Technical Data Report

Coastal Operations and Sensitivity Mapping for the Confined Channel Assessment Area

ENBRIDGE NORTHERN GATEWAY PROJECT

Polaris Applied Sciences Inc.
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2010
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### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>British Columbia</td>
</tr>
<tr>
<td>CCAA</td>
<td>Confined Channel Assessment Area</td>
</tr>
<tr>
<td>CRIMS</td>
<td>Coastal Resource Information Management System</td>
</tr>
<tr>
<td>DFO</td>
<td>Fisheries and Oceans Canada</td>
</tr>
<tr>
<td>ILMB</td>
<td>Integrated Land Management Bureau</td>
</tr>
<tr>
<td>SCAT</td>
<td>Shoreline Cleanup Assessment Technique</td>
</tr>
<tr>
<td>SSOG</td>
<td>Southern Strait of Georgia</td>
</tr>
<tr>
<td>TDR</td>
<td>Technical Data Report</td>
</tr>
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</table>
1 Introduction

Shoreline information can help to identify resources that might be affected by a hydrocarbon spill. After a spill, the focus of the initial response actions is on safety, limiting the size of the affected area and protecting previously identified sensitive areas. A coastal sensitivity atlas, together with a comprehensive marine and shoreline database, helps decision-makers identify and prioritize the protection of areas in the event of an emergency response.

Information on the following was collected for the confined channel assessment area (CCAA):

- shoreline types (e.g., mud, sand and rock)
- shoreline sensitivity (e.g., areas of ecological importance or importance to Aboriginal groups)
- coastal operations (e.g., locations of airports, boat launches and anchorages)

The information collected is based on existing information provided by the Government of British Columbia. Verification of data (shoreline ground-truthing) is proposed in collaboration with participating local Aboriginal groups. Appendices C and D summarize biological, physical, logistical and Aboriginal resources along the shoreline of the CCAA. Operations and sensitivity maps will be revised after receiving information from ground truthing and input from participating Aboriginal groups and stakeholders.

1.1 Objectives

The purpose of this report is to describe the baseline biophysical (sensitivity) and operational characteristics of the CCAA (Douglas Channel to Chatham Sound, and Principe Channel) that are important for spill response consideration.
2 Methods

The Government of British Columbia has developed oil spill sensitivity atlases for Southern Georgia Strait and West Vancouver Island. The atlas developed for the Enbridge Northern Gateway Project (the Project) generally follows the Government’s approach in terms of content and format.

2.1 Study Area for Existing Data Review

Numerous sources of information were reviewed, many of which contained province-wide data. Within the datasets reviewed (see below), only the information pertinent to the CCAA (see Figure 2-1) was used for the coastal maps generated. The geographic extent of each coastal map is shown in Figure 2-2. (For an explanation of the index map numbering, see Section 3.2).

Information for this report has been generated and synthesized from existing literature sources and field surveys for the following key data categories:

- coastal oil spill response operations and logistics:
  - boat ramps
  - marinas and anchorages
  - airports and heliports
  - wharves, mooring structures and piers
  - shoreline substrate
  - oil residency
  - fish processors
  - nearshore bathymetry
  - log rafting and dump areas

- coastal sensitivities to oil spills:
  - anadromous fish streams
  - coastal biophysical characteristics (British Columbia shoreline classification)
  - herring spawning areas
  - hatcheries
  - shellfish aquaculture sites
  - shorebird concentration areas
  - coastal areas used by Aboriginal groups
  - parks, ecological reserves and marine protected areas
  - rock fish conservation areas
  - finfish concentration areas
  - marine mammal haulout and concentration areas (harbour seals)
  - long-term oil residency (protected fine-grained beaches and coarse, porous beaches – cobble, pebble or boulder)
2.1.1 Study Area for Field Surveys

Coastal mapping focused on the CCAA (see Figure 2-1). The CCAA encompasses Douglas Channel to Chatham Sound and an alternative tanker route through Principe Channel.

The coastal atlas maps encompass the CCAA (see Figures 2-1 and 2-2), but the detailed shoreline database includes a broader area, particularly in Chatham and Caamaño Sounds.

2.2 Review of Existing Data Sources

Shoreline and coastal information for the CCAA atlas was compiled from public databases, reports and from other studies (e.g., for fisheries and marine mammals). The foundation for most of the atlas database was the shoreline data maintained by the Integrated Land Management Bureau (ILMB) of the British Columbia provincial government (ILMB 2009a, Internet site; see also Appendix A). The primary databases and shoreline imagery consulted for additional information include:

- ILMB coastal datasets
- Coastal Resource Information Management System (CRIMS) (ILMB 2009b, Internet site)
- Fisheries and Oceans Canada (DFO)
- British Columbia Parks
- Coastal Aerial Survey Videotapes (1999 and 2000) that were collected in development of the ILMB source data (see Figure 2-3)

The Government of British Columbia has a program to develop a map index of shoreline sensitivity to oil spills and oil spill cleanup countermeasures. That effort will encompass the British Columbia coastal area. For this TDR and the coastal atlas, coastal sensitivity with respect to oil spills is simplified into two categories:

- coastline where long-term oil persistence would be possible or likely, because of combined low wave energy exposure and coarse, porous substrate (such as cobble or boulder)
- coastline where oil effects and persistence could be longer term, because of low-energy, fine-grained habitats such as mud-vegetated flats

These two sensitivity categories are derived from shoreline attributes in the British Columbia database: coastal class and exposure. Because exposure is defined several ways in the British Columbia database, the attribute selected for defining low wave exposure is, in order of preference and as available in the British Columbia database:

1. observed exposure
2. calculated exposure
3. biological exposure

The British Columbia biophysical shorezone mapping database was imported into a Microsoft Access™ database (see Figure 2-4) to allow for easier and cleaner ties between shore segments and associated data fields. In doing this, the team discovered a number of inaccuracies or conflicts in the British Columbia data. Many of these were resolved and communicated to the ILMB.
**Video Coverage**

**BC Shoreline**

**Survey Year**

- 1997
- 1998
- 1999
- 2000

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**REFERENCES:**


**PROJECT:**


**DATE:**

[3] 20100226

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**CONTRACTOR:**

Polaris Applied Sciences, Inc.

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**ENBRIDGE NORTHERN GATEWAY PROJECT**

Aerial Videotape

Shoreline Coverage

---

**APPENDIX D**

1. NAD 83
The Microsoft Access database provides a direct linkage between shore segments, coastal attributes and the aerial video survey videotape imagery that were acquired and re-sampled (converted from video to sub-sample digital fixed image frames) from the ILMB. DVDs with digital aerial video footage were prepared as a complementary component of the coastal atlas and are linked to segments defined in the MS Access database.

2.3 Field Surveys

A preliminary field survey was conducted from small vessels between September 7 and 18, 2005. The surveyed area encompassed Kitimat Arm, Douglas Channel and Principe Channel. The survey resulted in additional information on area sensitivities and operations considerations for oil spill response planning, as well as time requirements for potential shoreline ground-truthing of the data.
3 Results of Baseline Investigations

3.1 Shoreline Classification

The ILMB mapping program divides the shoreline into units based on 35 coastal class types. The units are further divided using alphanumeric codes and described in detail. As it was impractical to create unique distinguishable colour bands or symbols for the 35, the classes were reduced to 15 types (using a British Columbia translation matrix). The 15 shoreline types in the CCAA coastal atlas are the same types as those used in the Southern Strait of Georgia (SSOG) atlas.

The CCAA is represented by 10,271 shoreline units encompassing approximately 3,500 km of shoreline (see Table 3-1). The predominant shoreline type in the CCAA is rock with gravel beach (29%), followed by rock, sand and gravel beach (25%) and rock cliff (21%), forming a combined 75% of the shoreline in the area (see Figure 3-1). For details of shoreline types, see Appendix B.

Table 3-1 Shoreline Types in the CCAA

<table>
<thead>
<tr>
<th>Type</th>
<th>Type Name</th>
<th>Kilometres</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Rock platform</td>
<td>26</td>
<td>0.74</td>
</tr>
<tr>
<td>3</td>
<td>Rock cliff</td>
<td>722</td>
<td>20.61</td>
</tr>
<tr>
<td>4</td>
<td>Rock with gravel beach</td>
<td>1,027</td>
<td>29.30</td>
</tr>
<tr>
<td>5</td>
<td>Rock, sand and gravel beach</td>
<td>865</td>
<td>24.68</td>
</tr>
<tr>
<td>6</td>
<td>Rock with sand beach</td>
<td>24</td>
<td>0.69</td>
</tr>
<tr>
<td>7</td>
<td>Gravel beach</td>
<td>66</td>
<td>1.88</td>
</tr>
<tr>
<td>8</td>
<td>Gravel flat</td>
<td>12</td>
<td>0.33</td>
</tr>
<tr>
<td>9</td>
<td>Sand and gravel beach</td>
<td>80</td>
<td>2.29</td>
</tr>
<tr>
<td>10</td>
<td>Sand beach</td>
<td>17</td>
<td>0.49</td>
</tr>
<tr>
<td>11</td>
<td>Sand and gravel flat</td>
<td>160</td>
<td>4.57</td>
</tr>
<tr>
<td>12</td>
<td>Sand flat</td>
<td>393</td>
<td>11.20</td>
</tr>
<tr>
<td>13</td>
<td>Mud flat</td>
<td>3</td>
<td>0.08</td>
</tr>
<tr>
<td>14</td>
<td>Estuary, marsh or lagoon</td>
<td>99</td>
<td>2.83</td>
</tr>
<tr>
<td>15</td>
<td>Channel</td>
<td>3</td>
<td>0.08</td>
</tr>
<tr>
<td>16</td>
<td>Man-made</td>
<td>8</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>Total shoreline</td>
<td>3,505</td>
<td>100</td>
</tr>
</tbody>
</table>

NOTE: Based on the ILMB database (ILMB 2009a, Internet site), with revisions.
Figure 3-1  Shoreline Types in the CCAA
3.2 Shoreline Operations Maps

Shoreline types are mapped by class (see Table 3-1). Operations maps are indexed by British Columbia region (see Appendix C), with the letter prefix corresponding to one of the following regions:

- D- Douglas Channel (e.g., D01 corresponds to the first map in the Douglas Channel series, located at Kitimat) (Maps D01-D09)
- C- Chatham Sound (C01-C13)
- P- Principe Channel (P01-P05)
- N- North Area (N01-N09)

Appendix C provides 36 operational maps covering the CCAA. An index map (see Figure C-1) is provided with the atlas, and shown in the inset on each map, to indicate the location of each map.

Oil residency is shown graphically in the operations maps. Oil residency is defined in the following categories:

- long (months to years)
- medium-long (months to years)
- medium (weeks to months)
- short-medium (weeks to months)
- short (days to weeks)

These categories are computed summaries for oil residency provided by the British Columbia biophysical mapping project and are based on combinations of shore surface area, exposure to waves, substrate (or shore class) and slope.

Bathymetry for the nearshore is displayed at 10 m depth intervals up to 100 m. Additional operational and logistical information that has been added to the atlas maps from ILMB data sources and field survey results include locations of key features such as:

- marinas
- boat launch sites or boat ramps
- anchoring sites
- log raft or log dump (marshalling) areas
- mooring buoys, mooring structures, pilings
- airports and heliports
- submarine cables (no anchoring zones)
- fish processors (potential water intake sites)
3.3 Shoreline Sensitivity Maps

The British Columbia shorezone biophysical inventory describes nearshore and shoreline species, distribution and related information. Biozones and biobanding are two aspects included in the shorezone characterization studies and databank. The concept of cross-shore mapping and banding is summarized by Howes (2002, Internet site) (see also Figure 3-2). The British Columbia government is working to develop shoreline sensitivity mapping, including sensitivities to oiling and to oil cleanup, using indicator species in cross-shorezone assemblages (Morris 2005). A preliminary shoreline sensitivity index for the British Columbia coastline has been in development for several years (Ogborne, pers. comm.). When this TDR was prepared, the province-wide coastal sensitivity maps were not available.

Sensitivity maps were indexed by British Columbia region and maps were prepared at a scale of 1:57,000 (see Appendix D).

Information displayed on the 36 coastal sensitivity maps includes:

- eulachon spawning rivers
- fish hatcheries
- salmon rivers
- sea lion haulout areas
- herring spawning areas
- shorelines most sensitive to oiling:
- long oil residency: fine-grained (silt-mud) flats, marshes and lagoons
- oil penetration and remobilization potential: coarse-grained (cobble, cobble-boulder mix) beaches
- areas used by Aboriginal groups for fishing
- finfish areas
- shellfish aquaculture sites
- rockfish conservation areas
- areas used by Aboriginal groups (and a 1-km buffer)
- shore bird concentration areas
- parks and recreation areas
- ecological reserves
- protected areas (marine)
- marine parks

The timing (or seasonality) of resource sensitivity is to be added to the database or on the maps. The timing is important in coastal atlases developed for oil spill response, given that a resource may merit very high priority at certain times of the year (e.g., during sea otter pupping and haulouts).
Figure 3-2  Physical Shorezone (top) and Biophysical Cross-shore (bottom) used in British Columbia Shore Mapping
3.3.1 Parks, Ecological Reserves and Marine Protected Areas

A review of all parks, ecological reserves and marine protected areas was compiled and included on the sensitivity maps (see Tables 3-2 and 3-3 and Figure 3-3). The maps and atlas presented here are a compilation of information that was available at the time the draft atlas was prepared. As with all spill response planning documents, the atlas is subject to reviews, revisions, and updates as information becomes available or changes. According to information published by British Columbia Parks, the sole ecological reserve within the CCAA is the Dewdney and Glide Islands Ecological Reserve in Chatham Sound. British Columbia Parks states:

The purpose of the Ecological Reserve Act is to reserve Crown land for ecological purposes, including the following areas:

- Areas suitable for scientific research and educational purposes associated with studies in productivity and other aspects of the natural environment;
- Areas that are representative examples of natural ecosystems in British Columbia;
- Areas that serve as examples of ecosystems that have been modified by human beings and offer an opportunity to study the recovery of the natural ecosystem from modification;
- Areas where rare or endangered native plants and animals in their natural habitat may be preserved;
- Areas that contain unique and rare examples of botanical, zoological or geological phenomena.

The legislation guiding the program is very restrictive and all extractive activities are prohibited. As such, ecological reserves are considered to be the areas most highly protected and least subject to human influence.

The following marine protected areas are located in the CCAA:

- Foch-Gilttoyes Protected Area
- Jesse Falls Protected Area

3.3.2 Aboriginal Resources

The atlas sensitivity maps (see Appendix D) show the following with respect to Aboriginal resources:

- areas used by Aboriginal groups for fishing
- areas used by Aboriginal groups (and a 1-km buffer)
- hatcheries

The 1-km buffer added to areas used by Aboriginal groups is provided primarily to highlight the areas that are immediately adjacent to villages and that are likely to be for traditional use. Note that the maps do not show sites of cultural and historical significance, as locations of such sites are not publicly available. Aboriginal territories and lands and areas of Aboriginal interest in and near the CCAA will be updated following further consultation with participating Aboriginal groups and potential shoreline ground-truthing.
### Table 3-2  Marine Parks in the CCAA

<table>
<thead>
<tr>
<th>Special Area</th>
<th>Location</th>
<th>Logistics</th>
<th>Operational Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Inlet Marine Park</td>
<td>Located on the east side of Tolmie Channel across from Princess Royal</td>
<td>Accessible by boat only. Sheltered all-weather anchorage of</td>
<td>The tidal lagoon of Green Inlet with the reversing rapids at Baffle Point is not navigable.</td>
</tr>
<tr>
<td></td>
<td>Island, just west of Fiordland Recreation Area</td>
<td>Horsefly Cove</td>
<td></td>
</tr>
<tr>
<td>Klewnuggit Inlet Marine Park</td>
<td>Northeast shore and midway along Granville Channel.</td>
<td>Accessible by boat only. No vehicle access</td>
<td>The best anchorage can be found at the north end of the East Inlet in nine fathoms over a nice bottom.</td>
</tr>
<tr>
<td>Lowe Inlet Marine Park</td>
<td>Northeast shore of Granville Channel. The area around the falls, including</td>
<td>Accessible by boat only. No vehicle access</td>
<td>Visitors may anchor on either side of or in front of the falls.</td>
</tr>
<tr>
<td></td>
<td>the trails, is a First Nations Reserve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Union Passage Marine Provincial Park</td>
<td>Southern entrance to Granville Channel between Pitt and Farrant Islands.</td>
<td>Union Passage is reached using narrow entrances to the</td>
<td>These passages are swept by powerful currents and should be entered cautiously.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>northeast or southwest.</td>
<td></td>
</tr>
</tbody>
</table>

**SOURCE:** BC MOE 2009a, Internet site

### Table 3-3  Ecological Reserves in the CCAA

<table>
<thead>
<tr>
<th>Area Name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dewdney and Glide Islands</td>
<td>Dewdney and Glide Islands Ecological Reserve was established to provide a research area containing extensive bog and fen ecosystems representative of outer islands along the northern mainland coast. (Closed to the public.)</td>
</tr>
</tbody>
</table>

**SOURCE:** BC MOE 2009b, Internet site
3.3.3 Conservancies

Conservancies, such as protected areas and biodiversity areas or pending conservancies (as of 2008), are found throughout the CCAA (see Figure 3-3). Conservancies are not currently included on sensitivity maps (see Appendix D), as many conservancies had only ‘proposed’ status when the draft atlas was prepared. In addition, as conservancies cover relatively large areas, they are not necessarily helpful for identifying shoreline-specific sensitivities for focusing spill response efforts. Atlas maps will be updated with input from participating Aboriginal groups and stakeholders, and information from potential shoreline ground-truthing. Conservancies may be added at that time.

As stated by British Columbia Parks:

Conservancies are set aside for:

a) the protection and maintenance of their biological diversity and natural environments;

b) the preservation and maintenance of social, ceremonial and cultural uses of first nations;

c) the protection and maintenance of their recreational values; and

d) to ensure that development or use of their natural resources occurs in a sustainable manner consistent with the purposes of paragraphs (a), (b) and (c) [Park designations].

Highlights of the conservancy designation are as follows:

- The new (2008) conservancy designation explicitly recognizes the importance of these areas to Aboriginal groups for social, ceremonial and cultural uses.
- Commercial logging, mining and hydroelectric power generation, other than local run-of-the-river projects, are prohibited in a conservancy.
- Conservancies provide for a wider range of low impact, compatible economic opportunities than a Class A park. These economic opportunities must still not restrict, prevent or hinder the conservancy from meeting its intended purpose with respect to maintaining biological diversity, natural environments, Aboriginal group social, ceremonial and cultural uses, and recreational values.

Conservancies can be designated by two means. Conservancies can be established by either order in council under the Park Act or by inclusion in a schedule to the Protected Areas of British Columbia Act. Presently, all conservancies are established by inclusion in schedules to the Protected Areas of British Columbia Act.
4 References

4.1 Literature Cited

4.2 Personal Communication

4.3 Internet Sites


Appendix A  Atlas Data Sources
### Table A-1  Atlas Data Sources

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Year</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eulachon</td>
<td>2000</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Hatcheries</td>
<td>2001</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Community hatcheries</td>
<td>2001</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Northern Gateway pipeline</td>
<td>2005</td>
<td>Project environmental team</td>
</tr>
<tr>
<td>Salmon rivers</td>
<td>2001</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Chinook present</td>
<td>2001</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Coho present</td>
<td>2001</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Sea lion areas</td>
<td>2003*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Long oil residency</td>
<td>2007</td>
<td>Based on the shore units file from the ILMB</td>
</tr>
<tr>
<td>Herring spawning</td>
<td>2003*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Herring spawning</td>
<td>2007</td>
<td>DFO - GIS</td>
</tr>
<tr>
<td>Aboriginal group fisheries</td>
<td>2004</td>
<td>DFO</td>
</tr>
<tr>
<td>Finfish</td>
<td>2005</td>
<td>BC ftp site</td>
</tr>
<tr>
<td>Shellfish aquaculture</td>
<td>2004</td>
<td>BC ftp site</td>
</tr>
<tr>
<td>Rockfish conservation areas</td>
<td>2005</td>
<td>DFO - <a href="http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC">http://www-heb.pac.dfo-mpo.gc.ca/maps/themesdata_e.htm#DFOBC</a></td>
</tr>
<tr>
<td>Areas used by Aboriginal groups</td>
<td>2007</td>
<td>ILMB</td>
</tr>
<tr>
<td>Areas used by Aboriginal groups: 1-km buffer</td>
<td>2007</td>
<td>Polaris - based on shape file for areas used by Aboriginal groups (above)</td>
</tr>
<tr>
<td>Shorebird areas</td>
<td>2003*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Additional shorebird areas</td>
<td>2006</td>
<td>Project environmental team</td>
</tr>
<tr>
<td>Ecological reserves</td>
<td>2009</td>
<td>BC Parks</td>
</tr>
<tr>
<td>Marine protected areas</td>
<td>2009*</td>
<td>BC Parks</td>
</tr>
<tr>
<td>Point data operations</td>
<td>2005</td>
<td>Project environmental team</td>
</tr>
<tr>
<td>Marina</td>
<td>2001*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Moorage</td>
<td>2001*</td>
<td>BC CRIMS</td>
</tr>
</tbody>
</table>
## Table A-1  Atlas Data Sources (cont’d)

<table>
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<th>Data Type</th>
<th>Year</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>Boat launch</td>
<td>2001*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Anchor site</td>
<td>2001*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Hazards</td>
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<td>BC CRIMS</td>
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<td>2004*</td>
<td>BC CRIMS</td>
</tr>
<tr>
<td>Shoreline types</td>
<td>2007</td>
<td>Based on the shore units file from the ILMB</td>
</tr>
<tr>
<td>Oil residency</td>
<td>2007</td>
<td>Based on the shore units file from the ILMB</td>
</tr>
<tr>
<td>Bathymetry</td>
<td>2005</td>
<td>Contoured from data points provided by Northern Gateway</td>
</tr>
<tr>
<td>Sat photos (Landsat)</td>
<td>2000</td>
<td>Project environmental team</td>
</tr>
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**NOTE:**
*Metadata provides the update date, but not the date of all individual data*
Appendix B  BC Coastal Shoreline Types
Table B-1 BC Coastal Shoreline Types

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<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>- NONE -</td>
<td>Not Defined (Not Applicable)</td>
</tr>
<tr>
<td>2</td>
<td>Rock Platform</td>
<td>Near horizontal rocky intertidal areas &gt;30 m in width. A thin sediment veneer may be associated with the ramps but the veneer is typically patchy and there are no organized beach features. Most commonly associated with sedimentary bedrock outcrops.</td>
</tr>
<tr>
<td>3</td>
<td>Rock Cliff</td>
<td>Steep sloped (&gt;20°) rock coasts. Small pockets of sediment occur sporadically within the indentations along the coast.</td>
</tr>
<tr>
<td>4</td>
<td>Rock with Gravel Beach</td>
<td>Rock and pockets of clastic sediments (rubble, boulder, cobble or pebble beach). Sediments can occur on well-developed beach forms, such as berms or beach terraces, or as large patches of sediment in an otherwise rocky shoreline. Beaches typically occur in the middle to upper intertidal zones and often include log deposits in the supratidal zone.</td>
</tr>
<tr>
<td>5</td>
<td>Rock, Sand and Gravel Beach</td>
<td>Rock with pockets of clastic sediments including sand beaches; they typically occur in the middle to upper intertidal zones and often include log deposits in the supratidal zone. The gravel in the lower and middle intertidal zones frequently occurs as armour over the sand–gravel mixture. Distributions may be intermittent and patchy along the coast within small indentations.</td>
</tr>
<tr>
<td>6</td>
<td>Rock with Sand Beach</td>
<td>Similar characteristics to a rock platform but with a sand beach (sand content &gt;90%). The beaches typically occur in the middle to upper intertidal zones and often include log deposits in the supratidal zone. Distributions may be patchy, occurring intermittently along the coast within small indentations.</td>
</tr>
<tr>
<td>7</td>
<td>Gravel Beach</td>
<td>Sediments usually consist of a boulder- cobble- pebble mixture with &lt;10% sand content. Beach slopes are in the range of 5° to 20° with the berm at the steepest part of the intertidal zone. Lower to middle intertidal zones are commonly armoured. Because of the low sand content, these beaches are highly permeable.</td>
</tr>
<tr>
<td>8</td>
<td>Gravel Flat</td>
<td>Sediments usually consist of a boulder- cobble- pebble mixture with &lt;10% sand content. Beach slopes are low (&lt; 5°), with the berm at the steepest part of the intertidal zone. Lower to middle intertidal zones are commonly armoured. Because of the low sand content these beaches are highly permeable.</td>
</tr>
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### Table B-1  BC Coastal Shoreline Types (cont’d)

<table>
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<tr>
<th>Type</th>
<th>Name</th>
<th>Definition</th>
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<tr>
<td>9</td>
<td>Sand and Gravel Beach</td>
<td>Sediments are a mixture of boulders, cobbles, pebbles and sand (&gt;10% sand content and &gt;10% gravel content). Beach slopes are in the range of 5° to 20° with the berm at the steepest part of the intertidal zone. Lower to middle intertidal zones are commonly armoured by cobbles, with the sand layer in the subsurface. These beaches usually have a permeability similar to that of sand beaches.</td>
</tr>
<tr>
<td>10</td>
<td>Sand Beach</td>
<td>Sediments are &lt;10% gravel and &gt;50% sand. Beach slopes are in the range of 5° to 20° with the berm at the steepest part of the intertidal zone. Sediments are highly mobile in moderate to high energy exposure areas. Beach permeability may range from high to low depending on the mud content of the beach. Ridge and runnels or swash bars may occur in the lower or middle intertidal zones.</td>
</tr>
<tr>
<td>11</td>
<td>Sand and Gravel Flat</td>
<td>Sediments are a mixture of boulders, cobbles, pebbles and sand (&gt;10% sand content and &gt;10% gravel content). Beach slopes are low (&lt;5°), with the berm at the steepest part of the intertidal zone. Lower to middle intertidal zones are commonly armoured by cobbles, with the sand layer in the subsurface. These beaches usually have a permeability similar to that of sand beaches.</td>
</tr>
<tr>
<td>12</td>
<td>Sand Flat</td>
<td>Sediments are &lt;10% gravel and &gt;50% sand. Beach slopes are low (&lt;5°), with the berm at the steepest part of the intertidal zone. Beach permeability may range from high to low depending on the mud content of the beach. Multiple ridge and runnels or swash bars are common in the lower or middle intertidal zones.</td>
</tr>
<tr>
<td>13</td>
<td>Mud Flat</td>
<td>Sediments are &lt;10% gravel and &gt;50% mud. Beach slopes are low (&lt;5° to 20°), with the berm at the steepest part of the intertidal zone. Berm sediments, located near the high-tide mark are usually coarser than those of the beach flat. Beach permeability is low due to the high mud content.</td>
</tr>
<tr>
<td>14</td>
<td>Estuary, Marsh or Lagoon</td>
<td>Estuaries are characterized by high variable distributions in texture, although muds and organics are common. Marshes frequently rim the estuary at the high water mark. Brackish water conditions are common due to freshwater input to the estuary from stream runoff. Exclusively confined to low wave exposure environments.</td>
</tr>
<tr>
<td>15</td>
<td>Channel</td>
<td>A current-dominated region in the intertidal area as opposed to a wave-dominated area in the intertidal area composed of either bedrock or sediment substrate.</td>
</tr>
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Table B-1  BC Coastal Shoreline Types (cont’d)

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<tr>
<th>Type</th>
<th>Name</th>
<th>Definition</th>
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<tr>
<td>16</td>
<td>Man-made</td>
<td>Man-made features or structures within the intertidal zone such as wharves, seawalls, breakwaters, log dumps, boat ramps, marinas and piers. Common construction materials are; concrete, timber, pilings, rubble and rock. Intertidal zone widths are often narrow due to the vertical nature of most structures.</td>
</tr>
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</table>

SOURCE: ILMB 2009a
Appendix C Coastal Operations Maps
Table C-1 Coastal Operations Atlas Key

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</table>
Shoreline Types
- Estuary, Marsh or Lagoon
- Mud Flat
- Sand Flat
- Sand Beach
- Sand and Gravel Beach
- Sand and Gravel or Gravel Flat
- Gravel Beach
- Rock and Gravel Beach
- Rock and Sand Beach
- Rock and Sand and Gravel Beach
- Rock Platform
- Rock Cliff
- Man-made

Oil Residency
- Long (months to years)
- Medium-Long (months to years)
- Medium (weeks to months)
- Short-Medium (weeks to months)
- Short (days to weeks)

Logistics
- Marina
- Dolphin/Mooring Buoy/Pillings
- Boat Launch
- Anchor Site
- Log Raft/Dump
- Submarine Cable
- Airport
- Heliport
- Processors
- Bathymetry (m)

REFERENCES: WGS 84
1:57,000 UTM N9
FIGURE NUMBER: C-4
PROJECTION: ENBRIDGE NORTHERN GATEWAY PROJECT
CONTRACTOR: Polaris Applied Sciences, Inc.
DATE: 20090720
AUTHOR: AWG
APPROVED BY: ET
PREPARED FOR: PREPARED BY:
SCALE: 1:57,000 DATUM: WGS 84
DATUM: UTM N9

Chatham Sound Operations Map
(Map C03)
Shoreline Types
- Estuary, Marsh or Lagoon
- Mud Flat
- Sand Flat
- Sand Beach
- Sand and Gravel Beach
- Sand and Gravel or Gravel Flat
- Gravel Beach
- Rock and Gravel Beach
- Rock and Sand Beach
- Rock and Sand and Gravel Beach
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Oil Residency
- Long (months to years)
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- Boat Launch
- Anchor Site
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- Heliport
- Processors
- Bathymetry (m)

REFERENCES:
WGS 84
1:57,000

FIGURE NUMBER:
PROJECTION:
CONTRACTOR:
DATE:
AUTHOR:
APPROVED BY:
PREPARED FOR:
PREPARED BY:

ENBRIDGE NORTHERN GATEWAY PROJECT
Chatham Sound Operations Map
(Map C05)

Shoreline Types
- Estuary, Marsh or Lagoon
- Mud Flat
- Sand Flat
- Sand Beach
- Sand and Gravel Beach
- Sand and Gravel or Gravel Flat
- Gravel Beach
- Rock and Gravel Beach
- Rock and Sand Beach
- Rock and Sand and Gravel Beach
- Rock Platform
- Rock Cliff
- Man-made

Oil Residency
- Long (months to years)
- Medium-Long (months to years)
- Medium (weeks to months)
- Short-Medium (weeks to months)
- Short (days to weeks)

Logistics
- Marina
- Dolphin/Mooring Buoys/Pillings
- Boat Launch
- Anchor Site
- Log Raft/Dump
- Submarine Cable
- Airport
- Heliport
- Processors
- Bathymetry (m)

REFERENCES:
WGS 84
1:57,000

FIGURE NUMBER:
PROJECTION:
CONTRACTOR:
DATE:
AUTHOR:
APPROVED BY:
PREPARED FOR:
PREPARED BY:

ENBRIDGE NORTHERN GATEWAY PROJECT
Chatham Sound Operations Map
(Map C05)
Shoreline Types:
- Estuary, Marsh or Lagoon
- Mud Flat
- Sand Flat
- Sand Beach
- Sand and Gravel Beach
- Sand and Gravel or Gravel Flat
- Gravel Beach
- Rock and Gravel Beach
- Rock and Sand Beach
- Rock and Sand and Gravel Beach
- Rock Platform
- Rock Cliff
- Man-made

Oil Residency:
- Long (months to years)
- Medium-Long (months to years)
- Medium (weeks to months)
- Short-Medium (weeks to months)
- Short (days to weeks)

Logistics:
- Marina
- Dolphin/Mooring Buoy/Pillings
- Boat Launch
- Anchor Site
- Log Raft/Dump
- Submarine Cable
- Airport
- Heliport
- Processors
- Bathymetry (m)

REFERENCES:
- WGS 84
- 1:57,000
- DATUM: AWG
- SCALE: 1:57,000
- PROJECTION: UTM N9
- FIGURE NUMBER: C-7
- CONTRACTOR: Polaris Applied Sciences, Inc.
- PREPARED BY: AWG
- DATE: 20090720
- APPROVED BY: ET
- AUTHOR: AWG
- APPROVED BY: ET
- PREPARED FOR: PREPARED FOR:

ENBRIDGE NORTHERN GATEWAY PROJECT

Chatham Sound Operations Map
(Map C06)
**Enbridge Northern Gateway Project**

**Chatham Sound Operations Map**

(Map C07)

**Scale:** 1:57,000

**Projection:** UTM N9

**Datum:** WGS 84

**Prepared For:**

Polaris Applied Sciences, Inc.

**Prepared By:**

AWG

**Date:** 20090720

**Approved By:** ET

**REFERENCES:**

WGS 84

**FIGURE NUMBER:**

**PROJECTION:**

**CONTRACTOR:**

Enbridge Northern Gateway Project

**DATE:**

20090720

**AUTHOR APPROVED BY:**

AWG ET

**Scale:** 1:57,000

**Projection:** UTM N9

**Datum:** WGS 84

**Shoreline Types**

- Estuary, Marsh or Lagoon
- Mud Flat
- Sand Flat
- Sand Beach
- Sand and Gravel Beach
- Sand and Gravel or Gravel Flat
- Gravel Beach
- Rock and Gravel Beach
- Rock and Sand Beach
- Rock and Sand and Gravel Beach
- Rock Platform
- Rock Cliff

**Oil Residency**

- Long (months to years)
- Medium-Long (months to years)
- Medium (weeks to months)
- Short-Medium (weeks to months)
- Short (days to weeks)

**Logistics**

- Marina
- Dolphin/Mooring Buoy/Pillings
- Boat Launch
- Anchor Site
- Log Raft/Dump
- Submarine Cable
- Airport
- Heliport
- Processors
- Bathymetry (m)

**Oil Residency**

- Long (months to years)
- Medium-Long (months to years)
- Medium (weeks to months)
- Short-Medium (weeks to months)
- Short (days to weeks)

**Logistics**

- Marina
- Dolphin/Mooring Buoy/Pillings
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- Anchor Site
- Log Raft/Dump
- Submarine Cable
- Airport
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- Processors
- Bathymetry (m)
Shoreline Types
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Oil Residency
- Long (months to years)
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- Medium (weeks to months)
- Short-Medium (weeks to months)
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Logistics
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Shoreline Types
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Oil Residency
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- Medium (weeks to months)
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- Short (days to weeks)

Logistics
- Marina
- Dolphin/Mooring Buoy/Pillings
- Boat Launch
- Anchor Site
- Log Raft/Dump
- Submarine Cable
- Airport
- Heliport
- Processors
- Bathymetry (m)
Appendix D   Coastal Sensitivity Maps
NOTE: Where a legend indicates First Nations Land or First Nations Fishery, this refers to areas or fisheries used by Aboriginal groups.

**Table D-1**

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<thead>
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<th>Figure Number</th>
<th>Map Number</th>
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<td>D-37</td>
<td>P05</td>
<td>Principe Channel</td>
</tr>
</tbody>
</table>
Eulachon Spawning Rivers
Hatcheries
Northern Gateway Pipeline
Salmon Rivers
SealAreas
Long Oil Residuary: Fine Grain Flats, Marshes, Lagoons
Oil Penetration/Remobilization Potential: Coarse Grained Beaches
Herring Spawning
First Nations Fishery
Finfish Aquaculture
Shellfish Aquaculture
Rockfish Conservation Areas
First Nations Land
First Nations: 1 km buffer
Shore Bird Areas
Park/Recreation Area
Ecological Reserve
Protected Area
Marine Park

ENBRIDGE NORTHERN GATEWAY PROJECT
Douglas Channel Sensitivity Map
(Map D01)

REFERENCES:
WGS 84
1:57,000

CONTRACTOR:
Polaris Applied Sciences, Inc.

DATE:
20090720

AUTHOR:
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APPROVED BY:
ET

PREPARED FOR:

PREPARED BY:

PROJECTION:
CONTRACTOR:
PREPARED FOR:
DATE:
AUTHOR:
APPROVED BY:
PREPARED BY:
SCALE:
DATUM:
Sensitivity Map
ENBRIDGE NORTHERN GATEWAY PROJECT D-15
1:57,000
WGS 84
Douglas Channel Sensitivity Map
(Map D01)
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Hatcheries

Northern Gateway Pipeline

Salmon Rivers

Sealion Areas

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First Nations: 1 km buffer

Shore Bird Areas

Park/Recreation Area

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Protected Area

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REFERENCES:

WGS 84

1:57,000

UTM N9

CONTRACTOR:

Date:

Author:

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20090720

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ENBRIDGE NORTHERN GATEWAY PROJECT

Douglas Channel Sensitivity Map

(Map D07)
ENBRIDGE NORTHERN GATEWAY PROJECT
North Area Sensitivity Map
(Map N05)

REFERENCES:
WGS 84
1:57,000

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Polaris Applied Sciences, Inc.

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ET

SCALE:
1:57,000

PROJECT:
Sensitivity Map

DATUM:
WGS 84

PROJECTION:
UTM N9

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D-28

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