4.0 ENVIRONMENTAL SETTING

This chapter provides a description of the physical, biological and socio-economic setting of the proposed project.

4.1 Physical Environment

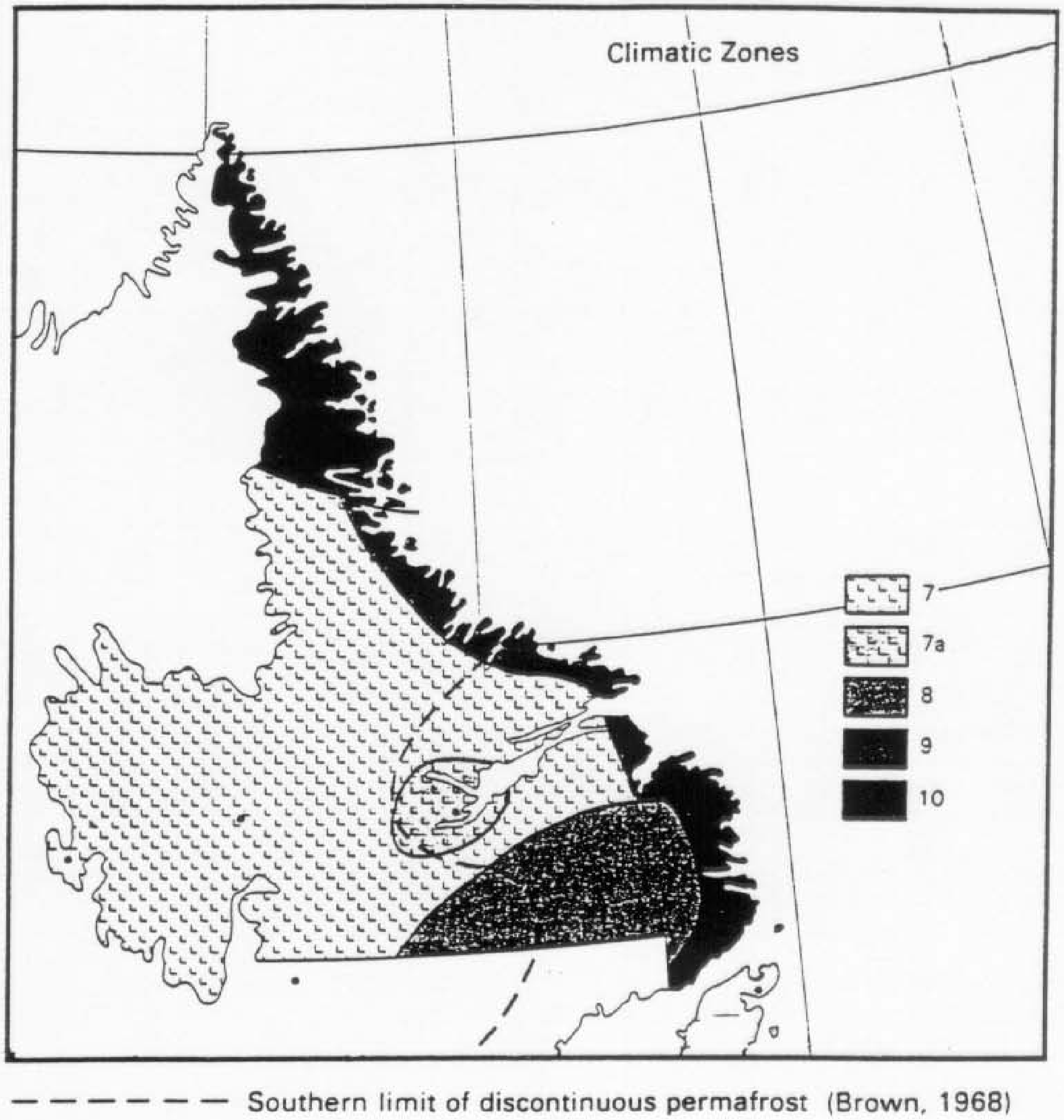
4.1.1 Ambient Noise

Ambient noise varies depending on many factors, including terrain, temperature, season, wind and proximity to naturally-occurring noise sources such as running water or rapids. Ambient noise levels may vary by over a factor of 10 depending on site conditions. The study area is, for the most part, wilderness, with virtually no human-made noise. Background noise levels are anticipated to be in the range of 20 to 30 dBa (i.e., decibels in the A-weighted spectrum, which reflects the spectral response of human hearing) (Kinsler et al. 1982). The noise levels may increase due to certain natural causes (e.g., running water, wind in deciduous trees and other weather events). Beside a medium stream with small rapids, noise levels may approach 50 dBA, roughly the level of conversation. For example, ambient noise measurements collected along three rivers in the interior of Labrador (Kenamu, Kenemich and Naskaupi Rivers) ranged between 52 and 64 dBa, depending on site conditions (Trimper et al. 1998). The lower noise levels were recorded at wooded sites along slow-moving water, while the higher noise levels were recorded in open areas near rapids.

Noise levels decrease with distance (USDOT 1995). Point sources decrease by approximately 6 dBA per doubling of distance. Line sources, such as busy roads, emit noise that attenuates by approximately 3 dBA per doubling of distance. Foliage and snow cover will tend to increase the attenuation rate. The noise levels in the vicinity of roads with relatively low traffic volumes are typically characterized by sustained levels of background noise broken periodically by the pass-by of a vehicle. Typical peak levels of noise at the edge (an average of 15 m from the vehicle) of a highway such as the TLH - Phase III may be expected to be in the range of approximately 80 dBA for heavy trucks and 76 dBA for medium trucks.

4.1.2 Climate

The study region is best characterized as occurring in the Interior Labrador and Interior Lake Melville climatic regions (Banfield 1981). The part of the proposed highway which occurs in the Interior Labrador region is described as possessing a relatively continental influence (i.e., long and severe winters with heavy snow accumulation, and short, cool summers receiving the highest proportion of precipitation). The Interior Lake Melville area characterizes the western portion of the proposed highway, towards Happy Valley-Goose Bay. This region is similar to the Interior Labrador region, except that it experiences less harsh climate (i.e., shorter winters, warmer summers and longer growing period). The climate zones of Labrador as presented by Macpherson and Macpherson (1981) are shown in Figure 4.1. Rollings (1997) describes the climatic zones of southeastern and interior Labrador as follows:



7. Interior Labrador
7a. Interior Lake Melville Area
8. Southeastern Labrador interior
9. Coastal Labrador
10. Northern Labrador

Source: Rollings 1997.

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FIGURE 4.1

CLIMATIC ZONES IN LABRADOR

Southeastern Labrador Interior: This upland area is closer to the Strait of Belle Isle frontal cyclone track than the Interior of Labrador. The climate is less continental than rest of the interior, with a greater proportion of total precipitation occurring in winter. Annual precipitation is in the 1,000 to 1,200 mm range.

Interior Labrador: The interior of Labrador has a continental climatic regime. Annual precipitation is generally in the 900 to 1,100 mm range, with the highest precipitation occurring in the summer. Winters are long with heavy snow accumulation. Air temperatures can be below -15°C for extended periods. Summers are short and cool, with occasional brief spells of daily maxima in the 23°C to 27°C range. Winds are light.

Interior Lake Melville Area: The climate of the Interior Lake Melville area is similar to the Interior of Labrador, except that the summers are notably warmer and the winters are much shorter.

4.1.2.1 Cartwight Area

For Cartwight, the average daily temperature in the warmest month (July) is 12.3°C, with an average daily maximum and minimum temperature of 17.8°C and 6.9°C, respectively. The mean daily temperature in the coldest month (January) is -13.8°C, with a mean daily maximum and minimum temperature of -9.2°C and -18.5°C, respectively. During the month of July, extreme maximum and minimum (average) daily temperatures have been recorded as high as 36.1°C (1995) and as low as -1.7°C (1997); and during the month of January, extreme maximum and minimum (average) daily temperatures have been recorded as high as 10.0°C (1998) and as low as -37.8°C (1993). Extreme daily temperatures are provided in Table 4.1.

The average annual precipitation for Cartwright is 996.5 mm. Precipitation occurs in the form of rainfall (annual average 530.5 mm) and snowfall (annual average 474.4 cm). July is the month of greatest rainfall (average 88.2 mm) and February is the month of least rainfall (average 3.7 mm). The greatest amount of snowfall predominantly occurs in March (average 87.2 cm), with no snowfall (average) recorded occurring in the months of July and August. Occurrences of extreme daily precipitation has been recorded in the months of March and December in 1994 (with 86.1 and 88.9 mm, respectively). The most extreme daily snowfall has also occurred in the months of March and December (1994), while most extreme daily rainfall has occurred in the months of September 1995 and November 1994 (with 66.8 and 62.7 mm, respectively). The month of heaviest 'month-end snow cover' occurs in February (131 cm); the least amount of snow occurs in June to September (0 cm). Extreme daily precipitation is provided in Table 4.1. Extreme wind and gust speeds are also provided in Table 4.1.

May to October have been recorded with the most days with a maximum temperature above 0°C, with an average of 239 days per year with a maximum temperature greater than 0°C. The number of days with measurable rainfall over a year is 110, which mainly occurs between May and October. Measurable snowfall has been recorded to occur 95 days per year, with the majority of measurable snow occurring between the months of November and April. Measurable precipitation generally occurs 14 to 17 days per month, with a total of 189 days per year. Freezing precipitation has been recorded as occurring two to three days per month during the months between November and May. Fog occurs 35 days per year, with 60 percent of occurrence of fog during the months of May to August. Thunderstorms rarely occur (four days per year), but when they do occur it is generally in July and August. Hours of bright sunshine has been recorded at 1,464.5 hours per year (mean). Station pressure ranges (monthly) from a low of 100.54 kilopascals (kPa) to a high of 101.27 kPa.

Table 4.1 Extreme Precipitation, Temperature, and Wind and Gust Speeds, Cartwright and Happy Valley-Goose Bay

	Jan	Feb	Mar	Apr	May	Jn	Jul	Aug	Sep	Oct	Nov	Dec
Cartwright												
Extreme Daily Rainfall (mm)	20.6	16	14	34.5	31.8	59	57	53	67	49	62.7	25.1
Extreme Daily Snowfall (cm)	61	70.8	86.1	53.1	32	14	0	0	15	33.8	38.1	8.9
Extreme Daily Precipitation (mm)	55.6	74.8	86.1	53.1	31.8	59	57	53	67	49	62.7	88.9
Extreme Maximum Temperature (°C)	10	11.7	13.9	18.2	30	35	36	32	29	23.3	17.6	13.3
Extreme Minimum Temperature (°C)	-38	-34	-32	-26	-15	-6	-2	-1	-5	-12	-21	-33.9
Extreme Hourly Wind Speed (km/hr)	117	103	105	100	83	97	68	70	87	108	97	103
Extreme Gust Speed (km/hr)	141	121	126	103	108	97	84	87	107	138	130	126
Happy Valley-Goose Bay												
Extreme Daily Rainfall (mm)	6.6	26.4	24.4	30.2	29	70	67	79	44	44.7	36.8	26.2
Extreme Daily Snowfall (cm)	71	39.6	40.8	36.3	33.8	24	0	0	19	27.7	40.6	35.6
Extreme Daily Precipitation (mm)	40.8	39.6	52.3	42.9	33.8	80	67	79	44	45.7	40.6	32.5
Extreme Maximum Temperature (°C)	11.2	10.6	16.4	21.2	32.1	36	38	33	30	22.8	16.7	11.7
Extreme Minimum Temperature (°C)	-39	-39	-36	-30	-15	-4	0.6	0	-7	-17	-26	-36.7
Extreme Hourly Wind Speed (km/hr)	84	77	77	64	77	58	64	64	72	74	74	81
Extreme Gust Speed (km/hr)	143	129	106	98	103	122	101	101	122	111	133	111
Source: Environment Canada n.d.; 1998.												

The relative humidity ranges from 78 to 88 percent (0600L) on a month-to-month basis. The wind speed ranges from 15 km/hr (July and August) to 24 km/hr (December).

The most frequent direction the wind blows is from a southwest direction (July to February) and from a north or northwest direction May to June. The occurrence of extreme hourly and gust speed are linked with wind from the north, northwest or west direction and generally occur during the autumn to spring of the year. Extreme wind and gust speeds are provided in Table 4.1.

4.1.2.2 Happy Valley-Goose Bay Area

For Happy Valley-Goose Bay, the average daily temperature in the warmest month (July) is 15.5°C, with an average daily maximum and minimum of 21.1°C and 9.8°C, respectively. The mean daily temperature during the coldest month (January) is -17.3°C, with a mean daily maximum and minimum of -12.3°C and -22.4°C, respectively. During the month of July, extreme maximum and minimum (average) daily temperatures have been recorded as high as 37.8°C (1994) and as low as 0.6°C (1997); and during the month of January, extreme maximum and minimum (average) daily temperatures have been recorded as high as 11.2°C (1997) and as low as -38.9°C (1995). Extreme daily temperatures are provided in Table 4.1.

The average annual precipitation for Happy Valley-Goose Bay is 959.5 mm. Precipitation occurs in the form of rainfall (annual average 557.3 mm) and snowfall (annual average 463.8 cm). July is the month of greatest rainfall (average 119.4 mm) and February is the month of least rainfall (3.9 mm). The greatest amount of snowfall predominantly occurs in March (average 76.8 cm), with no snowfall (average) recorded occurring in the months of July and August. Occurrences of extreme daily precipitation have been recorded in the months of June (1996), July (1998) and August (1999) (with 69.6, 66.8 and 79.2 mm, respectively). The most extreme daily snowfall occurred in the month of January (1998), while most extreme daily rainfall occurred in the months of July (1998) and August (1995) (with 66.8 and 79.2 mm, respectively). The month of heaviest 'month-end snow cover' occurs in February (89 cm); the least amount of snow cover occurs in May to September (0 cm). Extreme daily precipitation is provided in Table 4.1.

May to October have been recorded with the most days with a maximum temperature above 0°C, with an average of 236 days per year with a maximum temperature greater than 0°C. The number of days with measurable rainfall over a year is 109, which mainly occurs between May and October. Measurable snowfall has been recorded to occur 99 days per year, with the majority of measurable snow occurring between November to April. Measurable precipitation generally occurs 13 to 18 days per month, with a total of 190 days per year. Freezing precipitation has been recorded as occurring two to three days per month during the months between November and March. Fog occurs 11 days per year. Hours of bright sunshine has been recorded at 1,607.6 hours per year (mean). Thunderstorms rarely occur (eight days per year), but when they do occur, it is generally between June and August. Station pressure ranges (monthly) from a low of 100.26 kPa to a high of 100.78 kPa. The relative humidity ranges from 71 to 83 percent (0600L) on a month-to-month basis.

The wind speed ranges from 14 km/hr (July and August) to 18 km/hr (December). The most frequent wind direction is from a westerly direction (July to March) and from a northeasterly direction April to June. Extreme wind and gust speeds are provided in Table 4.1.

4.1.3 Landscape

The topography of the project region rises rapidly from sea level along the coast to inland elevations of 600 m asl. The surface is rough and undulating with deeply dissected margins. Lower valley floors contain deep deposits of glacial till and shallow peat. Permafrost is isolated and mainly in wetlands. Dominant vegetation is comprised of closed, dense stands of black and white spruce with balsam fir on slopes. Exposed hilltops are covered with dwarf, krummholz forms of black spruce and bare rocks are usually covered with lichens. Wetland areas dominate the central portion of this area. The part of the proposed highway, west towards interior Labrador, possesses a relatively continental influence (i.e., long and severe winters with short and cool summers heavy snow accumulation, and the highest proportion of precipitation occurring in the summer).

The topography and terrain of the area north of the proposed highway route varies from inland valley area to hills and mountains, including the Mealy Mountains range. Elevation ranges from 30 to 150 m in the Happy Valley-Goose Bay area to elevations of 1,150 m in the Mealy Mountains range. Along the proposed outfitter route, the elevations range from 50 to 600 m. The proposed route crosses several ponds, rivers (such as the Traverspine, Kenamu, Eagle and Paradise rivers), bogs and marshes.

The proposed highway passes through boreal forest and tundra/boreal forest transition zones. In these areas, it is expected that black spruce, balsam fir, white spruce and larch are the dominant species found. White birch and trembling aspen may also be found in areas following a fire. Low-ground cover likely to be found in the area include lichens, mosses, low-lying shrub and berries. In boggy areas, common plants found include Labrador tea, bog laurel and bakeapple.

4.1.3.1 Geology

The region lies on the eastern edge of the Canadian Shield, which forms the central core of the North American continent. The Shield extends from the Great Lakes-St. Lawrence River system west to Alberta and Great Bear Lake in the Northwest Territories, north into the Arctic Archipelago, and east to the Labrador Sea. The Shield is subdivided into seven Geological Provinces (Bear, Slave, Churchill, Superior, Southern, Nain and Grenville). The proposed TLH - Phase III route lies in Grenville Province, which extends in a band along the southern edge of the Shield from Georgian Bay in Ontario to the Labrador Sea (Figure 4.2).

The outfitter route crosses Grenville Province lithologies of Late Paleoproterozoic age (1,000 million and 1,700 million years). The region is divided geologically into several components: in the south, gneisses, foliated granitoid rocks and a metamorphosed mafic intrusion; in the north, the Mealy Mountains Intrusive Suite, comprising anorthosite and monzonite, and minor leucotroctolite, leuconorite, monzonorite, quartz monzonite and granite; and in the east, gneisses and moderately to strongly foliated granitoid rocks.

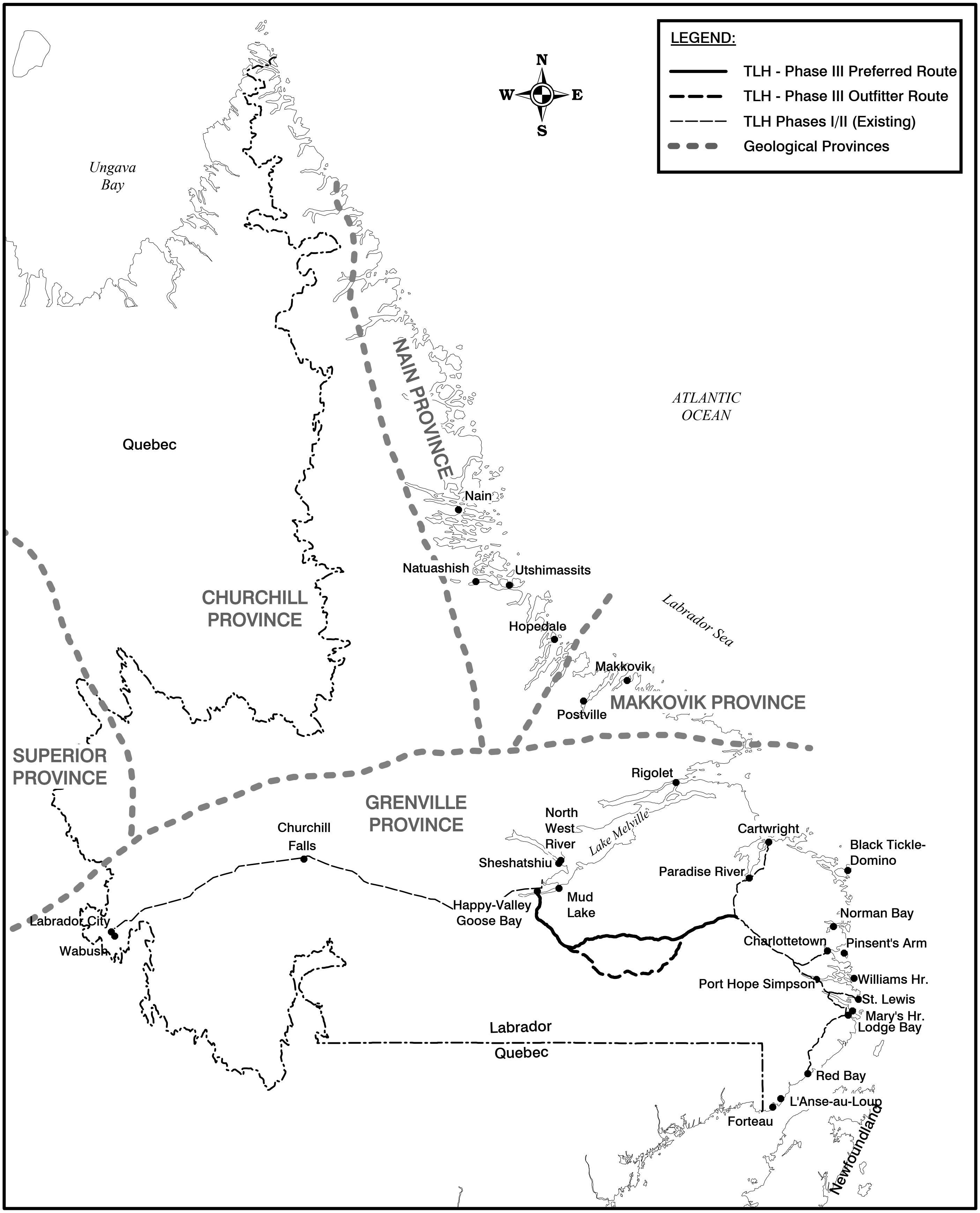

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FIGURE 4.2

LABRADOR GEOLOGICAL PROVINCES

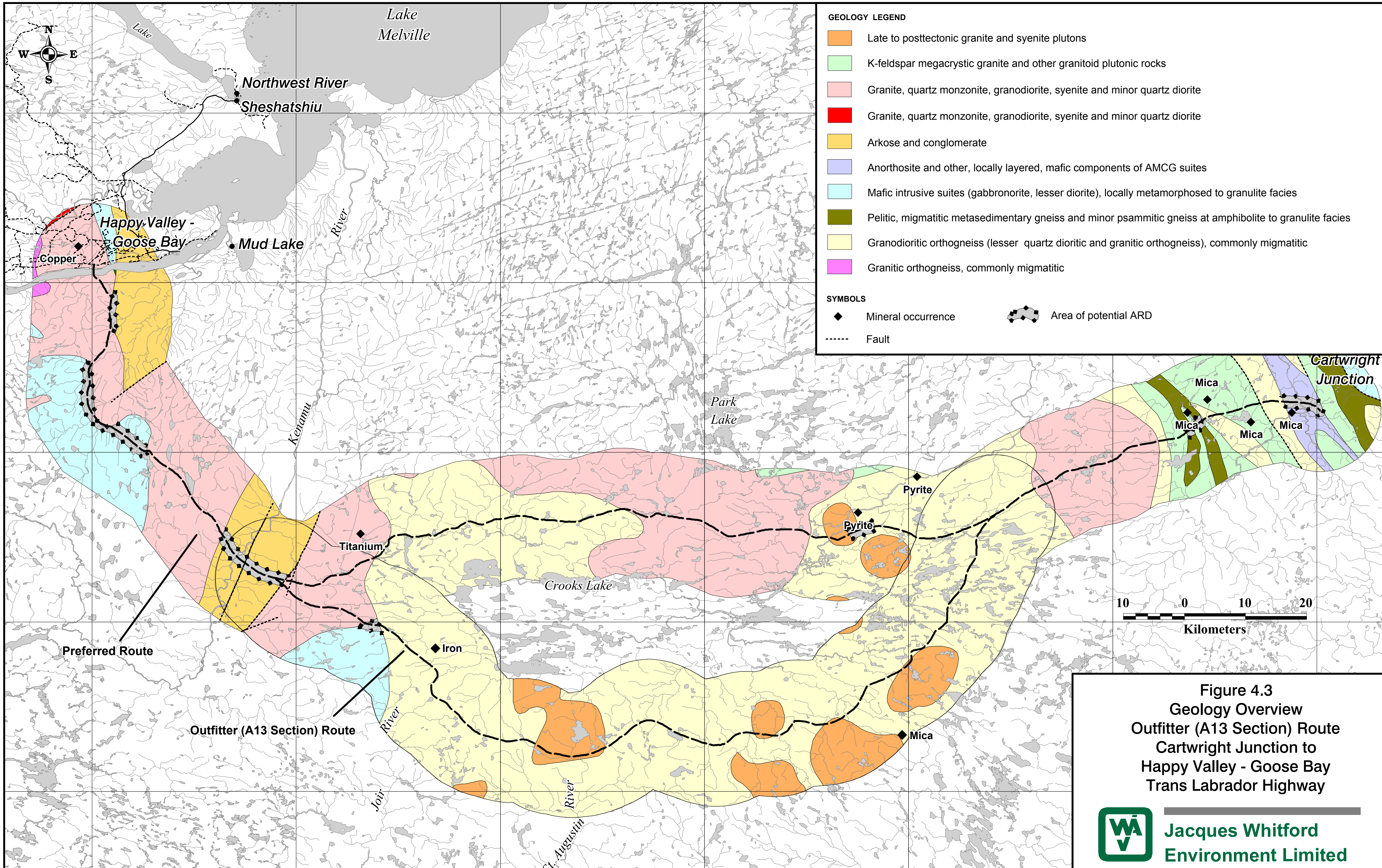
The geology along the proposed outfitter route is illustrated in Figures 4.3 to 4.6, with Figures 4.4 to 4.6 focusing on the A13 segment of the outfitter route. This 1:1,000,000 scale compilation was complied based on information from the following sources: Wardle (1994), Wardle and Crisby (1986) (13F/SE); Gower and van Nostrand (1996) (13G/SE); Gower (1999) (13B/NW); Gower (1998) (13B/NE); van Nostrand et al. (1992) (13A/NW) and Gower et al. (1986) (13H/SW). Due to the lack of exposed bedrock in the area, much of the information available on the geology of the area was obtained from interpretation of geophysical data. While the results of these studies provide a good overview of the area geology, specific details for the route may vary. As noted in Chapter 3.0, areas with a high potential for acid-generating rock will be ground-truthed prior to construction.

As outcrop exposure along the outfitter route is relatively limited, the disturbance of any potential acid-generating rock will be limited. There are seven mineral occurrence sites, identified by past reconnaissance mapping and sampling, in the vicinity of the outfitter route. These were identified by the provincial Department of Mines and Energy, presented in the Mineral Occurrence Database (MODS), and represent areas of outcrop that contain anomalous traceable quantities of that mineral. However, five of these occurrences are common to the preferred route (four on the eastern portion and one in the vicinity of Happy Valley-Goose Bay). On the A13 section of the outfitter route, there were two mineral occurrences identified (Figure 4.3). None of the two mineral occurrences identified are associated with sulphide-bearing rock (i.e., the rock that hosts minerals having acid generating potential). The lithologies along the proposed highway route that typically contain higher amounts of sulphide minerals are metasedimentary gneiss, mafic intrusions and sedimentary rocks. The potential areas for ARD are shown on Figures 4.3 to 4.6.

Within Block 1 (Figure 4.4), the bedrock geology is dominated by granite to granitic gneiss, mafic intrusive rocks, and sedimentary rocks. There is one mineral occurrence in the area; iron, and is not associated with sulphide mineralogy. It is the mafic intrusive and sedimentary rocks that are more likely to host sulphide occurrences. Therefore, areas of ARD are most likely to occur where the proposed highway passes close to these mafic intrusive and sedimentary rocks.

The geology within Block 2 (Figure 4.5) is dominated by granitic gneiss and granite. There is only one mineral occurrence in the area; mica, and is not associated with sulphide mineralogy. The area is not deemed to have potential to produce ARD, based on the compiled geology and mineral occurrence information.

The geology of Block 3 (Figure 4.6) is similar to that of Block 2, and is dominated by granitic gneiss and granite. The area is not deemed to have potential to produce ARD, based on the compiled geology and mineral occurrence information.



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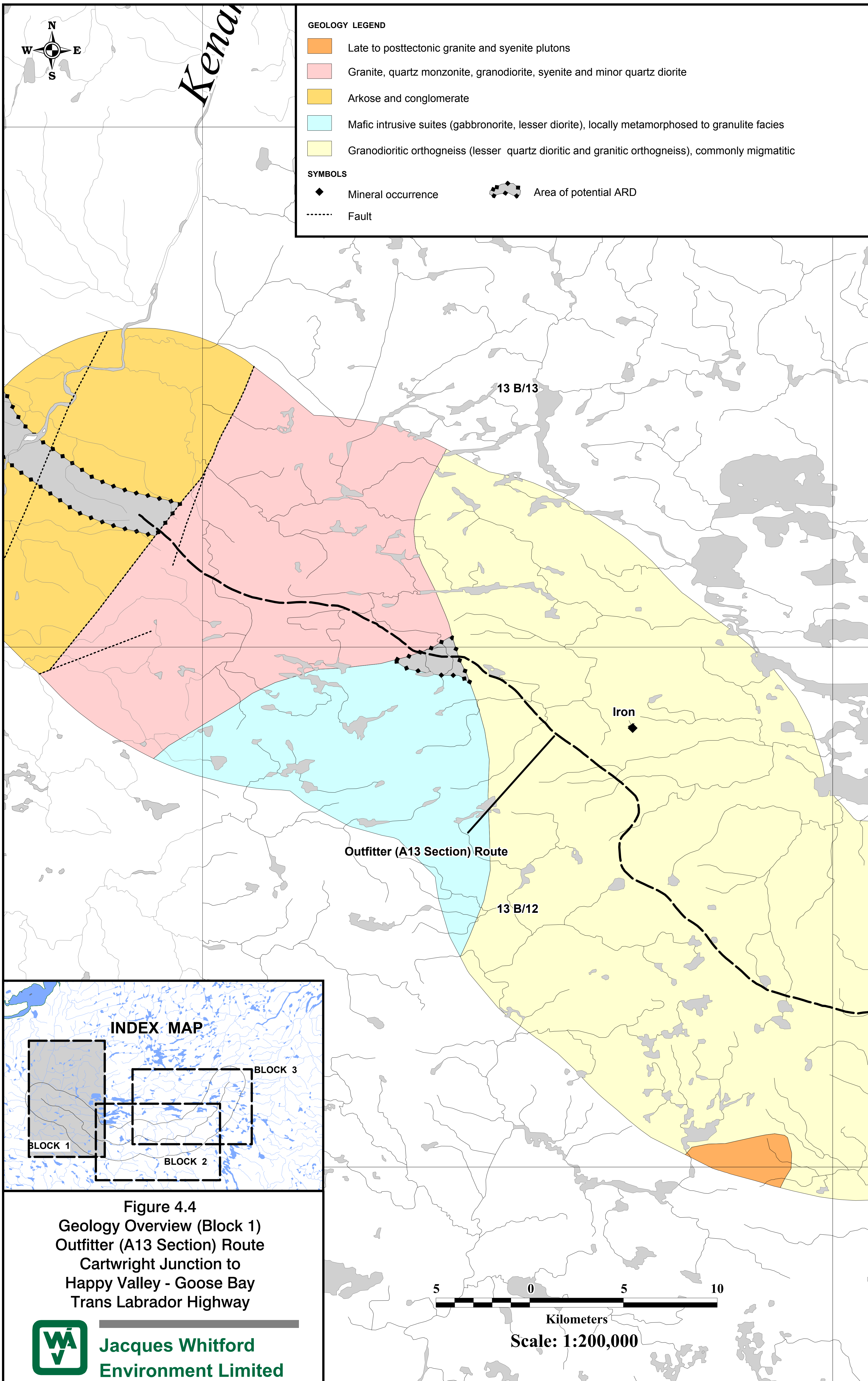

Figure 4.4
Geology Overview (Block 1)
Outfitter (A13 Section) Route
Cartwright Junction to
Happy Valley - Goose Bay
Trans Labrador Highway

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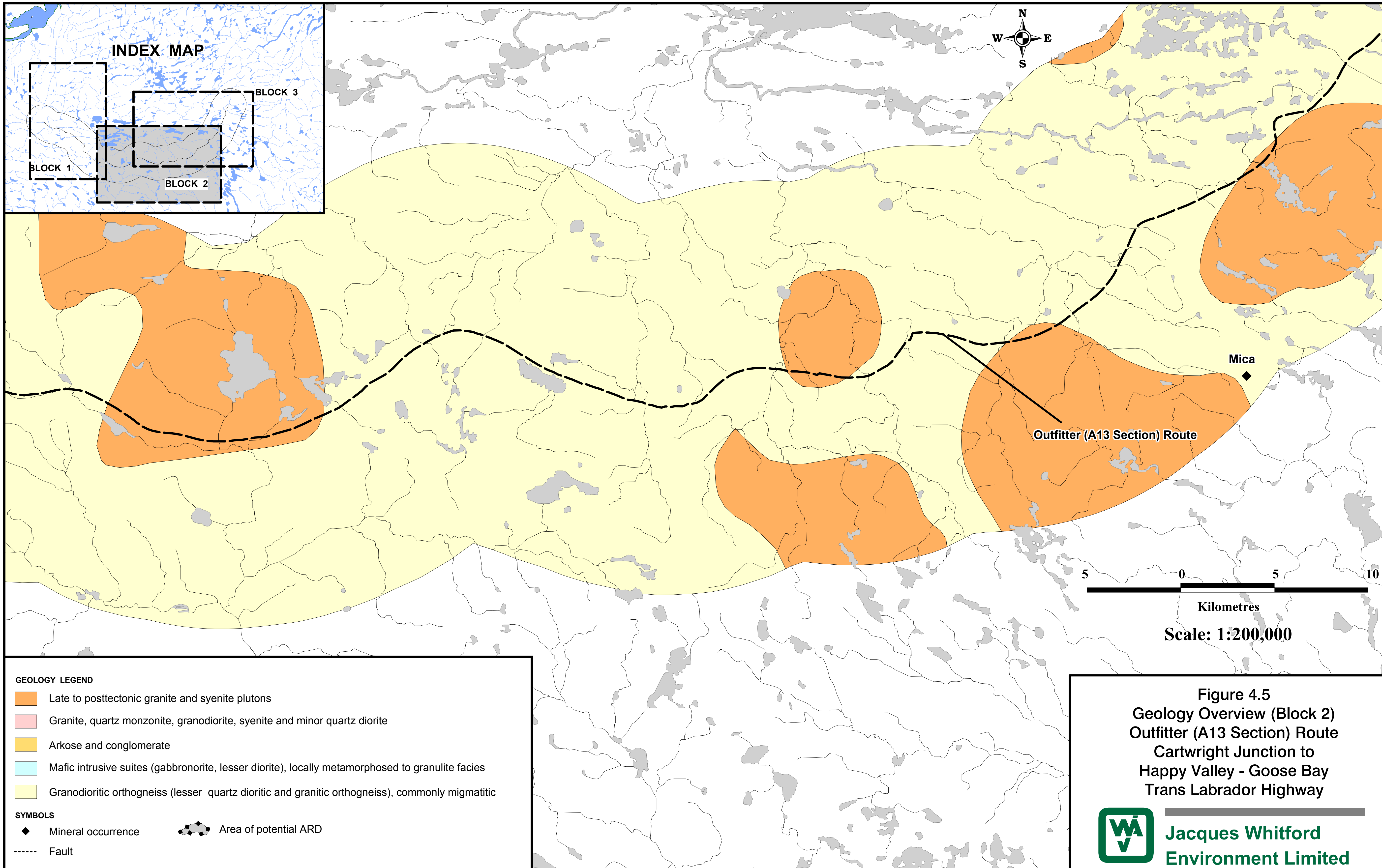

Figure 4.5
Geology Overview (Block 2)
Outfitter (A13 Section) Route
Cartwright Junction to
Happy Valley - Goose Bay
Trans Labrador Highway

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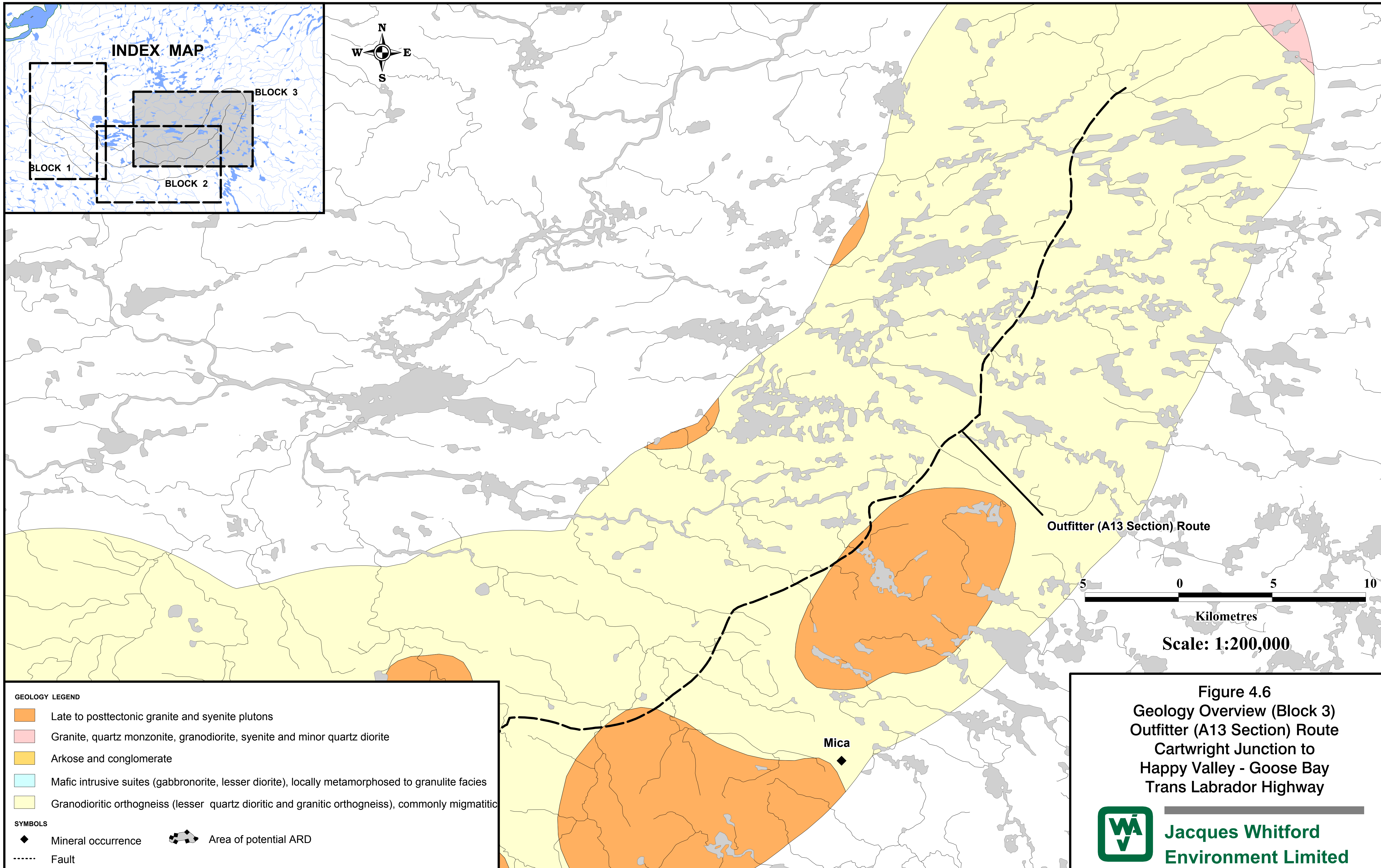

Figure 4.6
Geology Overview (Block 3)
Outfitter (A13 Section) Route
Cartwright Junction to
Happy Valley - Goose Bay
Trans Labrador Highway

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4.1.3.2 Geomorphology and Surficial Geology

Geomorphology is defined as the study of changes in the shape of the earth or parts of it (i.e., landforms), and the processes that cause change. The geomorphology maps (Figures 4.7 to 4.10) are based on original surficial geology mapping carried out by Fulton et al. (1969; 1970). The geomorphological classification is based on a landform system, comprised of seven genetic categories: morainal deposits; glaciofluvial deposits; lacustrine deposits; marine deposits; colluvial deposits; organic deposits; and alluvial deposits. The morphological features associated with these genetic categories are:

- structural linear (valley or trough controlled by a feature);
- drumlins;
- morainal ridge;
- esker;
- abandoned river channel;
- kettle holes;
- abandoned beach ridge; and
- escarpment in unconsolidated materials.

Within the area surrounding the proposed outfitter route, the dominant surficial materials are glacial till, consisting of basal lodgement tills and ablation till. The glacial till, also referred to as morainal deposits, comprise more than 90 percent of the study area (Figures 4.7 to 4.10). The till covers much of the area as gentle rolling terrain. It was formed by the release and consolidation of debris from a glacier when the basal ice reached its pressure melting point as the ice moved; the moving ice aligned fragments of this debris, known as lodgement till, in the same direction as the flow of the glacier. Approximately 30 to 40 percent of the lodgement till occurs as a thin veneer, less than 1 m over bedrock. The other 50 to 60 percent occurs as a 1-to 5-m thick layer covering bedrock.

Morainal deposits are dominantly sandy and gravelly basal (lodgment) till. However, they can include ablation till and minor amounts of other drift materials, locally mantled by boulders and blocks. These deposits area subdivided into five classes:

- till and minor sand and gravel of variable thickness, generally occurring as ridges and hummocks in a broad depression with ridges and channels oriented transverse to the axis of the valley (appears to consist of a complex of shear and ablation landforms, which have been gullied by meltwater erosion, or of ridges of ablation debris; linear belts of these deposits generally parallel direction of ice flow);
- basal (lodgment) till and minor sand, gravel, and finer materials generally 1 to 10 m thick, consisting mainly of rounded or flat-topped knolls and mounds 2- to 10-m high (many of which might be classified as ice-pressed drift forms or stagnant ice features; linear belts of these deposits generally trend perpendicular to direction of ice flow);
- basal (lodgment) till generally 1- to 5-m thick;
- gently rolling surface (ground moraine) with symbols indicating areas of drumlinoid moraine; and
- basal (lodgment) till veneering rock that is generally less than 1 m thick but may be thicker on distal or down ice sides of hills and on lower parts of slopes (general geomorphic expression is that of the underlying rock, locally contains other glacial deposits and colluvium and in limited areas may consist almost entirely of boulders).

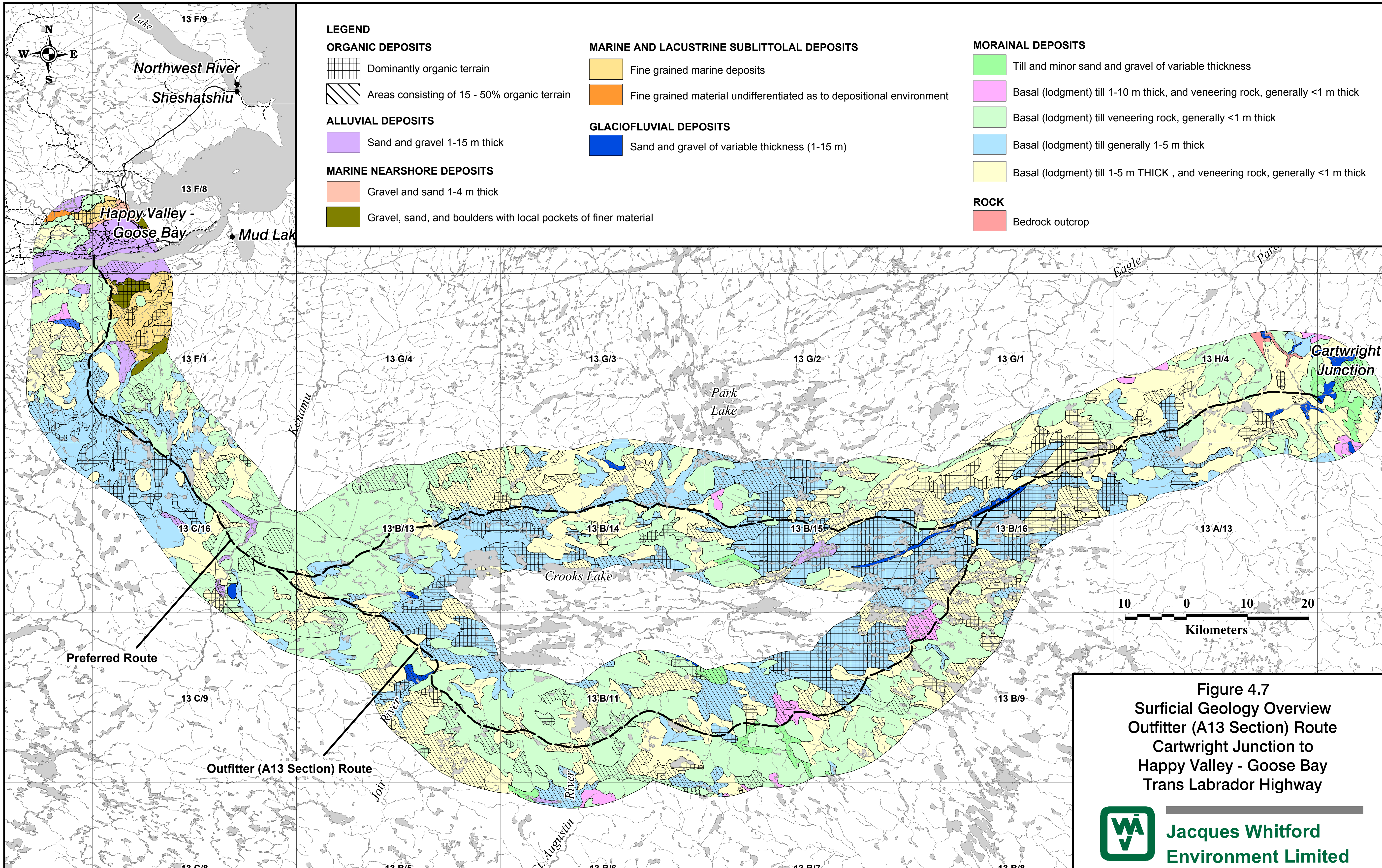

Figure 4.7
Surficial Geology Overview
Outfitter (A13 Section) Route
Cartwright Junction to
Happy Valley - Goose Bay
Trans Labrador Highway

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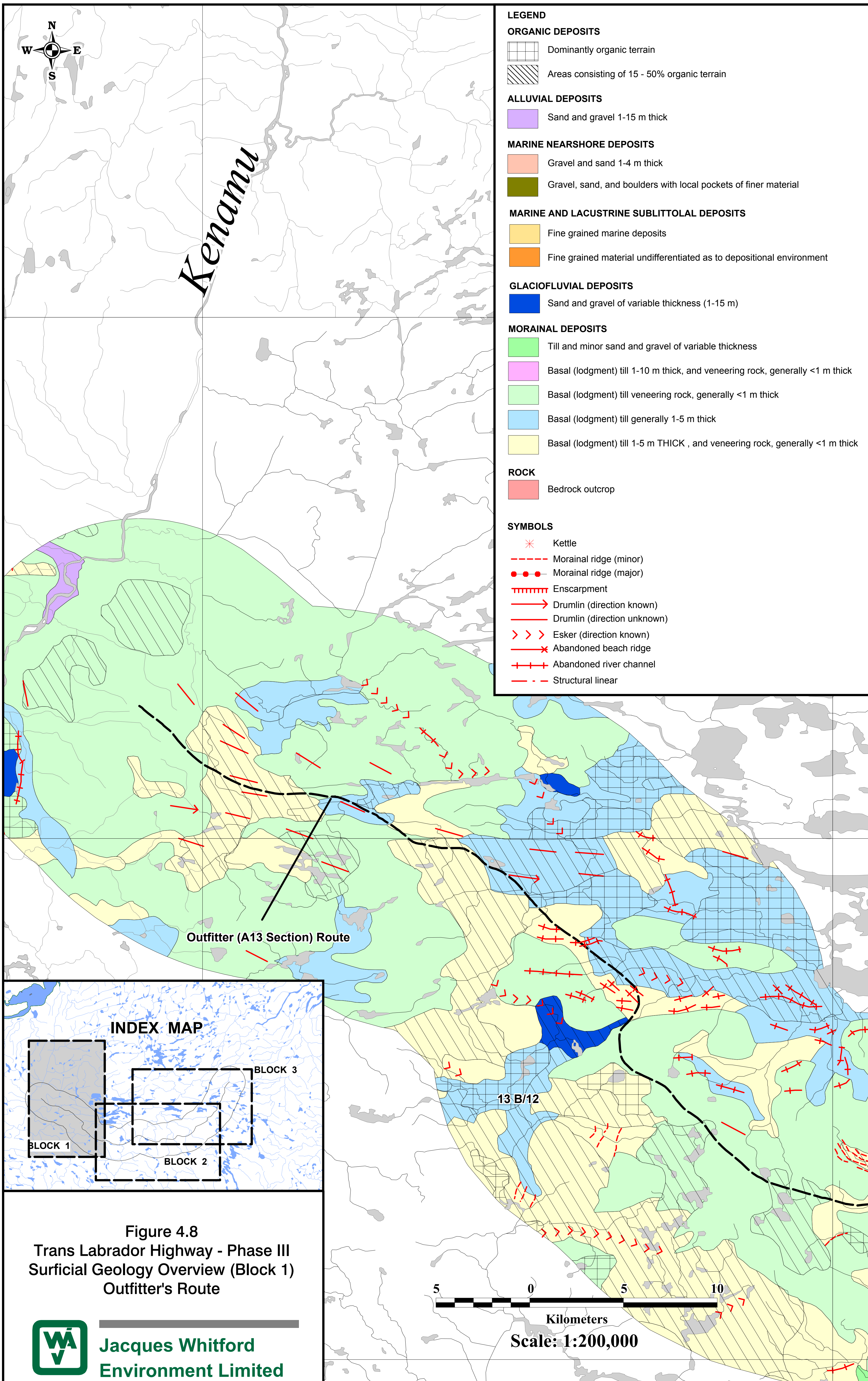

Figure 4.8
Trans Labrador Highway - Phase III
Surficial Geology Overview (Block 1)
Outfitter's Route

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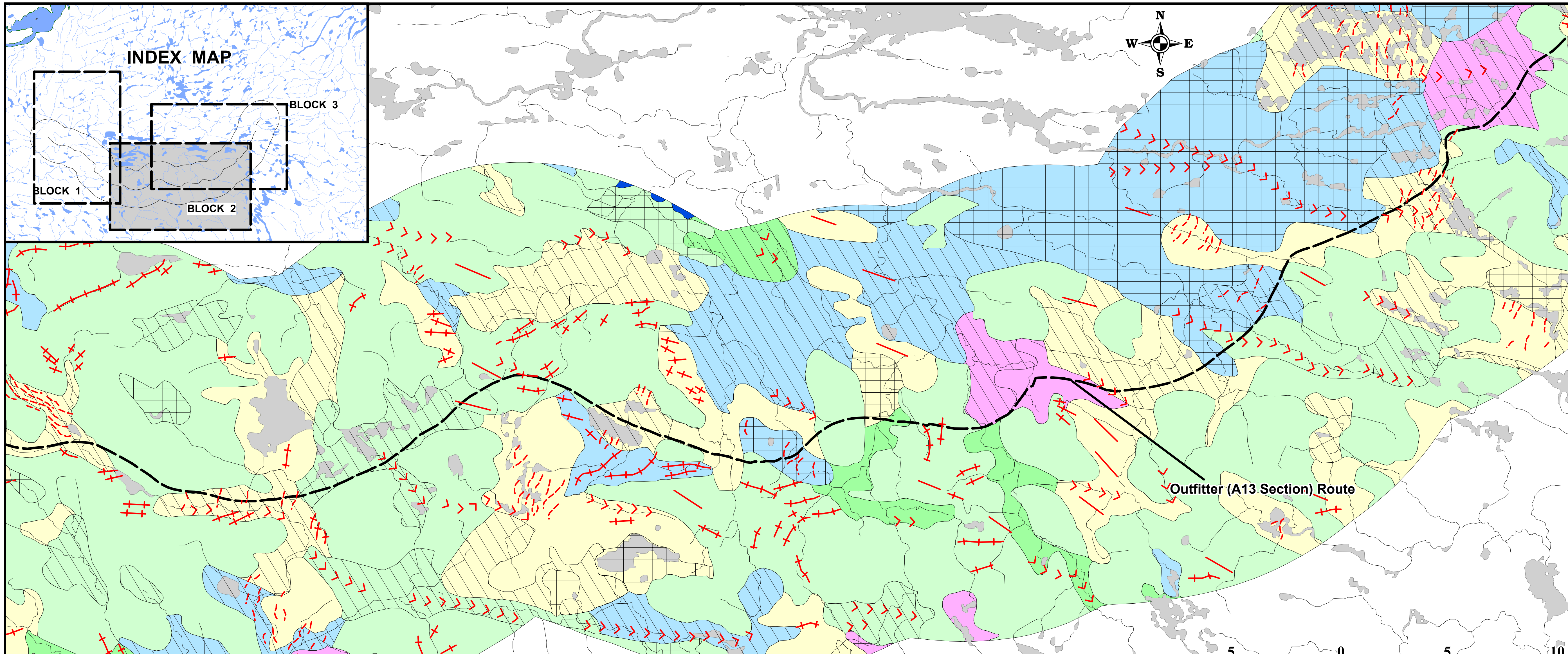

LEGEND

ORGANIC DEPOSITS
- Dominantly organic terrain
- Areas consisting of 15 - 50% organic terrain

ALLUVIAL DEPOSITS
- Sand and gravel 1-15 m thick

MARINE NEARSHORE DEPOSITS
- Gravel and sand 1-4 m thick
- Gravel, sand, and boulders with local pockets of finer material

MARINE AND LACUSTRINE SUBLITTOLAL DEPOSITS
- Fine grained marine deposits
- Fine grained material undifferentiated as to depositional environment

GLACIOFLUVIAL DEPOSITS
- Sand and gravel of variable thickness (1-15 m)

MORAINAL DEPOSITS
- Till and minor sand and gravel of variable thickness
- Basal (lodgment) till 1-10 m thick, and veneering rock, generally <1 m thick
- Basal (lodgment) till veneering rock, generally <1 m thick
- Basal (lodgment) till generally 1-5 m thick
- Basal (lodgment) till 1-5 m THICK , and veneering rock, generally <1 m thick

ROCK
- Bedrock outcrop

SYMBOLS
- Kettle
- Morainal ridge (minor)
- Morainal ridge (major)
- Encarpment
- Drumlin (direction known)
- Drumlin (direction unknown)
- Esker (direction known)
- Abandoned beach ridge
- Abandoned river channel
- Structural linear

Figure 4.9
Surficial Geology Overview (Block 2)
Outfitter (A13 Section) Route
Cartwright Junction to
Happy Valley - Goose Bay
Trans Labrador Highway

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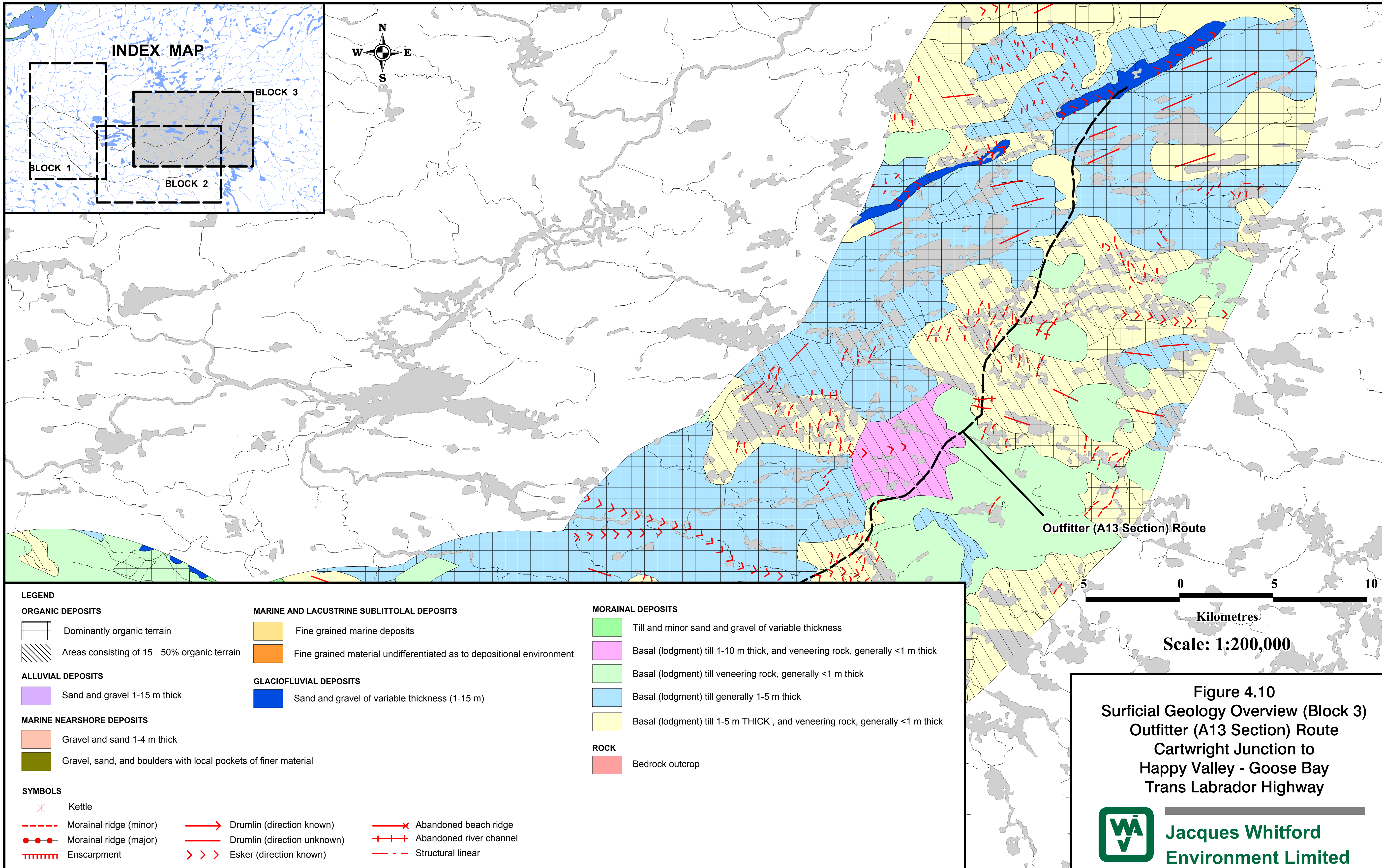

Figure 4.10
Surficial Geology Overview (Block 3)
Outfitter (A13 Section) Route
Cartwright Junction to
Happy Valley - Goose Bay
Trans Labrador Highway

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Other surficial materials found in the area are alluvial deposits (covering approximately 0.3 percent of the area) and glaciofluvial deposits (approximately 0.7 percent) (Figures 4.7 to 4.10). Fulton et al. (1969; 1970) outline the characteristics of these surficial materials:

- Alluvial deposits are sand and gravel 1- to 15-m thick in the form of terraces and plains that formed as stream floodplains and deltas. Generally, they occur in large valleys and commonly overly considerable thicknesses of finer-grained lacustrine or marine sediment. They can also be overlain by extensive bogs where cemented soil horizons have impeded drainage.

- Marine nearshore deposits are comprised of sand, gravel, boulders, and minor finer material less then 4 m thick, commonly developed on unconsolidated materials of other origins. These deposits are subdivided into two classes: gravel and sand 1- to 4-m thick, generally in the form of beaches and strand plains; and gravel, sand and boulders, with local pockets of finer material. These deposits commonly overlie and include areas of till. They are developed as a lag on till or by concentration of boulders due to the action of floating ice.

- Marine and lacustrine sublittoral deposits are comprised of silt, fine-grained sand and clay, commonly laminated. They can have variable thickness and can exceed 100 m. They commonly occur in coastal sections of large valley or flat surfaces in places deeply dissected, commonly overlain by alluvial sand and gravel. These deposits are subdivided into three classes: fine-grained lacustrine deposits (rarely exposed but probably present at depth in many large valleys); fine-grained marine deposits, locally subject to landsliding and what appears to be failure by liquefaction; and fine-grained material undifferentiated as to depositional environment.

- Glaciofluvial deposits are sand and gravel deposits of variable thickness (1- to 15-m) deposited by water from melting glaciers. Deposits occur as ridges, hummocks, terraces and plains, and are generally located within or at the mouths of valleys. Due to the discontinuous nature of many of these deposits, areas mapped as this unit may commonly contain other deposits.

4.1.3.3 Soils

The inland region of southeastern Labrador is relatively devoid of bedrock exposure (less then 1 percent), and surficial cover (other than organic terrain) is comprised mainly of glacial deposits, typically less than 5 m thick. The lack of soil is due to post-glacial marine submergence, which removed most of the unconsolidated deposits (Greene 1974). The surficial cover has an inferred, approximate maximum average thickness of 3.1 m along the outfitter route. This average thickness value was derived from statistical gridding algorithms applied to the surficial geology boundary data obtained from provincial geological mapping. Field investigation will be required to verify or determine the accuracy of this information.

From a geotechnical point of view, the glacial till (morainal deposits) that covers approximately 99 percent of the study area would generally be considered to be a good foundation soil for highway construction. Based on the in situ gradation, moisture content and fines (silt and clay) content, specific handling and earthmoving requirements would be assessed through geotechnical investigation and recommendations for construction of roads and associated infrastructure.

From the review of surficial geology along the study area, the initial approximately 20 km of highway construction may encounter fine-grained marine and lacustrine deposits (silts, clays and fine sand). These soils are geotechnically more complex and can be problematic from an earthworks and construction perspective. Assessment of the soils slope stability, bearing strength and any special construction procedures would be addressed during a geotechnical investigation.

As further detailed in the wetlands section of this report (Section 4.2.1.2), organic terrain comprises a large (estimated 30 to 40 percent) proportion of the surficial ground cover. Its importance during highway construction will be a function of its characteristics, including classification strength, thickness and moisture content, to name some the of geotechnical considerations. Based on geotechnical assessment of the above characteristics, prediction of their behavior during and following highway construction, decisions concerning the removal (partial or total) of organic terrain in preparation for placement of highway construction materials, can be made.

4.1.3.4 Permafrost

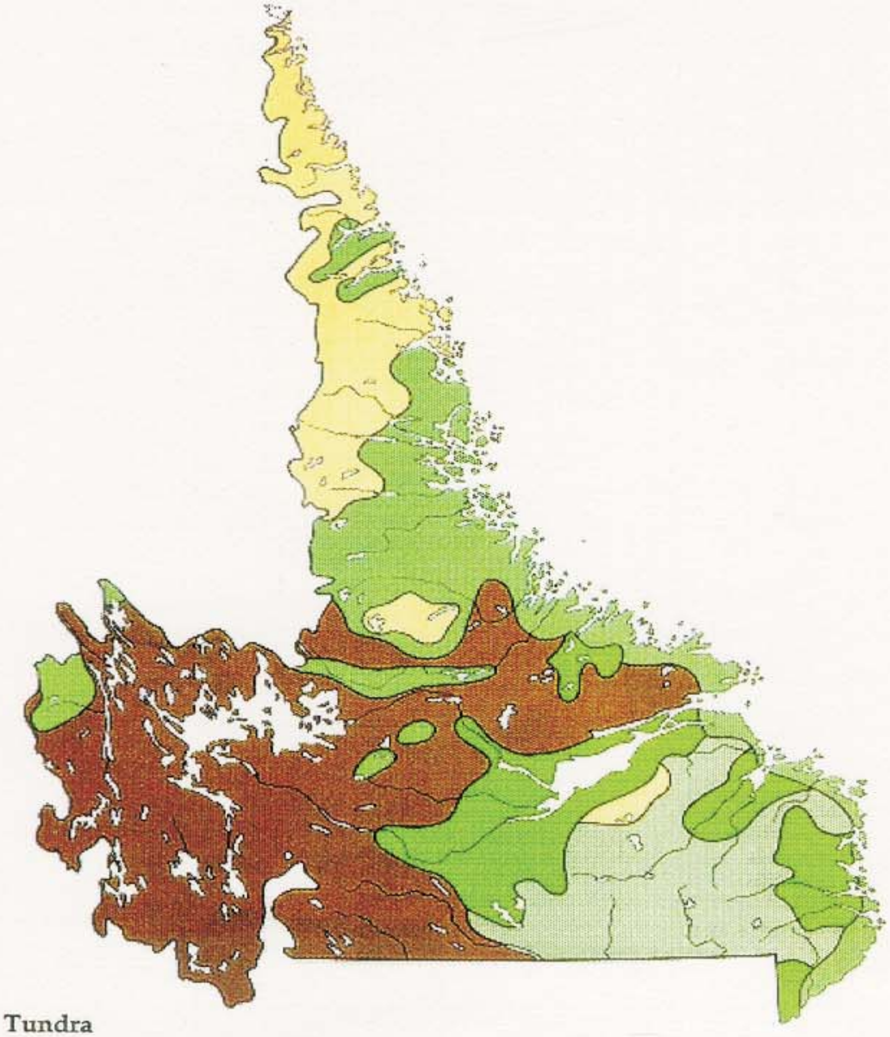
Permafrost in southeastern Labrador (Heginbottom et al. 1995) occurs as isolated patches, usually less than 10 percent by area. In the lower latitudes, it is common for permafrost to be found in boggy terrain, not unlike that found along the outfitter route. However, no detailed mapping of permafrost has been completed in the area.

Consultation with WST personnel, other provincial government staff, and local contractors determined that permafrost was not a concern for construction of the TLH - Phase II. Over the past seven to ten years, the Department of Forest Resources and Agrifoods has constructed 40 to 50 km of roads in Southern Labrador and permafrost has not been encountered. Similarly, local contractors who have worked extensively along the south coast are not familiar with the existence of permafrost in these areas even at depths of up to 6 m (20 feet). Although year-round frost is unlikely in the region, winter frost can sometimes persist until late June (JW 1998a).

4.2 Terrestrial Environment

4.2.1 Vegetation

Vegetation in Labrador can be divided into three broad classes: forests (trees and shrubs); wetlands (bogs, marshes and water bodies); and barrens (little vegetation). Western, central and southeastern Labrador have been classified as either Boreal Woodland or Boreal Forest (Rowe 1972). North of approximately 56°N latitude, vegetation quickly disappears in the Low Arctic Tundra. A Forest Tundra transition zone lies between approximately 55°N and 56°N latitude. Forest Tundra also exists in the form of a 50-km wide band on the east and south-east coasts. Wetlands can be found throughout Labrador south of 55°N latitude. Wetlands are found in areas of low local relief. These areas are numerous in the western plateau and also in the central and eastern areas. Barrens exist in coastal areas, north of approximately 55°N latitude, and in the Mealy Mountains. The five classes of vegetation in Labrador (Rollings 1997) are shown in Figure 4.11.



Tundra

The low treeless vegetation of high latitudes and altitudes, usually characterized by lichens, sedges and dwarf shrubs.

Forest and Tundra

A patchwork of tundra "barrens" and patches of stunted forest forming a transition zone between tundra and subarctic forest and peatlands. Tundra expands northward.

Barrens

Sparsely forested heath and moss barrens, stunted open and patchy or sometimes continuous cover of Black Spruce and Balsam Fir alternating with moss and heath barrens, rock outcrops and lakes on a generally featureless, windswept terrain.

Peatland

A patchwork of lakes and rivers, bogs, swamps and muskeg with areas of upland barrens and forest.

Forest

Conifers form the majority of the forest cover and the most prevalent species over the range is Black Spruce, usually found in pure stands or mixed with Balsam Fir and White Birch. On deeper lowland soils, Black Spruce, Balsam Fir, White Spruce, White Birch and Balsam Poplar are common.

0 50 100 150 200
KILOMETRES

Source: Rollings 1997.

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FIGURE 4.11

VEGETATION CLASSIFICATION IN LABRADOR

Wilton (1964) recognized four distinct forest quality classes in Labrador: excellent; good; fair to marginal; and scrub to submarginal. The western end of the proposed highway route travels through an area of coastal plain surrounding Lake Melville. This area is classified by Wilton as an excellent forest zone. The forest is dominated by black spruce and balsam fir, with white birch and trembling aspen sometimes occurring. Scientific names for vegetation are provided in Appendix B. Plateau bogs, often with large and scattered pools of water, occur along the coastal plain of Lake Melville. Ribbed fens, characterized by narrow strings of fen vegetation alternating with numerous pools, occur in upland depressions (Meades 1990). Areas of black spruce/lichen forest also occur in this area.

The central portion of the proposed highway route travels through black spruce forest intermixed with numerous bogs and wetlands. The eastern portion of the A13 section of the outfitter route is aligned through extensive wetland areas as it travels north to meet the portion of the highway near the Eagle River, that is common to both routes. Lichen woodland occurs on eskers and area of coarse till. Alder swamps are common along rivers (Meades 1990).

The eastern portion of the highway route travels through an area of undulating landscape where closed-crown forest dominates. Sites that have been burned are occupied by birch forests on steep, moist slopes or lichen woodland on well-drained areas. Domed bogs occur in valleys (Meades 1990).

4.2.1.1 Ecological Land Classification

Numerous authors have classified the biophysical environment of Labrador in the last 40 years (i.e., Hirvonen 1984; Lopoukhine et al. 1978; Meades 1990). The most recent classification, completed by the Ecological Stratification Working Group (ESWG) (1996) is the most comprehensive biophysical classification available and was used for this study.

The proposed highway route encompasses two ecozones, the Boreal Shield and Taiga Shield, within which four ecoregions are defined: the Lake Melville and Paradise River ecoregions within the Boreal Shield ecozone; and the Mecatina River and Eagle Plateau ecoregions within the Taiga Shield ecozone. Ecozones represent large and very generalized ecological units characterized by various abiotic and biotic factors. An ecoregion is part of an ecozone characterized by distinctive regional factors such as climate, physiography, vegetation, soil, water and fauna (ESWG 1996). A description of each ecozone and ecoregion is provided below and illustrated in Figure 4.12.

Boreal Shield Ecozone

The Boreal Shield ecozone is a large U-shaped zone extending across Canada from northern Saskatchewan to Newfoundland and Labrador. A mosaic of rolling uplands and hills dominates the terrain. The bedrock is mostly Precambrian granite and surficial glacial deposits cover much of the land surface. Soils range from Podzol, which dominate in the south, to Brunisols, which dominate in the north. Numerous small to medium-sized lakes dot the landscape. Generally, this ecozone has a continental climate characterized by cold winters and short warm summers. In coastal areas in Atlantic Canada, the climate is moderated by maritime conditions.

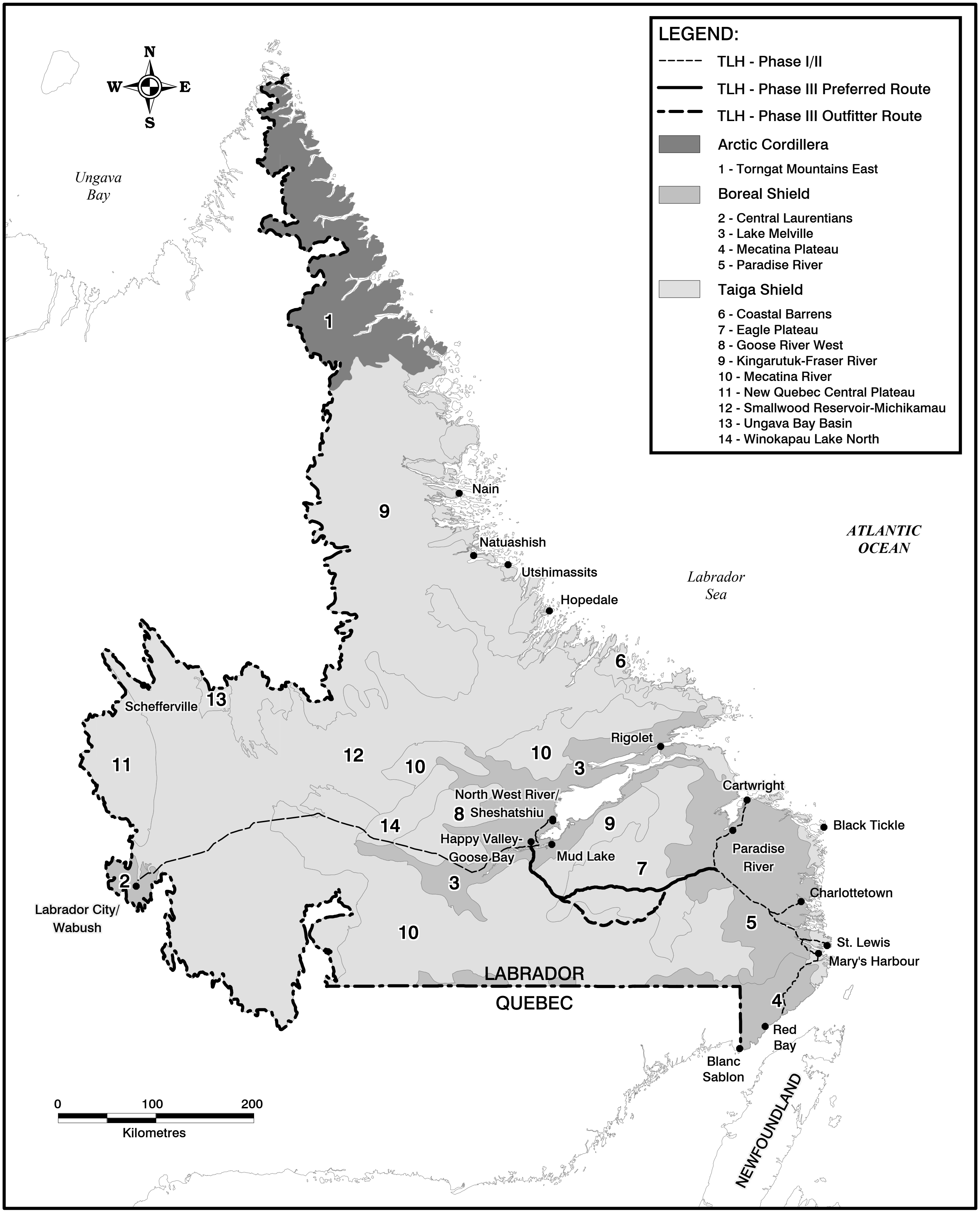

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Figure 4.12

Labrador Ecozones and Ecoregions

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Over 80 percent of the ecozone is forested mainly by closed canopy conifers such as white and black spruce, balsam fir and tamarack. Deciduous trees include white birch, trembling aspen and balsam poplar. Non-forested areas tend to be covered with a range of communities, dominated by lichens, shrubs and forbs (ESWG 1996).

Lake Melville Ecoregion

This ecoregion surrounds Lake Melville and represents a narrow extension of the boreal forest into the Taiga Shield ecozone. The ecoregion is an irregular lowland much dissected by river valleys. Elevations are generally not high, to approximately 300 m asl, although elevations may reach 500 m asl in a few areas. Its mixed forests are dominated by productive, closed stands of balsam fir, black spruce, white birch and trembling aspen and includes some of the best timberland in Labrador. Humo-Ferric Podzols are the dominant soils, with Dystric Brunisols occurring on drier, coarse-textured outwash and Organic Cryosols on fen-bog sequences.

The ecoregion is marked by humid, cool summers and cold winters. The mean annual temperature is approximately -2°C. The mean summer temperature is 8.5°C and the mean winter temperature is -13°C. The mean annual precipitation ranges from 800 to 1,000 mm (ESWG 1996).

Paradise River Ecoregion

The eastern portion of the proposed highway route passes through this ecoregion that covers the southeastern corner of Labrador. Inland portions of the ecoregion, such as the area of the highway, are only slightly affected by the Atlantic Ocean. From the coast, elevations rise steadily and reach 215 to 365 m asl. Its forests are dominated by closed stands of black spruce and balsam fir with an understory of feathermoss. On disturbed sites, birch, aspen and black spruce are dominant. The area is covered with sandy morainal deposits of variable thickness; eskers and river terraces occur sporadically. Humo-Ferric Podzolic soils are dominant and permafrost occurs in isolated patches with low ice content, mainly in wetlands.

The mean annual temperature is approximately 0°C. The mean summer temperature is 8.5°C and the mean winter temperature is -8.5°C. Mean annual precipitation varies from 900 mm in the northeast to 1,100 mm in the southwest (ESWG 1996).

Taiga Shield Ecozone

This ecozone lies on either side of Hudson Bay with the western segment occupying central Québec and Labrador. The ecozone is largely defined by two large biophysical features, the taiga forest and the Canadian Shield. Most of the ecozone is characterized by rolling terrain in a mosaic of uplands and associated wetlands dominated by Precambrian bedrock outcrops and glacial deposits. The main soil types are Podzols, Brunisols, Gleysols and Organic Cryosols. Permafrost is discontinuous but widespread and thousands of small waterbodies are distributed throughout the ecozone. Wetlands cover poorly drained lowlands and depressions. The climate is characterized by relatively short, cool summers and long, cold winters.

Vegetation is comprised of open lichen forests interwoven with shrublands and meadows more typical of Arctic tundra. It is at the northern boundary of this ecozone that the latitudinal limits of tree growth are reached. The best stands of trees occur along streams and rivers in protected valleys (ESWG 1996).

Mecatina River Ecoregion

The highway route passes through the Mecatina River ecoregion, which extends to the southern Labrador boundary with Québec. The landscape comprises a rugged undulating to hilly plateau with deep, dissected valleys. Elevations range from 215 to 600 m asl. The predominant vegetation includes low, open and sometimes closed canopy stands of black spruce, with an understory of dwarf birch, Labrador tea, lichens and mosses. The forests in this ecoregion are transitional, with the northeast portion of the ecoregion generally having closed canopy of typical coniferous boreal forests to the south. Sandy morainal deposits of variable thickness are predominant with fluvioglacial deposits sporadically distributed in the form of eskers and river terraces. Humo-Ferric Podzolic soils are dominant and permafrost occurs in isolated patches, mainly in wetlands.

The mean annual temperature is approximately -1°C for the ecoregion. The mean summer temperature is 10°C and the mean winter temperature is -13°C. Mean annual precipitation increases from north to south and ranges from 800 to 1,000 mm (ESWG 1996).

Eagle Plateau Ecoregion

The climate of the Eagle Plateau ecoregion is continental and not affected by the Atlantic Ocean. The ecoregion is a level to gently undulating peatland area interrupted by eskers, exposed bedrock and shallow rivers. Extensive string bogs with much open water are the dominant feature, representing between 25 and 50 percent of the landscape. Open pools are surrounded by fen vegetation, including sedges, brown mosses and sphagnum mosses. String bogs have open, dwarf black spruce with tamarack, Labrador tea and feathermoss. Mesisols and Fibrisols are the dominant soils and permafrost is sporadically distributed, mainly in peatlands.

The mean annual temperature is approximately 1°C. The mean summer temperature is 8.5°C and the mean winter temperature is -11°C. Mean annual precipitation ranges from 900 to 1,150 mm (ESWG 1996).

4.2.1.2 Wetlands

Wetlands are generally defined as areas that have the water table at, near or above the soil surface for all or much of the year. Classification of wetlands in Labrador conforms to the Canadian Wetland Classification System (NWWG 1988). Five classes of wetlands are recognized: bog and fen (also called peatlands); marsh; swamp; and shallow water. Peatlands in Labrador vary greatly, from raised bogs of little value to waterfowl, to string bogs, ribbed fens and unpatterned fen-marsh complexes that may be relatively productive habitat for geese and dabbling ducks (Goudie and Whitman 1987). Fen-marsh complexes may be more important then ribbed fens for diving ducks as the water bodies are larger and deeper.

Four general wetland types are found within central and southern Labrador. Bogs are peatlands in which the water table is located at or near the surface. The surfaces of bogs may be level with surrounding terrestrial habitats or may be raised above them. The groundwater within the rooting zone of bogs is derived mainly from precipitation and is essentially independent of the mineral rich groundwater in surrounding mineral soils. Consequently, bogs are typically nutrient-deficient and acidic. Fens, like bogs, are peatlands that develop as a result of the accumulation of organic matter on poorly drained soils. However, unlike bogs, fens are relatively nutrient-rich due to inputs of groundwater from surrounding upland soils. Marshes are mineral wetlands or peatlands that are periodically inundated by standing or slowly moving water. Surface waters in marshes generally fluctuate seasonally. The substrate of marshes usually consists of mineral soil, although it occasionally consists of well decomposed peat. Swamps are either mineral wetlands or peatlands that contain standing water or slowly flowing water in pools and channels. The water table is typically located at or near the surface of the soil and there are often seasonal fluctuations in water level. The rooting zone of plants in swamps is infiltrated by nutrient-enriched surface waters or groundwater; consequently, plant productivity is generally high.

4.2.1.3 Rare and Endangered Vascular Plant Species

None of the three vascular plants listed under provincial endangered species legislation are likely to occur in the vicinity of the proposed highway as all three, Longs braya (*Braya longii*), Fernald's milk vetch (*Astragalus robbinsii*), and barrens willow (*Salix jejuna*) are restricted to limestone barrens. This habitat type has not been identified in the project region.

Species have been identified through provincial ranking criteria ranging from S1 to S3. S1 species are extremely rare throughout their range in Labrador (typically five or fewer occurrences or very few remaining individuals). S1 species may be especially vulnerable to extirpation. S2 species are rare throughout their range in Labrador (6 to 20 occurrences or few remaining individuals) and may be vulnerable to extirpation. S3 species are uncommon throughout their range in Labrador (21 to 100 occurrences). In instances where the status of a species is poorly understood, a range of S rankings may be provided (i.e., S2S3).

Only two rare plant records from the Atlantic Canada Conservation Data Centre (ACCDC) are known for this area (S. Gerriets, pers. comm.), small northern bog-orchid and sensitive fern. Small northern bog-orchid is listed as S3S4 by the ACCDC, indicating that it is uncommon to common in Labrador. The ACCDC record indicates this plant was found near the Churchill River, approximately 6 km north of the proposed highway (Figure 4.13). Sensitive fern is listed as S2S3, indicating that it is considered to be rare to uncommon in Labrador. The ACCDC record indicates this plant was found near the Eagle River, approximately 25 km north of the proposed highway (Figure 4.13).

The lack of rare plant records for the area is attributable mainly to the paucity of botanical records for Labrador. As such, these records alone would not provide adequate information to assess whether rare species are likely to be present.

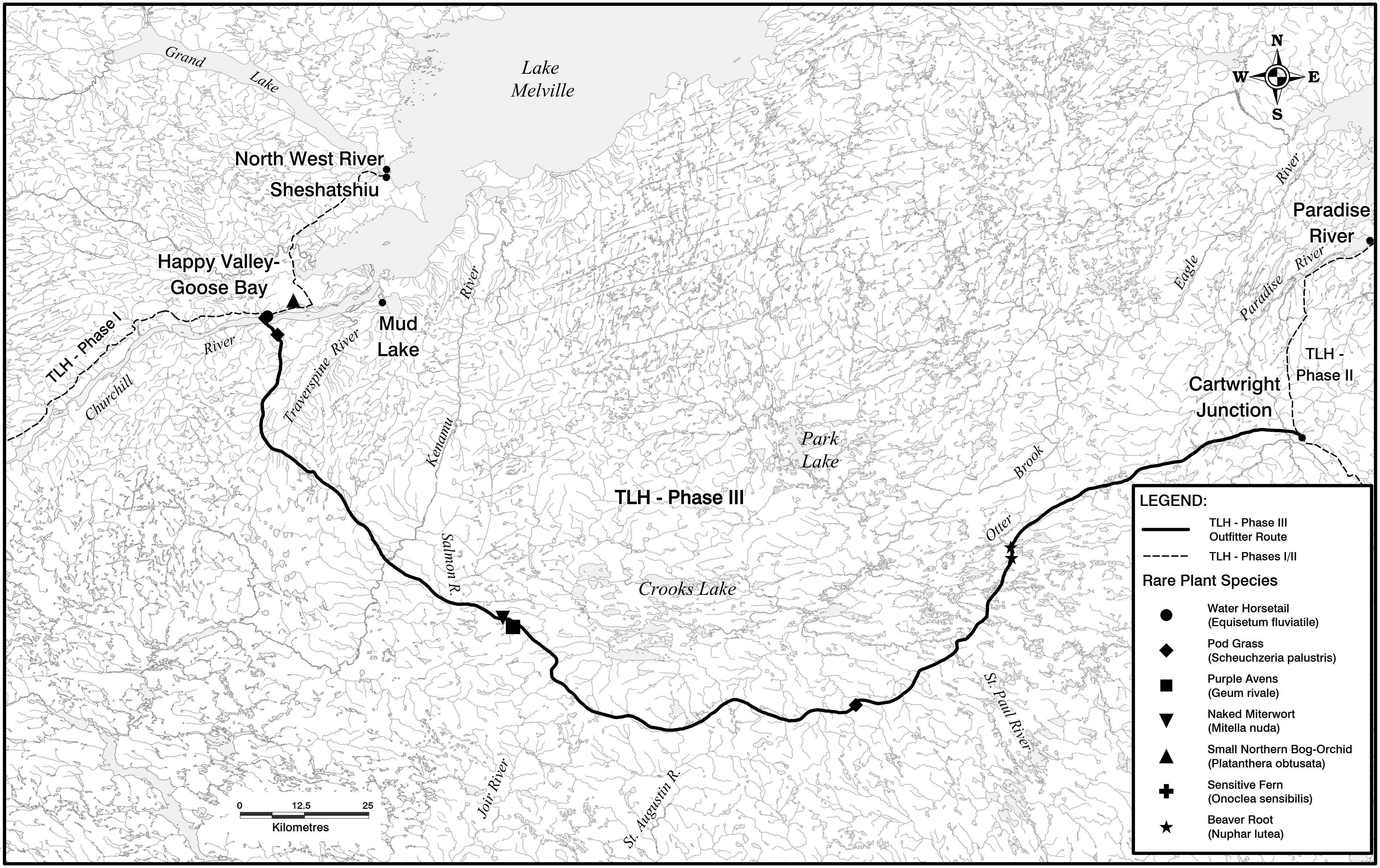

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Figure 4.13

Rare Plant Species Locations

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Some limited botanical surveys were conducted at 30 wetland habitats found along the A13 section of the proposed outfitter route in 2003. As well, rare plant species were identified during wetland surveys of the preferred route in 2002. As the western and eastern sections of the proposed TLH - Phase III highway are common to both alternatives, observations from 2002 on the common sections are included here. These surveys were restricted to identification of the most abundant species at each of these wetlands in order to provide descriptions of various wetland types. It should also be noted that the locations of these species are only approximations and their position relative to the final highway right-of-way has not been determined. During these surveys in 2002 and 2003, five plant species of special status were encountered. These include water horsetail (*Equisetum fluviatile)*, pod grass (*Scheuchzeria palustris*), purple avens (*Geum rivale*), naked miterwort (*Mitella nuda*) and beaver-root (*Nuphar lutea* ssp. *variegata*).

Water horsetail is listed as S1S3, indicating that population status in Labrador is poorly understood and it ranges from extremely rare to uncommon. This species is typically found growing in shallow standing water or in very wet substrates along shorelines. The species was found at two locations - in a shore bog situated in the flood plain of the Churchill River, approximately 40 m from the highway centerline, and in a slope fen near kilometre point (KP) 99.7, approximately 170 m south of the highway centerline (Figure 4.13).

Pod grass grows in shallow pools in bogs and fens or in quagmires. The ACCDC ranks this species as uncommon (S3). In the study area it was found at two sites near the Churchill River and at the edges of bog pools in a string bog (Figure 4.13).

Purple avens is typically found in wet meadows, bogs and peaty shores. In the study area, this species was found in a stream swamp under an overstory of downy alder, bog willow and beaked willow (Figure 4.13). Purple avens is ranked by ACCDC as very rare to rare (S1S2) in Labrador.

Naked miterwort was found in the same wetland as the purple avens (Figure 4.13). This species is typically associated with cool or mossy woods or swamps, stream banks and bog. It is ranked as S2? indicating that the species has been tentatively ranked as rare but the status of the species in Labrador is poorly understood.

Beaver-root is typically found growing in pools in deeper pools in bogs or fens as well as in shallow areas of ponds, lakes and sluggish streams. It was noted from a basin bog and a string bog (Figure 4.13). This species is relatively widespread and abundant in the study area. It was observed on many lakes ponds and wetlands during low level helicopter flights along the route. Beaver-root is ranked as uncommon to fairly common (S3S4) by ACCDC.

It is important to note that the ACCDC rankings for species in Labrador are very conservative and it is likely that all of these species are more widespread and abundant than their ranking would indicate. This is attributable to the fact that there is little plant distribution data available for Labrador.

Given the length of the highway and the relative inaccessibility of the area, it will not be possible to survey the entire route. Instead, the rare vascular plant surveys will be focused in areas that have a high probability of supporting rare plants. To this end, a rare vascular plant distribution modeling study, similar to the one prepared for the preferred route, was undertaken to identify species likely to be present along the highway right-of-way. The area covered includes the A13 section of the proposed outfitter route only since a modeling exercise completed for the preferred rout included the two end sections that are common to the outfitter and preferred routes.

Federal and provincial publications, including species identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and those listed under the provincial *Endangered Species Act*, were reviewed, as well as the ACCDC database of records of uncommon and rare plants in Newfoundland and Labrador.

The modeling exercise identifies potentially sensitive areas and provides direction regarding where further investigations should take place. Species distribution data for plant species considered uncommon or rare were consulted to determine likelihood of occurrence in the project area. The habitat preferences of the species that may occur in the region were then compared to the habitat data collected along the outfitter (A13 section) route in order to determine if suitable habitat was present. From this review, sites with high potential to support rare vascular plant species were identified. Details of the modeling exercise and the results are provided in Appendix C.

The methodology to be used for the rare plant survey on the TLH - Phase III route will be the same as that used for the rare plant survey conducted for Phase II of the TLH. The geographic extent of a survey site will be defined as the area where the right-of-way passes through or within 100 m of a high potential site. Potential sites were identified by a modelling exercise described in Appendix C. Survey sites will be transferred onto 1:12,500 black and white aerial photos of the route and will be used to aid in navigation. The UTM coordinates (NAD83) for the beginning, end and any right-of-way turns within the survey sites will be entered into a GPS unit to facilitate the location of these points in the field.

The study team will consist of a botanist, navigator/field assistant and helicopter pilot. At each of the survey areas the botanist and navigator will land as close to the survey site as possible and use GPS to navigate to one end of the survey site. A transect, which will run along the centerline of the proposed highway route, will then be established through the survey site. Each transect will be broken down into legs; the number of legs dictated by whether the right-of-way is straight or curved, the degree of the curve, and the length of the transect. Straight transects will contain one leg, while curved transects will contain a number of legs linked together to approximate the curve or curves dictated by the right-of-way. The minimum length of a leg will be 100 m. The coordinates of each leg will be entered into the GPS as waypoints prior to commencing the field survey. Bearing and distance between adjacent waypoints on the transect will also be calculated. A compass and hipchain will then be used to navigate along the transect. The use of a hipchain line to mark the transect will allow the survey to be focused within the right-of-way. A zigzag course to either side of the transect will be followed, keeping the hipchain line to the left. When the end of the transect is reached, the course will be reversed, and the same pattern followed on the opposite side of the hipchain line back to the beginning of the transect.

All observations of vascular plants will be recorded. Areas of unusual habitat types will be searched more intensively than areas supporting common habitat types. Plants which can not be identified in the field will be returned to the laboratory for identification. The nomenclature used in the study will be that of Rouleau (1978). The locations of rare species will be recorded on the route mapping or aerial photos, and/or GPS coordinates taken. The number of individual shoots will be recorded and, where possible, the general distribution of the species in the surrounding area will be determined. Specimens of rare species will be dried and retained as voucher specimens. Samples can be provided to a Newfoundland herbarium following consultation with the Inland Fish and Wildlife Division.

4.2.2 Avifauna

Migratory birds generally begin to arrive in Labrador in late April to early May. Waterfowl, shorebirds and raptors such as bald eagle congregate along the coast and in areas of open water inland while waiting for rivers, lakes and wetland areas to become ice free. Scientific names of avifauna are provided in Appendix B.

A variety of raptor species inhabit Labrador, many of them arriving in the spring to breed before migrating to southern latitudes to overwinter. Raptors found in the region include bald eagle, osprey, rough-legged hawk, red-tailed hawk, great horned owl, merlin and American kestrel. Various owl species also inhabit the region, including great horned owl, boreal owl and short-eared owl. The short-eared owl is an open ground hunter and would be expected to inhabit bog complexes and other open areas. This species was listed as being of special concern by COSEWIC in 1994 and as vulnerable in 2002 under the Newfoundland and Labrador Endangered Species Act. Golden eagle and peregrine falcon may be present in the region during migration, although both species tend to nest farther north in Labrador or along the Labrador coast. Similarly, snowy owl and gyrfalcon are not known to nest in the region but may occur infrequently when Arctic prey populations cyclically decline and the birds move south to hunt. Further information on raptors is provided in Section 7.1.

Productive wetland habitat is limited in extent and coverage in Labrador, resulting in relatively low densities of breeding waterfowl. However, the sheer size of Labrador means that while waterfowl are spread over the landscape at low densities, the number of waterfowl that nest in the region represents upwards of 40 percent of the breeding population in the northern Atlantic flyway (Goudie and Whitman 1987). Waterfowl species that commonly occur include black duck, green-winged teal, ring-necked duck, northern pintail, common merganser, red-breasted merganser, common goldeneye, Canada goose, scaup, surf scoter and black scoter. Common loons frequently inhabit larger waterbodies and greater yellow-legs are ubiquitous in wetland areas. Gulls and terns are also seen during the summer months.

Harlequin duck are listed as being of special concern by COSEWIC and vulnerable under the Newfoundland and Labrador *Endangered Species Act*. This species is known to nest in the Churchill River watershed, to the west of the project region (i.e., Fig River), and have been observed on Natashquan River and Little Mecatina River to the south. However, the majority of the breeding population of harlequin ducks occurs north of Lake Melville (JW 1998b).

A range of passerine birds also inhabit the region, many of them migrants that come to Labrador to breed during the summer months. General groups are represented including those that rely on forest, openings and edges, bogs, barrens, and shrubs and thicket type habitats. These general species groups include woodpeckers, warblers, thrushes, sparrows and finches. Willow ptarmigan, ruffed grouse and spruce grouse are also present. Further information on waterfowl is presented in Section 7.2 and information on passerine birds is provided in Section 6.2 of the TLH - Phase III EIS/CSR (JW/IELP 2003a).

Ivory gull and Caspian tern are listed as vulnerable by COSEWIC. The ivory gull breeds in the high Arctic, but may winter in coastal regions of Labrador and on pack-ice off northeastern Newfoundland. It is not expected that this species would be present in the study area. The Caspian tern breeds on sandy or rock islands in lakes and large rivers in the interior or on coastal islands. In Labrador, this species is known to nest in Lake Melville. It is possible that these birds could pass through the study area while migrating to wintering areas in the Gulf of Mexico and the Caribbean.

4.2.3 Wildlife

Caribou numbers are generally low in southern Labrador. Prior to a recent population estimate from work conducted in conjunction with this EIS/CSR, Schaefer (1997), estimated the MMCH to number less than 600 animals. A recent estimate for the MMCH is approximately 2,500 +/- 1,500 animals; however, Otto (2002a) cautions that the apparent population increase is biologically improbable and cannot be confirmed without further information on the population age structure. The range of the MMCH extends from Lake Melville south and from the Kenamu River headwater, east to the Labrador coast. The RWMCH is estimated to number less than 200 animals (Schaefer et al. 1999). Unpublished information provided by the Department of Forest Resources and Agrifoods (F. Phillips, pers. comm.) and the Department of National Defence (T. Chubbs, pers. comm.) indicates that individuals of the RWMCH have occasionally been identified using the Happy Valley-Goose Bay region. Since 1982, when these animals first were collared and studied, there has been use of habitat south of the Churchill River, particularly in the Minipi River/Dominion Lake area. A collared Red Wine animal was also found to have calved south of Mud Lake and an individual wintered around a large bog complex at the headwaters of the Traverspine River in 1999-2000. However, to date, no Red Wine animals have been observed east of the Kenamu River. The area west of the Kenamu River is an area where the range of individuals from the Red Wine Mountain and Mealy Mountains herds may overlap. Potential effects of the highway and mitigation measures identified would apply to individuals of both herds if they were present in the area west of the Kenamu River. Both the MMCH and RWMCH herds are listed as threatened by COSEWIC. Refer to Section 7.3 for further discussion on the MMCH.

Moose occur in low densities, particularly in association with forested river valleys. The proposed highway falls within portions of the western portion of Area 53 and the eastern portion of Area 57. However, moose hunting is prohibited along much of the proposed highway route, specifically from the Kenamu River east to the Eagle River. Other large mammals that occur in the region include black bear and wolf.

Smaller mammals are prey for a variety of furbearers as well as for black bear and wolf. These prey species include snowshoe hare, red squirrel, and northern flying squirrel, all associated with areas of coniferous forest, as well as a variety of voles and mice, including meadow vole, Gapper's red-backed vole, deer mouse, northern bog lemming, heather vole, meadow jumping mouse and woodland jumping mouse. Porcupine are also present in the region and appear to have increased in numbers in Labrador over the last several years (I. Schmelzer, pers. comm.). During aerial surveys for waterfowl conducted in support of this EIS/CSR, evidence of porcupine browsing was observed on black spruce trees at numerous sites in the survey zone.

Furbearer species in the region include red fox, lynx, beaver, muskrat, river otter, ermine, least weasel, American mink and American marten. Areas of bog interspersed with scrub forest area considered marginal habitat for species such as marten and lynx; therefore, it is likely that in these areas, marten and lynx would favour river valleys where tree growth is best. Mink, beaver, muskrat and otter are associated with rivers and lakes in the region. Refer to Section 7.4 for detailed discussion on furbearers. Scientific names of all wildlife are provided in Appendix B.

The wolverine is listed as endangered by COSEWIC. Wolverines were once distributed throughout Labrador and Québec, but there have been no confirmed sightings of this species since the 1950s. There is a record of one wolverine being trapped in the Muskrat Falls area of the Churchill River in the 1950s (Knox 1994). In 1989, wolverine tracks were reported to the west of Sandwich Bay, north of the Eagle River (Knox 1994). These are the only two records for wolverine in the region of the proposed highway route. Reasons for the decline are believed to be overharvesting, persecution (i.e., poisoning) and a decline in caribou populations at the turn of the century, which limited the amount of available carrion, an important food source for wolverine. Wolverines tend to avoid areas of human activity and have large home ranges extending from less than 100 km^2 for females to over 1,000 km^2 for males (Environment Canada 2002). The species also exhibits a more generalized use of open areas and a wider variety of vegetation types than other mustelids such as marten.

Roads that permit human access can be detrimental to wolverines, particularly if hunting or trapping occurs. As well, wolverines do not tend to thrive in habitats that have been permanently altered by development and human settlement (Environment Canada 2002). It is likely that any recovery of wolverine in Labrador will occur north of Lake Melville, in tundra regions where there is little human disturbance and a large caribou herd to provide scavenging opportunities from wolf kills. It is unlikely that wolverine currently exist in the study area. However, a recovery plan has been developed and it is possible that wolverine may be re-introduced to Labrador at some time in the future.

4.3 Freshwater Environment

4.3.1 Watersheds

The TLH - Phase III outfitter route will cross six large watersheds, the Paradise River, Eagle River, St. Augustin River, Kenamu River and Traverspine River, which is a tributary of the Churchill River and the Churchill River itself. The route will also pass through a small portion of Joir River, a tributary of the Little Mecatina River, watershed. However, there are no watercourse crossing in the Joir River watershed. The proposed watercourse crossings vary from small streams to the Churchill River. The nearest communities to the proposed route are Paradise River and Cartwright, approximately 50 and 75 km from Cartwright Junction, respectively, and Happy Valley-Goose Bay at the western end of the route. No permanent residences are located along the route and existing outfitting operations are distant from the route, with the closest being approximately 8 km from the proposed route.

4.3.2 Water Quantity and Quality

Weather stations in Happy Valley-Goose Bay and Cartwright and a stream flow station on the Eagle River have provided long-term data for the region of the proposed new highway. Summary information on regional precipitation and runoff is provided in Table 4.2, along with water quality determined for Eagle River. A small number of water quality measurements obtained for Paradise River and Eagle River in the 1970s are reported in Anderson (1985) and these tend to be lower values than those in Table 4.2.

Table 4.2 Precipitation, Runoff, Maximum Stream Flow and Water Quality Data

Characteristic	Range of Values
Mean annual precipitation (mm)	900 - 950
Mean annual snowfall (cm)	425 - 450
Mean annual runoff (mm)	700 - 800
Ice cover	early November to June
Eagle River Maximum monthly stream flow (m^3/sec)	> 900
Water Quality	
Turbidity (Jackson turbidity units - JTU)	0.60 - 1.90
Chloride (mg/L)	1.0 - 2.0
Calcium (mg/L)	0.8
pH	6.6 - 7.0
Total Alkalinity (mg/L)	8.0 - 9.0
Regional sensitivity to acid rain	moderate
Source: Derived from Government of Newfoundland and Labrador 1992a.	

There are no groundwater wells or municipal water supplies along the proposed highway route (Government of Newfoundland and Labrador 1992a).

4.3.3 Fish

Several species of freshwater fish are found in the watersheds along the route. A summary of the freshwater fish found in the watersheds along the route are provided in Table 4.3.

The Paradise River drains in a northeast direction into Sandwich Bay on the coast of Labrador. The TLH - Phase II runs, in part, parallel to Paradise River. The outfitter route/preferred route will cross the main stem near Paradise Junction and then traverse over 50 km of the watershed in an west-southwest direction. Anadromous Atlantic salmon have access to spawning and rearing habitat up to and 75 km beyond the highway crossings. The Paradise River is a scheduled salmon river.

The Eagle River, also draining to Sandwich Bay, is one of the largest salmon rivers in North America and is the second of two scheduled salmon rivers along the proposed route. There are several outfitting operations that cater to recreational angling on the Eagle River. The outfitter route will cross approximately 180 km of the Eagle River watershed.

Table 4.3 Fish Species in Watersheds Crossed by the Trans Labrador Highway - Phase III

Species	Paradise River	Eagle River	Kenamu River	Traverspine River	St. Augustin River	Churchill River
Atlantic salmon - *Salmo salar* [1 2]	✓	✓	✓	✓	✓	✓
Brook trout - *Salvelinus fontinalis* [1 2]	✓	✓	✓	✓	✓	✓
Threespine stickleback - *Gasterosteus aculeatus*		Sus	✓			✓
Burbot - *Lota lota*			Rare	✓		✓
Lake trout - *Salvelinus namaycush*						✓
Arctic charr - *Salvelinus alpinus*						✓
Lake whitefish - *Coregonus clupeaformis*			✓			✓
Round whitefish - *Prosopium cylindraceum*			✓			✓
White sucker - *Catastomus commersoni*	✓	✓	✓		✓	✓
Longnose sucker - *Catostomus catostomus*		✓	✓		✓	✓
Rainbow smelt - *Osmerus mordax* [1]	✓	Sus	✓	✓		✓
Atlantic sturgeon - *Acipenser oxyrhynchus* [1]			Rare			✓
American eel - *Anguilla rostrata*[1]	✓	Sus				✓
Ninespine stickleback - *Pungitius pungitius*	✓	Sus				✓
Northern pike - *Esox lucius*	✓	✓			✓	✓
Lake chub - *Couesius plumbeus*				U		✓
Mottled sculpin - *Cottus bairdi*						✓
Slimy sculpin - *Cottus cognatus*						✓
Pearl dace - *Semotilus margarita*						✓
Longnose dace - *Rhinichthys cataractae*						✓

Legend:
1. sea run
2. resident
✓ reported
Sus suspected
U unconfirmed

Source: Anderson 1985; Black et al. 1986; Dubois 1996; Lockerbie 1987; G. Bird (pers. comm.).

West of the Eagle River, Kenamu River drains north to Hamilton Inlet, which includes Lake Melville and Groswater Bay. The outfitter route will cross this watershed at a location approximately 80 km from the river mouth. Most of the length of Kenamu River is suitable rearing habitat for Atlantic salmon, with only partial barriers presented by rapids on the main stem. However, slow waters in the lower reaches of the river produce poor angling conditions and there is little fishing activity (Anderson 1985).

The Traverspine River also flows in a northerly direction to enter the lower Churchill River, 10 km from the mouth. The outfitter route/preferred route will traverse the basin at the approximate middle, which is 20 to 25 km wide. The route then runs up the western side of the Traverspine basin to a bridge across the Churchill River. Various potential barriers to salmon migration have been described on the Traverspine River, but again, angling activity is very low due to its remoteness and the presence of poorly suited conditions for angling (Anderson 1985).

The proposed bridge crossing the Churchill River is located approximately 20 km from the mouth of the river. Although there are 20 species of fish reported in Churchill River, only some of these have been reported below Muskrat Falls. The area of the crossing is wide with sandy substrate.

4.4 Cultural and Socio-economic Environment

4.4.1 Historic Resources

4.4.1.1 Precontact Period (8,000 BP to Contact with Europeans)

The predecessors of today's Innu and Inuit culture and society lived in Labrador, where they harvested the resources of the land and the sea, depending on the seasons. Previous archaeological fieldwork in Labrador-Ungava and Québec North Shore has generally focused on the coast, where work has established that archaeological sites are rich and abundant, and the culture-historical sequence long and complex, extending over approximately 8,000 years (JW/IELP 2001a; 2001b). The sequence begins with an initial Palaeo-Indian/early Maritime Archaic occupation in the Strait of Belle Isle (McGhee and Tuck 1975).

The Maritime Archaic Indians moved into the region from the south as the glaciers retreated and the land and sea became accessible and capable of providing resources. Maritime Archaic Indians harvested marine and terrestrial animals on a seasonal basis and expanded northward along the coast over thousands of years (Fitzhugh 1972).

After 4,000 BP, coastal Labrador was also colonized by Arctic-adapted peoples from the north (Cox 1978). Thereafter, Labrador precontact history is characterized by Intermediate Indian (Nagle 1978) and Recent Indian (Fitzhugh 1978) occupations interdigitating with Palaeo-Eskimo occupations (Pre-Dorset, Groswater, Dorset), culminating with the arrival of the Thule, ancestors of the modern Labrador Inuit, approximately 700 BP (Fitzhugh 1994; IELP 2002; Kaplan 1983).

The Pre-Dorset moved into Labrador from the eastern Arctic. The Pre-Dorset culture expanded down the coast of Labrador to roughly as far south as the Nain area (Cox 1978). They harvested resources from marine waters and forested inner bays on a seasonal basis (Hood 1993). The next known occupation of Labrador occurred during the Intermediate Indian period when a group of people moved into Labrador from areas to the south and west (Nagle 1978). Intermediate Indians harvested interior resources for most of the year and made limited use of marine and coastal resources during the summer months (Fitzhugh 1972).

Sites associated with the Groswater culture are found along the coast of Labrador and on the island of Newfoundland. Archaeological evidence indicates their subsistence strategy was focused primarily on marine and coastal resources, with more limited, seasonal harvesting of interior resources. Dorset people also relied heavily on marine and coastal animals and their sites are found along the entire coast of Labrador and on the island of Newfoundland (Cox 1978; Fitzhugh 1972; Tuck and Fitzhugh 1986).

The late precontact Indian culture may be descended from the previous Intermediate Indian culture and, possibly, from remnant Maritime Archaic Indian groups farther south. The late precontact Indians had an interior/maritime adaptation, similar to that of the Maritime Archaic culture, although it is likely that they spent much more time in the interior. Innu of Labrador are descended from the late precontact Indians (Loring 1992).

The last precontact occupation of Labrador was by the Thule culture. Thule people migrated into Labrador from the eastern Arctic. Within a few generations of arriving in Labrador, people of this highly successful marine hunting culture had moved down the coast as far south as Nain (Fitzhugh 1977). Inuit of Labrador are descended from the Thule.

In summary, Labrador was colonized initially by Maritime Archaic groups from the south shortly after deglaciation. These groups arrived in the southeast part of Labrador by 8,000 BP and had colonized most of coastal Labrador, between the Strait of Belle Isle and Lake Melville by 7,500 BP. A sequence of Indian occupations may be traced from that time to the present day Innu along the coast and in the hinterland. Palaeoeskimo groups first arrived in Northern Labrador from the eastern Canadian Arctic region by 4,000 BP and reached the central and southern Labrador coast by 2,800 BP. Thule groups, the direct ancestors of the Inuit, arrived in Northern Labrador by 900 BP and their culture progressively replaced the Dorset culture. Aspects of Labrador precontact history are discussed within the content of the larger discussion of historic resources in Section 7.11.

4.4.1.2 Historic and Contemporary Period (Arrival of Europeans to Present)

Archaeological and historical records also confirm a lengthy European presence on the Québec North Shore and coastal Labrador, from Sept-Îles to Hamilton Inlet. This was one of the first areas of North America to come to the attention of Europe and beginning with a probable Norse occupation in the eleventh century. Since that time, the area has seen almost continuous occupation or exploitation by the French, Basques and British during the past five centuries.

The first Europeans to see Labrador were the Norse approximately 1,000 years ago. After approximately 500 BP, Labrador also became a focus for European activities, including whaling - initially by Basque whalers in the sixteenth century (Tuck and Grenier 1989), fishing, sealing, and fur-trading (Kennedy 1995; McAleese 1991). The abundant resources soon attracted European fishers and merchants to the coast of Labrador. French, Portuguese and Basque fishing fleets soon made annual treks to Labrador to harvest fish and bring the catch back to Europe. Archival documents indicate amicable relations between the Basque and the native Indians, who were reported to have assisted in flensing and rendering whale blubber into oil destined for use in Europe (Barkham 1980 in Loring 1992).

European fishing in the waters off Labrador continued through the succeeding centuries and remained an important mainstay of the economy up until the closure of the commercial cod fishery in recent years. The seventeenth, eighteenth and nineteenth centuries saw the introduction of new European economic pursuits (e.g., the fur trade) and ideological belief systems. After British sovereignty over Canada was established with the Treaty of Paris in 1763, Moravians established a number of missions along the North Coast of Labrador, and permanent settlements were established. These European influences resulted in broad, sweeping changes to the traditional settlement, subsistence patterns, and belief systems of the Aboriginal peoples of Labrador (Brice-Bennett 1977). Year-round settlement in communities, and the introduction of European economies to Innu and Inuit populations, changed their culture and traditional lifestyles and European diseases caused drastic reductions in their populations.

The Innu of Labrador are part of a population of approximately 10,000, whose traditional land base includes most of the Quebéc-Labrador Peninsula. Their language belongs to the Algonquan linguistic family and they share many cultural traits with their western neighbours, the Cree. Historically, they were known as the Montagnais and Naskapi, depending on where they lived (Armitage 1990).

The Naskapi Innu culture was closely tied to the migratory caribou herds. Traditionally, these Innu groups spent most of the year in the interior of the Quebéc-Labrador Peninsula, hunting caribou and small game and fishing (Loring 1992). The necessities of life (physical and spiritual) were obtained from the caribou. Summer was a time of visiting, relaxation, and preparing gear for the winter hunting groups. This mobile, interior-oriented settlement pattern was maintained until a major decline of the caribou population in the early twentieth century, after which Innu maintained a regular seasonal presence near the coast and became more closely linked to the trading posts at Utshimassits and elsewhere along the coast (Leacock and Rothschild 1994; Loring 1992; VanStone 1985). Historic and contemporary camp locations reflect a complex network of travel routes, linking Québec North shore and Central Labrador Innu communities (JW/IELP 2001a; 2001b). Historic and Contemporary Innu Land and Resource use are further discussed in Section 7.12.

Contemporary Labrador Innu live primarily in the communities of Sheshatshiu, Utshimassits and Natuashish. The economy is based on employment (e.g., construction, transportation) but still includes the opportunity to pursue traditional harvesting activities with the aid of modern hunting and fishing gear and means of transportation (snowmobiles, motorboats and aircraft).

4.4.2 Regions and Communities

Labrador encompasses a vast area with diverse social and economic landscapes. Regional economic zones and select communities within them are illustrated in Figure 3.2.

Central Labrador (Regional Economic Zone 3) is the inland area adjacent to Lake Melville, and includes the Town of Happy Valley-Goose Bay (Labrador's largest community), the Town of North West River, the Innu community of Sheshatshiu and the smaller settlement of Mud Lake.

Southern Labrador (Regional Economic Zone 4) is the area between Groswater Bay and Cape Charles. It includes the Towns of Cartwright, Charlottetown, Port Hope Simpson, St. Lewis and Mary's Harbour, and the smaller communities of Paradise River, Black Tickle-Domino, Norman Bay, Pinsent's Arm, Williams Harbour and Lodge Bay. There are also a number of smaller coastal settlements in the region which are inhabited on a seasonal basis.

In western Labrador, Hyron (Regional Economic Zone 2) includes the neighbouring mining towns of Labrador City and Wabush, and the community of Churchill Falls.

The Labrador Straits is the region across the Strait of Belle Isle from the island of Newfoundland. It includes the Towns of Red Bay, Pinware, West St. Modeste, L'Anse au Loup, Forteau and L'Anse au Clair, and the communities of Capstan Island, L'Anse Amour and Point Amour.

Along the northern coast of Labrador, the Inukshuk region (Regional Economic Zone 1) encompasses the area north of Hamilton Inlet. It includes the Town of Nain and the communities Hopedale, Makkovik, Postville, and Rigolet, the populations of which are predominantly Inuit. The Innu community of Utshimassits is also located on the north coast. The residents of this community are in the process of being relocated to a new community, currently under construction at Natuashish (Sango Bay).

The following sections provide a description of the existing socio-economic environment of Labrador. The discussion focuses primarily on those regions through which the proposed highway will pass (i.e., Central and Southern Labrador). However, it also includes consideration of other Labrador regions, as the proposed project will provide improved access to a number of these areas.

4.4.3 Population

Population data for Labrador, including each of the regions and communities discussed above, and for the province of Newfoundland and Labrador as a whole, are provided in Table 4.4.

In 2001, the population of Central Labrador was 9,654, which comprised 34.6 percent of the population of Labrador as a whole. During that year, 82.5 percent of Central Labrador's population resided in the Town of Happy Valley-Goose Bay, with 11.7 percent in the communities of Sheshatshiu and Mud Lake and the remaining 5.7 residing in North West River. The region's total population decreased by 5.7 percent from 1996 to 2001, with only Sheshatshiu/Mud Lake seeing a population increase over that period (Table 4.4).

A total of 2,717 persons resided in Southern Labrador in 2001, representing 9.8 percent of Labrador's total population. Cartwright is the largest community in Southern Labrador, with 23.2 percent of the region's population in 2001. Port Hope Simpson and Mary's Harbour comprised 18.7 and 16.6 percent of the region's population in that year, respectively. Southern Labrador's population decreased by 5.5 percent from 1996 to 2001 (Table 4.4).

The populations of Labrador's other regions ranged from 1,996 (Labrador Straits) to 10,283 persons (Western Labrador) in 2001. The 2001 population of Labrador as a whole was 27,864, comprising 5.4 percent of the total population of the province of Newfoundland and Labrador (512,930). From 1996 to 2001, Labrador's population decreased by approximately 5.7 percent (Table 4.4).

Between 1996 and 2001, both Southern and Central Labrador underwent population changes. In Southern Labrador, all but two towns (Cartwright and Charlottetown) had a decline in population. In Central Labrador, Happy Valley-Goose Bay showed a decline in population, while other communities experienced a population growth. The population in both areas is a mix of aboriginal (i.e., Innu, Inuit, and Métis) and non-aboriginal peoples.

Table 4.4 Population by Community and Region

Community/Region	1996	2001	% Change
Central Labrador			
Happy Valley-Goose Bay	8,655	7,969	-7.9
North West River	567	551	-2.8
Sheshatshiu and Mud Lake (Subdivision C, SUN*)	1,018	1,134	+11.4
Total	10,240	9,654	-5.7
Southern Labrador			
Cartwright	628	629	+0.2
Charlottetown	330	346	+4.8
Port Hope Simpson	577	509	-11.8
St. Lewis	312	290	-7.1
Mary's Harbour	474	450	-5.1
Subd. B, SUN*	555	493	-11.2
Total	2,876	2,717	-5.5
Western Labrador			
Labrador City	8,455	7,744	-8.4
Wabush	2,018	1,894	-6.1
Churchill Falls (Subdivision D, SUN*)	717	645	-10.0
Total	11,190	10,283	-8.1
Labrador Straits			
Red Bay	275	264	-4.0
Pinware	144	140	-2.8
West St. Modeste	170	175	+2.9
L'Anse au Loup	621	635	+2.3
Forteau	505	477	-5.5
L'Anse au Clair	264	241	-8.7
Subd. A, SUN*	83	64	-22.9
Total	2,062	1,996	-3.2
Labrador North Coast			
Nain	1,176	1,159	-1.4
Utshimassits	512	580	+13.3
Hopedale	591	559	-5.4
Postville	223	215	-3.6
Makkovik	367	384	+4.6
Rigolet	317	317	0
Total	3,186	3,214	+0.9
Labrador (Total)	29,554	27,864	-5.7
Newfoundland and Labrador (Total)	552,156	512,930	-7.1

Notes:
* The smaller, unincorporated communities of that region (combined population).
1996 population data provided in this table are based on revised data issued by Statistics Canada after the official census release.
Source: Statistics Canada 2002.

4.4.4 Community Life

In Southern Labrador, Cartwright, Charlottetown, Port Hope Simpson, St. Lewis, Mary's Harbour and Red Bay are incorporated towns. In Central Labrador, the towns of Happy Valley-Goose Bay and North West River are incorporated, while the community of Sheshatshiu is administered under their Band Council and Mud Lake is unincorporated. Happy Valley-Goose Bay serves as the main administrative centre for Central

Labrador. All municipalities have municipal plans that define land use designations and the manner in which development may occur and each municipality is in charge of providing and maintaining infrastructure, such as roadways and solid waste management.

Residents rely on marine transport in the summer and fall for travel and the movement of goods, and snowmobiles in the winter. Access to scheduled air service year-round is available to all communities for travel within Labrador and to other regions. Common daily transport within towns and communities is by foot, vehicle and all-terrain vehicles in the spring to fall and snowmobiles in the winter. While large centres have year-round road access, snowmobile use is still common in the winter. A network of secondary roads connects all towns and two primary roads, sections of the TLH, extend from western Labrador to Happy Valley-Goose Bay and Red Bay to Cartwright.

Health care services and infrastructure in Southern and Central Labrador fall under the jurisdiction of Health Labrador Corporation and Grenfell Regional Health Services (GRHS). The Health Labrador Corporation, based in Happy Valley-Goose Bay, is responsible for community clinics and mental health services in the local communities. The GRHS is based in St. Anthony (Newfoundland) and is responsible for health care and community and mental health services in the remaining areas of Southern Labrador and the Labrador Straits. The Department of Human Resources and Employment is responsible for income support and labour market services. The Department of Health and Community Services is responsible for child welfare, community corrections services, and family and rehabilitative services. Within Southern Labrador, social services are provided through offices in Cartwright, Mary's Harbour and Forteau. Within Central Labrador, services are provided through offices in Happy Valley-Goose Bay and Sheshatshiu. These government departments have a number of programs in place.

Policing in Labrador is the responsibility of the RCMP. There are detachments in Happy Valley-Goose Bay, Cartwright, and Mary's Harbour. Happy Valley-Goose Bay has a semi-volunteer fire department. There are volunteer fire departments in North West River/Sheshatshiu, Charlottetown and Cartwright. Volunteer departments are responsible for handling all fires within towns and at waste disposal sites. Forest fire suppression and monitoring is the responsibility of the Department of Forest Resources and Agrifood. The Labrador Regional Office is located in Happy Valley-Goose Bay, supported by District Offices in Cartwright (Districts 20 and 21) and North West River (District 19). In addition, there are satellite offices for District 21 in Port Hope Simpson and Red Bay.

Most towns and communities have recreational facilities available for residents. Snowmobiling is a popular pastime in the winter months as a recreational activity, with a large amount of trails available for travel. In addition, there are other outdoor activities such as skiing and snowshoeing. Sports such as curling, hockey and skating are also popular, and many communities have outdoor and indoor rinks. Various churches have been established throughout the communities. The region also has a tradition of local "craft" culture, which is reflected across all of Newfoundland and Labrador.

4.4.5 Resource Use and Users

Labrador residents make use of land and water resources for subsistence and recreation and, to a limited degree, commercial ventures. A variety of other resource use activities could potentially be carried out in the area in which the TLH – Phase III will be located. Activities include hunting, trapping, fishing, forestry, mining and quarrying, military activities, parks, reserves and special areas, and cabins, trails and recreational areas. Resource users include the Innu, Settler/Métis, other residents of Labrador and tourists to the area.

The TLH - Phase III passes through an area that has traditionally been used by the Innu and is currently subject to a land claim being negotiated between Innu Nation and the governments of Canada and Newfoundland and Labrador. The harvesting areas most important to Sheshatshiu Innu are the Mealy Mountains, the shoreline of Hamilton Inlet (near the mouth of river and streams), the shoreline of major rivers in the area, in particular the Kenamu, Kenemich and English rivers, Paradise River and the upper parts of Saint-Paul and Saint-Augustin rivers, Eagle River and its tributaries and the shoreline of the larger lakes at the headwaters of the Eagle River (JW 2003a). Caribou and fish, supplemented by beaver, porcupine, seal, hare, grouse, ptarmigan and waterfowl, are the main animals harvested. The Innu also trap otter, mink, muskrat, fox, lynx, marten and ermine, as well as hunt black bear. Berries are also gathered in the mid to late summer. Trees, mainly black spruce, birch and tamarack are harvested for firewood, shelters, tools and other implements (JW 2003a).

Land areas historically used by the Settler or Métis overlap with those used by the Innu, including trapping along the Eagle, Paradise and Kenamu rivers, and hunting in the Mealy Mountains and the Eagle River Plateau (JW 2003a). Settlers from the Happy Valley-Goose Bay area primarily used the Traverspine and Kenamu rivers, the Mealy Mountains and eastward towards the Eagle Plateau, whereas Settlers from Cartwright and Paradise naturally tended to use Paradise and Eagle rivers, as well as the Great Meshes (Stopp 2002). Furbearers trapped included beaver, fox, lynx, marten, otter and mink While trapping, subsistence activities included hunting caribou when available and porcupine, partridges and rabbit for immediate needs (Stopp 2002).

The 115 watercourse crossings along the route are located within the Churchill River, Traverspine River, Kenamu River, Eagle River, St. Augustin River and Paradise River watersheds. The Eagle and Paradise rivers receive the most use, while activity on the Kenamu and Traverspine rivers is primarily limited to the lower portions of the rivers, due to inaccessibility in the upper portions of the rivers (JW 2003a).

Wildlife hunting has played a key role in both historical and contemporary land use in Labrador (JW 2003a). Moose hunting occurs at the western (Muskrat Falls area) and eastern (Paradise River) portions of the proposed TLH - Phase III. Moose hunting is not permitted south of Lake Melville. Caribou hunting south of Lake Melville is also not permitted as the MMCH is protected under COSEWIC and provincial legislation. Black bear hunting is permitted in the area around the TLH - Phase III. However, the number of licenses issued annually is low. Bears appear to be more likely destroyed around communities for nuisance reasons. Small game (ptarmigan, grouse and hare), migratory birds (ducks, geese and snipe) and murres are also hunted in Central and Southern Labrador. There is no legal hunting of harlequin ducks, as they are protected under COSEWIC and provincial legislation. All seabird species, except murres, are protected under the *Migratory Birds Protection Act*.

Trapping is also carried out in the study area, primarily in the Eagle River area in the east, and in the west, in the Kenamu River and Traverspine River areas (JW 2003a). The main species currently targeted is marten, due to the continued higher value of marten pelts. Other species trapped are beaver, ermine, weasel, fox, coyote, lynx, mink, muskrat, otter, squirrel and wolf.

In Central and Southern Labrador, Atlantic salmon, Arctic charr, brook trout, lake trout, northern pike and smelt are most important species from a recreational or subsistence perspective. Of the five watersheds crossed by the TLH - Phase III route, only two have scheduled salmon rivers (i.e., the Eagle River and Paradise River watersheds) (JW 2003a). There are 16 scheduled rivers in the area, including the Eagle River and Paradise River. A special trout management plan is also in place for Gilbert's Lake and Chateau Pond in Zone 3. Labrador residents (Aboriginal and non-Aboriginal) can also participate in a subsistence fishery for salmon and trout. The Innu have a co-management arrangement with DFO.

Along the proposed outfitter route, resident angling activity is currently concentrated near the communities of Happy Valley-Goose Bay and Cartwright (JW 2003a). Near Happy Valley-Goose Bay, anglers fish a variety of species, with the most common being brook trout or speckled trout. Many of the lakes in the region are used for trout angling, but Lake Melville, Grand Lake and certain tributaries to the Churchill River are probably the more common fishing areas. Salmon angling in the Happy Valley-Goose Bay area is limited. Ice fishing is also common in the Happy Valley-Goose Bay area, in particular on Lake Melville (W. Maclean, pers. comm.). Salmon fishing is probably the most common activity in the Cartwright and Paradise River area, with fishing occurring on the Eagle River, White Bear River, Paradise River and North River. Smelt fishing and, to a lesser degree, trout fishing also occur. Resident fishers account for the bulk of the fishing activity, with the number of resident fishers having almost tripled over the past decade. The number of non-resident (Canadian and foreign) have also increased. Smelt is the most commonly caught species, followed by brook trout, landlocked salmon, sea trout, Arctic charr, lake trout, northern pike and Atlantic salmon.

There are 19 commercial outfitting camps located in Central and Southern Labrador near the TLH - Phase III route that offer fishing and/or big game hunting adventures (JW 2003a). Each of these are "fly-in" camps, currently accessed by float plane and/or helicopter, usually from Happy Valley-Goose Bay. Fishing activity at these camps is usually within approximately 5 to 10 km of the camp location. Some of the angling undertaken at these camps is hook and release.

There are no existing provincial or federal parks in Central Labrador. However, the Mealy Mountains have been identified by Parks Canada as a candidate for national park status. The study area for the proposed Akamiuapishku/Mealy Mountains National Park encompasses approximately 21,500 km^2, extending from Lake Melville and Groswater Bay, south to the Eagle River and east from the Kenamu River to the coast of Labrador. The proposed highway will cross the southern edge of the park study area, south of Park Lake. There are no proposed provincial parks and reserves in Central Labrador, and there has been no indepth study of candidate sites in Labrador to date (S. French, pers. comm.). There are currently no rivers in Labrador designated or nominated under the Canadian Heritage Rivers System (CHRS). However, the CHRS Board has approved the preparation of a systems study of rivers in Labrador. There are five IBP sites in Central Labrador, but no wildlife or wilderness reserves. There is one ecological reserve within the region; the Gannet Islands Ecological Reserve is a group of seven islands at the mouth of Sandwich Bay.

Local trails exist around communities throughout Central and Southern Labrador, and are used by local residents, primarily for hunting, fishing, trapping and berry-picking activities. A developed biking trail exists in and around Happy Valley-Goose Bay. Recreational activities such as cross-country skiing and hiking are not common in Central and Southern Labrador, and canoeing and kayaking are also limited. However, snowmobiling is popular, with trail systems existing throughout Central and Southern Labrador. Cabins are common throughout Central and Southern Labrador and are used for hunting, trapping, fishing and general recreational purposes.

The area at the western end of the TLH - Phase III route (both north and south of the Churchill River) contains Labrador's most productive forests (DFRA 2002). The areas around Paradise River and Cartwright are noted to contain commercial timber. Black spruce and balsam fir are the most common tree species in the area. Forests in the area are currently managed primarily for fuelwood and lumber. Only a small portion of these two areas of commercial timber have been subject to forest harvesting operations, which have been relatively small scale. While all commercial harvesting activities at the western end of the route have occurred north of the Churchill River, in an area 15 to 80 km northwest of Happy Valley-Goose Bay, the area south of the Churchill River is also included in the forest management plan for the area. The area south of the Churchill River has a greater area of productive forest and an estimated volume of net commercial timber more than twice that of the north area.

There are no producing mines or developing properties in Central and Southern Labrador; however, some mineral exploration has and continues to occur in Southern and Central Labrador. The transmission line from the hydroelectic power generating facility at Churchill Falls is the only hydroelectric development infrastructure in the study area. However, a new dam and power plant have been proposed for the lower portion of the Churchill River at Gull Island with related transmission infrastructure. As well, approximately 119 km of the outfitter route lies within the Department of National Defence's (DND) LLTA.

4.4.6 Employment and Business

Central Labrador has a total labour force of 5,320 persons, of which 90.5 percent resided in Happy Valley-Goose Bay. The region had a participation rate of 72.4 percent, and an overall unemployment rate was 18.0 percent. Of those who received employment income in 1995, 50.3 percent worked full-time for the entire year (Statistics Canada 1998).

Southern Labrador has a total labour force of 1,040 persons (Statistics Canada 1998). Labour force participation rate was 48.3 percent, which was considerably lower than that of Labrador, and Newfoundland and Labrador as a whole. Regional unemployment rate was 52.4 percent, which was also considerably higher than that for Labrador as a whole. Of the Southern Labrador residents who received employment income in 1995, only approximately 17 percent worked full-time for the entire year. The remainder worked seasonally or on a part-time basis.

4.4.6.1 Central and Southern Labrador

Happy Valley-Goose Bay is the largest community in Labrador, and has a relatively well-developed and diversified economy. Low-level military flight training forms the basis for the economy of the Central Labrador region. Happy Valley-Goose Bay offers a wide range of commercial goods and services, and serves as the primary administrative and service centre for central and northern Labrador, with various government agencies and educational and health care services located there. The communities of North West River and Sheshatshiu are located approximately 25 km northeast of Happy Valley-Goose Bay, and include a number of businesses. The smaller settlement of Mud Lake is located 5 km to the east of Happy Valley-Goose Bay. A considerable portion of the labour force of these smaller communities is employed in the provision of government services, and many residents also still practice traditional, “non-wage” activities such as hunting, trapping and fishing.

Economic activity in Southern Labrador has traditionally been based on the inshore fishery, particularly the harvesting and processing of species such as cod and salmon. Despite the downturn in these traditional fisheries, the exploitation of alternative species (particularly shellfish) has resulted in a substantial amount of fish harvesting and processing in Southern Labrador in recent years. The number and type of businesses in the Southern Labrador region is relatively limited, although this varies considerably between communities. Although isolation has traditionally limited economic development and diversification in Southern Labrador, improved access to, from and within the region as a result of the recently completed TLH - Phase II (Red Bay to Cartwright) will likely provide opportunities for future economic growth.

4.4.6.2 Other Regions

In Western Labrador, the economies of Labrador City and Wabush are based primarily on iron ore mining. The Churchill Falls (Labrador) Company (CFL Co) operates a 5,428 MW hydroelectric generating plant and related transmission infrastructure at Churchill Falls.

Fishing activity has traditionally been an important component of the economy of the Labrador Straits and, like Southern Labrador, recent years have seen a focus on the harvesting and processing of shellfish. However, the Labrador Straits region is characterized by a somewhat stronger and more diversified economy than those areas further north along the Labrador coast.

The economy of Northern Labrador has long been based on a combination of casual or seasonal employment and resource harvesting activities such as hunting, trapping, fishing and gathering activities that provide food, income or both (VBNC 1997). Economic activity in Northern Labrador includes commercial fishing and fish processing, quarrying at Ten Mile Bay near Nain, and other businesses. A considerable portion of the region’s wage economy is also based on the provision of government, health and education services in these communities. Voisey’s Bay Nickel Company Limited (VBNC) (a division of Inco Ltd.) is currently developing a nickel-copper-cobalt mine and mill at Voisey’s Bay, located in Northern Labrador.

4.4.7 Tourism and Recreation

Tourism is an integral part of the Labrador economy, and offers considerable potential for future development. Tourism-related activities that occur in Labrador at present include hunting and fishing, nature tourism (e.g., bird, whale and iceberg watching), adventure tourism (e.g., camping, hiking, kayaking and canoeing), and cultural and heritage tourism (e.g., visiting historic sites and festivals).

Sports fishing and hunting have traditionally been the primary contributors to Labrador’s tourism industry (DDRR 1996). There are currently approximately 70 commercial outfitting camps throughout Labrador that offer fishing and/or big game hunting adventures (DTCR 2002a). There are also adventure tours for whale, seabird and iceberg watching along the coast. Labrador’s rugged and scenic natural environment also offers considerable opportunities for camping, hiking and boating, with a number of existing and proposed parks and reserves (Section 4.4.5). There are also various historic and heritage attractions and festivals throughout Labrador that attract tourists each year.

These attractions and events are complemented by a range of tourism-related services and infrastructure, such as transportation, accommodations, and food and beverage establishments.

In addition to being important aspects of Labrador's tourism industry, outdoor activities such as hunting, trapping, angling, berry picking, snowmobiling, and boating are also very popular among local residents (Section 4.4.5). Communities in the region have also established and maintain recreational infrastructure and services (e.g., stadiums, swimming pools, soccer and softball fields, community centres, playgrounds). The number and type of facilities varies considerably between communities, and is generally greater in the larger municipalities, such as Happy Valley-Goose Bay.

4.5 Data Availability and Gaps

When the environmental assessment was initiated, areas of concern with respect to data availability and quality included raptors, migratory birds/waterfowl, caribou, detailed information on watercourse crossings, historic resources, wetlands, riparian and sensitive habitat, species at risk, and Innu land and resource use.

The lack of information on avifauna (raptors and waterfowl) and caribou was addressed in component studies conducted in conjunction with the environmental assessment. These studies provided the data necessary to assess the environmental effects on avifauna and caribou.

Detailed information on specific watercourse crossing locations could not be obtained, because the highway route has not been surveyed and detailed design information is not available. Therefore, an aerial survey was conducted to gather information on approximate crossing locations of 115 watercourses. The 115 crossing locations were photographed and 250-m sections above and below the crossing were videotaped. A ground survey was conducted at 42 of the watercourse crossings. In addition to documenting information on the characteristics of each crossing location, information on riparian vegetation was also collected at each crossing location.

A separate field investigation was conducted of wetlands along the proposed highway route. Wetlands were identified and described through a review of topographical mapping and aerial photography for the area, and helicopter and ground-based surveys. Literature on species at risk in Labrador was reviewed to identify any species that may potentially be designated under the COSEWIC list and/or the provincial *Endangered Species Act*.

The fact that the route has not been surveyed also affected the historic resources field study. The preliminary right-of-way was investigated.

As the highway will cross land that is subject to a land claim by Innu Nation, and concerns regarding Innu land and resource use had been identified, a separate study of Innu land and resource use was conducted by Armitage and Stopp (2003).

Data availability on wildlife harvesting (e.g., number of wildlife being harvested) was limited or provided as estimates only, and in most cases, was not available. There were also no data available on illegal harvesting activity. In addition, information on cabin locations was not available.

Comprehensive and up-to-date information is available regarding Labrador's socio-economic environment. Data from existing sources, such as the Census of Canada, were identified, reviewed and used in conducting the environmental assessment, with additional information gathered through interviews with local residents and officials, as required. Therefore, there is adequate information available regarding the socio-economic environment upon which to base the environmental assessment.

4.6 Likely Future Conditions

Without the highway, no substantial changes are expected to occur with respect to avifauna, wildlife, historic resources, services and infrastructure, and employment and business. Avifauna and wildlife (including caribou) will be subject to similar pressures from hunting and trapping. If fur prices remain low, trapping will not likely increase. Also, continued out-migration may lead to a decrease in hunting and trapping activity.

As changes have been noted in the recent past with respect to resource use and users and tourism and recreation, it can be expected that these components may be subject to some further change. Given that fishing activity among residents has almost tripled in the past decade and non-resident fishing activity has also increased, there may be further increases in the number of fishers and fishing activity, especially if there is any expansion of the tourism industry in the area. As fishing appears to be the most common and widely practiced harvesting activity in the area, any growth in the tourism sector is likely to be focused around fishing. Similarly, any further cabin development or recreational use in the area may also lead to additional fishing activity. Any increased harvesting pressure on fish resources could have implications for fish stocks.

Should the Akamiuapishku/Mealy Mountains National Park be established, it would encompass approximately 21,500 km^2, extending from Lake Melville and Groswater Bay, south to the Eagle River and east from the Kenamu River to the coast of Labrador. The park would set rules that would offer protection to resources within its boundaries, as well as rules regarding resource use activities within the park. Similarly, should any area river be designated a Canadian Heritage River, this would also bring with it additional protection rules for that river.

Most historic resources and sites will remain as is without the highway. Some historic resources in Southern Labrador, such as historic buildings within communities, may be restored and maintained as tourist attractions. However, there are few such buildings remaining and others may be lost if action is not taken soon to save existing structures. Growth in the region's tourism industry is expected to be slow without the highway.

The socio-economic environment of Labrador will be affected in the future by other ongoing and potential projects and activities. As well, change in Southern Labrador will continue as a result of the recently completed TLH - Phase II (Red Bay to Cartwright). The recently proposed changes to Southern Labrador's marine and air traffic services and infrastructure and any related socio-economic effects will occur whether or not the TLH - Phase III is constructed.

The Phase II portion of the highway will likely provide opportunities for future economic growth in Southern Labrador, in areas such as forestry, mineral exploration and mining, and tourism. Any increase in forestry activity would likely be concentrated around Happy Valley-Goose Bay north of the Churchill River and in the Cartwright-Paradise River area. Forestry operations south of the Churchill River would be restricted due to the lack of access (i.e., no bridge across the river and no road access). Similarly, any mineral exploration activity in the area south of Lake Melville would likely remain low. Further activity would likely be concentrated in Southern Labrador. The low-level flight training activity would continue in the area.

In addition, the Voisey's Bay Mine/Mill development will generate direct, indirect and induced employment and business opportunities through Labrador and the province as a whole. This will help to curb the population decline that most regions of Labrador have experienced in recent years, as well as having positive implications for other components of the socio-economic environment such as services and infrastructure. The development of other potential large-scale projects, such as the Churchill River Power Project (if it proceeds), would contribute further to these positive socio-economic effects in Labrador.

The environmental effects analyses presented in Chapter 7.0 of this EIS/CSR consider the likely future condition of the environment as a result of these other activities in assessing and evaluating project-specific and cumulative environmental effects.

5.0 ISSUE SCOPING AND STAKEHOLDER CONSULTATION

The scope of an environmental assessment must be established early in the process to ensure that the analysis remains focused and manageable. VECs (i.e., components of the natural and socio-economic environment that are valued by society) are used to focus an assessment. An issue scoping process is used to define the VECs for an environmental assessment and identify the key issues and concerns to be considered in an assessment.

This chapter provides a summary of the issue scoping process undertaken to identify VECs, both biophysical and socio-economic, for the TLH - Phase III environmental assessment and the issues and concerns that were considered in the assessment. The complete description of the various aspects of the issue scoping process and issues and concerns is provided in Chapter 4 of JW/IELP (2003a), the EIS/CSR for the preferred route. It was during this issue scoping and consultation process that the outfitter route was identified by members of the Newfoundland and Labrador Outfitters Association. The majority of the issues and concerns identified during the process are also relevant to the outfitter route.

5.1 Project Scope

The project scope encompasses those components and activities considered part of the project for the purpose of the environmental assessment (Canadian Environmental Assessment Agency 1994). Understanding the project scope is important for carrying out the issue scoping exercise and determining the VECs to be considered in the assessment.

The components and activities of the project are discussed in detail in Chapter 3.0. The project encompasses all construction and operations activities and structures within the 40 m right-of-way for the highway, including intersections, watercourse crossings, temporary watercourse diversions, laydown areas, borrow pits, construction camps, waste disposal infrastructure, maintenance depots, signage and roadside pull-offs.

All phases of project design, construction and operation, as defined in Chapter 3.0, are considered within the project scope. Accidental events which may occur along the route in relation to project activities and components described above are also considered within the scope of the project. Accidental events considered are highway failure, fires, fuel or chemical spills, vehicle and equipment collisions and other accidents, and vehicle failure.

5.2 Issues Scoping

The scoping process for the TLH - Phase III environmental assessment involved:

- reviewing the guidelines issued by the Department of Environment for the assessment;
- carrying out a community education and consultation program with the Innu;
- holding public information sessions;
- consulting with outfitters, municipalities, and local economic development and tourism organizations;
- reviewing public submissions received during the public review period for the project registration;
- reviewing information available on Innu Nation web sites, as well as on media web sites;

- reviewing results of field and archival research undertaken in relation to the assessment; and
- reviewing reports and documentation related to work already undertaken on Phases I and II of the TLH.

5.2.1 Environmental Assessment Guidelines

The *Guidelines for Environmental Impact Statement and Comprehensive Study, Cartwright Junction to Happy Valley-Goose Bay Trans Labrador Highway*, as issued by the Minister of Environment in December 2002, provide the framework for the environmental assessment. Discussions were also held with representatives of the Environmental Assessment Committee, established by the Department of Environment for the assessment, to clarify specific requirements pertaining to work scope.

5.2.2 Consultation with Innu Nation

During the winter 2002, WST carried out a community education and consultation program with Innu Nation regarding the proposed TLH - Phase III project. The program was carried out according to the terms of a process agreement between WST and Innu Nation, and is reported in the consultation report prepared by Innu Nation (2002). Innu Nation (2002) indicates that the consultation program involved:

- briefing meetings, involving representatives of WST and Innu Nation, were held in mid-January 2002;
- a project manager and three Innu commissioners were hired to carry out the consultation;
- information leaflets describing the project and consultation program were distributed to 220 households;
- a public meeting, hosted by WST and Innu Nation, was held on February 13, 2002, at the Labrador Interpretation Centre in North West River (18 Innu, not including the Innu commissioners, participated in the session and translation was provided by the commissioners);
- a presentation was made to senior students at Peenamin McKenzie School in Sheshatshiu;
- an announcement about the consultation program was played on the community radio station;
- a questionnaire was developed to guide interviews held during the program; and
- interviews were carried out with people (primarily older people) having knowledge about the area and/or experience with highway development elsewhere in Labrador.

5.2.3 Labrador Métis Nation Comments and Submissions

The Labrador Métis Nation (LMN) provided a written submission to the Department of Environment regarding the environmental registration of the TLH - Phase III project. In addition, a report on a study carried out by the LMN in cooperation with the Coasts Under Stress program at Memorial University of Newfoundland (Gibson et al. 2002) was also provided to WST. The LMN web site was also reviewed for any further issues and concerns.

5.2.4 Public Consultation

Complete details on the public consultation program are provided in Section 4.2.4 of JW/IELP (2003a), and the various information and communication materials used during the program are provided in Appendices G to Q of JW/IELP (2003a).

The public consultation program involved four public information sessions, which were held in Happy Valley-Goose Bay, North West River, Cartwright and Port Hope Simpson from October 7 to 10, 2002. The purpose of these sessions was to inform area residents about the highway development and to identify issues and concerns. The sessions were open to all members of the public interested in the project, with a total of 94 people participating in the four sessions. The sessions provided an opportunity for visitors to speak directly with representatives from WST and/or the Chairperson of the Environmental Assessment Committee established for the TLH - Phase III project. JW and IELP representatives organized the sessions and handled logistics.

The public information sessions were advertised in regional newspapers for the area, and posters were placed in prominent community locations. The newspaper announcements and posters described the open houses and stated the date, location, and time of the events. These ads also included a contact address, telephone number and a fax number and requested the public to forward any comments or concerns that they had about the project. In addition, the sessions in Happy Valley-Goose Bay and North West River were announced on local radio stations, including the Innu community radio station. A letter of notification was also sent to the Minister of Environment, and notices were sent to aboriginal organizations, town councils, local service districts, and economic development and tourism organizations informing them of the event and inviting them to attend.

Each session featured a series of displays, an information handout and a comment form. The display panels and information handout highlighted the highway route and provided details on the project description, project phases and schedule, watercourse crossings, environmental design features and the environmental assessment. A 1:250,000 scale topographical map showing the route for the highway was used to aid discussion. The comment form was developed as a means to obtain public input about the project.

5.2.5 Public Consultation Follow-up

Follow-up letters were sent to 34 Aboriginal organizations, municipalities, and economic development and tourism organizations after the public information sessions. The letters provided an update on the public consultation program and had attached a copy of the information handout and comment form distributed at the public information sessions. Individuals were encouraged to forward any comments, issues or concerns that they or their respective organizations had regarding the proposed TLH - Phase III development.

These letters were followed by contacting each of the organizations individually. Individuals contacted were asked to identify whether they had any concerns about the proposed TLH - Phase III development. It should be noted that some contacts at organizations were not reached during the telephone follow-up.

Various other contacts were made for the environmental assessment and component studies completed for the project. These contacts were made to identify issues and concerns, as well as to collect data and information that were necessary for carrying out the environmental assessment. The results of these interviews are documented in the respective studies and were taken into consideration in the environmental assessment.

5.2.6 Interviews with Outfitters

All outfitting operations in central and southern Labrador were contacted as part of the tourism and recreation component study prepared for the environmental assessment (JW/IELP 2003a). During these contacts, outfitters were also asked whether they had any issues or concerns related to the proposed TLH - Phase III development. In addition, written correspondence was received from the Newfoundland and Labrador Outfitters Association and various operators during the public review period of the environmental registration for the project.

5.2.7 Previous Studies and Other Information Sources

As discussed in Chapter 3.0, FGA (1993) conducted a social and economic feasibility study of a highway system through Labrador. FGA (1993) found that the majority of individuals consulted in all areas of Labrador viewed the highway as positive. While most residents were looking forward to having the highway built, a number of issues and concerns, applicable to this environmental assessment, were identified in the FGA (1993) feasibility study and taken into consideration in the environmental assessment.

A number of media sources (internet, radio and newspaper) were also searched to identify any issues or concerns from other sources. In addition, recent reports related to the project and/or transportation in Labrador were also reviewed.

5.3 Summary of Issues and Concerns

A summary of issues and concerns identified from all sources, along with the location of where these are discussed in this report, are provided in Table 5.1. Note that the list of issues and concerns is the same as that presented in Table 4.3 in JW/IELP (2003a).

Table 5.1 Summary of Issues and Concerns Identified and Where Addressed in the EIS/CSR

Issues and Concerns	Where Addressed in the EIS/CSR
Highway Design and Construction	
Project rationale (i.e., highway just being built to facilitate removal of forest resources).	Section 3.1.2
Alternative routes will not be adequately considered.	Section 2.1
Information on construction methods for watercourse crossings and type of structures.	Section 3.4.4
Borrow material required.	Section 3.3.8
Borrow pit, construction camp and laydown locations.	Sections 3.3.6, 3.3.7 and 3.3.8
Methods for culvert installation work and monitoring.	Section 3.4.4
Highway proximity to major rivers (spring high water levels).	Section 4.3.2
Highway not being paved.	Section 3.4
Construction schedule (i.e., will highway actually be completed).	Section 3.4.1

Issues and Concerns	Where Addressed in the EIS/CSR
Site preparation and construction practices.	Section 3.4.2.
Erosion and sedimentation control practices.	Section 3.10.3 and Table 3.7
Control of dust and noise.	Section 3.4.2.5 and Table 3.7
Blasting operations.	Section 3.4.2.4
Disposal of debris and excess rock.	Section 3.4.2.4
Acid rock drainage.	Sections 3.4.2.4, 7.7 and 7.8
Storing, handling and transportation of hydrocarbons and other hazardous materials.	Section 3.7.3
Waste management at work and construction camp locations.	Section 3.3.9
Employment	Sections 3.4.3, 7.15.8.1 and 7.16.8.1
Training and education requirements.	Sections 3.4.3
Construction site decommissioning and rehabilitation.	Section 3.4.2.7
Highway decommissioning.	Section 3.6
Accidental and/or unplanned events.	Sections, 3.7, 7.1.4, 7.1.8, 7.2.4, 7.2.8, 7.3.4, 7.3.8, 7.4.4, 7.4.8, 7.5.4, 7.5.8, 7.6.4, 7.6.8, 7.7.4, 7.7.8, 7.8.4, 7.8.8, 7.9.4, 7.9.8, 7.10.4, 7.10.8, 7.11.4, 7.11.8, 7.12.4, 7.12.8, 7.13.4, 7.13.8, 7.14.4, 7.14.8, 7.15.4, 7.15.8, 7.16.4 and 7.16.8
Highway Operation and Maintenance	
Deep rock cuts and snow clearing problems.	Section 3.5.3
Highway safety and need for roadside pull-offs.	Section 7.18.4.2
Level of highway maintenance.	Section 3.5.3
Funding availability for ongoing maintenance.	Section 3.5
Employment	Sections 3.5.4 and 7.15.8.2
Biophysical Environment	
Effects on wetlands.	Section 7.9
Effects on water resources.	Section 7.8
Effects on riparian habitat and other sensitive habitat.	Section 7.10
Effect on flora and fauna species at risk.	Section 7.6
Effects on caribou.	Section 7.3
Effects on furbearers.	Section 7.4
Effects on avifanua and their habitat.	Sections 7.1 and 7.2
Effects on fish and fish habitat, including eastern brook trout and Atlantic salmon.	Section 7.5
Effects on fish may lead to effects on animals that feed on the fish.	Sections 7.1, 7.2 and 7.4
Effects on fish migration due to improper culvert placement.	Section 7.5
Monitoring of fish populations along the route.	Section 7.5.11
Highway may cause wildlife to move away from the area.	Sections 7.1, 7.2, 7.3, 7.4 and 7.6
Effects on wildlife and fish populations due to increased harvesting.	Sections 7.2, 7.3, 7.4, 7.5 and 7.12

Issues and Concerns	Where Addressed in the EIS/CSR
Wildlife and fish habitat loss or fragmentation.	Sections 6.1, 6.2, 6.3, 6.4, 6.5 and 6.6
Need to consider meteorological and atmospheric conditions.	Section 4.1.2
Effects of hazardous material spills on water and fish resources.	Sections 7.5 and 7.8
Surface water quality near highway and drainage areas.	Section 7.8
Dust from highway operation settling on water and vegetation causing pollution and subsequent effects on aquatic life and wildlife.	Sections 7.5, 7.8, 7.9 and 7.10
Environmental degradation.	Section 7.9 and 7.10
Concern about the Eagle River system, including concern about fish stocks, water resources and the watershed's role as a breeding area for waterfowl.	Section 7.2, 7.5 and 7.8
Resource Use and Users	
Access from watercourse crossings will lead to over-harvesting of fish, in particular at crossing number 46.	Sections 7.5 and 7.12
Improved access to the area, resulting in increased waterway use, fishing, wildlife harvesting, cabin development, recreational activities, overland travel on snowmobile and all-terrain vehicles, timber harvesting and mineral exploration, and introduction of new resource use activities.	Section 7.12
Year-round access created to an area that was previously only accessed in the winter.	Section 7.12
Access to the area by forestry companies, including forest access roads, removing forest resources and taking the resources to the island for processing.	Sections 7.1.10, 7.2.10, 7.3.10, 7.4.10, 7.5.10, 7.6.10, 7.8.10, 7.9.10, 7.10.10, 7.11.10, 7.12.10, 7.13.10, 7.14.10 and 7.15.10
Resource depletion resulting from improved access.	Sections 7.2, 7.3, 7.4, 7.5 and 7.12
Effect on trap lines in the vicinity of the Eagle River crossing area.	Section 7.12
Proximity to Eagle River and crossing on the river, as well as proximity to other major rivers.	Sections 7.12 and 7.14
Proximity of highway to outfitting operations.	Sections 7.12 and 7.14
Effect of improved access on outfitting operations.	Sections 7.12 and 7.14
Potential for more fish camps to be constructed.	Sections 7.12 and 7.14
Construction of secondary roads providing further improved access through the area.	Sections 7.1.10, 7.2.10, 7.3.10, 7.4.10, 7.5.10, 7.6.10, 7.8.10, 7.9.10, 7.10.10, 7.11.10, 7.13.10, 7.14.10 and 7.15.10
Illegal hunting and fishing activity.	Sections 7.2, 7.3, 7.4, 7.5 and 7.12
Enforcement of resource harvesting activities.	Sections 7.2.7, 7.3.7, 7.4.7 and 7.5.7
Adequacy of current regulatory controls to protect resources.	Sections 7.1.10, 7.2.10, 7.3.10, 7.4.10, 7.5.10, 7.6.10, 7.8.10, 7.9.10, 7.10.10, 7.11.10, 7.12.10, 7.13.10, 7.14.10 and 7.15.10
Cumulative effects of forestry activities and other induced activities.	Sections 7.1.10, 7.2.10, 7.3.10, 7.4.10, 7.5.10, 7.6.10, 7.8.10, 7.9.10, 7.10.10, 7.11.10, 7.13.10, 7.14.10 and 7.15.10

Issues and Concerns	Where Addressed in the EIS/CSR
Improved access resulting in increased use of rivers and congestion on the rivers.	Sections 7.5, 7.12 and 7.14
Loss of wilderness character.	Section 7.14
Effects of the project on resource use and users, including Aboriginal people and other Labrador residents.	Section 7.12 and Armitage and Stopp 2003
Effect of highway on watercourse navigability.	Section 3.3.4
Vandalism at outfitting camps.	Section 7.14
Littering and waste along the highway.	Section 3.5
Cultural and Historic Resources	
Damage or destruction of cultural resources, such as burial and archaeological sites, due to construction activities and improved access.	Section 7.11.8
Effect on archaeological and historic resources.	Section 7.11.8
Tourism and Recreation	
Highway will harm eco-tourism development.	Section 7.14.8
Effect on fishing and outfitting industry.	Section 7.14.8
Effect on potential future tourism development.	Section 7.14.8
Enhancing tourism features.	Section 7.14.8
Effect on tourism and recreation activities.	Section 7.14.8
Effect on parks and reserves, in particular the proposed Akamiuapishku/Mealy Mountains National Park and its ability to fulfill the requirements for a national park.	Section 7.13.8
Effect of changing transportation network/infrastructure on tourism in Central Labrador.	Section 7.14.8
Aboriginal Way of Life, Culture and Resource Use	
Highway development too close to lakes used by the Innu for wildlife harvesting.	Section 7.12.8
Effects on Innu land and resource use, including land and resource by Innu people in Québec.	Section 7.12.8
Improved access by non-Innu people to traditional Innu areas, may disrupt Innu use of the areas.	Section 7.12.8
Effect on Innu resource harvesting, way of life and culture.	Section 7.12.8
Lack of benefits for Aboriginal people and other Labradorians.	Sections 1.3.3 and 3.2
Lack of respect for Aboriginal rights.	Armitage and Stopp 2003
Métis way of life, land use and culture will be negatively affected.	Section 7.12.8
Effect of improved access on trapping, an important aspect of Métis heritage, culture and economy.	Section 7.12.8
Effect on Aboriginal land claims.	Sections 1.3.3 and 3.2
Employment and business opportunities for Aboriginal people and companies.	Section 7.15.8
Socio-economic Environment	

Issues and Concerns	Where Addressed in the EIS/CSR
Employment and business opportunities for local people and companies.	Section 7.15.8
Opportunities for Aboriginal people and women.	Sections 3.6.4 and 715.8
Social and economic benefits.	Sections 7.15 and 7.16
Economic development opportunities in induced industries.	Section 7.15
Costs for goods may increase	Section 7.15.8
Control of development along the highway.	Sections 7.1.10, 7.2.10, 7.3.10, 7.4.10, 7.5.10, 7.6.10, 7.8.10, 7.9.10, 7.10.10, 7.11.10, 7.12.10, 7.13.10, 7.14.10 and 7.15.10
Limited benefit for Cartwright due to highway traffic potentially by-passing Cartwright and heading straight for Happy Valley-Goose Bay.	Section 7.14.8
Effect on community life.	Section 7.16.8
Effect on employment and business.	Section 7.15.8
Effect on regional and local economies.	Section 7.15.8
Effect on goods and services supply and production in the region.	Section 7.15.8
Effect on transportation and shipping within the region.	Section 7.15.8
Environmental Assessment and Planning	
Environmental protection and emergency response/contingency planning.	Section 3.9.3, 3.9.4, 3.9.5
Environmental awareness sessions should be held for workers.	Section 3.9.6
Monitoring, mitigation and follow-up programs.	Section 3.9.8 and 8.2
Lack of Aboriginal involvement in monitoring programs.	Armitage and Stopp 2003
Cumulative environmental effects including those from activities resulting from improved access.	Sections 7.1.10, 7.2.10, 7.3.10, 7.4.10, 7.5.10, 7.6.10, 7.8.10, 7.9.10, 7.10.10, 7.11.10, 7.13.10, 7.14.10 and 7.15.10
Need to ensure that the study area is appropriate for the component being considered.	Section 6.1
Need comprehensive environmental assessment.	Section 6.1
Need to consider the precautionary principle.	Section 3.9.1
Sustainable use of renewable resources/project contribution to sustainable development.	Sections 7.1.9, 7.2.9, 7.3.9, 7.4.9, 7.5.9, 7.6.9, 7.7.9, 7.8.9, 7.9.9, 7.10.9, 7.11.9, 7.12.9, 7.13.9, 7.14.9, 7.15.9, 7.16.9 and 7.5
Public information program.	Section 5.2

5.4 Identification of Valued Environmental Components

The 16 VECs identified for the environmental assessment of the outfitter route and the rationale for their choice are listed in Table 5.2. The 16 VECs are described below. Note that the order in which they are listed does not indicate importance.

Table 5.2 Rationale for Valued Environmental Component Selection

VECs		Rationale		
		EIS/Comprehensive Study Guidelines	**Consultation with Innu Nation**	**Public Consultation and Interviews**
1	Raptors	✔		✔
2	Waterfowl	✔	✔	✔
3	Caribou	✔	✔	✔
4	Furbearers	✔	✔	✔
5	Fish and Fish Habitat	✔	✔	✔
6	Species at Risk	✔		✔
7	Geomorphology	✔		
8	Water Resources	✔	✔	✔
9	Wetlands	✔		
10	Riparian Habitat	✔		
11	Historic Resources	✔	✔	✔
12	Resource Use and Users	✔	✔	✔
13	Akamiuapishku/Mealy Mountains National Park	✔	✔	✔
14	Tourism and Recreation	✔	✔	✔
15	Community Life	✔	✔	✔
16	Employment and Business	✔		✔

5.4.1 Raptors

Raptors are considered a VEC because they are important predators, often representing the top of the food chain, and are viewed as indicators of ecosystem health.

5.4.2 Waterfowl

Waterfowl are considered a VEC because they represent a traditional land use activity carried out by residents.

5.4.3 Caribou

Caribou are considered a VEC because the proposed TLH - Phase III lies within the range of the MMCH, a 'resident' herd exhibiting characteristics typical of woodland caribou, such as short seasonal movements and low densities. Woodland caribou in Labrador are listed as threatened by COSEWIC (COSEWIC 2002).

5.4.4 Furbearers

Furbearers are considered a VEC because they represent several species with important ecological niches (e.g., as predators or prey) and those that may dramatically influence habitat for other species (e.g., beaver). Furbearers also have important implications for the Labrador economy. Although waning in recent years, trapping effort for furbearers represents one of the most important traditional land use activities carried out by residents.

5.4.5 Fish and Fish Habitat

Fish (and the habitat that supports the various species) are the backbone for much of the outfitter industry and are considered a VEC due to the potential burden that could be placed on the various populations due to the presence of the highway, related to improved access and the potential for increased angling activity, in particular on Eagle River.

5.4.6 Species at Risk

Species at risk have been designated as such by COSEWIC and/or provincial legislation and as such, are considered a VEC.

5.4.7 Geomorphology

Geomorphology is considered a VEC because it provides potential habitat or migratory routes for some species. In addition, the existing landforms along the proposed TLH - Phase III are remote and undisturbed.

5.4.8 Water Resources

Water resources are considered a VEC because of their potential as a conduit or pathway for contaminants to travel beyond an initial area of introduction. In addition, the flow volumes must be managed at each crossing.

5.4.9 Wetlands

Wetlands are considered a VEC because they serve a number of important functions, such as natural purification and storage of freshwater, natural flood reduction and control, habitat for a wide range of species, and a natural storage base for carbon.

5.4.10 Riparian Habitat

Riparian habitat is considered a VEC because it provides a critical source of diversity within larger habitats such as forest, lake, and marsh. These habitat attributes attract a great variety of terrestrial wildlife to a riparian zone and a large portion of the vertebrate fauna in a forested region is associated with riparian zones.

5.4.11 Historic Resources

Any development has the potential to disturb or destroy known and unknown heritage resources and archaeological sites. The historic resource potential includes major rivers and inland terraces, as well as archaeological investigations into a 8,000-year sequence of human occupation. Thus, historic resources are considered a VEC.

5.4.12 Resource Use and Users

The TLH - Phase III passes through an area that has traditionally been used by the Innu and is currently subject to a land claim being negotiated between Innu Nation and the governments of Canada and Newfoundland and Labrador. Project activities have the potential to interact with resource use and users in the area, including during construction, operation and accidental events. Concerns regarding resource use and users were raised by regulators, Aboriginal people, other Labrador residents and tourism operators. Thus, resource use and users are considered a VEC.

5.4.13 Akamiuapishku/Mealy Mountains National Park

Akamiuapishku/Mealy Mountains National Park is considered a VEC because of the concern about the potential effects of a highway on a national park, specifically, disturbance of vegetation and wildlife in the area surrounding the highway right-of-way and enhanced human access to the southern portion of the proposed park.

5.4.14 Tourism and Recreation

Tourism was included as a VEC due to the concerns raised by regulators about the potential effects on the area's existing tourism industry and the potential for further development of this sector when the highway is complete.

5.4.15 Employment and Business

Employment and business was identified as a VEC because of the issue of employment and business opportunities associated with the project, and the issue of how the project will affect the standard of living of the residents of the study area.

5.4.16 Community Life

Community life is considered a VEC because people place a major emphasis on the quality of their community life, including the provision of a wide range of affordable facilities and services and the existence of a safe and healthy environment in which to live and work.

5.5 Project-Valued Environmental Component Interactions

The potential interactions between project phases and VECs are summarized in Table 5.3. The specific nature and extent of the interactions are discussed in the environmental effects assessment in Chapter 7.0.

Table 5.3 Potential Interactions between Project Phases and VECs

VEC	Project Phase		
	Construction	Operation	Accidental Events
Raptors	• alteration or loss of habitat • avoidance of habitat • vehicular traffic disturbance	• avoidance of habitat • vehicular disturbance	• loss of habitat • mortality • fuel or chemical spill reducing foraging opportunities • collisions with vehicles
Waterfowl and Passerine Birds	• alteration or loss of habitat • avoidance of habitat • vehicular traffic disturbance • increased hunting pressure	• avoidance of habitat • vehicular traffic disturbance • increased hunting pressure	• alteration or loss of habitat • mortality • fuel or chemical spill oiling waterfowl or reducing foraging opportunities • collisions with vehicles
Caribou	• alteration or loss of habitat • visual disturbance • avoidance of habitat	• vehicle noise/visual disturbance • increased harvesting (legal and illegal) • avoidance of habitat	• loss of habitat • mortality • fuel or chemical spills contaminating forage • collisions with vehicles
Furbearers	• alteration or loss of habitat • visual disturbance • attraction to camps • avoidance of habitat	• avoidance of habitat • increased harvesting pressure • vehicle noise/visual disturbance	• loss of habitat • mortality • fuel or chemical spill reducing foraging opportunities • collisions with vehicles
Fish and Fish Habitat	• habitat alteration leading to displacement and/or reduced productivity or mortality • fording streams in areas of sensitive habitat could harm eggs or alevin • blasting activities in or near waterbodies • in-stream construction resulting in disturbance • increased suspended sediment resulting in smothering habitat and/or affecting fish health • increased nutrient loading due to improper domestic waste disposal • increased angling pressure	• introduction of sediment from runoff, grading, ditch cleaning and ice control • if dedicated service depots, then risk of improper hazardous materials and waste disposal • increased angling pressure	• forest fire (slope destabilization and erosion) • highway crossing failure such as collapse, washout or flooding • loss or alteration of habitat • contamination of habitat
Species at Risk	• alteration or loss of habitat • vehicle noise/visual disturbance • avoidance of habitat	• vehicle noise/visual disturbance • avoidance of habitat	• loss of habitat • mortality • fuel or chemical spill reducing foraging opportunities or oiling waterfowl • collisions with vehicles

VEC	Project Phase		
	Construction	Operation	Accidental Events
Geomorphology	• vegetation clearing and disposal • reduced aesthetics	• no interaction	• fuel or chemical spill moving through porous material to other areas
Water Resources	• increased suspended sediment • increased nutrient loading	• increased suspended sediment from runoff, dust	• fuel or chemical spill resulting in contamination of resources • forest fire (slope destabilization and erosion) • highway crossing failure such as collapse, washout or flooding
Wetlands	• physical disturbance • altered hydrological regime	• sedimentation • dust • vehicle emissions	• fuel or chemical spill resulting in contamination of wetlands
Riparian Habitat	• physical disturbance	• vehicle emissions • dust	• forest fire (slope destabilization and erosion • fuel or chemical spill resulting contamination of riparian habitat
Historic Resources	• ground surface disturbance	• increased or more extensive human use of area leading to interactions with archaeological sites or artifacts	• forest fire resulting in damage or loss of historic resources from both the fire itself and firefighting activities.
Resource Use and Users	• altering or restricting access to resources • wildlife avoidance/habitat loss • reduction of quality of land and resource use (noise, dust and other disturbances) • reduced aesthetics • reduction in navigability of rivers due to installation of watercourse crossing structures	• improved access to land and resources • reduction in navigability of rivers due to watercourse crossing structures • reduced aesthetics	• forest fire resulting in loss of resources • fuel or chemical spill resulting in contamination of resources • failure of highway section or crossing structure disrupting use or affecting wildlife and fish resources
Akamiuapishku/ Mealy Mountains National Park	• vegetation clearing and disposal • reduced aesthetics	• improved access to land and resources • reduction in navigability of rivers due to watercourse crossing structures • vehicular noise disturbance • reduced aesthetics	• forest fire resulting loss of park resources • fuel or chemical spill resulting in contamination of park resources

<table>
<tr><th rowspan="2">VEC</th><th colspan="3">Project Phase</th></tr>
<tr><th>Construction</th><th>Operation</th><th>Accidental Events</th></tr>
<tr><td>Tourism and Recreation</td><td>• noise, dust and other disturbances may affect visitation levels
• competition for use of existing facilities between contractors and visitors
• altering or restricting access to resources</td><td>• increased mobility of local residents and visitation by non-residents
• reduced aesthetics
• loss of remoteness</td><td>• forest fire (reduced aesthetics)
• fuel or chemical spill contaminating resources
• vehicle accidents
• highway failure restricting access</td></tr>
<tr><td>Community Life</td><td>• increased demand on infrastructure and services</td><td>• changes in social characteristics as a result of improved access</td><td>• loss of property
• mortality</td></tr>
<tr><td>Employment and Business</td><td>• generation of direct employment
• equipment and supplies expenditures
• increase in amount of disposable income in area
• labour force displacement and wage inflation</td><td>• improved access to and within area
• changes to traditional movement patterns may affect use and provision of services and infrastructure
• increased competition between local and other, now accessible, businesses</td><td>• loss of property (forest fire)
• highway failure restricting access</td></tr>
</table>

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT METHODS

The methods used for the assessment of the alternative route are the same as those used for the assessment of the preferred route (as presented in JW/IELP 2003a). Therefore, to assist with the review of this assessment and eliminate the need for cross-referencing between documents, the description of methods presented below is reprinted directly from JW/IELP (2003a), the assessment for the preferred route.

The methods used for the environmental assessment of the TLH - Phase III are largely based on the work of Beanlands and Duinker (1983) and the Canadian Environmental Assessment Agency (1994; 1999). The methods outlined below meet the requirements of both the Newfoundland and Labrador *Environmental Protection Act* and CEAA. The EIS/CSR guidelines, issued by the Minister of Environment in December 2002, also shaped the approach used for the assessment. This approach has been effective for other assessments conducted under both the provincial and federal environmental assessment processes.

The environmental assessment focuses on the VECs identified through the issue scoping and consultation program, as described in Chapter 5.0. The assessment is conducted on a VEC-by-VEC basis, with each VEC being addressed in a single section. Specific steps for assessing each VEC are:

- determining assessment boundaries;
- describing the existing environment;
- identifying potential interactions between the project and VEC;
- identifying issues and concerns;
- presenting existing knowledge about the potential project-VEC interactions, and issues and concerns;
- identifying mitigation measures;
- assessing environmental effects;
- evaluating environmental effects significance;
- assessing and evaluating cumulative environmental effects; and
- identifying environmental monitoring and follow-up programs, if required.

These steps are described in detail in the following sections.

6.1 Boundaries

Boundaries focus an environmental assessment and help determine the most effective use of available resources. General definitions of the environmental assessment boundaries for this assessment are provided below. Specific boundaries for each VEC are described in the environmental effects analysis section of each VEC.

Project boundaries are defined by the spatial and temporal extent of project components and activities. Spatial project boundaries reflect the geographic extent over which project activities occur, as defined by the project "footprint" and may vary between project phases. In the case of an accidental event, spatial boundaries could range from a specific location within the project area to a much larger area (e.g., in the event of a forest fire).

Temporal project boundaries are defined by the timing and duration of the construction and operation phases, as described in Chapter 3.0. Interactions between the project and a VEC may vary in nature and degree during project construction and operation, as well as in the case of an accidental event. While the likelihood of an accidental event occurring is low, it is possible that such events could occur at any time over the life of the project and overlap with temporal boundaries for the construction and operation phases.

Ecological boundaries are determined by the spatial and temporal distributions of the biophysical VECs included in the assessment. Spatial ecological boundaries are determined by the distribution and movement patterns of biophysical components and/or physical elements such as watershed boundaries. Environmental effects may be limited to the immediate project area or may extend beyond this area as the distribution and/or movement of a species can be local, regional, national or international in nature.

Temporal ecological boundaries consider the relevant characteristics of the VEC, including the natural variation of a population or ecological component, time to respond to an effect and recover from the disturbance, and any sensitive or critical periods in a VEC's life cycle such as spawning or migration.

Spatial socio-economic boundaries are determined by the socio-economic VECs being assessed. These boundaries are further defined to address specific characteristics such as the location of communities potentially affected by the highway. As with ecological boundaries, temporal socio-economic boundaries consider the natural variation of socio-economic components, time to respond to an effect and recover from the disturbance, and any critical periods associated with the VEC.

Administrative boundaries refer to the spatial and temporal limitations placed on an environmental assessment due to political, social, cultural and economic factors. Spatial administrative boundaries refer to the management areas defined for natural and socio-economic elements, including such areas as the Innu land claim boundary, resource management areas and regional economic zones. Temporal administrative boundaries, such as resource harvesting seasons, are defined by the time periods associated with management plans and activities.

6.2 Methods

Methods used to collect data and other information are described for each VEC. Details related to reviewing existing information sources, contacting key informants or conducting field work are described, as appropriate, for each VEC.

6.3 Existing Environment

The existing (baseline) environment for each of the VECs is described. The description for each VEC is limited to a discussion of the status and characteristics of the VEC within its defined spatial and temporal assessment boundaries. The description of the baseline environmental effects of past and existing projects and activities are considered.

Existing environment descriptions are based on information gathered from existing literature and databases, aerial photographs, topographic maps, and data obtained from government departments and other organizations. Information from key informant interviews and field research supplement the information obtained from existing sources. Known information and data gaps associated with each VEC are identified, as appropriate.

6.4 Environmental Effects Analysis

The environmental assessment focuses on the potential interactions between each of the VECs and project components and activities, as well as on the issues and concerns identified in Chapter 5.0. The stages in the environmental effects analysis are described in Sections 6.4.1 to 6.4.6.

6.4.1 Potential Interactions

The first step in the effects analysis is to identify the potential interactions between project components and activities and each of the VECs. The nature of the project-VEC interactions are described.

6.4.2 Issues and Concerns

VEC-specific issues and concerns, as identified through the issue scoping program outlined in Chapter 5.0, are described.

6.4.3 Existing Knowledge

Existing knowledge about the potential interactions is reviewed and summarized. This summary includes information from such sources as scientific literature and/or monitoring results from similar projects.

6.4.4 Mitigation

A proactive approach is taken towards minimizing or eliminating potential adverse environmental effects by incorporating environmental considerations directly into project planning and design (Chapter 3.0). Many of these environmental protection measures are required by legislation or regulations. Therefore, they must be addressed before a project can proceed.

After reviewing the potential interactions, issues and concerns, and existing knowledge, technically and economically feasible mitigation measures for reducing or eliminating potential adverse effects are identified. Where potential positive effects are noted, optimization measures are identified. These mitigation and optimizations measures are described within the appropriate effects analysis sections and are considered in the effects analysis.

6.4.5 Environmental Effects Assessment

The project-VEC interactions are analyzed to determine the potential effects. The analysis for each VEC is carried out for each project phase and potential accidental and/or unplanned events. Potential accidental or unplanned events considered are highway failure, forest fires and on-site fires, fuel or chemical spill, vehicle and equipment accidents, and vehicle failure. The analysis uses qualitative and, where possible, quantitative information available from existing knowledge and appropriate analytical tools. The analysis considers the identified mitigation measures. The resulting environmental effects predictions (residual effects) are outlined.

Environmental effects summary tables prepared for each VEC highlight the qualitative and quantitative ratings determined for the predicted environmental effects associated with each project phase. A sample summary table is presented in Table 6.1.

Table 6.1 Example Environmental Effects Summary Table

	Construction	Operation	Accidental/Unplanned Events
Mitigation:			
Environmental Effects Criteria Rating			
Magnitude			
Geographic Extent			
Frequency			
Duration			
Reversibility			
Ecological/Socio-economic Context			
Environmental Effects Evaluation			
Significance			
Level of Confidence			
Likelihood[1]			
Sustainable Use of Resources[1]			
[1] Likelihood is only defined for effects rated as significant, and Sustainable Use of Resources is only defined for those effects rated as significant and likely (Canadian Environmental Assessment Agency 1994).			
Environmental Monitoring and Follow-up: • •			

Key:	
Magnitude:	High, Medium, Low, Nil or Unknown
Geographic Extent (km^2):	<1, 1-10, 11-100, 101-1,000, 1,001-10,000, >10,000 or Unknown
Frequency (events/year):	<10, 11-50, 51-100, 101-200, >200, Continuous or Unknown
Duration (months):	<1, 1-12, 13-36, 37-72, >72 or Unknown
Reversibility:	Reversible, Irreversible or Unknown
Context:	Existing Disturbance (High, Medium, Low, Nil or Unknown)
Significance:	Significant, Not Significant, Positive or Unknown
Level of Confidence:	High, Medium, Low
Likelihood:	High, Medium, Low or Unknown
Sustainable Use of Resources:	High, Medium, Low or Unknown

This table outlines the qualitative and quantitative ratings for the summary criteria are outlined in Table 6.1. The following criteria, which are consistent with those outlined in CEAA guidelines, are used to provide a common basis for describing potential effects:

- magnitude - nature and degree of a predicted environmental effect (Table 6.2);
- geographic extent - area over which an effect occurs;
- frequency - how often a disturbance will occur;
- duration - how long a disturbance will occur;
- reversibility - ability of a VEC to return to an equal or improved condition after the disturbance has ended (e.g., reclaiming habitat area equal or superior to that lost during construction); and
- ecological and socio-economic context - level of existing disturbance due to past and/or existing human activities.

Table 6.2 Definitions for Magnitude

Rating	Magnitude
High	An environmental effect affecting a whole stock, population or definable group of people, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons.
Medium	An environmental effect affecting a portion of a population, or one or two generations, or where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons.
Low	An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where there are distinguishable changes in a specific parameter, but the parameter is within the range of natural variability determined from local knowledge over many seasons.
Nil	No environmental effect.
Unknown	An environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

6.4.6 Environmental Effects Evaluation

The residual environmental effects of each project phase are evaluated as either significant, not significant or positive, based on the definitions of significance developed for each VEC. Specific definitions of significance are developed for each VEC. Where appropriate, significant and not significant ratings are further rated as major or moderate (significant) and minor or negligible (not significant). The definitions used in this environmental assessment are qualitative and integrate key factors, such as magnitude (e.g., the portion of the VEC population affected), potential changes in VEC distribution and abundance, effect duration (i.e., time required for the VEC to return to pre-project levels), interrelationships between populations, species and/or users, and changes in the overall integrity of affected populations.

Significant environmental effects are those adverse effects that will change a VEC's status or integrity beyond an acceptable level. An adverse environmental effect that does not meet the criteria for a significant environmental effect is rated as not significant. A positive effect is one that enhances a VEC. Significance ratings for predicted environmental effects associated with each VEC are presented in the environmental effects summary table for each VEC, with ratings determined for each project phase and potential accidental and/or unplanned events.

Assessing and evaluating potential environmental effects may be difficult in some cases due to limitations in available information. Therefore, ratings are provided to indicate the level of confidence in each prediction. The likelihood of the occurrence of any predicted significant effects is also indicated. Subsection 16(2)(d) of CEAA indicates that a comprehensive study must also consider the capacity of renewable resources (i.e., sustainable use of resources that are likely to be significantly affected by a project) to meet the needs of the present and those of the future. Definitions for likelihood and sustainable use of resources are presented in Table 6.3.

Table 6.3 Definitions for Likelihood and Sustainable Use of Resources

Rating	Likelihood	Sustainable Use of Resources
High	An environmental effect is probable and there is no uncertainty based on previous scientific research/experience.	Previous research/experience indicates that the environmental effect on the VEC would not reduce biodiversity or the capacity of resources to meet present and future needs.
Medium	An environmental effect may occur but there is some uncertainty based on previous scientific research/experience.	Previous research/experience indicates that the environmental effect on the VEC may, to a certain extent, reduce biodiversity or the capacity of resources to meet present and future needs.
Low	An environmental effect has a small probability of occurring and there is little uncertainty based on previous scientific research/experience.	Previous research/experience indicates that the environmental effect on the VEC would reduce biodiversity or the capacity of resources to meet present and future needs.
Nil	An environmental effect has no probability of occurring and there is no uncertainty based on previous scientific research/experience.	Previous research/experience indicates that the environmental effect on the VEC would eliminate biodiversity or the capacity of resources to meet present and future needs.
Unknown	There is insufficient research, experience, aboriginal knowledge to predict the likelihood of an environmental effect occurring.	There is insufficient research/experience to indicate whether the environmental effect on the VEC would reduce biodiversity or the capacity of resources to meet present and future needs.

6.5 Cumulative Environmental Effects

Individual environmental effects are not necessarily mutually exclusive of each other. Individual effects can combine and interact resulting in cumulative environmental effects that may be different in nature or extent from the effects of individual activities. Subsection 16(1) of CEAA states that environmental assessments carried out under the act must consider *any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out*, as well as the significance of these effects. Cumulative environmental effects are considered for each of the VECs. Factors considered in assessing cumulative effects for this assessment are:

- spatial and temporal boundaries;
- interactions among the project's environmental effects;
- interactions between the project's environmental effects and those of existing projects and activities;
- interactions between the project's environmental effects and those of planned projects and activities; and
- mitigation measures used towards achieving a no-net-loss or net-gain outcome.

Cumulative effects due to the accumulation and/or interaction of the project's own environmental effects are considered as part of the project-specific environmental effects analysis carried out for each VEC (as described above in Section 6.4).

The next portion of the assessment focuses on the cumulative effects of the project resulting from the interactions between the project's predicted residual environmental effects and those of other relevant projects and activities. The existing (baseline) environment description for each VEC reflects the effects of past and ongoing human activities on the region's natural and human environments. An overview of past and/or current actions that are likely to interact with those of the project to cause cumulative effects, as well as the effects of these past and/or current actions, is provided for each VEC. Where appropriate, the current status of the VEC due to natural and/or anthropogenic factors is indicated (e.g., a statement is made as to whether a VEC population is declining, stable or increasing).

Future planned projects and activities considered in this assessment include those that are ongoing or likely to proceed, and have been issued permits, licences, leases or other forms of approval as specified by the Canadian Environmental Assessment Agency (1994).

The environmental assessment also considers the potential cumulative environmental effects of the proposed TLH - Phase III project due to future actions potentially induced by the project. Induced action are *projects and activities that may occur if the action under assessment is approved ... they usually have no direct relationship with the action under assessment and represent the growth-inducing potential of an action* (Canadian Environmental Assessment Agency 1999:20).

The uncertainty associated with induced actions and their effects presents a challenge for cumulative effects assessment (Bonnell et al. 2002). The likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known. In addition, controlling most potential induced actions and related effects is beyond the responsibility of WST and depends on planning, cooperation and enforcing regulations. As a result, assumptions are made for assessing cumulative effects of induced actions, including:

- other projects and activities will be subject to appropriate planning and management;
- other projects and activities will be subject to the appropriate government requirements (e.g., legislation, regulations and guidelines) for protecting crown resources;
- relevant government agencies will have adequate resources to effectively carry out their mandate with respect to enforcement;
- adherence to existing regulatory requirements will not measurably change; and
- the TLH - Phase III will be designated a protected road and subject to the *Protected Road Zoning Regulations* administered by MAPA.

Relevant uncertainties and assumptions are presented in the cumulative effects assessments for each VEC. Cumulative effects significance are evaluated in the same manner as that described for the project-specific effects.

Determining cumulative environmental effects of the TLH - Phase III project considers the following existing, planned or potential projects and activities (assuming appropriate planning and management are in place and regulatory requirements and mitigation measures are fulfilled):

- existing sections of the TLH (Phases I and II);
- other roads in central and southern Labrador;
- Akamiuapishku/Mealy Mountains National Park;
- hydro development, including transmission lines;
- forestry activities;
- tourism and recreation activities, including outfitting operations;
- land and resource use activities, including consideration of improved access, by Innu and other residents of Labrador;
- Voisey's Bay mine/mill development;
- mineral exploration; and
- low-level military flight training.

6.6 Environmental Monitoring and Follow-up

Environmental monitoring and follow-up programs are an essential part of an environmental assessment. They provide a means for verifying environmental effects predictions and examining the effectiveness of mitigative measures. Programs also provide assurances to regulators and the public that environmental legislation, standards and commitments are being followed. Any environmental problems identified through a monitoring or follow-up program can be addressed in an effective and timely manner.

ECM refers to monitoring development activities to ensure compliance with regulatory and self-imposed environmental requirements (Barnes et al. 1986). EEM involves taking repetitive measurements of environmental variables over time to detect changes caused by external influences directly or indirectly attributable to a specific anthropogenic activity or development (Duinker 1985). ECM and EEM are described in detail in Section 3.9.8.

Monitoring and follow-up programs should be well-defined and focused to ensure efficient use of time and resources. Therefore, they should focus on issues that are poorly understood and/or of primary concern. Commitments to both ECM and EEM are discussed, as required, for each VEC.