support;
- Telecommunications;
- Independent verification services;
- Accommodation services;
- Maintenance services (fire safety equipment, crane, life saving appliances, rotating equipment and turbines);

- Condition monitoring and inspection services;
- Medical services;
- Helicopter services;
- Supply and support vessels;
- Waste management;
- Weather forecasting;
- Ice management;
- Personal protective equipment; and
- Laboratory supplies.

3.0 TARGETS

This section presents the targets Husky has established for women's employment and goods and services procurement, in support the objectives of this Plan. These targets are described for both the construction and operations phases of the WREP.

3.1 Employment

3.1.1 Construction Phase

Construction phase targets for the employment of women have been developed based, by four digit NOC (National Occupational Classification) code, on 2006 Statistics Canada information on women's share of employment in the required occupations. The targets have been updated on the basis of more recent data on the graduation of women from provincial professional and vocational training programs and on input from government agencies and community groups representing women's interests.

The following targets have been established:

- Managers and other professional (excluding administrative positions): 30%
- Civil engineers: 20%
- Other engineers: 15%
- Technicians and technologists: 20%
- Forepersons: 2%
- Journey-persons and apprentices (plant operators): 15%
- Journey-persons and apprentices (carpenters and joiners): 12%

- Journey-persons and apprentices (plumbers, pipefitters and ironworkers): 5%
- Journey-persons and apprentices (labourers and trades helpers): 12%

A more detailed list of women's construction phase employment targets by occupation and NOC code, together with supporting Statistics Canada, graduation and other supportive information, is provided in Table C.1 (Appendix C).

It is not practical to set quantitative employment targets for the other designated groups because of limitations in the success of self-reporting procedures. However, diversity monitoring will report the available data and describe Husky and contractor initiatives directed at these groups.

3.1.2 Operations Phase

As discussed above, the employment associated with WREP operations mostly forms part of, and is largely indistinguishable from, other White Rose operations employment. Given this, and building on the monitoring of women's employment that has been ongoing since 2003, the targets for operations employment will be annual increases in women's share of all White Rose (including WREP) employment. These will be measured and reported for both Husky's White Rose operations workforce and for the total Husky and contractor operations workforce, including offshore and onshore workers. These annual increase targets reflect an overall goal of continuous improvement.

There will also be continued annual analysis and reporting of women's share of operations employment in eight occupational categories:

- Management;
- Administrative/clerical;
- Engineers;
- Technicians/technologists;
- Professionals (includes accountants, geologists, geophysicists, and information technology and human resources professionals);
- Marine crew;
- Other field crew; and
- Students.

While it is recognized that fluctuations in the scale and types of project activity make it very unlikely that there will be increases in each occupational category in each year, the annual monitoring and reporting of trends for these different occupational groups will help identify those requiring additional efforts.

It is not practical to set operations phase quantitative employment targets for the other designated groups because of limitations in the success of self-reporting procedures. However, White Rose (including WREP) operations diversity monitoring will continue to report the available data and describe Husky and contractor initiatives directed at these groups.

3.2 Business

3.2.1 Construction Phase

The awarding of construction phase contracts to businesses majority owned, managed and controlled by women will be monitored and reported. However, the limited identification and registration of such businesses, and the high degree of variability in the size and types of contracts awarded over the course of construction, make it impractical and unproductive to set quantitative targets.

3.2.2 Operations Phase

The awarding of operations phase contracts to businesses majority owned, managed and controlled by women will be monitored and reported. However, the limited identification and registration of such businesses, and the high degree of variability in the size and types of contracts awarded over time, means that it is currently impractical and unproductive to set quantitative targets. However, this will be subject to further review at the completion of WREP construction to see if registration levels and the flow of awards are such as to warrant establishing, monitoring and reporting quantitative targets.

4.0 ACTIONS

The following sections describe actions that Husky will undertake to promote diversity on the WREP and to meet the Diversity Plan targets. These actions build on the 2003 White Rose Diversity Plan and draw on the company's relevant human resources, contracting and other policies and initiatives.

4.1 Managing

Husky recognizes that success in building diversity requires corporate leadership and commitment. The Manager, Administration and Regulatory Affairs, reporting directly to the Senior Vice-President, Atlantic Region, and supported by senior Husky personnel in the areas of human resources, industrial benefits and government and community relations, is responsible for the overall management of benefits, including diversity. This internal Husky team will continue to work to:

- Provide leadership in diversity matters, and promulgate and promote this Diversity Plan;
- Maintain and support internal diversity communications and information procedures, information systems, and compliance, auditing and reporting standards;
- Ensure WREP contractors and sub-contractors comply with their diversity responsibilities as outlined in this Plan;

- Provide an effective liaison on diversity matters with external stakeholders, including the C-NLOPB, provincial and municipal governments, training institutions, industry and professional associations, interest and advocacy groups, and the general public; and

- Meet all corporate and regulatory diversity requirements and targets.

Husky will continue to implement management initiatives that will facilitate diversity throughout the WREP, including:

- Conducting management diversity training to create awareness of the elements of diversity and its impact on conducting business;

- Ensuring that all Requests for Proposals state that contractors and sub-contractors must operate in a manner consistent with Husky's employment and contracting diversity principles and policies;

- Requiring that the main WREP construction phase contractors acknowledge the existence and importance of the Diversity Plan, identify a management contact accountable for diversity, and monitor and report their compliance with the Plan's requirements;

- Continuing to require that the main operations phase contractors submit annual Diversity Plans describing their diversity performance over the previous year and plans for the year to come;

- Continuing to hold annual workshops with the main project contractors, to provide information about diversity matters and exchange experiences and lessons; and

- Continuing to require diversity awareness training for its operations employees, to instill a foundational understanding of diversity and to support growing a diversity culture.

4.2 Recruitment and Selection

WREP employment diversity will be supported through the recruitment and selection of job candidates and the employment of women apprentices. In particular, Husky and its main contractors will:

- Include an equal opportunities statement in all advertisements for WREP positions;

- Work with community organizations and industry groups to provide information on opportunities within the oil and gas sector in order to encourage members of designated groups to apply for WREP positions;

- Implement promotional efforts targeted at candidates belonging to designated groups;

- Work with the main construction contractors and the Office to Advance Women Apprentices to identify and implement initiatives to increase the number of women apprentices;

- Evaluate re-instating an offshore apprentice program similar to the *SeaRose FPSO* program conducted in 2007/2008;

- Identify relevant associations/organizations and special interest groups and notify them directly regarding WREP recruitment requirements; and

- Provide WREP co-op, internships and summer employment assignments to qualified diversity group members.

4.3 Employee Development

Husky and its main contractors will continue to provide employees who are members of designated groups with opportunities to advance their careers through employee development initiatives. Access to skills development and training will be supported by eliminating barriers for diversity group members and by promoting their involvement in such initiatives. Positive actions to enhance the participation of these groups in employee development opportunities will include:

- Ensuring they have equality of access to leadership training and career development programs; and

- Encouraging and supporting networking groups that provide career development and mentoring.

4.4 Work Environment and Equipment

Husky recognizes that providing a respectful work environment and appropriate work equipment is important to hiring and retaining members of designated groups. Accordingly, Husky and its main contractors will:

- Endeavour to provide women, Aboriginal people and people with disabilities with an inclusive and culturally-sensitive work environment;

- Ensure that personal protective and other equipment is appropriate for all workers;

- Ensure office buildings and any construction camp make appropriate provision for disability access;

- Promote the inclusion of diversity group members on employee committees; and

- Adopt, publicize and strictly enforce anti-harassment policies at all offshore and onshore workplaces and any construction camp.

In addition, during the construction phase, Husky or its site contractor will:

- Have a diversity advocate on site at all times, to whom employees would have confidential access and who would be required and empowered to bring forward diversity concerns to both Husky and the contractor; and

- Undertake a semi-annual workplace 'climate survey' of female employees and disability accessibility and accommodation audit, to establish their workplace experiences respecting gender-related issues.

4.5 Work/Family Balance

While work/life balance is important for both female and male employees, it is more important for attracting and retaining women, given the employment cycle and traditional care responsibilities of women. Husky recognizes that supporting women employees in balancing the responsibilities of their career and their family life is important to hiring and retaining them. Accordingly, Husky and its main contactors will:

- Provide Husky employees and all WREP operations employees with assistance in balancing work and personal life, for example through vacation flexibility, paid and unpaid time off, childcare and eldercare information support, a flexible work schedule (where possible), and an employee assistance or equivalent program; and

- Offer training opportunities and invitations to meetings to Husky employees and all WREP operations employees who are on maternity leave, so they can maintain a connection to the work place.

4.6 Business Access

Husky recognizes that it can be more difficult for businesses majority owned, managed and controlled by individuals from designated groups to connect with the proponents of large resource development projects. Accordingly, Husky will undertake a number of actions to facilitate procurement process access for such companies and require that the main construction and operations phase contractors undertake comparable initiatives. They include:

- Consulting with the Newfoundland and Labrador Association of Women Entrepreneurs (NLOWE) and other local organizations and business networks to identify businesses majority owned, managed and controlled by individuals from designated groups;

- Supporting diverse business development initiatives of NLOWE and other relevant business networks and community organizations, including encouraging businesses majority owned, managed and controlled by women to register with WEConnect and holding supplier forums targetted at such companies;

- Participating in conferences, trade shows, information sessions and business networking events to provide information related to the WREP, its procurement process and diversity business access policies and practices;

- Ensuring diverse companies are aware of any specific standards, practices, qualifications or certifications required by Husky and provide them with information on how to meet these requirements; and

- When requested, providing diverse companies with feedback on tenders and bids to help identify areas for improvement and encourage capacity development.

4.7 Information and Communications

Husky believes that effective internal and external information and communications are important to building diversity. In particular, Husky will:

- Communicate WREP employment and business requirements, initiatives and targets to all contractors; and

- Ensure that inclusive language and a representation of diversity in images are used in all WREP-related public information; and

- Work with representatives of diversity agencies to develop an information package on career opportunities in the oil and gas industry that is designed to be accessible to youth in the target groups.

In addition, Husky and its main contractors will:

- Include discussion of diversity in employee orientations, to ensure that they understand policies and know how inclusion is practiced throughout the WREP.

4.8 Community Outreach

Community outreach includes the actions that Husky and its main contractors take to further the goals of the Diversity Plan through engagement with community groups, programs and education institutions. They include:

- Communicating projected WREP human resources requirements and Husky diversity policies to post-secondary institutions, industry groups and other interested parties;

- Participating in schools programs, career fairs, scholarship programs and other initiatives to promote careers in technical, engineering and trade/operational roles, including materials that reflect Husky's commitment to diversity;

- Promoting careers in the oil industry to students who are members of designated groups, highlighting education requirements and providing real life examples of what it is like to work in the industry, so as to encourage the students to acquire further education to meet skills requirements, and thereby increase the pool of designated group members qualified to work in the industry;

- Partnering with organizations or support programs for persons with disabilities so as to ensure those who are interested in pursuing oil industry careers are aware of oil industry career options;

- Partnering with organizations or support programs that expose girls and women to engineering, technology, mathematics and science to support non-traditional career choices;

- Providing four $2,500 scholarships each year, for five years, targeted at women and persons with disabilities; and

- Providing two research grants of up to $20,000 each year, for five years, for community-based organizations to conduct research related to building the pool of available qualified workers from underrepresented groups.

4.9 Monitoring and Reporting

Husky will continue to closely monitor and to report its diversity performance and that of its contractors, including its success in meeting the diversity targets set out in Section 3.0.

In the case of the WREP construction phase, monitoring results will be provided to the Government of Newfoundland and Labrador on a quarterly basis. This reporting will document the latest and trend data for each of the quantitative target measures, provide summary results from the semi-annual workplace ‘climate survey’ of female employees, and describe significant developments in implementing this Plan. This information will also be reviewed by Husky and the main construction contractors with a view to identifying good practice and further refining and developing diversity processes, policies, targets and initiatives

Monitoring results for Husky’s White Rose (including WREP) operations activity will continue to be provided to the C-NLOPB in an annual Diversity Report. This information will again be reviewed by Husky and its contractors to identify good practice and further refine and develop White Rose diversity processes, policies, targets and initiatives.

APPENDIX A

Table A.1 Construction Phase Labour Requirements

Table A.1 Construction Phase Person-Hours (Full Time Equivalents) Required

NOC Code	Role	Qtr 3, 2013	Qtr 4, 2013	Qtr 1, 2014	Qtr2, 2014	Qtr 3, 2014	Qtr 4, 2014	Qtr 1, 2015	Qtr 2, 2015	Qtr 3, 2015	Qtr 4, 2015	Qtr 1, 2016	Qtr2, 2016	Qtr 3, 2016	Qtr 4, 2016	Qtr 1, 2017	Qtr2, 2017	Qtr 3, 2017
Graving Dock Construction																		
NOC-0113	Purchasing managers	890(2)	811(1)	834(1)	891(1)	413(1)												
NOC-0211	Engineering managers	3561(6)	3246(4)	3337(4)	3566(5)	1650(4)												
NOC-1221	Administrative officers	890(2)	811(1)	834(1)	891(1)	413(1)												
NOC-1241	Administrative assistants	2671(5)	2434(3)	2503(3)	2674(3)	1238(3)												
NOC-2131	Civil engineers	13354(24)	12171(15)	12514(16)	13371(17)	6189(15)												
NOC-2234	Construction estimators	2671(5)	2434(3)	2503(3)	2674(3)	1238(3)												
NOC-7205	Contractors and supervisors, other construction trades, installers, repairers and servicers	2644(5)	1983(3)	1574(2)	1077(1)	410(1)												
NOC-7302	Contractors and supervisors, heavy equipment operator crews	7046(13)	5289(7)	4199(5)	2872(4)	1095(3)												
NOC-7521	Heavy equipment operators (except crane)	59023(107)	44298(56)	35164(46)	24053(31)	9177(22)												
NOC-7611	Construction trades helpers and labourers	21161(38)	16169(20)	13215(17)	9681(12)	3839(9)												
CGS Construction																		
NOC-0211	Engineering managers					3904(5)	5530(7)	5799(8)	6136(8)	6204(8)	5462(7)	5934(8)	6136(8)	6204(8)	6204(8)	6069(8)	4997(6)	0 (0)
NOC-1221	Administrative officers					1301(2)	1843(2)	1933(3)	2045(3)	2068(3)	1821(2)	1978(3)	2045(3)	2068(3)	2068(3)	2023(3)	1666(2)	0 (0)
NOC-1225	Purchasing agents and officers					1735(2)	2458(3)	2577(3)	2727(3)	2757(3)	2428(3)	2637(3)	2727(3)	2757(3)	2757(3)	2697(4)	2221(3)	0 (0)
NOC-1241	Administrative assistants					8676(11)	12288(16)	12887(17)	13637(17)	13786(17)	12138(15)	13187(17)	13637(17)	13786(17)	13786(17)	13487(18)	11104(14)	0 (0)
NOC-2131	Civil engineers					19625(25)	27793(35)	29149(38)	30843(40)	31182(39)	27454(35)	29827(38)	30843(40)	31182(39)	31182(39)	30504(40)	25115(32)	0 (0)
NOC-2132	Mechanical engineers					5496(7)	7784(10)	8164(11)	8638(11)	8733(11)	7689(10)	8354(11)	8638(11)	8733(11)	8733(11)	8543(11)	7034(9)	0 (0)
NOC-2231	Civil engineering technologists and technicians					8468(11)	11993(15)	12578(16)	13309(17)	13455(17)	11847(15)	12870(17)	13309(17)	13455(17)	13455(17)	13163(17)	10837(14)	0 (0)
NOC-2234	Construction estimators					2077(3)	2941(4)	3085(4)	3264(4)	3300(4)	2905(4)	3157(4)	3264(4)	3300(4)	3300(4)	3228(4)	2658(3)	0 (0)
NOC-7201	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations					0 (0)	0 (0)	1076(1)	7492(7)	14257(13)	10101(10)	11552(11)	15819(15)	11549(11)	2950(2)	1268(1)	1317(2)	4(0)
NOC-7203	Contractors and supervisors, pipefitting trades					0 (0)	0 (0)	36(0)	151(0)	763(1)	680(1)	690(1)	683(1)	655(1)	654(1)	289(0)	0 (0)	0 (0)
NOC-7204	Contractors and supervisors, carpentry trades					0 (0)	0 (0)	21(0)	2053(2)	2785(3)	1906(2)	2250(2)	2481(2)	2122(2)	698(1)	189(0)	0 (0)	0 (0)
NOC-7205	Contractors and supervisors, other construction trades, installers, repairers and servicers					836(1)	1772(2)	2555(2)	8490(8)	13798(13)	10415(10)	13596(13)	18473(17)	11945(11)	4644(4)	1879(2)	851(1)	0 (0)
NOC-7236	Ironworkers					93(0)	11959(19)	48940(74)	112236(134)	153917(156)	105105(105)	119680(120)	160178(158)	122712(124)	33836(36)	16671(19)	13833(23)	38(0)
NOC-7252	Steamfitters, pipefitters and sprinkler system installers					0 (0)	0 (0)	341(0)	1417(1)	7153(11)	6377(10)	6469(10)	6395(10)	6133(10)	6119(10)	2701(5)	0 (0)	0 (0)
NOC-7271	Carpenters					0 (0)	0 (0)	242(0)	23950(22)	32490(29)	22236(20)	26254(24)	28940(27)	24757(22)	8144(7)	2197(2)	0 (0)	0 (0)
NOC-7302	Contractors and supervisors, heavy equipment operator crews					1649(2)	2335(3)	2449(3)	2591(3)	2619(3)	2306(3)	2506(3)	2591(3)	2619(3)	2619(3)	2562(3)	2110(3)	0 (0)
NOC-7521	Heavy equipment operators (except crane)					11790(15)	16698(21)	17512(23)	18530(24)	18734(24)	16494(21)	17919(23)	18530(24)	18734(24)	18734(24)	18327(24)	15089(19)	0 (0)
NOC-7611	Construction trades helpers and labourers					13550(17)	22322(27)	27130(32)	59567(61)	88032(87)	68265(68)	86324(86)	112809(110)	78150(78)	39211(42)	24132(29)	16170(21)	0 (0)

APPENDIX B

Construction Phase Procurement Opportunities

Table B.1 Construction Phase Procurement Opportunities

Major Equipment Packages	Potential Supplier Locations		
	NL	Other Canada	Foreign
Graving Dock Construction			
Road upgrading	X	X	
Water supply connection	X	X	
Power supply connection	X	X	
Concrete batch plant		X	X
Supporting buildings (offices/mess/medical clinic/temporary sheds)	X	X	
Site excavation	X	X	
Berm construction	X	X	
Spoils disposal	X	X	
Pumps (site dewatering)		X	X
Settling pond	X	X	
Fencing	X	X	
Site security	X	X	
Diesel fuel	X	X	
Waste disposal	X	X	
CGS Construction			
Cement	X		
Aggregate and add mixtures	X		
Rebar	X		
Construction of structural steel	X		
Dewatering pumps		X	X
Tower crane		X	X
Hoists	X	X	
Slipforms	X	X	
Magnetite ballast	X	X	
Conductor frames	X	X	
Guide frames	X	X	
Stair tower	X	X	
Ladder tower	X	X	
Vertical pipe guides	X	X	
Caisson roof false work	X	X	
Major Equipment Packages	**Potential Supplier Locations**		

	NL	Other Canada	Foreign
Cap slab false work	X	X	
Tubulars			X
Seawater inlet and ballast manifolds	X	X	
Dill cutting shoots	X	X	
Pipework clamps and guides	X	X	
Topsides			
Living quarters	X	X	X
Integrated deck		X	X
Drilling equipment set		X	X
Flare boom assembly	X	X	X
Helideck	X	X	X
Lifeboat stations	X	X	X
CGS Tow Out and Topsides Integration			
Tow out channel dredging			X
Berm removal			X
Tow out tugs	X	X	
Accommodation vessel		X	X
Assistant tug	X	X	
Supply vessel	X	X	
Diesel fuel	X	X	
WHP Tow Out, Hook up and Commissioning			
Tow out route survey	X	X	
Tow out tugs			X
Flowlines, risers, umbilicals			X
Dive support vessel			X
Construction vessel			X
Custom brokerage	X	X	
Diesel fuel	X	X	

APPENDIX C

Table C.1 Diversity Targets

Table C.1 Diversity Targets

Category	NOC Code	Occupations	NL Female Labour Force, 2006 (%)	NL Female Graduates 2006-2011 (%)	WREP Req. (Peak)	Target (% and peak #)	Rationale
Managers and other Professionals	0113	Purchasing Managers	11.1	-	2	30 (4)	Based on federal participation statistics No target provided for administrative positions because women dominated
	1225	Purchasing Agents and Officers	36.9	-	6		
	2234	Construction Estimators	0.0	0.0	6		
Engineers	2131	Civil Engineers	14.6	30.1	71	20 (14)	~ 40% of graduates from MUN Civil Eng. Program are women; this is far above the level of women graduates in other engineering programs so a separate target has been established
	0211	Engineering Managers	4.8	-	21	15 (17)	Based on federal participation statistics
	2133	Electrical and Electronics Engineers	6.8	18.7	21		Locally, % of women graduates from these programs ranges between ~0% (Computer Engineering) to 25% (Architects) 2012 WR Project participation rate - 17% There are no local programs for industrial, geological, or petroleum engineering, which may hamper recruitment Specific efforts are recommended in fields with particularly low participation (Computer and Electrical Engineering)
	2132	Mechanical Engineers	6.8	17.3	25		
	2134	Chemical Engineers	25.0	-	10		
	2141	Industrial and Manufacturing Engineers	10.7	-	8		
	2144	Geological Engineers	0.0	0.0	9		
	2145	Petroleum Engineers	21.1	-	8		
	2147	Computer Engineers (Except Software Engineers and Designers)	8.7	8.9	2		
	2151	Architects	0.0	21.8	9		
Technicians and Technologists	2231	Civil Engineering Technologists and Technicians	6.8	23.1	28	20 (9)	Based on % of graduates locally. Local graduate rates far exceed federal participation statistics 2012 WR Project participation rate = 8%
	2251	Architectural Technologists and Technicians	16.7	35	2		

Category	NOC Code	Occupations	NL Female Labour Force, 2006 (%)	NL Female Graduates 2006-2011 (%)	WREP Req. (Peak)	Target (% and peak #)	Rationale
Foreperson	7205	General Foreperson and Foreperson for the following categories: Bricklayers and Allied Crafts - Concrete Finisher, Laborers - Trades Helpers (Formwork, Concrete, Slip, Accessway)	6.7	-	25	2 (>1)	Based on federal participation statistics
	7302	General Foreperson and Foreperson for the following categories: Plant Operators (Crane Operator, Heavy Equipment Operator, Construction Equipment Operators [Stressing, Slip])	0.0	-	8		
	7201	Ironworkers - Rodperson General Foreperson and Foreperson, Structural General Foreperson and Foreperson	0.0	-	28		
	7204	General Foreperson and Foreperson for the following categories: Carpenters and Joiners - Scaffolder, Carpenter (Formwork, Stopends, Accessway)	0.0	-	4		

Category	NOC Code	Occupations	NL Female Labour Force, 2006 (%)	NL Female Graduates 2006-2011 (%)	WREP Req. (Peak)	Target (% and peak #)	Rationale
Trades (Apprentice and Journey Person)	7521	Journey Person and Apprentices for the following categories: Plant Operators (Heavy Equipment Operator, Construction Equipment Operators [Stressing, Slip])	2.0	13.7	67	15 (10)	Based on % of graduates locally. Local graduate rates far exceed federal participation statistics
	7271	Journey Person and Apprentices for the following categories: Carpenters and Joiners - Scaffolder, Carpenter (Formwork, Stopends, Accessway)	1.1	10.2	41	12 (5)	
	7252	Plumbers and Pipefitters - Pipefitters Journey Person and Apprentices	2.5	7.5	5	5 (18)	
	7236	Ironworkers - Rodperson Journey Person and Apprentices, Structural Journey Person and Apprentices and Journey person (shop)	1.3	-	360		
	7611	Journey Person for the following categories: Laborers - Trades Helpers (Formwork, Concrete, Slip, Accessway)	11.7	-	150	12 (18)	Based on federal participation statistics

Husky Energy

PROCEDURE

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Revision	**Date**	**Reason For Issue**	**Prepared**	**Checked**	**QA Review**	**Approved**

Table of Contents

1.0 Introduction

1.1 Husky Operational Integrity Management System (HOIMS)

Husky's Operational Integrity Management System (HOIMS) covers all of Husky's businesses, with particular emphasis on projects and operations, and manages Operational Integrity through the life-cycle of the assets. HOIMS includes 14 elements, with each element containing well defined aims and a clear set of expectations. These expectations guide Husky employees in effectively managing the risks associated with our business and creating a safe and secure place to work. The 14 elements of HOIMS are listed in Table 1-1 below.

Table 1-1: Husky Operational Integrity Management System Elements

1	Leadership, Commitment & Accountability	2	Safe Operations
3	Risk Assessment & Management	4	Emergency Preparedness
5	Reliability & Integrity	6	Personnel Competency & Training
7	Incident Management	8	Environmental Stewardship
9	Management of Change	10	Information, Documentation & Effective Communication
11	Compliance Assurance & Regulatory Advocacy	12	Design, Construction, Commissioning, Operating & Decommissioning
13	Contracted Services & Materials	14	Performance Assessment & Continuous Improvement

Management is responsible for ensuring effective systems and procedures are implemented and adequate resources are made available to meet the HOIMS expectations. Business Units, Operating Districts, Facilities and Functional Areas will implement HOIMS. The resources applied will be consistent with the evaluated Operational Integrity risk.

Achieving conformance to HOIMS expectations requires commitment and sustained efforts over many years. Strong leadership and commitment at all levels of our organization and clearly established responsibilities and accountabilities are key to the success of HOIMS.

Resources will be applied and dedicated to the implementation of HOIMS, and progress will be tracked and monitored at the business units, operating districts, facility, functional areas and corporate levels. Periodic reviews and audits will be undertaken to ensure that HOIMS is effectively integrated in our daily operations and to continuously improve our performance.

Husky's Environmental Management System has its basis in HOIMS. More specifically, Element 8 titled "Environmental Stewardship" sets a clear aim to: "Operate responsibly to minimize the environmental impact of how we conduct business" and "Leave a positive legacy behind us when we leave". A clear set of expectations details how Husky Energy intends to meet this aim. They are the following:

8.1 A process is implemented to assess the risks and potential impacts to the environment associated with our operations. Such assessments are subject to periodic review and, where appropriate, a Life Cycle Value Assessment is carried out.

8.2 Management systems are established and specific measures are implemented to eliminate, minimize, prevent, detect, control and mitigate environmental threats. Our first priority is prevention.

8.3 Environmental impact is monitored and reported to demonstrate compliance with relevant local, national and international regulations and to ensure that any commitments are honored. Local sites metrics and targets are set to drive continual improvement in managing waste, emissions and discharges and energy efficiency.

8.4 A process is implemented to evaluate and manage the specific risks and liabilities associated with decommissioning and reclamation.

Environmental management of Husky's East Coast operations is achieved using a compilation of tools to manage the environmental component of its business. Systems, plans and procedures are in place to manage Husky's environmental commitments, regulatory obligations and stakeholder expectations, as well as areas of risk. All plans and procedures are responsive to applicable legislation and undergo periodic reviews to ensure compliance with legislation.

As a key part of these expectations, all of Husky's East Coast environmental assessments undergo annual reviews. These reviews are to assist Husky Energy in fulfilling its responsibilities under the *Canadian Environmental Assessment Act* by ensuring that the scope of the assessment(s) and the mitigations committed to therein remain valid.

1.2 Purpose of Environmental Protection Plan

The Environmental Protection Plan (EPP) is an important component of the overall project planning and implementation of construction projects. EPPs are often required as part of a project approval by governments following an environmental assessment, before construction occurs. EPPs provide a practical way in which a proponent can demonstrate its understanding of environmental regulations, practices and procedures required to reduce or eliminate the potential environmental effects of the project.

Husky Energy has committed to the development and implementation of a comprehensive EPP to help ensure a high level of environmental protection throughout its work areas and activities associated with the construction of the Concrete Gravity Structure (CGS) in Argentia, NL. An EPP is a working document for use in the field for project personnel and contractors, as well as at the corporate level for ensuring commitments made in policy statements are implemented and monitored. EPPs provide a quick reference for project personnel and regulators to monitor compliance and to make suggestions for improvements.

This EPP for Construction provides the general protection procedures for the routine activities associated with construction activities anticipated for the Project and identifies applicable permits, authorizations and approvals, as well as key site-specific conditions of approvals, as appropriate.

The specific purposes of the EPP are to:

- Provide a reference document to ensure that commitments to minimize environmental effects will be met;
- Document environmental concerns and appropriate protection measures;
- Provide concise and clear instructions to project personnel regarding procedures for protecting the environment and minimizing environmental effects;
- Provide a reference document for personnel when planning and/or conducting specific activities and working in specific areas.
- Provide a training aid during implementation efforts;
- Communicate changes in the program through the revision process; and
- Provide a reference to applicable legislative requirements and guidelines.

1.3 Organization of the Environmental Protection Plan

This EPP provides instructions to ensure Project personnel understand and implement environmental protection procedures for both routine activities and unplanned events and activities associated with the construction of the Project for Husky Energy.

The style and format of the EPP is intended to enhance its use by Project personnel in the field and to provide an important support document between the overall approach to environmental protection planning and the specific requirements in various permits, approvals and authorizations issued for specific Project components and activities.

The EPP comprises the following sections:

- **Section 1** provides an introduction to the EPP. It outlines the EPP purpose, organization, development and implementation, site-specific approach to EPP development, environmental orientation and the Husky Energy Project Overview.
- **Section 2** provides the scope of the EPP.
- **Section 3** provides the responsibilities and accountabilities of key personnel.
- **Section 4** provides an overview of the environmental concerns and general environmental protection procedures for planned Project activities.
- **Section 5** contains the site-specific EPPs for the principle work areas for the construction.

- **Section 6** provides the contingency plans for potential unplanned and accidental events and the key Project and regulatory personnel and emergency contact information.

- **Section 7** lists the permits, approvals and authorization required during construction.

1.4 Development and Implementation of the Environmental Protection Plan

The focus of this EPP is for the construction of the CGS at the Argentia site. The EPP will be revised and expanded as required to meet the requirements of the Project, and to meet the Terms and Conditions of environmental approvals.

EPPs typically undergo continuous revision to reflect new and site-specific construction sequences and work methods and environmental protection requirements and responsibilities. This EPP is structured to allow for updates and revisions as work continues.

1.5 Environmental Orientation and Training

Providing targeted assistance to employees and Contractors is essential to ensuring that they understand how to work in a safe and environmentally responsible manner. To that end, both Husky Energy and its Contractors will provide appropriately targeted orientation, training programs and materials to assist personnel with fulfilling their responsibility to work in a safe and environmentally responsible manner consistent with our policies.

As appropriate, Husky and its Contractors provide job specific technical, health, safety and environmental training and orientations. Husky Energy's formal and in-house training program considers the level of training required for the position and responsibilities of the personnel involved. The aim of the training programs is to provide an understanding of the procedures, equipment, risks and potential hazards that may occur.

All personnel working on the Project will be familiar with the EPP and the environmental protection procedures described herein. Husky Energy will ensure that all contractor employees receive a site-specific orientation to this EPP. The following will be included in the training program:

- Communication on Husky Energy Health, Safety and Environment (HSE) commitment and obligations to the EPP;

- Work description with discussion of the individual activities and the particular environmental concerns associated with each activity;

- Instruction on the specific environmental protection procedures for the work, including applicable documentation;

- Communication procedures to report any unplanned events requiring emergency response;

- Maintenance of the EPP; and
- Enforcement of the EPP.

In addition to the environmental orientation, the following opportunities will be implemented prior to and during the construction process:

- A detailed review with the Husky Energy and the Contractor Construction Managers will be completed prior to commencement of construction operations. The HSEQ Lead (or designate) will meet with the above referenced Construction Managers, the associated contractor supervisors, and the HSE Advisor to review in detail the requirements of this plan and ensure adequate preparations have been made.

- The Contractor Construction Manager will hold a Project kick-off meeting with the main supervisory personnel for all contractors to review this plan, the key elements, and the roles and responsibilities therein, at every critical phase of Project construction.

- Contractors will hold tool box meetings prior to commencement of each shift. Tool box meetings will be held by supervisors working at the site and all workers will attend. It will be held to discuss any health, safety and environmental issues that have arisen or are expected to arise that day.

- Environmental monitoring at the project site is an essential component that supports commitment for environmental protection. Environmental monitoring of construction activities will occur on a daily basis by representatives from Husky Energy HSE personnel, as well as the engineering management contractor and its construction sub-contractors. Every aspect of the operation is subject to environmental inspections. The basis for environmental monitoring rests with the principles, procedures and guidelines presented in the EPP. As a supplement to this, conditions of regulatory permit approvals also assist in establishing a foundation for which to conduct environmental monitoring activities. Non-conformance items noted during environmental inspections shall be documented and addressed. Target dates will be identified and required responsibilities assigned to the appropriate personnel. Corrective actions for non-conformance items will be communicated in the daily meetings and all actions shall be to the satisfaction of Husky Energy HSE advisor. If serious non-conformance items are noted that require immediate attention, appropriate personnel shall be contacted and mitigative measures implemented immediately.

- For each new job task that has potential for environmental impact an in-depth analysis will be conducted on each step in the job procedure prior to the work commencing. Environmental risk will be incorporated into the Job Safety Analysis. The intent of this is to identify all potential environmental hazards, and provide appropriate mitigative measures as provided in Section 4.0 and other applicable sections of this EPP. The initial development of the assessment will be the responsibility of the contractor performing the work. A formal review will be conducted with participants to include Husky Energy HSE advisor, front line supervisors and project design/field engineers.

1.6 Husky Energy Project Overview

As part of the Wellhead Platform (WHP) development, Husky Energy is constructing a CGS in a purpose-built graving dock at Argentia, Newfoundland & Labrador. The WHP will consist of a CGS with topsides consisting of drilling facilities, wellheads and support services such as accommodations, utilities, flare boom and a helideck. Argentia is situated on a peninsula located on the eastern shore of Placentia Bay. It is accessed via Hwy 100 approximately 43km south west of the Trans-Canada Highway 1 and 130 km from the City of St. John's.

The CGS construction site is located at the northeast portion of the Northside Peninsula, bordering Argentia Harbour. The overall construction site area will be approximately 20 hectares. Land clearing or watercourse diversion will not be required for the CGS graving dock construction. General excavating and grading activities will be required.

The CGS will be constructed in the dry, meaning all concrete construction will be completed in a de-watered graving dock. Upon completion of the CGS, the CGS structure will be floated to one of two potential deep-water sites in Placentia Bay, where it will be mated with the topsides structure. The WHP will then be towed to and installed in the western portion of the White Rose Field and tied back to the existing *SeaRose FPSO* flowlines.

The proposed construction site will consist of the following infrastructure:

- Graving Dock - The graving dock will be excavated behind the natural coastal berm to a depth of approximately -18 m Chart Datum (CD). An excavated cement bentonite cut-off wall, approximately 900 mm thick with a permeability of 10^{-8} m/s, will be constructed. The cut-off wall will extend to a depth of -28 m CD along the sea bund side and continued for 120 m along the sides of the graving dock. The cut-off wall will be removed as part of the bund removal and float out channel dredging activities after flooding of the graving dock prior to the float out of the CGS.

- Support facilities - include offices, a mess hall, a medical clinic, temporary sheds, sewage treatment facility, lay down areas, storage areas, and other facilities associated with large civil engineering construction sites. The construction site will be fully fenced with a security-controlled entrance. All buildings will be temporary and set on concrete or wooden sleepers or trailers above ground.

- Existing roads, water supply infrastructure, and power supply infrastructure will be used. If required, existing infrastructure will be extended into the site in a manner compatible with the final site layout.

- Settling Pond - A settling pond shall be provided through which all water removed from the graving dock will pass before discharge to the sea. The settling pond shall be sized to allow sufficient residence time for suspended solids to settle. The settling pond will be located outside of any cut off wall provided and will have an impermeable liner. The dewatering volumes and surface water drainage will be mixed. In addition, any concrete batch water will be directed toward the settling pond before discharge.

- Fuel Storage - Fuel storage (if required) will be provided on site in suitably segregated and bunded storage and distribution areas located close to the emergency generators Fuel will be delivered to site by tanker.

- Concrete Production - Two 60 m^3/hr concrete batch plant(s) will be provided covering an area of 14,000 m^2.

2.0 SCOPE

The Argentia EPP describes environmental protection procedures and contingency plans, designed to protect the local/regional terrestrial, freshwater and marine environments of the Argentia site, as well as the nearby communities and commercial fishers. These procedures and plans will be implemented during the onshore and near shore construction phase of the Project at the Argentia site.

Note that all activities associated with tow-out of the completed WHP from the deep-water site in Placentia Bay to the offshore location are beyond the scope of this EPP.

3.0 RESPONSIBILITIES AND ACCOUNTABILITIES

This section outlines the roles and responsibilities of all Project personnel, including Husky Energy company personnel and contractor personnel, with respect to environmental management of this Project.

3.1 Husky Energy Project Manager

The Husky Energy Project Manager is the primary person responsible for all aspects of the Project, including environmental, health and safety performance. Specific environmental responsibilities of the Project Manager include:

- Ensuring adequate plans and resources are in place to achieve Company commitments to minimize environmental impacts;
- Ensuring compliance with relevant regulations, authorizations, permits and protocols;
- Reviewing incident reports as they are submitted and ensuring the proper course of action is taken to manage unexpected environmental conditions or events;
- Ensuring ongoing communication with appropriate regulatory agencies and other interested parties on behalf of the Company; and
- Ensuring that revisions are updated and incorporated to this EPP.

3.2 Husky Energy Health, Safety, Environment & Quality (HSEQ) Manager

The HSEQ Manager will be primarily responsible for the overall health and safety of workers and protection of the environment during Project construction and commissioning. Specific responsibilities of the HSEQ Manager include:

- Development of the EPP;
- Maintenance of the EPP;
- Providing, along with the Construction Manager, information about emergencies and potential consequences to Company employees, contractors and the public;
- Ensuring implementation of training and orientation of all contractors on site; and
- Conducting audits to ensure compliance with this procedure.

3.3 Husky Construction Manager

The Husky Construction Manager will oversee all construction operations at the site. In regard to health, safety and environment (HSE), the Construction Manager will be responsible for:

- Promoting and demonstrating commitment to HSE;

- Ensuring adherence with the Husky Energy and Contractor HSE policy, standards and procedures;
- Ensuring all personnel at the site are competent and adequately oriented;
- Being familiar with the elements of this EPP;
- Ensuring the elements of this EPP are enacted;
- Communicating any new revisions to the EPP at the daily toolbox meetings; and
- Implementing any necessary corrective actions.

3.4 Health, Safety and Environment Advisor

The HSE Advisor will report to the HSEQ Manager and will provide advice and input as to the means necessary to meet the expectations of this EPP and the relative success thereof. The HSE Advisor has the authority to stop an operation if determined there are unacceptable risks to health, safety and the environment, in consultation with the HSEQ Manager, Construction Manager, Site Safety Supervisor or their designates. The HSE Advisor will be responsible for:

- Acting as the initial contact person for any releases or spills of substances (emergencies);
- Receiving, along with the Contractor, reports of all spills of fuel and hazardous materials immediately after the event. Any spill to the marine environment and spills of 70 L or more on land will be reported immediately;
- Ensuring an Incident Report is completed and submitted to all relevant personnel and regulatory bodies (if required).
- Monitor on-site Project activities, evaluate the contractors' environmental performance, and assess and interpret environmental protection procedures as set down in this EPP.
- Interact with other members of the Project Team on environmental procedures and requirements, participate in Project meetings, conduct environmental reviews of drawings, and help to revise and update this EPP.
- Ensuring compliance with all applicable permits, contract documents, Husky Energy and Contractor HSE policies and commitments made during the planning and application process;
- Assisting in the preparation and delivery of environmental orientation presentations to Company and Contractor staff;
- Suspending work in the event of non-compliance with the recommendations of this EPP, permit or authorization conditions or as standard procedure to prevent unacceptable risks to health, safety and environment;

- Advising on the proper course of action to be taken to manage unexpected environmental conditions or events;
- Monitoring work site activities and conditions on a daily basis to identify problem areas;
- Ensuring that monitoring and follow-up studies are conducted as necessary;
- Assisting with the implementation of emergency plans;
- Liaising with appropriate regulatory agencies during onsite inspections or visits and other interested parties;
- Organizing on-site meetings as required to address site specific issues; and
- Review and approve all relevant contingency plans submitted by the Contractor.

3.5 Contractor Representatives

All Contractors working at the site will be oriented to the Husky Energy HSE expectations and this EPP. All workers are required to:

- Protect themselves, others and the environment by identifying hazards and implementing appropriate solutions;
- Comply with all regulations, this EPP, and the Husky Energy HSE policy, contractor safety policies and/or procedures that pertain to the operations; and
- Notify the Construction Manager or immediate supervisor of any incident that results in (or could have the potential to result in) injury to personnel, property or the environment.

3.6 All Company and Contractor Personnel

All persons working on the Project have the authority and responsibility to:

- Familiarize themselves with the EPP and any revisions that may be made during construction;
- Adhere to the EPP and comply with applicable Husky Energy HSE policies, regulations, permits and authorizations;
- Initiate EPP revision requests, if required, to improve the quality of the EPP; and
- Shutdown an operation if they believe there are risks to health, safety and environment.

4.0 ENVIRONMENTAL PROTECTION PROCEDURES

4.1 Surveying

Any required site surveying activities for construction shall be conducted primarily on previously disturbed land with negligible environmental effect expected from these activities. Since the site is on previously disturbed land clearing of vegetation is not a concern. The surveying activities that may be required include traversing and establishing of permanent benchmarks.

4.1.1 Environmental Concerns

Surveying activities may disturb vegetation, wildlife, and historic resources.

4.1.2 Environmental Protection Procedures

Traversing

- No attempt to harass or disturb wildlife will be made by any person.
- Vehicles will yield the right-of-way to wildlife.
- Archaeological sites and features will not be disturbed during survey work. Any historic resource discoveries will be reported as per Section 6.3.
- All-terrain vehicles (ATVs) will not be allowed off the right-of-way except as approved by the HSE Advisor.

Establishing Targets, Permanent Benchmarks and Transponder Locations

- A driven T-bar, well embedded to readily identify each benchmark location will be used.
- No attempt to harass or disturb wildlife will be made by any person.
- Standard iron bars and sledge hammers are to be used to establish benchmarks.
- Survey crews must have a briefing on the recognition of historic resources prior to commencing work.

4.2 Clearing of Vegetation

Due to the nature of the site (previously developed), vegetation clearing will not be required and as such will not be discussed as part of this EPP.

4.3 Quarrying and Aggregate Removal

4.3.1 Environmental Concerns

The principal concerns for quarry development and associated aggregate removal include the potential for sedimentation of marine and freshwater systems, loss of terrestrial habitat and historic resources, noise, dust and quarry development/ reclamation plans.

4.3.2 Environmental Protection Procedures

All quarried material will be obtained from an existing quarry which holds a valid Quarry Permit obtained from the NL Department of Natural Resources. Husky Energy will ensure that all quarried materials are obtained in compliance with the quarry permit and applicable regulatory requirements.

4.4 Erosion Prevention

4.4.1 Environmental Concerns

The potential for erosion and resulting effects to water quality, fish and fish habitat is a key environmental concern associated with construction activities.

4.4.2 Environmental Protection Procedures

Erosion prevention practices shall be applied throughout work areas on exposed or erodible materials. The application of erosion control measures is found throughout Section 4.0 but reiterated here to provide a more thorough evaluation of site-specific activities by project personnel.

General

Primary means of erosion control are the avoidance of activities contributing to erosion. All areas of exposed erodible soils are to be stabilized by back-blading or grading to meet engineered slope requirements. Where erosion along exposed erodible slopes is a potential concern and a natural vegetation buffer of less than 30 m from the high water mark exists between erodible areas and water bodies, a silt fence shall be constructed to control sediment runoff.

Engineering requirements will vary depending on the locations of the silt fence and will take such factors into consideration as drainage/surface area of exposed soils and time of year the silt fence is employed.

Erosion and sedimentation control measures have been designed for construction to minimize the effects of construction activities on the environment. They include: site drainage ditching system, including culverts and risers; installation of sedimentation control ponds; temporary run-off interceptor ditches; and check sediment dam traps which will provide both energy dissipation and sedimentation control. However, regardless of these protection measures, if an environmental inspection reveals that sediment is entering a watercourse, further mitigative measures shall be implemented.

4.5 Excavations, Embankment and Grading

Excavation, embankment and grading of common rock and other materials may be required at various locations within the Project.

4.5.1 Environmental Concerns

The principal environmental concerns associated with excavation, embankment and grading are potential effects on water quality, fish and fish habitat, and terrestrial habitat due to ground disturbance.

4.5.2 Environmental Protection Procedures

All work shall be conducted in a manner which controls potential sedimentation of watercourses and bodies of water in or adjacent to the work areas as outlined in the following procedures:

- Excavation, embankment and grading in the vicinity of water bodies shall be done in a manner that ensures erosion and sedimentation of watercourses and bodies of water is minimized.
- A buffer zone of undisturbed vegetation shall be maintained between construction areas and all watercourses, bodies of water and ecologically sensitive areas.
- Excavated soil will be disposed as per the requirements of all applicable permits.

4.6 Dust Control

4.6.1 Environmental Concerns

The environmental concerns associated with dust include human health effects and potential effects on aquatic ecosystems, waterfowl and vegetation.

4.6.2 Environmental Protection Procedures

The following measures will be taken to mitigate potential effects of dust:

- Dust from construction activities shall be controlled where possible by the frequent applications of water and/or use of calcium chloride;
- Any application of calcium chloride will be in accordance with guidelines available from the NL Department of Transportation and Works.
- All dust control agents will be stored in areas away from water bodies.
- Efforts to be made to minimize fugitive dust emissions; specific types and frequency of dust control measures to be determined by site conditions.
- Locations where water is to be applied, the amount of water to be applied and the times at which it will be applied will be determined by the Construction Manager.

- Water will not be applied in situations where surface water could freeze and create a potential traffic hazard.

- Water will be applied by means of a pressure type distributor equipped with a spray system of nozzles that will ensure a uniform application of water. Minimal amounts of water required to control dust will be applied such that potential for surface runoff of sediment is minimized.

- Waste oil, or other petroleum products, will not be used for dust control under any circumstances.

- Fine-grained soils and granular materials will be transported in covered trailers or trucks to reduce air-borne particulates.

4.7 Trenching

4.7.1 Environmental Concerns

Where excavation for the construction of water lines or any other infrastructure is undertaken, potential runoff of sediment-laden water could result in effects on marine or freshwater fish and fish habitat, water quality and historic resources.

4.7.2 Environmental Protection Procedures

The following measures will be implemented to minimize the potential effects of trenching.

- Where possible, topsoil will be stored for later use during rehabilitation.

- Excess overburden and excavated bedrock material will be disposed of as per the requirements of the applicable permits.

- Dewatering of trenches will make use of measures to minimize and control the release of sediment laden water through the use of filtration, erosion control devices, settling ponds, straw bales, geotextiles or other devices.

4.8 Pumps and Generators

4.8.1 Environmental Concerns

A variety of water pumps, hoses and generators will be in frequent use in many areas of the construction site. Environmental concerns are associated with any accidental spills or chronic leaks contaminating bodies of water.

4.8.2 Environmental Protection Procedures

- Oils, grease, gasoline, diesel, or other fuels shall be stored at least 100 m from any surface water.

- Drip pans shall be placed underneath pumps and generators. Absorbent material will be kept at all sites where pumps and generators are in use.

- Hoses and connections on equipment located near bodies of water shall be inspected routinely for leaks and drips.

- All leaks shall be reported immediately to the HSE Advisor. Upon detection of a leak, the equipment (i.e., pump, generator, etc.) should be shut down immediately and corrective action taken to repair the leak and clean up any contaminated soil and/or water.

4.9 Precasting

4.9.1 Environmental Concerns

Both wooden and metal formwork will be constructed. With regards to wooden formwork, the active faces may be treated with form oils. During precasting activity, both metal and wooden formwork will be prepared prior to each concrete pour with form oil (a hydrocarbon-based product). Many of these substances are known to be toxic or possibly pose occupational hazards. The implementation of a Workplace Hazardous Materials Information System (WHMIS) program is directly applicable to the use of these materials in precasting activities.

The major concern regarding the use of these substances is their release to the environment through spillage and use. Precasted units are often subjected to high and/ or low pressure washing after removal from formwork for curing or cleaning purposes. This washwater may contain cement, concrete additives, and form oil.

Cement is very alkaline and washwater from cleaning or curing precast units will probably breach the upper acceptable limit (pH 9.0) under the NL *Environmental Control Water and Sewage Regulations, 2003*. Washwater may also contain concrete additives and agents, and form oil, many of which are toxic to aquatic species. Aggregates, particularly the finer sand fractions can be expected to be washed from precast units in the washwater. Such washwater, chemicals and sediments can affect aquatic life and aquatic habitat.

4.9.2 Environmental Protection Procedures

The following protection procedures are intended to minimize the potential impact of the discharge of these substances in association with precasting activities.

Storage and use of Epoxies, Paints and Form Oil

- All form oil which is stored in bulk will be contained in above-ground, double-walled tanks or smaller containers inside dyked secure areas.

- All epoxies, paints and form oils which are stored in drums and smaller containers will be stored in an enclosed area protected from contact with vehicles and stored in compliance with WHMIS protocols.

- The application of form oil to formwork will be done in a manner which minimizes the amount used and ensures that incidental or accidental release to the environment is minimized.

Washwater and Runoff Control

Runoff from the precast area and washwater from the cleaning and curing of precast units, will be directed to the settling pond.

- Settling pond effluent will be tested routinely (at least monthly or as directed by the Environmental Team) for parameters related to concrete additives to be used in the production of concrete, or form oil. The settling pond effluent discharge will meet contaminant levels specified in Schedule A of the NL *Environmental Control Water and Sewage Regulations, 2003.*

- The settling pond will be cleaned as directed by the HSE Advisor to ensure that the retention capacity is maintained at all times.

4.10 Equipment Operations

A variety of equipment will be used on-site during construction, which are potential sources of noise, air emissions and potential leaks or spills.

4.10.1 Environmental Concerns

Noises associated with construction activity may negatively affect wildlife. Air emissions may have air quality implications. Accidental leaks or spills of fuel or other hazardous materials may affect soils, water, fish, vegetation and wildlife.

4.10.2 Environmental Protection Procedures

- All approvals, authorizations and permits for Project activities will be followed.

- Noise control procedures will be put in place during construction.

- All equipment will have exhaust systems regularly inspected and mufflers will be operating properly.

- All equipment (e.g., diesel generators, etc.) will meet the requirements of the provincial Sections 16 and 20 of the *Air Pollution Control Regulations* under the NL *Environmental Protection Act*.

- All equipment use during construction will follow the environmental protection procedures outlined in this EPP. In the case of an accidental event resulting from the use of equipment (e.g., a fuel spill), the appropriate contingency plan will be implemented.

- Regular maintenance inspections for leaks will be made on all equipment. If problems are identified the equipment will be taken out of service and mitigated to prevent release of hydrocarbons into the environment (drip tray, spill pan, absorbent material, etc.).

- Use of environmentally friendly hydraulic fluids in equipment operating within 100 m of a water body will be investigated.

4.11 Dewatering – Work Areas

4.11.1 Environmental Concerns

The major concerns associated with dewatering are sedimentation and direct fish mortality and/or habitat destruction for freshwater and marine fish species.

4.11.2 Environmental Protection Procedures

- Water pumped from excavations or work areas, or any runoff or effluent directed out of the project site will have silt removed via a settling pond, filtration or other suitable treatment before discharging to a body of water. Effluent discharge will comply with the NL *Environmental Control Water and Sewage Regulations, 2003* under the NL *Environmental Protection Act*.

- Where possible, clean water will be discharged to vegetated areas to further reduce any potential effects on watercourses.

- The size of sedimentation pond will be designed to accommodate the anticipated volume of collected water and to meet discharge criteria engineered for water quality.

- Discharged water will be encouraged to follow natural surface drainage patterns.

- Contingency measures will be implemented to deal with storm events and high run-off in order to minimize adverse environmental effects from these events. Erosion prevention and sediment containment materials such as silt fence material, rip rap, straw bales, filter fabric and designated equipment will be available to address contingency/emergency situations.

- Site drainage will be directed toward the settling pond.

4.12 Marine Vessels

This section of the EPP is intended to provide general guidance for Project supervision and environmental staff to prevent or minimize potential effects in the biophysical environment.

4.12.1 Environmental Concerns

Project vessel traffic may interfere with local fishing boats and other vessel traffic. The potential exists for vessels to collide, run aground and/or sink. Such events may lead to the accidental release of fuel and other hazardous materials to the marine environment. The release of ballast or bilge water could introduce non-indigenous species or deleterious substances into Placentia Bay.

4.12.2 Environmental Protection Procedures

- All vessel activities will be governed in accordance the *Canada Shipping Act, 2001* and all associated regulations including the *Vessel Pollution and Dangerous Chemicals Regulations*.

- Construction Safety Zones (CSZs) will be established at the deep-water mating site in Placentia Bay. Husky Energy will establish an overall Project agreement with commercial fishers using the Placentia Bay area that addresses safe operations and compensation.

- For the safety of the work crews and commercial fishers in the area, fishing inside the CSZ will be restricted during construction activities.

- To minimize interference with other marine traffic, Notices to Shipping/Mariners will be issued by the Canadian Coast Guard (CCG) regarding Project vessel traffic.

- Marine traffic associated with Project construction will use designated routes.

- Husky Energy will consult with the area fish harvesters to discuss and agree on an appropriate Vessel Traffic Management Plan for the safe and efficient operation of Project marine traffic and fishing vessel operations in the Project area.

- Communications will be maintained directly at sea by Project vessels via marine radio to facilitate information exchange. Relevant information about marine operations occurring outside the CSZs will also be publicized, when appropriate, using established communications mechanisms, such as Notices to Shipping (Continuous Marine Broadcast and NavTex) and CBC Radio's (Newfoundland and Labrador) Fisheries Broadcast.

- Project vessel masters will observe the following basic rules:

  - Demonstrate they have appropriate safety and emergency procedures on board;

  - Advise the Argentia authorities of their time of departure from their port of origin and their estimated time of arrival;

  - Travel at the recommended speed within the traffic lanes,

  - Notify the Argentia authorities of their progress at sea or, if stopping at other ports enroute, update their estimated time of arrival;

  - Relevant Canadian Hydrographic Charts or electronic charting systems must be on board prior to leaving their port of origin; these charts must be kept on board at all times;

  - Implement best management practices designed to achieve zero discharge of oily waste while at the site and along the Project shipping route;

  - All Project-related vessels shall have onboard adequate oil spill response equipment to handle an accidental release of product into the environment; and

  - Notify the CCG and the Argentia site office of any releases or spills of substances (emergencies) immediately and identify the location.

- No Project-related vessels will discharge wastes or bilge water into surrounding waters. The discharge of garbage from ships into Canadian waters and the waters of the Fishing Zones of Canada is prohibited.

- All crewmembers will be familiar with emergency procedures for both life threatening and potentially polluting situations.

- All stationary hazards, such as moored platforms or vessels, will be clearly marked according to the *Navigable Waters Protection A*ct approvals and/or the *Collision Regulations* under the *Canadian Shipping Act, 2001*.

- All vessels will comply with the *Canadian Shipping Act, 2001 Ballast Water Control and Management Regulations*;

- All vessels must comply with the Argentia Project Waste Management Plan.

4.13 Noise Control

4.13.1 Environmental Concerns

A variety of noises associated with construction and operation activity can negatively affect wildlife distribution and abundance. Noises associated with blasting are temporary in nature and noises associated with drilling are considered long-term, but localized.

4.13.2 Environmental Protection Procedures

Measures will be implemented wherever possible to minimize potential effects arising from a variety of noise sources, including:

- Adherence to all applicable permits and approvals.

- All equipment will have exhaust systems regularly inspected and mufflers will be operating properly.

4.14 Historic Resources

4.14.1 Environmental Concerns

There are no known archaeological sites located in the project area. However, potential exist that activities such as dredging of the tow-out channel may uncover historic resources.

4.14.2 Contingency Procedures

If suspected historic resources are identified the Discovery of Historic Resources contingency plan as per Section 6.3 will be enacted.

4.15 Concrete Production

4.15.1 Environmental Concerns

The major concern relating to concrete production activities is the effects of washwater released to the environment. Liquid wastes may contain hazardous materials such as cement, concrete additives and form oil.

Cement is very alkaline and washwater from spoiled concrete or from the cleaning of the batch plant mixers and mixer trucks, conveyors and pipe delivery systems can be expected to have very high pH, which may exceed the acceptable limit, as determined by the provincial regulation of discharges to a body of water. Similarly, spoiled concrete or washwater would contain concrete additives and agents, some of which are toxic to aquatic species. Aggregates, particularly the finer sand fractions, can be expected to be washed from spoiled concrete or discharged in washwater. Uncontrolled release of such washwater, chemicals and sediments could adversely affect aquatic life and aquatic habitat.

4.15.2 Environmental Protection Procedures

- Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems shall be directed to a closed system rinsing/settling pit.
- In the event that water from the closed settling system is to be released, it shall be tested prior to release, for parameters related to any concrete additives used in the production of concrete (e.g., total hydrocarbons, sodium hydroxide), pH, and total suspended solids. The water to be released shall also meet the limits specified in Schedule A of the NL *Environmental Control Water and Sewage Regulations, 2003* and shall adhere to those portions of the *Fisheries Act* that relate to fish habitat protection and pollution prevention. Release shall be via runoff control procedures.
- If water to be released does not meet discharge criteria, it will be further treated until these discharge criteria have been met.
- The settling pit shall be cleaned on an as required basis to ensure that the retention capacity is maintained at all times.
- An onsite interim holding/processing area for off-spec or excess concrete will be designated and approved. Final disposal will be at an approved facility.
- Any chemicals that are kept on site must be stored in accordance with the National Fire Code and *Occupational Health and Safety Regulations*. Chemicals kept on site will be stored in a secure area. Liquid chemicals will be placed inside a dyked area.
- Installation of dust control equipment in the concrete batch plant.
- The Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations will be adhered to during concrete production activities.
- All drainage from an aggregate storage area will be directed to a drainage control device such as a settling pond.

4.16 Linear Developments

4.16.1 Environmental Concerns

Linear developments encompass a diverse range of standard construction-related activities, such as ditching, right-of-way clearing and grubbing, roads, pipelines and transmission line construction. Environmental concerns associated with linear developments include potential sedimentation/erosion, the loss of vegetation, fish/wildlife habitat and historic resources.

4.16.2 Environmental Protection Procedures

<u>Road Construction</u>

- Aggregate (fill) materials for road construction will not be removed from any stream.
- Siltation control measures such as sediment traps and check dams will be installed where required. Solids that accumulate in a settling pond or behind a sediment trap will be removed on a regular basis to ensure such devices remain effective.
- Work will not be undertaken on easily erodible materials, during or immediately following heavy rainfalls.
- Buffer zones will be flagged prior to any disturbance activities.
- Any historic resource discoveries will be reported to the Provincial Archaeological Office.
- Natural vegetation will be left in place where possible.
- Drainage from areas of exposed fill will be controlled by grading or ditching and directed away from watercourses. Surface water will be directed away from work areas by ditching. Runoff from these areas will have silt removed by filtration or other suitable methods.
- The requirements of ditch blocks/check dams or sediment traps to intercept runoff will be determined in the field in consultation with the HSE Advisor and Contractor.
- Check dams will be used as required to reduce runoff from work areas with exposed soil.
- In areas where natural vegetation must be removed, the vegetation layer will be stored for possible use as erosion control material on exposed slopes.
- Temporary erosion control will be applied on exposed slopes in sensitive areas immediately following exposure of a slope.
- The cutting and filling phase of road construction, and the development of other work areas, will be conducted in a manner that ensures minimum disturbance and controls potential sedimentation of watercourses and water bodies in or adjacent to the roads, as outlined in the following procedures:

- Cutting and filling will be done only upon completion of grubbing. Where engineering requirements do not require grubbing, filling will occur without any disturbance of the vegetation mat or the upper soil horizons;

- Road fill will be dry and ice-free. On areas of sensitive terrain, the fill will be end-dumped from the established road bed.

- Culverts will be installed to maintain natural cross-drainage and to prevent ponding.

Transmission Line Development

Wood, pressure-treated with pentachlorophenol (PCP) or ammonical copper arsenate (ACA), shall not be used. Alternatives to wood will be preferred, or where necessary wood treated with either ACQ (amine) or Copper Azole.

Pipeline Development

Pipelines such as those for sedimentation pond discharge shall be constructed above ground and follow the access roads. All exterior surface pipelines with the potential to freeze shall be gravity self-draining to containment or employ other protection measures to prevent spillage to the environment. The environmental protection procedures for road construction as outlined above shall be used for pipeline construction where applicable.

Drainage

Drainage discharge locations will be determined in consultation with the HSE Advisor.

- Roads will be adequately ditched so as to allow for good drainage.

- Roadside ditches will discharge onto vegetated areas, never directly into a watercourse.

- Wherever possible, ditches will be kept at the same gradient as the road.

- The location of all culverts will be marked with a post so they can be located during snow removal operations or if they become covered from debris accumulation.

4.17 Vehicular Traffic

4.17.1 Environmental Concerns

Direct physical disturbances from vehicular movements can adversely affect both terrestrial and aquatic environments. During any construction-related operation, the level of activity involving equipment movement, types of equipment and supply, requires various infrastructures such as roads, to conduct the work efficiently and in an environmentally acceptable manner. Typically, vehicles ranging in size from ATVs to heavy equipment, all of which can result in ground disturbance, may be used during access road construction. Husky Energy is committed to the proper development of access roads in order to minimize environmental damage resulting from equipment movement and supply of operations.

4.17.2 Environmental Protection Procedures

- ATVs will not be allowed on the site except as required by the Contractor in the performance of the work.

- Where possible, the use of ATVs will be restricted to designated trails, thus minimizing ground disturbance.

- Vehicle movements will be restricted to developed areas such as access roads.

- Appropriate speed limits and road signage will be established and enforced to minimize environmental disturbance and accidents.

- During winter when the ground is covered with snow, snowmachines and track-heavy equipment (dozers), whether equipped with low-impact tread or not, will not be used for equipment movement and supply outside of established roadways, pathways or trailways. Where possible, this equipment will use established pathways, also minimizing disturbances to vegetation.

- Equipment and vehicles will yield the right-of–way to wildlife. Any attempt to interfere with the natural movement of wildlife will be considered harassment and dealt with accordingly.

- All Project vehicles, including ATVs, will be properly inspected and maintained in good working order including all exhaust systems, mufflers and any other pollution control devices.

4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances

A variety of fuels and potentially hazardous materials will be used during Project construction activities. Gasoline, diesel fuel, grease, motor oil and hydraulic fluids are all needed for equipment. Other potentially hazardous materials that may be used routinely include:

- Propane;

- Acetylene;

- Paints;

- Epoxies;

- Concrete additives;

- Antifreeze; and

- Cleaners and solvents.

4.18.1 Environmental Concerns

When transporting, storing, handling, transferring, or using petroleum products or other hazardous materials, the uncontrolled release to the environment through spills and leaks is of utmost concern. This may result in contamination of air, soil, marine, and/or freshwater (both surface and ground water). Adverse effects on human health and safety, terrestrial, aquatic and marine habitat and species may occur as a consequence of air, soil, and water quality degradation.

Transport of Petroleum Products and Other Hazardous Materials

The transport of fuel and other hazardous materials will be undertaken in compliance with the *Transportation of Dangerous Goods Act* and associated regulations. All goods entering the site will be inspected to ensure that the appropriate placards or labels and manifest are in place and the security of the product is assured. All persons handling dangerous goods must show proof of certification of training in the transportation of dangerous goods as required under the Act. Security staff and the HSE Advisor will be trained in the requirements of the Act.

Storage of Fuel and Other Hazardous Materials

All bulk storage of fuel products and other hazardous materials on land will be stored in above-ground, self-dyked tanks in compliance with the *Storage and Handling of Gasoline and Associated Products Regulations.*

The following conditions shall apply to the storage of fuels and other hazardous materials.

- Before installing fuel storage tanks, the necessary approvals under the *Storage and Handling of Gasoline and Associated Products Regulations* shall be obtained from the Services NL.

- Fuels and other hazardous materials shall only be handled by persons who are trained and qualified in handling these materials. The WHMIS will be implemented to ensure proper handling and storage are achieved.

- Petroleum products and other hazardous materials shall be stored on level terrain at least 100 m from any surface body of water unless otherwise approved by the Husky HSEQ Manager.

- Fuels shall be stored inside dykes or self-dyked units and will be clearly marked to ensure they are not damaged by moving vehicles. The markers will be visible under all weather conditions.

- Storage areas will be equipped with suitable fire fighting equipment.

- Any above-ground fuel tank shall be positioned over an impervious mat and shall be surrounded by an impervious dyke of sufficient height (minimum height 0.6 m) to contain:

- Where a dyked area contains only one storage tank, the dyked area shall retain not less than 110% of the capacity of the tank.

- Where a dyked area contains more than one storage tank, the dyked area shall retain not less than 110% of the capacity of the largest tank or 100% of the capacity of the largest tank plus 10% of the aggregate capacity of all the other tanks, whichever is greater. Otherwise approved self-dyked storage tanks shall be used where required.

- Dyked areas are to be dewatered on an as needed basis. The water shall be decontaminated prior to release into the environment.

- Any dykes of earthwork construction shall have a flat top not less than 0.6 m wide, and be constructed and maintained to be liquid tight to a permeability of 25 L/m²/day. The distance between a storage tank shell and the center line of a dyke shall be at least one half the tank height. Dykes shall be fenced.

- Fuel storage areas and non-portable transfer lines shall be clearly marked or barricaded to ensure that they are not damaged by moving vehicles. The markers will be visible under all weather conditions. Barriers will be constructed in compliance with the provincial *Storage and Handling of Gasoline and Associated Product Regulations*.

- Waste oils, lubricants, and other used oil shall be reused, recycled or disposed of at an approved, licensed waste management facility in accordance with the NL *Used Oil Control Regulations*.

- All storage tank systems shall be inspected on a regular basis as per Sections 20 and 21 of the *Storage and Handling of Gasoline and Associated Products Regulations*. This involves, but is not limited to, gauging or dipping and the keeping of reconciliation records for the duration of the program.

- Contracted suppliers of petroleum products and other hazardous materials shall comply with provisions of this EPP. Also, before transporting or positioning fuel at the site, have a Fuel and Hazardous Material Spills Contingency Plan which has been accepted by Husky Energy.

- Smoking shall be prohibited within 10 m of a fuel storage area.

- Hot Work Permits shall be required before undertaking welding or torch cutting at a fuel storage area.

- Refueling or servicing of mobile equipment on land shall not be allowed within 100 m of a watercourse except at a specifically designated refueling site where conditions will allow for containment of accidentally spilled fuel (i.e., secondary containment).

- Within 30 days of known decommissioning of a storage tank system, empty the system of all products, remove the tank and associated piping from the ground, remove any contaminated soil, clean the area and restore the site.

- Any soil contaminated by small leaks of fuel, oil or grease from equipment shall be disposed of in accordance with the NL *Environmental Protection Act* and *Used Oil Control Regulation*. The *Used Oil Control Regulation* will be used as a guideline to the NL Department of Environment and Conservation requirements for such disposal.

- A fuel and other hazardous materials spill contingency plan, and appropriate emergency spill equipment shall be in place on site.

- Bulk fuel storage facilities shall be dipped on a weekly basis in order to accurately gauge fuel consumption. These consumption rates shall allow for visually undetectable sources of contamination to be identified and corrected.

- Outdoor storage of gasoline or diesel in portable containers is acceptable only in designated areas for that purpose.

- Drums of petroleum products or chemicals will be tightly sealed against corrosion and rust and surrounded by barrier and contains secondary containment.

- For storage of waste oils, other waste petroleum products, and spent hazardous materials, the requirements of the Waste Management Plan will be followed.

- Petroleum products and other hazardous materials shall only be handled by persons who are trained and qualified in handling these materials, as per the WHMIS. WHMIS regulations shall be implemented to ensure proper handling and storage is achieved.

- Tanks that are decommissioned will be purged of all hydrocarbons and vapours by a certified contractor, verified gas free by a gas detection meter, rendered unfit for further use by cutting holes in it, and disposed of in a manner approved by Services NL.

- A fuel and other hazardous materials spill contingency plan, and appropriate emergency spill equipment, will be in place on site. A copy of contingency plan is to be forwarded to the Government Services Centre.

<u>Fuel Transfer – From Tanker Truck to Storage Tanks</u>

The following procedures shall apply to the transfer of petroleum products:

- In all cases, transfer to storage tanks will be attended by a qualified person for the duration of the operation. This person will be trained in proper fuel handling procedures to minimize the risk of an unattended spill. The attendant will be trained in the requirements of the spill contingency plan and WHMIS.

- Exposed pipelines will be protected from vehicular collision damage by the installation of guard rails.

- Regular inspections of hydraulic and fuel systems on all operating machinery shall be carried out and records kept during the duration of near shore construction. Leaks shall be repaired immediately.

Equipment Fuelling

The following procedures shall apply to the fuelling of heavy construction equipment:

- Fuelling and lubrication of equipment shall occur in such a manner as to minimize the possibility of contamination to soil or water.
- When refueling equipment, operators shall:
  - Use leak-free containers and reinforced rip and puncture-proof hoses and nozzles;
  - Be in attendance for the duration of the operation; and
  - Seal all storage container outlets except the outlet currently in use.
- Regular inspections shall be made of hydraulic and fuel systems on machinery. Leaks shall be repaired immediately.
- Refueling or servicing of mobile equipment on land shall not be allowed within 100 m of a watercourse except at a specifically designated refueling site where conditions will allow for containment of accidentally spilled fuel (i.e., secondary containment).
- Fuelling attendants shall be trained in the requirements under the spill contingency plan.

Hazardous Materials

Use of hazardous materials must comply with WHMIS and established safety practices and procedures. All materials/products that are WHMIS controlled and/or may pose a hazard to people or the environment, regardless of quantity, and that are no longer usable shall be designated as hazardous waste and is subject to the provisions of the Waste Management Plan.

The following procedures shall apply to hazardous materials other than petroleum products:

- Hazardous materials shall be used only by personnel who are trained and qualified in the handling of these materials and only in accordance with manufacturers' instructions and government regulations, as outlined in the Material Safety Data Sheets. WHMIS regulations are in force throughout the Argentia facility, as are provisions of the *Transportation of Dangerous Goods Act*. All employees involved with hazardous materials shall be appropriately trained.
- All hazardous wastes shall be managed (i.e. handled, stored, removed and disposed of) in an acceptable manner in accordance with government regulations and requirements, as discussed in the Waste Management Plan.
- Material Safety Data Sheets must be available on-site prior to receipt of any hazardous materials.

Form Oil Use

- When possible, form oils shall be applied to forms in-situ by spraying.
- If form oils must be applied to forms before they are placed then this shall be done in one designated area approved of by the HSE Advisor. If rollers must be used then oil absorbent cloths shall be placed under the forms to capture and contain excess form oil that splashes or runs off the forms during application.
- Waste or excess form oil that is not to be kept for future use shall be managed in accordance with provisions of the Waste Management Plan.

Permits and Authorizations

The permits and authorizations pertaining to storage of petroleum products and other hazardous materials will likely be required. Conditions of all permits, authorizations, licenses, etc shall be respected.

Spills of Fuel and Hazardous Materials

- All necessary precautions shall be implemented to prevent the spillage of fuels and other hazardous materials used during the construction phase.
- All spills of fuel and hazardous materials shall be reported immediately to the HSE Advisor. Any spill to the marine or freshwater environments and spills of 70 L or more on land shall be reported immediately to the CCG at 709-772-2083 or 1-800-563-9089
- Every effort shall be made to immediately control the source of the leak or spill and clean up the contaminated area.
- All material and equipment used during spill clean up must be stored properly until it can either be disposed of or cleaned to avoid further contamination. Disposal of clean up materials must be in accordance with the provisions of this EPP, the Waste Management Plan and all government regulations and requirements.
- There shall be appropriate emergency spill response equipment on site for all phases of the Project.
- A complete list of the emergency spill response equipment shall be available on site and kept up to date.
- All emergency response equipment should be kept in good working condition suitable for required use.
- Regular inspections of all spill response supplies and equipment will be conducted and documented to ensure adequate supply and condition.
- The use of chemical dispersants to treat oil slicks shall take place only under the authorization of Environment Canada, Environmental Protection Branch (Newfoundland and Labrador).

4.19 Sewage Treatment, Disposal and Compliance Testing

4.19.1 Environmental Concerns

The accidental release of untreated sewage is a concern to human health, drinking water quality, and freshwater and marine ecosystems.

4.19.2 Environmental Protection Procedures

- The sewage disposal system shall comply with the Provincial Standards, guidelines, and NL *Environmental Control Water and Sewage Regulations, 2003.*
- Development of sewage treatment facilities shall be undertaken in consultation with the relevant regulatory agencies for a temporary or permanent sewage collection system, and a Certificate of Approval shall be obtained from the Services NL and the NL Department of Environment and Conservation.
- Portable latrines used in work areas shall be routinely inspected and properly maintained. Sewage removed from the facilities shall be transported to a dumping station at the sewage treatment/disposal facility. All human fecal waste must be contained and disposed in a manner that meets all environmental and health requirements. Any concerns must be brought to the immediate attention of the HSE Advisor.
- Treated effluent will be monitored in order to determine compliance with provincial regulations. The frequency of sampling and the constituents to be sampled will be identified by the NL Department of Environment and Conservation in the sewage treatment plant certificate of approval.
- Sewage sludge, which accumulates at the bottom of the plant, must be pumped out as required and disposal of this material shall comply with provisions of the Waste Management Plan.

4.20 Waste Management

Solid waste will be generated during construction and operation of the Argentia facility. Waste streams will be identified as domestic waste, paper, cardboard, wood and scrap steel and metals. This section contains procedures for waste minimization, recycling and disposal.

4.20.1 Environmental Concerns

Solid waste, if not properly controlled and disposed of, can be unsightly and cause human safety and health concerns. Disposal of solid waste in the marine environment has potential to harm marine life. Uncontrolled hazardous waste can contaminate soils, surface and groundwater, and can be toxic to vegetation, fish and wildlife if ingested in sufficient quantities.

4.20.2 Environmental Protection Procedures

A Waste Management Plan will be in place to address waste generation, handling, disposal during construction and operation of the Argentia facility. Contractors will be responsible for developing a waste management plan which will adhere to the overall Husky Energy Waste Management Plan.

Disposal of all types of waste material into a body of water is strictly prohibited.

Upon termination of operations the site will be rehabilitated to the satisfaction of the NL Department of Environment and Conservation. All material, equipment, buildings and waste is to be removed from the site and disposed of in accordance with the legislation. The site will be vegetated by placing organic material, if necessary, and seeding as required.

Non-hazardous Waste

- Waste receptacles will be installed at all active areas for use by construction personnel.
- Waste management procedures will comply with federal, provincial and municipal waste management regulations, as well as additional municipal and disposal facility requirements.
- Waste generated will be handled, stored, transported and disposed of in accordance with all applicable acts, regulations and guidelines.
- Solid wastes will be sorted at the facility into recyclable/reusable and non-recyclable. Material not deemed acceptable for recycling/re-use will be disposed of in an acceptable manner at an approved landfill site.
- Certified contractors will be retained for safe transport of solid waste to the approved facility.
- Recyclable material will be collected and transported to a licensed recycling facility using local services authorized by Husky Energy.
- An effort will be made to minimize the amount of waste generated by application of the 4-R principals (reduce, reuse, recycle, recover) to the extent practical.
- Domestic waste will be gathered daily and stored in closed containers until disposed of at an approved waste disposal site.
- Food waste will be stored in a manner that ensures that wildlife will not be attracted.
- Waste containers will be covered to prevent the escape of windblown debris and will be clearly labelled.

Hazardous Waste

- Hazardous waste generated will be handled, stored, transported and disposed of in accordance with all applicable acts, regulations and guidelines.
- Waste oil will be collected separately and offered for recycling or stored for collection by an approved special waste collection and disposal company. Handling, storage, and disposal of waste oils and lubricants will be in compliance with the NL *Used Oil Control Regulations.*
- Greasy or oily rags or materials subject to spontaneous combustion will be deposited and kept in an appropriate receptacle. This material will be removed from the work site on a regular basis and will be disposed of in approved waste disposal facilities.
- Handling and transportation of hazardous waste will be in compliance with the *Transportation of Dangerous Goods Act* and *Regulations* and the *Hazardous Products Act* (WHMIS)

4.21 Avifauna Management

4.21.1 Environmental Concerns

Lighting, noise and project construction activities can potentially interfere with the migratory patterns of birds and the behaviour of transient or resident marine birds.

4.21.2 Environmental Protection Procedures

The following mitigative measures are designed to reduce the interference that site activities will have on birds as well as reduce the effect of site construction will have on local bird populations.

- Survey of nesting birds to be completed before any clearing or site preparation begins. If nesting bird species at risk are discovered, operations in the immediate area of the nest are to be suspended until the young have fledged.
- Directional and fully shielded light fixtures will be employed, depending on safety and navigational requirements. This type of light fixture would illuminate only the immediate working area below the lamp, with little or no diffusion of light laterally and above the lamp.
- Workers should be instructed to report any collisions of birds with structures and if collisions occur frequently, a plan to address further mitigative measures will be established.
- If work is suspended, construction lighting should be extinguished during these periods to reduce the attraction of birds.
- A combination of scaring tactics, including visual and acoustic deterrent devices may be used. If measures such as the use of firearms or aircraft are considered, a scare permit is required from the Canadian Wildlife Service (CWS). Please contact

Donna Johnson, CWS Permits Administrator at (506) 364-5017 for more information on obtaining this permit.

- If a raptor nest is observed during construction it will be reported to the Forest Resources Office at Paddy's Pond and the NL Department of Environment and Conservation Wildlife Division.

- Any migratory bird nests or colonies found on site will be "buffered" during breeding season whenever possible until young have fledged, and nests will be left intact and undisturbed in compliance with the *Migratory Birds Convention Act* and *Regulations*.

- Boat activity and human presence will be restricted near colony-nesting birds where possible.

- Project access roads to have reasonable speed limits to minimize potential mortality of bird species at risk from road kills.

- No personnel will approach, feed or harass wildlife if encountered.

- Firearms will not be permitted on or near the work site. Hunting by Project employees on site will be forbidden.

- All food waste will be properly contained and disposed of on a regular basis at an approved facility.

- The NL Department of Environment and Conservation Wildlife Division and Environment Canada's CWS should be contacted with regards to any rare or endangered wildlife species encountered. Other wildlife encounters will be reported to the Regional Conservation Officer at Paddy's Pond. Guidance as to the appropriate action to take will be given by these authorities.

- All personnel shall be advised of rare or endangered species potentially occurring in the Project area. The environmental assessment process determined limited potential for rare or endangered wildlife species in the Project area.

- Site personnel will always yield the territory to the animal.

- Site personnel will be alert to the signs of animal presence (e.g., nests.) and report to the HSEQ Manager.

4.22 Marine Construction – Removal of Shoreline Berm / Dredging

4.22.1 Environmental Concerns

Environmental concerns from dredging include noise and the disturbance to fish and fish habitat. Marine construction activities can also disturb nearshore terrestrial habitat and cause seabirds, waterfowl and marine mammals to avoid the area. As well, there may be some potential for historic resources to be disturbed.

In addition, Project vessel traffic may interfere with local fishing boats and other vessel traffic. The potential exists for vessels to collide, run aground and/or sink. Such events may lead to the accidental release of fuel and other hazardous materials to the marine environment.

4.22.2 Environmental Protection Procedures

- There will be no side-casting of dredged materials. Material will be removed from the marine environment and disposed in “The Pond”.
- Tow out channel dredging will be completed using a trailing suction hopper dredger. A site-specific sediment suspension model (AMEC 2012) demonstrated that using a trailing suction hopper dredger, suspended sediment levels will not exceed the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002).
- Cutter suction dredge or a backhoe dredger will be utilized for shoreline dredging. Earth-moving equipment will be required to lower the level of the shoreline to the minimum dredging depth of the cutter suction dredge.
- Water quality will be measured during dredging activities to ensure that total suspended solid levels and contaminant concentrations in the water column are within limits prescribed by the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* when considered in conjunction with existing ambient water quality and site-specific factors.
- Additional mitigative actions (e.g., turbidity curtains) will be undertaken as deemed necessary by the HSE Advisor.
- The operation of heavy equipment will be confined to dry, stable areas.
- All heavy equipment will be serviced and fuelled on land at least 100 m from the marine environment or in designated areas designed for spill containment.
- All heavy equipment must be in good condition. Regular mechanical inspections for leaks on all equipment will be made and repairs undertaken immediately.
- A Fuel and Other Hazardous Material Spill Contingency Plan will be in place and appropriate emergency spill equipment available on-site.
- Any disturbed areas along the shoreline should be immediately stabilized to prevent erosion.
- If Historic resources are discovered they will not be disturbed and will be reported to the NL Provincial Archaeology Office (PAO).

4.23 Species at Risk

A species at risk is defined as a species which is extirpated, endangered, threatened or of special concern. A number of species at risk have the potential to exist in or can migrate within project areas, and may be affected by project activities:

Fish species at risk that could occur in Placentia Bay include the following Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed species: Atlantic cod (Newfoundland and Labrador population, Southern population); American plaice (Newfoundland and Labrador and Maritime populations); American eel; and Atlantic salmon.

Harlequin Duck (*Species at Risk Act* (SARA)-listed as Special Concern) occur in the waters off Cape St. Mary's Seabird Ecological Reserve (Section 5.1.5.1). Between 1998 and 2008, there have been incidental sightings of Red Knot rufa subspecies (COSEWIC assessed as endangered) along the Cape Shore of Placentia Bay (Garland and Thomas 2009). There are no known critical nesting, feeding, staging or over wintering areas of at risk bird and mammal species in the immediate vicinity of the nearshore area.

Marine mammals species at risk that may occur in Placentia Bay include the SARA listed blue and fin whale and the COSEWIC-assessed harbour porpoise (Northwest Atlantic population). The leatherback sea turtle is listed as a Schedule 1 species under SARA and may also be present in Placentia Bay.

4.23.1 Environmental Concerns

A significant concern regarding species at risk is that activities related to project development and operation will result in a decline in abundance or a change in distribution of an at-risk population. Natural repopulation may not occur if numbers decrease at too high a rate or avoidance of an area becomes permanent.

A significant adverse environmental effect would be one that results in an unmitigated or non-compensated loss of habitat, mating behaviour, or feeding ability (i.e. loss of food source).

4.23.2 Environmental Protection Procedures

- During the marine construction phase at the Argentia site, petroleum products and other chemicals/materials which have potential toxic effects or the potential to harm habitats will be stored and handled in accordance with the *Canada Shipping Act, 2001*.
- On land, proper storage of oils is important to inhibit leakage or seeping into the marine environment. Related regulations can be found under the *Storage and Handling of Gasoline and Associated Products Regulations*, the *Heating Oil Storage Tank Regulations*, and the *Used Oil Control Regulations* under the NL *Environmental Protection Act*.
- Use of settlement ponds and/or containment areas for concrete washwater.
- Treatment of washwater from batch plants prior to discharge/disposal.
- Use of silt curtains if required to control sedimentation into the marine environment.
- Any ATV use shall comply with *All-Terrain Vehicle Use Regulations*. Where possible, the use of ATVs and vehicles shall be restricted to designated trails, thus minimizing ground disturbance.

- All equipment will be serviced and fuelled on land at least 100 m from the marine environment or in designated areas designed for spill containment.

- All equipment will have muffled exhausts to minimize noise.

4.24 Sensitive and Special Areas

Sensitive areas of habitat within the Nearshore Study Area include the Placentia Bay Extension Ecologically and Biologically Significant Area (EBSA), eelgrass beds, capelin beaches, coastal wetlands, Important Bird Areas, and otter haul-outs. Of these, eelgrass beds are most vulnerable to project activities. Outside the areas to be dredged, a change in habitat quality due to sedimentation is not expected to have considerable adverse environmental effects since eelgrass is resilient to sedimentation in the water column. As there are multiple eelgrass beds in the Nearshore Study Area, the removal of one small eelgrass bed from near the graving dock is considered to be not significant.

4.24.1 Environmental Protection Procedures

- Marine vessels entering project area will respect traffic lanes;

- Marine vessels entering the project area will have to avoid designated CSZs, and;

- Development of spill prevention procedures and contingency plans

5.0 SITE-SPECIFIC APPROACH TO EPP DEVELOPMENT

In addition to the general environmental protection procedures provided in Section 5.0, this EPP also provides stage/site-specific EPPs in relation to primary work areas and project components associated with project construction. These site-specific EPPs provide information on: planned project components and activities; general environmental issues and concerns; potential effects, general environmental protection procedures applicable to that site/stage; site-specific environmental protection measures; and associated compliance monitoring requirements.

Project Work Scope

The key project development parameters that comprise the planned work scope are presented as follows.

- Site Preparation and Infrastructure Development;
- Graving Dock Construction
- Infilling “The Pond”
- Cement Works and CGS Construction
- Removal of Shoreline Berm and Dredging
- Tow-out to Deepwater Site and Topsides Mating

5.1 Site Preparation and Infrastructure Development

The overall construction site area will be approximately 20 hectares. Land clearing or watercourse diversion will not be required for the CGS graving dock construction. General excavating and grading activities will be required. Additional onshore surveys to support site preparation and necessary repairs or upgrades to existing infrastructure may be required.

Approximately 250,000 m^3 of this material removed from the graving dock excavation will be used to level and grade the area surrounding the graving dock site above existing grade to approximately 8 m CD.

Associated site infrastructure is as follows:

- **Road Construction, Upgrades and Parking** - The graving dock site will maximize the use of existing access roads. The road system that currently exists is within 500 m of the graving dock site. Such infrastructure will be extended into the site in a manner compatible with the final site layout. Any required repairs and construction will also be made to the existing roads to prepare them for industrial use.

- **Water Supply** - Site will maximize the use of the existing water supply. An existing source of potable, fire, and industrial water is located near the construction site. Additional water supply infrastructure will be extended into the area in a manner compatible with the final site layout.

- **Power Supply** - Site will maximize the use of the existing grid power. Although grid power will be the primary source of electricity, there will be an emergency generator on site with a capacity of approximately 750 kilowatts. This will be used in the case of a grid black-out to provide on-site power for services such as the concrete batching plant, emergency lighting around the site, and dewatering pumps. The graving dock site location is within 500 m of existing overhead power lines. These lines will be extended into the site and then fed to a site distribution system. The same will be done for communication lines.

- **Site Buildings** - Support facilities include a concrete batching plant, offices, temporary sheds, lay down areas and storage areas. The construction site will be fully fenced with a security-controlled entrance.

- **Sewage Treatment Plant** – Sanitary sewage will be treated onsite using a wastewater treatment plant. All treated effluent will meet the requirements of the NL *Environmental Control Water and Sewage Regulations, 2003* Schedule A prior to ocean disposal.

Environmental Protection Procedures

Standard Mitigation Measures

Standard Mitigation Measures relevant to Site Preparation and Infrastructure Development are listed in Table 5-1, and presented in Section 4.0.

Table 5-1: Relevant Environmental Protection Procedures

EPP Section	Relevance
4.1 Surveying	√
4.2 Clearing of Vegetation	
4.3 Quarrying and Aggregate Removal	√
4.4 Erosion Prevention	√
4.5 Excavations, Embankment and Grading	√
4.6 Dust Control	√
4.7 Trenching	√
4.8 Pumps and Generators	√
4.9 Precasting	
4.10 Equipment Operations	√
4.11 Dewatering – Work Areas	√
4.12 Marine Vessels	
4.13 Noise Control	√

EPP Section	Relevance
4.14 Historic Resources	√
4.15 Concrete Production	
4.16 Linear Developments	√
4.17 Vehicular Traffic	√
4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances	√
4.19 Sewage Treatment, Disposal and Compliance Testing	√
4.20 Waste Management	√
4.21 Avifauna Management	√
4.22 Marine Construction – Removal of Shoreline Berm / Dredging	
4.23 Species At Risk	√
4.24 Sensitive and Special Areas	√

Area Specific Measures

- In addition to the environmental protection procedures identified above, specific conditions of all government permits, approvals, and authorizations shall be followed.

5.2 Graving Dock Construction

The graving dock will be excavated using traditional earth-moving equipment, blasting will not be required. The floor area of the dock at the toe of the bund will be approximately 150 m x 150 m. Approximately 1,100,000 m^3 of material will be removed with approximately 250,000 m^3 of this material used to level and grade the area surrounding the graving dock site above existing grade to approximately 8 m CD.

The proposed graving dock will be excavated behind the natural coastal berm to a depth of approximately -18 m CD. A bentonite cut-off wall, approximately 900 mm thick will be constructed to minimize the ingress of water into the graving dock. The wall has been designed with a permeability of 10^{-8} m/s to a depth of -28 m CD at the sea bund side. The cut-off wall can be locally removed by a cutter suction dredger during the flooding of the graving dock prior to the float out of the CGS.

Environmental Protection Procedures

Standard Mitigation Measures

Standard Mitigation Measures relevant to graving dock construction are listed in Table 5-2, and presented in Section 4.0

Table 5-2: Relevant Environmental Protection Procedures

EPP Section	Relevance
4.1 Surveying	√
4.2 Clearing of Vegetation	
4.3 Quarrying and Aggregate Removal	
4.4 Erosion Prevention	√
4.5 Excavations, Embankment and Grading	√
4.6 Dust Control	√
4.7 Trenching	√
4.8 Pumps and Generators	√
4.9 Precasting	
4.10 Equipment Operations	√
4.11 Dewatering – Work Areas	√
4.12 Marine Vessels	
4.13 Noise Control	√
4.14 Historic Resources	√
4.15 Concrete Production	
4.16 Linear Developments	√
4.17 Vehicular Traffic	√
4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances	√
4.19 Sewage Treatment, Disposal and Compliance Testing	√
4.20 Waste Management	√
4.21 Avifauna Management	√
4.22 Marine Construction – Removal of Shoreline Berm / Dredging	
4.23 Species At Risk	√
4.24 Sensitive and Special Areas	√

Area Specific Measures

- In addition to the environmental protection procedures identified above, specific conditions of all government permits, approvals, and authorizations shall be followed.

- If deemed necessary based on conditions encountered during excavation (e.g., visual and olfactory evidence of contamination), soil sampling will be conducted on the material excavated from the graving dock site and results will be compared to the CCME *Soil Quality Guidelines for Industrial Sites* as well as the Atlantic PIRI RBCA Tier I criteria. Soil with TPH levels above 1,000 mg/kg will be quarantined for treatment/offsite disposal as required. Note that prior to any onsite treatment Husky

Energy will obtain approval from Service NL and the NL Department of Environment and Conservation.

- Erosion protection and sedimentation control measures (e.g., silt fence, riprap, etc.) will be implemented as required to prevent sedimentation of waterbodies.

- A plan will be developed to ensure that the site is dewatered during excavation and that resulting groundwater is directed into the settling pond.

- All dewatering wells will be developed and filters installed to remove particulate matter prior to pumping.

- Certificates of Approval for all drilled wells will be obtained as per Section 58 of the NL *Water Resources Act*.

- A rock lined drainage ditch will be constructed around the peripheral area of the graving dock. All drainage from the ditch will be directed toward the settling pond.

- Surface water drainage and water generated from construction dewatering activities will be directed into a settling pond prior to discharge into the marine environment. Water samples will be collected at the overflow weir and compared to the NL *Environmental Control Water and Sewage Regulations, 2003* Schedule A parameters. Samples will be collected and analyzed as follows:

  - Once a day for first week of pumping prior to discharge or where additional source of water are added to the treatment system.

  - Twice a week (every three or four days) for next three weeks.

  - Once a month thereafter.

- If exceedances are detected appropriate mitigation measures will be implemented. Also, the applicable regulatory bodies will be contacted.

- Effluent discharge from the settling pond will be visually inspected on a daily basis. If issues are identified a sample will be collected immediately.

- Silt fences as well as a crushed stone lined ditch will be installed downstream of the overflow weir.

5.3 Infilling “The Pond”

Material from the graving dock that is not used for leveling and grading (approximately 850,000 m^3) and all the material to be dredged (approximately 368,000 m^3) will be disposed of in “The Pond”.

Environmental Protection Procedures

Standard Mitigation Measures

Standard Mitigation Measures relevant to Infilling "The Pond" are listed in Table 5-3, and presented in Section 4.0.

Table 5-3: Relevant Environmental Protection Procedures

EPP Section	Relevance
4.1 Surveying	√
4.2 Clearing of Vegetation	
4.3 Quarrying and Aggregate Removal	
4.4 Erosion Prevention	
4.5 Excavations, Embankment and Grading	
4.6 Dust Control	
4.7 Trenching	
4.8 Pumps and Generators	
4.9 Precasting	
4.10 Equipment Operations	√
4.11 Dewatering – Work Areas	
4.12 Marine Vessels	√
4.13 Noise Control	√
4.14 Historic Resources	
4.15 Concrete Production	
4.16 Linear Developments	
4.17 Vehicular Traffic	√
4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances	√
4.19 Sewage Treatment, Disposal and Compliance Testing	
4.20 Waste Management	√
4.21 Avifauna Management	√
4.22 Marine Construction – Removal of Shoreline Berm / Dredging	
4.23 Species At Risk	√
4.24 Sensitive and Special Areas	

Area Specific Measures

- In addition to the environmental protection procedures identified above, specific conditions of all government permits, approvals, and authorizations shall be followed.

- During infilling of “The Pond”, water will be displaced over a weir structure. Water samples will be collected and compared to the NL *Environmental Control Water and Sewage Regulations, 2003*. Samples will be collected and analyzed as follows:

  - Bi-weekly samples for TSS will be collected. If site conditions dictate, additional sampling will be completed as determined by the site ;

  - Weekly samples will be collected and compared to the NL *Environmental Control Water and Sewage Regulations, 2003* Schedule A parameters.

- If TSS exceedances are detected appropriate mitigations will be implemented (e.g., silt curtains, flocculation, etc.). Silt fences as well as a crushed stone lined ditch will be installed downstream of the overflow weir.

- Effluent discharge from the “The Pond” will be visually inspected on a daily basis. If issues are identified samples will be collected immediately.

5.4 Cement Works and CGS Construction

The CGS will be constructed in the dry, which means completing the CGS in the graving dock, prior to towing to the Placentia deep-water site for topsides mating. The primary materials for the CGS are cement, sand, gravel and steel rebar for the concrete and structural steel and pipe for the shaft. The current estimate of the required volume of concrete is approximately 64,000 m³. Slip-forming and other standard CGS construction methods will be used for the caisson and central shaft construction after completion of the base slab. Concrete batch plant(s) will be used on site for concrete production.

Potential activities associated with CGS construction in the dry dock are as follows:

- Concrete batch plant operation;
- Concrete placement; and
- Slip-forming;

Environmental Protection Procedures

Standard Mitigation Measures

Standard Mitigation Measures relevant to CGS Construction are listed in Table 5-4, and presented in Section 4.0.

Table 5-4: Relevant Environmental Protection Procedures

EPP Section	Relevance
4.1 Surveying	√
4.2 Clearing of Vegetation	
4.3 Quarrying and Aggregate Removal	√
4.4 Erosion Prevention	√
4.5 Excavations, Embankment and Grading	

EPP Section	Relevance
4.6 Dust Control	√
4.7 Trenching	
4.8 Pumps and Generators	√
4.9 Precasting	√
4.10 Equipment Operations	√
4.11 Dewatering – Work Areas	√
4.12 Marine Vessels	
4.13 Noise Control	√
4.14 Historic Resources	
4.15 Concrete Production	√
4.16 Linear Developments	
4.17 Vehicular Traffic	√
4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances	√
4.19 Sewage Treatment, Disposal and Compliance Testing	√
4.20 Waste Management	√
4.21 Avifauna Management	
4.22 Marine Construction – Removal of Shoreline Berm / Dredging	
4.23 Species At Risk	
4.24 Sensitive and Special Areas	

Area Specific Measures

- In addition to the environmental protection procedures identified above, specific conditions of all government permits, approvals, and authorizations shall be followed.

- Dewatering and sampling activities will continue as per Section 5.2.

5.5 Removal of Shoreline Berm and Dredging

Once the CGS is completed, the graving dock will initially be flooded to equalize the hydrostatic pressure, then a combination of land-based excavation equipment and a cutter suction dredge will be used to remove the shoreline berm, after which the float-out will occur. The dredger will be used to create an exit channel from the graving dock to a water depth of approximately -18 m CD to accommodate the draft of the CGS. During this period, the marine activities from the dredging operation will be closely coordinated with the Port of Argentia.

Shoreline Dredging

Shoreline dredging activities can be executed with the use of a cutter suction dredge or a backhoe dredger. Earth-moving equipment will be required to lower the level of the shoreline to the minimum dredging depth of the cutter suction dredge. Once the soil is loosened by the cutter suction dredge, the soil will be sucked into the dredger and pumped through a floating pipeline from the stern of the barge to the shoreline where it will be connected to a land-based pipeline for discharge to “The Pond” on the tip of the Argentia Peninsula. If a backhoe dredger is used it will deposit the excavated material into a transportation barge alongside the dredger. The barge will transport the dredged material to quayside for offloading and transportation to “The Pond” by earth-moving equipment.

Tow-out Channel Dredging

Tow out Channel dredging will be completed using a trailing suction hopper dredger

As part of the WREP environmental assessment, a site-specific sediment suspension model (AMEC Environment & Infrastructure (AMEC) 2012a) demonstrated that using this dredge method, suspended sediment levels will not exceed the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002). Suspended sediment concentrations above 25 mg/L are expected to persist for no more than 4 hours within an area of approximately 0.7 km^2, in all wind scenarios. Concentrations above 10 mg/L would persist for approximately six hours, and total suspended solid levels above 5 mg/L would last for about 10 hours for a single dredging operation. A trailing suction hopper dredger will transfer the sediment into the hopper of the vessel. The soft material within the tow-out corridors could be removed easily with a trailing suction hopper dredger, and if necessary, the assistance of a backhoe dredger for harder material may be required.

Once full, the dredge vessel will transit to quayside where it will be connected to a temporary land-based pipeline and the material pumped ashore for discharge to “The Pond”. These pipelines can be extended and repositioned in such a way that the sediment will be placed evenly over “The Pond” area. At the end of the pipeline, earth-moving equipment will be used for the final spreading and levelling of the material, if necessary.

The marine logistics associated with the dredging operation will be coordinated with the Port of Argentia. As previously stated, “The Pond” at the head of the Argentia Peninsula has been evaluated as the primary spoils disposal site.

Environmental Protection Procedures

Standard Mitigation Measures

Standard Mitigation Measures relevant to Removal of Shoreline Berm and Dredging are listed in Table 5-5, and presented in Section 4.0.

Table 5-5: Relevant Environmental Protection Procedures

EPP Section	Relevance
4.1 Surveying	
4.2 Clearing of Vegetation	
4.3 Quarrying and Aggregate Removal	
4.4 Erosion Prevention	√
4.5 Excavations, Embankment and Grading	√
4.6 Dust Control	√
4.7 Trenching	
4.8 Pumps and Generators	√
4.9 Precasting	
4.10 Equipment Operations	√
4.11 Dewatering – Work Areas	
4.12 Marine Vessels	√
4.13 Noise Control	√
4.14 Historic Resources	√
4.15 Concrete Production	
4.16 Linear Developments	
4.17 Vehicular Traffic	√
4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances	√
4.19 Sewage Treatment, Disposal and Compliance Testing	√
4.20 Waste Management	√
4.21 Avifauna Management	
4.22 Marine Construction – Removal of Shoreline Berm / Dredging	√
4.23 Species At Risk	
4.24 Sensitive and Special Areas	√

Area Specific Measures

- In addition to the environmental protection procedures identified above, specific conditions of all government permits, approvals, and authorizations shall be followed.

5.6 Tow-out to Deepwater Site and Topsides Mating

Once construction of the CGS is complete, the structure will be floated out of the graving dock and towed to a deep-water site in Placentia Bay for installation of the topsides. Two potential deep-water sites have been identified, west of Red Island and west of Merasheen Island. A decision between the two potential mating sites will be made after further site evaluation, including local stakeholder consultation, to obtain all necessary information about the tow-out route and the deep-water location.

Upon arrival at the deep-water site, the tow tugs will hold the structure at the required location while four moorings are connected to the structure and tightened to maintain position for the installation of the topsides. The CGS will be ballasted to a predetermined depth for the installation of the topsides.

The position of the CGS will be maintained by four pre-installed seabed anchors, which will be connected to mooring points on the CGS by anchor chain approximately 1,500 m each in length. Each leg of the overall mooring system will be comprised of a seabed anchor, pennant wire and buoy for deployment and recovery of the anchor, a chain connecting the anchor to the CGS and a tension pontoon aligned with the chain. These moorings will be set and marked just prior to the float out of the CGS from the graving dock. The mooring systems will be recovered and removed from the deep-water site once the topsides facility has been mated with the CGS and is under tow to the offshore site. The CGS itself will not be in contact with the seafloor.

During the mating operation and inshore hook-up work, the Port of Argentia will be used as a logistics base for the supply of materials, equipment and personnel. There will be limited marine traffic between the deep-water site and the Port of Argentia throughout the time that the WHP is at the deep-water site.

Environmental Protection Procedures

Standard Mitigation Measures

Standard Mitigation Measures relevant to topsides mating and commissioning are listed in Table 5-5, and presented in Section 4.0.

Table 5-6: Relevant Environmental Protection Procedures

EPP Section	Relevance
4.1 Surveying	
4.2 Clearing of Vegetation	
4.3 Quarrying and Aggregate Removal	
4.4 Erosion Prevention	
4.5 Excavations, Embankment and Grading	
4.6 Dust Control	
4.7 Trenching	
4.8 Pumps and Generators	√
4.9 Precasting	

EPP Section	Relevance
4.10 Equipment Operations	√
4.11 Dewatering – Work Areas	
4.12 Marine Vessels	√
4.13 Noise Control	√
4.14 Historic Resources	√
4.15 Concrete Production	
4.16 Linear Developments	
4.17 Vehicular Traffic	
4.18 Storage Handling and Transfer of Fuel and Other Hazardous Substances	√
4.19 Sewage Treatment, Disposal and Compliance Testing	√
4.20 Waste Management	√
4.21 Avifauna Management	
4.22 Marine Construction – Removal of Shoreline Berm / Dredging	
4.23 Species At Risk	√
4.24 Sensitive and Special Areas	√

Area Specific Measures

- In addition to the environmental protection procedures identified above, specific conditions of all government permits, approvals, and authorizations shall be followed.

6.0 CONTINGENCY PLANS

Contingency plans to deal with accidents and unplanned situations will be implemented and modified as required throughout the Project.

The objectives of these contingency plans are to avoid/minimize the following:

- Danger to persons;
- Area affected by a spill or fire;
- Degree of disturbance to the area during clean-up; and
- Degree of disturbance to wildlife.

Husky Energy has established a series of contingency plan processes that apply to this EPP. These are listed below and described in the following sections:

- Fire Contingency Plan;
- Spill Contingency Plan;
- Wildlife Encounters;
- Discovery of Historic Resources; and
- Vessel Accidents.

6.1 Fuel and Hazardous Material Spills

<u>Environmental Concerns</u>

The uncontrolled release to the environment of fuels and hazardous materials can negatively impair the quality of air, soil and water (freshwater and marine), and harm vegetation, wildlife, aquatic organisms, historic resources and human health and safety.

<u>Personnel Training</u>

All workers employed by contractors and subcontractors shall be required to attend an employee environmental orientation session prior to, or shortly after, commencing work on the Project. All personnel shall be made aware of the WHMIS regulations and the enactment of these on the Argentia construction site. Supervisory staff members, including the members of the Project Environment and Regulatory Team, shall be trained as “On-Scene Commanders” for the purposes of cleaning up a fuel or hazardous materials spill. They shall be trained in spill clean-up procedures and how to mobilize the necessary equipment and personnel. Clean-up equipment will be present in specific areas of the site. A Spill Response Team shall be trained to carry out actual deployment and operation of spill equipment. Practice drills (deployment and communications exercises) shall be conducted to maintain a state of readiness for an emergency.

As appropriate, workers shall be trained and/or certified under the *Transportation of Dangerous Goods Act*.

Prevention

The Contractor will be responsible for ensuring the following procedures are implemented to minimize the likelihood of a spill.

1. A Spill Prevention Plan will be submitted by the Contractor for approval by the HSEQ Manager.

2. Regular inspections of containment reservoirs (i.e., tanks, drums, vessels, etc).

3. Ensure that equipment is in good working order and will inspect equipment periodically for fuel or hydraulic fluid leaks.

4. All mechanics and outside service personnel are to ensure every precaution is taken to prevent spills from oil changes, antifreeze, hydraulic top ups, etc. Wherever practical, drip pans/ containers will be used.

5. All empty oil, antifreeze and hydraulic containers are to be collected from the site of the maintenance and placed in approved containers or returned to the shop for disposal.

6. Oils and lubricants will be stored on level terrain, inside an appropriately dyked area, in locations approved by the Construction Manager.

7. Storage of potentially hazardous materials and equipment refuelling/servicing will be conducted in accordance with the procedures outlined in this EPP.

Initial Response and Reporting

In the event of a fuel or hazardous material spill, the following procedures shall apply.

1. The individual who discovers the leak or spill shall notify his immediate supervisor and provide as much information as possible. The individual shall make a reasonable attempt to immediately stop the leakage and contain the flow without compromising his/her health and safety or that of others.

2. Spill location, type of fuel or hazardous material (if known), volume, and terrain condition at the spill site shall be determined and reported immediately to the HSE Advisor who shall immediately notify the Construction Manager, HSEQ Manager (or designate), and the HSE Advisor.

3. Any spill in-water, and spills greater than 70 L on land, or any amount on land that can enter water frequented by fish shall be reported to the CCG by calling the spill reporting number 1-800-563-9089. Required pertinent information includes:

   - Name of reporter and phone number;

   - Time of spill or leak;

- Time of detection of spill or leak;
- Type of product spilled or leaked;
- Amount of product spilled or leaked;
- Location of spill or leak;
- Source of spill or leak;
- Type of accident - collision, rupture, overflow, other;
- Owner of product and phone number;
- If the spill or leak is still occurring;
- If the spill or leaked product is contained, and if not, where it is flowing;
- Wind velocity and direction;
- Temperature;
- Proximity to bodies of water, water intakes, and facilities;
- Tidal action where applicable; and
- Snow cover and depth, terrain, and soil conditions.

Clean up Procedures for Spills on Land

The Husky Energy Construction Manager, in consultation with the Environmental Monitor, and regulatory authorities will:

- Assemble at the spill equipment containers location or as directed by the On-Scene Commander;
- The On-Scene Commander will brief the Response Team on the spill situation;
- Assess site conditions and environmental effect of various clean-up procedures.
- Choose and implement an appropriate clean-up procedure.
- All members shall be provided with personal protective equipment (PPE) (i.e., life vests, rubber gloves, boots), as appropriate;
- The team will transport necessary equipment to the spill location to start clean-up;
- Attempt to contain the spill by ditching, deploying absorbent materials, etc;
- All contaminated soil in the area will be removed and replaced if appropriate;

- Deploy on-site personnel to mobilize pumps and empty drums or other appropriate storage to the spill site;

- Protect beaches by deploying additional boom or absorbent materials;

- If wildlife are observed in the area attempt to keep them away using boats or noise generating devices;

- Dispose of all contaminated debris, cleaning materials, and absorbents in an approved landfill site;

- The boundaries of the spill area will be marked for future monitoring and clean-up if needed; and

- Take all necessary precautions to ensure that the incident does not reoccur.

Clean up Procedures for Spills in Water

A marine spill necessitates immediate on-site response. Therefore, spill equipment will be stored onsite, and trained emergency response people will be available. In organizing a cleanup of shoreline pollution, site conditions and the impact of various containment and cleanup procedures, including the following, will be assessed:

- If on-site equipment is not adequate, immediately mobilize additional containment and cleanup equipment and manpower in consultation with the CCG;

- If the area has less than 1/10th ice cover and currents are relatively weak (less than 0.5 knots), deploy containment boom and recover as much fuel as possible with work boats, pump, and sorbents;

- Protect all beaches by deployment of floating boom if possible;

- Dispose of all contaminated debris, cleaning materials, and absorbents at an approved landfill site; and

- If feasible and necessary, establish a holding and cleaning facility for oil-fouled birds.

The procedure for a shoreline pollution cleanup will include:

- Assemble at the spill equipment containers location or as directed by the On-Scene Commander;

- The On-Scene Commander will brief the Response Team on the spill situation;

- Assess site conditions and environmental impact of various cleanup procedures;

- All members shall be provided with PPE (i.e., life vests, rubber gloves, boots), as appropriate;

- If conditions necessitate/permit deploy the containment boom using the spill response boat;
- Deploy on-site personnel to mobilize pumps and empty drums or other appropriate storage to the spill site;
- Deploy on-site personnel to build containment dykes and commence pumping the contained material into drums;
- Apply absorbents if necessary;
- If appropriate, use a water hose or other means to concentrate product in a location easily accessible for clean-up;
- Protect beaches by deploying additional boom or absorbent materials;
- If wildlife are observed in the area attempt to keep them away using boats or noise generating devices;
- Dispose of all contaminated debris, cleaning materials, and absorbents in an approved landfill site;
- Locate, map, and stake the boundaries of contaminated beach and landfill for future monitoring and treatment;
- Assess and appropriately treat any areas disturbed by cleanup activities; and
- Take all necessary precautions to ensure that the incident does not reoccur.

Site Restoration

Following a spill event, the site may require restoration by the contractor responsible for the spill to return the site to its original use prior to the incident. Restoration will be approved by the Construction Manager. Restoration may involve replacing contaminated soil with clean fill or routing watercourses away from the contaminated site until it can be cleaned up. Husky Energy will consult with applicable regulatory agencies to determine appropriate site restoration requirements.

Follow-up Regulatory Report

Following the spill incident and response, the HSE Advisor shall be responsible for preparing a written report which shall be sent (as soon as possible and no later than 30 days after the spill) to the:

Government Service Centre
Services NL
5 Mews Place
P.O. Box 8700
A1B 4J6

and

Environment Canada, Emergency Response Coordinator,
P.O. Box 5037
St. John's, NL
AIC 5V3

6.2 Wildlife Encounters

The objective is to minimize interactions on-site personnel may have with wildlife during Project construction and to ensure compliance with applicable acts and regulations.

6.2.1 Environmental Concerns

Encounters with wildlife may result in distress for both the animal and the employee. Serious injury could result to site workers in some instances. Threats to personnel include encounters with bears, any animals with young, moose (when in rut) and rabid animals such as fox, wolf, beavers, etc. Bites from any animals are potentially dangerous. Wildlife encounters have the potential to distress animals to the point of altering feeding and breeding behaviour. Physical injury or death to wildlife could also occur e.g. collision of vessels with marine mammals.

If the animal encountered is a species listed under the SARA or the Newfoundland and Labrador *Endangered Species Act*, the observation will be reported immediately to the CWS and the NLDEC. Section 32 of SARA prohibits killing, capturing and destruction of critical habitat for those species listed on Schedule 1 as extirpated, endangered and threatened. Critical habitat is defined as the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

6.2.2 Contingency Procedures

<u>Encounters with Marine Mammals and Birds Species (at Risk or Not)</u>

The following measures will be implemented by both Contractor and Company personnel in the event that marine mammals are observed in close proximity to Project vessels during construction activities:

(a) No personnel will approach, feed or harass wildlife if encountered.

(b) Take all normal precautions to avoid a collision.

(c) Concentrations of sea ducks, other waterfowl or shorebirds will not be approached.

(d) Only vessels equipped with mufflers will be used.

(e) Food scraps that could attract birds will be collected and properly disposed of.

(f) Husky Energy will comply with the *Migratory Bird Convention Act*, SARA and the NL *Endangered Species Act* and all applicable Regulations.

(g) Marine vessel speed will be restricted to 10 knots to reduce the risk of collision.

(h) The CWS and Wildlife Division's regional Conservation Officer located at the Forest Resources Office at Paddy's Pond will be contacted with regard to wildlife encounters with rare or endangered wildlife species. Guidance as to the appropriate action to take will be given by these authorities.

Terrestrial Wildlife Species (at Risk or Not) Encounter Prevention Measures

The following measures will be implemented by both Contractor and Company personnel to minimize the likelihood of wildlife encounters.

(a) No personnel will approach, feed or harass wildlife if encountered.

(b) Firearms will not be permitted on or near the work site. Hunting by Project employees on site will be forbidden.

(c) All food waste will be properly contained and disposed of on a regular basis at an approved facility.

(d) The CWS and Wildlife Division's regional Conservation Officer located at the Forest Resources Office at Paddy's Pond will be contacted with regard to wildlife encounters with rare or endangered wildlife species. Guidance as to the appropriate action to take will be given by these authorities.

(e) Personnel will be advised of rare or endangered wildlife potentially occurring within the Project area.

(f) No pets will be allowed at the site.

(g) If large wildlife (e.g., moose) are struck with vehicles or equipment, the regional Conservation Officer located at the Forest Resources Office at Paddy's Pond will be notified.

(h) Always yield the territory to the animal.

(i) Be alert to the signs of animal presence (e.g., footprints, droppings, etc.) and report to the Construction Manager. Wildlife encounters pose a risk for stress or injury to both the wildlife and site personnel (i.e., moose-vehicle collisions). Control measures and environmental protection procedures have been put in place to minimize the risk to wildlife and humans.

6.3 Discovery of Historic Resources

There are no known archaeological sites in the project area however the possibility exist that activities such as dredging may uncover historic resources. This contingency plan focuses on the procedures to be implemented in the case of a suspected archaeological or heritage resource discovery.

Environmental Concerns

Heritage and archaeological resources may be disturbed or discovered during construction activity. These features represent a valuable cultural resource, and uncontrolled disturbance could result in loss or damage to these resources and the information represented by them.

Contingency Procedures

Prior to construction, all personnel working on the site will be informed of their responsibility to report any unusual findings, and to leave such findings undisturbed.

Archaeological Discovery

In the event of the discovery of a historic artifact or archaeological site, the following procedures shall apply:

- Work in the immediate area will be suspended and the Construction Manager and HSE Advisor will be notified immediately.
- The HSEQ Manager will contact the PAO.
- The site area will be flagged for protection and avoidance, with an appropriate buffer zone determined in consultation with the PAO.
- An Incident Report Form will be filed with the Project Manager.
- In the event that the PAO determines the find is an archaeological deposit, the Company and its contractors will take direction from the PAO regarding further contacts and required actions.
- The Company will take all reasonable precautions to prevent employees or other persons from removing or damaging any such articles or sites until they have been assessed.
- A qualified archaeologist will conduct an archaeological assessment of the resource and report the resource to the PAO. No work at that particular location will continue until the qualified archaeologist, in consultation with the PAO authorizes renewal of the work.

6.4 Vessel Accidents

Environmental Concerns

There exists the potential that vessels involved during construction activities may run aground, become involved in collisions with structures or other vessels, or sink due to inclement weather or other reason. Negative environmental effects may result if fuel, hazardous materials, or other physical/chemical substances are released to the environment during vessel accidents. The priority concern is for the health and safety of all crew members and passengers.

Contingency Procedures

1. All stationary hazards, such as moored platforms or vessels, will be marked in accordance with CCG regulations.

2. Project related vessels shall be aware of the designated CSZs and use a safe shipping route to its port destination.

3. No Project related vessels shall discharge wastes, bilge water, ballast water, pollutant, or other deleterious substance into Canadian waters. The discharge of garbage (solid galley wastes, food wastes, paper, rags, plastics, glass, metal, bottles, junk or similar refuse) from ships into Canadian waters and waters of the Fishing Zones of Canada is prohibited.

4. Placentia Traffic will issue Notices to Shipping in the area and Notices to Mariners, giving information about all aspects of safety.

5. All crew members will be familiar with emergency procedures for both life-threatening and potentially polluting situations.

6. If a ship is in distress, it is the Captain's duty to do whatever possible to save the crew and passengers and to protect vessel and cargo. The order of priority of action will be for the protection of human life, prevention of pollution of the environment, and prevention of shipping lane impediment.

7. When ships collide, it is the Captain's responsibility to do the utmost to rescue, help and/or assist the other vessel if this can be done without putting own ship, crew or cargo into further danger.

8. The ship's Captain will immediately contact the CCG, Marine Emergencies, 24-hour Report Line for vessels in distress (1-800-565-1633), through which the appropriate agencies will be notified and specific action taken.

6.5 Fire Contingency Plan

Construction related activities could result in fire that could spread to the surrounding area. Alternatively, a forest fire started offsite could spread to the Project area. This contingency plan contains procedures for fire prevention as well as response action plans for non-forest fires (e.g., localized fires, such as equipment) and forest fires.

6.5.1 Environmental Concerns

Fires could result in terrestrial habitat alteration, wetland habitat loss and direct mortality of wildlife. Fire fighting chemicals and any spilled materials could enter the freshwater, wetland and marine environments and adversely affect biota and habitat if allowed to disperse and persist. Fires also have the potential for adverse effects on air quality and could pose risks to human health and safety.

6.5.2 Contingency Procedures

Prevention Measures

Husky Energy and contractors will take all precautionary measures to prevent fire hazards when working at the site. These include but are not limited to the following measures:

- All flammable waste will be disposed of in on a regular basis.
- Smoking will be permitted in designated areas only.
- Husky Energy and its contractors will be trained in fire prevention and response.
- Firefighting equipment, sufficient to suit onsite fire hazards will be maintained in proper operating condition and to the manufacturer's/national Fire Protection Association standards. Husky Energy will ensure that its personnel and contractors are trained in the use of such equipment.

Non-forest Fires Response Action Plan

- Notify nearby personnel.
- On-site personnel will take immediate steps to extinguish the fire using appropriate equipment.
- Notify the Husky Energy Project Manager and the Construction Manager.
- If the fire cannot be contained, contact the Placentia Fire Department.
- In case of related medical emergencies, the Placentia RCMP detachment will be notified immediately.

Forest Fires Response Action Plan

- Fires will be reported immediately.
- Notify the Husky Energy Project Manager and the Construction Manager.

- In case of related medical emergencies, the Placentia RCMP detachment will be notified immediately.

- Contact the Forestry and Agrifoods Agency's Forest Fire Protection Centre in Gander (1 866 709 3473 or 1-709 256-3473)

7.0 PERMITS, APPROVALS AND AUTHORIZATIONS

The following table provides a potential list of permits, licences, approvals, and other forms of authorization required for the undertaking.

Regulatory Agency	Permit and/or Regulatory Approval	Activity Requiring Regulatory Approval
Government of Canada		
Fisheries and Oceans Canada	Approval under Section 36 of the *Fisheries Act*	Waste water discharge to the marine environment
Fisheries and Oceans Canada	Approval under Section 35(2) of the *Fisheries Act*	Dredging activities, nearshore and in tow-out corridors
Environment Canada	Section 35 of the *Migratory Birds Convention Act*	Waste water discharge to the marine environment
Transport Canada	Approval under *Navigable Waters Protection Act*	Mating topsides at the deep-water site Dredging activities, nearshore and in tow-out corridors
Government of Newfoundland and Labrador		
Water Resources Management Division	Alteration to a Body of Water (Schedule A to H). This application form is required as well as the appropriate Schedule application form (see below).	Any activity in or near any body of water including infilling, dredging, pumping out of a waterbody
Water Resources Management Division	Alteration to a Body of Water - Schedule H - Other Alterations	Other works within 15 m of a waterbody
Water Resources Management Division	Certificate of Approval for Site Drainage	Water run-off from the WREP site
Water Resources Management Division	Water Use Authorization	Water withdrawal and/or operation for use during construction
Water Resources Management Division	Certificate of Approval for Water and Sewerage Works	Water and sewage distribution system Operation of a sewage treatment plant
Water Resources Management Division	Non-Domestic Drilled Well Permit	Dewatering wells
Forest Services Branch	Commercial Operating Permit	Construction activities
Government Services Branch	Certificate of Approval for Waste Management System	Waste management activities Rock disposal areas Dredge spoils disposal

Regulatory Agency	Permit and/or Regulatory Approval	Activity Requiring Regulatory Approval
Government Services Branch	National Building Code Form (FC/NBC - Long Form) or Request for Approval of Plans (FC/NBC - Short Form)	Buildings on Site
Government Services Branch	Building Accessibility Exemption	Building on Site
Department of Environment and Conservation	Certificates of Approval for the Construction and/or Operation of various industrial facilities	Facilities with air emissions and/or effluent discharge may be required to obtain a Certificate of Approval for the construction and operation of the facility (e.g., batch plant)
Government Services Branch	Fuel storage system registration – storage and handling of gasoline and associated products	All tanks onsite
Canada-Newfoundland and Labrador Offshore Petroleum Board		
C-NLOPB	Decision Report on the Development Application	Construction of the WHP and operation offshore

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Baseline Hydrogeological Characterization Concrete Gravity Structure Graving Dock Site Argentia, NL

Prepared for

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Final Report

File No. 121412512

Date: April 10, 2013

EXECUTIVE SUMMARY

Acting at the request of Husky Energy (Husky), Stantec Consulting Ltd. (Stantec) carried out a baseline hydrogeological characterization of the proposed Concrete Gravity Structure (CGS) graving dock site in Argentia, Newfoundland and Labrador (NL), herein referred to as the “site”. This hydrogeological characterization was required to gain a better understanding of the hydrogeological conditions at the proposed CGS graving dock site, and in particular to provide information on potential impacts to groundwater quality and quantity in the site area related to the construction and operation of the graving dock facility.

The hydrogeological characterization provided herein is based primarily on information obtained from several previous studies conducted by Stantec and others, including a detailed geotechnical borehole drilling program (Golder, 2012, a & b) and a water well drilling and hydraulic testing program (Stantec, 2013). Relevant geological and hydrogeological information from publically-available mapping and from other consulting and Public Works Government Services Canada (PWGSC) studies completed in the immediate area were also researched, and integrated into this assessment.

Site Description & Project Overview

The proposed CGS graving dock site is located in the northeast portion of the Argentia Northside peninsula. The Northside peninsula is a roughly triangular-shaped low-lying peninsula that is surrounded on all sides by the ocean, and is connected to the mainland by a narrow isthmus at the south end in the area of Sandy Cove. The approximately 20 hectares of land comprising the site is currently owned by the Argentia Management Authority (AMA), and is under lease to Husky for the proposed construction of a graving dock to be used for the construction of a Concrete Gravity Structure for the White Rose Extension Project.

Based on information provided by Husky, the graving dock will measure approximately 153.5m x 153.5 m at the floor, and will be excavated behind a natural coastal berm to a depth of approximately -18mCD. A cut-off wall, approximately 900 mm thick, will be constructed to minimize the ingress of water into the graving dock. The wall is designed with a permeability of 10^{-8} m/s to a depth of -28 mCD at the sea bund side, and will continue landwards approximately half way around the sidewalls and to a depth of -10 mCD.

Conclusions

Based on the findings of the current study, the following conclusions are made with respect to hydrogeological characterization of the CGS graving dock site:

Hydrogeological Properties of CGS Graving Dock Area

Based on a variety of hydraulic testing and statistical analysis techniques, the site area is characterized as an unconfined to leaky, highly stratified unconsolidated aquifer with interbedded silt, clay, fine to coarse-grained sand and gravels in excess of 42 m thick. Based on hydraulic testing of test well PW1, the aquifer has a geometric mean transmissivity of 222.7 m^2/d, a geometric mean coefficient of storage of 3.5E-03 and a geometric mean hydraulic conductivity of 1.8E-4 m/s. The soils exhibit a wide range of K from 4E-11 m/s for clay-silt to 2.1E-1 m/s for clean gravel, with a geometric mean in the order of 6E-4 m/s (slug tests) to 9.6E-6 m/s (sieve analysis).

Water levels range in depth from 1.0 to 9.4 mbgs, and 2.9 to 4.6 mCD. The dominant direction of groundwater flow is southeastward from the vicinity of the main runways to the coastline at an average horizontal hydraulic gradient of 1.2 percent and an average velocity of 0.02 to 0.75 m/day. Small downward vertical hydraulic gradients (<1%) are expected in the vicinity of the Northside runways, and small upward gradients (<1%) are suspected in the vicinity of the CGS graving dock site and near the coastline.

Drawdown Area of Influence of CGS Graving Dock Dewatering

Using the mean transmissivity (222.7 m^2/d) and storage coefficient (4.5E-03) from the hydraulic testing of PW1, the potential drawdown interference is predicted at various distances from the site for a variety of pumping times and pumping rates using the modified Cooper-Jacob non-equilibrium method (Cooper et al, 1946). A 100-day time frame is selected as this is typical of seasonal minimum (extreme dry summer) and maximum (extreme wet spring or fall) recharge conditions. Preliminary calculations of drawdown area of influence suggests 100 day radii of influence (ROI) varying from 400 m at 454 L/min (100 Igpm) to greater than 2,000 m (i.e., the extent of the peninsula) at sustained pumping rates of 2,273 L/min (500 Igpm) or more. Under sustained pumping required to dewater the graving dock to elevation -18 mCD (i.e., minimum of 5,683 L/min), it is estimated that the groundwater table will experience approximately 10 m of drawdown (i.e., approach sea level) in the runway area approximately 600 m northwest of the site, and approximately 5 m of drawdown will occur in the vicinity of the Pond, located approximately 1,300 m northwest of the site.

Groundwater Baseline Chemistry

The groundwater quality is characterized as a clear, very hard (hardness 215 mg/L), slightly alkaline (190 mg/L, mean pH 8.1), calcium bicarbonate water type of moderate dissolved solids (conductance 520 uS/cm, est. TDS 350 mg/L). All analyzed parameters meet applicable environmental groundwater guidelines. With the exception of traces of toluene (5 µg/L), phenanthrene (0.024 µg/L) and petroleum hydrocarbons in several wells, no BTEX, TPH, VOCs, PAHs or PCBs were detected during the pumping test program.

Water Quality Impact Potential from Contaminated Sites

A review of recent monitoring of remediated sites known to occur northeast, northwest and southwest of the site suggests that concentrations of petroleum, PAHs, PCBs, metals, and VOCs continue to decline, and that there does not appear to be any residual major sources of free product in the area. Based on the reported low levels of petroleum hydrocarbons, PAHs, metals, PCBs and VOCs and the general absence of free product in groundwater at the historical contaminated sites, no significant problems with inducing impacted groundwater into the CGS graving dock site are anticipated.

Impacts to Groundwater Users

No groundwater users are known to be present on the Northside Peninsula. It is assumed all activities are serviced by water pipeline from the mainland. No dewatering impacts to groundwater users are therefore anticipated on the Northside Peninsula associated with the CGS graving dock site. Because the Placentia Bay acts as a recharge boundary, no impacts to well users on the Southside are anticipated.

Effects on Surface Waters

With the exception of small wetlands, no surface water bodies are present in proximity to the CGS graving dock site. The closest major surface water body, the Pond, is located 1,200 to 1,500 m northwest of the site. While it is possible that the area of drawdown influence of the CGS graving dock could reach the Pond, the degree of interaction would depend on the duration of pumping, the rate of pumping, and the degree of hydraulic isolation of the Pond for the underlying aquifer (e.g., bottom sediment permeability). No effects are anticipated on surface waters located off the Northside Peninsula.

Groundwater Monitoring Plan

As indicated in the White Rose Extension Project Scoping Document (C-NLOPB, 2012), a monitoring strategy is required during the CGS graving dock dewatering and operation stage. This strategy should build on the baseline monitoring work currently on-going, using similar sampling protocols and QA/QC procedures. A general framework for a groundwater flow and quality monitoring plan for the CGS graving Dock site is provided herein based on results of this baseline hydrogeological site characterization.

The statements made in the executive summary are subject to the same limitations included in the Closure Section 9.0 and are to be read in conjunction with the remainder of this report.

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LIST OF ACRONYMS AND UNITS

Acronym/Unit	Definition
µg/L	microgram per litre
µS/cm	micro Siemens per centimetre
ACOA	Atlantic Canada Opportunities Agency
AMA	Argentia Management Authority
BTEX	Benzene, toluene, ethylbenzene and toluenes
CBR	California Bearing Ratio Test
CCV-DSS	consolidated constant volume direct simple shear test
CD	Chart Datum
CGS	Concrete gravity structure
CIU	consolidated undrained triaxial compression test
cm	centimetres
C-NLOPB	Canada-Newfoundland Offshore Petroleum Board
CoCs	chemicals of concern
ESA	Environmental Site Assessment
HHERA	Human Health and Ecological Risk Assessment
i	horizontal hydraulic gradient
Igpm	imperial gallons per minute
K	hydraulic conductivity
L/min	litres per minute
m	metre
m/day	metres per day
m/s	metres per second
m2	square metre
m2/day	square metres per day
m3	cubic metre
m3/day	cubic metre per day
m3/year	cubic metre per year

masl	metres above sea level
mbgs	metres below ground surface
mbgs	metres below ground surface
mg/L	milligram per litre
mm	millimetre
MOE	Ontario Ministry of the Environment
n	effective porosity
NAVFAC	United States Naval Facility
NB77	Northside Building 77
NBFF	Northside Bulk Fuel Farm
NFSA	Northside Fuel Storage Area
NFSB	Northside Fuel Storage and Buildings
NFTA/ACRP/NSSP	Northside Salvage Yard, Fire Training Area and Road near the Pond
NLFB	Northside Landfill B
NOAS	Northside Old Arena Site
NSRF	Northside Ship Repair Facility
NYDB	Northside Yard Dump and Building 606
OW	observation wells
PAH	Polycyclic aromatic hydrocarbon
PCBs	Polychlorinated biphenyls
PIRI	Partnership in RBCA Implementation
ppt	parts per thousand
PVC	Polyvinyl chloride
PW	pumping well
PWGSC	Public Works and Government Services Canada
RBCA	Risk-based Corrective Action
ROI	Radius of Influence
SVOC	Semi-volatile organic compounds
T	transmissivity
TDS	total dissolved solids
TPH	Total petroleum hydrocarbon
Usgpm	United States gallon per minute
VOC	Volatile organic compound
WREP	White Rose Extension Project

1.0 INTRODUCTION

Acting at the request of Husky Energy (Husky), Stantec Consulting Ltd. (Stantec) carried out a baseline hydrogeological characterization of the proposed Concrete Gravity Structure (CGS) graving dock site in Argentia, Newfoundland and Labrador (NL), herein referred to as the "site" (Drawing No. 121412512-EE-01 in Appendix A). A hydrogeological characterization was required to gain a better understanding of the hydrogeological conditions at the proposed CGS graving dock site, and in particular to provide information on potential impacts to groundwater quality and quantity in the site area related to the construction and operation of the graving dock facility.

This site characterization is based primarily on information obtained from several previous studies conducted by Stantec and others, including a detailed geotechnical borehole drilling program (Golder, 2012, a & b) and a water well drilling and hydraulic testing program (Stantec, 2013). Relevant geological and hydrogeological information from publically-available mapping and from other consulting and Public Works Government Services Canada (PWGSC) studies completed in the immediate area were researched, and integrated into this assessment.

1.1 Site Description & Project Overview

The proposed CGS graving dock site is located in the northeast portion of the Argentia Northside peninsula, as shown on Drawing Nos. 121412512-EE-01 and -EE-02 in Appendix A. The Northside peninsula is a roughly triangular-shaped low-lying peninsula that is surrounded on all sides by the ocean, and is connected to the mainland by a narrow isthmus at the south end in the area of Sandy Cove. The site is bordered to the north, west and south by vacant land and to the east by the waters of Argentia Harbour. Access to the site is via Provincial Highway Route 100, which ends at the Marine Atlantic Ferry Terminal at the south end of the peninsula, followed by a series of paved and gravel roads on the peninsula remaining from historical operations.

The approximately 20 hectares of land comprising the site is currently owned by the Argentia Management Authority (AMA), and is under lease to Husky for the proposed construction of a graving dock to be used for the construction of a Concrete Gravity Structure for the White Rose Extension Project. Based on information provided by Husky, the graving dock will measure approximately 153.5m x 153.5 m at the floor, and will be excavated behind a natural coastal berm to a depth of approximately -18mCD. A cut-off wall, approximately 900 mm thick, will be constructed to minimize the ingress of water into the graving dock. The wall is designed with a permeability of 10^{-8} m/s to a depth of -28 mCD at the sea bund side, and will continue landwards approximately half way around the sidewalls and to a depth of -10 mCD. The graving dock construction site plan is provided in Drawing No. 121412512-EE-03 in Appendix A, and shows the layout of the proposed graving dock facility and associated site infrastructure.

1.2 Background & Historical Contamination

The Northside peninsula was formerly part of a United States Naval Facility (NAVFAC) that was constructed during the Second World War and occupied until 1994. The Northside peninsula was the site of the airport, main dock facilities and main fuel storage for the NAVFAC. The proposed CGS graving dock site overlies the southwest portion of the former Bulk Fuel Tank Farm area, known as the Northside Fuel Storage Area (NFSA) (see Drawing No. 121412512-EE-02 in Appendix A). The southwest portion of NFSA contained barracks and recreational buildings for enlisted personnel, as well as numerous warehouses, aircraft maintenance hangars, and general support and administration buildings. The NAVFAC Argentia property officially closed in October 1994, and the facility was reverted to the Government of Canada. At this time Public Works and Government Services Canada (PWGSC), as custodians for the Crown, assumed ownership and administrative control of the property. In 2001, PWGSC transferred the Government of Canada property in Argentia to the Argentia Management Authority (AMA), a group established in 1995 by the Atlantic Canada Opportunities Agency (ACOA) to redevelop the former base.

Property-wide environmental investigations of the former NAVFAC were carried out under the direction of PWGSC from 1993 to 1995, and included Phase I through Phase IV Environmental Site Assessments (ESAs) and human health and ecological risk assessments (HHERA). These studies identified various contaminated sites on the Argentia Northside Peninsula due to former military operations and waste disposal activities. During the environmental investigations, the contaminated sites were given letter codes (e.g., NFSA) based on the local site names used formerly at the Argentia NAVFAC property. These letter codes were used by PWGSC in naming the monitoring wells, and are referred to in this report. For reference, the contaminated sites within the study area are labeled along with their corresponding letter codes on Drawing No. 121412512-EE-02 in Appendix A (Dillon Consulting Ltd., 2010).

Results of the ESAs and HHRAs carried out by PWGSC from 1993 to 1995 identified eleven (11) Northside sites as “areas of environmental concern” containing unacceptable risks based on observed levels of contaminants (primarily in soils). These included:

- Northside Fuel Storage Area (NFSA);
- Northside Bulk Fuel Farm (NBFF);
- Northside Salvage Yard, Fire Training Area and Road near the Pond (NFTA/ACRP/NSSP);
- Northside Yard Dump and Building 606 (NYDB);
- Northside Landfill B (NLFB);
- Northside Building 77 (NB77);
- Northside Fuel Storage and Buildings (NFSB);
- Northside Old Arena Site (NOAS); and,
- Northside Ship Repair Facility (NSRF).

The principal contaminant types identified in soil at these sites was petroleum hydrocarbons, and to a lesser extent metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). Site remediation involving tank and pipeline removal, excavation, product removal, containment, and capping was undertaken from 1998 to 2010 at these sites. In particular, a large-scale soil remediation program was completed at the NFSA from 2005 to 2007 involving aeration/land-farming of approximately 175,000 m^3 of petroleum hydrocarbon-impacted soil. With respect to groundwater, results of the risk assessments concluded that, with the exception of petroleum hydrocarbons, no other chemicals of concern detected in groundwater at the Argentia sites posed a significant human health or ecological risk based on the specific land use scenario assumed for each site (i.e., residential, commercial/industrial and limited land use).

A long-term groundwater-monitoring program at the Argentia property was initiated by PWGSC in 1997 to monitor changes in groundwater quality associated with various site remediation activities. Details pertaining to long-term groundwater monitoring at the Argentia property are discussed further in Section 4 of this report.

1.3 Study Objectives and Scope

The objective of this report is to characterize the hydrogeology of the CGS graving dock site area. This information is derived from previous studies, and on-going geotechnical and hydrogeological investigations at the site.

1.4 Assessment Limitations

Because work is underway at the site, the information presented herein is limited to site specific and historical data available at the time of writing. It is anticipated that a second aquifer testing program currently underway at a test well, PW2, located in the seaward portion of the site will augment the data obtained from hydraulic testing of test well PW1 completed in January – February, 2013, and reported herein.

1.5 Report Structure

The report is laid out in 5 sections. Section 1 describes the Project and study objectives, and provides various background information about the site. Section 2 describes the methods and procedures utilized in the collection and interpretation of relevant information. Section 3 provides a baseline interpretation of the hydrogeological conditions in the vicinity of the CGS graving dock site. Section 4 discusses environmental issues associated with the Project. Section 5 summarizes relevant conclusions, and Section 6 provides general recommendations for the collection of site-specific hydrogeological information going forward.

2.0 FIELD PROGRAMS

The following sections summarize the work completed in 2011 and 2012 at the CGS graving dock site. Further information and a detailed interpretation of hydrogeological conditions are provided in Stantec (2013).

2.1 Previous Work

In June 2011, Stantec was retained by Husky to provide geotechnical and environmental engineering services related to the development of a Concrete Gravity Structure graving dock at the former NAVFAC Base in Argentia. The purpose of the work was to review the geotechnical and environmental conditions (i.e., environmental contamination) at two sites in Argentia identified by Husky, and to provide an interpretation regarding the conditions for each site in aid of final site selection. Stage I of this work involved a desktop review of available data for the two proposed sites, including Site A, located in the general vicinity of the current site on the Northside Peninsula, and Site B located on the southside of Argentia. This work included an overview of previous geotechnical and environmental investigations, identification of data gaps in the current knowledge of subsurface conditions, and recommendations for additional field investigation to further characterize the geotechnical and environmental conditions at the two proposed sites. The Stage I work is detailed in Stantec Report No. 121413435 "*GBS Site Selection Study Stage I – Desktop Review, Argentia, NL*" dated October 11, 2011. Stage 2 of this work involved a geotechnical and environmental site investigation comprised of borehole drilling, soil sampling, monitor well installation and water quality sampling, and was carried out from November 2011 to January 2012. The results of the Stage 2 investigation are detailed in Stantec Report No. 121613435 "*Geotechnical and Environmental Services Stage 2 - Geotechnical / Environmental Site Investigation, Proposed GBS Construction Site, Argentia, NL*" dated March 23, 2012, and additional environmental investigation to delineate the extent of petroleum hydrocarbon impacted soil identified during the Stage 2 geotechnical and environmental investigation in March 2012 is detailed in Stantec report No. 121613435 "*Phase II Environmental Site Assessment, Site A, Proposed GBS Construction Site Argentia, NL*" dated April 5, 2012.

In September 2012, a test pit excavation and soil sampling program was carried out at a new proposed location for the CGS graving dock site to assess environmental conditions at the site to determine what, if any, environmental impacts exist. The current location for the CGS graving dock site is located immediately south of former Site A. The results of the 2012 test pit program are detailed in Stantec Draft Report No. 121613435 "*Test Pit Program, Revised Concrete Gravity Structure Casting Basin Site Argentia, NL*" dated November 1, 2012.

The September 2012 test pit program consisted of excavation of ten (10) test pits with related soil sampling at locations distributed to provide full coverage across the site. The test pits were excavated to the groundwater table and terminated at depths ranging from between 3.5 m below ground surface (mbgs) to 6.0 mbgs. Soil samples were collected from each test pit and analyzed for petroleum hydrocarbon indicator parameters, including benzene, toluene, ethylbenzene, and xylenes (BTEX), and total petroleum hydrocarbons (TPH), as well as polychlorinated biphenols (PCBs), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), metals, and dioxins/furans. Results of the investigation indicated no free phase petroleum hydrocarbon product or other field evidence of impacts in any of the test pits, and concentrations of petroleum hydrocarbons, PCBs, VOCs, metals, dioxins/furans and PAHs were either non-detect or detected at levels below the applicable assessment criteria in the soil samples analyzed.

In the Fall 2012, Husky Energy commissioned geotechnical, and hydrogeological site investigations in support of design and development of the graving dock site (Golder, 2012 a & b, and Stantec, 2013). These investigations are summarized below.

2.2 Geotechnical Borehole Drilling and Testing

From October 9 to November 24, 2012, Golder Associates oversaw the drilling of nine (9) geotechnical boreholes (i.e., BHA6 to BHA10, and BHA12 to BHA15) completed as monitor wells. Details regarding the drilling of these geotechnical boreholes are provided in Golder (2012a), along with borehole logs presenting subsurface conditions encountered at the borehole locations, as well as specific monitor well construction details. Table C.1 in Appendix C summarizes the borehole and monitor well construction details. The locations of geotechnical boreholes completed as part of Golder’s 2012 geotechnical program are shown on Drawing No. 121412512-EE-03 in Appendix A. The geotechnical boreholes were advanced using sonic drilling techniques, and with the exception of BHA6 (26 m deep), were advanced to an average depth of 41.2 m below ground surface (mbgs). The boreholes were 203 mm (8”) in diameter, and each was instrumented with a 51 mm diameter PVC monitoring well with No. 10 slot casing screened over the bottom 3.0 to 6.1 m.

A program of geotechnical laboratory testing of numerous sonic core (bag samples) and 5 Shelby tube samples was performed by Golders Associates Ltd. (Golders, 2013) using the Golders, Gemtec, TerrAtlantic and Maxxam laboratories. Geotechnical testing included: 52 Atterberg limits, 51 water contents, 11 bulk and dry densities, 110 grain size analyses (including 51 hydrometer tests), 9 particle size tests on 9 subsamples taken from the Shelby tube samples. Chemical testing included: 3 sulphate ion concentration tests, 3 pH tests. Mechanical behavior and strength testing included: 13 standard proctor density tests, 7 California bearing ratio (CBR) tests 6 consolidated undrained triaxial compression (CIU) tests and 6 consolidated constant volume direct simple shear (CCV-DSS) tests. The results were used to characterize the geotechnical properties of the materials at the site.

2.3 Observation Well Construction

A total of nine observation wells (OW) were drilled and completed as monitor wells by Golder Associates between November 24 and December 21, 2012 for use during the hydrogeological investigation. Details regarding the drilling of these observation wells are provided in Golder (2012a), along with borehole logs presenting subsurface conditions encountered at the borehole locations, as well as specific monitor well construction details. Table C.1 in Appendix C summarizes the borehole and monitor well construction details. The locations of the observation wells completed as part of Golder’s 2012 geotechnical program are shown on

Drawing No. 121412512-EE-03 in Appendix A. Two well depths were installed, including six (6) wells (OW1, 3, 4, 5, 9 and 10) to an average depth of 21.3 m to monitor conditions near the base of the proposed excavation, and three (3) wells (OW6, 7 and 8) to an average depth of 41.1 m to monitor conditions below the CGS graving dock excavation and supplement the geotechnical borehole wells. With the exception of OW6 (6.1 m screen), each well was constructed with 51 mm diameter, fully-penetrating, No. 10 Slot PVC screens ranging in depth from 18.2 m to 22.9 m, set in silica sand packs in the 200 mm diameter boreholes.

2.4 Test Well PW1 Well Construction

The test well (PW1) was constructed between January 3 and 16, 2013 by P. Sullivan and Sons Ltd. of Paradise, NL. Test well PW1 is located towards the center of the graving dock approximately 60 m southeast of the northwest limit of the proposed excavation (Drawing No. 121412512-EE-03 in Appendix A). The borehole logs for nearby boreholes OW1, OW3, OW4 and OW5 were used to select a suitable screen for test well PW1. Based on the alternating fine to coarse grained strata, a screen slot size of No. 40 (0.040 inch) was selected to minimize the degree of borehole development needed to render the screen hydraulically efficient in alternating strata.

The construction details for well PW1 including depths and stratigraphic information recorded during drilling are provided in the Borehole Record in Appendix B. The borehole was drilled using a direct rotary drilling method with combined Symmetrix casing advancement systems to advance a 300 mm diameter steel well casing to a total depth of 24.3 mbgs. The aquifer materials within the casing were expelled as the casing was advanced, which provided a good check on expected stratigraphy. Once the casing had been advanced to 24.3 m depth, water and air were circulated to ensure that all residual material was removed.

A 200 mm diameter well screen assembly was welded together on surface and lowered down the borehole inside the 300 mm diameter casing. The well assembly included a 6.5 m long section of 200 mm diameter Johnson wire-wrapped stainless steel well screen with No. 40 slot (0.040 inch openings) set from 1.6 m to 19.8 m depth. Based on the finer grained material encountered in the lower section of the borehole, a 4.5 m length of solid well casing was set from 19.8 m to 24.3 m depth to limit the well screen to the coarser grain material. Once the well screen assembly was lowered in place, a filter pack comprised of No. 2 silica sand was installed in the annular space between the outside 300 mm casing and the 200 mm diameter well screen assembly in approximately 6 m sections. Following the installation of each filter pack section, the outside casing was retracted approximately 5 m to expose the filter pack to the natural sand material and allow the filter pack to settle. The upper 200 mm casing was grouted from the surface to approximately 1.2 mbgs.

The well screen was developed over a period of approximately 34 hours using a combination of surging and air lift pumping techniques.

2.5 Baseline Tidal Monitoring

On December 19, 2012, Stantec initiated a baseline tidal influence monitoring program at the site. This program was carried out to evaluate whether the groundwater system at the site was tidally influenced, and to determine preliminary estimates of the tidal response parameters for each affected well for use in detrending the tidal influence on hydraulic response data collected during subsequent aquifer testing programs.

Water levels were monitored using HOBO U20-001-02 water level loggers (Onset, Cape Cod, MA) with initial reference measurements collected using a Solinst Model 101 Water Level Meter. A total of ten (10) loggers were deployed, including eight (8) loggers in observation wells (i.e., OW1, OW8, OW9, OW10, BHA1, BHA7, BHA8 and BHA14) to record water levels and one (1) logger in observation well OW7 to record atmospheric pressure. Loggers were initially set to collect measurements at 30 min intervals. In addition, tidal water level data was obtained through the Canadian Hydrographic Service, Fisheries and Oceans Canada, Atlantic Tidal Water Level Network, which operates a tide gauge in Argentia, NL. On January 7, 2013, one (1) additional logger was installed in observation well BHA10.

Loggers were downloaded regularly throughout the water level monitoring program and water levels were verified at the time of downloading by collecting manual measurements using a water level meter.

Based on results, tidal influences were observed on groundwater levels in the majority of wells monitored across the site, with the exception of OW1, which is suspected to be damaged/blocked. In the wells where tidal effects were identified, groundwater levels fluctuated in an oscillatory pattern with the tides at amplitudes ranging from approximately 2 cm in well OW9 (i.e., approximately 1% tidal efficiency) up to 30 cm in borehole BHA8 (i.e., 15% tidal efficiency).

The tidal influence data collected from OW8, OW9, OW10, BHA7, and BHA8 during the baseline monitoring program, as well as subsequent baseline tidal data collected from PW1, OW1, OW3, OW4, OW5, and BHA10 was used in conjunction with a detrending program developed by the U.S. Geological Survey (Halford, 2006) to correct the time-drawdown data collected during aquifer testing of well PW1.

2.6 Water Level Monitoring

A continuous record of water levels was collected using data loggers from ten (10) monitor well locations at the site between December 19, 2012 and several days after completion of the PW1 pumping test. The background levels were collected at a 30 minute interval; the pumping test data were collected at a one minute interval.

2.7 Grain Size Analysis

Numerous soil samples were collected throughout the CGS graving dock site during Golder's 2012 geotechnical program. The distribution of grain size was used by Stantec to infer the order of magnitude hydraulic conductivity of the unconsolidated material at the site. A summary of hydraulic conductivity (K) values derived from the grain size analysis is provided on Table C.4 in Appendix C. Based on 71 grain size analysis, a wide range of hydraulic conductivity is indicated for the saturated sediments at this site, ranging from 4.0E-11 m/s for clay dominated materials to 2.1E-01 m/s for clean gravel, with a geometric mean K of 9.6E-6 m/s, median 2.9E-05 cm/s. The majority of the values (19) fall between K = 1E-04 m/s and 1E-03 m/s.

2.8 Slug Test Analysis

Estimates of hydraulic conductivity were determined based on analysis of slug tests (rising/falling head) completed as part of Golder's 2012 geotechnical program. An analysis of a total of 16 rising head and falling head slug tests was carried out using a variety of methods applicable for confined/unconfined aquifers, including the Bouwer-Rice and KGS (Kanzas Geological Survey model, Hyder, et. A., 1994) methods with the aid of the computer program AQTESOLV® Version 4.50.002 (HydroSOLVE Inc., Reston, VA). Table C.5 in Appendix C provides a summary of hydraulic conductivity (K) or radial (horizontal) hydraulic conductivity (K_r) values based on analysis of slug test. A wide range of hydraulic conductivity is indicated for the saturated soils at this site, ranging from 8.1E-08 m/s (OW10) to 1.8E-4 m/s (BHA13 in gravelly sand), with a geometric mean K of 5.8E-6 m/s.

2.9 Aquifer Testing

A step drawdown test and two short term tests at higher pumping rates (i.e., Pump Test A at 204 minute duration and Pump Test B at 60 minute duration) were performed on PW1 between January 18, 2012 and February 8, 2013. Based on this testing, a 58.2 hour constant rate pumping test was performed on PW1 at a pumping rate of 454 L/min (120 USgpm) January 17 and February 8, 2013. The goal was to implement a 96 hour test, but the pump failed after 58.2 hours. The testing was performed by P. Sullivan and Sons Ltd. under the direction of Stantec. The pumping test details are described in Stantec, 2013.

Water level measurements were monitored in the pumping well and ten (10) adjacent observation wells (OW1, OW3, OW4, OW5, OW8, OW9, OW10, BHA7, BHA8 and BHA10) located 16 m to 168 m from the pumping well. Recovery measurements were recorded in all wells following cessation of pumping for up to 4.5 days using data loggers.

2.9.1 Step Test

A step drawdown pumping test was completed in test well PW1 on January 18, 2013 using a Goulds Pumps 18GS30 68 L/min (18 USgpm) submersible pump. Testing involved pumping the well at incrementally higher pumping rates of 42 L/min (11.1 USgpm) to 163 L/min (43.1 USgpm) over four (4) 60 minute steps. Subsequent short term tests were performed with larger pumps at rates of 404 L/min (107 USgpm) for 204 min duration (i.e., Pump Test A), and 530 L/min (140 USgpm) for 60 minute duration (i.e., Pump Test B). Table C.2 in Appendix C summarizes the step drawdown pumping test results. The 60 minute pumping period responses for the short term tests (i.e., Pump Test A & B), and the 58 hour constant rate test are also included, for comparison. Plots of drawdown versus time for the step drawdown test, and short term Pump Test A and Pump Test B are shown in Figures A.1 to A.3 in Appendix A, respectively.

2.9.2 Constant Rate Pumping Test

A 58.2 hour constant rate pumping test was carried out in well PW1 between February 6, 2013 (12:05 pm) and February 8, 2013 (10:20 pm) at a rate of 454 L/min (120 USgpm). Water level measurements were recorded at pre-determined time intervals in the pumping well and ten (10) adjacent observation wells (OW1, OW3, OW4, OW5, OW8, OW9, OW10, BHA7, BHA8 and BHA10) located 16 m to 168 m from the pumping well. Following cessation of pumping at 58.2 hours due to a generator malfunction, recovery measurements were recorded in all wells for up to 4.5 days using data loggers.

The constant rate pumping test data was analyzed using a variety of methods applicable for confined/unconfined aquifers, including the Cooper-Jacob, Theis, and Residual Recovery (Theis and Jacob) methods, with the aid of the computer program AQTESOLV® Version 4.50.002 (HydroSOLVE Inc., Reston, VA). Table C.3 in Appendix C provides a summary of transmissivity (T) values based on analysis of the 58.2 hour constant rate pumping test data from PW1. Estimates of T based on analysis of time-drawdown data collected during the short-term constant rate pump test Pump Test A and Pump Test B are also provided.

2.10 Groundwater Quality Sampling

Water quality monitoring included field measurements of temperature, conductivity and salinity during the step drawdown and constant rate pumping tests to detect any changes in water quality indicative of seawater intrusion. Measurements were made from samples of well discharge using a YSI Professional-Plus handheld multi-parameter meter.

In addition, groundwater chemistry samples were collected from test well PW1 on February 9, 2013 following cessation of pumping, and baseline water samples were collected from observation wells OW1, OW8 and OW10 on December 19, 2012 during deployment of the data loggers. Prior to groundwater sampling, each well was purged by removing a minimum of three well volumes of water. The samples were collected into clean plastic bottles and were delivered to the Maxxam Analytics Inc. laboratory in Bedford, NS for chemical analysis. Groundwater samples were analyzed for general chemistry, as well as various chemicals of concern (COCs) detected in groundwater during historical groundwater monitoring in the site area, including petroleum hydrocarbons, dissolved metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs). In addition, previous results of groundwater sampling from former monitor well BH-A1 are also used herein to characterize baseline groundwater conditions at the site.

3.0 HYDROGEOLOGICAL CHARACTERIZATION

3.1 Climate

The Argentia area is located within the Maritime Barrens ecoregion which extends from the east to the west coast of Newfoundland along the south-central portion of the Island. This ecoregion has the coldest summers of the province, with frequent fog, strong winds and relatively mild winters. July and August are traditionally the warmest months, and January and February the coldest. Based on recent Canadian Climate Data for Argentia from 2004 to 2006, the mean annual precipitation is 1,134 mm (Environment Canada, 2012).

3.2 Topography and Drainage

Based on a review of topographic maps, the site is located on a low-lying (Northside) peninsula surrounded by Argentia Harbour to the east and Placentia Bay to the north and west. This physiographic region is characterized by very low relief and elevations ranging from 16 masl in the vicinity of the main runway to sea level, with a gentle slope from southwest to northeast. Elevations in the vicinity of the CGS graving dock site range from 4.27 mCD at BHA14 near the coastline south of the site to 11.7 mCD at OW1 in the northwestern portion of the site (Drawing No. 121412512-EE-03 in Appendix A). Note the elevation datum used during the current project is Chart Datum (CD), which based on information provided by Husky, is approximately -1.373 mean sea level. Existing regional elevation data cited in this report from areas outside the CGS graving dock site are referenced in m above sea level. With respect to the Northside peninsula, the highest elevation is in the vicinity of impacted area NBFF (24 masl), declining towards sea level to the north, east and south.

Most of the peninsula is vegetated with grasses and low shrub. The former runways are paved with asphalt and/or concrete. Large areas of excavation and fill are present due to remediation work on contaminated sites (e.g., NBFF and the NFSA).

3.3 Overburden Geology

The Northside peninsula is characterized as an undulating, landform associated with eroded remnants of a raised marine terrace (Catto & Taylor, 1998). Peat deposits reportedly covered the area prior to development; and peat remains have been identified in low lying depressions along the coastline and near site NLFB during previous intrusive investigations for others by Stantec (as Jacques Whitford Environment Ltd.). Based on a review of surficial geology maps and borehole logs, as well as stratigraphic data obtained during the drilling of well PW1, the overburden material in the site area generally consists of sand and gravel glaciofluvial/marine deposits.

3.3.1 Thickness

Overburden thickness in the site area is expected to exceed 40 m. Drilling during the current program did not encounter bedrock to depths of 41.2 m.

3.3.2 Stratigraphy

The stratigraphy in the site area is very complex, consisting of alternating layers of clay, silty clay, fine to coarse-grained sand, and gravel, with varying percentages of cobbles and boulders. Grain-size analysis (sieve and hydrometer) conducted by Golder (2012b) on select samples of overburden material collected from the geotechnical boreholes indicate that the sand and gravel deposits at the site are typically well-graded with a wide span in grain sizes and have an appreciable fines content (i.e., often greater than 10% silt/clay).

3.3.3 Hydraulic Properties

The hydraulic conductivity of the overburden materials at the site have been assessed using a variety of methods, including statistical evaluation of grain size and hydrometer tests data, rising and falling head slug tests, and constant rate pumping tests using up to 10 observation wells.

Table 3.1 summarizes the range of K values determined from the various methods. More detailed summary tables for grain size, slug test and pumping test K are included in Tables in Appendix C. On a small scale (0.3 to 1.0 m radius), the slug testing and grain size analysis suggests a geometric mean K in the order of 5.8E-06 to 9.6E-06 m/s. The wide range of grain size estimates reflects the type of material (4E-11 m/s for a clay-silt to 2.0E-01 for sandy gravel).

On a larger scale (15 to 168 m radius), results of constant rate pumping tests suggest an aquifer transmissivity in the order of 222 m^2/day, a K in the order of 1.8E-04 m/s, and a coefficient of storage of 4.5E-03. The higher K range in the pumping tests reflects a larger representative volume of aquifer where highly permeable coarse sand and gravel zones can dominate the drawdown response.

Table 3.1 Summary of Hydraulic Conductivity Testing

Source	Range (m/s)	Geomean (m/s)
Sieve Analysis	4.0E-11 to 2.1E-01	9.6E-06
Slug Tests	8.1E-08 to 1.8E-04	5.8E-06
Pumping Tests[1]	1.0E-04 to 3.2E-04	1.8E-04 (PW1 = 1.2E-04)

1 – Divide observation well T by saturated screen thickness.

3.4 Bedrock Geology

The bedrock geology underlying and surrounding the site is reportedly comprised of Pre-Cambrian aged, wavy bedded, gray to green tuffaceous siltstone and arkose (Big Head Formation) belonging to the Musgravetown Group (King, 1988). Bedrock was not encountered in any of the boreholes or test wells in this or historical studies in the Northside area. Based on available geological information, there does not appear to be any significant geological structural features (i.e., faults, folds etc.) in the area immediately surrounding the site.

3.5 Groundwater Flow Conditions

The Northside Peninsula has been the subject of extensive subsurface investigation for over the past 15 years, with over 100 boreholes and groundwater monitoring wells completed at various contaminated sites on the peninsula (Dillon, 2012). In addition, Stantec (as Newfoundland Geosciences Limited (NGL) and Jacques Whitford Limited (JWL)) has carried out several intensive hydrogeological investigations in the Northside area for a variety of clients over the past 20 years, including development of two steady-state numerical groundwater models (NGL 1997, NGL 2003). The following general description of hydrogeological conditions in the Northside area and the CGS graving dock site are derived from this past experience and the current drilling and hydraulic testing programs.

3.5.1 Water Table Depth

A review of monitoring well information both on and off of the site provides a reliable indication of groundwater levels in the area. The groundwater table at the site ranges from 1.0 mbgs at BHA14 to 9.4 mbgs at OW4, averaging 5.5 m across the site (Table C.1 in Appendix C), with elevations ranging from 2.8 to 4.9 mCD. The water level depth is greatest on the up-gradient northeast edge of the graving dock footprint (mean 8.8 m), and shallowest at the southern seaward edge (mean 1.3 m), consistent with the inferred southeasterly groundwater flow direction.

Groundwater elevations increase in a northwesterly direction from the site towards the abandoned runway area which defines the assumed watershed divide on the peninsula. Groundwater elevation in this area is estimated to be approximately 10 m asl (i.e., ~ 11.373mCD).

Annual water table fluctuations are generally small (10 to 20 cm) based on historical monitoring.

3.5.2 Groundwater Flow Directions

Hydrogeologically, the Northside Peninsula is considered to be essentially an oceanic island that is hydraulically isolated from the mainland (e.g., Southside) by saline intrusion. The aquifer is described as an unconfined to leaky freshwater aquifer, the lateral and vertical extent of which is controlled by the surrounding ocean boundary of Placentia Bay. Groundwater recharge is expected to occur throughout the unconfined aquifer, and to move radially from the inferred watershed in the abandoned runway area towards the coastlines. Saline water is expected to occur at depth below this freshwater zone. The thickness of the freshwater “lens” is estimated to be in the order of 120 m below central portion of the peninsula, thinning towards the shorelines.

The dominant direction of groundwater flow at the site is assumed to follow topography, which is towards the southeast and Argentia Harbour. It is expected that the shallow groundwater system in the area will be largely controlled by surface runoff and local recharge, while at moderate depths the flow system may be influenced by seawater intrusion.

Based on Stantec's previous experience in the Northside area, rainwater recharging the peninsula area is expected to recharge vertically downward to the water table, and then flow radially from inferred recharge in the vicinity of the former runways towards discharge points along the coastlines, local wetlands and surface water features.

3.5.3 Horizontal Hydraulic Gradient

Assuming a mean groundwater elevation of 10 m asl in the vicinity of the runways, and essentially 0 m at the seacoast, the horizontal hydraulic gradient across the site is estimated to be in the order of 10 m / 825 m = 0.012 (1.2%).

3.5.4 Vertical Hydraulic Gradient

Historical monitoring in the Northside area suggests a downward vertical hydraulic gradient of 0.003 to 0.008 (0.3 to 0.8%) at monitor well pairs in the vicinity of the runways; upward vertical hydraulic gradients are anticipated near the shore line.

While no monitor well nests are present at the site, a comparison of shallow well OW10 with deep well BHA7 at similar topographic elevation (9.45 mCD and 9.48 mCD) suggests a small upward vertical hydraulic gradient of 0.003 from the deep zone (20 to 40 m depth) to the shallow zone (1.5 to 13.7 m depth), which is consistent with expected groundwater flow patterns. Stronger upward vertical gradients would be expected along the coastline.

3.5.5 Groundwater Velocity Estimates

Groundwater velocity is generally estimated using the Darcy approach (v = Ki/n, where "v" is average linear groundwater velocity, K is hydraulic conductivity, "i" is horizontal hydraulic gradient and "n" is effective porosity. Using a geometric mean K of 5.8E-06 to 1.8E-04 m/s (Table 3.1), a horizontal hydraulic gradient of 0.012 and an effective porosity of 0.25 for the saturated unconsolidated materials, the pre-construction (background) groundwater flow velocity across the site is estimated to be in the order of 0.02 m/day to 0.75 m/day.

3.5.6 Tidal Effect on Groundwater Levels

Tidal monitoring was carried out at the site between December 14, 2012 and January 3, 2013. Historical groundwater level monitoring on the Northside area suggested that tidal influences were restricted to 50 to 100 m from the shoreline. During the current testing, tidal responses ranged from approximately 2 cm in well OW9, a shallow well farthest from the coastline (approximately 1% tidal efficiency) to 30 cm in borehole BHA8, a deep well at a lower elevation (15% tidal efficiency). An average tidal efficiency of 3.5 % was noted for the site (Stantec 2013).

3.6 Groundwater Chemistry

Six manual measurements of temperature, conductivity and salinity during the PW1 pumping test indicted a water temperature range of 5.5 °C to 9.13 °C; relatively consistent conductivity declining with time of pumping from 463 μS/cm to 429 μS/cm, and low salinity (average 0.33 parts per thousand (ppt), indicative of fresh water quality (Table D.1 in Appendix D).

A total of four (4) water samples were collected from monitoring wells during the current field program. Tables D.2 and D.3, Appendix D summarize the results of general chemistry and metals respectively. Water samples from PW1, OW1 and BHA1 are considered to be representative of the local groundwater chemistry conditions in the vicinity of the site; while the general chemistry of the remaining wells (i.e., OW8 and OW10) are considered to be influenced by drilling with salt water. PW1 is a post pumping sample, collected to evaluate potential changes to groundwater chemistry at the site resulting from pumping. The data for BH A1 is from the previous Stantec 2012 program but is included to characterize groundwater quality at the site, since it is located within the footprint of the graving dock.

Based on groundwater chemistry from PW1, which should exhibit the least bias from saline drilling water (after 58 hours of pumping), the groundwater is generally characterized as a clear, very hard (hardness 215 mg/L), slightly alkaline (190 mg/L, mean pH 8.1), calcium bicarbonate water type of moderate dissolved solids (conductance 520 uS/cm, est. total dissolved solids (TDS) 350 mg/L). Since there are no applicable NL provincial environmental guidelines for general chemistry and metals in groundwater, results are compared to the Ontario Ministry of the Environment (MOE) Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act*: Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for Industrial/Commercial Property Use, April 2011 (MOE, 2011). All general chemistry and metals parameters in the five (5) groundwater samples collected from the site meet MOE guidelines, where such criteria exist.

With the exception of traces (3 to 5 μg/L) of toluene in OW1 and PW1, no BTEX or total petroleum hydrocarbon was detected (Table D4 in Appendix D). Low level TPH in the C10 to C18 range was detected at OW8 and OW10 (i.e., 0.065 mg/L and 0.071 mg/L, respectively); however, no resemblance to petroleum hydrocarbons was noted. All parameters met respective Atlantic PIRI Tier I guidelines for petroleum hydrocarbon impacts in groundwater on a commercial/industrial site.

With the exception of toluene, no VOC compounds were detected (Table D.5, Appendix D). With the exception of a trace (0.024 μg/L) of phenanthrene at OW10 that is well below the 580 μg/L OMOE Guideline, no SVOCs were detected in PW1 (Table D.6, Appendix D). No PCBS were detected in any of the wells (Table D.7, Appendix D).

The general chemistry and field monitoring during the PW1 pumping test indicates no evidence of saline intrusion during the 58.4 hour pumping test period.

3.7 Groundwater Recharge & Discharge

Groundwater recharged by precipitation is expected to recharge freely into the unconfined sand and gravel aquifer over the entire peninsula, except in areas covered by runway, tarmac or buildings, which would promote direct runoff to the sea (assumed to be 20% of the land mass). Based on numerical modeling previously completed in the region, a preliminary estimate of groundwater recharge (baseflow) discharging to the marine environment is about 640 m^3/day (233,600 m^3/year), which suggests a groundwater recharge rate of 5% based on 1,134 mm/year and the estimated total 400 hectare area of the Northside Peninsula (i.e., 4,536,000 m^3/yr).

Dewatering activities during construction and operation of the CGS graving dock site is expected to divert a considerable percentage of the natural discharge from the northeast area.

4.0 POTENTIAL ENVIRONMENTAL ISSUES

4.1 Saline Intrusion

While the sea water boundary is located only 45 m from the southern edge of the graving dock site (Drawing Nos. 121412512-EE-02 and 121412512-EE-03 in Appendix A), monitoring during the 58 hours of pumping at 120 USgpm indicated little evidence of saline intrusion. A review of the water levels during the 58.2 hours of pumping indicates a maximum drawdown to -1.94 mCD at PW1 (or -3.31 masl); while all the observation wells were generally at or above mean sea level (i.e., 1.2 mCD (-0.17 masl) to 4.5 mCD (3.13 masl)). The monitoring and post pumping chemistry are consistent with fresh groundwater.

While no saline intrusion occurred at the 454 L/min pumping rate, sustained pumping at much higher rates needed to dewater the graving dock to an average -18mCD may result in some degree of saline intrusion proportional to the ratio of fresh water capture and sea water capture.

4.1.1 Estimated Distance Drawdown & Radius of Influence

Using the mean transmissivity (222.7 m^2/d) and storage coefficient (4.5E-03) from the hydraulic testing of PW1, the potential drawdown interference can be predicted at various distances from the site for a variety of pumping times and pumping rates using the modified Cooper-Jacob non-equilibrium method (Cooper et al, 1946). Table C.6 (Appendix C) summarizes predicted 100 day distance drawdown for one or more wells pumping at rates between 454.6 L/min (100 Igpm) and 9,092 L/min (2,000 Igpm) (multiple wells). A 100-day time frame is selected as this is typical of seasonal minimum (extreme dry summer) and maximum (extreme wet spring or fall) recharge conditions. Drawdown at distances up to 2,000 m from the center of the CGS graving dock site is predicted. It should be noted that the theoretical estimates of distance-drawdown provided herein assume a simplified conceptual groundwater flow model throughout the Northside peninsula, with consistent aquifer hydraulic properties similar to that identified in PW1, and should be regarded as first-order estimates only. It is our understanding that detailed analysis of dewatering design and pumping requirements will be done by others.

Using the observed groundwater elevations (Table C.1, Appendix C), and assuming a graving dock bottom elevation of -18 mCD, the required drawdown will range from 20.9 to 22.0 m, mean 21.3 m throughout the CGS graving dock site area. Theoretical pumping rates that can achieve this degree of drawdown are shown in bold-hatched type in Table C.6 (Appendix C). It is also assumed that the dewatering pumps would be set at least 40 m below grade, resulting in available drawdowns of 31.0 to 40.0 m, mean 34.5 m. The bold-shaded type in Table C.6 (Appendix C) indicate pumping rates that could reach the pump intake within 100 days.

A number of observations can be made using this simple approach. An order of magnitude pumping requirement of 5,683 to 6,819 L/min (i.e., 1,250 to 1,500 Igpm) is expected to be needed to dewater the graving dock excavation, likely accomplished from multiple screened wells. An initial inference of area of pumping influence of 450 to 500 m was indicated by PW1 pumping at 454 L/min for 2.5 days. Assuming a 1.0 m allowable drawdown in receptor wells, theoretical estimates provided in Table C.6 (Appendix C) suggest 100 day radii of influence (ROI) varying from 400 m at 454 L/min (100 Igpm) to greater than 2,000 m (i.e., the extent of the peninsula) at sustained pumping rates of 2,273 L/min (500 Igpm) or more. Under sustained pumping required to dewater the graving dock to elevation -18 mCD (i.e., minimum of 5,683 L/min), it is estimated that the groundwater table will experience approximately 10 m of drawdown (i.e., approach sea level) in the runway area approximately 600 m northwest of the site, and approximately 5 m of drawdown will occur in the vicinity of the Pond, located approximately 1,300 m northwest of the site. The locations of the predicted 5 m and 10 m drawdown ROI are shown on Drawing No. 121412512-EE-02 in Appendix A).

4.2 Interference with Existing Wells

No residential, commercial or industrial water supply wells are known to be present within the inferred capture areas of the CGS graving dock site. A total of 29 environmental monitor wells distributed among five (5) historical impacted sites (i.e., NBFF, NFSA, NFSB, NLFB, and NOAS as shown on Drawing No. 121412512-EE-02 in Appendix A) are currently included within PWGSC's long term groundwater monitoring network. A number of these monitor wells, particularly the 14 monitor wells at the NSFA, NFSB, and NOAS are located within the predicted 10 m drawdown ROI of the site, and may experience a reduction in water levels or possibly dewatering depending on their construction and screened depth. Since Placentia Bay will act as a recharge boundary, no effects of dewatering activities at the CGS graving dock site are anticipated to occur on the Southside.

4.3 Groundwater-Surface Water Interaction

No significant streams or wetlands are identified within the inferred capture areas of the site. The natural watershed divide (currently in the vicinity of the northwest runway) is expected to shift north and west due to sustained dewatering activities, possibly towards the Pond. The Pond is located 1200 to 1500 m northwest of the site. While preliminary distance drawdown predictions indicate that this area could be affected (3 to 5 m of drawdown), the actual degree of interaction will depend on the permeability of the bottom sediments, and surface drainage conditions. Further work would be required to further assess this.

4.3.1 Conditions below the CGS Graving Dock Excavation

The proposed graving dock will be excavated behind a natural coastal berm to a depth of approximately -18 mCD. A cut-off wall, approximately 900 mm thick, will be constructed to minimize the ingress of water into the graving dock. The wall is designed with a permeability of

10^{-8} m/s to a depth of -28 mCD at the sea bund side, and will continue landwards approximately half way along the sidewalls (i.e., 150 m) and to a depth of -10 mCD.

The aquifer below the graving dock site is anticipated to have the same hydraulic properties as the upper zones that will be excavated. A very small upward vertical hydraulic gradient is present in the vicinity of the site and the adjacent coastline. Once dewatering has reached elevation -18 mCD, the upward gradient on the floor of the graving dock may increase, depending on the cut-off wall design and degree of lateral dewatering away from the excavation. It is anticipated that the seaward gradients will gradually decrease on the northwest, northeast and southwest sides of the graving dock, however, by reason of proximity, the potential gradient from the sea coast to the excavation could be about 42% (e.g., -19.37 m head elevation divided by 45 m distance).

The dewatering design (by others) will address the upward vertical head potential on the seaward floor side of the graving dock.

4.4 Mobilization of Impacted Groundwater from Outlying Areas and Discharge Water Quality

A large amount of groundwater monitoring data is available for the Northside peninsula for a seventeen-year monitoring period extending from 1994 to 2011 that can be used to assess baseline groundwater quality conditions. The most significant source of groundwater monitoring data is the long-term Argentia groundwater monitoring program by PWGSC, which has been carried out on an annual basis since 1997. The long-term PWGSC groundwater monitoring program has included a network of approximately 425 monitoring wells from 13 sites, with monitoring primarily for petroleum hydrocarbons, and to a lesser extent metals, PCBs, PAHs, and VOCs. This sampling network was been reduced significantly as remediation programs have been completed at the sites, and only 29 monitor wells are currently included in the Northside Peninsula monitoring program distributed among five (5) sites (i.e., NBFF, NFSA, NFSB, NLFB, and NOAS). Table 4.1 summarizes the groundwater quality results for each of the five (5) sites based on the most recent PWGSC groundwater monitoring program in 2011 by Dillon Consulting (Dillon, 2012).

Table 4.1 Summary of 2011 Northside Groundwater Monitoring Results

Site	No. Monitor Wells	Chemical Parameter	2011 Monitoring Results
NBFF	6	• Petroleum hydrocarbons	• Concentrations ranging from 0.3 to 35 mg/L. • One sample (NBFF-905-MW) exceeded the provincial discharge criteria of 15 mg/L. • Atlantic PIRI Tier I guideline of 20 mg/L, returning a concentration of 35 mg/L. • No free product identified • Concentrations have shown a decreasing trend over the monitoring period.
NFSA	8	• Petroleum hydrocarbons	• Concentrations ranging from <0.1 to 1.1 mg/L. • All detected concentrations below provincial discharge criteria of 15 mg/L. • No free product identified • Concentrations have shown a decreasing trend over the monitoring period.
NFSB	2	• Petroleum hydrocarbons • PCBs	<u>Petroleum Hydrocarbons</u> • Concentrations ranging from 0.6 to 4.3 mg/L. • All detected concentrations below provincial discharge criteria of 15 mg/L. • No free product identified • Concentrations have shown a decreasing trend over the monitoring period. <u>PCBs</u> • Concentrations ranging from 3.1 to 35 ug/L • No applicable discharge guideline. • Concentrations have shown a decreasing trend over the monitoring period
NLFB	9	• PAHs • Metals	<u>PAHs</u> • Concentrations of total PAHs ranging from 0.04 to 1.7 ug/L. • Concentrations below applicable federal aquatic guidelines • Concentrations have shown a decreasing trend over the monitoring period. <u>Metals</u> • Monitored for lead (Pb) and cadmium (Cd). Concentrations ranging from non-detect to 1.9 ug/L & non-detect to 0.06 ug/L, respectively. • Concentrations below applicable federal aquatic guidelines • Concentrations have shown a decreasing trend over the monitoring period
NOAS	4	• Petroleum hydrocarbons • PCBs • PAHs	<u>Petroleum Hydrocarbons</u> • Concentrations ranging from non-detect to 0.3 mg/L. • All detected concentrations below provincial discharge criteria of 15 mg/L. • No free product identified

Site	No. Monitor Wells	Chemical Parameter	2011 Monitoring Results
			• Concentrations have shown a decreasing trend over the monitoring period. PCBs • Concentrations ranging from 0.002 to 0.005 ug/L • No applicable discharge guideline. • Concentrations have shown a decreasing trend over the monitoring period. PAHs • Concentrations of total PAHs ranging from 0.02 to 1.7 ug/L. • Concentrations below applicable federal aquatic guidelines • Concentrations have shown a decreasing trend over the monitoring period.

Based on long-term groundwater monitoring completed on the Northside peninsula, petroleum hydrocarbons, metals, PCBs, PAHs, and VOCs levels in groundwater have shown an overall decreasing trend over the monitoring period. Most recent groundwater sampling within the study area has indicated non-detectable to low concentrations of these parameters, that overall are below applicable federal and provincial aquatic guidelines, where such criteria exist.

It is anticipated that during the initial stages of the dewatering program, the water quality will be essentially fresh, and the main issues will be silt and sediment control. Based on the reported low levels of petroleum hydrocarbons, PAHs, metals, PCBs and VOCs and the general absence of free product in groundwater at the historical contaminated sites, no significant problems with inducing impacted groundwater into the CGS graving dock site are anticipated. While some low level dissolved parameters could theoretically be induced towards the site under sustained pumping, the large volumes of water produced are expected to afford some degree of dilution. Notwithstanding, monitoring should be considered of sump waters prior to discharge to the receiving environment (assumed to be Placentia Bay).

5.0 SUMMARY OF CONCLUSIONS

5.1 Hydrogeological Properties of CGS Graving Dock Area

Based on a variety of hydraulic testing and statistical analysis techniques, the site area is characterized as an unconfined to leaky, highly stratified unconsolidated aquifer with interbedded silt, clay, fine to coarse-grained sand and gravels in excess of 42 m thick. Based on hydraulic testing of PW1, the aquifer has a geometric mean transmissivity of 222.7 m^2/d, a geometric mean coefficient of storage of 3.5E-03 and a geometric mean hydraulic conductivity of 1.8E-4 m/s. The sediments exhibit a wide range of K from 4E-11 m/s for clay-silt to 2.1E-1 m/s for clean gravel, with a geometric mean in the order of 6E-4 m/s (slug tests) to 9.6E-6 m/s (sieve analysis).

Water levels range in depth from 1.0 to 9.4 mbgs, and are 2.9 to 4.6 mCD. The dominant direction of groundwater flow is southeastward from the vicinity of the main runways to the coastline at an average horizontal hydraulic gradient of 1.2 percent and an average velocity of 0.02 to 0.75 m/day. Small downward vertical hydraulic gradients (<1%) are expected in the vicinity of the Northside runways, and small upward gradients (<1%) are suspected in the vicinity of the CGS graving dock and near the coastline.

5.2 Drawdown Area of influence of CGS Graving Dock Dewatering

Preliminary calculations of drawdown area of influence suggests that drawdown in excess of 1.0 m could occur throughout the northern end of the Northside Peninsula under sustained pumping for dewatering.

5.3 Groundwater Baseline Chemistry

The groundwater quality is characterized as a clear, very hard (hardness 215 mg/L), slightly alkaline (190 mg/L, mean pH 8.1), calcium bicarbonate water type of moderate dissolved solids (conductance 520 uS/cm, est. TDS 350 mg/L). All analyzed parameters meet applicable environmental groundwater guidelines. With the exception of traces of toluene (5 µg/L), phenanthrene (0.024 µg/L) and petroleum hydrocarbons in several wells, no BTEX, TPH, VOCs, PAHs or PCBs were detected during the pumping test program.

5.4 Water Quality Impact Potential from Contaminated Sites

A review of recent monitoring of remediated sites known to occur northeast, northwest and southwest of the site suggests that concentrations of petroleum, PAHs, PCBs, metals, and VOCs continue to decline, and that there does not appear to be any residual major sources of free product in the area. Based on the reported low levels of petroleum hydrocarbons, PAHs, metals, PCBs and VOCs and the general absence of free product in groundwater at the historical contaminated sites, no significant problems with inducing impacted groundwater into the CGS graving dock site are anticipated.

5.5 Impacts to Groundwater Users

No groundwater users are known to be present on the Northside Peninsula. It is assumed all activities are serviced by water pipeline from the mainland. No dewatering impacts are therefore anticipated the Northside. Because the Placentia Bay acts as a recharge boundary, no impacts to well users on the Southside are anticipated.

5.6 Effects on Surface Waters

With the exception of small wetlands, no surface water bodies are present in proximity to the CGS graving dock site. The closest major surface water body, the Pond, is located 1,200 to 1,500 m northwest of the site. While it is possible that the area of drawdown influence of the CGS graving dock could reach the Pond, the degree of interaction would depend on the duration of pumping, the rate of pumping, and the degree of hydraulic isolation of the Pond for the underlying aquifer (e.g., bottom sediment permeability). No effects are anticipated on surface waters located off the Peninsula.

6.0 GROUNDWATER MONITORING PLAN

6.1 Introduction

As indicated in the White Rose Extension Project Scoping Document (C-NLOPB, 2012), a monitoring strategy is required during the CGS graving dock dewatering and operation stage. This strategy should build on the baseline monitoring work currently on-going, using similar sampling protocols and QA/QC procedures. The following outlines a general framework for a groundwater flow and quality monitoring plan for the CGS graving Dock site based on results of this baseline hydrogeological site characterization.

6.2 CGS Graving Dock Discharge Monitoring Plan

An approximate volume of 1,200,000 m^3 of soil will be excavated from the CGS graving dock and large volumes of groundwater will be discharged from the CGS graving dock sumps as the excavation advances to the design depth elevation of -19m CD. The finished graving dock base will be built back up to -18m CD to allow for a drainage layer.

6.2.1 Monitoring Parameters

A settling pond will be installed as a means of sediment settlement in the discharge system. Routine discharge water quality monitoring will include: conductance (degree of salinity), total suspended solids (TSS), and petroleum hydrocarbon compounds to detect movement of any residual hydrocarbons from up-gradient and adjacent remediated areas. Other chemicals of concern (CoCs) will be analyzed during the early months to confirm absence of specific CoCs.

6.2.2 Monitoring Frequency

Monitoring will be done weekly for the initial phase of CGS graving dock construction until stable conditions are attained. The monitoring frequency for some parameters may decrease to monthly during facility operation; however, routine monitoring of conductivity will be done weekly and ground water levels will be monitored continuously using automated equipment.

6.2.3 Contingency Plan (Flooding)

An emergency response contingency plan will be established as part of the health and safety program to deal with sudden inrushes, extreme rainfall events, major storms (hurricane induced tidal surge) or major pump failures that could result in rapid flooding of the basin. Mitigative actions will include continuous monitoring, provision of spare pumps, back-up power and emergency escape routes.

6.3 Aquifer Monitoring Plan

The CGS graving dock dewatering will result in drawdown in the host aquifer that decreases with distance from the excavation. While preliminary estimates of drawdown extent exceed 2,000 m, the actual degree of drawdown will depend on the mitigative effects of the proposed interception walls. Monitoring of water levels in the aquifer adjacent to and at distance from the excavation also provides a good indication of the effectiveness of dewatering, and progression of hydraulic gradients and water pressure outside of the site.

6.3.1 Key Monitoring Well Locations

Monitor wells should be located immediately outside of the cut-off walls to monitor pressures on the walls; between the CGS graving dock and the coastline, and at distances inland from the site to monitor horizontal hydraulic gradient. Some of the existing BHA series and OW series wells may also be incorporated into the monitoring system. The objective will be to provide continuous surveillance on the configuration of the water table around the site, and vertical hydraulic gradients and pressures below the floor of the CGS graving dock.

In addition to the proximity wells, where possible, existing PWGSC monitor wells will be monitored in outlying areas of the site, particularly in the areas of the inferred water table divide near the runway, and between the runway and the Pond to detect changes in the watershed divide and groundwater flow patterns.

6.3.2 Monitor Well Design

The monitor wells should be conventional schedule 40, flush-threaded PVC pipe and No. 10 or 20 slot screens, similar to that used for the existing monitoring wells. Because the static water levels will be at or below elevation -18 mCD, the close-in perimeter wells should be constructed to depths of -25 to -40 mCD with short screens. At least two multi-level monitor well nests should be present with a shallow (elevation -22 to -25 mCD) screen and a deep (elevation -30 to -40CD) screen to monitor upward vertical hydraulic gradients.

Each new well should be thoroughly developed to render the screen hydraulically efficient, subjected to a falling head/rising head slug test to determine hydraulic conductivity, and surveyed into common datum (top of casing and grade).

6.3.3 Monitoring Procedures

The majority of monitoring wells should be measured at least monthly using an electric water level tape. The depth to water would be added to the cumulative database, and ultimately used to generate long-term water level hydrographs for select wells.

Selected wells should be instrumented with automated water level data loggers, set at reading intervals of 15 minutes to one hour. Cumulative hydrographs generated from monthly download of these data loggers will provide continuous record of water level conditions at key locations around the site.

6.3.4 Monitoring Frequency

A monthly manual water level monitoring frequency is recommended for the initial year of operation. Longer times may be warranted thereafter; depending on project life.

6.3.5 Sampling Parameters

Water quality monitoring in the monitoring wells is not strictly required, unless there is a concern about movement of a contaminant plume from one of the remediated areas. Nonetheless, water quality monitoring will be carried out as part of the project's Environmental Protection Plan (EPP). Because saline intrusion is the most likely water quality change, a quarterly conductivity profile of selected wells may be useful in establishing the fresh-saline water interface around the CGS graving dock site. This is usually done by lowering a SCT probe slowly through the water column and monitoring conductance, temperature and salinity at 1 m intervals.

For areas where petroleum hydrocarbon impacts are suspected, quarterly monitoring for TPH and BTEX parameters can be done using standard sampling protocols established for the adjacent PWGSC monitoring program.

6.3.6 Monitoring Network Maintenance

Monitor wells need little maintenance. The wells should be inspected on an annual basis, and any needed repairs such as casing covers, and flushing should be done.

6.4 Reporting

In order to maintain a consistent, accurate and useful monitoring program, all aspects of the sampling, analysis, and data management will be maintained and trended in a consistent manner so that ground water levels and water quality will be comparable over long time periods. Groundwater Monitoring reports will be prepared and submitted quarterly to the NL Department of Environment and Conservation over the life of the project.

6.4.1 Database Management

A database management system will be established for the CGS graving dock project. This will be populated with the baseline work currently underway, and added to the new monitoring data over the course of the project.

The database will include ground water levels, water chemistry, hydraulic testing works, borehole logs, inventory of relevant documentation and reports, and any other information deemed useful to regulators or Husky consultants who may need to evaluate the data. The databases will include tabular data in a master spreadsheet, specific summary tables generated from the spread sheets, cumulative water level hydrographs for each monitoring well, cumulative hydrochemical trend plots for key indicator compounds (e.g., electrical conductivity), and other outputs.

6.4.2 Monitoring Reporting

All information will be reviewed and interpreted by a qualified subject matter expert. Pending the stipulations of the regulators, these reports will likely form the support documentation for regulatory reports.

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8.0 CLOSURE

This report has been prepared for the sole benefit of Husky Energy. The report may not be relied upon by any other person or entity without the expressed written consent of Stantec Consulting Ltd. and Husky Energy.

Any uses that a third party makes of this report, or any reliance on decisions made based on it, are the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this report.

The recommendations and predictions contained in the above report are based solely on the scope of work completed to date, including the aquifer test data obtained during this investigation. While the recommendations and predictions of individual wells and aquifer performance are based on sound hydrogeological principles, undetected hydraulic conditions may occur which were not apparent from limited duration aquifer tests. Since these could result in variations in predicted water levels over time, it is strongly recommended that wells be closely monitored over the initial year of operation. Any significant deviations from the predicted well performance should be immediately reported to Stantec Consulting Ltd.

This report was prepared by Michael Haverstock, M.Sc., P.Eng. and David MacFarlane, M.Sc., P.Geo. and was reviewed by Carolyn Anstey-Moore, M.A.Sc., M.Sc., P.Geo., and Robert MacLeod, M.Sc., P.Geo. We trust that this report meets your present requirements. If you have any questions or require additional information, please contact our office at your convenience.

Respectfully submitted,

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CAROLYN ANSTEY-MOORE
SIGNATURE
04/10/13
DATE
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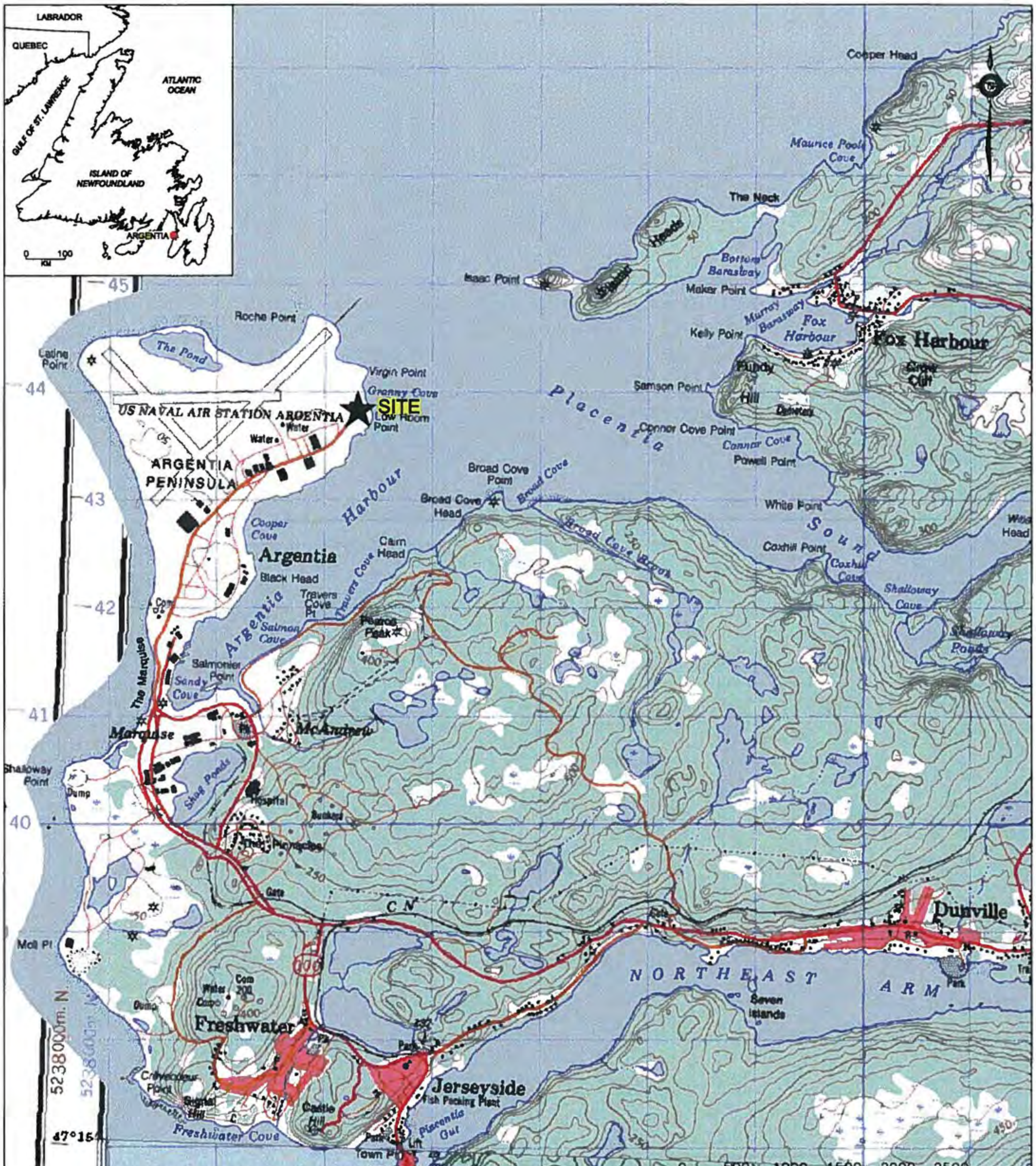
APPENDIX A

Drawings & Figures



NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

CLIENT: HUSKY ENERGY	SCALE: 1:50,000	DATE: MAR. 28, 2013	
	DRAWN BY: N.M.	CHECKED BY:	
PROJECT TITLE: BASELINE HYDROGEOLOGICAL CHARACTERIZATION, CONCRETE GRAVITY STRUCTURE GRAVING DOCK SITE, ARGENTIA, NL	EDITED BY: -	REV. No. 0	
	DRAWING No: 121412512-EE-01		
DRAWING TITLE: SITE LOCATION PLAN	CAD FILE: 121412512-EE-01.DWG		Stantec

28MAR13 10:00AM

Abbreviation	Site
ACND	Area of Concern Net Dipping
ACRP	Area of Concern Road Near The Pond
NB77	Northside Building 77
NBFF	Northside Bulk Fuel Farm
NDT1	Northside Day Tank
NFSA	Northside Fuel Storage Area
NFSB	Northside Fuel Storage associated with Buildings
NFTA	Northside Fire Training Area
NFTB	Northside Fire Training Area B
NGS1	Northside Gas Station
NIOT	Northside Irving Oil Tanks
NLFA	Northside Landfill A
NLFB	Northside Landfill B
NMGR	Northside Machine Gun Range
NOAS	Northside Old Arena Site
NQNP	Northside Quarry Near The Pond
NSCP	Northside Concrete Plant
NSRF	Northside Rifle Range
NSRR	Northside Rifle Range
NSSP	Northside Shore Property
NSUB	Northside Unknown Building
NYDB	Northside Yard Dump
PTHP	Pond; The Pond

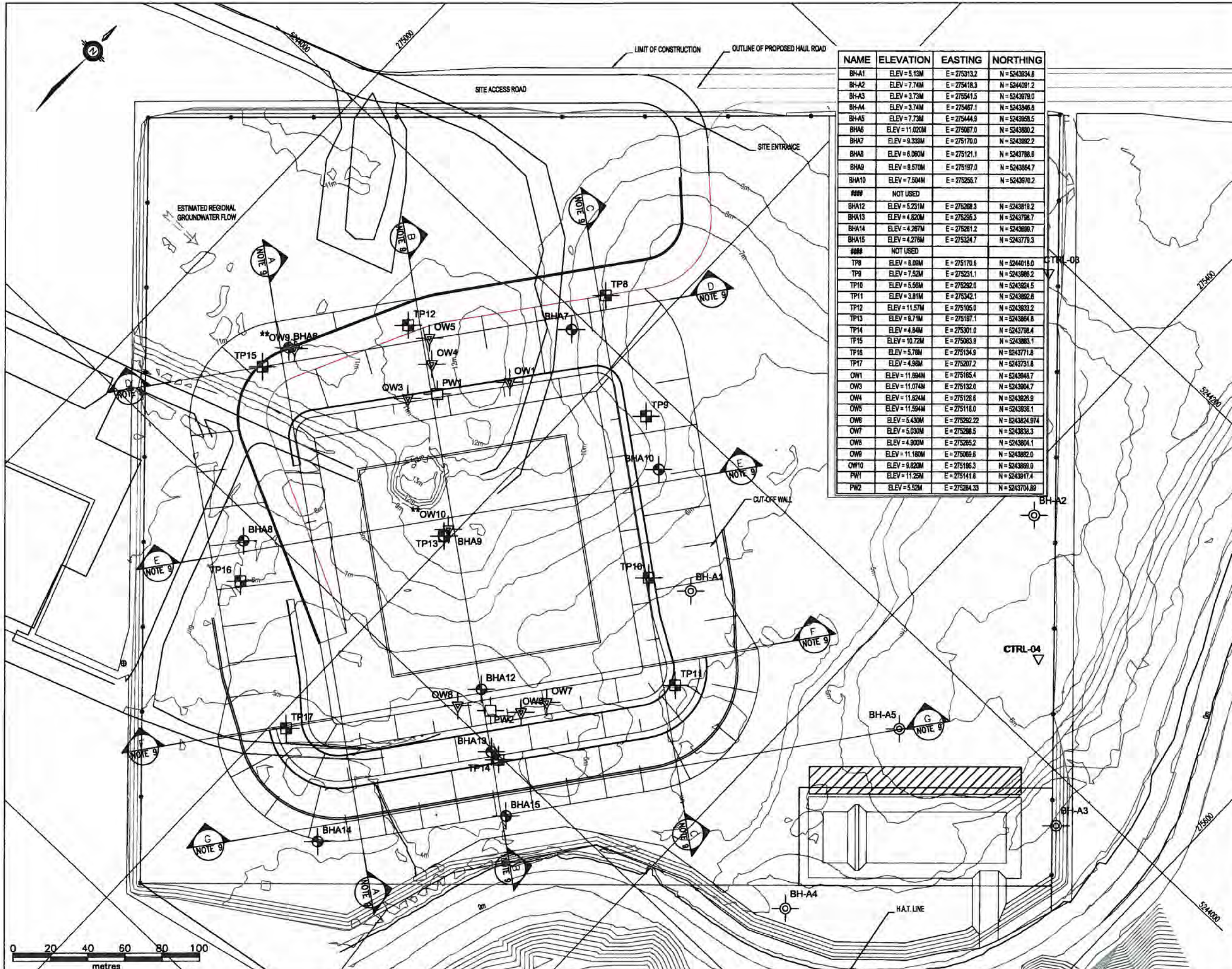
CLIENT: **Husky Energy**

PROJECT TITLE: **Baseline Hydrological Characterization, Concrete Gravity Structure Graving Dock Site, Argentia, NL**

DRAWING TITLE: **Inferred Regional Groundwater Flow - Argentia Northside Peninsula**

SCALE: 1:12,500	DATE: MARCH 27, 2013	
DRAWN BY: HW	CHECKED BY:	
EDITED BY: -	REV. No. 0	
DRAWING No.: NA		
MAP FILE: 121412512_002.MXD		

Stantec



NAME	ELEVATION	EASTING	NORTHING
BH-A1	ELEV = 5.13M	E = 275313.2	N = 5243934.8
BH-A2	ELEV = 7.74M	E = 275418.3	N = 5244091.2
BH-A3	ELEV = 3.73M	E = 275541.5	N = 5243979.0
BH-A4	ELEV = 3.74M	E = 275467.1	N = 5243846.8
BH-A5	ELEV = 7.73M	E = 275444.9	N = 5243958.5
BHA6	ELEV = 11.020M	E = 275067.0	N = 5243880.2
BHA7	ELEV = 9.339M	E = 275170.0	N = 5243992.2
BHA8	ELEV = 6.060M	E = 275121.1	N = 5243788.6
BHA9	ELEV = 9.570M	E = 275197.0	N = 5243864.7
BHA10	ELEV = 7.504M	E = 275255.7	N = 5243970.2
###	NOT USED		
BHA12	ELEV = 5.231M	E = 275268.3	N = 5243819.2
BHA13	ELEV = 4.820M	E = 275295.3	N = 5243798.7
BHA14	ELEV = 4.267M	E = 275261.2	N = 5243699.7
BHA15	ELEV = 4.276M	E = 275324.7	N = 5243779.3
###	NOT USED		
TP8	ELEV = 8.09M	E = 275170.6	N = 5244018.0
TP9	ELEV = 7.52M	E = 275231.1	N = 5243986.2
TP10	ELEV = 5.56M	E = 275292.0	N = 5243924.5
TP11	ELEV = 3.81M	E = 275342.1	N = 5243892.8
TP12	ELEV = 11.57M	E = 275105.0	N = 5243933.2
TP13	ELEV = 9.71M	E = 275197.1	N = 5243864.8
TP14	ELEV = 4.84M	E = 275301.0	N = 5243798.4
TP15	ELEV = 10.72M	E = 275063.9	N = 5243883.1
TP16	ELEV = 5.78M	E = 275134.9	N = 5243771.8
TP17	ELEV = 4.98M	E = 275207.2	N = 5243731.8
OW1	ELEV = 11.694M	E = 275165.4	N = 5243948.7
OW3	ELEV = 11.074M	E = 275132.0	N = 5243904.7
OW4	ELEV = 11.624M	E = 275128.6	N = 5243926.9
OW5	ELEV = 11.594M	E = 275118.0	N = 5243936.1
OW6	ELEV = 5.430M	E = 275292.22	N = 5243824.974
OW7	ELEV = 5.030M	E = 275298.5	N = 5243838.3
OW8	ELEV = 4.900M	E = 275265.2	N = 5243804.1
OW9	ELEV = 11.160M	E = 275069.6	N = 5243882.0
OW10	ELEV = 9.820M	E = 275196.3	N = 5243869.0
PW1	ELEV = 11.25M	E = 275141.8	N = 5243917.4
PW2	ELEV = 5.52M	E = 275284.33	N = 5243704.89

LEGEND

- NOVEMBER 2012 GEOTECHNICAL BOREHOLE LOCATION
- SEPTEMBER 2012 TEST PIT LOCATION
- 2011 INVESTIGATION EXISTING BOREHOLE LOCATION
- PROPOSED OBSERVATION WELL LOCATIONS (ONGOING)
- PROPOSED PUMPING WELL LOCATION (ONGOING)
- ESTIMATED REGIONAL GROUNDWATER FLOW

NOTES:
1. DRAWING BASED ON INFORMATION PROVIDED BY HUSKY ENERGY (CAD FILE No. WH-K-98W-K-LY-00005-001.DWG).
2. THIS DRAWING ILLUSTRATED SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

CLIENT:

HUSKY ENERGY

PROJECT TITLE:

BASELINE HYDROGEOLOGICAL CHARACTERIZATION,
CONCRETE GRAVITY STRUCTURE
GRAVING DOCK SITE, ARGENTIA, NL

DRAWING TITLE:

SITE PLAN

Stantec Consulting Ltd.

SCALE: 1:2000	DATE: MAR. 28, 2013	
DRAWN BY: N.M.	CHECKED BY:	
EDITED BY: -	REV. No.: 0	
DRAWING No: 121412512-EE-03		
CAD FILE: 121412512-EE-02.DWG		

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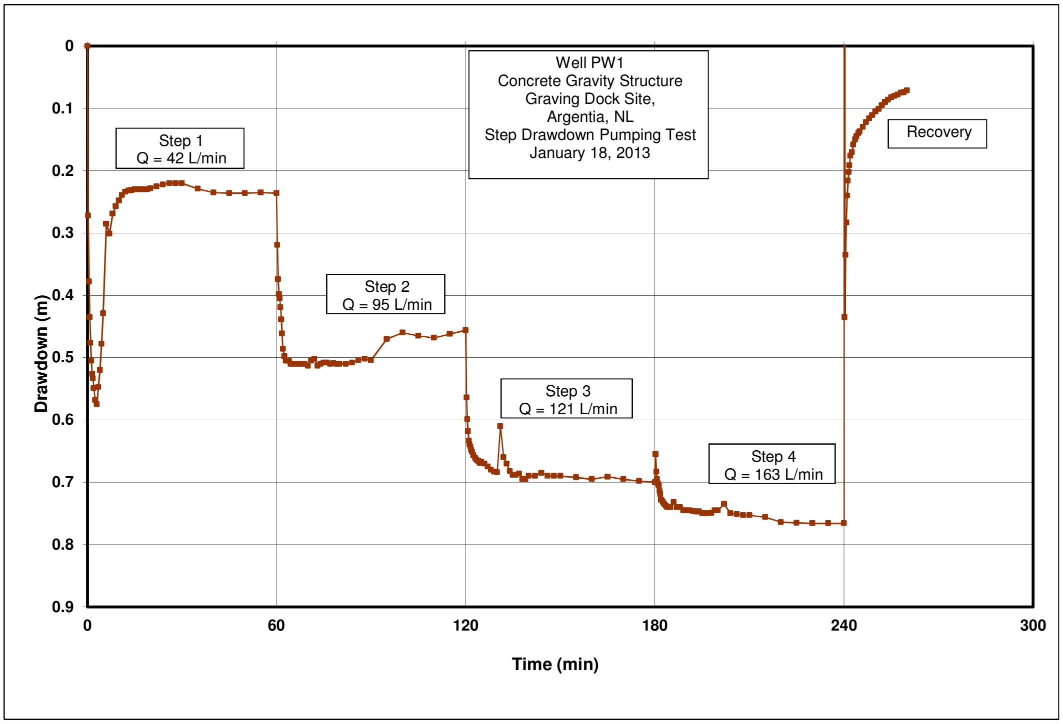


Figure A.1 Drawdown Responses in Step Drawdown test in PW1

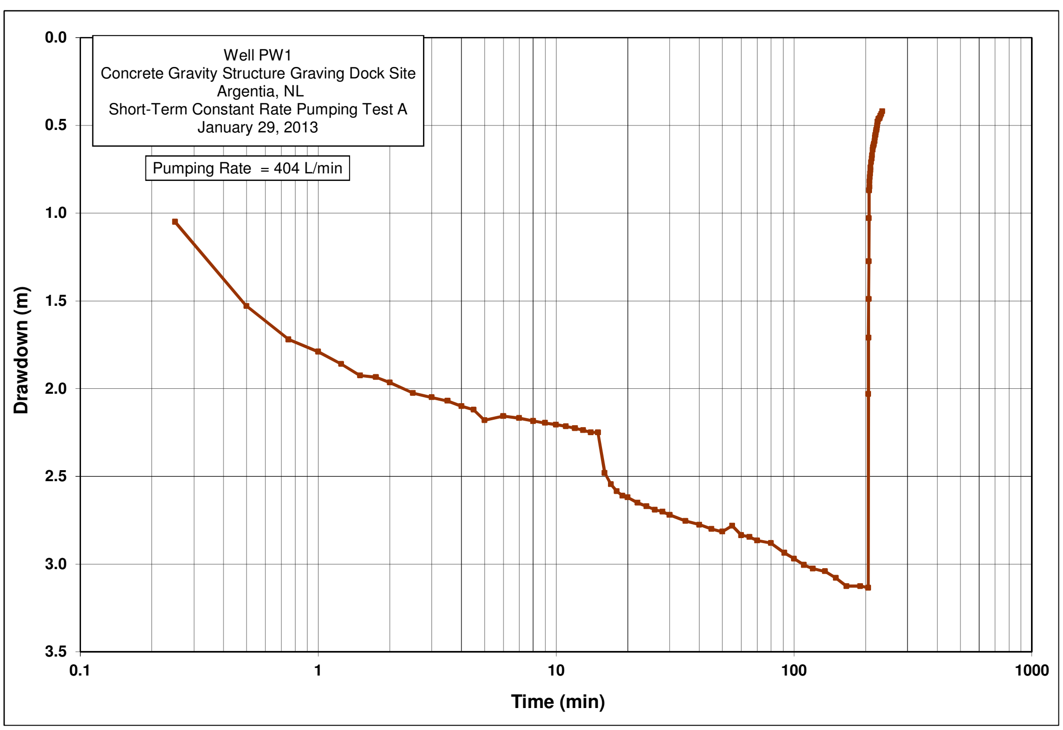


Figure A.2 Drawdown Responses for Short Term Pump Test A in PW1

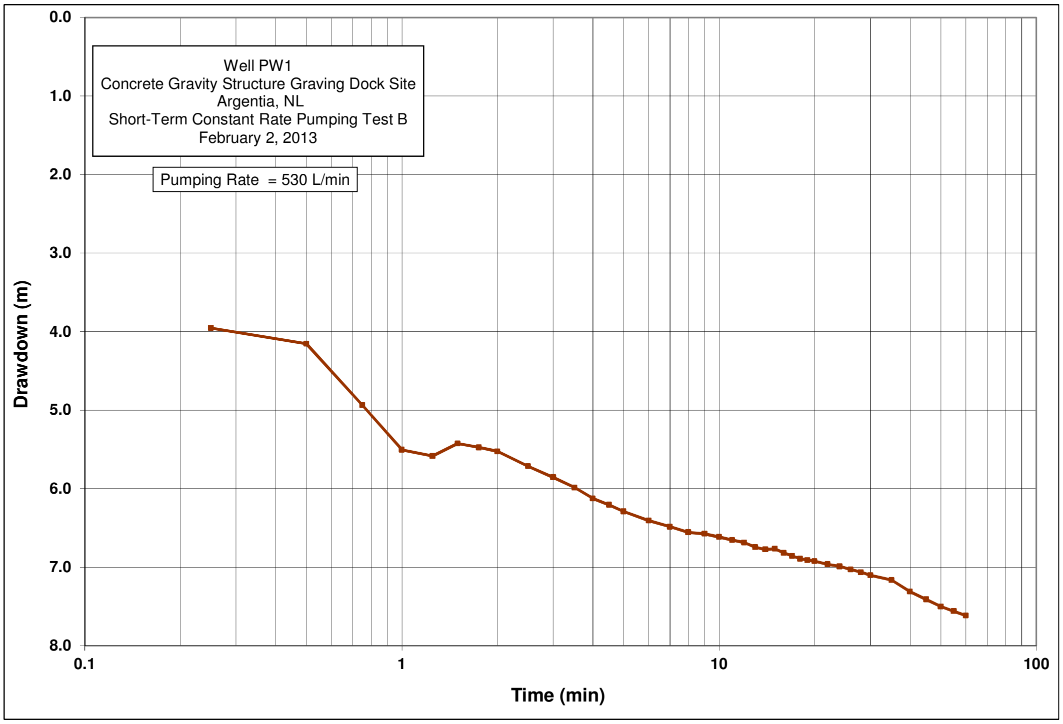


Figure A.3 Drawdown Responses for Short Term Pump Test B in PW1

APPENDIX B

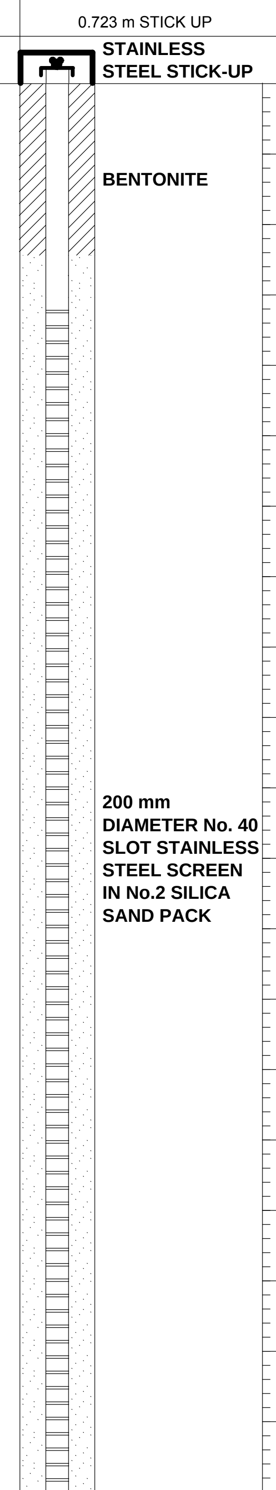
Borehole Record – PW1

WELL RECORD

Stantec

CLIENT	Husky Energy
PROJECT	Hydrogeological Investigation, Test Well PW1 Concrete Gravity Structure,
LOCATION	Graving Dock Site, Argentia, NL
DATES (mm-dd-yy): BORING	1-4-13 to 1-6-13
WATER LEVEL	8.23m 1-18-13
BOREHOLE No.	PW1
PAGE	1 of 3
PROJECT No.	121412512
DRILLING METHOD	Rotary Drill w/symmetrix
SIZE	300mm
DATUM	Chart Datum

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm)	SAMPLES: N-VALUE OR RQD %	HYDROCARBON ODOUR	APPARENT MOISTURE CONTENT	PID (ppm)	TPH (ppm)	WELL CONSTRUCTION DETAILS
0	11.25	Light brown, silty SAND with gravel (SM)			BS	1							0.723 m STICK UP; STAINLESS STEEL STICK-UP; BENTONITE
					BS	2							
3	8.20	Light brown, GRAVEL (GP)			BS	3							
					BS	4							200 mm DIAMETER No. 40 SLOT STAINLESS STEEL SCREEN IN No.2 SILICA SAND PACK
6	5.15	Light brown, GRAVEL with sand (GP)			BS	5							
				▼ (8.23)	BS	6							
					BS	7							



WELL RECORD

Stantec

BOREHOLE No. PW1

CLIENT Husky Energy

PROJECT Hydrogeological Investigation, Test Well PW1 Concrete Gravity Structure,

LOCATION Graving Dock Site, Argentia, NL

DATES (mm-dd-yy): BORING 1-4-13 to 1-6-13

WATER LEVEL 8.23m 1-18-13

PROJECT No. 121412512

DRILLING METHOD Rotary Drill

SIZE 300mm w/symmetrix

DATUM Chart Datum

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD %	HYDROCARBON ODOUR	APPARENT MOISTURE CONTENT	PID (ppm)	TPH (ppm)	WELL CONSTRUCTION DETAILS
		Continued from Previous Page											
10													
11					BS	8							
12					BS	9							
13													
14					BS	10							200 mm DIAMETER No. 40 SLOT STAINLESS STEEL SCREEN IN No.2 SILICA SAND PACK
15													
16					BS	11							
17													
18	-7.04	Brown silty SAND (SM) to sandy SILT (ML)											
19					BS	12							
20													

Stantec WELL RECORD

BOREHOLE No. PW1
PAGE 3 of 3
CLIENT Husky Energy
PROJECT No. 121412512
PROJECT Hydrogeological Investigation, Test Well PW1 Concrete Gravity Structure,
DRILLING METHOD Rotary Drill
LOCATION Graving Dock Site, Argentia, NL
SIZE 300mm w/symmetrix
DATES (mm-dd-yy): BORING 1-4-13 to 1-6-13
WATER LEVEL 8.23m 1-18-13
DATUM Chart Datum

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD %	HYDROCARBON ODOUR	APPARENT MOISTURE CONTENT	PID (ppm)	TPH (ppm)	WELL CONSTRUCTION DETAILS
		Continued from Previous Page					mm						
20					BS	13							
21–22					BS	14							200 mm DIAMETER SOLID STAINLESS STEEL WELL CASING
23–24	-13.13				BS	15							END CAP
		End of Borehole											
25													
26													
27													
28													
29													
30													

APPENDIX C

Summary Tables

Table C.1 Monitor Well Construction Details (MWs used in Hydraulic Testing)

Well	Drill Date	Depth (mbgs)	Diameter (mm)	Casing Stick-up (m)	Elevation TOC (m)	Elevation Grade (m)	Static Water level Depth (mbtoc)	Static Water level Elevation (m)	Screen Length (m)	Sand Pack From (m)	Sand Pack To (m)	Sand Pack Length (m)
PW1	16-Jan-13	24.30	200	1.00	12.25	11.25	8.23	4.02	18.20	1.20	19.8	18.60
OW1	3-Dec-12	21.34	51	1.08	12.79	11.71	8.20	4.59	20.00	1.34	21.34	20.00
OW3	27-Nov-12	21.34	51	1.07	12.10	11.03	8.96	3.14	20.00	1.34	21.34	20.00
OW4	28-Nov-12	21.34	51	1.05	12.62	11.57	9.36	3.26	20.00	1.34	21.34	20.00
OW5	4-Dec-12	21.34	51	0.98	12.65	11.67	9.28	3.38	20.00	1.34	21.34	20.00
OW6	2-Dec-12	41.1	51	1.04	6.16	5.43	3.00	3.14	6.10	32.50	40.3	7.80
OW7	14-Dec-12	36.5	51	0.36	6.21	5.03	2.30	3.14	22.90	11.25	35.9	24.65
OW8	8-Dec-12	41.15	51	1.11	6.05	4.94	3.11	2.94	20.00	21.15	41.15	20.00
OW9	16-Dec-12	22.90	51	1.08	12.22	11.14	8.80	3.42	21.40	1.50	22.90	21.40
OW10	15-Dec-12	13.70	51	1.40	10.85	9.45	7.60	3.25	12.20	1.50	13.70	12.20
BHA6	14-Nov-12	41.1	51	-	11.27	11.02	Well abandoned		3.05	21.40	26.3	4.90
BHA7	15-Nov-12	41.15	51	1.00	10.48	9.48	7.12	3.36	3.05	36.00	41.15	5.15
BHA8	23-Nov-12	41.15	51	0.94	7.09	6.15	4.02	3.08	3.05	32.90	41.15	8.25
BHA9	7-Nov-12	41.2	51	-	9.67	9.57	Well abandoned		3.05	37.20	41.2	4.00
BHA10	26-Nov-12	41.15	51	0.82	8.36	7.54	5.44	2.92	3.05	32.60	41.15	8.55
BHA12	26-Nov-13	41.2	51	1.23	6.52	5.23	2.10	3.13	6.10	33.00	40.4	7.40
BHA13	20-Nov-12	41.1	51	1.35	5.93	4.82	1.50	3.32	6.10	32.90	40.2	7.30
BHA14	16-Nov-12	41.1	51	0.64	5.22	4.27	1.00	3.27	6.10	32.60	39.9	7.30
BHA15	12-Nov-12	41.1	51	0.85	5.15	4.28	1.40	2.88	3.05	36.00	40.1	4.10
					Minimum	4.27	1.00	2.88	2.88			2.88
					Maximum	11.71	9.36	4.59	4.59			4.59
					Mean	8.50	5.72	3.33	3.33			3.33

No. 10 Slot PVC Screens

Table C.2 Step Test Response Summary - Test Well PW1 (18-Jan-13)

Step	Step Time	Pumping Rate			Water Level (m)	Drawdown (m)	Uncorr. Specific Capacity		Mean Q/s (m^2/d)
	(Min)	(USgpm)	(L/min)	(m^3/d)			m^2/d	L/min/m	
1	60	11.0	41.6	60.0	12.25	0.24	250	173	275
2	60	25.0	94.6	136.3	16.25	0.46	296	206	
3	60	32.0	121.1	174.4	22.59	0.70	249	173	
4	60	43.0	162.8	234.4	29.47	0.77	304	211	
PT1 (3.4 hr)	60	106.7	404	581.8	12.14	2.84	205	142	
PT2 (1 hr)	60	140.0	530	763.2	16.36	7.62	100	70	
PT3 (58 hr)	60	120.0	454.2	654.0		4.15	158	109	

Table C.3 Summary of Hydraulic Testing Data - PW1

Well	Pumping Rate (m^3/d)	Distance from Pumping Well (m)	Transmissivity (m^2/s)	Transmissivity (m^2/day)	Storage coefficient	Method
Short Term (3.5 hr) Pump Test A (29-Jan-13)						
PW1	582 (404 Lpm)	-	0.002675	226.8	1.2E-03	Cooper-Jacob
				313.0	-	Theis Recovery
Short Term (1 hr) Pump Test B (2-Feb-13)						
PW1	763 (530 Lpm)	-	0.003623	79.8	6.3E-02	Cooper-Jacob
				-	-	Theis Recovery
58.2 Hour constant Rate Pump Test (6-Feb-13 to 9-Feb-13)						
PW1	654 (454 Lpm)	-	0.001174	101.4	-	Cooper-Jacob
			0.001521	131.4	-	Theis
			0.001865	161.1	-	Theis Recovery
OW1		39	-	-	no response	Cooper-Jacob
OW3		16	0.002001	172.9	0.008152	Cooper-Jacob
			0.001904	164.5	0.01009	Theis
			0.001675	144.7	-	Theis Recovery
OW4		16	0.00216	186.6	0.00345	Cooper-Jacob
			0.002784	240.5	0.0004445	Theis
			0.002023	174.8	-	Theis Recovery
OW5		30	0.002405	207.8	0.002635	Cooper-Jacob
			0.002855	246.7	0.0008412	Theis
			0.002077	174.8	-	Theis Recovery
OW8		168	0.002542	219.6	0.005311	Cooper-Jacob
			0.002674	231.0	0.00587	Theis
			0.004647	401.5	-	Theis Recovery
OW9		80	0.002462	212.7	0.0156	Cooper-Jacob
			0.002167	187.2	0.02367	Theis
			0.002479	214.2	-	Theis Recovery
OW10		73	0.002197	189.8	0.004719	Cooper-Jacob
			0.002138	184.7	0.00538	Theis
			0.002114	182.6	-	Theis Recovery
BHA7		78	0.01052	908.928	0.04389	Cooper-Jacob
			0.006154	531.7056	0.06514	Theis
			0.005518	476.7552	-	Theis Recovery
BHA8		131	0.006385	551.7	0.008379	Cooper-Jacob
			0.004514	390.0	0.01207	Theis
			0.005881	508.1	-	Theis Recovery
BHA10		123	0.003717	321.1	0.001449	Cooper-Jacob
			0.005782	499.6	-	Theis
			0.003026	261.4		Theis Recovery
Composite			0.001762	152.2	0.01177	Cooper-Jacob
			0.001762	152.2	0.004995	Theis Recovery

Table C.3 Summary of Hydraulic Testing Data - PW1

Well	Pumping Rate (m^3/d)	Distance from Pumping Well (m)	Transmissivity (m^2/s)	Transmissivity (m^2/day)	Storage coefficient	Method
Distance Drawdown (t = 58 hrs)			0.001546	133.6	0.01215	Cooper-Jacob
		Apparent Well	**1.5E-03**	**131.3**	**-**	
		Aquifer Mean	**2.8E-03**	**239.7**	**7.4E-03**	
		Aquifer Geomean	**2.6E-03**	**222.7**	**4.5E-03**	

Table C.4 Summary of Grain Size Distribution K Analysis

Sample No.			Depth			
BH	Sample ID	Sample Type	From [m]	To [m]	Subsurface Unit	Est'd K [cm/s]
BH A10	26-B	SC-B	39.01	39.32	Sand (SP)	4.50E-06
BH A12	2-1-B	SC-B	1.83	2.21	Gravel (GW)	5.63E-05
BH A12	4-B	SC-B	5.18	5.49	Gravel (GW)	1.62E-02
BH A12	6-B	SC-B	7.92	8.23	Sand (SW)	7.04E-05
BH A12	7-B	SC-B	9.75	10.06	Gravel (GW)	1.00E-04
BH A12	8-B	SC-B	11.58	11.89	Silty Sand (SM)	2.94E-05
BH A12	12-B-2	SC-B	20.42	20.73	Silt (ML); Silty Sand (SM)	8.10E-08
BH A12	14-B	SC-B	23.16	23.47	Silt (ML); Silty Sand (SM)	6.97E-07
BH A12	16-B	SC-B	26.82	27.13	Sand (SW)	1.18E-04
BH A12	19-B	SC-B	31.09	31.39	Silty Sand	8.66E-08
BH A12	22-B	SC-B	35.43	35.74	Sand	1.45E-04
BH A12	24-B	SC-B	38.71	39.01	Gravelly Sand	1.90E-04
BH A13	3-B	SC-B	3.66	3.96	Silty-Gravel Sand	2.50E-05
BH A13	4-B	SC-B	5.18	5.49	Gravel	1.26E-05
BH A13	5-B	SC-B	7.01	7.32	Gravelly Sand	3.60E-03
BH A13	7-B	SC-B	9.75	10.06	Sand	1.44E-03
BH A13	9-B	SC-B	12.80	13.11	Sand	2.60E-04
BH A13	11-B	SC-B	15.85	16.15	Sand	4.00E-04
BH A13	13-B	SC-B	19.10	19.46	Silty Sand	2.56E-07
BH A13	15-B	SC-B	22.24	22.56	Silty Sand	2.56E-09
BH A13	17-B	SC-B	24.54	24.84	Gravelly Sand (SW)	4.00E-04
BH A13	19-B	SC-B	28.04	28.35	Sand (SP)	2.00E-05
BH A13	21-B	SC-B	31.45	31.88	Silty Sand (SM)	4.00E-09
BH A14	4-B	SC-B	5.18	5.49	Gravelly SAND	1.62E-03
BH A14	6-B	SC-B	8.59	8.84	Sandy GRAVEL	3.83E-04
BH A14	9-B	SC-B	12.50	12.80	Gravelly Sand	7.02E-05
BH A14	10-B	SC-B	14.02	14.33	Sandy GRAVEL	5.04E-07
BH A14	13-B	SC-B	18.90	19.20	Gravel	1.72E-04
BH A14	14-B	SC-B	20.73	21.03	Silty Sand (SM)	4.61E-08
BH A14	17-B	SC-B	24.84	25.15	Silty Sand (SM)	1.75E-04
BH A14	19-B	SC-B	28.04	28.35	Silty Gravel (GM)	5.76E-08
BH A14	22-B	SC-B	32.49	32.66	Sand	2.36E-04
BH A15	2-B	SC-B	2.44	2.74	Rootmat	2.25E-04
BH A15	5-B	SC-B	6.40	6.71	Sandy Gravel	1.60E-03
BH A15	6-B	SC-B	8.23	8.53	Gravel	2.11E-01
BH A15	8-B	SC-B	11.10	11.58	Sandy Gravel	1.69E-04
BH A15	11-B	SC-B	15.54	16.08	Fine Sand	1.01E-04
BH A15	16-B					2.56E-09
BH A15	17-B	SC-B	25.15	25.50	Silty Clay	3.60E-06
BH A15	18-B	SC-B	26.52	26.82	Clayey Silt	6.40E-08
BH A15	20-B	SC-B	29.57	29.87	gravelly silty sand	5.40E-06

Table C.4 Summary of Grain Size Distribution K Analysis

Sample No.			Depth			
BH	Sample ID	Sample Type	From [m]	To [m]	Subsurface Unit	Est'd K [cm/s]
BH A15	21-B	SC-B	31.09	31.45	Silty Sand	3.60E-06
BH A15	24-B	SC-B	35.36	35.66	silty clay	1.60E-08
BH A15	26-B	SC-B	38.71	39.01	silty sand	4.00E-07
BH A15	28-B	SC-B	40.23	40.54	silty sand	4.00E-07
BH A6	2-B	SC-B	2.13	2.36	FILL	6.30E-05
BH A6	12-B	SC-B	17.37	17.68	Sand	5.04E-04
BH A6	14-B	SC-B	20.02	20.32	Sand	2.70E-05
BH A6	16-B	SC-B	23.16	23.47	Sandy Gravel	6.85E-03
BH A6	17-B	SC-B	24.38	24.69	Silty Sandy Gravel	4.10E-04
BH A6	26-B	SC-B	38.79	39.09	Medium Sand	1.29E-04
BH A7	5-B	SC-B	6.71	7.01	Silty Clay	1.76E-08
BH A7	10-B	SC-B	14.02	14.33	Silty CLAY (CL)	3.14E-08
BH A7	12-B	SC-B	17.68	17.98	Clayey SILT (ML)	1.68E-06
BH A7	15-B	SC-B	21.34	21.64	Sandy Gravel (GW)	1.02E-03
BH A7	17-B	SC-B	24.64	25.04	Sand (SW)	1.41E-04
BH A7	19-B	SC-B	28.04	28.35	Silty Sand (SM)	1.08E-07
BH A7	21-B	SC-B	31.09	32.00	Silty Sand (SM)	1.28E-05
BH A7	24-B	SC-B	35.97	36.27	Sandy Silt (ML)	2.70E-08
BH A7	26-B	SC-B	38.10	38.40	Sandy Silt (ML)	1.54E-07
BH A8	4-B	SC-B	5.18	5.49	Gravelly Sand (SW)	2.80E-04
BH A8	11-B	SC-B	16.00	16.31	Silty Sand (SM)	8.00E-05
BH A8	14-B	SC-B	20.42	20.73	Gravelly Sand (SW)	3.60E-03
BH A8	18-B	SC-B	26.37	26.67	Sand (SW)	1.13E-06
BH A9	4-B	SC-B	5.18	5.49	Medium Sand	6.00E-07
BH A9	6-B	SC-B	8.84	9.14	Gravel	1.28E-05
BH A9	12-B	SC-B	17.07	17.53	Gravel	7.68E-05
BH A9	24-B	SC-B	35.66	36.12	Gravelly clayey Sand	2.56E-03
BH A9	25-B	SC-B	37.29	37.64	Silty Clay	3.60E-10
BH A9	26-B					4.00E-11
BH A9	27-B	SC-B	39.62	40.06	Silty Sand	1.60E-08
Summary:						
Geometeric Mean		-	16.57	17.06	-	9.61E-06
Median		-	20.58	20.96	-	2.94E-05
Minimum		-	0.61	0.91	-	4.00E-11
Maximum		-	40.23	40.54	-	2.11E-01
#		108	108	108		71

Table C.5 Summary of Slug Testing - CGS Graving Dock Site

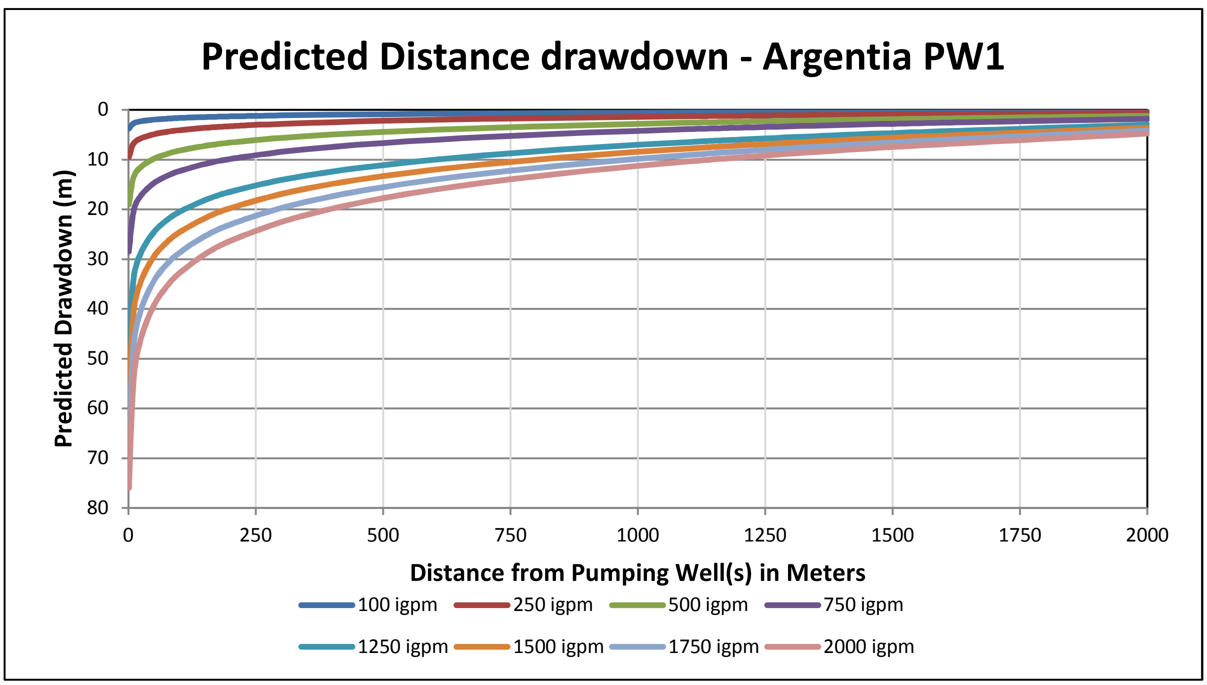
Well	Test Date	Test Type	Screen From (m)	To (m)	Material	K (m/s)	Ss	Method
OW1	15-Dec-12	Rising Head	1.34	21.34		2.80E-06	-	Bouwer & Rice
OW3	15-Dec-12	Falling Head	1.34	21.34		5.15E-07	-	Bouwer & Rice
OW4	15-Dec-12	Rising Head	1.34	21.34		2.09E-06	7.6E-03	KGS
OW5	15-Dec-12	Falling Head	1.34	21.34		1.50E-06	-	Bouwer & Rice
OW6	15-Dec-12	Rising Head				2.72E-05	1.1E-01	KGS
OW7	15-Dec-12	Rising Head				1.10E-05	1.4E-03	KGS
OW8	15-Dec-12	Rising Head	21.15	41.15		3.53E-05	-	Bouwer & Rice
OW9	15-Dec-12	Rising Head	1.5	22.9		1.55E-05	-	Bouwer & Rice
OW10	15-Dec-12	Falling Head	1.5	13.7		8.07E-08	-	Bouwer & Rice
A7	15-Dec-12	Falling Head	36	41.15	clay-silt	6.16E-06	6.2E-06	KGS
A8	15-Dec-12	Falling Head	32.9	41.15	sand	1.05E-06	1.7E-04	KGS
A10	15-Dec-12	Rising Head	32.6	41.15	Sand	4.12E-05	2.6E-04	KGS
A12	15-Dec-12	Falling Head			Sd, Grav	5.09E-05	2.1E-04	KGS
A13	15-Dec-12	Falling Head			Grav-Sd	1.82E-04	1.9E-04	KGS
A14	15-Dec-12	Rising Head			Sd, Grav	1.87E-05	5.0E-06	KGS
A15	15-Dec-12	Falling Head			silty-Sd	6.45E-07	1.9E-03	KGS
		Minimum				**8.07E-08**		
		Maximim				**1.82E-04**		
		Mean				**5.83E-06**		

Table C.6 Predicted 100 Day Distance Drawdown at Various Combined Pumping Rates

Distance	igpm	100	250	500	750	1,000	1,250	1,500	1,750	2,000
(m)	L/min	455	1,137	2,273	3,410	4,546	5,683	6,819	7,956	9,092
1		3.80	9.49	18.99	**28.48**	**37.97**	**47.47**	**56.96**	**66.46**	**75.95**
10		2.72	6.80	13.60	**20.40**	**27.19**	**33.99**	**40.79**	**47.59**	**54.39**
25		2.29	5.73	11.45	17.18	**22.90**	**28.63**	**34.36**	**40.08**	**45.81**
50		1.97	4.91	9.83	14.74	19.66	**24.57**	**29.49**	**34.40**	**39.32**
75		1.78	4.44	8.88	13.32	17.76	**22.20**	**26.64**	**31.08**	**35.52**
100		1.64	4.10	8.21	12.31	16.41	**20.52**	**24.62**	**28.72**	**32.83**
150		1.45	3.63	7.26	10.89	14.52	18.14	**21.77**	**25.40**	**29.03**
200		1.32	3.29	6.58	9.88	13.17	16.46	19.75	**23.04**	**26.34**
300		1.13	2.82	5.64	8.45	11.27	14.09	16.91	19.72	**22.54**
400		0.99	2.48	4.96	7.44	9.92	12.40	14.88	17.37	19.85
500		0.89	2.22	4.44	6.66	8.88	11.10	13.32	15.54	17.76
600		0.80	2.01	4.01	6.02	8.02	10.03	12.04	14.04	16.05
700		0.73	1.83	3.65	5.48	7.30	9.13	10.95	12.78	14.61
800		0.67	1.67	3.34	5.01	6.68	8.35	10.02	11.69	13.36
900		0.61	1.53	3.06	4.59	6.13	7.66	9.19	10.72	12.25
1000		0.56	1.41	2.82	4.22	5.63	7.04	8.45	9.86	11.27
1100		0.52	1.30	2.59	3.89	5.19	6.48	7.78	9.08	10.37
1200		0.48	1.19	2.39	3.58	4.78	5.97	7.17	8.36	9.56
1500		0.37	0.93	1.87	2.80	3.73	4.67	5.60	6.54	7.47
2000		0.24	0.60	1.19	1.79	2.39	2.98	3.58	4.18	4.78

47.47 below 40 m pump setting
28.48 within dewatering window

Pump Setting: 40 m (available drawdown 31-40, meam 34.5 m
CSG Bottom elevation: -18 m
Pumping Level Required: 20.9 to 22.0, mean 21.3 m



APPENDIX D

Water Chemistry Summary Tables

Table D.1 Field chemistry - Pumping Test PW1

Time (minutes)	Salinity (o/oo)	pH (units)	Conductivity (µS/cm)	Temperature (^{o}C)
10	0.33	8.27	430	5.50
300	0.33	6.82	461	8.03
1180	0.33	7.15	449	7.91
1345	0.33	7.28	463	9.13
1575	0.32	6.70	450	8.33
2968	0.32	6.81	429	7.27
Mean	**0.33**	**7.17**	**447**	**7.70**

Notes: o/oo - parts per thousand; µS/cm - microseimens/centimetre; ^{o}C - degrees Celsius

Table D.2 Results of Laboratory Analysis of General Chemistry Parameters in Groundwater

Parameters	Units	RDL	Guideline[1]	BH A1	OW1	PW1	PW1 Lab-Dup	OW8	OW8 Lab Dup	OW10
Sodium (Na)	mg/L	0.1	2,300	78.0	156.0	25.2		693.0		**4,280**
Potassium (K)	mg/L	0.0		6.0	7.8	0.8		45.6		98.4
Calcium (Ca)	mg/L	0.1		69.7	87.1	63.7		128.0		552.0
Magnesium (Mg)	mg/L	0.1		22.5	34.5	13.6		137.0		516.0
Total Alkalinity (Total as CaCO3)	mg/L	25	-	330.0	170.0	190.0	-	130.0	-	80.0
Dissolved Sulphate (SO4)	mg/L	10	-	57.0	50.0	23.0	-	200.0	-	990.0
Dissolved Chloride (Cl)	mg/L	1.0	2,300	78.0	360.0	31.0	-	1500.0	-	**8,600**
Reactive Silica (SiO2)	mg/L	0.50	-	12.0	13.0	12.0	-	6.3	-	8.2
Orthophosphate (P)	mg/L	0.010	-	nd	nd	nd	-	nd	-	nd
Phosphorus (P)	mg/L	0.100		<0.1	<0.1	<0.1		<0.1		<0.1
Nitrate + Nitrite	mg/L	0.050	-	nd	4.30	2.10	-	0.21	-	1.00
Nitrite (N)	mg/L	0.010	-	0.01	0.04	nd	-	0.01	-	0.04
Nitrogen (Ammonia Nitrogen)	mg/L	0.050	-	0.35	nd	nd	-	0.79	-	0.14
Colour	TCU	5.0	-	20	nd	nd	-	nd	-	nd
Turbidity	NTU	0.50	-	170	52	6.1	-	0.8	-	51.0
Conductivity	uS/cm	1.0	-	930	1,500	520	520	5,000	5,000	24,000
pH	pH	N/A	-	7.60	7.67	8.1	8.11	7.85	7.87	7.73
Hardness				267	360	215		883	-	3502
Total Organic Carbon (C)	mg/L	5.0	-	13 (1)	nd	nd	-	nd	-	nd

Notes:

[1] = Ontario Ministry of the Environment (MOE) Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act: Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for Industrial/Commercial Property Use

"-" = not analysed, not applicable or no applicable guideline

ND = Not Detected above the RDL

RDL = Reportable Detection Limit

Lab-Dup = Laboratory QA/QC duplicate sample

Bold/Shaded = value exceeds applicable criteria

Table D.3 Results of Laboratory Analysis of Dissolved Metals in Groundwater

Parameter	Units	RDL	Guideline[1]	BHA1	OW1	PW1	OW8	OW10
Aluminum (Al)	ug/L	5.0	-	nd	nd	nd	nd	nd
Antimony (Sb)	ug/L	1.0	20,000	nd	nd	nd	nd	nd
Arsenic (As)	ug/L	1.0	1,900	nd	nd	nd	nd	nd
Barium (Ba)	ug/L	1.0	29,000	109	109	28.4	128	123
Beryllium (Be)	ug/L	1.0	29	nd	nd	nd	nd	nd
Bismuth (Bi)	ug/L	2.0	-	nd	nd	nd	nd	nd
Boron (B)	ug/L	50	45,000	69	75	nd	238	1,130
Cadmium (Cd)	ug/L	0.017	2.7	nd	0.221	nd	0.135	0.59
Chromium (Cr)	ug/L	1.0	810	nd	nd	nd	nd	nd
Cobalt (Co)	ug/L	0.40	66	1.58	0.89	0.47	nd	nd
Copper (Cu)	ug/L	2.0	87	nd	nd	nd	nd	nd
Iron (Fe)	ug/L	50	-	296	nd	nd	72	nd
Lead (Pb)	ug/L	0.50	25	nd	nd	nd	nd	nd
Manganese (Mn)	ug/L	2.0	-	8,310	552	15.7	848	1,320
Molybdenum (Mo)	ug/L	2.0	9,200	nd	nd	nd	nd	nd
Nickel (Ni)	ug/L	2.0	490	nd	nd	nd	nd	nd
Selenium (Se)	ug/L	1.0	63	nd	nd	nd	nd	nd
Silver (Ag)	ug/L	0.10	1.5	nd	nd	nd	nd	nd
Strontium (Sr)	ug/L	2.0	-	316	395	130	1,330	2,210
Thallium (Tl)	ug/L	0.10	510	nd	nd	nd	nd	nd
Tin (Sn)	ug/L	2.0	-	nd	nd	nd	nd	nd
Titanium (Ti)	ug/L	2.0	-	nd	nd	nd	nd	nd
Uranium (U)	ug/L	0.10	420	0.38	0.38	2.21	4.31	nd
Vanadium (V)	ug/L	2.0	250	nd	nd	nd	nd	nd
Zinc (Zn)	ug/L	5.0	1,100	6.1	5.4	12.7	nd	nd

Notes:

[1] = Ontario Ministry of the Environment (MOE) Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act: Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for Industrial/Commercial Property Use (April 2011)

"-" = not analysed, not applicable or no applicable guideline

ND = Not Detected above RDL

RDL = Reportable Detection Limit

Table D.4 Results of Laboratory Analysis of Petroleum Hydrocarbons in Groundwater

Sample I.D.	Sample Date	BTEX Parameters (mg/kg)				Total Petroleum Hydrocarbons (mg/kg)					Resemblance/Comment
		Benzene	Toluene	Ethylbenzene	Xylenes	C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{50}	Modified TPH[2]	
BHA1	3-Feb-12	nd	nd	nd	nd	nd	nd	nd	-	nd	-
OW1	19-Dec-12	nd	0.003	nd	nd	nd	nd	nd	-	nd	-
PW1	9-Feb-13	nd	0.005	nd	nd	nd	nd	nd	-	nd	-
OW8	19-Dec-12	nd	nd	nd	nd	nd	0.065	nd	-	nd	No resemblance to petroleum hydrocarbons
OW10	19-Dec-12	nd	nd	nd	nd	nd	0.071	nd	-	nd	No resemblance to petroleum hydrocarbons
	RDL	0.001	0.001	0.001	0.002	0.01	0.05	0.05	0.1	0.1	-
	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	-
	Guidelines[1]	20	20	20	20	-	-	-	-	20	-

Notes:

1 = Atlantic Partners in RBCA (Risk-Based Corrective Action) Implementation (PIRI) Tier I Risk-Based Screening Levels (RBSLs) for a commercial/industrial site with non-potable groundwater, coarse grained soil, and fuel oil impacts (July 2012)

2 = TPH - C_6 - C_{32} (excluding BTEX).

RDL = Reportable Detection Limit.

ND = Not detected above standard RDL.

"-" = Not analyzed, not applicable or no applicable guideline.

Table D.4 Results of Laboratory Analysis of Petroleum Hydrocarbons in Groundwater

Sample I.D.	Sample Date	BTEX Parameters (mg/kg)				Total Petroleum Hydrocarbons (mg/kg)					Resemblance/Comment
		Benzene	Toluene	Ethylbenzene	Xylenes	C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{50}	Modified TPH[2]	
BHA1	3-Feb-12	nd	nd	nd	nd	nd	nd	nd	-	nd	-
OW1	19-Dec-12	nd	0.003	nd	nd	nd	nd	nd	-	nd	-
PW1	9-Feb-13	nd	0.005	nd	nd	nd	nd	nd	-	nd	-
OW8	19-Dec-12	nd	nd	nd	nd	nd	0.065	nd	-	nd	No resemblance to petroleum hydrocarbons
OW10	19-Dec-12	nd	nd	nd	nd	nd	0.071	nd	-	nd	No resemblance to petroleum hydrocarbons
	RDL	0.001	0.001	0.001	0.002	0.01	0.05	0.05	0.1	0.1	-
	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	-
	Guidelines[1]	20	20	20	20	-	-	-	-	20	-

Notes:

1 = Atlantic Partners in RBCA (Risk-Based Corrective Action) Implementation (PIRI) Tier I Risk-Based Screening Levels (RBSLs) for a commercial/industrial site with non-potable groundwater, coarse grained soil, and fuel oil impacts (July 2012)

2 = TPH - C_6 - C_{32} (excluding BTEX).

RDL = Reportable Detection Limit.

ND = Not detected above standard RDL.

"-" = Not analyzed, not applicable or no applicable guideline.

Table D.5 Results of Laboratory Analysis of Volatile Organic Compounds in Groundwater

Parameter	Units	RDL	Guideline[1]	BHA1	OW1	PW1	OW8	OW10
Chlorobenzenes								
1,2-Dichlorobenzene	ug/L	0.50	4,600	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	ug/L	1.0	9,600	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	ug/L	1.0	8	nd	nd	nd	nd	nd
Chlorobenzene	ug/L	1.0	630	nd	nd	nd	nd	nd
Volatile Organics								
1,1,1-Trichloroethane	ug/L	1.0	640	nd	nd	nd	nd	nd
1,1,2,2-Tetrachloroethane	ug/L	1.0	3.2	nd	nd	nd	nd	nd
1,1,2-Trichloroethane	ug/L	1.0	4.7	nd	nd	nd	nd	nd
1,1-Dichloroethane	ug/L	2.0	320	nd	nd	nd	nd	nd
1,1-Dichloroethylene	ug/L	0.50	1.6	nd	nd	nd	nd	nd
1,2-Dichloroethane	ug/L	1.0	1.6	nd	nd	nd	nd	nd
1,2-Dichloropropane	ug/L	1.0	16	nd	nd	nd	nd	nd
Benzene	ug/L	1.0	44	nd	nd	nd	nd	nd
Bromodichloromethane	ug/L	1.0	85,000	nd	nd	nd	nd	nd
Bromoform	ug/L	1.0	380	nd	nd	nd	nd	nd
Bromomethane	ug/L	3.0	5.6	nd	nd	nd	nd	nd
Carbon Tetrachloride	ug/L	1.0	0.79	nd	nd	nd	nd	nd
Chloroethane	ug/L	8.0	-	nd	nd	nd	nd	nd
Chloroform	ug/L	1.0	2.4	nd	nd	nd	nd	nd
Chloromethane	ug/L	8.0	-	nd	nd	nd	nd	nd
cis-1,2-Dichloroethylene	ug/L	2.0	1.6	nd	nd	nd	nd	nd
cis-1,3-Dichloropropene	ug/L	2.0	-	nd	nd	nd	nd	nd
Dibromochloromethane	ug/L	1.0	82,000	nd	nd	nd	nd	nd
Ethylbenzene	ug/L	1.0	2,300	nd	nd	nd	nd	nd
Ethylene Dibromide	ug/L	1.0	0.25	nd	nd	nd	nd	nd
Methylene Chloride(Dichloromethane)	ug/L	3.0	610	nd	nd	nd	nd	nd
o-Xylene	ug/L	1.0	-	nd	nd	nd	nd	nd
p+m-Xylene	ug/L	2.0	-	nd	nd	nd	nd	nd
Styrene	ug/L	1.0	1,300	nd	nd	nd	nd	nd
Tetrachloroethylene	ug/L	1.0	1.6	nd	nd	nd	nd	nd
Toluene	ug/L	1.0	18,000	nd	nd	5.8	nd	nd
trans-1,2-Dichloroethylene	ug/L	2.0	1.6	nd	nd	nd	nd	nd
trans-1,3-Dichloropropene	ug/L	1.0	-	nd	nd	nd	nd	nd
Trichloroethylene	ug/L	1.0	1.6	nd	nd	nd	nd	nd
Trichlorofluoromethane (FREON 11)	ug/L	8.0	2,500	nd	nd	nd	nd	nd
Vinyl Chloride	ug/L	0.50	0.5	nd	nd	nd	nd	nd
Total VOC	ug/L			0	0	5.8	0	0

Notes:

[1] = Ontario Ministry of the Environment

"-" = not analysed, not applicable or no applicable guideline

ND = Not Detected above RDL

RDL = Reportable Detection Limit

Table D.6 Results of Laboratory Analysis of Semivolatile Organic Compounds (incl. PAHs) in Groundwater

Parameter	Units	RDL*	Guideline[1]	BHA1	OW1	OW1 Lab-Dup	PW1	OW8	OW10
Acenaphthene	ug/L	0.2 (0.01)	600	nd	nd	nd	nd	nd	nd
Acenaphthylene	ug/L	0.2 (0.01)	1.80	nd	nd	nd	nd	nd	nd
Anthracene	ug/L	0.2 (0.01)	2.40	nd	nd	nd	nd	nd	nd
Benzo(a)anthracene	ug/L	0.2 (0.01)	4.70	nd	nd	nd	nd	nd	nd
Benzo(a)pyrene	ug/L	0.2 (0.01)	0.75	nd	nd	nd	nd	nd	nd
Benzo(b/j)fluoranthene	ug/L	0.2 (0.01)	0.75	nd	nd	nd	nd	nd	nd
Benzo(g,h,i)perylene	ug/L	0.2 (0.01)	0.20	nd	nd	nd	nd	nd	nd
Benzo(k)fluoranthene	ug/L	0.2 (0.01)	0.40	nd	nd	nd	nd	nd	nd
1-Chloronaphthalene	ug/L	1	-	nd	-	-	-	-	-
2-Chloronaphthalene	ug/L	0.5	-	nd	-	-	-	-	-
Chrysene	ug/L	0.2 (0.01)	1.00	nd	nd	nd	nd	nd	nd
Dibenz(a,h)anthracene	ug/L	0.2 (0.01)	0.52	nd	nd	nd	nd	nd	nd
Fluoranthene	ug/L	0.2 (0.01)	130	nd	nd	nd	nd	nd	nd
Fluorene	ug/L	0.2 (0.01)	400	nd	nd	nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	ug/L	0.2 (0.01)	0.20	nd	nd	nd	nd	nd	nd
1-Methylnaphthalene	ug/L	0.2 (0.01)	1,800	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	ug/L	0.2 (0.01)	1,800	nd	nd	nd	nd	nd	nd
Naphthalene	ug/L	0.2 (0.01)	1,400	nd	nd	nd	nd	nd	nd
Perylene	ug/L	0.2 (0.01)	-	nd	nd	nd	nd	nd	nd
Phenanthrene	ug/L	0.2 (0.01)	580	nd	nd	nd	nd	nd	0.024
Pyrene	ug/L	0.2 (0.01)	68	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	ug/L	0.5	4,600	nd	-	-	-	-	-
1,3-Dichlorobenzene	ug/L	0.5	9,600	nd	-	-	-	-	-
1,4-Dichlorobenzene	ug/L	0.5	8	nd	-	-	-	-	-
Hexachlorobenzene	ug/L	0.5	3.10	nd	-	-	-	-	-
Pentachlorobenzene	ug/L	0.5	-	nd	-	-	-	-	-
1,2,3,5-Tetrachlorobenzene	ug/L	0.5	-	nd	-	-	-	-	-
1,2,4,5-Tetrachlorobenzene	ug/L	0.5	-	nd	-	-	-	-	-
1,2,3-Trichlorobenzene	ug/L	0.5	-	nd	-	-	-	-	-
1,2,4-Trichlorobenzene	ug/L	0.5	180	nd	-	-	-	-	-
1,3,5-Trichlorobenzene	ug/L	0.5	-	nd	-	-	-	-	-
2-Chlorophenol	ug/L	0.3	3,300	nd	-	-	-	-	-
4-Chloro-3-Methylphenol	ug/L	0.5	-	nd	-	-	-	-	-
m/p-Cresol	ug/L	0.5	-	nd	-	-	-	-	-
o-Cresol	ug/L	0.5	-	nd	-	-	-	-	-
1,2,3,4-Tetrachlorobenzene	ug/L	0.5	-	nd	-	-	-	-	-
2,3-Dichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,4-Dichlorophenol	ug/L	0.3	4,600	nd	-	-	-	-	-
2,5-Dichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,6-Dichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
3,4-Dichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
3,5-Dichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,4-Dimethylphenol	ug/L	0.5	39,000	nd	-	-	-	-	-
2,4-Dinitrophenol	ug/L	10	11,000	nd	-	-	-	-	-
4,6-Dinitro-2-methylphenol	ug/L	7	-	nd	-	-	-	-	-
2-Nitrophenol	ug/L	0.5	-	nd	-	-	-	-	-
4-Nitrophenol	ug/L	1	-	nd	-	-	-	-	-
Pentachlorophenol	ug/L	1	62	nd	-	-	-	-	-
Phenol	ug/L	0.5	12,000	nd	-	-	-	-	-
2,3,4,5-Tetrachlorophenol	ug/L	0.4	-	nd	-	-	-	-	-
2,3,4,6-Tetrachlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,3,5,6-Tetrachlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,3,4-Trichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,3,5-Trichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,3,6-Trichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
2,4,5-Trichlorophenol	ug/L	0.5	1,600	nd	-	-	-	-	-
2,4,6-Trichlorophenol	ug/L	0.5	230	nd	-	-	-	-	-
3,4,5-Trichlorophenol	ug/L	0.5	-	nd	-	-	-	-	-
Benzyl butyl phthalate	ug/L	0.5	-	nd	-	-	-	-	-
Biphenyl	ug/L	0.5	1,000	nd	-	-	-	-	-
Bis(2-chloroethyl)ether	ug/L	0.5	300,000	nd	-	-	-	-	-
Bis(2-chloroethoxy)methane	ug/L	0.5	-	nd	-	-	-	-	-
Bis(2-chloroisopropyl)ether	ug/L	0.5	20,000	nd	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	ug/L	2	140	nd	-	-	-	-	-
4-Bromophenyl phenyl ether	ug/L	0.3	-	nd	-	-	-	-	-
p-Chloroaniline	ug/L	1	400	nd	-	-	-	-	-
4-Chlorophenyl phenyl ether	ug/L	0.5	-	nd	-	-	-	-	-
Di-N-butyl phthalate	ug/L	2	-	nd	-	-	-	-	-
Di-N-octyl phthalate	ug/L	0.8	-	nd	-	-	-	-	-

Table D.6 Results of Laboratory Analysis of Semivolatile Organic Compounds (incl. PAHs) in Groundwater

Parameter	Units	RDL*	Guideline[1]	BHA1	OW1	OW1 Lab-Dup	PW1	OW8	OW10
2,4-Dinitrotoluene	ug/L	0.5	2,900	nd	-	-	-	-	-
3,3'-Dichlorobenzidine	ug/L	0.5	640	nd	-	-	-	-	-
Diethyl phthalate	ug/L	1	38	nd	-	-	-	-	-
2,6-Dinitrotoluene	ug/L	0.5	2,900	nd	-	-	-	-	-
Dimethyl phthalate	ug/L	1	38	nd	-	-	-	-	-
Diphenyl Ether	ug/L	0.3	-	nd	-	-	-	-	-
Hexachlorobutadiene	ug/L	0.4	0.44	nd	-	-	-	-	-
Hexachlorocyclopentadiene	ug/L	2	-	nd	-	-	-	-	-
Hexachloroethane	ug/L	0.5	94	nd	-	-	-	-	-
Isophorone	ug/L	0.5	-	nd	-	-	-	-	-
Nitrobenzene	ug/L	0.5	-	nd	-	-	-	-	-
Nitrosodiphenylamine/Diphenylar	ug/L	1	-	nd	-	-	-	-	-
N-Nitroso-di-n-propylamine	ug/L	0.5	-	nd	-	-	-	-	-
Total SVOC	ug/L			0	0	0	0	0	0.024

Notes:

[1] = Ontario Ministry of the Environment (MOE) Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act: Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for Industrial/Commercial Property Use (April 2011)

"-" = not analysed, not applicable or no applicable guideline

ND = Not Detected above RDL

RDL = Reportable Detection Limit; RDL in brackets for OW series data

Table D.7 Results of Laboratory Analysis of Polychlorinated Biphenyls in Groundwater

Sample ID	Sampling Date	Total PCBs (ug/L)
BH A1	3-Feb-12	nd
OW1	19-Dec-12	nd
OW8	19-Dec-12	nd
OW10	9-Dec-12	nd
PW1	9-Feb-13	nd
PW1 Lab-Dup	9-Feb-13	nd
	RDL	0.05
	Guideline[1]	0.2

Notes:

1 = Ontario Ministry of the Environment (MOE) Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act: Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for Industrial/Commercial Property Use (April 2011)

ND = Not Detected above the RDL.

RDL = Reportable Detection Limit.

"-" = Not analysed, not applicable or no applicable guideline.

Lab-Dup = Laboratory QA/QC duplicate sample