6.5 Fish and Fish Habitat

Several species of fish are present in the numerous lakes, ponds, rivers and streams of the region. These waterbodies comprise fish habitat, which for the purpose of this assessment includes the water quality, sediment quality and all of the aquatic flora and fauna that are present in the region's fish bearing waters. Fish and fish habitat form complex food webs that sustain themselves and interconnect with other ecological components, including predators, prey and grazers. Freshwater fish have played an important role in the subsistence, recreation and economy of Labrador.

6.5.1 Boundaries

The TLH - Phase III will cross through five major watersheds in Southern Labrador. Boundaries for freshwater fish and fish habitat are discussed in terms of project boundaries, ecological boundaries, and administrative boundaries.

The project boundary is the 40 m wide right-of-way at the proposed stream crossing locations (Figure 6.21). Temporal project boundaries are seasonal for construction and year-round for operation.

The ecological boundaries for the freshwater fish and fish habitat consider spatial and temporal boundaries. The highway will cross five large watersheds in Southern Labrador, which have diverse fish communities. The highway (i.e., footprint) crosses a very small portion of each watershed. None of the fish species in the region are known to be restricted to a small area either inside or outside of the survey area, so these are Population Type 3, (i.e., species that have a widespread distribution pattern and very small proportion of their population confined at any one time within a given zone of influence). The population of all species extend well beyond the study area as the ecological boundary. Temporal boundaries are year-round for brook trout and other resident species and seasonal for the anadromous species (Atlantic salmon, Arctic char and sea-run brook trout).

The regulatory boundaries fall under provincial and federal jurisdictions. As in other areas of Newfoundland and Labrador, freshwater aquatic resources are regulated by several provincial and federal departments. The *Fisheries Act* is the primary federal legislation governing protection and management of fish and fish habitat in both marine and freshwater environments. DFO has jurisdiction for fisheries and fish habitat protection in the province. DFO recreational and commercial regulations are in effect. There are two scheduled salmon rivers along the length of the project area, the Eagle and Paradise Rivers. Specific regulations pertain to these rivers. Environment Canada has responsibility for Section 36 of the *Fisheries Act*, which regulates the release of deleterious substances (DFO is responsible for sedimentation issues). The NWPA is enforced by the CCG of DFO. The creation of a federal park in the Mealy Mountains area will bring some of that area under the jurisdiction of Parks Canada, which may then place recreational fishing under the control of Parks Canada. Settlement of land claims with Innu Nation may place portions of the study area under some form of aboriginal regulatory authority.

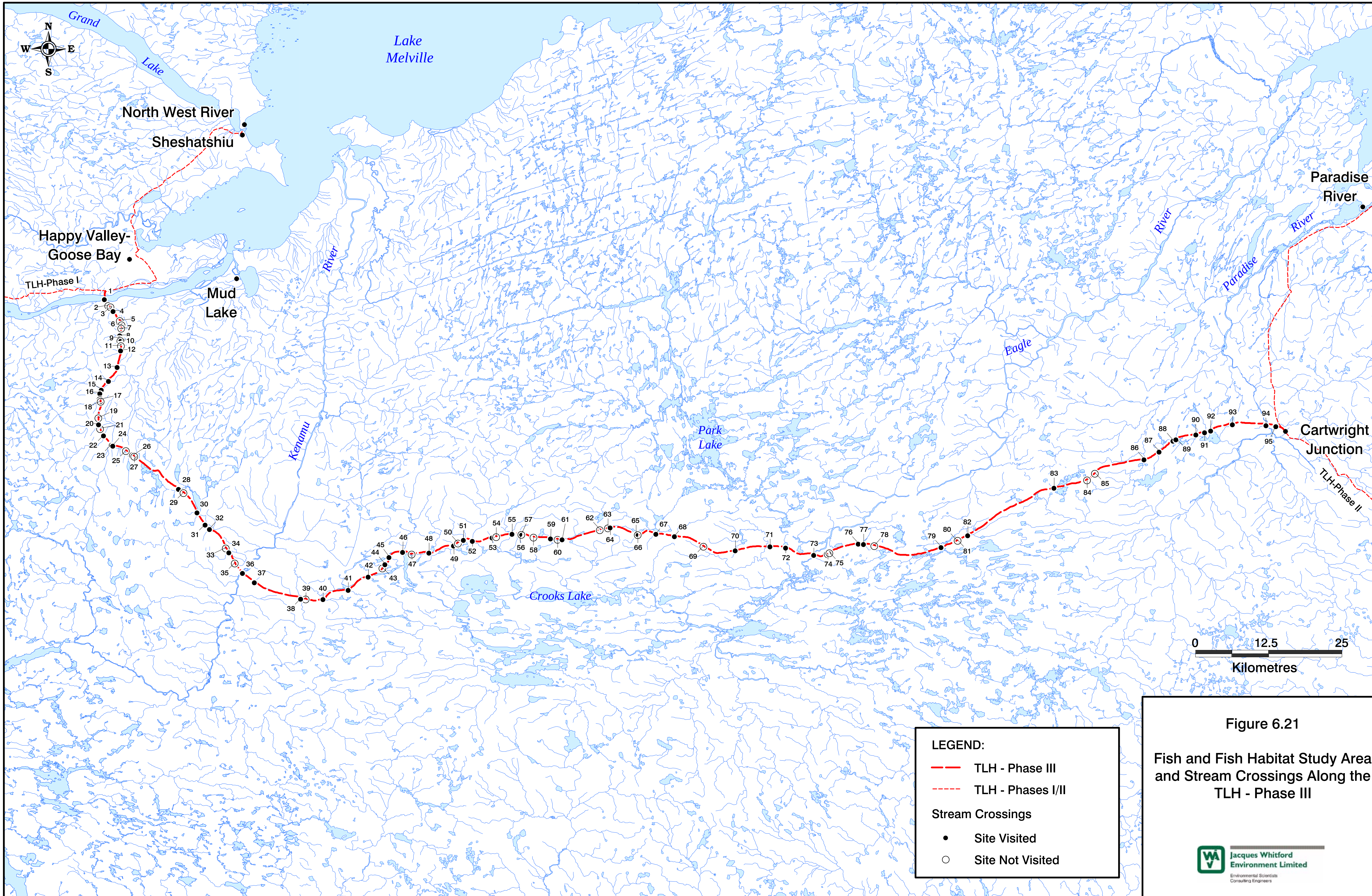

Figure 6.21

Fish and Fish Habitat Study Area and Stream Crossings Along the TLH - Phase III

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The Water Resources Division of the DOE has jurisdiction over water quality and water quantity in the watersheds pursuant to the *Waters Resources Act* (2002), which regulates development within 15 m of a waterbody and which has provisions to regulate development within wetlands and flood plains. Regulations under the *Water Resources Act* include the *Environment Control (Water and Sewage) Regulations*, which regulate discharges to a body of water. Further discussion on the effects of the proposed highway on water resources is provided in Section 6.7.

6.5.2 Methods

A preliminary review of the existing literature included Anderson (1985), 1:50,000 topographical maps, aerial photographs and information provided by WST from their route selection and preliminary design phases. Based on the information provided by WST, ninety-five watercourse crossings were identified for habitat assessment.

The scope of the Fish and Fish Habitat section is based on the EIS guidelines (Appendix A). Fish habitat surveys were conducted at all of the stream crossing locations. On-ground investigations were conducted as required to address the guidelines and as described in the Fish Habitat Component Study (JW and IELP 2003), which is summarized in this section.

A Fish and Fish Habitat Component Study (JW/IELP 2003) was conducted in September 2002 to gather information on the proposed stream crossing locations. As a part of the component study, habitat assessment surveys were undertaken for all identified watercourse crossing locations. However, because actual engineering surveys have not been completed, detailed design information is not available and precise watercourse crossings sites have not been confirmed.

Fish surveys were not required by DFO. WST, in consultation with other stakeholders, planned to include qualitative electrofishing surveys in the field studies that were conducted. However, due to the late timing of the field surveys, fish sampling has been deferred until the summer of 2003. Fish observed during the ground surveys at crossing locations were noted; however, the lack of observations should not be taken as an indication of fish absence.

Other information and effects assessments related to fish habitat and fish will be found in the following sections:

- geomorphology is described in Section 6.7;
- wetlands are discussed in Section 6.9;
- riparian vegetation is described in Section 6.10; and
- recreational and subsistence fish harvesting are described in Section 6.12 - Resource Use and Users.

6.5.3 Existing Environment

There is limited historical information and habitat surveys available on watersheds in Southern Labrador. The proposed route for the highway is remote from any communities, except at the Happy Valley-Goose Bay end, and is remote from the coastlines and the shore of Hamilton Inlet/Lake Melville.

The TLH - Phase III will cross watercourses ranging from small, possibly intermittent, brooks to large rivers, including the Churchill River (Figure 6.21). Watersheds in this area are described in Table 6.12 with regard to barriers to fish migration and the fish species present. For additional information refer to Anderson (1985).

Table 6.12 General Information on Watersheds Crossed by the TLH - Phase III

Watershed	Barriers to Fish Migration	Fish Species Present
Main Route		
Churchill River	Muskrat Falls is a complete barrier (40 km)	Atlantic salmon, brook trout, threespine stickleback, burbot, lake trout, Arctic char, lake whitefish, round whitefish, white sucker, longnose sucker, rainbow smelt, Atlantic sturgeon, American eel, ninespine stickleback, northern pike, lake chub, mottled sculpin, slimy sculpin, pearl dace, longnose dace
Traverspine River	Approximately 20 percent of watershed area is unaccessible. Partial obstructions have been identified at several locations	Atlantic salmon, brook trout, burbot, rainbow smelt
Kenamu River	All of the river is generally accessible	Atlantic salmon, brook trout, threespine stickleback, lake whitefish, round whitefish, white sucker, rainbow smelt, longnose sucker
Eagle River	Two relatively small tributary areas are not accessible due to barriers	Atlantic salmon, brook trout, white sucker, longnose sucker, northern pike
Paradise River	Two partial barriers on tributaries that connect 20 km and 40 km from mouth	Atlantic salmon, brook trout, threespine stickleback, white sucker, American eel, ninespine stickleback
Note: Only complete barriers to fish migration are included and are reported as the distance in kilometres from the mouth of the river or tributary in question. For information on the extent and location of partial barriers to migrating fish, refer to Anderson (1985). Source: Anderson 1985.		

There are 20 species of fish reported in the Churchill River, although only a portion of these are in the lower reaches, where the highway will cross. The watersheds to be crossed by the highway contain both anadromous and resident Atlantic salmon and brook trout. The Churchill River also has anadromous Arctic char in the lower reaches. These species all use stream habitat for spawning and rearing and stream migration is an important aspect in the lifestyle of anadromous species (Scruton et al. 2000). Lake whitefish, round whitefish and lake trout are predominantly lake-dwelling salmonids that occur in some of the watersheds. The habitat preferences of these species are summarized by Bradbury et al. (1999).

Non-salmonid species found in some of the watersheds include northern pike, longnose sucker, white sucker, burbot, rainbow smelt, forage fish such as threespine and ninespine stickleback and the catadromous American eel.

Paradise River and Eagle River are scheduled salmon rivers crossed by TLH - Phase III and catch statistics for Eagle River are summarized in Section 6.14 - Land and Resource Use.

6.5.3.1 Fish Habitat

The field surveys were similar to those conducted for TLH - Phase II (i.e., aerial surveys by helicopter). However, this study conducted comprehensive ground surveys at many of the watercourse crossings.

An aerial survey of the watercourse crossings on the TLH - Phase III route between Happy Valley-Goose Bay and Cartwright Junction was conducted from September 23 to October 2, 2002. The survey collected field information at three levels of detail:

- assembling the compiled information provided by WST and any other desk-top sources such as topographic mapping;
- videotaping recording of the stream for 250 m upstream and downstream of proposed crossing location; and
- detailing aerial and (in many cases) on ground surveys of the stream section at the crossing location.

Habitat characterization was completed at each watercourse crossing site, using methods described by Sooley et al. (1998), using methods that were modified from Sooley et al. (1998), and modified methods from the assessment of TLH - Phase II, including:

- depth (estimated as 0 to 1 m, 1 to 2 m, >2 m or unknown);
- channel width (i.e., wetted width estimated as 0 to 2 m, 2-5 m, 5 to 20 m, or > 20 m);
- flow type (steady, riffle, rapids, pools - see Table 6.13);
- substrate composition (fines/gravel, cobble, boulder or bedrock - see Table 6.14);
- bank material (fines/gravel, cobble, boulder or bedrock - see Table 6.14);
- backslope (shallow, medium or deep gully, forest stream, flood plain, bog/fen - see Table 6.15);
- Beak salmonid habitat type (see Table 6.16);
- bank vegetation (bog, grasses, shrubs, or trees);
- cover (instream, overhang, canopy);
- presence/absence of potential obstructions (falls, rapids, chute and cascade); and
- gradient (estimated as (0 to 1 percent, 1 to 3 percent, 3 to 5 percent or 7 percent).

All data were recorded on standardized field data sheets. Photographs were taken to augment the videotape record. A detailed aerial assessment was not possible on all watercourse crossings due to the small size of some streams and visual obstruction created by thick tree canopy.

Table 6.13 General Stream Flow (Habitat) Types

Stream Flow	Definition
Run	Swiftly flowing water with some surface agitation but no major flow obstructions, coarser substrate (gravel, cobble, and boulders).
Riffle[1]	Shallower section with swiftly flowing, turbulent water with some partially exposed substrate (usually cobble or gravel dominated).
Pocketwater	Turbulence increased greatly by numerous emergent boulders, which create eddies or scour holes (pockets) behind the obstructions.
Flat (or steady)[1]	Water surface is smooth and substrate is made up of organic matter, sand, mud, and fine gravel. This habitat differs from a pool due to the length, associated with low gradient. This habitat type generally has a flat bottom.
Pool [1]	Deeper area comprising full or partial width of stream, due to the depth or width flow velocity is reduced. Pool has rounded surface on bottom.
Cascade (rapids)[1]	Areas of steeper gradient with irregular and rapid flows, often with turbulent white water. Rapids are primarily associated with larger stream sections and rivers. In larger rivers, it is recommended that the survey crew not attempt to conduct cross sections in these types of habitat.
Glide	Wide, shallow pool flowing smoothly and gently, with low to moderate velocities and little or no surface turbulence. Substrate usually consists of cobble, gravel and sand.

[1] Flows characterized during the aerial survey were described by these four types.
Source: Sooley et al. 1998.

Table 6.14 Classification of Substrate

Substrate	Description
Bedrock (BR)	Continuous solid rock exposed by the scouring forces of the river/stream
Boulder (Bo)	Boulder sized rocks from 25 cm to greater than 1 m in diameter
Small Boulder	Boulder sized rocks from 25 cm to 1 m diameter
Rubble (R)	Large rocks from 14 to 25 cm in diameter
Cobble (C)	Moderate to small sized rocks from 3 to 13 cm in diameter
Gravel(G)	Small stones from 2 mm to 3 cm in diameter
Fines (F)	Sand and smaller sized material on margins of streams or between rocks and stones, up to 2 mm in diameter

Source: Bradbury et al. 2001.

Table 6.15 Riparian Backslope

Backslope	Description
Shallow Gully	up to 1 m deep. Gullies are typically well-defined, steep-sided channels which contain sporadic flooding but may suffer bank erosion depending on bank material
Medium Gully	2 to 3 m deep
Deep Gully	3 to 4 m deep
Forest Stream	has low to medium gradient and a well-defined channel with some spilling over the banks - erosion may occur due to reduced stability of forest soils
Flood Plain	is a wide, shallow course with narrow channel(s) in middle - flooding occurs onto grasses with little lasting effect
Bog/Fen	with few permanent narrow cut channels and auxiliary intermittent channels - periodic flooding causes no lasting effect
Source: Bradbury et al. 2001.	

Table 6.16 Beak Salmonid Habitat Classification Types

Type	Definition
I	Good salmonid spawning and rearing habitat; often with some feeding pools for larger age classes: **flows:** moderate riffles; **current:** 0.1 to 0.3 m/s; **depth:** relatively shallow, 0.3 to 1 m; **substrate:** gravel to small cobble size rock, some larger rocks or boulders; and **general habitat types:** primarily riffle, pool.
II	Good salmonid rearing habitat with limited spawning, usually only in isolated gravel pockets, good feeding and holding areas for larger fish in deeper pools, pockets or backwater eddies: **flows:** heavier riffles to light rapids; **current:** 0.3 to 1 m/s; **depth:** variable from 0.3 to 1.5 m; **substrate:** larger cobble/rubble size rock to boulders and bedrock, some gravel pockets between larger rocks; **general habitat types:** run, riffle, pocketwater, pool.
III	Poor rearing habitat with no spawning capabilities, used for migratory purposes: **flows:** very fast, turbulent, heavy rapids, chutes, small waterfalls, **current:** 1 m/s or greater; **depth:** variable, 0.3 to 1.5 m; **substrate:** large rock and boulders, bedrock; and **general habitat types:** run, pocketwater, cascades.
IV	Poor juvenile salmonid rearing habitat with no spawning capability, provides shelter and feeding habitat for larger, older salmonid (especially brook trout): **flows:** sluggish; **current:** 0.15 m/s; **depth:** variable but often 1 m; **substrate:** soft sediment or sand, occasionally large boulders or bedrock, aquatic macrophytes present in many locations; and **general habitat types:** flat, pool, glide.
Source: Sooley et al. 1998.	

The scope of work for the field study included on-ground surveys for selected crossing locations. The selected locations included all crossings that could safely be accessed and which had an upstream basin area greater than 2 km^2, and Beak Type I and II habitat.

The ground surveys included detailed measurements of the section where the crossing is proposed and other sampling that included: a sample for water quality determination, stream flow velocity, stream gradient and any observations of fish. This information along with details of the stream habitat and riparian habitat were all recorded on the field data sheets.

6.5.3.2 Description of Watersheds

The results of the aerial and ground surveys of watercourse crossings conducted by JW in each watershed are described in the following sections. The watershed drainage area is provided along with a watercourse crossing number, as well as the width of the stream, the flow, and the habitat type as defined by Beak at each crossing area.

Churchill River

The Churchill River is the largest river in Labrador; its 93,415 km^2 watershed extends from the far western border of Labrador to Lake Melville. However, the proposed highway crosses the river 23 km from the mouth; therefore, direct effects on fish habitat are limited to the river sections within this distance from the mouth. Potential effects to fish would include disruption of migrations; however, migrations on the river are limited to the areas below Muskrat Falls, located 40 km from the mouth. Very little of the watershed falls under the potential influence of the project. There are several minor tributaries that are crossed by the route progressing south of the main stem of the river. Seven of eleven watercourse crossings have limited upstream basins (<2 km^2), and they are all small streams in width. Six of eleven watercourse crossings are in potentially productive (Type II) habitat (Table 6.17).

Table 6.17 Summary Information of Crossings on the Churchill River and Minor Tributaries

Stream Crossing Number	Channel Width				Flow Type	Beak Habitat Type	Comment
	0-2 m	2-5 m	5-20 m	> 20 m			
1				x	riffle	II	Churchill River
2	x				(riffle)	(II)	Upstream Basin area < 2 km^2
3	x				n/a	n/a	Upstream Basin area < 2 km^2
4	x				(riffle)	(II)	
5	n/a				n/a	n/a	Upstream Basin area < 2 km^2
6	x				(riffle)	(II)	Upstream Basin area < 2 km^2
7	x				(riffle)	(II)	Upstream Basin area < 2 km^2
- 8 -		x			riffle	II	Fish observed (1)
- 9 -	x				riffle	II	
10	x				n/a	n/a	Upstream Basin area < 2 km^2
11	x				n/a	n/a	Upstream Basin area < 2 km^2
12	x				n/a	n/a	

Crossing locations are shown in Figure 6.21, flows are defined in Table 6.23 and habitat types are defined in Table 6.16.
Crossing numbers indicated with hyphens are those where ground surveys were conducted.
N/A denotes watercourse crossings where the stream was obscured by forest canopy and habitat character could not be determined.
Flow and habitat types in brackets are estimated from partial views or immediately adjacent sections.

Heavy forest in this area features a canopy that obscures most of the stream crossing locations, thus limiting the ability to closely characterize the stream sections and associated habitat. The Churchill River was not surveyed on the ground as most of the width is not accessible for sampling and measurements. Two of four ground surveys were completed, while forest cover prevented access by helicopter to the other two sites.

Traverspine River

The Traverspine River is a tributary to Churchill River, extending 50 km to the south. The proposed route roughly bisects the Traverspine watershed in a southeasterly orientation. Fifteen watercourse crossings in this basin are mostly small streams of less than 5 m width and less than 2 km^2 upstream areas (Table 6.18).

Table 6.18 Summary Information of Crossings on the Traverspine River and Tributaries

Stream Crossing Number	Channel Width				Flow Type	Beak Habitat Type	Comment
	0-2 m	2-5 m	5-20 m	> 20 m			
- 13 -		x			riffle	II	Brook trout observed (1)
14		x			riffle	I	
15			x		riffle	II	
- 16 -			x		riffle/pool	II	
17	x				n/a	n/a	Upstream Basin area < 2 km^2
18	x				n/a	n/a	Upstream Basin area < 2 km^2
19	x				n/a	n/a	Upstream Basin area < 2 km^2
20		x			(riffle)	(II)	
21	x				n/a	n/a	Upstream Basin area < 2 km^2
- 22 -				x	rapids	III	
- 23 -			x		riffle	II	Traverspine River
- 24 -			x		rapids	III	
25	x				n/a	n/a	Upstream Basin area < 2 km^2
26	x				n/a	n/a	Upstream Basin area < 2 km^2
27	x				n/a	n/a	Upstream Basin area < 2 km^2

Crossing locations are shown in Figure 6.21, flows are defined in Table 6.13 and habitat types are defined in Table 6.16.
Crossing numbers indicated with hyphens are those where ground surveys were conducted.
N/A denotes watercourse crossings where the stream was obscured by forest canopy and habitat character could not be determined.
Flow and habitat types in brackets are estimated from partial views or immediately adjacent sections.

Of the eight crossing locations that were to be surveyed on the ground, five were accessible by helicopter. Three of these are Type II habitat and two are Type III (cascades) habitat. Field data on all of the watercourse crossings are reported in the Fish and Fish Habitat Component Study (JW/IELP 2003).

Kenamu River

The proposed route roughly bisects the Kenamu River watershed, in an east-west orientation. Fifteen watercourse crossings were identified for investigation (Table 6.19).

Table 6.19 Summary Information of Crossings on the Kenamu River and Tributaries

Stream Crossing Number	Channel Width				Flow Type	Beak Habitat Type	Comment
	0-2 m	2-5 m	5-20 m	> 20 m			
- 28 -			x		riffle	II	
29	x				n/a	n/a	Upstream Basin area < 2 km^2
30			x		steady	IV	
31	x				n/a	n/a	Osprey (prevented ground survey)
32	x				(riffle)	(II)	
33	x				(riffle)	(II)	Upstream Basin area < 2 km^2
34	x				(riffle)	(II)	
35							No stream was visible at the coordinates
- 36 -				x	riffle	II	Kenamu River
- 37 -	x				steady	IV	
- 38 -			x		riffle	II	
39	x				n/a	n/a	Upstream Basin area < 2 km^2
- 40 -		x			riffle	II	
- 41 -		x			riffle	I	
- 42 -		x			riffle	II	

Crossing locations are shown in Figure 6.21, flows are defined in Table 6.13 and habitat types are defined in Table 6.16.
Crossing numbers indicated with hyphens are those where ground surveys were conducted.
N/A denotes watercourse crossings where the stream was obscured by forest canopy and habitat character could not be determined.
Flow and habitat types in brackets are estimated from partial views or immediately adjacent sections.

Most of the watercourse crossings are less than 5 m in width. The Kenamu River is over 20 m in width at the crossing location. Three watercourse crossings did not require ground surveys, one crossing had no visible flow or channel, and one crossing could not be accessed because osprey threatened to charge the helicopter on three separate occasions. Seven of the remaining ten watercourse crossings were surveyed on the ground; the remainder could not be accessed due to tree cover.

Eagle River

The proposed route transects the upper half of the Eagle River watershed and 40 crossing locations were identified for investigation. All were overflown and surveyed from the air. Fifteen watercourse crossings did not require ground surveys based on the upstream basin area (Table 6.20). Two crossings had no visible channel or flow, seven crossings were Type IV habitat (no ground survey required). Of the remaining 16 crossings, 14 were surveyed on the ground and two could not be accessed due to trees. Six of the smaller crossings were obscured by canopy and overhang, but of the ones that could be seen clearly, 17 were Type II habitat and 17 were Type IV habitat.

Table 6.20 Summary Information of Crossings on the Eagle River and Tributaries

Stream Crossing Number	Channel Width				Flow Type	Beak Habitat Type	Comment
	0-2 m	2-5 m	5-20 m	> 20 m			
43	x				n/a	n/a	Pond ? Upstream Basin area < 2 km^2
44					n/a	n/a	This crossing (pond) has been removed by realignment of the route
45				x	riffle	II	
46		x			steady	IV	
47	x				steady	IV	Upstream Basin area < 2 km^2
- 48 -		x			riffle	II	
49	x				steady	IV	
50	x				(steady)	(IV)	Upstream Basin area < 2 km^2
- 51 -		x			riffle	II	
- 52 -			x		riffle	II	
- 53 -	x				riffle	II	
54							No stream was visible at the coordinates
- 55 -			x		riffle	II	
- 56 -	x				riffle	II	
57							No stream was visible at the coordinates
58	x				steady	IV	Upstream Basin area < 2 km^2
59	x				riffle	II	
60	x				steady	IV	Upstream Basin area < 2 km^2
- 61 -		x			riffle	II	
62	x				steady	IV	Upstream Basin area < 2 km^2
63	x				steady	IV	Upstream Basin area < 2 km^2
- 64 -	x				riffle	II	
- 65 -		x			riffle	II	
66	x				steady	IV	Upstream Basin area < 2 km^2
- 67 -		x			riffle	II	
- 68 -	x				riffle	II	
69	x				(riffle/steady)	(II/IV)	Upstream Basin area < 2 km^2
70	x				steady	IV	
71			x		steady	IV	
72	x				steady	IV	
- 73 -				x	riffle	II	Eagle River
74	x				n/a	n/a	Upstream Basin area < 2 km^2
75	x				riffle	II	Upstream Basin area < 2 km^2
76	x				steady	IV	
77				x	steady	IV	
78	x				steady	IV	Upstream Basin area < 2 km^2
- 79 -				x	riffle	II	
80	x				steady	IV	Upstream Basin area < 2 km^2
81	x				steady	IV	Upstream Basin area < 2 km^2
- 82 -		x			riffle	II	

Crossing locations are shown in Figure 6.21, flows are defined in Table 6.13 and habitat types are defined in Table 6.16.
Crossing numbers indicated with hyphens are those where ground surveys were conducted.
N/A denotes watercourse crossings where the stream was obscured by forest canopy and habitat character could not be determined.
Flow and habitat types in brackets are estimated from partial views or immediately adjacent sections.

Paradise River

Phase II of the TLH runs along the lower half of Paradise River en route to the communities of Paradise River and Cartwright. The route of the TLH-Phase III intersects approximately midway along Paradise River (Cartwright Junction) and then bears west across the watershed. Thirteen watercourse crossings have been identified (Table 6.21) including Paradise River itself. The terrain has a numerous wetland areas and low relief, and hence, seven of the crossings are Type IV habitat (steadies). In one case, there was no visible channel or flow and in another, the stream increasingly diminished in visible flow until it disappeared, as subsurface flow through the substrate. The remaining stream crossing locations were surveyed on the ground.

Table 6.21 Summary Information of Crossings on the Paradise River and Tributaries

Stream Crossing Number	Channel Width				Flow Type	Beak Habitat Type	Comment
	0-2 m	2-5 m	5-20 m	> 20 m			
83		x			steady	IV	
84		x			steady	IV	Upstream Basin area < 2 km^2
85							No stream was visible at the coordinates
86			x		steady	IV	
- 87 -	x				riffle	II	
- 88 -			x		steady	IV	
- 89 -		x			riffle	II	
- 90 -	x				steady	IV	
- 91 -			x		steady	IV	
92	x				intermittent	nil	Stream appears to go underground
93		x			steady	IV	
- 94 -				x	riffle	II	Paradise River
- 95 -	x				riffle	II	

Crossing locations are shown in Figure 6.21, flows are defined in Table 6.13 and habitat types are defined in Table 6.16.
Crossing numbers indicated with hyphens are those where ground surveys were conducted.
N/A denotes watercourse crossings where the stream was obscured by forest canopy and habitat character could not be determined.
Flow and habitat types in brackets are estimated from partial views or immediately adjacent sections.

6.5.3.3 Fish Surveys

The identification and characterization of 'potential' fish habitat has been done without reference to verifying fish presence and use of the habitat. Conservatively, WST have committed to approaching all watercourse crossings as being fish habitat unless there are counter-indications. The Terms of Reference for the component study did not require any fish sampling to be conducted.

DFO have made a preliminary determination that the planned highway construction methods are not likely to result in a harmful alteration, disturbance or destruction (HADD) of productive fish habitat as described under Section 35(2) of the *Fisheries Act* (B. Brown, pers. comm.). WST have committed to approaching all watercourse crossings as being fish habitat, where suitable productive habitat is present, and thus, consideration will be given to preserving water quality, fish, fish spawning and rearing habitat and potential fish migration, as was done for TLH - Phase II. These measures will address fish and fish habitat issues for the purpose of environmental protection.

WST have committed to fish population studies to be completed during the construction phase, when time and access will be more favourable for conducting comprehensive surveys. The protocols to be used have been developed by the Inland Fish and Wildlife Division, who will take the lead in the survey. This will provide extensive baseline information on fish in the area.

6.5.3.4 Fish Species

Although many species are present in the streams and lakes along the highway route, the two that are most likely to be affected by the project are Atlantic salmon and brook trout, by their wide distribution and presence in stream sections and the importance of streams as nursery habitat for both anadromous and resident forms. The following summaries for Atlantic salmon and brook trout are taken largely from Scruton et al. (1997).

Atlantic Salmon

Atlantic salmon are the dominant salmonid species in southern Labrador. They occur in the anadromous form that live at sea and return to freshwater to spawn and the resident form that spend their life in freshwater. The Labrador stock status is poorly known but optimistic indicators were reported in 1998 for improved spawning escapements (DFO 1998). Large salmon returns and escapements have been consistently low in Labrador and exploitation of large salmon is a continuing concern. Additional discussion on the recreational angling returns for Labrador is provided in Section 6.14.3.1.

The habitat preferences of salmon in freshwater are summarized in Table 6.22. Adults spawn the fall from mid-September to mid-November. They prefer well-aerated gravel substrate, often located in tributaries to the major rivers. Following spawning, the spent salmon (kelts) return to the sea, or overwinter in freshwater pools or lakes and then return to sea.

Salmon eggs remain in the gravel overwinter and hatch from mid-April to mid-June. Alevins remain in the gravel for four to five weeks while they absorb their yolk sac. They then emerge as fry and commence feeding. Young salmon remain in streams as parr until they are three to six years old, at which time they will migrate to sea as smolt. Parr prefer coarse substrate (rubble, boulder and to a lesser extent cobble) and as they grow, they prefer faster water (riffle and rapids). Cover is not as important to salmon parr as it is for brook trout.

molt move to sea from mid-May to mid-June in Labrador, when water temperatures are from 5 to 10˚C. Following a brief acclimation in estuarine conditions, the smolt may go inshore or offshore to feed. After one to three years at sea, the salmon return to their natal streams. Those that return in one year are smaller and are called grilse, as opposed to larger multi-sea winter salmon.

Table 6.22 Habitat Preferences of Atlantic Salmon

Habitat Attribute	Atlantic Salmon Life Stage	
	Spawning	**Rearing**
Location	tail of pools in streams	variable
Water Depth (cm)	20 to 70	fry : 15 to 20 parr : 15 to 25
Water Velocity (cm/s)	0 to 80 (may not spawn in <10)	fry : <40 (5 to 32) small parr : 10 to 50 large parr : 5 to 100
Substrate Class	40 to 50 percent gravel or larger (7.8 to 12.5 cm grade)	fry : pebble/cobble small parr : pebble large parr : cobble/boulder
Other factors		
Timing	Fall	
Temperature (ºC)	3 to 11 (usually below 7)	8 to 24
pH	>5.0	

Notes:
- fry (<40 mm long); small parr (40 to 70 mm); large parr (>70 mm).
- Information derived predominantly from Scruton et al. (2002).

Brook Trout

Brook trout are widely distributed throughout Labrador, including both sea-run and landlocked (resident) forms. Their life cycle and seasons are similar to Atlantic salmon, except that they tend to be smaller and their habitat preferences are correspondingly shifted (Table 6.23).

Brook trout move into stream sections from mid-August and spawn during the month of September, and often extending into October. Spawning is conducted in headwater streams where gravels are well aerated by flow or upwelling. Some spawning occurs in lake habitat, where substrate is suitable and again where upwelling occurs.

The eggs hatch from mid-May to mid-June and the larvae emerge from the gravel as fry when their yolk is depleted. The fry prefer quiet edge water in streams or the margins of ponds. As they grow larger, the juveniles will tolerate faster water and deeper pools. Juvenile trout and salmon often cohabit within streams and feed at the same trophic level.

Adults will occupy a variety of habitats in response to available food, cover, competitors and predators. Preferred habitat includes riffles and pools with deeper water, abundant cover (instream or overhang), suitably cool water temperature and fairly good water quality.

The population status of brook trout is also poorly known, particularly in the remote areas such as the study area for TLH - Phase III.

Table 6.23 Habitat Preferences of Brook Trout

Habitat Attribute	Brook Trout Life Stage	
	Spawning	**Rearing**
Location	Streams and ponds Often in upwelling areas	Streams, rivers, ponds and lakes
Water Depth (cm)	-	6 to 90 18 to 40 optimum
Water Velocity (cm/s)	-	0 to 45 6 to 21 optimum
Substrate Class	Gravel - Fines reduce success Broadcast spawn over coarse substrate	Various
Other factors Timing Temperature (ºC) pH	 Fall 4 to 10 >5.0	 0 to 24 11 to 16 optimum

Notes:
- \- Indicates not specified in recent literature.
- Information derived predominantly from Scruton et al. (1997) and Scruton et al. (2002).

6.5.4 Potential Interactions

Construction activities conducted instream or adjacent to stream banks have the potential to alter fish habitat, leading to displacement and/or reduced productivity or mortality in the population. Initial surveying of the route and clearing the right-of-way will require watercourse crossings by fording, boat, or helicopter. Fording streams at areas of sensitive habitat may destroy eggs or fry in gravel substrate.

At the start of construction, grubbing and debris disposal will take place in close proximity to watercourses. Excavation (cuts and fills) will be completed along the route and borrow pits will be operated where necessary. There may be a requirement for blasting near waterbodies to construct bridge abutments, to level the highway foundation or to establish the right-of-way. Blasting has the potential to cause direct damage to fish (i.e., injury to air bladders and mortality from toxic blast residues) and effects to fish habitat from shotrock and sediment introduction. Culverts and bridges will be placed at watercourse crossings, requiring in stream construction and potential disturbance of fish and fish habitat.

Altering habitat may also occur as a result of changes in water quality through an increase in suspended solids or accidental release of contaminants (waste, fuel, lubricants) into the water body. Increased suspended sediment in watercourses may be caused by fording, right-of-way clearing, grubbing, excavation, borrow pit operation, culvert and bridge installation, subgrade construction, concrete and aggregate production and rehabilitation of areas used during construction. Increased suspended sediment may adversely affect fish habitat by smothering habitat (i.e., feeding, spawning and rearing habitat) and affecting fish health (physical harm, physiological effects, behavioural effects such as an inability to detect predators and prey).

Concrete batch manufacturing will occur at some watercourse crossings. Concrete batch plants and aggregate washing have the potential to introduce silty material into watercourses. Liquid concrete products and truck washing residues have a high pH and can be toxic to plants, invertebrates and fish.

Temporary construction camps will be established to house work crews. If not properly handled and disposed of, domestic sewage and waste from these camps could end up in watercourses. The main concern with domestic sewage is the potential to increase nutrient loading in a watershed.

The installation of culverts or narrow bridge abutments will potentially cause restrictions in flow or increased gradients that may inhibit fish passage, particularly those that migrate into streams prior to spawning. Increased flow velocities or stretches of sustained flow, such as through a culvert, may be too much for some fish to overcome, or may unduly weaken fish that do manage to complete passage through the obstruction. Another barrier to fish passage could be created when water flows primarily under the culvert during low flow conditions.

There is the potential for any instream structures (culverts, bridge abutments or pilings) to affect productive fish habitat.

As sections of the highway are constructed, access to angling areas will be facilitated. This may lead to increased angling activity (and the potential for poaching), and may indirectly affect fish populations.

Many interactions that may occur during construction (sedimentation, contamination) also apply during operation, albeit to different levels of intensity, timing, and/or spatial distribution. During operation, suspended sediment may be introduced into fish-bearing water. Sediment could be introduced from runoff from the highway surface, shoulder grading, ditch cleaning, sand application (ice control), and through airborne dust.

Salt is not used for ice control in Labrador as it is ineffective at the normal cold temperatures and excessive salt leads to destruction of the roadbed (through irregular freezing and thawing). A very small amount of salt (<5 percent) is mixed with sand to prevent freezing prior to application for improved traction under icy conditions.

Service depots that are planned for the project may store and handle various hazardous materials, such as fuels, lubricants, solvents and antifreeze. As well, each depot will have waste handling/holding facilities. Improper waste disposal could result in the introduction of hazardous materials to watercourses.

Culverts or bridges that are installed without provision for fish passage may impede or prevent fish migration if the water velocities are excessive. Faulty installations or developing problems with the installations can lead to fish passage problems if the situations are not inspected and rectified.

The highway will provide new access to watercourses and again, the increased human use of watercourses may indirectly affect fish and fish habitat (e.g., resource and subsistence harvesting, recreational activities and poaching).

Acid rock drainage (ARD), as described in Section 2.5.2.4, may be encountered along the highway route.

Hazardous materials that will be used during the construction and operation of the TLH - Phase III include fuels, lubricants, solvents, preservatives and antifreeze; these could be accidentally introduced into fish habitat through a spill of these materials. Also, hazardous materials will be transported on the route during normal highway operation. Many of these substances are acutely toxic to fish, plants and invertebrates. Other materials may cause chronic or acute degradation of water quality and fish habitat.

Fire can occur as a result of construction activities, temporary camp operation and highway maintenance activities, accidents relating to the operation and use of the TLH - Phase III, or accidents unrelated to the highway (i.e., lightening strikes). Fire and subsequent burning of forests can lead to a degradation in water quality for fish due to slope destabilization and erosion and may result in pH changes, an increase in suspended sediment or the mobilization of metals from sediments.

Highway crossing failure such as a collapse, washout or flooding can occur during seasonal high flow periods. This could be as a result of exceptionally high flows or due to a failure in local drainage due to poor design or obstruction by ice or debris. Washout of a gravel highway will result in the release of sediment and silt that may enter watercourses. It could also lead to dangerous conditions where the risk of vehicular accidents is increased (i.e., increasing the risk of hazardous materials spills).

6.5.5 Issues and Concerns

Issues and concerns with respect to fish and fish habitat have been raised and discussed at the public consultation meetings and through regulator consultation. Most concerns relate to effects of highway construction and/or operation on fish and fish habitat, and the effect of improved access to watercourses, specifically access to key angling areas. There is concern that some of the watercourse crossings may affect fish migration, especially during construction. A concern for the introduction of dust from highway operation was also repeatedly raised during stakeholder consultations. The public, aboriginal groups, and regulators were concerned that appropriate studies be conducted to identify existing fish and fish habitat and measure be taken to protect these during construction and operation. WST will cooperate and support fish surveys planned by Inland Fish and Wildlife Division for 2003 (Section 6.5.11).

Culverts or bridges that were installed without provision for fish passage may disrupt fish spawning migrations and subsequent recruitment and habitat use. Excessive water flow or insufficient water depth or flow could be a barrier to fish passage.

Any disturbance or removal of fish habitat by the placement of instream structures could have an adverse effect on the local populations and would not conform to DFO's no net loss guiding principle for fish habitat management.

Much of the public concern with respect to fish and fish habitat is related to improved access and the potential for increased angling activity, in particular on Eagle River. There is concern that an increase in angling pressure will lead to subsequent declines in fish stocks. Many stakeholders (including outfitters and aboriginal groups) are concerned that improved access would affect their ability to fish in area rivers and the amount of fish that they could take.

There is concern about the effect of construction activities, such as grubbing, blasting, right-of-way clearing, vegetation burning, bridge and culvert installation, other in stream work, quarrying and borrowing activity, and concrete and aggregate production, on fish and fish habitat, fish migration and water quality. Concern was raised about possible siltation resulting from maintenance activities, such as grading and ice control, and the effect that it might have on spawning and rearing habitat. The accidental release of contaminants into waterbodies during transport, storage, use and/or disposal of wastes, fuels, lubricants, solvents and other deleterious substances is a concern. Some stakeholders feel that fish migration will be affected by culvert installations, even when baffles, natural substrates, and other mitigation methods are employed. There may also be concern about the loss of riparian vegetation (tree canopy cover) through vegetation clearing, increased timber harvesting or forest fires.

Acid generating rock has been raised as a concern, which is discussed in Section 2.5.2.4. Drainage from acid generating rock sources to fish habitat may have a detrimental effect on fish or their food sources.

6.5.6 Existing Knowledge

Sedimentation (increased sediment load and deposition) is perhaps the most recognized environmental effect on aquatic systems during project construction, which has the potential to affect all trophic levels. Sediment deposition can result from a variety of activities, including fording, blasting, vegetation clearing, highway construction, and bridge and culvert installation. Suspended sediment also occurs naturally in watercourses along the route, as witnessed following a heavy rain during the field survey in September to October 2002. The environmental effects of sediment are well studied and understood. Anderson et al. (1996) reviewed the effects of sediment release on fish and their habitats. Anderson et al. (1996) and Trow Consulting Engineers Ltd. (1996) summarized the effects of sedimentation and siltation on fish habitat as follows:

- degradation of water quality (i.e., oxygen levels, light penetration, water temperature, water chemistry such as organic content and metals) leading to changes in primary production and food availability;
- changes in stream morphology and stream bed porosity leading to degradation of spawning substrates, holding pools, instream cover and overwintering habitat;
- reducing the diversity and abundance of bottom dwelling fish food organisms; and
- the destruction of aquatic vegetation that are buried by sediments.

The direct effects on fish include:

- behavioural responses - these are first level responses, usually temporary and not resulting in a change in health;
- minor physiological influences - where the fish may avoid the exposure but there may be effects to health due to exposure or reduction in food supply;
- physiological changes - due to long term exposure affecting life stages or feeding; and
- effects on eggs and larvae which cannot avoid areas of exposure - larvae are most sensitive, eggs are marginally more tolerant.

Sedimentation alters habitat by changing the physical characteristics, distribution and relative abundance of existing substrate types. These changes may result in changes in the carrying capacity of the population. Sedimentation may fill rearing pools, cover coarse substrates and alter channel flow, thereby reducing the suitability of habitat for existing communities of fish and aquatic invertebrates.

Sediment may clog interstitial spaces in gravel, preventing the flow of oxygenated water and removal of waste products from developing eggs deposited in the gravel (Rogerson 1986). This often lowers the dissolved oxygen content in the water, which can lead to suffocation and egg mortalities and may prevent further use of spawning areas (Beschta and Jackson 1979; Chapman 1988). Pore space size determines the percolation rate of water through substrate and also influences movement of emerging alevins through gravel (Lotspeich and Everest 1981). The elimination of sheltered areas between boulders and gravel particles will also affect juvenile fish distribution (Scrivener and Brownlee 1989). The benthic macroinvertebrate populations are also affected by changes to the physical habitat structure, causing changes in relative species abundance and community structure.

Acute lethal effects to fish from suspended solids are unlikely to occur unless the concentrations are high and exposure is chronic (Alabaster and Lloyd 1982). Trow Consulting Engineers Ltd. (1996) notes that impaired water quality can adversely affect fish by:

- clogging gills;
- damaging (abrading) gill membranes;
- reducing fish ability to feed by sight (reduced visibility);
- altering fish behaviour; and
- making fish susceptible to disease due to the added stress of a turbid environment.

These effects are species-dependent, as some fish are better adapted to higher suspended solid levels than others. The seasonal susceptibility of fish depends on life stages and migrations for some species, as outlined in Table 6.24.

Table 6.24 Critical Periods for Fish in Labrador

Species	Life Stage or Activity				
	Spawning Migration	Spawning	Incubation	Hatching	Downstream Migration
Anadromous Species (sea-run)					
Brook Trout	Jun 20 - Sep 1	Sep 1 - Sep 30	Sep 1 - Jun 15	May 15 - Jun 15	Jun 15 - Jul 15
Atlantic Salmon	Jul 1 - Aug 31	Oct 1 - Nov 15	Oct 1 - Jun 15	Apr 15 - Jun 15	May 15 - Jun 15
Smelt	May 1 - Jun 15	May 1 - Jun 15	May 1 - Jul 15	Jun 1 - Jul 15	Jun 1 - Jul 15
Arctic Char	Jul 1 - Sep 30	Oct 1 - Nov 15	Oct 1 - Jun 15	Apr 15 - Jun 15	May 15 - Jun 30
Resident Species (non sea run)					
Brook Trout	Aug 15 - Sep 30	Sep 1 - Sep 30	Sep 1 - Jun 15	May 15 - Jun 15	n/a
Landlocked salmon	Aug 1- Oct 31	Sep 15 - Oct 31	Sep 15 - Jun 15	May 15 - Jun 15	n/a
Lake Whitefish	Sep 1 - Oct 15	Sep 20 - Oct 30	Sep 20 - Jun 15	May 15 - Jun 15	n/a
Northern Pike	Apr 1 - Apr 15	Apr 15 - May 15	12-14 days	May 1 - May 30	n/a
Lake Trout	localized in lakes	Sep 1 - Oct 30	Oct 1 - Mar 15	Mar 15 - Apr 30	n/a
Source: Scruton et al. 1997.					

Sedimentation and siltation can be virtually eliminated during construction and operation, if proper mitigative steps are taken as discussed in Section 2.6. Current Canadian guidelines for suspended solids have been set by the Canadian Council of Resource and Environment Ministers (CCME 2001). Suspended solids should not increase by a level exceeding 10 mg/L when background suspended solids concentrations are equal to or less than 100 mg/L. Suspended solids should not increase by a level exceeding 10 percent of background concentrations when background concentrations are greater than 100 mg/L.

Sensitive habitats include spawning gravels, especially if they are at the site of construction, fording or immediately downstream. Eggs or alevins may be in the gravel between September to May of the following year. Eggs or alevins can be physically destroyed by fording activities or be displaced, becoming susceptible to predation or settling in less favourable habitat. Sediment that is mobilized during fording may settle on spawning habitat and cause smothering of eggs or alevins immediately downstream of the area of disturbance.

Clearing vegetation near riverbanks removes shaded habitat and increases bank erosion. Fish are sensitive to changes in water temperature (Kelsall et al. 1977). Shaded areas provide cooler temperatures during periods of warm, sunny weather. Any reduction in available spawning or rearing habitat or barriers to traditional spawning migrations routes could undermine the reproductive potential of the local stock.

Blasting can have physical and chemical effects on fish and fish habitat. Shock waves and vibrations from blasting can damage a fish's swim bladder and rupture internal organs, and may kill or damage fish eggs or alevins (Gosse et al. 1998; Wright and Hopky 1998). Blasting can cause resuspension of sediments (Munday et al. 1986), bank failure and resultant sedimentation, and habitat avoidance. Nitrogen-based explosives can affect aquatic life through direct toxicity of the compounds, reducing dissolved oxygen during nitrification and providing nutrients for aquatic plants. Nitrite is highly toxic to fish and can reduce the oxygen carrying capacity of blood; ammonia can cause gill damage and nitrate promotes algal growth. Pommen (1983) provides detailed information on the potential chemical effects of blasting. Guidelines for blasting near waterbodies, including specifications for blasting materials, their use, time of year and additional precautions, are outlined by DFO (Gosse et al. 1998; Wright and Hopky 1998).

Sulphide bearing rock may be encountered as a result of blasting and excavation along the highway route. Once exposed to the air, the sulphides may oxydize to produce acid rock drainage. This process is often accelerated by bacterial action on the exposed rock surfaces. The drainage from reactive rock surfaces will have a reduced pH, which may be detrimental to fish and aquatic fauna, particularly if the buffering capacity of local waters is low. The detrimental effects may be exacerbated by an elevation in dissolved metals such as arsenic, copper, aluminum, lead and zinc among others, which are often associated with sulphide bearing rock, and which will more readily dissolve at reduced pH. Once started, acid generation often accelerates and is difficult to stop at source.

There is ample literature on the potential effects of reduced pH and elevated metals on aquatic fauna, particularly in relation to the mining industry. Suffice it to say that as more parameters exceed the CCME Guidelines for the Protection of Aquatic Life (CCME 2001), the potential for harmful effects increase. Depending on the metal concentrations and the susceptibility or tolerance of specific fish or invertebrate species, the detrimental effects range from simple avoidance, to various degrees of impairment in reproduction, mobility and growth, to outright chronic or acute toxicity. Fortunately there are effective mitigations that will reduce the effects of acid rock drainage, and some of these are listed below, under geomorphology (Section 6.7) and water resources (Section 6.8). Unlike the mining industry, which is focusses on exploiting sulphide bearing mineralized rock, highway construction can detect and avoid the issue, wherever possible.

Hazardous materials spilled into the aquatic environment can contaminate food sources and fish eggs and alevins could be smothered (such as hydrocarbons), resulting in mortality. The nature and duration of these effects is dependent on the characteristics of the materials spilled and on-site specific factors such as species and life stages present, water temperature, wind conditions and water flow rates.

The introduction of liquid concrete products or wash residues into watercourses can destroy fish and aquatic plants due to sedimentation and changes in water chemistry (primarily pH). The control of deleterious discharges to waterbodies and the protection of fish habitat are covered under the federal *Fisheries Act* (Section 36(3)) and the operation of concrete batch plants are outlined in provincial guidelines (Department of Environment and Lands 1992).

The main concern with domestic sewage is the potential to increase nutrient loading, suspended sediment or introduce oil and grease or other contaminants into a watercourse. These introductions can lead to eutrophication of waterbodies, adverse sediment effects or water quality contamination.

Observations made in several studies describe the harmful effects of hydrocarbon contamination on aquatic life, including prevention of normal cell growth (Woodward et al. 1981; Tilseth et al. 1984). Levels of hydrocarbons above 10 ppm, water-soluble fraction, are toxic to fish but are not reached without vigorous mixing of the fuel and water. Invertebrates and developing fish eggs may be affected if located in shallow or turbulent water which is subjected to a fuel spill before any measurable dilution has occurred. There is little documentation concerning the effect of these contaminants on adult freshwater fish. Observations following the *Exxon Valdez* spill suggest that the Pacific salmon population in the area was not adversely affected by the presence of oil on the water surface (Baker et al. 1991). Although mortality may not result from exposure, these fish may experience some physiological stress when exposed to contaminants. Chronic and acute hydrocarbon contamination has been linked to tainting in fish flesh. In addition, the coating of the water surface by hydrocarbons could greatly reduce irradiance, and cause an effect upon levels of resident phytoplankton. This would reduce net primary productivity and affect water quality. The potential accumulation of hydrocarbons in stream sediment, with resulting re-mobilization at a later date or introduction into the food chain through the benthos, could prolong the duration of effects.

Several authors have reported that in the years following forest fires, sedimentation, alkalinity and temperature of streams and lakes in the area are increased, thereby slightly altering fish habitat in the affected area. However, the magnitude of change in these factors is dependent on the size of the burned area and the size and flow rate of affected streams. Smaller streams are probably more susceptible to habitat alteration as a result of fire than are large rivers (Kelsall et al. 1977).

Improperly installed culverts can impede fish migration either permanently or temporally. Complete barriers block the use of the upper watershed, which often provides the most productive spawning habitat. Fry produced in the upper portions of the watershed have access to the entire downstream watershed for rearing. Temporal barriers block migration some of the time and result in loss of production by the delay they cause (anadromous salmonids survive a limited amount of time in fresh water and a delay can cause limited distribution or mortality).

Some common conditions at culverts that create migration barriers include:

- excess drop at culvert outlet;
- high velocity within culvert barrel;
- inadequate depth within culvert barrel;
- turbulence within the culvert;
- debris accumulation at culvert inlet; and
- loss of flow beneath installed culvert (underflow).

Partial barriers block smaller or weaker fish of a population and limit the genetic diversity that is essential for a robust population. Fish passage criteria accommodate weaker individuals of target species including, in some cases, juvenile fish (WDFW 1999).

Culvert installations at a few locations along TLH - Phase II experienced water loss in the culvert, where most of the water flowed under the culvert barrel rather than through it, during low flow conditions. This was a result of the coarse fill used to embed the culvert pipe.

The issue of improved access leading to potential removal of excessive numbers of fish was addressed following the construction of TLH - Phase II by restrictions imposed by DFO on angling in the region. Restrictions were placed on brook trout fishing in two waterbodies (Gilbert Lake and Chateau Pond), which reduced the daily bag limit and possession limit. Modelled on the Indian Bay management plan, the restrictions were reduced season and bag limits on the recreational fishery. Other restrictions were placed on fishing in nine rivers (including Paradise River) that were designated as scheduled salmon rivers, with all of the regulations associated with that designation.

6.5.7 Mitigation

The WST is committed to minimizing adverse environmental effects of the project. Regulations, guidelines, codes of good practice, mitigation and environmental protection measures specifically related to the protection of fish and fish habitat are integral parts of the project description and environmental protection planning, and are outlined or detailed in Section 2.10 and include:

- watercourse crossing installation carried out in the dry by diverting or pumping water around the construction area;
- pipe arch culverts will be used on many streams;
- culverts will be countersunk where required to maintain a water depth in the pipe and to reduce any drop at the outlet;
- where the existing stream gradient warrants, baffles will be installed in the corresponding culverts to maintain a water depth to facilitate fish passage and to provide shelter from flow for smaller fish;
- all instream work will be carried out between June 30 and September 1, unless otherwise approved by DFO, to avoid sensitive periods for fish;
- fish will be removed from de-watered areas and returned unharmed to the watercourse;
- fording activities will be minimized or avoided, where possible;
- a 20-m buffer will be maintained along watercourses wherever possible ;
- riparian areas that must be disturbed will be stabilized to control erosion;
- during the clearing of the right-of-way, a temporary buffer zone will be left in place at each stream crossing until such time as the crossing is constructed;
- ARD potential will be investigated along the highway route to identify areas of potential acid generation and areas of acceptable source material and additional measures will be defined based on the results of the initial investigation;
- adherence to regulations, guidelines, codes of good practice;
- follow-up inspections verifying culvert installation and operation; and
- details provided in EPP.

There are no unique or extraordinary mitigation measures that apply to this project with regard to protecting fish and fish habitat.

Many of the potential adverse effects stem from the improved access provided by the highway, and the associated increase in human presence and activities in this previously remote area. Mitigating these potential effects, is for the most part, beyond the ability and responsibility of WST. Managing these actions and their potential effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented by the appropriate agencies in an effective and timely manner.

An example of mitigation that could be implemented by regulatory agencies to reduce the anticipated effects of the project, would be special recreational fishing regulations imposed on designated waterbodies in response to projected increases in angling effort. As noted above, this was done following the construction of TLH - Phase II. Paradise River was designated as a scheduled salmon river following the construction of TLH - Phase II, additional designations could be considered prior to the operation of TLH - Phase III.

6.5.8 Environmental Effects Assessment

The following sections discuss the environmental effects of the proposed project on fish and fish habitat for each project phase.

6.5.8.1 Construction

Construction may have localized effects on fish and fish habitat. Effects will be limited to one construction season at any given location. Both instream and near-stream activities conducted during construction may affect fish and fish habitat from the point of disturbance to some distance downstream. The migration season is the most sensitive time of year for many fish species. The consideration of environmental sensitivities during the design of the project, with subsequent built-in mitigative measures as well as adherence to WST's standard mitigative measures to be developed and included in the construction EPP will prevent or minimize any adverse effects. Also, WST's resident engineer or the ESO will ensure that the contractor complies with the EPP, and all permits, approvals and authorizations. WST also has the benefit of experience with the recently completed TLH - Phase II, which had similar challenges to those projected for TLH - Phase III.

Any sedimentation and siltation, noise from construction activities, and discharges or spills into watercourses, may harm fish and/or fish habitat. While mitigation measures will minimize sediment disturbance, it is likely that temporary sedimentation will result from the limited instream construction. However, any sedimentation will be within permitted levels. Instream work, which may cause avoidance by fish and/or damage to local aquatic habitat, will be limited to the approximate "footprint" of the bridge foundation and culvert structures. With the proper mitigative and environmental protection measures, effects of sedimentation and siltation will be further reduced and environmental effects will be localized.

The proposed highway has not been surveyed; therefore, specific requirements for blasting have not yet been defined. It is anticipated that there will be requirements for blasting during construction, but it is unlikely that underwater blasting will be required. As well, blasting will not be required at all watercourse crossings. Noise (shock waves) from blasting could cause local disturbance to fish, resulting in short-term avoidance. Effects of blasting near watercourses will be reduced by timing activity to avoid sensitive seasons and by implementing additional measures as outlined by DFO (Gosse et al. 1998; Wright and Hopky 1998). With the proper mitigative procedures, as proposed by WST, it is anticipated that the environmental effects from blasting will be localized and limited to select watercourse crossings.

The potential effects of acid generating rock can be greatly reduced by the identification of reactive rock sources. These areas may be avoided or the disturbance of such areas reduced to reduce the exposed rock surfaces (i.e., shallower cuts and careful control of waste). Drainage from such areas can be directed away from freshwater bodies to increase buffering of low pH. It is unlikely that actual treatment of drainage water (e.g., neutralization) would be required. With proper monitoring of the nature of source rock and excavated areas, and reasonable care of site drainage, the potential effects of ARD can be kept to a level that will not adversely affect fish and fish habitat.

Compliance with the existing provincial water and sewer regulations will ensure that adverse environmental effects from sewage are reduced to acceptable levels. WST is committed to ensuring that sewage and waste disposal for construction camps complies with the Department of Health guidelines and the *Environment Control (Water and Sewage) Regulations.*

Unless there is clear evidence that the stream where a culvert is to be located is not fish habitat, all watercourse crossings will be considered fish habitat and all structures will be designed and installed to provide fish passage. This will include proper siting and sizing of the culvert to ensure that water velocities are not excessive for any period of time beyond brief freshets. Many of the large culverts will be pipe arch culverts, to reduce the requirements for road fill (i.e., they have a lower profile with respect to capacity). Arch culverts provide a better range of flows for fish passage and often have substrate material settle in the culvert through bedload movement. Culverts will be adequately countersunk to maintain a minimum water depth in the culvert and avoid drops at the discharge end. Where required, baffles will be placed in culverts to provide cover and rest areas during fish passage and to provide adequate water depth for fish passage. These measures were applied with success in TLH - Phase II. One problem that did occur at a few locations along TLH - Phase II was the issue of water loss in the culvert during low flow conditions, where most of the water flowed under the culvert barrel rather than through it. This was primarily the result from using clean fill (blast rock) to embed the culvert - resulting in seepage through the rock fill. This will be rectified at the affected locations by sealing the inflow end with concrete. Measures will be taken to ensure the fill around culverts in TLH - Phase III is impermeable, to avoid water loss in the culvert. Gosse et al. (1998) provide DFO guidelines for proper culvert installation. WDFW (1999) also provide a comprehensive discussion on the issue of providing fish passage through culverts.

The permanent instream structures will include all culverts and bridges structures, where abutments are in the stream or pilings are placed for the three multi-span structures. These are not anticipated to cause destruction of productive fish habitat. In addition to these structures, there will be a partial causeway on the Churchill River, which will have a footprint of 25,000m^2. The existing foundation at the location of the proposed causeway is predominantly sand substrate. This substrate is not the most suitable habitat for spawning or rearing for any of the twenty species of fish reported in the lower Churchill River by Anderson (1985), particularly as most of the footprint area extends out into the river. The causeway will be constructed of clean rockfill with armour stone to protect the slopes from erosion. This texture will provide habitat and protection for some fish species.

6.5.8.2 Operation

Highway operation may affect fish populations (particularly salmonids) migrating to and from the upstream sections of the various watercourses. This effect will extend over the life of the highway. However, mitigative measures built into bridge and culvert design will reduce effects on migration. Regular inspection and maintenance will be conducted to avoid debris build-up or beaver workings in culvert inlets. Culverts will be kept free of blockages to avoid flooding and ensure that fish passage is not impeded.

Maintenance activities, such as grading and ice control, which will be limited to sand application, may also cause sediment to be deposited in the watercourses. Reasonable care in application of sand and controlling erosion from grading will reduce this effect substantially.

Improved access may lead to increased human presence around watercourses, in particular for fishing and cabin developments, if cabins are not specifically regulated, which may lead to increased disturbance in or near watercourses. Increased fishing pressure, either in compliance with all pertinent regulations, or in combination with increased potential poaching activities, will selectively remove reproductive adults from the localized fish populations. This in turn will reduce overall spawning activity and subsequent recruitment, to the detriment of the population. Recovery usually follows due either to a willful reduction in fishing effort based on low success rates, or due to resource management practices. Reversing the effects of ‘over-fishing’ may take some time, depending on the species and environmental circumstances.

Concern has been raised for the potential effects of airborne dust from highway operation on aquatic habitat and fish. Although this is a highly visible and possibly chronic phenomenon, the material that would be deposited in streams and ponds is mainly fine sediment. Accumulations of this material will be easily mobilized and flushed from the streams by high flows. The eventual fate will likely be ponds, lakes and other depositional areas as is the case for other suspended sediments.

6.5.8.3 Accidental Events

Fuel or chemical spills entering fish-bearing streams could temporarily degrade water quality and have subsequent effects on freshwater fish. In addition, contaminants can accumulate in sediments and be mobilized slowly over time. If a major spill of a highly toxic and soluble material were to occur at one of the watercourse crossings, the geographic extent would include both the crossing site and areas downstream in the watershed, potentially down to the mouth, depending on the quantity and toxicity of the material spilled. The time of year when effects would be most severe would be mid- to late September, through to hatch-out time for fry. Mortalities could potentially occur at all life stages of fish within the affected area. Changes in water quality could also affect other trophic levels, resulting in drift or direct mortalities of benthic organisms. Sublethal effects at the top and bottom of the affected area would include avoidance behaviour and disruption of migratory patterns. The extent of the effect would be dependent on the nature and volume of the material spilled. Again, the lack of detailed information on fish and fish habitat at each crossing location limits the ability to use these parameters in the context of an accidental event to evaluate alternatives.

The magnitude of the effect of a spill would be dependent on a number of factors, such as season, species, life stage. Reversibility of physical effects is high, due to the dynamic nature of lotic water systems and it, too, is dependent on species. The high spring flows and high bedload transport will effectively flush the system during the spring following the event. Insect populations would be replaced within a season or two; benthic drift from upper portions of the brook would re-establish other food resources. For resident fish populations, individuals from other portions of the watershed would re-establish within the affected area. For migratory fish populations, unaffected individuals of all age classes may be present in other areas of the watershed or may be at sea, depending on the time of the potential accidental event, allowing for re-establishment of these fish within the affected area over time. Migration runs of Atlantic salmon occur annually; therefore, re-establishment would probably increase the following fall.

Contingency procedures will be developed and included in the construction EPP to ensure that a fast and effective response will occur in the event of a spill.

The potential effects of a forest fire in the project area could be significant. A forest fire could alter water quality within streams, resulting in subsequent effects on the population of freshwater fish. Due to the limited number of available personnel during operation and the isolation of some areas, fire fighting capabilities would be limited. Fire within the project area could occur during any phase of the project due to lightning or human activities. Factors influencing the severity and duration of effects include time of year, extent of fire damage and type of fire (chemical, forest). Risk of forest fire is slightly higher than under natural conditions due to the presence of human activity along the highway route, which may be subsistence, recreational or commercial in nature.

A fire during late summer or early fall could interfere with migration and spawning of salmonid species if the interaction was of long duration. During early life stages (i.e., eggs, alevins), salmonids are more sensitive to the deposition of ash and sediment through runoff and have limited avoidance ability. Therefore, fires during the fall (spawning) and winter (incubation) present a greater risk to salmonid populations. Eggs are very sensitive to pH and temperature changes, thus a fire in the post-spawning period could result in high egg mortality. If the forest fire affects a large proportion of the stream and occurs during the late fall, the magnitude of the effect of such a fire would be moderate for salmonids. Reversibility of physical effects is high, but would occur over a number of years. Spring flows and high bedload transport will effectively flush the system during the spring following the event; however, erosion within the watershed would continue to contribute sediments to the stream system for a number of years. Changes to groundwater patterns and contribution to baseflow in the stream may be altered during this period due to changes in evaporation and infiltration rates. Restoration of bank stability and cool temperatures would rely on the re-establishment of riparian plant communities through vegetative succession.

As well, a temporary degradation of water quality due to increased sedimentation and culvert or concrete debris would occur in the event of highway failure or washout. This could have a subsequent effects on freshwater fish. Factors influencing the geographic extent, duration and magnitude of effects include time of year, and location in watershed. The extent of the effects of such a highway failure or washout on fish is predicted to be low due to the localized nature of the watercourse crossings and the normally limited amount of material that is available to be mobilized or displaced in a washout. Reversibility is high due to the dynamic nature of streams, high spring discharges and high spring bedload transportation.

Roads are most susceptible to washouts during the high flow period during and immediately following the spring snow melt. The highway design will focus on protection of the aquatic environment by incorporating buffer zones, drainage and erosion control features and very conservative culvert design criteria. Culverts will be installed with consideration for highway and stream gradient, ice conditions, bank stability and, where warranted, protection of fish habitat.

6.5.9 Environmental Effects Evaluation

Criteria for rating the significance of environmental effects on fish and fish habitat are population-based and were modified for this study after Conover et al. (1985). A population is defined as *a group of organisms of the same species occupying a particular area at the same time* (Curtis 1975). Fish populations under assessment are mainly resident and anadromous salmonid (brook trout and Atlantic salmon) stocks as well as other species of the five watersheds, through which the proposed TLH - Phase III will cross. The populations (or stocks) under assessment extend throughout the wider region, beyond that bound by the study area. Residual environmental effects on fish populations associated with construction, operation and accidental events are summarized in Table 6.25.

The following definitions are used to rate the significance of the predicted residual environmental effects of the project on fish and fish habitat.

A **major (significant) effect** is one affecting a whole stock or population of a species in one of the watersheds in such a way as to cause a change in abundance and/or distribution beyond which natural recruitment (reproduction and in-migration from unaffected areas) would not return that population, or any populations or species dependent upon it, to its former level within several generations. A residual environmental effect on fish habitat that has the same consequence for populations would also be a major residual environmental effect. Generally a major significant effect is not reversible.

A **moderate (significant) effect** is one affecting a portion of a population in one of the watersheds that results in a change in abundance and or distribution over one or more generations of that portion of the population, or any populations or species dependent upon it, but does not change the integrity of any population as a whole; it may be localized. A change in fish habitat (including food sources) that produces the same result in populations would also be assessed as a moderate effect. A moderate significant effect may or may not be reversible.

A **minor (not significant) effect** is one affecting a specific group of individuals in a population in one of the watersheds at a localized area and/or over a short period (one generation or less), but not affecting other trophic levels or the integrity of the population itself. As above, equivalent population environmental effects ratings are assigned to environmental effects on fish habitat. A minor effect is reversible.

A **negligible (not significant) effect** is one affecting the population or a specific group of individuals at a localized area and/or over a short period in such a way as to be similar in effect to small random changes in the population due to natural irregularities, but having no measurable environmental effect on the population as a whole.

Table 6.25 Environmental Effects Summary - Fish and Fish Habitat

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • watercourse crossing installation carried out in the dry by diverting or pumping water around the construction area; • all instream work will be carried out between June 30 and September 1, unless otherwise approved by DFO, to avoid sensitive periods for fish; • bedrock geology examined for ARD potential, confirmatory sampling will be conducted; • fish removed from de-watered areas will be returned unharmed to the watercourse; • fording activities will be minimized or avoided, where possible; • culverts will be sized and installed to maintain water depth, maintain moderate flow rates and avoid outlet drops; • where necessary, baffles will be installed in culverts to ensure fish passage and protection • adherence to regulations, guidelines, codes of good practice; and • details provided in EPP.			
Environmental Effects Criteria Ratings			
Magnitude	Nil - Low	Nil - Low	Low- High
Geographic Extent	1-10 km^2	1-10 km^2	11-100 km^2
Frequency (times per year)	< 10	< 10	< 10
Duration (months)	< 1	< 1	37632
Reversibility	High	High	Moderate
Ecological/Socio-economic Context	May affect resource use and users, and tourism and recreation VECs	May affect resource use and users, and tourism and recreation VECs	May affect resource use and users, and tourism and recreation VECs
Environmental Effects Evaluation			
Significance	Not Significant (Minor)	Not Significant (Minor)	Significant (Moderate)
Level of Confidence	High	High	Moderate
Likelihood[1]	n/a	n/a	Low
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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: • Resident engineer or the ESO will be on-site during highway and watercourse crossing construction. • Regular monitoring along highway route evaluating flow, erosion, debris and sedimentation at watercourse crossings. • Regular monitoring of public use of highway including accidents, spills and waste disposal.			

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

6.5.9.1 Construction

Construction of the TLH - Phase III will have minor (not significant) environmental effects. Effective mitigation and environmental measures will minimize effects during highway construction. The duration of any potential adverse effects on fish and fish habitat is limited to one construction season at any location.

6.5.9.2 Operation

Highway operation will have minor (not significant) environmental effects. The duration of the effect could be indefinite, as it would exist throughout the operation phase; the frequency reflects various maintenance schedules and natural perturbations. Again, knowledge and understanding of the potential effects of project operation on fish is reasonably high.

6.5.9.3 Accidental Events

Accidental events would have a moderate (significant) environmental effect if these events occur. Due to the uncontrollable and unpredictable nature of events such as forest fires, and hazardous spills, potential exists for these events to occur. WST will implement mitigative measures to minimize the risk of these events occurring. However, accidental events (including hazardous materials spills, fires, and flooding/road washout) cannot be eliminated. Based on the environmental effects analysis, a worst-case accidental event would result in an adverse and moderate effect on fish and fish habitat. The likelihood of such events occurring is very low given the construction and design standards, and operating and maintenance procedures to be followed and routine monitoring. Reversibility is moderate.

6.5.10 Cumulative Environmental Effects

The potential environmental effects of the construction and operation of TLH - Phase III on fish and fish habitat have been discussed in the preceding sections. Past and on-going development activity in the project area has been relatively limited. Fish resources in the region have been affected by resident and non-resident angling in the area, although the intensity and distribution of the recreational fishery in the area has been limited due to the relative inaccessibility of the project area to date. Fish populations are considered to be relatively stable at present, although the actual status of the stocks are poorly known.

Although there is some potential for direct interaction between the potential effects of the proposed highway on fish and fish habitat in combination with those of Phases I and II of the TLH, this would be largely limited to watersheds at the ends of the proposed new highway section (i.e., Paradise River and Churchill River). The effects to fish and fish habitat in the lower portion of the Churchill River by other past and on-going activities include the Churchill Falls project and various developments along the river. Potential new effects of the proposed Churchill River project would focus on Gull Island; some distance upstream from Muskrat Falls, which is the limit to fish migration past the proposed Churchill River crossing of the TLH - Phase III. However, for the most part, fish and fish habitat along most of the proposed highway route have been largely unaffected by human activity. Other past, on-going and potential projects and activities elsewhere in Labrador such as the Voisey's Bay Mine/Mill have not or will not have an effect on fish populations which occur within the proposed project area. There is little potential for interaction between the effects of these actions and those of the proposed project.

The new highway will provide increased and year-round access to this previously remote area. As discussed previously, this will likely result in an increase in angling activity throughout the region, particularly in ponds and rivers which are in close proximity to the highway. The highway will also facilitate future resource development such as forestry, mineral exploration, cabin development, and other land and resource use activities which have the potential to affect fish and fish habitat. The various projects and activities which may be induced by the proposed highway are regulated under provincial and federal legislation and as such, there are measures available to assess and mitigate their potential adverse environmental effects. Forestry guidelines, for example, stipulate that a minimum 20 m (but more likely a larger) vegetation buffer be maintained along waterbodies during forest harvesting. This would provide a measure of protection to fish and fish habitat. These potential projects and activities will proceed only in compliance with applicable regulations, and many would themselves be subject to environmental assessment.

Details such as the likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known and the control of most potential induced actions and related effects is beyond the ability and responsibility of WST. Control depends on appropriate enforcement, management and planning on the part of relevant regulatory agencies to ensure that any such effects are avoided or reduced. As a result, a number of assumptions have been made in considering induced actions in the cumulative effects assessment, 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.

With the implementation of these mitigation measures, particularly appropriate planning and enforcement, the proposed project is not likely to result in significant adverse cumulative effects to fish and fish habitat in combination with other projects and activities that have been or will be carried out.

The creation of the Akamiuapishku/Mealy Mountains National Park would provide increased protection to fish resources in the area by placing portions of the route under rigorous constraints with regard to angling, other resource harvesting, highway construction, and the use of motorized vehicles.

6.5.11 Environmental Monitoring and Follow-up

A resident engineer or the Environmental Surveillance Officer will be present during construction of all watercourse crossings to ensure proper bridge and culvert installation and proper sediment control techniques are used. DFO will be consulted throughout construction to ensure that bridges and culverts are installed according to agreed specifications. In addition, watercourse crossings and runoff from the highway will be monitored after construction to ensure that erosion and sedimentation are minimized and culverts do not become blocked.

Also, all bridges and culverts will be monitored during the spring runoff after construction to ensure that culvert and bridges along the route can adequately handle the large amount of water runoff during this time of the year. As an example of this, follow-up monitoring of the TLH - Phase II culvert installations will be conducted in 2003 to determine which culverts need to be adjusted or if necessary replaced.

Regular monitoring will occur throughout operation, including a review of garbage disposal practices, requirements for washroom facilities, potential accidents and spills, culvert blockages and forest fire hazards.

Commencing in the summer of 2003, WST and the Inland Fish and Wildlife Division will implement a monitoring program designed to collect information on fish populations in affected watersheds. The study will provide baseline data for assessing the long-term effects of improved access on fish populations and it will support the development of management strategies to conserve fish populations if/when they become necessary. The study will be conducted over a 10 year period and will include data from the construction and operational phases of the TLH-Phase III. WST and the Inland Fish and Wildlife Division are seeking other partners for this work, which would permit an expanded focus. The results of this monitoring program will greatly enhance the database on existing conditions and provide information that will verify the assumptions made in this assessment.

6.6 Species at Risk

The species at risk considered for this assessment are short-eared owl and harlequin duck. Short-eared owl and harlequin duck were chosen because they are listed as a species of special concern under COSEWIC and under the provincial *Endangered Species Act*. Short-eared owls are known to occur within the project region and while there are no records of harlequin ducks breeding in the project region, the species has been documented breeding to the west and some individuals may make seasonal use the area during migration.

Woodland caribou, specifically the MMCH, are considered threatened under COSEWIC and under provincial endangered species legislation. A detailed effects analysis for the MMCH is provided in Section 6.3. Therefore, this species is not considered in this section.

Other species at risk such as Barrow's goldeneye, peregrine falcon, eskimo curlew and wolverine are not likely to occur within the project region and are not specifically considered in this section. Refer to Section 6.2 for information on Barrow's goldeneye and eskimo curlew. Refer to Section 6.1 for information on peregrine falcon and Section 6.4 for information on wolverine.

6.6.1 Boundaries

Project boundaries for species at risk are defined by the spatial and temporal extent of project activities and the anticipated zones of influence in the area surrounding the proposed highway route. This boundary for short-eared owl is a 2-km wide corridor centered on the highway. For harlequin ducks, the boundary is 10 km on either side of watercourse crossings on rivers determined to be potential habitat.

Both bird species are migratory; therefore, temporal boundaries extend from May through October. Both species are generally widespread and only a small proportion of their populations are likely to be located at any one time within the project area.

The federal and provincial governments are responsible for management of both harlequin duck and short-eared owl through designation under COSEWIC and the provincial *Endangered Species Act*, respectively. Current legislation and agreements regarding harlequin ducks include the *Migratory Birds Convention (1916), Migratory Birds Convention Act* and the *North American Waterfowl Management Plan* (CWS and USFWS 1986; CWS, USFWS and SEMARNAP 1998). Raptors in Newfoundland and Labrador are managed under the provincial *Wildlife Act*.

The spatial environmental assessment boundary for short-eared owl and harlequin duck is defined as the range of the populations of these species which may occur in the project region. Predictions of environmental effects will be made for the eastern North American population of harlequin duck and the Atlantic Canadian population of short-eared owl.

6.6.2 Methods

Numerous surveys have been conducted for harlequin ducks within the project region, including five aerial surveys conducted by the study team between early May and late August 2002 in support of this EIS (JW and LMSS 2003b). As a result, there is sufficient baseline information available for undertaking the effects analysis for harlequin ducks.

The effects analysis for short-eared owls relies on available literature (including published and unpublished sources), as well as observations made during aerial surveys for waterfowl and raptors.

6.6.3 Existing Environment

6.6.3.1 Short-eared Owl

The short-eared owl is an open ground hunter whose main prey is small mammals. The owl inhabits relatively open habitats such as marshes and tundra and is nomadic, covering extensive areas within its winter and summer range. The short-eared owl breeds or winters in North, South and Central America, Europe, Asia and Africa (Environment Canada 2002b). In Canada, this species breeds in every province and territory, withdrawing from the northern parts of its range and remaining only in the southern parts of provinces in winter. The species was listed by COSEWIC due to concerns related to destruction of marshes and native grasslands in western and central Canada. The fact that these owls are ground nesters has contributed to their decline in western Canada, as they are exposed to predators and farm machinery. Similarly, they are attracted to the open areas associated with airports and are vulnerable to collisions with aircraft (Environment Canada 2002b). However, populations in Newfoundland and Labrador and the Maritimes have remained stable (Environment Canada 2002b). Short-eared owls are found at low densities throughout their range; exact numbers are not known.

During a waterfowl survey on June 2, 2002, one short-eared owl was observed flying over an area of open wetland complexes approximately 30 km west of Cartwright Junction (see Figure 6.1 in Section 6.1). Refer to Section 6.1 and the Raptor Component Study (JW and LMSS 2003a) for further information on short-eared owls.

6.6.3.2 Harlequin Duck

Harlequin ducks have not been observed to breed in the project region. However, individuals may use the area during migration. The current estimate of the eastern North America wintering population is approximately 1,500 birds (Robertson and Goudie 1999) and 6,200 moulting harlequin ducks were counted along the western coast of Greenland during surveys in 1999 (Boertmann and Mosbech, cited in CWS 2000). Refer to Section 6.2 and the Waterfowl Component Study (JW and LMSS 2003b) for further discussion on harlequin duck.

The harlequin duck is a relatively uncommon seaduck which is unique among waterfowl because of its discontinuous distribution and its preference for breeding along fast moving streams (Dzinbal 1982). The breeding distribution of the eastern North American population includes southern Baffin Island, western Greenland, Ungava Bay, northern and central Labrador, the Gaspé Peninsula, Hudson Bay, James Bay, and western and southeastern Newfoundland (Montevecchi et al. 1995; Thomas and Robert 2000). Harlequin ducks moult along the coast of Greenland, although it is not known what proportion of this population breeds in North America. Moulting also occurs along the coast of Newfoundland and Labrador, and Québec (Thomas and Robert 2000). Wintering occurs in Greenland, the south coast of Newfoundland, the Atlantic Ocean and Bay of Fundy coasts of Nova Scotia and New Brunswick, and in Maine (Thomas and Robert 2000).

Breeding habitat is generally shallow, fast-flowing streams with suitable shoreline vegetation for nesting. Some successful nesting females will move broods into slower waters (Cassirer and Groves 1994), although this is not the case in all circumstances. Wintering habitat tends to be close to shore along exposed headlands and archipelagos. Migration and wintering habitat are similar (Robertson and Goudie 1999).

6.6.4 Potential Interactions

During construction, the clearing of vegetation may result in the loss of nesting habitat for short-eared owl. Noise and general disturbance including use of lights, blasting activities and vehicular movement during construction of the highway may also disturb nesting or foraging short-eared owl. During operation, noise and regular vehicular activity may also cause disturbance, resulting in avoidance of habitat in the vicinity of the highway. Fire could destroy nesting and foraging habitat for short-eared owls. Collisions with vehicles may cause mortality to short-eared owls.

While harlequin ducks are not known to breed in the project region, potential interactions are discussed pursuant to Guideline requirements. Removal of riparian habitat at watercourse crossings may result in loss of nesting habitat for harlequin duck. Noise and general disturbance including use of lights, blasting activities and vehicular movement, during construction of the highway and at watercourse crossings, may also disturb nesting or foraging harlequin ducks. Contamination of waterbodies resulting from spills of fuel or other hazardous materials or siltation could lead to oiling of harlequin ducks, as well as reduced foraging opportunities. Fire could destroy nesting habitat for harlequin ducks.

6.6.5 Issues and Concerns

Issue and concerns related to short-eared owls include:

- loss of nesting and foraging habitat due to vegetation removal;
- avoidance of habitat due to project-related disturbances (i.e., noise);
- loss of nesting and foraging habitat through fire; and
- mortality through vehicle collisions.

Issue and concerns related to harlequin duck (if they did occur in the project region) include:

- avoidance of habitat due to project-related disturbances (i.e., noise);
- removal of riparian nesting habitat at watercourse crossings;
- siltation from upstream construction activities that negatively impact invertebrate forage;
- alteration of nesting habitat as a result of fire; and
- mortality or lost foraging opportunities through spills of fuel or other hazardous materials.

6.6.6 Existing Knowledge

6.6.6.1 Short-eared Owl

There is little specific research with respect to the effects of roads on short-eared owls. However, studies done on other diurnal, open-ground species is applicable. Raptors will usually avoid areas of human presence and activity (Stalmaster 1987; Nelson 1979). However, there have been some reports of raptors continuing normal activities in areas of construction or human disturbance (reviewed in Nelson 1979).

A study that looked at flushing responses and flush distances of several diurnal raptor species found that walking disturbances resulted in more flushes by American kestrel, merlin and rough-legged hawks than vehicle disturbances (Holmes et al. 1993). Merlins perched along paved roads had shorter flush distances to walking disturbances than did individuals perched along gravel roads and rough-legged hawks perched nearer to the road flushed at greater distances than those farther away (Holmes et al. 1993).

Raptors may experience mortality on roads, particularly if the road is traversing open country. The openness of the landscape and the lack of tall vegetation, particularly along the roadside, may cause raptors hunting in these open areas to see a flat landscape into which the road merges (Harding 1986). For example, in Britain, over a four-month period, 12 short-eared owls were killed along an 8 km long busy trunk road that passed through a large marsh area (Harding 1986). Refer to Section 6.1 for further details on the effects of disturbance and highways on raptors.

6.6.6.2 Harlequin Duck

While there is little research with respect to effects of roads on harlequin ducks, studies have been conducted on the effects of human disturbance. Human activities along the banks of rivers where harlequin ducks nest may adversely affect breeding success. While the species is tolerant of moderate disturbance, chronically disturbed areas may eventually be abandoned (Thomas and Robert 2000). In areas where recreational fishing occurs, harlequin ducks may be disturbed as fishermen may remain in an area for extended periods of time (Thomas and Robert 2000).

Behavioural investigations of harlequin ducks in western Canada found that during white-water rafting activities, the ducks spent less of their loafing time sleeping and more time just resting, as they had to remain vigilant to avoid disturbances. The ducks also showed a measurable shift in habitat use within the area once rafting began (Hunt 1995). Refer to Section 6.2 for further details on the effects of disturbance and highways on waterfowl.

6.6.7 Mitigation

WST is proposing to reduce the project's potential effects on short-eared owls and harlequin ducks through project design and planning. Specific mitigative measures for short-eared owl include the following:

- notification of Inland Fish and Wildlife Division if an active nest is encountered;
- minimization of vegetation removal to a maximum of 30 m within the right-of-way;
- drainage to and through wetlands will be maintained to ensure continued wetland function;
- blasting activities timed to avoid sensitive areas such as active nest sites;
- construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding wetland areas wherever possible;
- no harassment of raptors (including short-eared owl) by project personnel;
- locations of raptors nests (including short-eared owl) will not be released to the public;
- WST will confer with Inland Fish and Wildlife Division on appropriate mitigations for all active short-eared owl nests found within 800 m of the highway; and
- vehicles will adhere to established speed limits and will yield to all wildlife.

Although harlequin ducks are not known to breed in the project region, WST is proposing the following specific mitigative measures:

- blasting activities coordinated to avoid sensitive areas such as incubation and early brood rearing areas;
- reduction or avoidance of in-stream activity;
- the highway right-of-way will be located a minimum of 20 m from the shoreline of waterbodies, where possible;
- construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding riparian areas wherever possible;
- use of accepted practices for erosion control or slope stabilization;
- removal of riparian vegetation will be restricted to that required construction of watercourse crossings;
- re-vegetation activities will use only native species;
- construction camps will be located outside of riparian zones; and
- design and implementation of fuel and other hazardous material spill contingency plans and emergency response in the event of an accident.

Many of the potential adverse effects of the project stem from the improved access provided by the highway, and the associated increase in human presence and activities in this previously remote area. Mitigating these potential effects is, for the most part, beyond the ability and responsibility of WST. Managing these actions and their potential effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented by the appropriate agencies in an effective and timely manner.

6.6.8 Environmental Effects Assessment

6.6.8.1 Construction

Short-eared Owl

There will be some loss of potential foraging and nesting habitat for short-eared owls through vegetation removal along the highway right-of-way. The amount of wetland or otherwise unforested area that will be removed is approximately 230 ha. However, the open habitat types (i.e., bogs, fens, swamps, heath) that will be affected by construction are not considered unique within the region, and are well represented in the surrounding area. There is abundant open habitat in the region and the vast majority of this habitat will remain undisturbed by project construction.

Noise and human disturbance during construction may cause short-eared owls to avoid habitat in the vicinity of the activity. Individuals may be particularly sensitive during the nesting and brood-rearing period from mid-May through mid-August. With the maintenance of an 800 m buffer of no activity around any active raptor nests, it is likely that disturbance effects from construction will be primarily an avoidance of potential foraging habitat in the area of disturbance.

Harlequin Duck

While harlequin ducks are not known to breed in the project region, a discussion of the potential effects of the project is presented here.

During construction, a minimum of 20 m of vegetation will be retained around all waterbodies that are adjacent to the highway route, where possible. In most areas, this amount of buffer will encompass the entire riparian zone around lakes and rivers, thereby ensuring that riparian habitat (potential harlequin duck habitat) function is maintained and there will be minimal disturbance to any harlequin duck that may be using habitat in the area of construction. At each highway water crossing, a maximum of 60 linear m of riparian habitat will be removed (30 m on either side of the crossing). Assuming a 20 m riparian zone width and a total of 95 watercourse crossings, this means that a maximum of approximately 8.55 ha of riparian habitat will be removed along the entire highway route. On any one body of water with a highway crossing, a maximum of 0.09 ha will be removed. Due to the large number of rivers, streams and lakes, there is abundant riparian habitat available in the region, of which the vast majority will remain undisturbed.

There are no documented occurrences of harlequin duck within the project region. Therefore, the likelihood of individuals of the Labrador population being negatively affected by construction of the highway is negligible.

6.6.8.2 Operation

Short-eared Owl

There will be no further loss of habitat during operation. An alteration of foraging patterns may result once the highway is in operation. However, a car moving along the highway without stopping would not likely be perceived as a threat to foraging short-eared owls in the vicinity, and the effect would be not significant. In the event of disturbance due to human presence, effects would be localized and short in duration.

Harlequin Duck

There are no documented occurrences of harlequin duck within the project region. No additional riparian habitat will be removed during operation. The maintenance of a minimum 20-m vegetation buffer between the highway and adjacent waterbodies, where possible, will limit the effects of highway-related disturbance on harlequin duck.

6.6.8.3 Accidental and/or Unplanned Events

Short-eared Owl

A forest fire could destroy nesting and foraging habitat for short-eared owls. A large fire may destroy hundreds of hectares of vegetation, which could result in a decrease in densities within the region affected. However, short-eared owls living in the boreal ecosystem have adapted to a cycle of naturally occurring fires and the proportion of a population affected during any one fire would be small. In fact, regeneration of burned areas will provide increased foraging opportunities as small mammal populations rec-colonize these areas. While open ground hunters such as short-eared owls are at greatest risk for vehicle collisions, due to the low density of the species in the region and the low volume of traffic expected along the highway, there is likely to be little mortality of individuals.

Harlequin Duck

An accidental spill of fuel or other hazardous materials into waterbodies or in riparian zones in the project area could cause mortality to harlequin ducks. Contamination of waterbodies could result in reduced foraging opportunities that influence survival and reproductive success. As noted above, the maintenance of a minimum 20-m vegetation buffer, where possible will provide a measure of protection to riparian habitat, should there be an accidental event such as a fuel or other hazardous material spill in the highway right-of-way. A forest fire could destroy nesting habitat for harlequin ducks. However, this species has adapted to breeding in the boreal ecosystem where fires naturally occur on a regular basis and the proportion of the population affected during any one fire would be small. Also, as noted above, there are no documented occurrences of harlequin duck within the project area.

A summary of the environmental effects associated with each project phase is presented in Section 6.6.9.

6.6.9 Environmental Effects Evaluation

The key potential interactions between project activities and species as risk such as harlequin duck and short-eared owl include direct disturbance and habitat loss. The following definitions are used to rate the significance of the predicted residual environmental effects of the project on species at risk:

A **major (significant) environmental effect** is one affecting the population of harlequin duck or short-eared owl in such a way as to cause a change in abundance and/or distribution beyond which natural recruitment (reproduction and in migration from unaffected areas) would not return that population, or any populations or species dependent upon it, to its pre-project level within several generations. The effect is not reversible.

A **moderate (significant) environmental effect** is one affecting a portion of the population of harlequin duck or short-eared owl in such a way as to cause a change in the abundance and/or distribution of that portion of the population or any populations or species dependent upon it over one or more generations, but does not change the integrity of any population as a whole. The effect may not be reversible.

A **minor (not significant) environmental effect** is one affecting a specific group of individuals of the population of harlequin ducks or short-eared owl in such a way as to cause a change in abundance and/or distribution in a localized area and/or over a short period (one generation or less), but not affecting other trophic levels or the integrity of the population itself. The effect is reversible.

A **negligible (not significant) environmental effect** is one affecting a specific group of individuals of the population of harlequin duck or short-eared owl in such a way as to cause a change in abundance and/or distribution in a localized area and/or over a short period (one generation or less) in a manner similar to small random changes in the population due to natural irregularities, but having no measurable effect on the population as a whole. The effect is reversible.

The proposed highway is a linear development that will avoid wetland areas, where possible, and will maintain a 20-m buffer of vegetation around waterbodies. Therefore, interactions between highway effects and harlequin duck or short-eared owl will be reduced. For both species, the environmental effects will be restricted to removal of habitat in the immediate highway corridor and potential noise disturbance during highway operation. Based on the preceding discussion and proposed mitigations, the residual effects of the project on short-eared owl and harlequin duck are assessed as minor (not significant) for construction and operation (Tables 6.26 and 6.27). The residual effects of an accidental event on both species is also considered minor (Tables 6.26 and 6.27). Overall, the project is not likely to result in significant adverse environmental effects on short-eared owl or harlequin duck.

Table 6.26 Environmental Effects Summary - Short-eared Owl

<table>
<tr><th></th><th>Construction</th><th>Operation</th><th>Accidental/Unplanned Events</th></tr>
<tr><td colspan="4">Mitigation:
• notification of Inland Fish and Wildlife Division if an active nest is encountered;
• minimization of vegetation removal to a maximum of 30 m within the right-of-way;
• drainage to and through wetlands will be maintained to ensure continued wetland function;
• blasting activities coordinated to avoid sensitive areas such as active nest sites;
• construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding wetland areas wherever possible;
• no harassment of raptors (including short-eared owl) by project personnel;
• locations of raptors nests (including short-eared owl) will not be released to the public;
• WST will confer with Inland Fish and Wildlife Division on appropriate mitigations for all active short-eared owl nests found within 800 m of the highway; and
• vehicles will adhere to established speed limits and will yield to all wildlife.</td></tr>
<tr><td colspan="4">Environmental Effects Criteria Ratings</td></tr>
<tr><td>Magnitude</td><td>Low</td><td>Low</td><td>Unknown</td></tr>
<tr><td>Geographic Extent</td><td><1 km^2</td><td>1-10 km^2</td><td>100 km^2</td></tr>
<tr><td>Frequency</td><td>Continuous</td><td>Continuous</td><td><10</td></tr>
<tr><td>Duration</td><td>72</td><td>>72</td><td>>72</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td><td>Irreversible</td><td>Unknown</td></tr>
<tr><td>Ecological/Socio-economic Context</td><td colspan="3">Low</td></tr>
<tr><td colspan="4">Environmental Effects Evaluation</td></tr>
<tr><td>Significance</td><td>Not Significant (Minor)</td><td>Not Significant (Minor)</td><td>Not Significant (Minor)</td></tr>
<tr><td>Level of Confidence</td><td>High</td><td>High</td><td>High</td></tr>
<tr><td>Likelihood[1]</td><td>n/a</td><td>n/a</td><td>n/a</td></tr>
<tr><td>Sustainable Use of Resources[1]</td><td>n/a</td><td>n/a</td><td>n/a</td></tr>
<tr><td colspan="4">[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).</td></tr>
<tr><td colspan="4">Environmental Monitoring and Follow-up:
No monitoring has been identified</td></tr>
<tr><td colspan="4">Key:

Magnitude: High, Medium, Low, Nil or Unknown
Geographic Extent (km^2): <1, 1-10, 11-100, 101-1000, 1001-10,000, >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</td></tr>
</table>

Table 6.27 Environmental Effects Summary - Harlequin Duck

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • blasting activities coordinated to avoid sensitive areas such as incubation and early brood rearing areas; • reduction or avoidance of in-stream activity; • the highway right-of-way will be located a minimum of 20 m from the shoreline of waterbodies, where possible; • construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding riparian areas wherever possible; • use of accepted practices for erosion control or slope stabilization; • removal of riparian vegetation will be restricted to that required construction of watercourse crossings; • re-vegetation activities will use only native species; • construction camps will be located outside of riparian zones; and • design and implementation of fuel and other hazardous material spill contingency plans and emergency response in the event of an accident.			
Environmental Effects Criteria Ratings			
Magnitude	Low	Low	Unknown
Geographic Extent	<1 km^2	1-10 km^2	100 km^2
Frequency	Continuous	Continuous	<10
Duration	72	>72	>72
Reversibility	Irreversible	Irreversible	Unknown
Ecological/Socio-economic Context	Low		
Environmental Effects Evaluation			
Significance	Not Significant (Minor)	Not Significant (Minor)	Not Significant (Minor)
Level of Confidence	High	High	High
Likelihood[1]	n/a	n/a	n/a
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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: No monitoring has been identified			
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			

6.6.10 Cumulative Environmental Effects

Angling, hunting and trapping have been ongoing in the project region for many years, although these activities tend to be localized and of short duration at any given time. Low-level flying of military aircraft has been occurring in the region since the 1980s. A portion (approximately 92 km) of the proposed highway route would occur within the existing LLTA. The existing sections of the TLH represent habitat loss and disturbance to short-eared owls in Labrador. Similarly, the development of the Voisey's Bay Mine/Mill project will also result in habitat loss and disturbance to this species. The Voisey's Bay Mine/Mill project will also result in habitat loss for harlequin duck in the North Tailings Basin area (VBEAP 1999). As well, potential hydroelectric development will have an effect on harlequin duck. Snowmobile trails are also found throughout the region. However, neither harlequin ducks or short-eared owls are likely to interact with this activity, as both species winter south of Labrador.

In addition to these local activities, harlequin duck may be affected by a range of activities and associated disturbances within their wintering habitat, particularly marine pollution. The extent to which these factors influence the Labrador population of harlequin ducks is unknown. However, key harlequin duck wintering areas in Atlantic Canada largely overlap with major shipping routes and areas of known oil spills (Thomas and Robert 2000). As large proportions of the eastern North American population concentrate in these areas, an oil spill could have population-wide effects.

The most important development activity that may occur following highway construction is commercial forestry. However, forestry guidelines stipulate that a minimum 20 m vegetation buffer be maintained along waterbodies following forest harvesting. This would provide a measure of protection to nesting and foraging habitat of harlequin duck. As short-eared owls are associated with open areas, forestry activity will have a negligible effect on them. Other land and resource activities, such as mineral exploration, hunting and angling, may also increase due to enhanced access provided by the proposed highway causing disturbance to species at risk. Travel through riparian zones is likely to increase in order to access waterbodies from the highway. Cabin development along the highway may also occur, creating areas of permanent human disturbance that may cause further alteration to riparian habitat in the area. Increased activity in the riparian zone could cause disturbance to breeding harlequin ducks. Legislation and regulations are in place to control these activities and their potential environmental effects.

Similarly, short-eared owls winter in the southern regions of Canada and into the United States, where they are exposed to vegetation clearing, pesticides and other pollution. The extent to which these factors influence the Labrador population of short-eared owl and, particularly, those which use the project area, is unknown. However, extensive development and human activity on wintering grounds is considered to be an important influence on migratory raptor populations.

Details such as the likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known and the control of most potential induced actions and their related effects are beyond the jurisdiction of WST. Control depends on appropriate enforcement, and management and planning on the part of relevant regulatory agencies. As a result, a number of assumptions have been made in 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;
- the level of 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.

The proposed Akamiuapishku/Mealy Mountains National Park would encompass approximately half of the highway route. The creation of this park would afford protection to riparian habitat from future activities such as cabin development and forest harvesting.

With the implementation of these mitigation measures, particularly appropriate planning and enforcement, the proposed project is not likely to result in significant adverse cumulative environmental effects on species at risk in combination with other projects and activities that have been or will be carried out.

6.6.11 Environmental Monitoring and Follow-up

Although no dedicated monitoring is identified for this VEC, the Inland Fish and Wildlife Division will be notified in the event of encounters with active short-eared owl nests. CWS will be notified in the event of any harlequin duck observations.

6.7 Geomorphology

Geomorphology encompasses a broad spectrum of surficial materials and landforms that result from the ongoing natural processes that shape the earth's surface.

6.7.1 Boundaries.

The project boundary is the 40m right-of-way and associated areas of physical disturbance. Although geomorphological features are not managed resources with an associated mandated regulatory agency, mineral or aggregate deposits that may be mined or quarried are administered by the Department of Mines and Energy.

The area within which the environmental effects predictions are made is the highway right-of-way.

6.7.2 Methods

Information on the surficial materials, formed and shaped by geomorphological processes, is available on 1:250,000 scale surficial mapping prepared during the late 1960s and early 1970s by provincial and federal government geologists (i.e., Fulton et al.1969; 1970). Using this available mapping, this study, evaluated the surficial geology of an area covering approximately 5,000 km^2, within a 10-km zone, around the proposed highway (refer to Figure 3.8) . Existing information on the surficial geology of the 10-km zone was entered into a GIS (Map Info GIS software was used). Mineral occurrences and bedrock geology were compiled from existing digital databases also available from the Department of Mines and Energy.

6.7.3 Existing Environment

Distinct geomorphology features noted in the 10-km zone along the TLH - Phase III route include eskers, kettles, abandoned river channels, drumlins, escarpments and morainal ridges.

There are approximately seven genetic surficial deposit categories defined within the 10-km zone around the proposed highway. Boggy terrain has been identified throughout the area, and is divided into two subcategories: areas consisting of 15 to 50 percent organic material; and those with greater than 50 percent organic terrain. Areas with 15 to 50 percent organic terrain occur throughout approximately 20 percent of the zone, while areas with greater than 50 percent organics comprise approximately 19 percent of the zone. The seven main genetic categories are described as follows:

- organic deposit: peat, mucky peat, and muck occurring in bogs, fens, swamps, and shallow lakes; thickness <3 m; coastal areas locally contain minor permafrost;

- alluvial deposit: sand and gravel 1 to 15 m thick in the form of terraces and plains that formed as stream floodplains and deltas; generally occurs in large valleys and commonly overlies considerable thicknesses of finer grained lacustrine or marine sediment; overlain by extensive bogs where cemented soil horizons have impeded drainage;

- marine nearshore deposit: sand, gravel, boulders, and minor finer material <4 m thick, commonly developed on unconsolidated materials of other origins. Can be subdivided into two classes; 1) gravel and sand 1 to 4 m thick; generally in the form of beaches and strand plains, and 2) gravel, sand, and boulders with local pockets of finer material; commonly overlies and includes areas of till; developed as a lag on till or by concentration of boulders due to the action of floating ice;

- marine and lacustrine sublittoral deposit: silt, fine grained sand and clay, commonly laminated; variable thickness but can exceed 100 m; commonly occurs in coastal sections of large valleys; flat surface in places deeply dissected, commonly overlain by alluvial sand and gravel. Can be subdivided into three classes; 1) fine-grained lacustrine deposits (rarely exposed but probably present at depth in many large valleys), 2) fine-grained marine deposits; locally subject to landsliding and what appears to be failure by liquefaction, and 3) fine-grained material undifferentiated as to depositional environment;

- glaciafluvial deposit: sand and gravel of variable thickness (1 to 15 m) deposited as ice contact or glaciofluvial deposits; occurs as ridges, hummocks, terraces, and plains; generally located within or at the mouths of valleys. Due to discontinuous nature of many of these deposits, areas mapped as this unit commonly may contain other deposits;

- morainal deposit: dominantly sandy and gravelly basal (lodgment) till but includes ablation till and minor amounts of other drift materials; locally mantled by boulders and blocks. Can be subdivided into four classes; 1) till and minor sand and gravel of variable thickness; generally occurs 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, 2) basal (lodgment) till and minor sand, gravel, and finer materials generally 1 to 10 m thick; consists 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, 3) basal (lodgment) till generally 1 to 5 m thick; gently rolling surface (ground moraine) with symbols indicating areas of drumlinoid moraine, and 4) basal (lodgment) till veneering rock; generally <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; in limited areas may consist almost entirely of boulders; and

- rock: rock and rock thinly covered by drift, colluvium, and vegetation; generally hilly and hummocky with steep slopes; includes small areas of other units and small swampy hollows;

No mineral deposits of economic significance are known to occur near the proposed TLH - Phase III. No recent mineral exploration activity has been reported near the proposed highway, and the closest activity is approximately 80 km to the southeast.

Soil types are considered similar to other types that have been identified in other areas of southern and eastern Labrador. There has been limited development activity in the area of the proposed highway. Therefore, it is not anticipated that any contaminated soils will be encountered.

The proposed highway occurs within a corridor that may have isolated areas of acid-generating rock. Field investigations will be conducted prior to highway construction to identify acid-bearing rocks, with subsequent application of mitigation and/or design modification (Section 2.5.2.4).

The proposed highway occurs within an area defined as having isolated patches of permafrost (0 to 10 percent) (NRCAN 2002). If encountered, permafrost is most likely to occur in areas of thick peat or organic deposits.

6.7.4 Potential Interactions

The areas where highway construction, and quarrying occurs, or where temporary construction camps and laydowns areas are established, will be physically disturbed. The extent of disturbance will be a function of highway design and construction methods and will be related to watertable location, proximity of waterbodies, drainage regimes, type of surficial material, and terrain type.

6.7.5 Issues and Concerns

Where construction activities interact with the natural environment, there are several potential issues and concerns which will require planning and management. These issues and concerns are typical of most construction projects and include exposure of acid-generating rock, slumping and erosion of soil, removal of fill material, and disturbance to areas of permafrost.

6.7.6 Existing Knowledge

Highway construction typically requires placement or the removal of soil or rock materials to achieve the desired design grades. Where the highway requires a cut through potentially acid generating rock, acid-rock drainage may be promoted when the rock is exposed to water and air. This acid drainage can affect water quality in the surrounding area.

Highways constructed over native soil deposits may be prone to instability resulting in slope failures, slumps, lateral spread of organic terrain, or landslides. Although potentially acid generating rocks were identified during preliminary discussions with geologists from the Department of Mines and Energy when the TLH - Phase II was being planned, later ground-truthing and field investigation, along with chemical analyses confirmed that the rocks in the area of the highway construction would not produce harmful effects to the surrounding area. Similar rocks types have been identified in the Phase III project area.

In order to meet the requirements for the design grade of a highway, landforms may be altered or removed. For example, an esker may be used for quarry or borrow material or it may be covered by the bed of the highway.

The TLH - Phase II indicated that the highway traversed fine grained marine deposits where slumping (soil instability) was predicted. These potentially problematic soils were identified during initial geotechnical investigations, and the anticipated slumps or soil failures were controlled or managed during construction. Similar soil conditions have been identified in the western portion of the proposed TLH - Phase III, approximately 10 km south of Happy Valley-Goose Bay (refer to Figure 3.9).

When highways are constructed over permafrost areas, thawing may occur. Thawing could lead to soil instability and subsequent damage to the highway bed, altered drainage patterns in the area, or increased siltation to nearby waterbodies.

6.7.7 Mitigation

WST is committed to minimizing adverse environmental effects of the project. Specific mitigative measures to address issues related to geomorphology include:

- the highway will be designed according to acceptable standards of practice reflecting the geotechnical characteristics of the native soils and fill materials;
- rock for highway construction, from areas determined to have AGR potential, will be tested and only materials with less than 0.3 percent total sulphur would typically be used for construction;
- minimize disturbance to eskers and other landforms, where possible;
- use material obtained from excavations within the right-of-way, where possible;
- minimize number of borrow pits established and deplete resources of borrow pits, where practical, before establishing new borrow pits;
- geotechincal field investigation for best design of highway embankments and slopes (areas of cuts and in-fill); and
- field investigation to examine areas of potential permafrost.

6.7.8 Environmental Effects Assessment

6.7.8.1 Construction

The proposed highway will cross fine grained marine deposits in the western portion of its route. The potential for slumping will be identified during geotechnical investigations, and slumps or soil failures will be controlled or managed during construction using techniques similar to the ones used during the construction of the TLH - Phase II.

In these areas where acid-generating potential has been identified, ground truthing and field investigation will be conducted. Geochemical assessment of potential acid-bearng rocks will be conducted prior to construction to determine sulphur content.

Only materials with less than 0.3 percent total sulphur will be used for highway construction, and the highway will be designed to avoid exposing materials that may generate acid.

Only one major glacial landform will be directly affected by highway construction. (refer to Figure 3.10). This area is a 10-km section of a large esker on the eastern end of the route where the highway will travel along the side of the esker. Less than 5 percent of this esker will be used as source material for highway construction. Eskers are relatively uncommon in the area. No major morainal ridges will be affected by highway construction. Some drumlins occur in the right-of-way (most appear to cross perpendicular to the highway route) and sections may be disturbed during construction (refer to Figures 3.8 to 3.11).

The project area is within a zone where permafrost is considered sporadic and may occur in up to 10 percent of the area. The likelihood of encountering permafrost along the highway route is low. However, the potential for permafrost along the route will be assessed prior to construction.

With implementation of appropriate pre-construction surveys, design specifications, and construction methods, the environmental effects of project construction on the geomorphological environment will be not significant.

6.7.8.2 Operation

There are no planned activities that will result in physical disturbance during operation. Some borrow pits developed during construction may continue to be used during operation and maintenance. No additional landforms will be altered or removed during highway operation and no additional construction activities will occur to interact with areas of permafrost. As well, no additional bedrock will be exposed, thereby eliminating any additional potential for generation of acid runoff to the environment. The environmental effects of the operations phase of the project on the geomorphological environment will be not significant.

6.7.8.3 Accidental and/or Unplanned Events

Slumping or erosion may occur following unusually heavy rainfalls or spring runoff. The likelihood of this occurring is low as the highway will be designed and constructed to meet the worst anticipated conditions based on historical precipitation and other weather patterns in the region. With implementation of appropriate design specifications and construction methods, slumping or erosion along the TLH - Phase III is unlikely to occur. In the event that slumping or erosion occurs along the highway route, the effects will likely be of short duration and relatively localized. The most obvious effect would be sedimentation of nearby waterbodies or wetlands. If the event occurred in an area with extensive wetlands or a large river or waterbody, sedimentation could occur over a relatively large area. However, the environmental effects of an accidental or unplanned event will be not significant.

6.7.9 Environmental Effects Evaluation

The following definitions are used to rate the significance of the predicted residual environmental effects of the project on geomorphological components of the environment.

A **significant environmental effect** is one that does not alter geomorphological features along the highway right-of-way, such that there is a measurable, sustained degradation in water quality as a result of the exposure of AGR, slumping and erosion, and/or disturbance to permafrost.

A **not significant environmental effect** is one that does not alter geomorphological features along the highway right-of-way, such that there is a measurable, sustained degradation in water quality as a result of the exposure of AGR, slumping and erosion, and/or disturbance to permafrost.

The environmental effects of the project will be restricted to covering of a portion of a large esker and possible removal of some portions of several drumlins in the immediate highway corridor. Based on the preceding discussion and proposed mitigations, the residual effects of the project on the geomorphological environment are predicted to be not significant for construction, operation, and accidental events (Table 6.28). Overall, the project is not likely to result in significant adverse environmental effects.

6.7.10 Cumulative Environmental Effects

Past and on-going development activity in the project area has been relatively limited. Therefore, it is unlikely that surficial or bedrock geology have been previously disturbed along most of the proposed highway route. Recreational and subsistence resource use activities in the area are not likely to have any effect on geomorphology. Other past, on-going and potential projects and activities elsewhere in Labrador, such as the TLH - Phases I and II and other roads, the Voisey's Bay Mine Mill, hydroelectric development and related transmission infrastructure, and low-level flying activity, have not or will not have an effect on geomorphology within the proposed project area. Therefore, there is little potential for interaction between the effects of these actions and those of the proposed project.

Potential future development activities which may occur as a result of the access provided by the highway once it is operational (such as forestry, mineral exploration and mining) may affect geomorphology in the project area. Details such as the likelihood, nature, location and timing of any such actions induced by the TLH - Phase III are not known and legislation and regulations are in place to control these projects and activities and their potential environmental effects. Appropriate management and planning on the part of relevant regulatory agencies will ensure that any such effects are avoided or reduced.

With the implementation of these mitigation measures the proposed project is not likely to result in significant adverse cumulative effects on geomorphology in combination with other projects and activities that have been or will be carried out.

The creation of the Akamiuapishku/Mealy Mountains National Park would provide increased protection to geomorphological features in the proposed project area from the effects of human activities, such as use of motorized vehicles, forest harvesting and potential mineral exploration and development activities.

Table 6.28 Residual Environmental Effects Summary - Geomorphology

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • the highway will be designed according to acceptable standards of practice reflecting the geotechnical characteristics of the native soils and fill materials; • source materials for highway construction will be tested for acid-generating potential and only materials with less than 0.3 percent total sulphur would typically be used for construction; • minimize disturbance to eskers and other landforms, where possible; • use of material obtained from excavations within the right-of-way, where possible; • minimize number of borrow pits established and deplete resources of borrow pits, where practical, before establishing new borrow pits; • geotechincal field investigation for best design of highway embankments and slopes (areas of cuts and in-fill); and • field investigation to examine areas of potential permafrost.			
Environmental Effects Criteria Rating			
Magnitude	Low	Low	Low
Geographic Extent	<1	<1	11-100
Frequency	<10	<10	<10
Duration	37-72	>72	Unknown
Reversibility	Irreversible	Irreversible	Irreversible
Ecological/Socio-economic Context	n/a		
Environmental Effects Evaluation			
Significance	Not Significant	Not Significant	Not Significant
Level of Confidence	High	High	High
Likelihood[1]	n/a	n/a	n/a
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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: Surveillance monitoring may be required during construction.			
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		

6.7.11 Environmental Monitoring and Follow-up

Following finalization of the detailed highway route, and prior to construction, a geological field investigation will be required to determine the actual condition of bedrock in areas where there is potential for acid rock drainage to occur. Testing will include laboratory screening for total sulphur, followed by analysis using the modified Sobek method (or other approved acid base accounting test), if required. Based on test results, further tests will be conducted on a select number of samples that are found to be "acid producing". These tests may include metals scan, total inorganic carbon and paste pH.

Similar field investigations will be required to characterize the nature and geotechnical parameters of the surficial soils and bedrock for highway design.

6.8 Water Resources

Water resources have been discussed to some extent under the heading of fish habitat in Section 6.5. An adequate supply of good quality water is essential to maintenance of fish, other aquatic and terrestrial flora and fauna, as well as the people of the region. For this reason water resources have been designated as a VEC.

Hydrology, the study of water flows or quantities of water, has been incorporated as a planning tool for the design and capacity of the stream crossing structures described in the Chapter 2 (Proposed Undertaking).

Water quality is discussed in this section as it pertains to existing conditions and the potential for effects due to the construction and operation of TLH -Phase III. Many of the mitigations for the maintenance of water quality are also discussed under fish and fish habitat.

6.8.1 Boundaries

The TLH - Phase III will cross through five major watersheds in Southern Labrador. Boundaries for water resources are defined in terms of hydrological boundaries, project boundaries, and administrative boundaries.

The project boundary for water resources consists of the 40-m wide right-of-way that will extend along the route, at each of the stream crossing locations (Figure 6.22). The survey area included an aerial survey of the streams 250 m upstream and downstream of each crossing location.

The hydrological boundaries for water resources include the stream or pond sections at each crossing location extending downstream to the mouth of the five watersheds through which the TLH - Phase III will cross..

As in other areas of Newfoundland and Labrador, freshwater resources are regulated primarily by the provincial government. The Water Resources Management Division of NDOE has jurisdiction over water quality and water quantity in the watersheds pursuant to the *Waters Resources Act*. The *Fisheries Act* is the primary federal legislation governing protection and management of fish and fish habitat. Under the act, Section 36 regulates the release of deleterious substances into fish bearing waters. Environment Canada has responsibility this aspect of the *Fisheries Act*.

6.8.2 Methods

The scope of the water resources section is based on the EIS guidelines (Appendix A). On-ground investigations were conducted as required to address the guidelines. Water sampling and flow measurements were obtained at all accessible stream crossing locations during the Fish and Fish Habitat Component Study field surveys. A complete description of the methods is provided in the Fish and Fish Habitat Component Study (JW/IELP 2003).

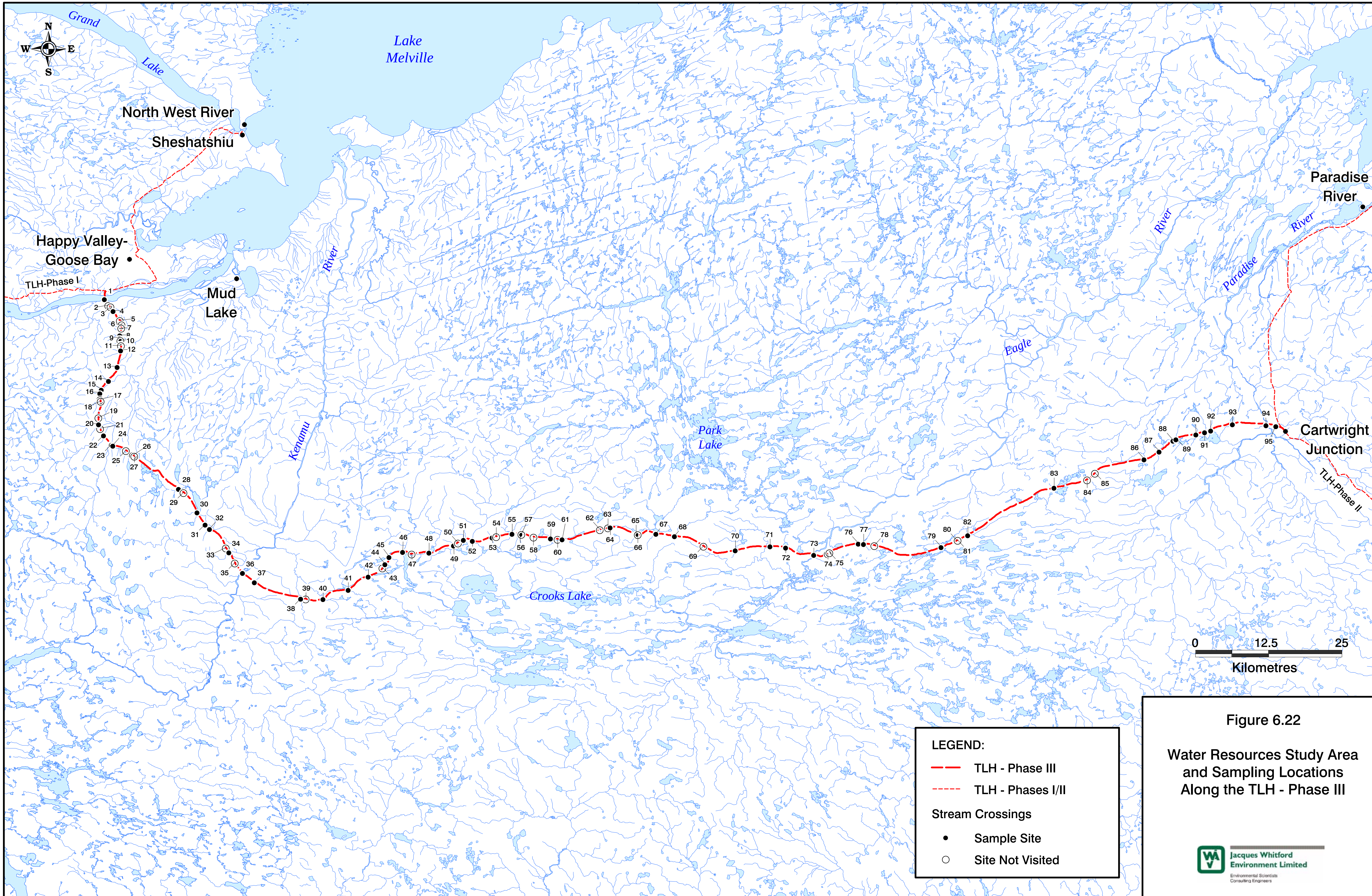

Figure 6.22

Water Resources Study Area and Sampling Locations Along the TLH - Phase III

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6.8.3 Existing Environment

Some of the requirements for the characterization of the existing environment outlined in the Guidelines are addressed in other parts of the EIS, namely:

- the hydraulic and design parameters and the methodologies used to determine the dimensions and capacities for all watercourse crossings are included in Section 2.4.4;
- climate data are included in Section 3.1.2;
- watershed characteristics are described in Section 3.3.2; and
- there are no estuarine features of concern with regard to TLH - Phase III as the watercourse crossings are from 23 to 100 km upstream of salt water.

There is limited historical information available on water quality and streamflow in Southern Labrador.

6.8.3.1 Watershed Areas

The location and upstream watershed areas of each of the proposed crossing locations are summarized in Tables 6.29 to 6.33. The upstream areas will largely determine the flow volumes that must be managed at each crossing. The flow rates are determined by factors such as gradient, run-off coefficient, topography and the presence of upstream waterbodies and wetlands. Climate will also influence the rate and amount of run-off based on rainfall, formation of ice and snow, and rate of melt of ice and snow. The sizes of the proposed water conveyance at each crossing structure are also provided in Tables 6.29 to 6.33.

Table 6.29 Summary of Watershed Areas at Stream Crossings - Churchill River and Tributaries

Stream Crossing #	Distance from South Bank of Churchill River (km)	Watershed Area Upstream of Crossing (km^2)	Water Transport Structure Bridge (m) or Culvert (mm) Size
* 1 *			Bridge : 3 x 120 m spans + causeway
2	0.8	0.5	1600
3	1.3	1	1600
4	2	2.6	2400
5	4	0.6	2000
6	4.6	0.5	2000
7	5.2	0.6	2000
8	6.5	4	2400
9	6.9	3.7	3000
10	7.4	1.8	3000
11	8.3	0.7	2400
12	8.7	4.7	3000

Crossing locations are shown on Figure 6.22.
* 1 * Denotes main stem of Churchill River with a total watershed area of 93,415 km^2.

Table 6.30 Summary of Watershed Areas at Stream Crossings - Traverspine River and Tributaries

Stream Crossing #	Distance from South Bank of Churchill River (km)	Watershed Area Upstream of Crossing (km^2)	Water Transport Structure Bridge (m) or Culvert (mm)Size
13	11.6	2.4	3000
14	14.3	3.1	3000
15	16.3	26.5	4,370 x 2,870 Pipe Arch
16	16.9	56.8	5,890 x 3,710 Pipe Arch
17	18.2	1.15	1600
18	18.5	0.5	2000
19	21.4	1.7	2000
20	22.5	2.1	2400
21	23.3	0.7	2400
22	24.6	77	5,890 x 3,710 Pipe Arch
* 23 *	26.7	191	Bridge : 15 m span
24	27	29	4,370 x 2,890 Pipe Arch
25	29.5	0.4	1600
26	30.9	0.15	1000
27	31.1	0.25	1000

Crossing locations are shown on Figure 6.22.
* 23* Denotes main stem of Traverspine River - Total drainage area for river is 728 km^2.

Table 6.31 Summary of Watershed Areas at Stream Crossings - Kenamu River and Tributaries

Stream Crossing #	Distance from South Bank of Churchill River (km)	Watershed Area Upstream of Crossing (km^2)	Water Transport Structure Bridge (m) or Culvert (mm)Size
28	40.2	72.3	4,370 x 2,870 Pipe Arch
29	41.3	0.78	2000
30	45.6	11.9	3000
31	48.2	2.7	2400
32	49.2	6.3	3000
33	53.7	1.5	3000
34	54.6	6.95	3000
35	56.7	1	2000
* 36 *	58.8	2,026.5	Bridge: 2 x 30 m spans
37	60.9	4.75	3000
38	69.4	41.6	4,370 x 2,870 Pipe Arch
39	70.3	1.3	2,000
40	73.3	14.3	3,890 x 2,690 Pipe Arch
41	78	7.8	3,890 x 2,690 Pipe Arch
42	82.2	2.9	2400

Crossing locations are shown on Figure 6.22.
* 36* Denotes main stem of Kenamu River - Total drainage area for river is 4,403 km^2.

Table 6.32 Summary of Watershed Areas at Stream Crossings - Eagle River and Tributaries

Stream Crossing #	Distance from South Bank of Churchill River (km)	Watershed Area Upstream of Crossing (km^2)	Water Transport Structure Bridge (m) or Culvert (mm)Size
43	85.1	0.5	1000
44	85.8	0	2000
45	87.4	5	2400
46	90.1	71.8	5,490 x 3,530 Pipe Arch
47	91.8	1.75	2400
48	94.7	36.7	3,890 x 2,690 Pipe Arch
49	99.3	2.6	2400
50	100.2	1.6	2400
51	101.3	11.8	3000
52	102.9	140	7,040 x 4,060 Pipe Arch
53	106.5	2.7	3000
54	107.2	0.3	1600
55	109.9	70.8	6,250 x 3,910 Pipe Arch
56	111.3	2	2000
57	111.6	1.5	3000
58	113.7	1	1200
59	116.7	9.4	3000
60	117.9	1.5	2400
61	118.6	13.1	3,890 x 2,690 Pipe Arch
62	125.3	1.5	3000
63	126.8	1	2400
64	127.2	3.8	2400
65	130.8	4.1	3000
66	131.1	0.7	1200
67	134.5	5.6	3000
68	137.7	2.05	2400
69	142.9	1.725	3000
70	148.7	4.6	3000
71	154.9	55.3	4,370 x 2,870 Pipe Arch
72	157.5	3.1	3000
73	162.6	3644	Bridge : 2 x 30 m spans
74	165.1	0.9	2400
75	165.4	1.9	2400
76	170.6	4.2	2400
77	171.2	17.3	3000
78	172.7	1.2	1600
79	184.8	376	Bridge : 20 m span
80	187.6	1.2	1400
81	187.9	1.1	1400
82	189.9	25	3000

Crossing locations are shown on Figure 6.22.
* 73* Denotes main stem of Eagle River South Branch - Total drainage area for river is 10,824 km^2.

Table 6.33 Summary of Watershed Areas at Stream Crossings - Paradise River and Tributaries

Stream Crossing #	Distance from South Bank of Churchill River (km)	Watershed Area Upstream of Crossing (km^2)	Water Transport Structure Bridge (m) or Culvert (mm)Size
83	206.7	11.4	3000
84	211.9	1.9	1600
85	213.8	0.8	2400
86	218.9	78	5,490 x 3,530 Pipe Arch
87	221.8	24	3000
88	224.8	35	3,890 x 2,690 Pipe Arch
89	225.3	6.55	3000
90	228.9	2.55	2400
91	230.6	16.6	4,370 x 2,870 Pipe Arch
92	231.7	2.5	2400
93	235.5	2.74	1800
* 94 *	241.2	3,339	Bridge : 60 m span
95	242.6	6.8	3000

Crossing locations are shown on Figure 6.22.
* 94* Denotes main stem of Paradise River - Total drainage area for river is 5,276 km^2.

Information was obtained for each crossing from the Fish and Fish Habitat Component Study (JW/IELP 2003). Details of the habitat surveys extending 250 m upstream and downstream of the proposed crossing sites are contained in the appendix to the Fish and Fish Habitat Component Study (JW/IELP 2003). Some of the details to indicate the character of each crossing that could be examined are summarized in Tables 6.34 to 6.38. The crossing location may be modified in the final design stage to conform to highway alignment and other issues.

Table 6.34 Summary of Watershed Areas at Stream Crossings - Churchill River and Tributaries

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
* 1 *	>2	>20	riffle, run	fines	U (unobstructed)
2	n/a	<2	(riffle)	fines, gravel, cobble	T (small size, overhanging veg.)
3	n/a	<2	n/a	n/a	T (small size, overhanging veg.)
4	<1	<2	(riffle)	fines	T (small size, overhanging veg)
5	n/a	n/a	n/a	n/a	T (small size, overhanging veg)
6	<1	<2	(riffle)	n/a	T (small size, overhanging veg)
7	<1	<2	(riffle)	n/a	T (small size, overhanging veg)
8	<0.5	2 to 5	riffle	fines	T (small size, overhanging veg)
9	<0.5	<2	riffle	fines	T (small size, shallow)
10	n/a	<2	n/a	n/a	T (small size, overhanging veg)
11	<1	<2	n/a	n/a	T (small size, overhanging veg)
12	<1	<2	n/a	n/a	T (small size, overhanging veg)

Crossing locations are shown on Figure 6.22.
Riffle flow is shallow with velocity of 0.3 to 1 m/s, run is deeper with velocity of 0.3 to 1 m/s.
(Brackets) indicate site obscured by trees and flow estimated from adjacent area, N/A indicates crossing obscured.
* 1 * Denotes main stem of Churchill River.

Table 6.35 Summary of Watershed Areas at Stream Crossings - Traverspine River and Tributaries

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
13	<1	2 to 5	riffle	cobble, boulder, gravel	T (Shallow, overhanging veg)
14	<1	2 to 5	riffle	cobble, boulder, gravel	P (shallow sections)
15	<1	5 to 20	riffle	cobble, boulder, gravel	P (chutes/rapids/ shallow)
16	<1	5 to 20	riffle/pool	boulder, rubble, gravel	P (chutes/rapids/ shallow)
17	n/a	<2	n/a	n/a	T (small size, overhanging veg)
18	n/a	<2	n/a	n/a	T (small size, overhanging veg)
19	n/a	<2	n/a	n/a	T (small size, overhanging veg)
20	<1	2 to 5	(riffle)	fines	T (small size, overhanging veg)
21	n/a	<2	n/a	n/a	T (small size, overhanging veg)
22	<1	>20	rapids	boulder, cobble, bedrock	P (chutes/rapids)
* 23 *	<1	5 to 20	riffle	boulder, bedrock, cobble	T (falls below crossing)
24	<1	5 to 20	rapids	boulder, cobble	T (falls below crossing)
25	n/a	<2	n/a	n/a	T (small size, overhanging veg)
26	n/a	<2	n/a	n/a	T (small size, overhanging veg)
27	n/a	<2	n/a	n/a	T (small size, overhanging veg)

Crossing locations are shown on Figure 6.22.
Riffle flow is shallow with velocity of 0.3 to 1 m/s, rapids have velocity > 1 m/s.
(Brackets) indicate site obscured by trees and flow estimated from adjacent area, N/A indicates crossing obscured.
* 23* Denotes main stem of Traverspine River.

Table 6.36 Summary of Watershed Areas at Stream Crossings - Kenamu River and Tributaries

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
28	<1	5 to 20	riffle	boulder, cobble, gravel	P (shallow sections)
29	n/a	<2	n/a	n/a	T (small size, overhanging veg)
30	<1	5 to 20	steady	fines, boulder	U (unobstructed)
31	n/a	<2	n/a	n/a	T (small size, overhanging veg)
32	n/a	<2	(riffle)	n/a	T (small size, overhanging veg)
33	<1	<2	(riffle)	(cobble)	T (small size, overhanging veg)
34	<1	<2	(riffle)	fines, gravel, cobble	T (small size, overhanging veg)
35	-	no visible stream	-	-	-
* 36 *	<1	>20	riffle	cobble, gravel, boulder	U (unobstructed)
37	<1	<2	steady	fines	T (small size, overhanging veg)
38	<1	5 to 20	riffle	boulder, cobble, bedrock	P (chutes, white water)
39	n/a	<2	n/a	n/a	T (small size, overhanging veg)
40	<1	2 to 5	riffle	fines	P (windfalls)
41	<1	2 to 5	riffle	fines, gravel	P (small size, overhanging veg)
42	<1	2 to 5	riffle	fines, cobble	P (shallow, small size upstream)

Crossing locations are shown on Figure 6.22.
Riffle flow is shallow with velocity of 0.3 to 1 m/s, steady has velocity of <0.3 m/s.
(Brackets) indicate site obscured by trees and flow estimated from adjacent area, N/A indicates crossing obscured.
* 36* Denotes main stem of Kenamu River

Table 6.37 Summary of Watershed Areas at Stream Crossings - Eagle River and Tributaries

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
43	n/a	<2	n/a	n/a	T (intermittent)
44	n/a	pond	n/a	n/a	T (intermittent)
45	<1	>20	riffle	fines, boulder	U
46	<1	2 to 5	steady	fines, cobble	U
47	n/a	<2	steady	n/a	T (small size, overhanging veg)
48	<1	2 to 5	riffle	boulder, cobble, fines	P (in stream boulder)

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
49	<1	<2	steady	fines	T (small size, overhanging veg)
50	<1	<2	(steady)	n/a	T (small size, overhanging veg)
51	<1	2 to 5	riffle	fines, cobble, boulder	P (in stream boulder)
52	<1	5 to 20	riffle	fines, boulder, cobble	P (cascade/rapids)
53	<1	<2	riffle	fines	T (small size, overhanging veg)
54	-	no visible stream	-	-	-
55	<1	5 to 20	riffle	fines, boulder, cobble	P (in stream boulder)
56	<1	<2	riffle	boulder, fines, cobble	T (small size, overhanging veg)
57	-	no visible stream	-	-	-
58	<1	<2	steady	fines	T (small size, overhanging veg)
59	<1	<2	riffle	boulder, cobble	T (small size, overhanging veg)
60	<1	<2	steady	fines	T (small size, overhanging veg)
61	<1	2 to 5	riffle	boulder, fines, cobble	P (shallow sections)
62	<1	<2	steady	fines	T (small size, overhanging veg)
63	<1	<2	steady	fines	T (small size, overhanging veg)
64	<1	<2	riffle	fines	T (small size, overhanging veg)
65	<1	2 to 5	riffle	fines	P (small size, shallow)
66	<1	<2	steady	fines	T (small size, overhanging veg)
67	<1	2 to 5	riffle	boulder, fines, cobble	P (shallow sections)
68	<1	<2	riffle	boulder, fines, cobble	T (small size, overhanging veg)
69	<1	<2	(riffle/steady)	n/a	T (small size, overhanging veg)
70	<1	<2	steady	fines, cobble, boulder	P (small size)
71	<1	2 to 5	steady	fines, cobble, boulder	U
72	<1	<2	steady	fines, cobble, boulder	P (small size, overhanging veg)
* 73 *	>2	90	riffle	boulder, cobble, bedrock	U
74	N/A	<2	N/A	n/a	T (small size, overhanging veg)
75	<1	<2	riffle	fines, cobble, boulder	T (small size, overhanging veg)

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
76	<1	<2	steady	fines	P (small size)
77	<1	>20	steady	fines, boulder, cobble	U
78	<1	<2	steady	n/a	T (small size, overhanging veg)
79	>2	40	riffle	cobble, fines, boulder	P (in stream boulder)
80	<1	<2	steady	fines, boulder	T (small size, overhanging veg)
81	<1	<2	steady	fines, boulder	T (small size, overhanging veg)
82	1 to 2	2 to 5	riffle	cobble, boulder, fines	P (in stream boulder)

Crossing locations are shown on Figure 6.22.
Riffle flow is shallow with velocity of 0.3 to 1 m/s, steady has velocity of <0.3 m/s.
(Brackets) indicate site obscured by trees and flow estimated from adjacent area, N/A indicates crossing obscured.
* 73* Denotes main stem of Eagle River South Branch.

Table 6.38 Summary of Watershed Areas at Stream Crossings - Paradise River and Tributaries

Stream Crossing #	Water Depth (m)	Approx. Width (m)	Flow Rate	Substrate	Obstructions to Navigation
83	<1	2 to 5	steady	fines, cobble, boulder	U
84	<1	2 to 5	steady	fines, cobble, boulder	T (small size upstream)
85	-	no stream visible	-	-	-
86	<1	5 to 20	steady	fines, boulder	U
87	<1	<2	riffle	boulder, fines, cobble	P (small size)
88	<1	2 to 5	steady	fines, boulder, cobble	P (shallow sections)
89	<1	2 to 5	riffle	cobble, fines, boulder	T (shallow)
90	<1	<2	steady	fines, boulder, cobble	T (small size, overhanging veg)
91	<1	5 to 20	steady	fines, cobble, boulder	P (shallow sections)
92	<1	<2	intermittent	fines, cobble, boulder	T (small size, intermittent)
93	<1	2 to 5	steady	fines, cobble, boulder	P (small size upstream)
* 94 *	>2	50	riffle	boulder, bedrock, N/A	U
95	<1	<2	riffle	fines, gravel, cobble	T (small size, overhang)

Crossing locations are shown on Figure 6.22.
Riffle flow is shallow with velocity of 0.3 to 1 m/s, steady has velocity of <0.3 m/s.
(Brackets) indicate site obscured by trees and flow estimated from adjacent area, N/A indicates crossing obscured.
* 94* Denotes main stem of Paradise River.

The above tables list the estimated depth and approximate width of each crossing, and a comment is provided on apparent obstructions to navigation. Flow is characterized as pool, steady, run, riffle or rapids. The definitions of these terms are provided in Table 6.39. Substrate is listed in order of predominance for the three most common classes at each site. Substrate classes are defined in Table 6.40. Photographs of the crossing sites are included in the appendices to the Fish and Fish Habitat Component Study (JW and IELP 2003).

Table 6.39 General Stream Flow (Habitat) Types

Stream Flow	Definition
Run	Swiftly flowing water with some surface agitation but no major flow obstructions, coarser substrate (gravel, cobble, and boulders).
Riffle[1]	Shallower section with swiftly flowing, turbulent water with some partially exposed substrate (usually cobble or gravel dominated).
Pocketwater	Turbulence increased greatly by numerous emergent boulders, which create eddies or scour holes (pockets) behind the obstructions.
Flat (or steady)[1]	Water surface is smooth and substrate is made up of organic matter, sand, mud, and fine gravel. This habitat differs from a pool due to the length, associated with low gradient. This habitat type generally has a flat bottom.
Pool [1]	Deeper area comprising full or partial width of stream, due to the depth or width flow velocity is reduced. Pool has rounded surface on bottom.
Cascade (rapids)[1]	Areas of steeper gradient with irregular and rapid flows, often with turbulent white water. Rapids are primarily associated with larger stream sections and rivers. In larger rivers, it is recommended that the survey crew not attempt to conduct cross sections in these types of habitat.
Glide	Wide, shallow pool flowing smoothly and gently, with low to moderate velocities and little or no surface turbulence. Substrate usually consists of cobble, gravel and sand.
[1] Flows characterized during the aerial survey were described by these four types. Source: Sooley et al. 1998.	

Table 6.40 Classification of Substrate

Substrate	Description
Bedrock (BR)	Continuous solid rock exposed by the scouring forces of the river/stream
Boulder (Bo)	Boulder sized rocks from 25 cm to greater than 1 m in diameter
Small Boulder	Boulder sized rocks from 25 cm to 1 m diameter
Rubble (R)	Large rocks from 14 to 25 cm in diameter
Cobble (C)	Moderate to small sized rocks from 3 to 13 cm in diameter
Gravel(G)	Small stones from 2 mm to 3 cm in diameter
Fines (F)	Sand and smaller sized material on margins of streams or between rocks and stones, up to 2 mm in diameter
Source: Bradbury et al. 2001.	

6.8.3.2 Water Quality

Water quality monitoring was conducted as part of the Fish and Fish Habitat Component Study. At each crossing location that was surveyed on the ground, water samples were obtained to determine selected water quality parameters (Tables 6.41 to 6.45). The samples were obtained at the proposed crossing sites and represent the water quality at and immediately downstream of each site.

Parameters, method of determination, limits and units of quantification, number of stations with quantifiable measurements, summary statistics and CCME guidelines for the Protection of Aquatic Life (CCME 2001) are also shown in Tables 6.41 to 6.45. The summary statistics provide the maximum, minimum and median values. If there were measured values for all locations, the mean value is also provided, otherwise there can be no mean that includes non-quantifiable results. Relevant field measurements are also included for the watersheds.

Table 6.41 Water Chemistry Results for Two Samples from Churchill River Tributaries

Parameters	Method	EQL	Units	Samples with Quantifiable Levels	Summary Statistics				CCME Guidelines *
					Maximum	Minimum	Median	Mean	
Temperature	Hydrolab		°C	2	7.83	7.79	7.81	8	narrative
pH	Hydrolab		units	2	8.76	7.99	8.375	8	6.5 - 9.0
Conductivity	Hydrolab		µS/cm	2	9.9	7.1	8.5	9	
Dissolved O_2	Hydrolab		mg/L	2	10.14	9.28	9.71	10	5.5 - 9.5
Turbidity	Hydrolab	0.1	NTU	2	3.3	0.8	2.05	2	narrative
Alkalinity (as CaCO3)	COBAS	5	mg/L	2	11	8	9.5	10	
Total Dissolved Solids	Grav.	10	mg/L	2	50	40	45	45	
Aluminum	ICP-MS	10	µg/L	2	310	240	275	275	5 - 100
Antimony	ICP-MS	2	µg/L	0	< 2		< 2		
Arsenic	ICP-MS	2	µg/L	0	< 2		< 2		5
Barium	ICP-MS	5	µg/L	2	22	12	17	17	
Beryllium	ICP-MS	5	µg/L	0	< 5		< 5		
Bismuth	ICP-MS	2	µg/L	0	< 2		< 2		
Boron	ICP-MS	5	µg/L	2	11	9	< 5	10	
Cadmium	ICP-MS	0.3	µg/L	0	< 0.3		< 0.3		0.017
Chromium	ICP-MS	2	µg/L	0	< 2		< 2		8.9
Cobalt	ICP-MS	1	µg/L	0	< 1		< 1		
Copper	ICP-MS	2	µg/L	2	5	2	3.5	4	2 - 4
Iron	ICP-MS	20	µg/L	2	890	470	680	680	300
Lead	ICP-MS	0.5	µg/L	1	0.8	0.8	< 0.5		1 - 7
Manganese	ICP-MS	2	µg/L	2	20	12	16	16	
Molybdenum	ICP-MS	2	µg/L	0	< 2		< 2		
Nickel	ICP-MS	2	µg/L	0	< 2		< 2		25 - 150
Selenium	ICP-MS	2	µg/L	0	< 2		< 2		1
Silver	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		0.1
Strontium	ICP-MS	5	µg/L	2	22	14	18	18	

Parameters	Method	EQL	Units	Samples with Quantifiable Levels	Summary Statistics				CCME Guidelines *
					Maximum	Minimum	Median	Mean	
Thallium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		0.8
Tin	ICP-MS	2	µg/L	0	< 2		< 2		
Titanium	ICP-MS	2	µg/L	2	8	2	5	5	
Uranium	ICP-MS	0.1	µg/L	1	0.1	0.1	< 0.1		
Vanadium	ICP-MS	2	µg/L	0	< 2		< 2		
Zinc	ICP-MS	2	µg/L	2	6	4	5	5	30
* CCME Guidelines for Protection of Aquatic Life (CCME 2001).									

Table 6.42 Water Chemistry Results for Five Samples from Traverspine River and Tributaries

Parameters	Method	EQL	Units	Samples with Quantifiable Levels	Summary Statistics				CCME Guidelines *
					Maximum	Minimum	Median	Mean	
Temperature	Hydrolab		°C	5	5.88	5.39	5.49	6	narrative
pH	Hydrolab		units	5	8.6	7.97	8.5	8	6.5 - 9.0
Conductivity	Hydrolab		µS/cm	5	7	5.4	5.5	6	
Dissolved O_2	Hydrolab		mg/L	5	12.67	11.04	11.23	12	5.5 - 9.5
Turbidity	Hydrolab	0.1	NTU	5	4.4	1.4	2.4	3	narrative
Alkalinity (as CaCO3)	COBAS	5	mg/L	5	9	6	7	7	
Total Dissolved Solids	Grav.	10	mg/L	5	50	30	40	38	
Aluminum	ICP-MS	10	µg/L	5	220	150	200	194	5 - 100
Antimony	ICP-MS	2	µg/L	0	< 2		< 2		
Arsenic	ICP-MS	2	µg/L	0	< 2		< 2		5
Barium	ICP-MS	5	µg/L	5	14	10	10	11	
Beryllium	ICP-MS	5	µg/L	0	< 5		< 5		
Bismuth	ICP-MS	2	µg/L	0	< 2		< 2		
Boron	ICP-MS	5	µg/L	1	5	5	< 5		
Cadmium	ICP-MS	0.3	µg/L	0	< 0.3		< 0.3		0.017
Chromium	ICP-MS	2	µg/L	0	< 2		< 2		8.9
Cobalt	ICP-MS	1	µg/L	0	< 1		< 1		
Copper	ICP-MS	2	µg/L	5	3	2	2	2	2 - 4
Iron	ICP-MS	20	µg/L	5	940	150	640	622	300
Lead	ICP-MS	0.5	µg/L	1	0.5	0.5	< 0.5		1 - 7
Manganese	ICP-MS	2	µg/L	5	20	2	8	10	
Molybdenum	ICP-MS	2	µg/L	0	< 2		< 2		
Nickel	ICP-MS	2	µg/L	1	2	2	< 2		25 - 150
Selenium	ICP-MS	2	µg/L	0	< 2		< 2		1.0
Silver	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		0.1
Strontium	ICP-MS	5	µg/L	5	24	16	17	18	
Thallium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		0.8
Tin	ICP-MS	2	µg/L	0	< 2		< 2		
Titanium	ICP-MS	2	µg/L	5	4	2	3	3	
Uranium	ICP-MS	0.1	µg/L	1	0.2	0.2	< 0.1		
Vanadium	ICP-MS	2	µg/L	0	< 2		< 2		
Zinc	ICP-MS	2	µg/L	5	5	2	3	3.2	30
* CCME Guidelines for Protection of Aquatic Life (CCME 2001).									

Table 6.43 Water Chemistry Results for Seven Samples from Kenamu River and Tributaries

Parameters	Method	EQL	Units	Samples with Quantifiable Levels	Summary Statistics				CCME Guidelines *
					Maximum	Minimum	Median	Mean	
Temperature	Hydrolab		°C	7	6.95	4.58	6.33	6	narrative
pH	Hydrolab		units	7	8.6	7.39	7.73	8	6.5 - 9.0
Conductivity	Hydrolab		µS/cm	7	8.6	4.6	6.1	6	
Dissolved O_2	Hydrolab		mg/L	7	12.72	8.93	10.86	11	5.5 - 9.5
Turbidity	Hydrolab	0.1	NTU	7	9.7	0.5	1.1	3	narrative
Alkalinity (as CaCO3)	COBAS	5	mg/L	7	11	6	8	8	
Total Dissolved Solids	Grav.	10	mg/L	7	30	20	20	24	
Aluminum	ICP-MS	10	µg/L	7	210	80	110	126	5 - 100
Antimony	ICP-MS	2	µg/L	0	< 2		< 2		
Arsenic	ICP-MS	2	µg/L	0	< 2		< 2		5
Barium	ICP-MS	5	µg/L	7	19	7	9	10	
Beryllium	ICP-MS	5	µg/L	0	< 5		< 5		
Bismuth	ICP-MS	2	µg/L	0	< 2		< 2		
Boron	ICP-MS	5	µg/L	0	< 5		< 5		
Cadmium	ICP-MS	0.3	µg/L	0	< 0.3		< 0.3		0.017
Chromium	ICP-MS	2	µg/L	0	< 2		< 2		8.9
Cobalt	ICP-MS	1	µg/L	1	1	< 1	< 1		
Copper	ICP-MS	2	µg/L	3	2	< 2	< 2		2 - 4
Iron	ICP-MS	20	µg/L	7	3200	110	450	787	300
Lead	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		1 - 7
Manganese	ICP-MS	2	µg/L	7	100	3	6	22	
Molybdenum	ICP-MS	2	µg/L	0	< 2		< 2		
Nickel	ICP-MS	2	µg/L	0	< 2		< 2		25 - 150
Selenium	ICP-MS	2	µg/L	0	< 2		< 2		1.0
Silver	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		0.1
Strontium	ICP-MS	5	µg/L	7	19	11	15	15	
Thallium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		0.8
Tin	ICP-MS	2	µg/L	0	< 2		< 2		
Titanium	ICP-MS	2	µg/L	4	6	2	2		
Uranium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		
Vanadium	ICP-MS	2	µg/L	0	< 2		< 2		
Zinc	ICP-MS	2	µg/L	7	4	2	2	2.6	30

* CCME Guidelines for Protection of Aquatic Life (CCME 2001).

Table 6.44 Water Chemistry Results for 14 Samples from Eagle River and Tributaries

Parameters	Method	EQL	Units	Samples with Quantifiable Levels	Summary Statistics				CCME Guidelines *
					Maximum	Minimum	Median	Mean	
Temperature	Hydrolab		°C	14	6.09	3.07	4.27	4	narrative
pH	Hydrolab		units	14	7.8	6.49	7.365	7	6.5 - 9.0
Conductivity	Hydrolab		µS/cm	14	9.2	2.4	6.2	6	
Dissolved O_2	Hydrolab		mg/L	14	12.57	9.61	11.065	11	5.5 - 9.5
Turbidity	Hydrolab	0.1	NTU	14	9.2	1.4	3.15	4	narrative
Alkalinity (as CaCO3)	COBAS	5	mg/L	11	34	< 5	6		
Total Dissolved Solids	Grav.	10	mg/L	14	40	10	30	29	
Aluminum	ICP-MS	10	µg/L	14	170	80	100	111	5 - 100
Antimony	ICP-MS	2	µg/L	0	< 2		< 2		
Arsenic	ICP-MS	2	µg/L	0	< 2		< 2		5
Barium	ICP-MS	5	µg/L	7	8	< 5	5		
Beryllium	ICP-MS	5	µg/L	0	< 5		< 5		
Bismuth	ICP-MS	2	µg/L	0	< 2		< 2		
Boron	ICP-MS	5	µg/L	1	6	< 5	< 5		
Cadmium	ICP-MS	0.3	µg/L	1	0.3	< 0.3	< 0.3		0.017
Chromium	ICP-MS	2	µg/L	0	< 2		< 2		8.9
Cobalt	ICP-MS	1	µg/L	0	< 1		< 1		
Copper	ICP-MS	2	µg/L	4	2	< 2	< 2		2 - 4
Iron	ICP-MS	20	µg/L	14	2300	150	520	736	300
Lead	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		1 - 7
Manganese	ICP-MS	2	µg/L	14	71	6	10.5	16	
Molybdenum	ICP-MS	2	µg/L	0	< 2		< 2		
Nickel	ICP-MS	2	µg/L	0	< 2		< 2		25 - 150
Selenium	ICP-MS	2	µg/L	0	< 2		< 2		1
Silver	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		0.1
Strontium	ICP-MS	5	µg/L	14	18	7	12	12	
Thallium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		0.8
Tin	ICP-MS	2	µg/L	0	< 2		< 2		
Titanium	ICP-MS	2	µg/L	3	3	< 2	< 2		
Uranium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		
Vanadium	ICP-MS	2	µg/L	0	< 2		< 2		
Zinc	ICP-MS	2	µg/L	14	8	2	2.5	3.4	30

* CCME Guidelines for Protection of Aquatic Life (CCME 2001).

Table 6.45 Water Chemistry Results for Seven Samples from Paradise River and Tributaries

Parameters	Method	EQL	Units	Samples with Quantifiable Levels	Summary Statistics				CCME Guidelines *
					Maximum	Minimum	Median	Mean	
Temperature	Hydrolab		°C	7	11.4	2.82	5.78	6	narrative
pH	Hydrolab		units	7	8.09	5.72	6.41	7	6.5 - 9.0
Conductivity	Hydrolab		μS/cm	7	8.1	4.1	4.8	5	
Dissolved O_2	Hydrolab		mg/L	7	12.9	8.91	11.51	11	5.5 - 9.5
Turbidity	Hydrolab	0.1	NTU	7	6.7	0.1	3.4	3	narrative
Alkalinity (as CaCO3)	COBAS	5	mg/L	1	7	< 5	< 5		
Total Dissolved Solids	Grav.	10	mg/L	7	50	30	40	39	
Aluminum	ICP-MS	10	µg/L	7	370	130	280	261	5 - 100
Antimony	ICP-MS	2	µg/L	0	< 2		< 2		
Arsenic	ICP-MS	2	µg/L	0	< 2		< 2		5
Barium	ICP-MS	5	µg/L	7	11	6	9	9	
Beryllium	ICP-MS	5	µg/L	0	< 5		< 5		
Bismuth	ICP-MS	2	µg/L	0	< 2		< 2		
Boron	ICP-MS	5	µg/L	0	< 5		< 5		
Cadmium	ICP-MS	0.3	µg/L	0	< 0.3		< 0.3		0.017
Chromium	ICP-MS	2	µg/L	0	< 2		< 2		8.9
Cobalt	ICP-MS	1	µg/L	0	< 1		< 1		
Copper	ICP-MS	2	µg/L	3	2	< 2	< 2		2 - 4
Iron	ICP-MS	20	µg/L	7	940	420	650	640	300
Lead	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		1 - 7
Manganese	ICP-MS	2	µg/L	7	15	5	9	10	
Molybdenum	ICP-MS	2	µg/L	0	< 2		< 2		
Nickel	ICP-MS	2	µg/L	0	< 2		< 2		25 - 150
Selenium	ICP-MS	2	µg/L	0	< 2		< 2		1.0
Silver	ICP-MS	0.5	µg/L	0	< 0.5		< 0.5		0.1
Strontium	ICP-MS	5	µg/L	7	16	9	12	12	
Thallium	ICP-MS	0.1	µg/L	0	< 0.1		< 0.1		0.8
Tin	ICP-MS	2	µg/L	0	< 2		< 2		
Titanium	ICP-MS	2	µg/L	7	5	2	3	3	
Uranium	ICP-MS	0.1	µg/L	1	0.1		< 0.1		
Vanadium	ICP-MS	2	µg/L	0	< 2		< 2		
Zinc	ICP-MS	2	µg/L	7	8	3	4	4.3	30

* CCME Guidelines for Protection of Aquatic Life (CCME 2001).

Overall, water quality is indicated to be generally dilute, which is typical for waters draining the Canadian Shield. The parameters that were investigated show the region to have near neutral pH, with localized areas prone to acidification, low total dissolved solids , low conductivity and low alkalinity. Dissolved metals are also generally low or non-detectable, with some elevated iron and aluminum.. Many of the metals were at concentrations that are below the Estimated Quantitation Limit (EQL). The EQL is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the Method Detection Limit.

Recent studies in the Churchill River (1998-99) found much the same water quality in the lower river sections (Newfoundland and Labrador Hydro unpublished data). Investigations on the lower Churchill River found evidence of marine influence in the lower sections of the Traverspine River where slightly elevated sodium and chloride concentrations were recorded.

The results were compared with the CCME Guidelines for the Protection of Aquatic Life (CCME 2001), and some parameters were noted to exceed these guidelines.

The guideline range for pH (6.5-9.0) was generally met by most sample results and the overall mean value was 7.4. No values exceeded pH 9.0 and four of seven samples collected within Paradise River watershed fell below pH 6.5. The lowest value was 5.72.

Aluminum concentrations in water often exceeded the guideline in Newfoundland and Labrador waters without apparent consequence. The speciation (molecular form) of aluminum is the key to the actual toxicity and the toxicity may be reduced when aluminum ions are bound to organic or other compounds. Based on the results reported, aluminum exceeds the guideline on almost all of the samples examined in this study.

Although the quantified levels of cadmium are below measurement (<0.3 µg/L), the guideline is lower still (0.017 µg/L). One sample from the Eagle River watershed had a concentration of measurable cadmium, which was above the guideline.

The guideline for iron (300 µg/L) is based on effects to fish and invertebrate development. A total of 28 of the 35 stations had iron levels that exceeded the freshwater guideline, to levels as high as 1,800 and, 2,300 µg/L (in Eagle watershed) and 3,200 µg/L (at a station in the Kenamu watershed).

Selenium and silver each have CCME guideline levels (1.0 mg/L and 0.1 µg/L, respectively) that are below the normal ELQ provided by the laboratory (2 µg/L and 0.5 µg/L, respectively); therefore, as with cadmium, the analytical results cannot be determined to guideline limits. However, all results were below the ELQ.

All other parameters that have CCME Guidelines for the Protection of Aquatic Life (CCME 2001) were determined to be below the guideline levels for all samples (i.e., arsenic, chromium, copper, lead, nickel, thallium and zinc).

6.8.3.3 Salt Loading

Sodium and chloride were not included in the analyses that were conducted on water samples collected at the proposed stream crossing locations. There are no CCME guidelines (for the protection of aquatic life)that apply to sodium or chloride. These parameters both have average values between 1-2 mg/L based on historic data obtained from Eagle River (Government of Newfoundland and Labrador 1992a). These ions, in addition to sulphate, are often naturally elevated in waterbodies that are near the coast by virtue of marine aerosols. However, the highway watercourse crossings for TLH - Phase III are quite removed from marine coastal influences, so this source of salt loading is greatly reduced as a factor in the local water quality.

Conductivity at the 35 sampling stations ranged from 2.4 to 9.9 µS/cm (mean of 6.1 µS/cm). This is quite a low range for conductivity, indicating low dissolved solids (including salt). This is not anticipated to change with the construction and operation of the highway, as road salt will not be used for ice control during winter months. The small amount of salt (<5 percent) that will be used to prevent freezing of sand, will be virtually undetectable in run-off and indistinguishable from natural variability in the streams.

6.8.4 Potential Interactions

The potential interactions between the project and water resources have been outlined in Section 6.5 - Fish and Fish Habitat. These are reviewed briefly below in point form.

Construction activities in and near waterbodies have the potential to alter water quality and water flows. Potential interactions between the project activities and water resources include:

- fording may be used to cross some streams at the beginning of construction;
- grubbing and debris disposal will take place in close proximity to watercourses;
- excavation (cuts and fills) will be completed along the route and borrow pits will be operated where necessary;
- rocks with potential for ARD may be encountered along the proposed route;
- blasting may be conducted near waterbodies to construct bridge abutments, to achieve the highway design elevation or to establish the right-of-way;
- culverts and bridges will be placed at watercourse crossings;
- hazardous materials (fuels and lubricants) will be used near waterbodies and used materials will be stored prior to disposal;
- concrete and aggregate production may occur near watercourse crossings;
- temporary construction camps will be established to house work crews;
- solid waste and domestic sewage will need to be handled and disposed of; and
- there will be generally improved access to stream crossing areas.

Many interactions that may occur during construction (sedimentation, contamination) also apply during operation, albeit to different levels of intensity, timing, or spatial distribution. Other potential interactions during operations include:

- runoff will occur along the highway;
- airborne dust from highway operation will be carried to adjacent waterbodies;
- ice control may be applied during winter operations;
- service depots that are planned for the project may store and handle various hazardous materials;
- each depot will have waste handling/holding facilities;
- faulty installations or developing problems with the installations may occur or be evident over time; and
- there will be generally improved access to stream crossing areas.

A summary of water quality issues that are associated with the construction and operation of the TLH - Phase III is provided in Table 6.46.

Table 6.46 Summary of Water Quality Issues Associated with TLH - Phase III Operation

Activity/Issue	Concern	Comment
Exposed acidic rock near watercourse crossings could lead to elevated concentrations in water.	pH, As, Fe, SO_4, Cu, Al, Total Acidity, Alkalinity, Conductivity	Measures are outlined in Section 6.7.7 for the detection and characterization of acidic rock. Measures will be taken to minimize disturbance to these areas so as to avoid potential leaching to freshwater.
Maintenance	Paints, Preservatives	Guidelines and practices for the proper handling of preservative coating materials will be included with appropriate contract documents.
Ice control	Salt	Salt will not be used on the TLH - Phase III for ice control. A small amount (<5 percent) will be mixed with sand to prevent freezing of stockpiles.
Dust Control	Minor effect to flora and fauna	No action is warranted.

Accidental events that could acutely or chronically affect water quality or water quantity include:

- hazardous material spills may occur during construction, operation or as a result of materials transported;
- fire can occur as a result of construction activities, temporary camp operation and highway maintenance activities, accidents relating to the operation and use of the TLH - Phase III, or accidents unrelated to the highway (i.e., lightening strikes); and
- highway crossing failure such as a collapse, washout or flooding can occur during seasonal high flow periods.

6.8.5 Issues and Concerns

The issues and concerns relating to the potential interactions during construction, operation and from accidental events are for the most part, the same as for fish and fish habitat.

Fording streams at areas of unstable banks or substrates may lead to increased sedimentation, which will degrade water quality. Erosion and resulting sedimentation will be also be increased from poorly controlled runoff from areas of clearing, grubbing, excavation, quarry/borrow pit operation, and aggregate production. The same can be said for runoff and airborne dust during operation of the highway.

Blasting has the potential to affect water quality by the introduction of toxic blast residues (ammonia).

Concrete batch plants and aggregate washing have the potential to introduce silty material into watercourses and liquid concrete products and truck washing residues have a high pH and can degrade water quality (i.e., toxic to plants, invertebrates and fish).

During highway construction, blasting and excavation may expose acid generating rock to the elements, resulting in ARD to streams and ponds.

Untreated sewage that is allowed to enter ponds and streams has the potential to introduce pathogens such as *E. coli*, harmful chemicals such as ammonia, and lead to excessive BOD loading and nitrification. Improper disposal of solid wastes can also introduce harmful chemicals. This reduces the water resource value for recreational and domestic use, and can affect aquatic life.

Ice control on the highway will be limited to the application of sand, with the resulting potential for increased sedimentation if highway drainage is poorly designed or poorly controlled.

All manner of hazardous materials that are improperly handled, store or accidentally spilled will potentially degrade water quality. These materials include fuels, lubricants, cleaners, solvents, deicing fluids, other materials that will be used during construction and operation, and materials that will be transported during operation.

Poorly designed or installed culverts and bridges have the potential to alter stream flow and result in scouring, which could lead to increased bank erosion, turbidity and sedimentation. Insufficient sizing of culverts could cause water back-up, flooding and subsequent erosion and increased turbidity. Another result of poor planning and inadequate sizing could be the formation of ice dams that obstruct water flow during spring breakup.

A regular inspection and maintenance program will be implemented to identify and rectify potential problem areas along the highway, where there is risk of culvert or highway failure. These types of failures are unlikely to occur but could result in moderate to massive introductions of sediment.

Forest fires could result in introductions of sediment and ash, which could change water chemistry and increase turbidity. When fire destroys riparian vegetation, the risk of erosion is increased.

6.8.6 Existing Knowledge

Sedimentation (increased sediment load and deposition) is perhaps the most recognized environmental effect on aquatic systems and water quality during highway construction. Sediment deposition can result from a variety of activities, including fording, blasting, vegetation clearing, highway construction, and bridge and culvert installation. Suspended sediment also occurs naturally in watercourses along the route, as witnessed following a heavy rain during the field survey in September to October 2002. The environmental effects of sediment are well studied and understood, mainly dealing with the effects on fish and fish habitat, as discussed in Section 6.5. Effects on water resources include:

- degradation of water quality (i.e., oxygen levels, light penetration, water temperature, water chemistry such as organic content and metals); and
- changes in stream morphology and stream bed porosity.

Sedimentation and siltation can be virtually eliminated during construction and operation, if proper mitigative steps are taken as discussed in Section 2.6. Current Canadian guidelines for suspended solids have been set by the Canadian Council of Resource and Environment Ministers (CCME 2001). Suspended solids should not increase by a level exceeding 10 mg/L when background suspended solids concentrations are equal to or less than 100 mg/L. Suspended solids should not increase by a level exceeding 10 percent of background concentrations when background concentrations are greater than 100 mg/L.

Experience in the construction of TLH-Phase II showed that during low flow conditions, much of the water was lost in some culvert pipes because it flowed under the pipe rather than through it. The cause of this was the use of oversized 'clean' fill in the culvert installation where water could flow through the material in question. Where this may not be a hydrologic problem or result in any problem with the integrity of the pipe installation, the reduction or loss of flow could prevent fish passage during the low flow condition (noting that fish passage may otherwise be impeded in the brook itself). Careful installation can prevent this occurrence, and follow-up monitoring will detect recurring problems that can then be remediated.

Clearing vegetation near riverbanks removes shaded habitat and increases bank erosion. Shaded areas provide cooler temperatures during periods of warm, sunny weather.

Blasting can cause resuspension of sediments (Munday et al. 1986), bank failure and resultant sedimentation. Nitrogen-based explosives can affect aquatic life through direct toxicity, reducing dissolved oxygen during nitrification and providing nutrients for aquatic plants. Nitrite is highly toxic to fish; ammonia can cause gill damage and nitrate promotes algal growth. Pommen (1983) provides detailed information on the potential chemical effects of blasting.

Acid rock drainage can result from the exposure of mineralized rock to water in the presence of oxygen and, bacteria. The resulting lower pH can severely reduce the pH of the runoff from the area and subsequently, affect the water quality in receiving streams and ponds where natural buffering does not occur. Natural buffering (alkalinity) is fairly low in most areas along the highway route.

The crushing and laying of granular rock has the potential to accelerate the ARD processes associated with sulphide-bearing rock, which is exposed through the highway construction process. The most significant problem with acid generation is that it may accelerate over time and, once begun, is almost impossible to stop the dissolution of metals. The incorporation of metals into organic compounds may result in increased bioavailability of metals or in bioaccumulation and toxicity, which in turn could lead to adverse effects within the ecosystems.

Hazardous materials spilled into the aquatic environment can degrade water quality, and result in adverse environmental effects on plants, invertebrates and fish.

The introduction of liquid concrete products or wash residues into watercourses can increase sedimentation and change water chemistry (primarily pH).

The main concern with domestic sewage is the potential to increase nutrient loading, suspended sediment or introduce oil and grease or other contaminants into a watercourse. These introductions can lead to eutrophication of waterbodies, adverse sediment effects or water quality contamination.

Several authors have reported that in the years following forest fires, sedimentation, alkalinity and temperature of streams and lakes in the area are increased, thereby altering water quality. The magnitude of change in these factors is dependent on the size of the burned area and the size and flow rate of affected streams. Smaller streams are probably more susceptible to habitat alteration as a result of fire than are large rivers (Kelsall et al. 1977).

Improperly installed culverts can change (throttle) stream morphology, leading to flooding, increased scouring and increased turbidity. Some of these changes may have effects on the upstream and downstream watercourse.

6.8.7 Mitigation

The WST is committed to minimizing adverse environmental effects of the project on water resources. Regulations, guidelines, codes of good practice, mitigation and environmental protection measures specifically related to the protection of fish and fish habitat are integral parts of the project description and environmental protection planning, and are outlined or detailed in Section 2.6 and include:

- water conveyance structures (culverts and bridges) will be designed and installed to accommodate extreme flow conditions (high and low flows), and reduce the potential effects of ice and other blockages;
- bedrock geology along the proposed route has been examined for ARD potential, confirmatory sampling will be conducted and the risk evaluated to determine final alignment and appropriate mitigation to limit ARD;
- watercourse crossing installation carried out in the dry by diverting or pumping water around the construction area;
- pipe arch culverts will be used on many streams;
- fording activities will be minimized or avoided, where possible;

- proper buffers will be maintained along watercourses wherever possible and at riparian areas that must be disturbed will be stabilized to control erosion;
- adherence to regulations, guidelines, codes of good practice;
- follow-up inspections verifying culvert installation and operation; and
- details provided in EPP.

As with the mitigations for the protection of fish and fish habitat, there are no unique or extraordinary mitigation measures that apply to this project with regard to water resources.

Many of the potential adverse effects stem from the improved access provided by the highway, and the associated increase in human presence and activities in this previously remote area. Mitigating these potential effects, is for the most part, beyond the ability and responsibility of WST. Managing these actions and their potential effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented by th appropriate agencies in an effective and timely manner.

6.8.8 Environmental Effects Assessment

The following sections discuss environmental effects and their ecological, social, cultural context on water resources for each project phase.

6.8.8.1 Construction

Construction may have localized effects on water quality. Effects will be limited to one construction season at any given location. Both instream and near-stream activities conducted during construction may affect water quality from the point of disturbance to some distance downstream. The main issue is likely increased turbidity and sedimentation and these will only remain elevated until the suspended material settles out, most likely at the first pond or steady downstream. The built-in mitigative measures, as well as adherence to WST's standard mitigative measures to be developed and included in the construction EPP, will prevent or minimize any adverse effects. Also, WST's resident engineer or the ESO will ensure that the contractor complies with the EPP, and all permits, approvals and authorizations. WST also has the benefit of experience with the recently completed TLH - Phase II, which had similar challenges to those projected for TLH - Phase III.

Any sedimentation and siltation and discharges or spills into watercourses, will degrade water quality. While mitigation measures will minimize sediment disturbance, it is likely that temporary sedimentation will result from the limited in stream construction. However, any sedimentation will be within permitted levels or be of very brief duration. Instream work, which may cause elevated suspended solids, will be limited to the "footprint" of the bridge foundations and culvert structures. Where possible, these will be installed in the dry, thus reducing the risk of sedimentation. With the proper mitigative and environmental protection measures, effects of sedimentation and siltation will be further reduced. Environmental effects on water quality will be localized.

The proposed highway has not been surveyed; therefore, specific requirements for blasting have not yet been defined. It is anticipated that there will be requirements for blasting during construction, but it is unlikely that underwater blasting will be required. As well, blasting will not be required at all watercourse crossings. With the proper mitigative procedures, as proposed by WST, it is anticipated that the environmental effects on water quality from blasting will be, at few locations, localized and, for the most part, controlled.

A review of surficial and bedrock geology has been conducted to determine areas along the proposed route where ARD potential exists. The highway design in those areas identified as at risk will be reviewed to determine if excavations and cuts are likely to expose reactive rock. The potential for exposure may be reduced by design modification (i.e., reduce cut and use more fill), local realignment, or other appropriate mitigative measures if the presence of reactive rock is confirmed in the field.

Compliance with the existing provincial water and sewer regulations will ensure that adverse environmental effects from sewage are reduced to acceptable levels. WST is committed to ensuring that sewage and waste disposal for construction camps complies with the Department of Health guidelines and the *Environment Control (Water and Sewage) Regulations.*

One problem that did occur at a few locations along TLH - Phase II was that, at a few locations, water flowed under the culvert barrel rather than through it. This could result in chronic or sporadic erosion and elevated suspended solids. The cause of the problem was using clean fill (blast rock) to embed the culvert - resulting in seepage through the rock fill. This will be rectified at the affected locations by sealing the inflow end with concrete. Measures will be taken to ensure the fill around culverts in TLH - Phase III is impermeable, to avoid this problem.

The effects of construction activities on water quality will be localized and of short duration, and is predicted to be minor.

6.8.8.2 Operation

Highway operation may affect water quality and hydrology at the stream crossing locations and downstream. Potential effects will extend over the life of the highway. However, mitigative measures built into bridge and culvert design will avoid or reduce these effects.

Maintenance activities, such as grading and ice control, which will be limited to sand application, may also cause sediment to be deposited in the watercourses. Reasonable care in application of sand and controlling erosion from grading will reduce this risk substantially.

Regular inspection and maintenance will be conducted to avoid debris build-up or beaver workings in culvert inlets. Culverts will be kept free of blockages to avoid flooding and control potential erosion.

Concern has been raised for the potential effects of airborne dust from highway operation on aquatic habitat and fish. Although this is a highly visible and possibly chronic phenomenon, the material that would be deposited in streams and ponds is mainly fine sediment. Accumulations of this material will be easily mobilized and flushed from the streams by high flows. The eventual fate will likely be ponds, lakes and other depositional areas as is the case for other suspended sediments. Dust control that will be applied to the highway will be limited to water spray during construction.

The effects of operation of the proposed highway on water quality is predicted to be minor.

6.8.8.3 Accidental Events

Fuel or chemical spills entering fish-bearing streams could temporarily degrade water quality. In addition, contaminants can accumulate in sediments and be mobilized slowly over time. If a major spill of a highly toxic and soluble material were to occur at one of the watercourse crossings, the geographic extent would include both the crossing site and areas downstream in the watershed, potentially to the river mouth, depending on the quantity and toxicity of the material spilled. Changes in water quality could also affect biological processes at all trophic levels. The extent of the effect would be dependent on the timing, nature and volume of the material spilled. Subsequent to a spill of hazardous materials, the high spring flows and high bedload transport would effectively flush the system during the spring following the event, thus setting a temporal boundary.

Contingency procedures will be developed and included in the construction EPP to ensure that a fast and effective response will occur in the event of a spill.

The potential effects of a forest fire in the project area could be significant. A forest fire could alter water quality within streams throughout the watershed. Due to the limited number of available personnel during operation and the isolation of some areas, fire fighting capabilities would be limited. Fire within the assessment area of the highway could occur during any phase of the project due to lightning or human activities. Factors influencing the severity and duration of effects include time of year, extent of fire damage and type of fire (chemical, forest). The risk of forest fire is slightly higher than under natural conditions due to the presence of human activity along the highway route, which may be subsistence, recreational or commercial in nature.

A fire that destroys much of the riparian vegetation could have short and long-term effects on water quality. In the short-term, elevated pH and suspended solids (from ash and silt) would immediately follow a major fire. The loss of riparian vegetation could lead to loss of shade and result in seasonally elevated water temperatures. In the medium to longer term, loss of riparian vegetation could lead to increased erosion and sedimentation. Spring flows and high bedload transport would effectively flush the system during the spring following the event; however, erosion within the watershed would continue to contribute sediments to the stream system for a number of years. Changes to groundwater patterns and contribution to baseflow in the stream may be altered during this period due to changes in evaporation and infiltration rates. Restoration of bank stability and cool temperatures would rely on the re-establishment of riparian plant communities through vegetative succession.

As well, a temporary degradation of water quality due to increased sedimentation and culvert or concrete debris would occur in the event of highway failure or washout. This could have a subsequent effects on freshwater fish. Factors influencing the geographic extent, duration and magnitude of effects include time of year, and location in watershed.

Roads are most susceptible to washouts during the high flow period during and immediately following the spring snow melt. The highway design will focus on protection of the aquatic environment by incorporating buffer zones, drainage and erosion control features and very conservative culvert design criteria. Culverts will be installed with consideration for highway and stream gradient, ice conditions, bank stability and, where warranted, protection of fish habitat.

6.8.9 Environmental Effects Evaluation

Potential effects on water quality will relate mainly to potential deterioration of water quality due to introduction of sediment, change in pH or the introduction of deleterious substances (such as hydrocarbons and ammonia). The following section provides evaluation criteria based on the potential adverse environmental effects of these changes in water quality.

Regulations and permit conditions will set water quality criteria for the undertaking. Failure to meet a water quality criterion is a serious regulatory issue, but may have reduced environmental implications in the context of a specific site or condition. The environmental significance of adverse water quality conditions will depend on the nature of the resulting adverse environmental effect.

The following definitions, which are used to rate the significance of the predicted residual environmental effects of the project on water quality are taken from the Duck Pond Copper Zinc Project EIS (JW 2001). A summary of the effects of the project on water resources is provided in Table 6.47.

A **major (significant) environmental effect** is rated as high magnitude and would result from a long-term (>37 months), widespread (>100 km^2), very frequent (>51 events/year) and non-reversible adverse effect to water quality that results in adverse effects to freshwater ecology (fish, fish food or fish predators) or water resource use by humans.

A **moderate (significant) environmental effect** would result from a shorter-term (13 to 36 months), less-widespread (11 to 100 km^2) frequent (11 to 50 events/year), and possibly reversible adverse effect to water quality that results in adverse effects to freshwater ecology (fish, fish food or fish predators) or water resource use by humans.

A **minor (not significant) environmental effect** is rated as low magnitude would result from a localized (<1 to 10 km^2), infrequent (<10 events/year), brief (1 to 12 months) and reversible effect to water quality that may result in adverse effects to freshwater ecology (fish, fish food or fish predators) or water resource use by humans.

A **negligible (not significant) environmental effect** is rated as nil or low magnitude and is one where water quality changes are beyond the range of natural variability, but the resulting ecological or socio-economic effects are not discernible, or are localized and fully reversible.

Table 6.47 Environmental Effects Summary - Water Resources

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • culverts and bridges will be designed and installed to accommodate extreme flow conditions and to reduce the potential effects of ice and other blockages; • bedrock geology examined for ARD potential, confirmatory sampling will be conducted; • watercourse crossing installation carried out in the dry by diverting or pumping water around area; • pipe arch culverts will be used on many streams; • fording activities will be minimized or avoided, where possible; • buffer areas will be maintained along watercourses and minimum riparian areas will be disturbed; • measures will be taken to control erosion; and • adherence to regulations, guidelines, codes of good practice, details provided in EPP.			
Environmental Effects Criteria Ratings			
Magnitude	Low	Low	Unknown
Geographic Extent	37630	37630	11-100
Frequency	<10	<10	<10
Duration	<1	<1	37632
Reversibility	Reversible	Reversible	Unknown
Ecological/Socio-economic Context	Low/Related to fish and fish habitat and resource use and users.		
Environmental Effects Evaluation			
Significance	Not Significant (Minor)	Not Significant (Minor)	Significant (Moderate)
Level of Confidence	High	High	Medium
Likelihood[1]	n/a	n/a	Low
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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: • compliance monitoring as required by federal and provincial authorizations, recommendations • regular inspection and maintenance at all crossing locations			
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		

Construction of the TLH - Phase III will have minor (not significant) environmental effects on water resources. Effective mitigation and environmental measures will minimize effects during highway construction. The duration of any potential adverse effects on water resources is limited to one construction season at any location.

Highway operation will have minor (not significant) environmental effects on water resources. The duration of the effect could be indefinite, based on recurrence throughout the operation phase; the frequency reflects various maintenance schedules and natural perturbations. Again, knowledge and understanding of the potential effects of project operation on water resources is reasonably high.

Accidental events would have a moderate (significant) environmental effect on water resources if these events occur. Due to the uncontrollable and unpredictable nature of events such as forest fires, and hazardous spills, potential exists for these events to occur. WST will implement mitigative measures to minimize the risk of these events occurring. However, accidental events (including hazardous materials spills, fires, and flooding/road washout) cannot be eliminated. Based on the environmental effects analysis, a worst-case accidental event would result in an adverse and moderate effect on water resources. The likelihood of such events occurring is very low given the construction and design standards, and operating and maintenance procedures to be followed and routine monitoring. Reversibility is moderate to high.

6.8.10 Cumulative Environmental Effects

The proposed TLH - Phase III will result in minor and fairly localized (1 to 10 km^2) effects to water quality during construction and operation of the highway. Development activity in the project area has been relatively limited to date, and there are no communities located along this portion of the TLH. Past and on-going activities in the area such as recreational hunting and angling, hiking/boating and aboriginal land and resource use activities have had limited effect on water quality in the region.

Although there is some potential for cumulative effects to water quality in combination with Phases I and II of the TLH, this would be limited to watersheds at the ends of the proposed highway (i.e., Paradise River and Churchill River). Other current and potential projects and activities elsewhere in Labrador, such as the Voisey's Bay Mine/Mill, have not or will not have an effect on water quality within the proposed project area. Therefore, there is little potential for interaction between the effects of these actions and those of the proposed project.

By its nature, the new highway will facilitate future economic development in the region, particularly resource development activities such as forestry. Forestry activities have the potential to affect water quality through, for example, the siltation of watercourses due to erosion after vegetative cover has been removed and from forest access roads. The improved access provided by the highway will also likely result in increased mineral exploration throughout the region. Environmental legislation, regulations and guidelines relating to forestry and mineral exploration activities (e.g., maintenance of buffer zones) will ensure that the effects of any such activities on water quality are controlled. There will also be improved access for hunting, fishing and other land and resource use activities. Cabin development will also likely increase which may affect water quality, particularly as proximity to a waterbody is often preferred. All of these activities are regulated under provincial and federal legislation and as such, there are measures available to assess and mitigate adverse environmental effects.

Details such as the likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known and the control of most potential induced actions and related effects is beyond the ability and responsibility of WST. Control depends on appropriate enforcement, management and planning on the part of relevant regulatory agencies to ensure that any such effects are avoided or reduced. As a result, a number of assumptions have been made in considering induced actions in the cumulative effects assessment, 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;
- the level of 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.

With the implementation of these mitigation measures, particularly appropriate planning and enforcement, the proposed project is not likely to result in significant adverse cumulative effects on water resources in combination with other projects and activities that have been or will be carried out.

The creation of the Akamiuapishku/Mealy Mountains National Park would provide increased protection to water resources in the proposed project area by placing portions of the route under rigorous constraints with regard to resource harvesting, highway construction, the use of motorized vehicles, and hunting, fishing and other recreational pursuits.

6.8.11 Environmental Monitoring and Follow-up

Environmental monitoring of water quality in the form of compliance monitoring will be conducted in accordance with provincial and federal regulatory requirements, and/or as deemed necessary by WST.

WST will review the need for additional water sampling where there is a concern about the effectiveness of the mitigation measures. The water quality of the area has been characterized on a regional basis from existing sources such as the *Water Resources Atlas of Newfoundland* (Department of Environment and Labour 1992) and from water sampling conducted at 35 stream crossing locations.

In addition to any water quality monitoring, there will be a program of follow-up monitoring of all stream crossing installations and structures to ensure that they are performing properly.

6.9 Wetlands

Wetland functions are the natural properties and processes (physical, chemical and biological) of wetland ecosystems. Wetlands 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. In recent years, wetland loss has been connected with increased flooding, poor water quality, desertification, and declines in fish and wildlife populations (Lynch-Stewart et al. 1999).

6.9.1 Boundaries

The project boundary is the cleared right-of-way and areas of associated physical disturbance.

Wetlands in Newfoundland and Labrador are under provincial jurisdiction, except on federal lands such as national parks. Newfoundland and Labrador has a *Policy for Development in Wetlands* under the *Environmental Protection Act*. Provisions for protecting wetland areas are also found under the *Wildlife Act* and the *Municipalities Act*. The objective of the *Policy for Development in Wetlands* is to permit developments that do not adversely affect water quantity or quality, hydrologic characteristics or function, or terrestrial and aquatic habitats of wetlands (Department of Environment and Labour 2001). A *Federal Policy on Wetland Conservation* was approved in 1991 and applies to the full range of federal activities. The objective of the policy is *to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and into the future* (Lynch-Stewart et al. 1999).

Maintenance of function in wetlands within 100 m of the centreline will be the basis on which the environmental effects analysis will be conducted for this VEC.

6.9.2 Methods

Wetlands along the proposed highway right-of-way were identified and described using a combination of helicopter and ground-based surveys. Each wetland type within 100 m of the centreline of the proposed highway was identified and recorded using a GPS. Wetlands were classified using the Canadian Wetland Classification System (NWWG 1988).

A detailed examination of the wetland types within this survey area was conducted to determine the relative frequency of occurrence of various wetland types and to describe the dominant plant species associated with each.

Following identification of the wetland types, three to six examples of each were randomly selected for floristic description. At each of the selected sites, the dominant plant species were identified and their cover estimated. Wetland vegetation was divided into three structural categories, trees (woody plants greater than 5 cm in diameter at breast height (DBH)), shrubs (woody plants less than 5 cm DBH) and ground vegetation (herbaceous vascular plants, bryophytes and lichens).

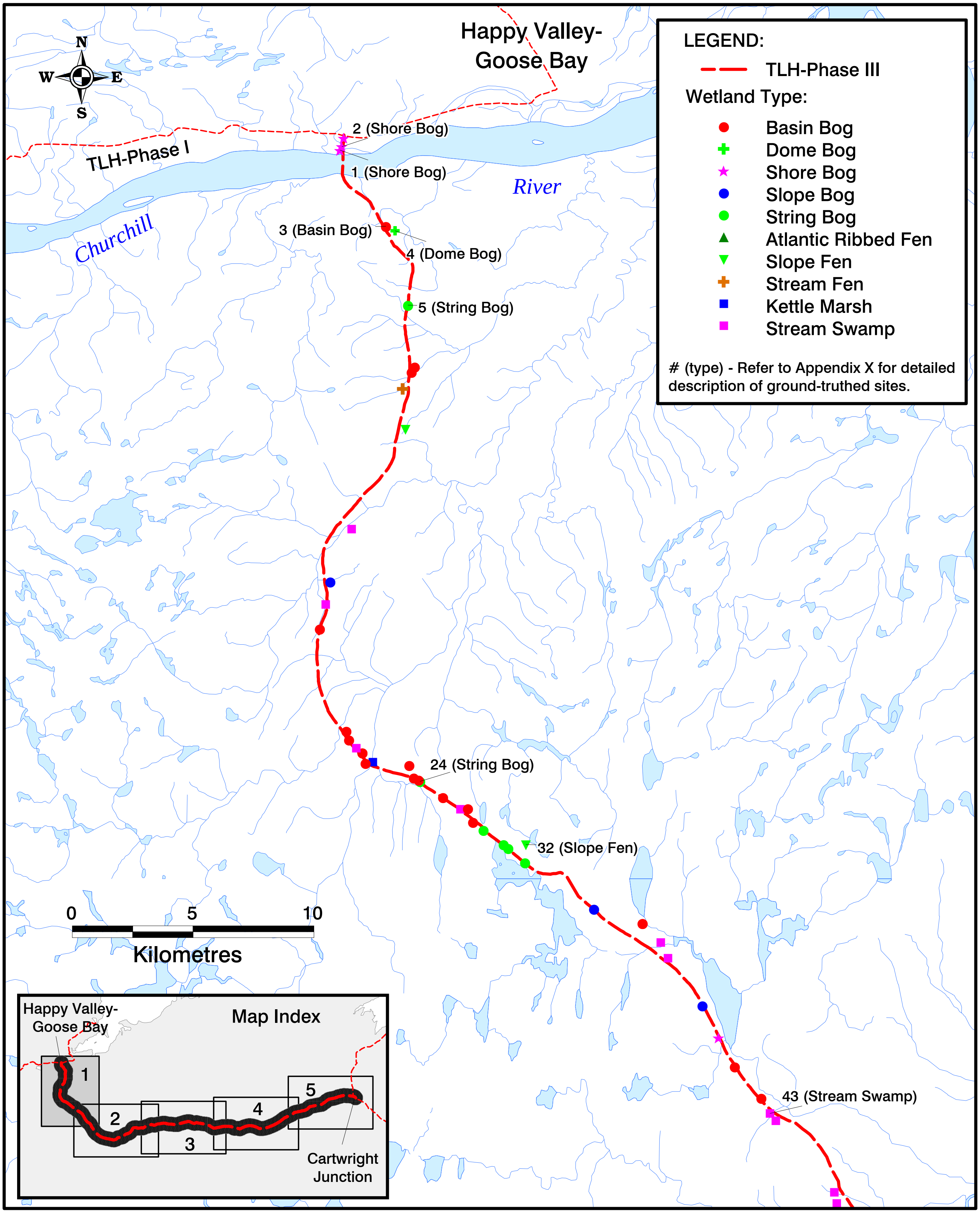
6.9.3 Existing Environment

A total of 345 wetlands were recorded during the aerial survey (Figures 6.23 to 6.27). Four general wetland forms were present along the route, including bog (72.5 percent of recorded wetlands), fen (15.4 percent of recorded wetlands), swamp (10.7 percent of recorded wetlands), and marsh (1.4 percent of recorded wetlands) (Table 6.48). Each wetland form is discussed below. Representative photos of each wetland type are provided in Appendix R.

Table 6.48 Wetland Types Within 100 m of the Highway Right-of-Way

Wetland Type and Form	Number within 100 m of RoW	Proportion of all Wetlands (%)
Bogs		
Dome Bog	3	0.8
Basin Bog	86	24.9
Shore Bog	26	7.5
Slope Bog	66	19.1
String Bog	69	20
Total	**250**	**72.5**
Fens		
Atlantic Ribbed Fen	11	3.2
Slope Fen	33	9.6
Stream Fen	9	2.6
Total	**53**	**15.4**
Marshes		
Kettle Marsh	**5**	**1.4**
Swamps		
Stream Swamp	**37**	**10.7**

The plants associated with each wetland type and the average percent cover of each plant in each wetland type are provided in Table 6.49. Detailed plant community descriptions for each ground-truthed site are presented in Appendix S. Scientific names of all plant species are provided in Appendix E.



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Environmental Scientists
Consulting Engineers

Figure 6.23

Wetland Survey - Block 1
TLH-Phase III

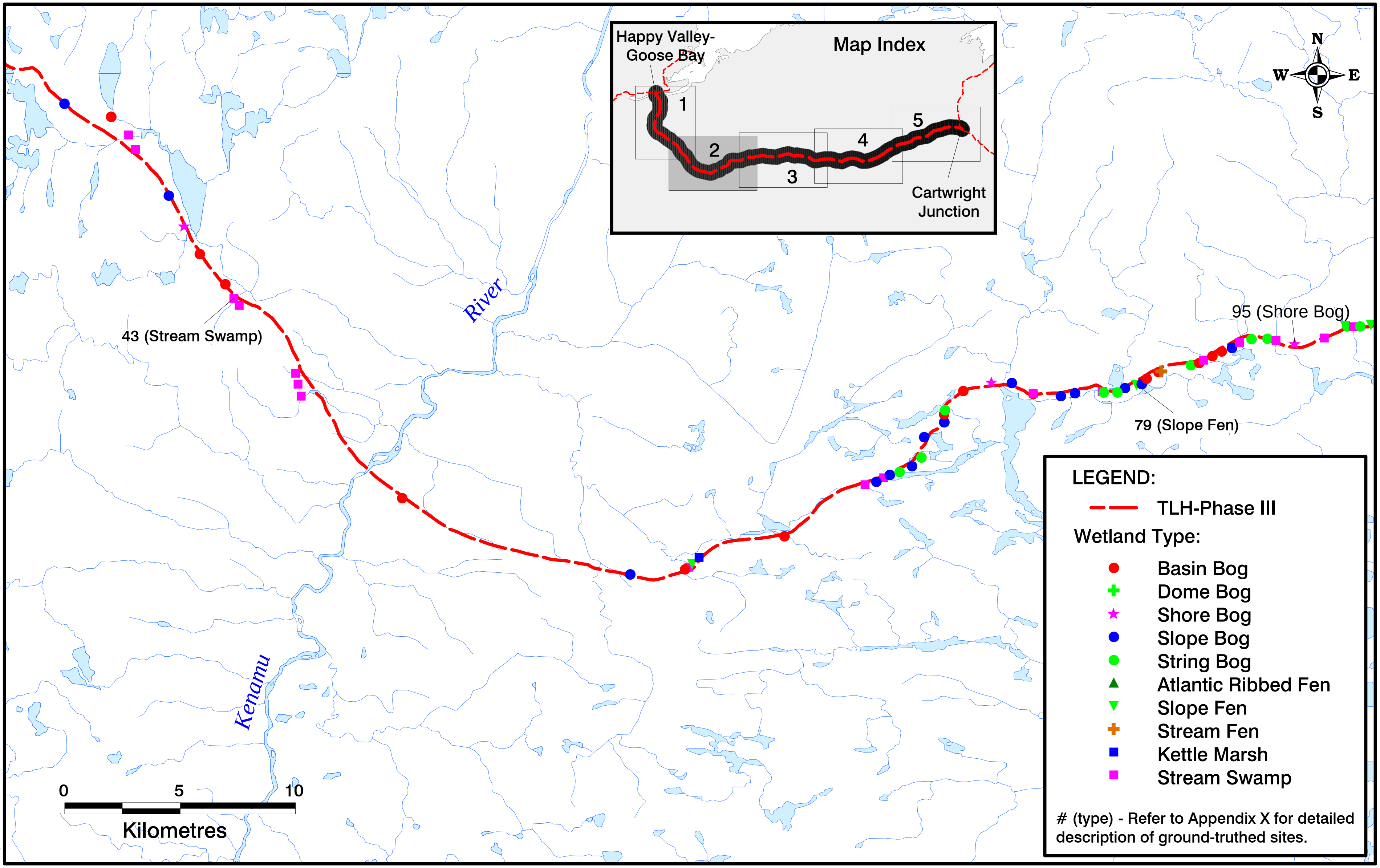

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Figure 6.24

Wetland Survey - Block 2
TLH-Phase III

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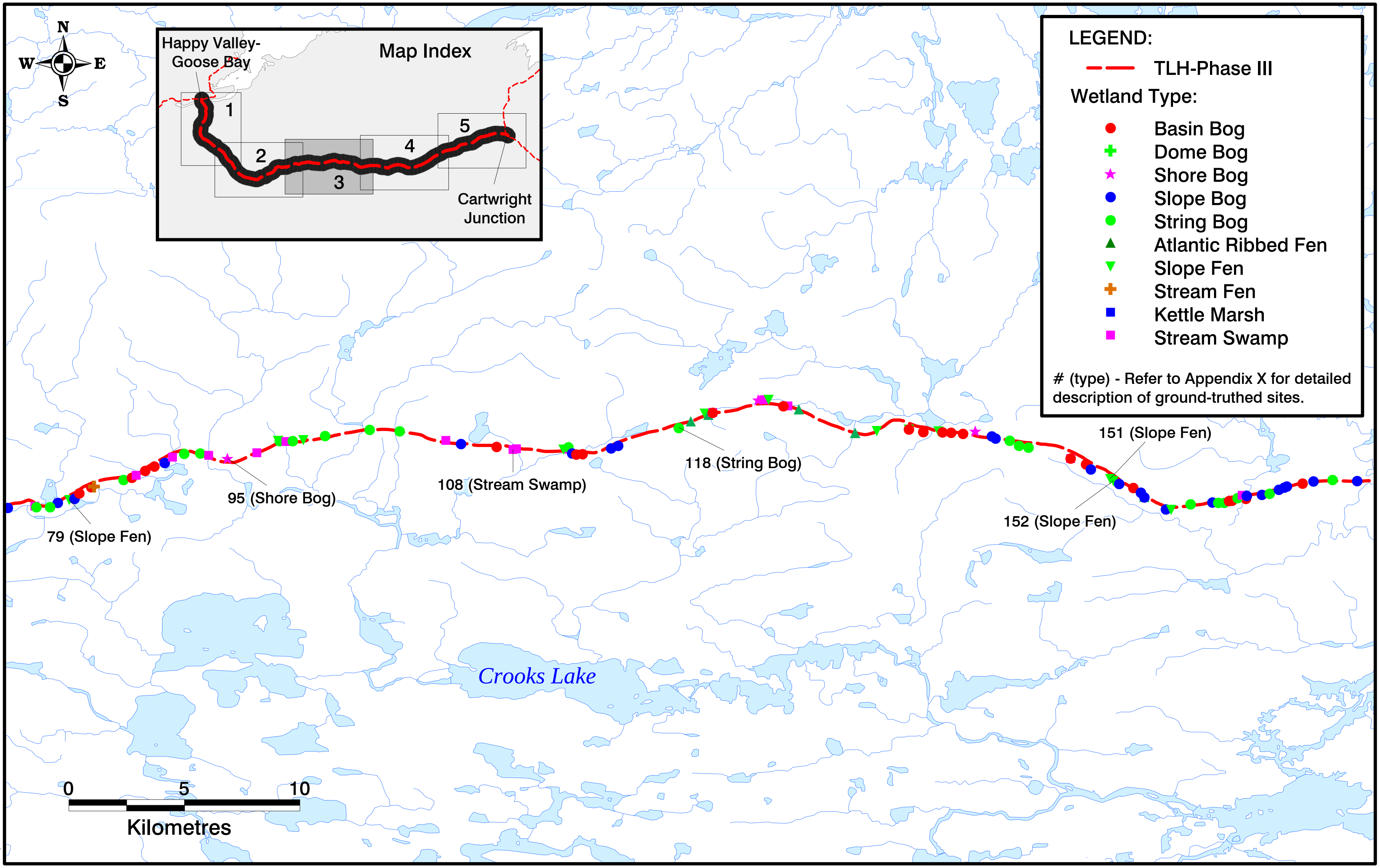

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Figure 6.25

Wetland Survey - Block 3
TLH-Phase III

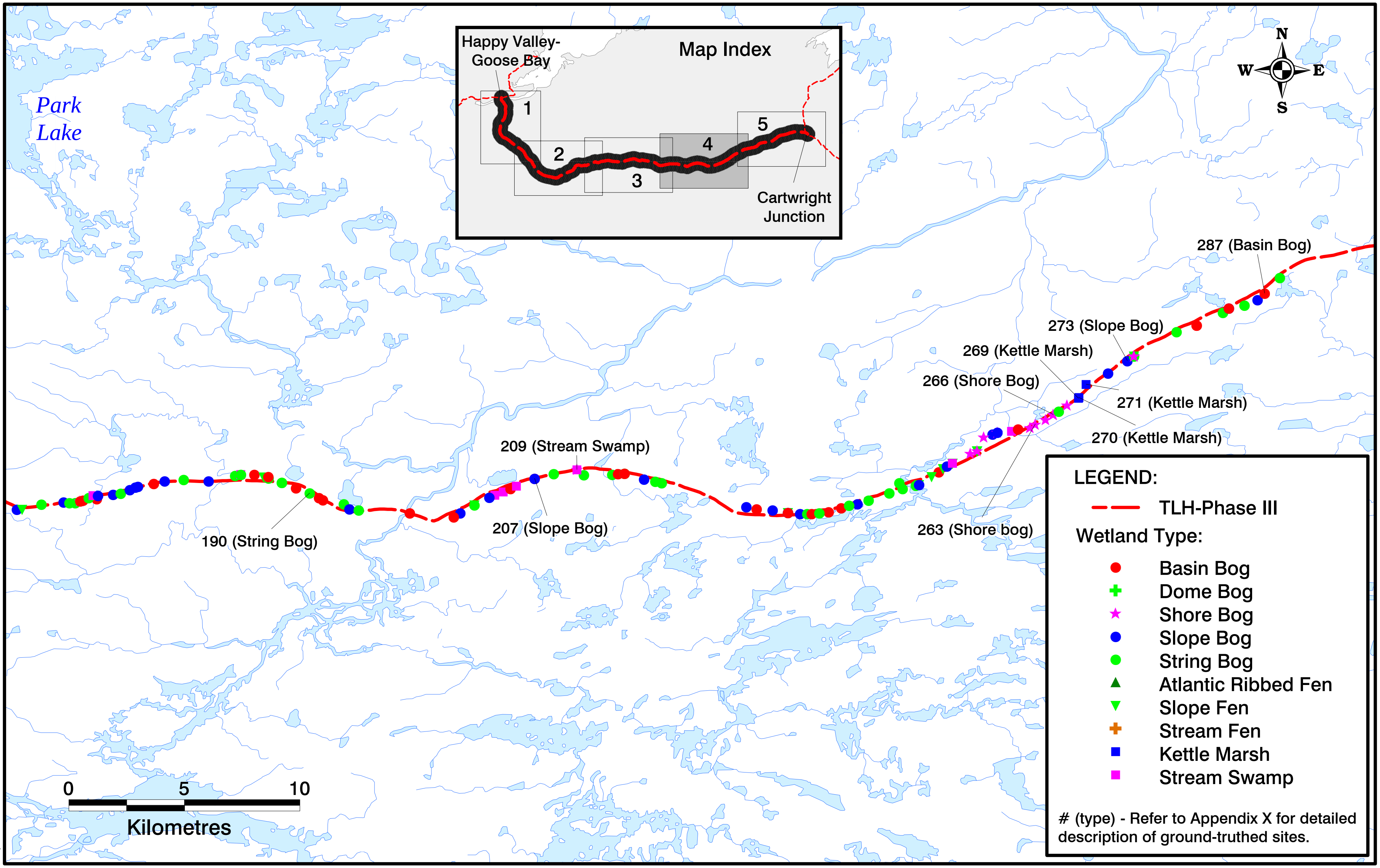

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Figure 6.26

Wetland Survey - Block 4
TLH-Phase III

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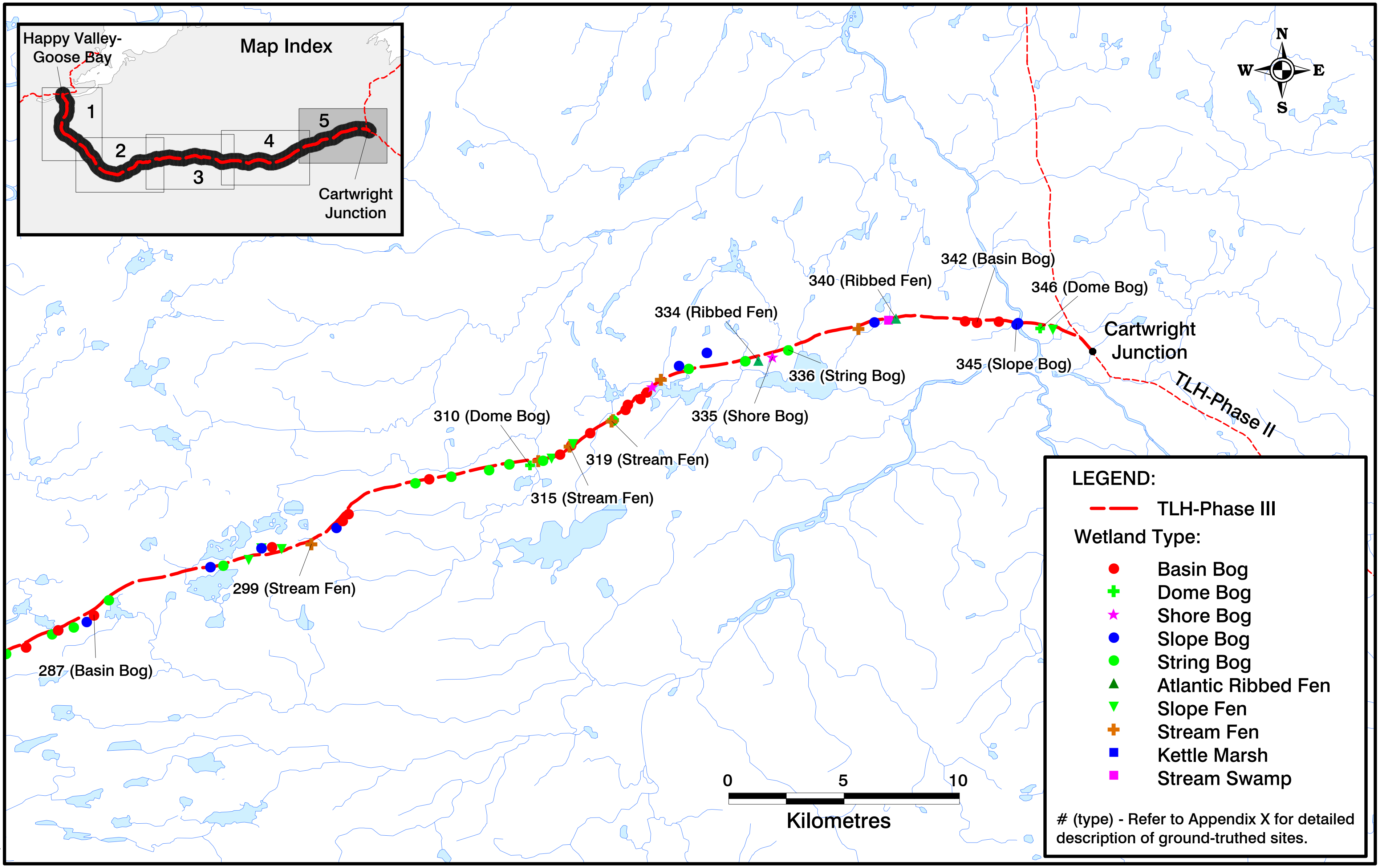

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Figure 6.27

Wetland Survey - Block 5
TLH-Phase III

Table 6.49 Dominant Plant Species and Percent Cover at Selected Wetland Sites

Common Name	Wetland Type									
	Dome Bog	Basin Bog	Shore Bog	Slope Bog	String Bog	Ribbed Fen	Slope Fen	Stream Fen	Kettle Marsh	Stream Swamp
Trees	**Average Cover (%)**									
Black Spruce	0.2	5	1.2	3.4	2	0.3	2	0.3	0	0
Tamarack	0.2	1	1.7	0.6	0.4	0.5	6	1.8	0	0.3
Shrubs	**Average Cover (%)**									
Leatherleaf	26.7	18.3	22.8	11	23	9.7	0	8.7	0.7	0
Black Spruce	0.7	26.7	7.9	21.7	8.3	4.5	1	3.3	0.2	0
Tamarack	5.3	11	6	10.5	10.2	9	9	3.5	0.2	0.3
Bog-rosemary	1.7	0.2	1	0.5	2.1	0.5	1.7	0.7	0	0
Bog Laurel	2.3	2.3	1.5	2	1.8	1	1.7	0.2	0	0
Sheep Laurel	3.3	2.3	0	0	0.4	0	0	0	0	0
Labrador Tea	0.7	5	3.2	2.7	1.2	0.3	0.2	0.7	0	0
Sweet Gale	0	0	2.2	0	0	0	0.2	15	0	0.3
Black Crowberry	0	1.7	1	5.2	0.4	0	0.2	0	0	0
Lowbush Blueberry	0	0	0	0.2	0	0	0	0	0	0
Alpine Bilberry	0	3.3	0.3	3.7	0.3	0.8	1.7	1.3	0.8	0
Northern Blueberry	0	0	0.2	0.1	0	0	0	0	0	0
Newfoundland Dwarf Birch	0	0	0	0	0.1	6	0.7	0.3	0	0
Glandular Birch	0	0	0.1	0.1	0	0	0	0	0	0.2
Dwarf Birch	0	0	0	0.1	0	0.7	5.3	1.7	0	0
Bog Willow	0	0	0	0	0	0	5	3.3	0	1.7
Pussy Willow	0	0	0	0	0	0	1.7	0	0	26.7
Balsam Willow	0	0	0	0	0	0	0.3	0	0	0
Mountain Flyhoneysuckle	0	0	0	0	0	0	1.2	1.7	0	0.2
Speckled Alder	0	0	1.1	0.1	0	0	0	0	0	46.7
Skunk Currant	0	0	0	0	0	0	0	0	0	1.3
Wild Red Raspberry	0	0	0	0	0	0	0	0	0	1
Ground Vegetation	**Average Cover (%)**									
Sphagnum moss	91.7	90	80.8	86.2	91	33.3	63.3	33.3	1.7	30
Deer Grass	21.7	1	0.8	9.2	6.4	18.3	0	15	0	0
Alpine Cottongrass	0	0	0	0	0	0	0.2	0	0	0
Bakeapple	10	5	3	6.2	4.8	0.7	0	0	0	0
Reindeer Moss Lichen	1	0.3	0	1.2	0.6	0	0	0	0	0
Reindeer Moss Lichen	2	0.3	1	0.5	0.6	0	0	0	0	0
Fewseed Sedge	7.3	9	12	12	12.6	26.8	0	36.7	26.7	0
Pitcher Plant	0.2	0	0	0	0.1	0	0	0	0	0
Three-leaved False Solomon's Seal	0	2.2	0.1	1.4	1	0	9.7	0.2	0	0
Rough Hairgrass	0	0	0	0	0	0	1.7	0	0	0
Fewflowered Sedge	2.3	5	0.3	1.5	0	0	10	0	0	0
Silvery Sedge	0	0	0	0	0	0	0.3	0	0	0

Common Name	Wetland Type									
	Dome Bog	Basin Bog	Shore Bog	Slope Bog	String Bog	Ribbed Fen	Slope Fen	Stream Fen	Kettle Marsh	Stream Swamp
Little Prickly Sedge	0	0	0	0	0	0	1.7	0	0	0
Coastal Sedge	0	0	0	0.2	0	16.6	0	2	0	0
Mud Sedge	0	0.2	1.3	1.2	3	3.3	9	3.3	0	0
Bog Sedge	0	0	0.6	0	0	0	5	0.2	0	0
Water Sedge	0	0	1.6	0	0	5	15	5	0	0
Arctic Hare's-foot Sedge	0	0	0	0	0	0	3.3	0	0	0
Three-fruited Sedge	0	0	0.2	0	0	0	0	0	0	5
Bottle Sedge	0	0	0	0	0	0	0	0	28.7	0
Brownish Sedge	0	0	0	0	0	0	0	0	3.3	0
Marsh Cinquefoil	0	0	0.2	0	0	0.2	0	0.2	0	0.2
Goldthread	0	0.3	0	1	0	2	0	0.3	0	0
Broom Moss	0	0	1.6	0	0	0	0	0	0	0
Water Horsetail	0	0	2	0	0	0	0.2	0	0	0
Tall Cottongrass	0	0	0	3.7	0.1	0	0	0	0	0
Rough Cottongrass	0	0	0	0	0	0.3	0	0	0	0
Hare's Tail	3.3	0	0	0	2	0	0	0.2	0	0
Tawny Cottongrass	0.2	0	0	0	2	0	0	0	0	0
Chammiso's Cottongrass	0	0.3	0	0	0	0	0	0	0	0
Creeping Snowberry	0	0	0.1	0	0	0	0	0	0	0
Smallflowered Woodrush	0	0	0	0	0	0	0.2	0	0	0
Bristly Clubmoss	0.3	0.1	0	0	0	0	0	0	0	0
Buckbean	0	0	0.8	0	0	0	0	0	0	0
Naked Miterwort	0	0	0	0	0	0	0	0	0	0.2
Moss spp.	0	0	0	0	0	0	3.3	0	1.7	3.3
Schreber's Moss	0	0.7	0.8	0	0	0	0	0.7	0	0
Pod Grass	0.2	0	2.6	0	0.6	0	0	0	0	0
Small Cranberry	0	1	0.2	0.5	0.8	0	0	0	0	0
Rough Aster	0	0	0	0.2	0	1.3	1.5	2.5	0	0
Hair-cap Moss	0	0	0.8	0	1	0	0	3.3	25.7	0
Thread Rush	0	0	0	0	0	0	0	0	8.5	0
Bluejoint	0	0	0	0	0	1.7	2.7	2	2.7	2.2
Violet	0	0	0	0	0	0	0	0	0.2	1.3
Bedstraw	0	0	0	0	0	0	0	0	0	0.3
Dewberry	0	0	0	0	0	0	0	0	0	2

6.9.3.1 Bogs

Bog is the most abundant wetland form along the route (Table 6.48). 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. The peat in bogs is composed largely of sphagnum peat and woody peat. However, sedge peat may be present in the lowest peat strata. Plants characteristic of bogs include sphagnum moss and erinaceus shrubs.

Bogs along the highway route are characterized by a continuous sphagnum moss carpet that is punctuated by patches of erinaceus shrubs, stunted conifers and graminoids. There is relatively uniform composition of plant species in bogs along the route. However, when the flora of the various bog forms are composed, there is some minor variation evident in species composition.

The shrub layer is moderately well developed and composed mainly of leather-leaf, stunted black spruce and tamarack. Other shrubs that are regularly associated with these bogs include bog laurel, bog-rosemary, Labrador tea, black crowberry, and alpine bilberry. Tree cover is diffuse and consists of a mixture of black spruce and tamarack, with black spruce typically more abundant than tamarack. In addition to sphagnum moss, the ground vegetation layer generally consists of fewseed sedge, bakeapple, deer grass, reindeer moss lichen, fewflowered sedge, mud sedge, and three-leaved false Solomon's seal. Bog pools typically support a growth of spatterdock and pod grass.

The bogs present along the highway route can be divided into five bog forms, including domed bog, basin bog, shore bog, slope bog, and string bog. Domed bogs are the least common bog form found along the route, with only three encountered during the survey (Table 6.48). Domed bogs are characterized by a dome-shaped peat deposit that rises gradually from the edge of the bog to a high point in the bog interior. Dome bogs often have a distinctive pattern of concentric bog pools. These bogs are generally large and have peat depths that are typically greater than 3 m. The vegetation of domed bogs found along the route differs from other bog forms in that it tends to have low cover of black spruce and Labrador tea and a high cover of deer grass and bake-apple. Domed bogs in the area are also characterized by the absence of black crowberry and alpine bilberry (Table 6.49).

Basin bog is the most common bog form, accounting for 25 percent of all of the wetlands recorded along the route (Table 6.48). Basin bogs are generally small bogs that develop in essentially closed basins without well defined inflows or outflows. The surface of the peat is flat and peat depths typically range from 1 to 2 m. The vegetation of basin bogs along the route can be distinguished from those of other bog forms by a relatively high cover of black spruce, Labrador tea and three-leaved false Solomon's seal (Table 6.49).

Shore bogs are non-floating bogs which have formed along the edge of a waterbody. Peat deposits in shore bogs are elevated above the surface of the water such that the surrounding surface waters do not infiltrate into the rooting zone. Twenty-six shore bogs were found along the proposed highway route (Table 6.48). The vegetation of these bogs was characterized by relatively high cover of Labrador tea and various sedge species, including fewseed sedge, water sedge, bog sedge, and mud sedge (Table 6.49). These bogs also typically have low cover of black spruce, tamarack, bakeapple, deer grass, and reindeer moss lichen. This is the only bog form in which sweet gale is present (Table 6.49). Sweet gale was typically found at the interface between the bog and the surrounding water body. Sweet gale was consistently found in shore bogs edging brooks but was infrequently recorded in shore bogs along the margins of lakes and ponds (Table 6.49).

Slope bogs are small bogs that form on the sides of hills. They typically develop in areas of high rainfall and/or low evapotranspiration. Slope bogs receive water from rainfall or drainage from other nutrient poor peatlands. They may receive some input of nutrient-enriched groundwater, particularly at the margins of the bog and, in these areas, support plant communities more reminiscent of fens than bogs. Peat accumulation in slope bogs may be in excess of 1 m. Slope bogs are abundant along the proposed highway route, with 66 slope bogs recorded within 100 m of the right-of-way of the highway (Table 6.48). The vegetation of slope bogs is generally similar to other bog forms in the area except that black spruce, tamarack, black crowberry, and alpine bilberry are more abundant (Table 6.49). The increased abundance of these species reflects the better drainage in this bog form. Leather-leaf cover in slope bogs is generally low compared to other bog forms (Table 6.49).

String bogs are the second most abundant wetland type found along the proposed highway route, with 86 recorded within 100 m of the highway right-of-way (Table 6.48). String bogs are often large and are typically found on gentle slopes. They are characterized by the presence of numerous linear pools that are oriented perpendicular to the flow of water through the bog. The pools are separated by narrow ridges of vegetated peat that are typically 2 to 3 m wide. Water in the bog is derived from nutrient-poor drainage from other bogs, as well as precipitation. Peat depths usually exceed 1 m. The vegetation of string bogs is characterized by high abundance of bog-rosemary, sphagnum moss and *Carex oligosperma* (Table 6.49).

6.9.3.2 Fen

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. The vegetation of fens typically consists of grasses, sedges and some sphagnum mosses. Consequently, the peat of fens is composed mainly of partially decomposed grasses and sedges rather than sphagnum moss. Peat depths in fens are generally thinner than in bogs in spite of the higher productivity of fens. This is attributable to the higher rates of decomposition in fens, which offsets the higher plant productivity. Many bogs are underlain by sedge peat, indicating that fens may eventually develop into bogs. In these instances, peat thickness increases to the point where the peat is no longer saturated with groundwater and nutrient-poor precipitation becomes the primary source of water in the rooting zone. This results in reduced sedge and grass biomass and increased biomass of sphagnum moss.

The plant communities present on the fens found along the proposed route are similar in species composition to the plant communities associated with bogs. Most of the dominant species are found in both wetland types (Table 6.49). The main difference between the two wetland types is the relative abundance of various species. The fens typically have substantially less sphagnum moss and erinaceus shrubs and considerably more sedge cover. Generally, the same sedge species are present. A few plant species are associated only with fens in the surveyed area, although they are generally not the dominant species. These include Newfoundland dwarf birch, dwarf birch, bog willow, coastal sedge, rough aster and blue-joint (Table 6.49).

Three fen forms were identified along the proposed highway route; Atlantic ribbed fen, slope fen and stream fen (Table 6.48). Atlantic ribbed fens are similar in appearance to string bogs. This type of fen is typically found on gentle slopes and, as in string bogs, the wetland consists of a series of parallel strips of peat separated by elongated pools oriented perpendicular to flow of water. The strips of vegetated peat are usually very narrow. Peat thickness ranges between 0.5 and 1.5 m. The vegetation in Atlantic ribbed fens in the survey area is composed mainly of herbaceous ground vegetation species, the most abundant of which are sphagnum moss, fewseed sedge, deer grass, coastal sedge, and bog sedge (Table 6.49). The presence of a high cover of coastal sedge differentiates Atlantic ribbed fens in the survey area from slope fen, and stream fen as well as from bogs.

Stream fens are found along the margins of channels in permanent and semi-permanent streams. The peat deposits in these fens are suffused by water from the stream during both normal and high water periods. Nutrients from the surface water are sufficient to maintain fen plant communities. Stream fens are typically small and are associated with small sluggish streams flowing through topographically defined basins in which the fen has established. In the survey area, the vegetation of stream fens is characterized by an abundant cover of sweet gale (Table 6.49). The ground vegetation layer can be distinguished from other fen forms by a relatively high abundance of fewseed sedge and rough aster (Table 6.49).

Slope fens form on seepage tracks on hillsides. Slope fens are generally small and have peat deposits that are less than 2 m in depth. In the survey area, the plant communities present on slope fens are substantially different from those present on other fen forms. Slope fens typically have a high cover of tamarack, dwarf birch, bog willow, sphagnum moss, mud sedge and water sedge (Table 6.49). Leather-leaf and fewseed sedge, which are important constituents of all other fen and bog forms, are absent in slope fens. The presence of three-leaved false Solomon’s seal, fewflowered sedge and bog sedge also differentiate this fen form from others found in the survey area (Table 6.49).

6.9.3.3 Marsh

Marshes are mineral wetlands or peatlands that are periodically inundated by standing or slowly moving water. Surface water in marshes generally fluctuate seasonally. The substrate of marshes usually consists of mineral soil, although it occasionally consists of well decomposed peat. The surfaces of marshes are typically laid out in zonal patterns consisting of pools, channels and distinctive patterns of plant species distribution.

Only one marsh form, kettle marsh, is present in the survey area and only five examples were identified within 100 m of the highway centreline (Table 6.48). Kettle marshes occur in well defined elliptical catch basins located in moraines and glacio-fluvial or glacio-lacustrine landscapes. These basins typically have relatively steep slopes. Water is derived from local surface water runoff and some interbasin or groundwater inflow.

Three of the kettle marshes identified during the survey were located within several hundred metres of each other at the base of an esker on which the proposed highway will be located. At the time of the survey, none of the marshes contained any standing water although all three marshes are found in basins which have no defined inflow or outflow. It appears that the basins fill with meltwater in the spring, eventually drying out through evaporation and infiltration.

The vegetation of these marshes is quite distinctive. There is very little tree or shrub cover. A few small black spruce and tamarack are present around the landward edge of the marsh. The most abundant shrub species are leather-leaf and alpine bilberry, which are also restricted to the outer edges of the marsh (Table 6.49). Ground vegetation varied between the individual marshes. In the largest marsh, fewseed sedge was the most abundant ground vegetation species, while in the smaller marshes, bottle sedge and hair-cap moss were the most abundant species. Other species characteristic of marshes in the survey area are thread rush and brownish sedge.

6.9.3.4 Swamp

Swamps are either mineral wetlands or peatlands that contain standing water or slowly flowing water in pools and channels. The watertable 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. As a result, plant productivity is generally high. Trees and shrubs are typically the dominant species.

Only one swamp form, stream swamp, was present along the proposed highway route (Table 6.48). Stream swamps occur along the banks of permanent or semi-permanent streams. Stream water maintains saturated soil conditions for much of the year. Water levels are highest during spring, following snow melt, and fall to their lowest level during the late summer. During high water periods, silt is often deposited in the stream swamp, which helps to maintain soil fertility. The vegetation of stream swamps in the survey area is characterized by the presence of dense, tall shrub thickets (Table 6.49). The dominant species are either speckled alder or pussy willow. Wild red raspberry and skunk currant are often found in the tall shrub understory. Trees are uncommon in this plant community and tree cover consists largely of scattered tamarack. The ground vegetation layer is also relatively sparse. The dominant species of the ground vegetation layer are sphagnum moss, blue-joint, dewberry, violet and bedstraw.

6.9.4 Potential Interactions

During construction, some areas of wetland may be altered through removal of wetland material, changes in drainage patterns that alter the natural hydrological regime, or sedimentation. During operation, emissions from vehicles including carbon, nitrogen and sulphur oxides, as well as minute particles of carbon and oil droplets (Bennett 1991), may contaminate wetland areas adjacent to the highway. Dust may inhibit photosynthesis in roadside plants. An accidental release of fuel or other hazardous material may contaminate wetland habitats adjacent to the highway.

6.9.5 Issues and Concerns

The primary issue related to wetlands and highway construction and operation is the potential for degradation of wetland function through removal of wetlands, sedimentation, changes in the hydrological regime, and pollution in the form of oxides, oil and dust.

6.9.6 Existing Knowledge

Wetlands perform a number of physical and ecological functions including:

- flood conveyance - wetlands adjacent to streams and rivers lie within natural floodplains and increase the ability of the landscape to accommodate flood flows without inundating adjacent lands;
- flood storage - wetlands have the capacity to store flood waters and to release them slowly, thus reducing peak flows;
- erosion control - wetland vegetation effectively stabilizes substrate and dissipates the energy of flowing water;
- pollution control - wetlands can filter sediments and organic matter, and use nutrients from the water flowing through them;
- support of small streams - wetlands often support base flows during drier periods and may prevent small streams from disappearing; and
- productivity - wetlands are often very productive, particularly for waterfowl and other birds.

Individual wetlands may exhibit a characteristic that makes them unique, such as their relative rarity in the general area or the presence of uncommon or rare flora or fauna.

Developments that are not directly on a wetland, but affect the local hydrologic regime, may also affect the wetland (Cox and Grose 2000). Highways can restrict the flow of surfacewater and groundwater to the point where water levels on the upflow side may be raised and those on the downflow side may be lowered. The effects that highways have on wetlands in which they are constructed depend primarily on the extent to which the surface and subsurface hydrology on the affected wetlands is disturbed. With surface flow, effective culvert placement can mitigate drainage-related effects of a highway embankment (Shuldiner et al. 1979). However, the change from a diffused flow to a concentrated flow, funneled through a culvert, may result in a disruption of the natural hydrologic flow regime and cause subsequent changes in the ecological environment. Similarly, impermeable fills and compression techniques used in highway construction may alter groundwater movements that affect the local water table (Shuldiner et al. 1979).

Oligotrophic communities (i.e., those with low nutrient levels) are likely to be particularly sensitive to pollutants, especially those which increase fertility, such as nitrogen (Angold 1997). The primary effect of nutrient enrichment is stimulation of plant growth that may increase populations of certain species already present in the environment and cause a decrease in other species that are not tolerant of such nutrients. For example, in southern England, where several roads with varying traffic densities were constructed in an otherwise undisturbed heathland, there was enhanced growth of vascular plants, particularly heather and grass species near the road, and a decrease in abundance and health of lichens near the road. This pattern was believed to be the result of increased nitrogen oxides from vehicle exhausts. The effect on lichen was detectable up to 80 m away from the road edge (Ferguson et al. 1984). The extent of the edge effect in the heath was closely correlated with the amount of traffic carried by the road, with a maximum edge effect of 200 m adjacent to a four-lane highway (>34,000 vehicles/12 hrs) (Angold 1997). Santelmann and Gorman (1988) also found that the heavy metal content of sphagnum mosses decreased geometrically away from a major road to a distance of 200 m. Near smaller roads, the effects were less reaching. For example, at 800 vehicles in 12 hours, the effects were measured up to 25 m from the road (Angold 1997).

During a storm event, sediment from highway construction has been estimated to be up to 200 times higher than that of grassed or forested lands (Shuldiner et al. 1979). This may affect plant and animal communities in wetlands because these communities are often adapted to limited ranges of substrate conditions and water quality.

6.9.7 Mitigation

WST has attempted to reduce the project's potential effects on wetland function through project design and planning. Specific mitigative measures include the following:

- highway route will avoid wetlands where feasible;
- vegetation removal restricted to 30 m within the right-of-way;
- the natural hydrologic regime of wetlands will be maintained using appropriate construction technologies for identified wetlands along the route;
- construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding wetland areas wherever possible;
- WST will conduct a field investigation of potential areas for rare or endangered plant species;
- use of accepted practices for erosion control or slope stabilization;
- any re-vegetation activities will use only native species;
- if construction machinery from outside Labrador is used, it will be washed prior to arrival in Labrador to avoid spread of invasive, non-native plant species; and
- design and implementation of fuel and other hazardous material spill contingency plans and emergency response measures in the event of an accidental or unplanned event.

In addition to the above mitigations, WST will consult with the Water Resources Division and apply for the appropriate Certificates of Approval.

Many of the potential adverse effects stem from the improved access provided by the highway, and the associated increase in activities in this previously remote area. Mitigating these potential effects is, for the most part, beyond the ability and responsibility of WST. Managing these actions and their potential effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented by the appropriate agencies in an effective and timely manner.

6.9.8 Environmental Effects Assessment

6.9.8.1 Construction

Some wetland habitat will be removed during highway construction because, in some areas, large patches of wetland are present and there are no routing alternatives to avoid these areas. However, only 230 ha (includes 105 ha of area classified as lichen scrub/open bog) of wetland vegetation will be removed within the highway right-of-way and, where the highway does cross wetlands, the route skirts the edge of these areas wherever possible.

As noted above, the majority of the wetlands found within 200 m of the centre line of the highway are bogs (72.5 percent), with basin bogs being the most common type (24.9 percent). Fens, marshes and swamps make up the remaining wetland types. Dome bogs were most infrequent along the highway route and were located on the far eastern and western ends of the highway (Figures 6.23 and 6.27). Kettle marshes were also relatively uncommon, with two located on the western end of the highway route (Figures 6.23 and 6.24) and a grouping of three in close proximity to each other, southeast of Park Lake (Figure 6.26). Overall, the wetlands that will be physically altered as a result of highway construction are ones that are well-represented within the study region.

WST has detailed procedures for prevention of erosion and siltation, maintenance of flows, and protection of vegetation and wetlands during construction (Section 2.10.2). These procedures represent the current best practices for highway construction and will limit construction effects such that ecological and physical functions of the wetlands adjacent to the highway will be maintained.

6.9.8.2 Operation

With proper placement of subgrade material, culverts and bridges, the natural hydrologic regime of wetlands adjacent to the highway will be maintained through standard WST construction procedures for wetlands. With the low density of roads and other developments, issues that may arise related to threshold levels of development that cause large changes to the hydrologic regime in a region, do not exist in Labrador. Some effects to plants and water quality from vehicle emissions and dust may occur in close proximity to the highway. However, the magnitude of effects from dust and emissions will be low and effects are likely to be restricted to <25 m from the highway. As long as the natural hydrologic regime is preserved and traffic levels along the highway remain relatively low, the ecological and physical functions of the wetlands adjacent to the highway will be maintained.

6.9.8.3 Accidental and/or Unplanned Events

An accidental spill of fuel or other hazardous material during construction or operation has the potential to contaminate wetland habitats adjacent to the highway. If the event occurred in the vicinity of a wetland with areas of open or flowing water, contaminants may affect a larger area than just the adjacent wetland. With the limited number of wetlands that will actually abut the proposed highway and with implementation of fuel and other hazardous material handling procedures, the likelihood of wetland areas being contaminated during an accidental event is low. Similarly, during operation, the likelihood of accidental releases of fuel or oil as a result of vehicle accidents will be low as the volume of traffic on the highway will be low and few accidents are likely to occur.

A summary of the environmental effects associated with each project phase is presented in Section 6.9.9.

6.9.9 Environmental Effects Evaluation

The following definitions are used to rate the significance of the predicted residual environmental effects of the project on wetland function.

A **significant environmental effect** is one affecting the ecological integrity of the wetlands within 100 m of the proposed highway in such a way as to impair wetland function to an extent where increased flooding along the route, occurs over several years, and/or there is a measurable sustained degradation in water quality.

A **not significant environmental effect** is one that does not affect the ecological integrity of the wetlands within 100 m of the proposed highway in such a way as to impair wetland function to an extent where increased flooding along the route, occurs over several years, and/or there is a measurable sustained degradation in water quality.

The proposed highway is a linear development that will have relatively low levels of traffic due to its location and the low human population of Labrador. The environmental effects will be restricted to removal of wetland habitat in the immediate highway corridor, and the effects of dust and vehicle emissions on the vegetation adjacent to the highway. Based on the preceding discussion and proposed mitigations, the residual effects of the project on wetland function are assessed to be not significant for construction, operation, and accidental events (Table 6.50). Overall, the project is not likely to result in significant adverse environmental effects that will impair wetland function.

Table 6.50 Environmental Effects Summary - Wetlands

	Construction	**Operation**	**Accidental/Unplanned Events**
Mitigation: • highway route will avoid wetlands where feasible; • vegetation removal restricted to 30 m within the right-of-way; • the natural hydrologic regime of wetlands will be maintained using appropriate construction technologies; • construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding wetland areas wherever possible; • WST will conduct a field investigation of potential areas for rare or endangered plant species; • use of accepted practices for erosion control or slope stabilization; • any re-vegetation activities will use only native species; • if construction machinery from outside Labrador is used, it will be washed prior to arrival in Labrador to avoid spread of invasive, non-native plant species; and • design and implementation of fuel and other hazardous material spill contingency plans and emergency response measure in the event of an accidental or unplanned event.			
Environmental Effects Criteria Ratings			
Magnitude	Low	Low	Low
Geographic Extent	<1 km^2	<1 km^2	101-1,000 km^2
Frequency	Continuous	Continuous	<10
Duration	72	>72	>72
Reversibility	Irreversible	Irreversible	Unknown
Ecological/Socio-economic Context	Low/Related to waterfowl, water resources and resource use and users.		
Environmental Effects Evaluation			
Significance	Not Significant	Not Significant	Not Significant
Level of Confidence	High	High	High
Likelihood[1]	n/a	n/a	n/a
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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: No monitoring or follow-up required			

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

6.9.10 Cumulative Environmental Effects

As a result of its relative inaccessibility, development activity in the project area has been relatively limited to date; therefore, there has been limited effects on wetlands in the region. Past and on-going hunting, trapping and angling activity in the region have also little effect on wetlands, as has snowmobile traffic in winter. Other past, on-going and potential projects and activities elsewhere in Labrador, such as the TLH - Phases I and II, the Voisey's Bay Mine Mill, hydroelectric development and related transmission infrastructure, and low-level flying activity, have not or will not have an effect on wetlands along the proposed highway route. Therefore, there is little potential for interaction between the effects of these actions and those of the proposed project.

The most important development activity that may occur following highway construction is commercial forestry. Forestry activities can cause changes to watertable levels, which may subsequently alter the attributes of neighboring wetlands, ponds and bogs. However, forestry activities avoid wetland areas wherever possible. Other land and resource activities, such as mineral exploration, hunting and angling, are also likely to increase due to enhanced access provided by the proposed highway. Travel over wetland areas may increase in order to access waterbodies and hunting areas from the highway. ATV use in particular has the potential to have adverse effects on wetlands. Cabin development along the highway may also occur, creating areas of permanent human disturbance that may cause further alteration to wetlands in the area. However, cabin development would likely occur on areas of mineral soil or glacial formations, rather than wetland areas. As discussed previously, legislation and regulations are in place to control these projects and activities and their potential environmental effects.

Details such as the likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known and the control of most potential induced actions and related effects is beyond the ability and responsibility of WST. Control depends on appropriate enforcement, management and planning on the part of relevant regulatory agencies to ensure that any such effects are avoided or reduced. As a result, a number of assumptions have been made in considering induced actions in the cumulative effects assessment, 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;
- the level of 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.

With the implementation of these mitigation measures, particularly appropriate planning and enforcement, the proposed project is not likely to result in significant adverse cumulative effects on wetlands in combination with other projects and activities that have been or will be carried out.

The creation of the Akamiuapishku/Mealy Mountains National Park would provide increased protection to wetlands in the proposed project area from the effects of human activities, such as use of motorized vehicles, forest harvesting and cabin development.

6.9.11 Environmental Monitoring and Follow-up

Monitoring requirements for wetlands have not been identified.

6.10 Riparian Habitat

Riparian habitat is defined as vegetation with characteristics that are a result of the influence of an adjacent waterbody. This vegetation can be distinguished from vegetation on the upslope away from the water source.

6.10.1 Boundaries

The project boundary is the cleared right-of-way approaching watercourse crossings.

Riparian habitat in Newfoundland and Labrador is under provincial jurisdiction except on federal lands such as national parks. Provisions for the protection of riparian habitat exist under the *Water Resources Act* and under forestry guidelines, the latter of which stipulates a minimum buffer of 20 m be retained around waterbodies where forest harvesting activities occur. Larger buffers may be required, depending on slope, waterbody sensitivity or aesthetic considerations.

Riparian habitat along waterbodies and rivers adjacent to the highway route or at watercourse crossings will be the basis on which the environmental assessment analysis will be conducted for this VEC.

6.10.2 Methods

Information used in conducting the assessment for riparian habitat include published literature and information gathered during characterization of watercourse crossings. The environmental effects analysis is based on a review of existing knowledge about riparian habitat and an assessment of the degree to which the various phases and components of the project may affect this VEC.

6.10.3 Existing Environment

Riparian areas provide 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 (Hunter1990). The differences in water levels between the spring flood season and summer low water, particularly along rivers and streams, produce the diversity of vegetation characteristics of riparian zones.

Beginning at the edge of the water and progressing inland away from it, there are usually small changes (greater elevation) in topography. Successive bands of vegetation (e.g., herbaceous plants that cover the bank to shrubs and full-sized trees farther back) are associated with the changes in topography (Menges 1986). The vegetation diversity is enhanced by a strong vertical component. From the surface of the water to the top of the canopy, there are several distinctive layers of vegetation. Where the larger vegetation is dominated by deciduous types, or where there is a mix of deciduous and coniferous, riparian zones provide one type of habitat in summer and another in winter after leaf fall. Vegetation diversity also occurs along the length of a large stream, less so in smaller (shorter) ones. Changes in vegetation are very apparent from the headwaters to the mouth of a large stream, particularly if it is large enough to have a distinct floodplain (Hunter 1990).

Riparian zones represent places of abundant water for terrestrial animals, particular the larger mammals (Hunter 1990). Also, the greater availability of water, often in combination with deeper soils, creates a somewhat humid microclimate in the riparian zone. This increases plant biomass production and allows for a diversity of soil organisms. Many riparian plant species remain green and succulent longer than upland vegetation, and sedges contain higher sustained protein and energy content than upland plants (Ohmart and Anderson 1986).

Riparian zones frequently have a high number of edges and strata in a comparatively small area; emergent vegetation in the shallow water near shore, sedges and rushes at the water/land interface, shrubs inside of that, and larger vegetation/trees farther back. These produce habitats for a greater number of species, reflecting the diversity of plant species and community structure. Thomas et al. (1979) found that wildlife use riparian zones disproportionately more than any other type of habitat. Riparian zones also function as ecological connectors in that they connect different vegetation types and habitats and act as corridors for the movement of animals (as well as for the movement of plants and nutrients) (Northland Associates Ltd. et al. 1996). A wide variety of avifauna and mammals may use riparian habitat along the proposed route.

A wide range of fish and aquatic organisms can be associated with riparian zones because of the diversity of vegetation and the variety of water habitats available. The ability of streams to produce or support fish populations is often dependent on the condition of the riparian vegetation (Cuplin 1986a). Shrubs, trees, and other woody vegetation are needed to shade streams and control high summer water temperatures for cold-water fish such as salmonids. Streambanks are strengthened and stabilized by the root systems of trees and shrubs. Although riparian vegetation provides a buffer from upland activities as well as a filter for overland soil erosion, streams with only grass and forb cover are often subject to streambank erosion during high water flows, heavy rain runoff, and snow melt.

Trees that overhang the water provide cover and shade, leaves and twigs that drop into the water provide stream energy through nutrient cycling, and falling insects provide food (Culpin 1986a; 1986b). Trees that fall across streams provide resting shelter and greater stream habitat diversity, as well as contributing to nutrient cycling and the food base. In summer, the food of salmonids may consist of as much as 35 percent terrestrial insects (Culpin 1986a). If woody vegetation is absent from the riparian zone, this source of food is also absent.

Tree species typical of riparian zones in the project area include balsam fir, black spruce, white spruce, larch or tamarack, aspen and white birch. Willow and alder are commonly found, particularly along rivers. Labrador tea is often the dominant shrub, with bog laurel and leatherleaf also common (Meades 1990).

A detailed analysis of riparian habitat was not conducted; however, a general description of shoreline vegetation at each highway stream crossing was completed during fisheries-related surveys (JW and IELP 2003). The general vegetation composition (i.e., bog, grasses, shrubs, trees) at the watercourse crossings is indicated in Table 6.51. Over 58 percent of the crossings had greater than 50 percent tree cover; 31 percent of the crossings had greater than 50 percent shrub cover (Table 6.51). At sites that had bog vegetation adjacent to waterbodies, it generally accounted for 30 percent or less of the cover. The exceptions were Sites 76 and 84, where bog comprised 90 and 95 percent of the cover, respectively (Table 6.51). Grasses were a minor component (generally less than 20 percent) at many of the locations (Table 6.51). Refer to Figure 6.21 for locations of watercourse crossings.

Table 6.51 Streamside Vegetation at Highway Watercourse Crossing Locations

Stream Crossing Number	Streamside Vegetation (% occurrence at crossing)			
	Bog	**Grasses**	**Shrubs**	**Trees**
Churchill River and Minor Tributaries				
1		5	25	70
2		5	35	60
3			20	80
4			20	80
5	Data Not Available			
6			50	50
7			40	60
8			60	40
9			40	60
10	Data Not Available			
11			50	50
12			40	60
Traverspine River				
13			40	60
14		10	50	40
15			40	60
16			50	50
17			50	50
18			40	60
19		5	20	75
20		5	45	50
21		5	25	70
22		5	35	60
23		10	40	50
24			20	80
25	30	10	30	30
26			30	70
27		5	50	45
Kenamu River				
28		5	35	60
29			40	60
30	40	10		
31			50	50
32			50	50

Stream Crossing Number	Streamside Vegetation (% occurrence at crossing)			
	Bog	Grasses	Shrubs	Trees
33			80	20
34		10	80	10
35	Data Not Available			
36		35	35	30
37			70	30
38			30	70
39			70	30
40		10	50	40
41			50	50
42		10	50	40
Eagle River				
43			40	60
44			50	50
45		5	15	80
46		30	20	50
47	10		40	50
48			40	60
49			50	50
50	5	5	40	50
51		10	60	30
52		20	40	40
53	10	10	30	50
54	Data Not Available			
55		10	30	60
56			50	50
57	Data Not Available			
58	20		50	30
59			40	60
60	20	5	40	35
61		10	30	60
62	20	10	40	30
63			20	80
64	20	20	20	40
65	30	10	30	30
66	Data Not Available			
67		5	40	55
68	10	10	40	40
69			30	70
70	40	20	20	20
71			60	40

Stream Crossing Number	Streamside Vegetation (% occurrence at crossing)			
	Bog	Grasses	Shrubs	Trees
72		10	40	50
73		10	40	50
74			40	60
75		5	30	65
76	90			10
77		10	30	60
78		10	20	70
79		10	30	60
80			50	50
81			50	50
82		10	40	50
Paradise River				
83	50		20	30
84	95			
85	Data Not Available			
86	30	10	30	30
87		20	60	20
88	20	10	60	10
89		10	70	20
90			30	70
91		10	60	30
92	Data Not Available			
93		10	70	20
94			30	70
95			20	80

6.10.4 Potential Interactions

Potential interactions are limited to physical disturbance during construction and release of emissions during operations or accidental events.

6.10.5 Issues and Concerns

Construction of the highway will result in the removal of some riparian habitat at watercourse crossings, possibly increasing the potential for siltation of adjacent waterbodies. During operation, emissions from vehicles, including dust, oxides of carbon, nitrogen and sulphur, as well as minute particles of carbon and oil droplets (Bennett 1991), may contaminate vegetation in riparian areas adjacent to the highway. An accidental release of fuel or other hazardous material may contaminate riparian habitats adjacent to the highway. A forest fire may cause destruction of riparian vegetation.

6.10.6 Existing Knowledge

Riparian zones are among the biologically richest, most sensitive and least abundant habitats in any area (Thomas et al. 1979). Although they may show considerable variation in size, structure, and vegetation, all riparian zones have a number of attributes (e.g., successional patterns, edges, vertical layering, special microhabitats) that provide biological diversity and make them extremely important to aquatic and terrestrial populations.

Where development occurs in riparian zones, two effects are consistent: the narrower the zone, the more it is affected by development; and development is likely to affect the habitat of the zone far more than indicated by the proportion of the area disturbed (Thomas et al. 1979).

Riparian zones are a critical source of diversity within larger ecosystems. They are generally more productive and more fragile than the remainder of the area surrounding them. Studies have shown that riparian zones are easily damaged, but the habitat can regenerate if the damage is not too severe (Ohmart and Anderson 1986). For example, eight years after long-term grazing by cattle ceased in riparian zones in several western US states, the vegetation had mostly recovered and the majority of avifauna and small mammal species had increased considerably (Ohmart and Anderson 1986).

Road construction has a more critical and long-lasting adverse effect on riparian zones than any other development activity (Thomas et al. 1979). Critical functions that can be affected by highways include shade, cycling of nutrients, contribution of large wood, and refugia for fish during floods (Ruediger and Ruediger no date). The attributes that make riparian zones such important habitats are altered or lost when roads are built within them, parallel to the waterbody. For example, zone size is reduced, vegetation structure and microclimates are altered, wildlife movement between habitats may be compromised, conditions are established for heavy surface runoff and increased sedimentation, and the overall effectiveness as both aquatic and terrestrial habitat is reduced (Thomas et al. 1979).

Road construction, parallel to a waterbody, in riparian systems can destroy natural ground cover and churn and mix the soil to produce transportable sediment, leading to a deterioration of water quality in streams that border the riparian zone. In some cases where stream channels are altered, small perennial streams may become intermittent (Ohmart and Anderson 1986).

Leaving buffer strips of riparian habitat between waterbodies and highway beds can be effective in reducing disturbance to the zone. Recommendations for width of buffer zones range from 10 m to 75 m, depending on the slope (Ohmart and Anderson 1986; Hunter 1990).

A study of breeding bird assemblages in Newfoundland determined that by leaving a riparian buffer of at least 20 m following forest harvesting in a balsam fir forest, the abundance of generalists, interior forest, and riparian species that was maintained was similar to that of control areas (Whitaker and Montevecchi 1999).

Forest harvesting operations include the construction and maintenance of roads (smaller and less disturbing than public roads, but more of them) and the clearing of large blocks of vegetation instead of the linear right-of-way clearing required for public roads. The effects of the two activities on the riparian zone are similar, but there appears to be potential for greater loss or alteration of riparian habitat associated with forest harvesting. However, the potential for recovery of riparian habitats is also probably greater after harvesting (Hunter 1990).

Riparian zones attract such recreational activity as angling, swimming, boating, camping and cabin development, especially if road access is provided. Fallen and dead trees, limbs, snags, and living trees that may be gathered for firewood are nesting, denning or resting habitat for a variety of wildlife species. Ohmart and Anderson (1986) found that there was a 40 percent decrease in bird density the day after a campground opened in a riparian area in Arizona.

6.10.7 Mitigation

WST has attempted to reduce the project's potential effects on riparian habitat through project design and planning. Specific mitigative measures include the following:

- the highway right-of-way will be located a minimum of 20 m from the shoreline of waterbodies, where possible;
- the natural hydrologic regime of adjacent wetlands will be maintained using acceptable construction techniques, including culverts, to ensure natural flows through riparian zones;
- construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding riparian areas wherever possible;
- WST will conduct a field investigation of potential areas for rare or endangered plant species;
- use of accepted practices for erosion control or slope stabilization;
- removal of riparian vegetation will be restricted to the required construction of watercourse crossings;
- fill areas typical of riparian stream approaches will not be grubbed;
- re-vegetation activities will use only native species;
- a 20 m temporary buffer zone of vegetation will be maintained on each side of stream crossing until such time as subgrade construction begins;
- if construction machinery from outside Labrador is used, it will be washed prior to arrival in Labrador to avoid spread of invasive, non-native species;
- construction camps will be located outside of riparian zones; and
- design and implementation of fuel and other hazardous material spill contingency plans and emergency response in the event of an accident.

In addition to the above mitigations, WST will consult with the Water Resources Division and apply for the appropriate Certificates of Approval.

Many of the potential adverse effects stem from the improved access provided by the highway, and the associated increase in human presence and activities in this previously remote area. Mitigating these potential effects is, for the most part, beyond the ability and responsibility of WST. Managing these actions and their potential effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is therefore to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented by the appropriate agencies in an effective and timely manner.

6.10.8 Environmental Effects Assessment

6.10.8.1 Construction

During construction, a minimum of 20 m of vegetation will be retained around all waterbodies that are adjacent to the highway route. In most areas, this amount of buffer will encompass the entire riparian zone around lakes and rivers, thereby ensuring that riparian habitat function is maintained. At each highway water crossing, a maximum of 60 linear m of riparian habitat will be removed (30 m on either side of the crossing). Assuming a 20 m riparian zone width, where possible, and a total of 95 watercourse crossings, this means that a maximum of approximately 11.4 ha of riparian habitat will be removed along the entire highway route. On any one body of water with a highway crossing, a maximum of 0.12 ha will be removed. Due to the large number of rivers, streams and lakes, there is abundant riparian habitat available in the region.

6.10.8.2 Operation

No additional riparian habitat will be removed during operation. The maintenance of a minimum 20 m vegetation buffer between the highway and adjacent waterbodies will limit the effects of dust and airborne emissions on riparian habitat. The maintenance of the vegetation buffer will provide wildlife with a security corridor that allows travel along the shoreline of waterbodies near the highway.

6.10.8.3 Accidental and/or Unplanned Events

As noted above, the maintenance of a minimum 20-m vegetation buffer, where possible, will provide a measure of protection to riparian habitat should there be an accidental event such as a fuel or other hazardous material spill in the highway right-of-way. A forest fire could destroy riparian habitat for a variety of species. However, boreal species have adapted to a cycle of naturally occurring fires and the proportion of the population affected during any one fire would be small.

With implementation of environmental protection planning, the potential for such accidental events occurring is extremely low. If such an accident should occur, the significance of its potential effects will be dependent upon the location and timing of the event and its nature and magnitude. WST's contingency planning and emergency response plans will ensure that any adverse are reduced.

6.10.9 Environmental Effects Evaluation

The following definitions are used to rate the significance of the predicted residual environmental effects of the project on maintenance of riparian habitat.

A **significant environmental effect** is one affecting riparian habitat along the corridor of the proposed highway in such as way as to impair its ecological function to the extent that there are measurable effects to water quality and/or dependent populations.

A **not significant environmental effect** is one that does not affect riparian habitat along the corridor of the proposed highway in such as way as to impair its ecological function to the extent that there are measurable effects to water quality and/or dependent populations.

The proposed highway is a linear development that will have relatively low levels of traffic due to its location and the low human population of Labrador. The primary environmental effects will be removal of riparian habitat at watercourse crossings and the effects of vehicles emissions and dust on riparian vegetation adjacent to the highway. Based on the preceding discussion and proposed mitigations, the residual effects of the project on riparian habitat are assessed to be not significant for construction, operation, and accidental events (Table 6.52). Overall, the project is not likely to result in significant adverse environmental effects that will impair the function of riparian habitat.

Table 6.52 Environmental Effects Summary - Riparian Habitat

	Construction	**Operation**	**Accidental/Unplanned Events**

Mitigation:

- the highway right-of-way will be located a minimum of 20 m from the shoreline of waterbodies, where possible;
- the natural hydrologic regime of adjacent wetlands will be maintained using acceptable construction techniques, including culverts, to ensure natural flows through riparian zones;
- construction vehicles will remain in the right-of-way and all-terrain vehicles will use designated routes, avoiding riparian areas wherever possible;
- WST will conduct a field investigation of potential areas for rare or endangered plant species;
- use of accepted practices for erosion control or slope stabilization;
- removal of riparian vegetation will be restricted to the required construction of watercourse crossings;
- fill areas typical of riparian stream approaches will not be grubbed;
- re-vegetation activities will use only native species;
- a 20 m temporary buffer zone of vegetation will be maintained on each side of stream crossing until such time as subgrade construction begins;
- if construction machinery from outside Labrador is used, it will be washed prior to arrival in Labrador to avoid spread of invasive, non-native species;
- construction camps will be located outside of riparian zones; and
- design and implementation of fuel and other hazardous material spill contingency plans and emergency response in the event of an accident.

Environmental Effects Criteria Ratings			
Magnitude	Low	Low	Low
Geographic Extent	<1 km^2	<1 km^2	101-1,000 km^2
Frequency	Continuous	Continuous	<10
Duration	72	>72	>72
Reversibility	Irreversible	Irreversible	Unknown
Ecological/Socio-economic Context	Low/Related to water resources, fish and fish habitat, wildlife and resource use and users.		
Environmental Effects Evaluation			
Significance	Not Significant	Not Significant	Not Significant
Level of Confidence	High	High	High
Likelihood[1]	n/a	n/a	n/a
Sustainable Use of Rescources[1]	n/a	n/a	n/a

[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:
No monitoring or follow-up required

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
Level of Confidence:	High, Medium, Low
Likelihood:	High, Medium, Low or Unknown
Sustainable Use of Resources	High, Medium, Low or Unknown

6.10.10 Cumulative Environmental Effects

As a result of its relative inaccessibility, development activity in the project area has been relatively limited to date, and has therefore had limited effect on riparian habitat in the region. Other past, on-going and potential projects and activities elsewhere in Labrador, such as the TLH - Phases I and II, the Voisey's Bay Mine Mill, hydroelectric development and related transmission infrastructure, and low-level flying activity, have not or will not have an effect on riparian habitat within the proposed project area. There is therefore little potential for interaction between the effects of these actions and those of the proposed project.

The most important development activity that may occur following highway construction is commercial forestry. However, forestry guidelines stipulate that a minimum 20 m vegetation buffer be maintained along waterbodies following forest harvesting, which protects riparian habitat. Other land and resource activities, such as hunting and fishing, may also increase due to enhanced access provided by the proposed highway. Travel through riparian zones is likely to increase in order to access waterbodies and hunting areas from the highway. Cabin development may occur in riparian areas as proximity to a waterbody is often preferred. However, as discussed previously, legislation and regulations are in place to control these projects and activities and their potential environmental effects.

Details such as the likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known and the control of most potential induced actions and related effects is beyond the ability and responsibility of WST. Control depends on appropriate enforcement, management and planning on the part of relevant regulatory agencies to ensure that any such effects are avoided or reduced. As a result, a number of assumptions have been made in considering induced actions in the cumulative effects assessment, 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;
- the level of 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.

With the implementation of these mitigation measures, particularly appropriate planning and enforcement, the proposed project is not likely to result in significant adverse cumulative effects on riparian habitat in combination with other projects and activities that have been or will be carried out.

The creation of the Akamiuapishku/Mealy Mountains National Park would provide increased protection to riparian habitat in the proposed project area from the effects of human activities, such as use of motorized vehicles, forest harvesting and cabin development.

6.10.11 Environmental Monitoring and Follow-up

A need for monitoring effects to riparian habitat has not been identified.

6.11 Historic Resources

Historic Resources include archaeological sites and artifacts, historic sites (such as heritage buildings) and objects, and contemporary camp sites. Several such sites were discovered within the proposed route corridor in 2002. Although the historic resources field assessment effort in preparation for the EIS is thought to be adequate, there remains potential for additional resources to be found in the project area. Historic resources are non-renewable and the information they contain cannot be replaced if they are damaged or destroyed. It is important that historic resources in the project area be protected.

6.11.1 Boundaries

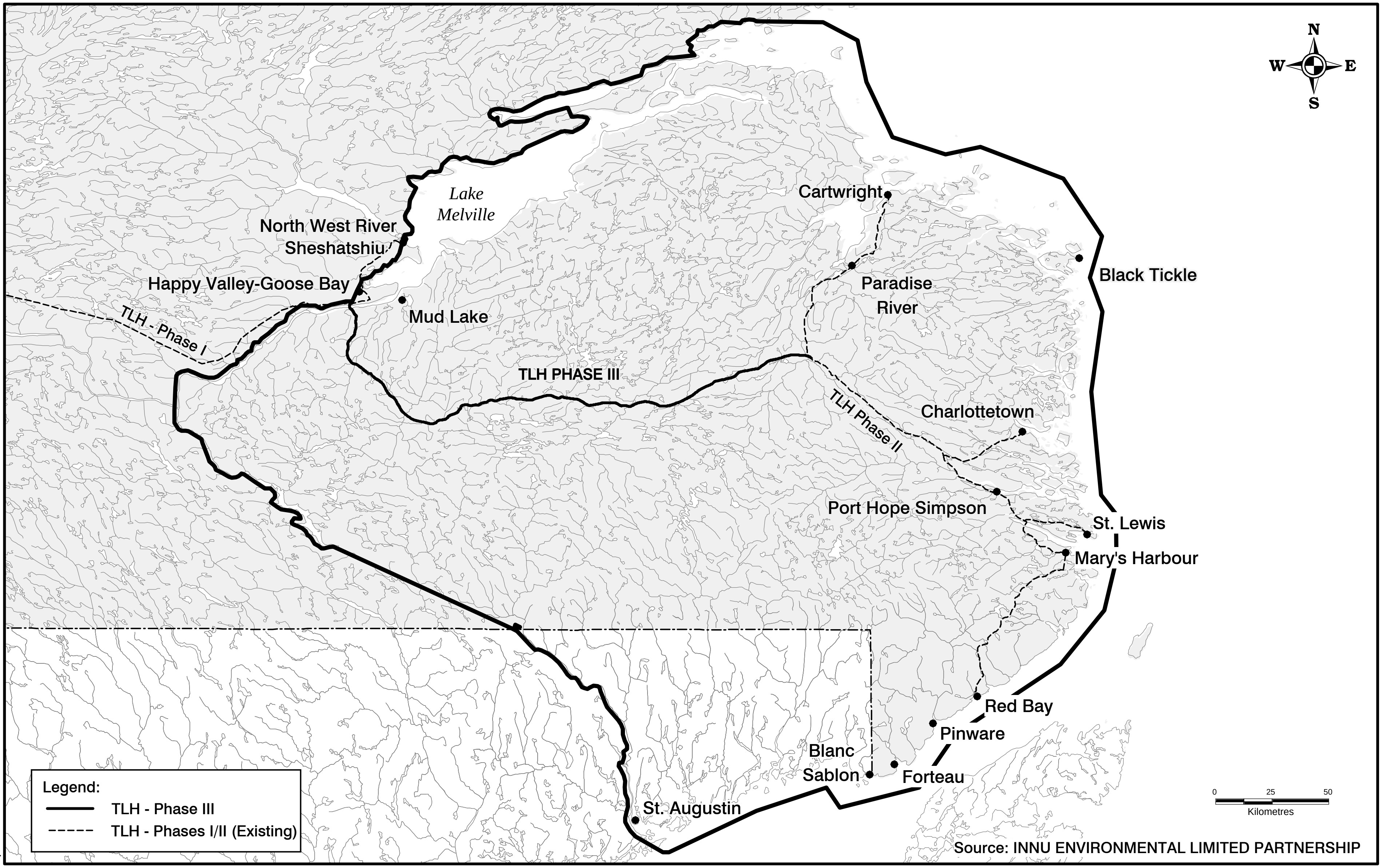
The spatial boundaries for historic resources include any areas where ground disturbance will occur. This project is defined by the 40 m right-of-way for the route between Happy Valley-Goose Bay and Cartwright Junction for an approximate distance of 250 km (Figure 6.28).

The primary temporal boundary for historic resources is construction, including all phases from surveying and vegetation clearing to site rehabilitation. However, as a result of improved access to previously inaccessible areas, archaeological and ethnographic sites located in certain areas within a 10 km-wide corridor along the route may be subjected to indirect effects during operation.

Protecting and managing archaeological resources in Newfoundland and Labrador is the responsibility of the Provincial Archaeology Office (PAO) of the Department of Tourism, Culture and Recreation. The PAO administers its mandate through the *Historic Resources Act*.

6.11.2 Methods

The Historic Resources Component Study (IELP 2002) was undertaken to assess high-potential locations along a 10 km-wide corridor along the proposed highway route and identify important historic resources which may suffer effects of highway construction and increased vehicle access to this hitherto remote area. The study was designed as a precursor to more detailed Historic Resources Impact Assessment along the actual right-of-way once the precise highway route is finalized.



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Jacques Whitford Environment Limited
Environmental Scientists
Consulting Engineers

Figure 6.28

Historic Resources Pre-Fieldwork
Overview Research Study Area

The primary objectives of the Historic Resources Component Study were to complete historic resources requirements for the environmental assessment of the project, predict archaeological potential, identify and understand the regional context of historic resources in the project area, and collect and review any required information for the interpretation of historic resources in the project area. Essential components of the study included:

- a pre-fieldwork overview research of a larger study region;
- an archaeological field survey within the project area (highway corridor); and
- preparation of a report on the results of the entire study, with identification of data gaps, where appropriate (IELP 2002).

The study area for the research encompasses all of southeastern Labrador and the Québec Lower North Shore, lying south of the north shore of Hamilton Inlet and the Churchill River and east of the western banks of the Minipi and Saint-Augustin rivers (Figure 6.28). This larger study area was researched to allow an understanding the cultural history of the region and to provide the field study team with a number of historic resources potential indicators used in targeting areas for fieldwork and background information from a larger regional context for the interpretation of sites located within the project area. The project area for the field research was defined as a 10 km corridor along the preferred routing for the highway, within which 12 areas or components were identified and investigated during visual inspection and subsurface testing programs (Figure 6.29).

The field study targeted a sample of high potential locations within a 10 km-wide corridor along the proposed route. As a result, field work conducted to date does not represent a precise assessment of the 40 m right-of-way and other project features.

6.11.2.1 Pre-Fieldwork Overview Research

The pre-fieldwork overview research involved an archaeological and ethnographic literature review, Innu land use and geomorphological data review, informant interviews and aerial photograph interpretation. The information obtained provided the background and context necessary for developing the strategy for the archaeological field assessment of the project area, including the identification of field survey areas.

The literature review included details on previous archaeological work, ethnographic research and traditional land and resource use within the study area and in Labrador and the Québec North Shore. The PAO Site Inventory was also reviewed. This information was researched in an effort to predict the basic chronology and nature of archaeological remains to be anticipated in the project area and list any historic resources already known to exist in the project area. The results provided a framework for the identification of further sites to be discovered during the field survey and for the interpretation of the survey results.

A review of map data on twentieth-century Innu land use data compiled by Innu Nation revealed broad patterns of land use, as well as clusters of known preferred campsites and route junctions that served as indicators of high archaeological potential.

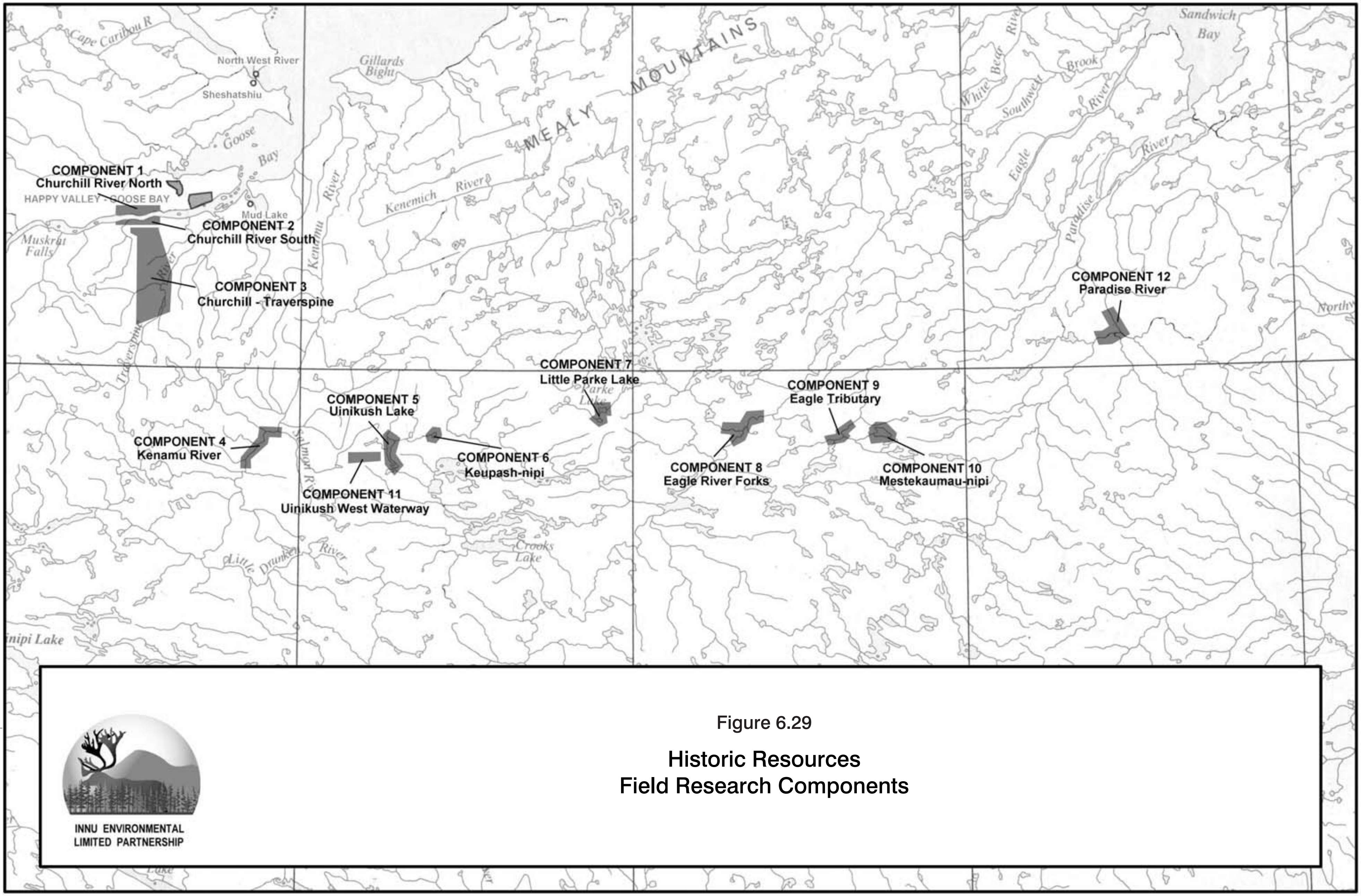

Figure 6.29

Historic Resources
Field Research Components

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The most relevant geomorphological data on post-glacial events and sea-level change were examined in detail for attributes bearing on the archaeological potential of marine and riverine terrace formation. Additional information obtained related to contemporary ecology and palaeoecology of the project area.

Innu and Settler individuals who are knowledgeable about land and resources use and/or the location of archaeological and ethnographic sites within the study area were interviewed. The objectives for informant interviewing were to:

- acquire information that could be used, in conjunction with information obtained from the literature review and aerial photograph interpretation, to predict areas of historic resources potential;
- establish if any historic resources are known to exist in the region; and
- provide social and cultural context to archaeological finds that are normally restricted to technical interpretations.

Twenty-four informants, five women and 19 men, provided information on land and resources use in the study area, as well as specific locations of traditional tent sites, tilts and other precontact and historic features. Informant interviews were conducted with eight individuals in Sheshatshiu, six in Happy Valley-Goose Bay, one in Mud Lake and nine in Cartwright, who had lived and harvested resources within the project area. Interviewers used a questionnaire that served as the framework for data collection. Topographic maps and audio-cassettes were also used to collect information. Interview summary forms were completed for each interview and interview consent forms for members of Innu Nation.

Aerial black and white photographs (1:50,000) dating to the late 1960s were examined to identify precise high-potential testing locations within selected larger areas selected from the land use and other data for the field program. Historic resource potential rating was based on criteria employed and tested during previous programs in Labrador (e.g., JW/IELP 2001a; 2001b). High potential zones included shoreline locations of level ground on points of land, at constrictions in waterways, near rapids and falls and at river confluence and relict terraces.

6.11.2.2 Field Survey

The principal objective of the field survey was to verify the predictions made on the basis of the pre-fieldwork overview research and to identify actual sites on the ground in locations that would likely be affected by the project. The field survey was conducted between August 21 and September 15, 2002. Twelve general areas of enhanced archaeological potential were investigated. The field survey included the excavation of 3,944 test pits at 128 distinct testing locations. Testing locations were recorded by means of GPS. Testing programs involved both close surface inspection and subsurface testing. Testing was concentrated in dry, level areas suitable for human settlement. This involved excavation of 20 cm by 20 cm test pits by means of shovel and trowel. Test pits were generally spaced at 5 to 10 m intervals along natural linear features such as shorelines and terrace edges. Areal testing was conducted in the vicinity of contemporary Innu camps or tilt locations identified in the field. At locations where materials of significance were identified during the surface evaluation, only limited testing was conducted to establish the nature and extent of the remains and to avoid any unnecessary site disturbance prior to decisions being made on mitigation. Artifact collection was kept to a minimum. The number and location of test pits were recorded. Photographs were taken of all relevant cultural features (IELP 2002).

6.11.3 Existing Conditions

Archaeological sites and artifacts hold valuable information on past and contemporary cultures, how cultures relate (or related) to one-another and how each culture relates (or related) to the environment in which they lived. They are non-renewable resources that sometimes offer the only information for reconstructing the history a particular group. For this reason, historic resources are valued by society and protected by legislation.

6.11.3.1 Precontact Period (8000 BP to 1500 AD)

During the precontact period, the inhabitants of south-central Labrador lived by hunting, fishing and gathering the plant, animal and lithic resources of their environment. They normally lived in small groups that moved over the land during the year to exploit resources as they became available. Precontact sites are usually found on the coast, near travel routes that extend from the coast into the interior, and in the hinterland near sources of game and freshwater.

The overview research indicates that the study area has been occupied by various cultures since approximately 8,000 years before present (BP). After 4,000 BP, coastal Labrador was also colonized by Arctic-adapted peoples from the North and thereafter, Labrador prehistory is characterized by a succession of cultures, sometimes overlapping. The origins of the various cultural traditions lie in two regions: south or west of Labrador; or the Arctic. Intermediate Indian and Recent Indian groups migrated into the region from the southern St. Lawrence region and Palaeo-Eskimo and Neo-Eskimo groups from the eastern Arctic (IELP 2002).

Maritime Archaic Indians

The sequence begins with an early Maritime Archaic population along the Gulf of St. Lawrence expanding their territory in the Strait of Belle Isle, then spreading northward from southern Labrador along the coast to central Labrador and reaching northern Labrador by 7,500 BP. The Maritime Archaic people were harvesting marine resources during the spring and summer months, and interior species during the winter (Fitzhugh 1972). Small single-family dwellings were used prior to 6,000 BP and multi-family long-houses of up to 80 to 90 m in length between 4,200 to 3,500 BP. Burial sites consist of rock mounds or small cemeteries and graves contain red ochre and grave goods. Early Maritime Archaic sites contain local vein quartz and slate, as well as chert obtained from Ramah Bay and Cape Mugford, northern Labrador (JW 2002). During the late Maritime Archaic period, the flaked stone tools were made almost exclusively from Ramah chert (Fitzhugh 1978a; Gramly 1978). After a 400 to 500-year period of overlap with the earliest Palaeo-Eskimo culture (Pre-Dorset, 4,000 to 3,500 BP), the Maritime Archaic culture disappeared from the archaeological record.

In Hamilton Inlet, the earliest Maritime Archaic sites discovered to date belong to the Sandy Cove Complex (5,200 to 4,500 BP) and were located in northeastern Groswater Bay. No Maritime Archaic sites were found in Lake Melville or westward, with one possible exception at Mud Lake (IEDE/JW 2000). All known Maritime Archaic sites in the study region are concentrated along the coast (JW 1998a) and there are no known Maritime Archaic Indian sites in the project area (IELP 2002).

Palaeo-Eskimo

The first Arctic-adapted people, the so-called Palaeo-Eskimo groups, arrived in northern Labrador approximately 4,000 years BP. The Palaeo-Eskimo tradition is divided into two periods, the Early and Late Palaeo-Eskimo, which are further represented by a number of complexes or phases (Early Palaeo-Eskimo: Independence 1, Early Pre-Dorset, Pre-Dorset and Groswater; Late Palaeo-Eskimo: Early, Middle, and Late Dorset), each with slight temporal and regional differences. In fact, some phases such as Pre-Dorset, Early and Middle Dorset appear to be restricted to Northern Labrador (IEDE/JW 2000).

While early Palaeo-Eskimo groups were moving into southern Labrador (circa 2,500 BP), the Late Palaeo-Eskimo people were entering Labrador from the north (Fitzhugh 1980; Tuck and Fitzhugh 1986). Both the Groswater and Dorset settlement and subsistence patterns are characterized by a primary focus on marine mammals and limited use of terrestrial species. Dorset sites have been located in protected inner bay regions, and on the extreme outer islands. Early Palaeo-Eskimo sites are generally marked by small scatters of lithics, sometimes associated with tent rings or mid-passage structures. Pre-Dorset lithic material was primarily chert form the Mugford region, although slate and Ramah chert was also used. Dorset material culture included extensive use of Ramah chert for flaked stone tools, soapstone for pots and lamps, and nephrite for cutting and engraving tools. Semi-subterranean winter sod houses with middens indicate long-term or repeated use of sites close to good hunting locations (JW/MIBC/TCC 1997).

Sites from both the Early and Late Palaeo-Eskimo periods are present in the study region and may represent as much as 15 percent of the total number of archaeological sites recorded to date (JW 1998a). However, previous archaeological field programs in Central Labrador have failed to locate Palaeo-Eskimo sites in the western Lake Melville area. The closest sites belonging to this tradition were located more than 100 km east of Sheshatshiu, in the Groswater Bay area (IEDE/JW 2000). Based on a review of over 1,500 archaeological sites distribution in Labrador and adjacent regions of Québec (JW/IELP 2001b), it is anticipated that no Palaeo-Eskimo sites will be discovered in the project area. No sites or materials belonging to this cultural tradition were found during the 2002 field survey.

Intermediate Indian

Several cultures were present in Labrador between 3,600 and 1,400 BP. They do not show the marked maritime character of the preceding Maritime Archaic but, instead, an adaptation to the use of interior resources, with seasonal exploitation of the inner coastal zone. Along the central and northern Labrador coast, the Intermediate Indian Period is represented by the Saunders Complex (Nagle 1978), a fusion of Brinex and Charles Complex identified by Fitzhugh (1972) in the North West River region. Sites consist of lithic scatters with occasional cobble hearths containing fire-cracked rock, charcoal, burnt bone or red ochre stains concentrations. No dwelling structures or burial features have been discovered here (Fitzhugh 1972; JW 2002).

In contrast to the previous precontact groups, the Intermediate Indians (3,500 to 2,000 BP) show a marked adaptation to interior resources, with some seasonal exploitation of marine resources. Caribou hunting and fishing likely occurred in the interior during the fall and winter, and limited exploitation of birds, fish and seals occurred along the coast in the spring or summer (Nagle 1978). Stone tools were made of chert from Cape Mugford and cherts from the Labrador interior, with possible sources in the Kanairiktok River (MacAleese 1993) and Seal Lake Region (Fitzhugh 1972). Occasional sites are located in sheltered bays and inlets and on inner islands. These coastal sites were occupied during spring and summer, while the fall-winter was spent in the interior (Fitzhugh 1972; Nagle 1978). Several precontact sites discovered at North West River or Sheshatshiu and in interior settings along the Churchill River and further north and west, in adjacent regions of Québec such as the Caniapiscau and Mushuau Nipi regions belong to this period (JW 2002; JW/IELP 2001b). Therefore, there is a potential for sites belonging to this tradition to be located in the project area. Two Intermediate Indian sites were discovered in the project area in 2002.

Recent Indian

Daniel Rattle (1,750 to 950 BP) and Point Revenge (1,250 to 350 BP) comprise the Recent Indian period, just before the historic contact between Innu and European culture. Recent Indian sites are found in the inner and outer coastal zones, indicating a more intensive use of marine resources than during the Intermediate period. Large multi-family tent structures containing abundant lithic materials and large deposits of calcined bone were found. Other sites consist of smaller tent rings or hearths associated with lithic material and, sometimes, calcined bone. Lithic materials are dominated by Ramah chert, which appears to have been traded widely over the Labrador coast and beyond. A few fragments of ceramics have also been found at late precontact sites (Fitzhugh 1978b; Loring 1992).

The Recent Indians (2,000 to 350 BP) are considered to be the predecessors of the present day Labrador Innu (Loring 1992). Sites relating to this tradition are generally small and lack evidence of any long-term occupation, suggesting the people were highly mobile and travelled in small groups.

Ramah chert was among the preferred lithic material for making stone tools and was traded through extensive networks. Numerous Late Precontact sites were discovered on the Québec North Shore, and along the coast of southern Labrador, where they may represent nearly 5 percent of all the reported sites (JW 1998a). In Labrador, they are normally located in coastal settings and the Recent Indian period appears to be only represented by the Point Revenge Complex in Central Labrador (Schwarz 1998); that Late Precontact sites are still extremely scarce in this region (JW/IELP 2001a). A single site pertaining to the Point Revenge Complex was found at North West River on a 7 m asl terrace. Extensive testing programs conducted along the Churchill River, between Happy Valley-Goose Bay and Churchill Falls, yielded several sites with precontact materials, but only one that may belong to the Recent Indian period (JW/IEDL 2001a). However, several sites were located in adjacent regions of Québec during the investigation of the Caniapiscau Reservoir (Denton 1989). No Recent Indian sites was found in the project area during the 2002 field research program.

Thule

The Labrador Inuit are the descendants of the eastern Thule culture, an Arctic-adapted People. The Thule, or Neo-Eskimo people, arrived on the Labrador coast by circa 700 BP (Fitzhugh 1994). Their maritime technology was highly adapted to the hunting of large marine mammals. Thule settlements are characterized by sod house structures, tent rings and boulder features such as burials and caches. By 350 BP, they had moved into the Hamilton Inlet region (Kaplan 1983; Fitzhugh 1977), but no definite Thule sites have been recorded in southern Labrador. Contact with Europeans in Labrador brought about broad-based culture change with the introduction of ceramics and metals and the geographic expansion southward to meet European traders. The Neo-Eskimo sites with a European-influenced material culture are ascribed to the Labrador Inuit (IELP 2002).

6.11.3.2 Historic Period (from the Arrival of Europeans to the Present)

When Europeans arrived in Labrador, the Innu and Inuit followed a hunter-gatherer way of life similar to their precontact predecessors. The historic period in southern Labrador is marked by the beginning of European occupation and resource exploitation. While the Norse visited Labrador during their brief expansion into the New World approximately 1,000 years BP, it was not until the 16th century, when the Basque began whaling operations in the Strait of Belle Isle, that a permanent European presence was established in Labrador. Successive European groups, including the Basque, Dutch, French and English, were drawn to the Labrador coast to access the marine resources of the region and trade with Aboriginal groups. European occupation of Labrador dramatically altered the traditional subsistence-settlement patterns of the Innu and Inuit. Aboriginal lifestyles and cultures influenced the way Europeans and the early Settlers adapted to the landscape and exploited the region's resources (JW 1998a; Kennedy 1995).

Inuit

The Labrador Inuit harvested marine resource along the edge of the land fast ice to the heads of bays (Fitzhugh 1977). There was also some seasonal use of the interior for hunting caribou, bear and, later, for trapping fur-bearing animals for trade. This settlement and subsistence pattern endured well into the twentieth century. Maintaining their coastal adaptation brought Inuit into constant contact with the European population (Settlers), resulting in a merging of cultures. As a result, it is often difficult to distinguish between Inuit and Settler sites, and some identified house features could be of either culture (Pastore and Auger 1984; Auger 1991).

There are presently no Inuit communities in the study area. However, Inuit and Settlers from Rigolet have used the northern portion of the study area (including Sandwich Bay and the Mealy Mountains) in the recent past for harvesting marine and terrestrial animals (Ames 1977). In addition, several Inuit enclaves along the southern Labrador coast persisted well into the early 19th century Kennedy (1995). There are numerous Inuit archaeological sites in southern Labrador and may represent more than 14 percent of all the sites reported to date (JW 1998a). Although several Inuit sites were reported in the interior of Ungava and Arctic Québec, Inuit sites in interior forested areas of Labrador are scarce at best. Therefore, it is unlikely that Inuit sites will be discovered in the project area. In fact, no sites were identified with this cultural tradition during the 2002 field assessment.

Innu

The Innu, historically known to Europeans as Montagnais and Naskapi, are thought to have descended from the Recent Indian tradition. It was suggested the Innu spent most of their time in the interior hunting caribou and fishing after withdrawing from the Labrador Coast due to intensification of European and Inuit activities during the 17th and 18th centuries (Loring 1992). Nevertheless, the Innu continued to visit the coast during the summer for hunting and fishing in the Lake Melville area where they interacted with people from other cultural traditions (Mailhot 1993).

The Innu inhabited a number of preferred sectors in the study region during the historic period and had contact with the French along the north shore of the Gulf of St. Lawrence, the Strait of Belle Isle and further north in the North West River Hamilton Inlet area. There is evidence the Innu were occupying the northern coastal portion of the study region in the 1770s (JW 1998a). In a 1766 report by Governor Palliser of Newfoundland, the Innu were described as inhabiting an area from the St. Lawrence, through the Strait of Belle Isle, and inland far from the coast (Tanner 1977). Aspects of historic and contemporary Innu land use are discussed within the context of the larger discussion of Innu land and resource use in Section 6.12. The Innu communities of Utshimassits (now Natuashish) and Sheshatshiu are also discussed in Section 6.16.

The Innu have continued to use extensive portions of the study region into the twentieth century. Late historic and contemporary Innu use of the study area is extensive and involves harvesting a variety of species year-round. During the period from 1900 to 1930, the Innu of North West River spent much of the year south of the Mealy Mountains, travelling by way of the Kenamu River. Joined by Innu groups from Sandwich Bay, they spent the fall in the Mealy Mountains hunting caribou. Both beaver and otter were trapped around the western headwaters of the Eagle River and its many tributaries and feeder lakes. Other mammals commonly hunted in the Eagle Plateau region included mink, muskrat, fox, lynx, marten, black bear, and snowshoe hare. Summer was spent on the coast of Hamilton Inlet. Frequently, groups travelled south to visit with friends and relatives in Saint-Augustin (Tanner 1977; JW/INEN 2001). The pre-fieldwork overview research further confirms that the project area traverses traditional Innu territory and contemporary harvesting areas (IELP 2002). The Eagle Plateau region was reached following the Kenamu or the Traverspine Rivers. Several travel routes including the Salmon and the Little Drunken Rivers were also identified, as well as several camp locations established along the way. Winter camps were established on the shoreline of major lakes, such as *Uinikush* and *Keupashnipi*. Further east, important settlement areas included the shoreline of major lakes such as *Nekuanikau* and *Kamishekemat*. Therefore, the potential for historic and contemporary Innu camps to be located in the project area is high. However, early historic Innu sites are extremely scarce in Central Labrador, but it has been suggested that this may be due to site visibility (JW/IELP 2001a). The 2002 field program confirmed that several reported Innu camps actually lie within the project area. However, none of these sites appear to pre-date the twentieth century.

European

Beginning around 1550, the Basque began over a half-century of whaling in the Strait of Belle Isle at Red Bay (Tuck and Grenier 1989). Although there are more than 30 sites along the Labrador coast affiliated with the Basque period, Red Bay was the largest operation. No sites associated with the Basque occupation of southern Labrador are known for the project area.

The French were initially drawn to the area for the fur trade in the interior along the Quebec-Labrador border. As the population of furbearers was gradually depleted, trapping activities shifted to the east, and the French focussed on resources on the island of Newfoundland and in Labrador. The French occupation of Labrador took the form of concessions issued by the king, who granted portions of land to those who carried recommendations from the governors or intendants of the colony. Each grantee was allowed exclusive rights to the seal fishery and use of fishing grounds and was granted the privilege of trading with Aboriginal people (Trudel 1978).

Economic activities centered around the sedentary seal and cod fisheries. The French sedentary cod fishery began in earnest during the first half of the 18th century. There had been some cod fishing earlier, with fishermen occasionally setting up shore stations for curing cod. The stations were abandoned at the end of the season. However, these types of operations ended during the 17th century. As a result of the Treaty of Utrecht (1713), more emphasis was placed on the cod fishing grounds around the Strait of Belle Isle. Activities centered around four harbours, with never less than 1,000 men being employed annually (Trudel 1978).

It is possible some of European sites located in coastal sections of the larger study are of French origin, given the French constructed structures along the shore and possibly travelled into the interior for water, wood and food. However, no sites of French affiliation are known to exist in the project area.

The period of French occupation diminished dramatically after the signing of the Treaty of Paris, concluding war with Britain in 1763. As a result of this treaty, the English expanded their fishing grounds to include Labrador from the Strait of Belle Isle to Cape Charles. The English cod fishery on the south coast of Labrador soon resulted in permanent settlements in this region. British merchants began to establish operations on the south coast of Labrador around the 1770s and eventually operated stations further north, along the Atlantic coast, showing greater interest in the salmon, seal and fur industries (Thornton 1981). No sites of English affiliation are known to exist in the project area.

The study region has a long history of contact between Europeans and Aboriginal people. In 1743, Louis Fornel *left two Frenchmen and a number of Indians to winter near the mouth of the Nord-Ouest River* to conduct exploration and trade and establish a winter post in *Baye des Esquimaux*, the old French name for Hamilton Inlet (Privy Council 1927, Vol. 7: 3123-3124; Trudel 1978). During the following decades, the fur trade flourished and vessels were sent each year to the region and a series of trading posts were established. The French were soon followed by the English, who first wintered in the region in 1777 (Fitzhugh 1972). Between 1773 and 1783, several French-Canadian merchants from Québec (Marcoux, Marchand and Dumontier) were pursuing trade at different posts in the Lake Melville region. In 1784, two competing French-Canadian companies established two posts, one in Sheshatshiu and the other at North West River. From 1829, English-Canadian traders took over these posts until they were bought by the Hudsons Bay Company (HBC) in 1837, one year after the HBC built Fort Smith at North West River. The name of Fort Smith was soon changed to North West River House. In the 19th century, the HBC also established a series of short-lived posts in the interior (e.g., Winokapau Post), where the Innu from the Lake Melville interacted with the Innu from Mingan and perhaps from other regions (Mailhot 1993). Révillon Frères, a competing French trading company, opened a post at North West River during the first decade of the twentieth century (Armitage 1990; Kennedy 1995). Finally, the HBC continued operation at North West River until the most recent times.

There are numerous archaeological sites of European origin in the study region and may count for nearly 24 percent of all reported archaeological sites (JW 1998a). However, a great majority of these sites are located in coastal settings. Nevertheless, three outposts of the HBC were established during the 19th century along the Churchill River, two of which were investigated through archaeological subsurface testing programs in recent years (JW/IELP 2001a). However, the 2002 overview research did not identify any sites related to such operation in the project area and no sites of European origin were discovered during the archaeological survey (IELP 2002).

Settler

Early Settlers were Europeans associated with the seasonal commercial fisheries. After the fishing season, young men overwintered in Labrador to hunt seals, catch salmon, repair gear, trap furs and construct boats (Thornton 1981). Permanent settlement by Europeans, particularly of English descent, eventually led to intermarriage with the local Aboriginal population, particularly Inuit (Kennedy 1995). Today, the Settler (or Métis) population of the study area is distributed in several communities in southern Labrador, the Labrador Straits and the Québec North Shore. Aspects of contemporary Settler land use are discussed within the context of the larger discussion of land and resource use in Section 6.12. The permanent communities throughout the region are discussed in Section 6.16.

The pre-fieldwork overview research identified several areas of the hinterland that were used by Settlers from Mud Lake, including the Kenamu River and adjoining waterways. Residents of Cartwright also provided land use information for the Eagle and Paradise Rivers, which were extensively used by trappers (IELP 2002). Several sites identified within the project area during the field survey are likely attributable to the Settler population of South-central Labrador. However, it must be noted that it is not always possible to distinguish between Innu and Settler trails and/or cutting locations (12 sites; see data gap, Section 6.5.3.5).

6.11.3.3 Site Distribution

A total of 37 archaeological and ethnographic sites were recorded during the 2002 field survey, two of these dating to the precontact period (Table 6.53). More than one-third (13) of these sites were found on Uinikush Lake. Next in importance was the Kenamu River, which yielded nine sites. Seven sites were recorded on *Keupashnipi*, just east of *Uinikush*, and five at the Eagle River Forks. The remaining components yielded a single site or none at all. In terms of cultural affiliation, most of the sites are definitely or probably Innu, with some definite or probable Métis sites being recorded as well on the Kenamu River and Eagle River Forks (IELP 2002).

Table 6.53 Site Distribution by Area Investigated during the Archaeological Survey

Area (Component)	Site Name	Description
1 Churchill River North	n/a	Nil
2 Churchill River South	n/a	Nil
3 Churchill-Traverspine	n/a	Nil
4 Kenamu Crossing	Kenamu River 1 Kenamu River 2 Kenamu River 3 Kenamu River 4 Kenamu River 5 Kenamu River 6 Kenamu River 7 Utshashumeku-shipiss 1 Utshashumeku-shipiss 2	Axe-cut trees, portage trail Axe-cut stumps and poles Axe-cut stumps and logs Plywood marten trap housing Abandoned fish camp Marten trap housing and cuttings Collapsed tilt and debris Subsurface lithic debitage Clearings, cut stumps, trap
5 Uinikush Lake	Uinikush 1 Uinikush 2 Uinikush 3 Uinikush 4 Uinikush 5 Uinikush 6 Uinikush 7 Uinikush 8 Uinikush 9 Uinikush 10 Pakatan Uinikush 1 Pakatan Uinikush 2 Pakatan Uinikush 3	Three campsites, caches, debris, trail Three campsites, cut trees Five campsites, plank canoe parts Low-cut stumps, clearings, trail Trail of axe-cut trees Two campsites, debris Three clearings, cut stumps Two clearings, low-cut stumps Tent site, two clearings, debris Subsurface lithic debitage Low-cut stumps, portage trail Low-cut stumps, clearings Cut stumps, cached plastic canoe
6 Keupash-nipi	Keupash-nipi 1 Keupash-nipi 2 Keupash-nipi 3 Keupash-nipi 4 Keupash-nipi 5 Keupash-nipi 6 Keupash-nipi 7	Tent poles, stove supports Axe-cut stumps Axe-cut stumps, possible clearings Campsite, debris, cut stumps, trails Two campsites, debris; Tent clearings, debris, cut stumps Axe-cut stumps
7 Little Parke Lake	Little Parke Lake 1	Decayed axe-cut stump
8 Eagle River Forks	Eagle Forks Traps 1 Eagle Forks Portage 1 Eagle Forks Cuttings 1 Eagle Forks Cache 1 Eagle Forks Cuttings 2	Two marten trap housings Large area of clearings, one tent pole High-cut tree stumps Drum cache, debris, cut stumps One large axe-cut tree
9 Eagle Tributary	Eagle Tributary Cuttings 1	One axe-cut stump
10 Mestekaumau-nipi	n/a	Nil
11 Uinikush West Waterway	Uinikush West Waterway 1	Low-cut stumps
12 Paradise River Crossing	n/a	Nil
Source: IELP 2002.		

Thirty-five of the 37 sites date to the contemporary or late historic periods (in most cases likely after 1950), a pattern which almost certainly reflects the greater visibility of sites dating to the latter half of the twentieth century. Relatively few sites appear to be in current use, which may relate to the fact that the highway corridor project area is situated to avoid the larger air-accessible lakes favoured by Innu families since the introduction of the Outpost Program. The remaining two are precontact sites, one located on Uinikush Lake, the other on the Kenamu, at the mouth of Salmon River. Both of these areas are identified in land use data and informant interviews as important locations of traditional Innu land and resource use during seasonal moves between western Lake Melville and the lakes of the Eagle Plateau. Their role in precontact settlement patterns may have been similar. Both precontact sites date to the Intermediate period (broadly, 3,500 to 2,000 BP), a period during which "Indian" settlement appears to have been particularly intensive in the interior (JW/IELP 2001a), while the coast was substantially occupied by Palaeo-Eskimo groups.

6.11.3.4 Archaeological Potential

The pre-fieldwork overview research allowed the identification of 12 areas (or components) of enhanced potential distributed along the route, which were targeted for field investigation. These areas were each characterized by a variety of indicators suggesting high potential and, in most cases, identifying a number of specific testing locations within each area that were to be targeted for field investigation (IELP 2002).

The pre-fieldwork overview research indicated that archaeological potential was particularly high at the major watercourse crossings (Churchill, Kenamu, Eagle and Paradise), and on lakes at the western edge of the Eagle Plateau. Several smaller lakes on the central plateau also appeared to have some potential to yield sites. Highlights of the research results include:

- Churchill River/Lake Melville Plain, where higher terraces have potential to yield early precontact sites;
- Kenamu River, where both Innu and Métis land and resource use is well documented;
- the western plateau, where traditional Innu travel routes lead from the Kenamu to the large lakes of the southwestern plateau, with a number of routes converging on Uinikush Lake;
- the central and Eastern Plateau, where there are indications of both Innu settlement and also trapping by Métis from Cartwright, though with the possible exception of Eagle Forks, land use indicators are not abundant (IELP 2002).

The pre-fieldwork overview research was followed by a field survey and results of this survey include:

- Areas 1, 2, 4, 5, 6, and 8 appear to have High Archaeological Potential. The potential along the Churchill River (Areas 1 and 2) has already been established during previous assessments in the area, though the 2002 work recovered no new sites. The Kenamu River and Uinikush Lake (Areas 4 and 5) both showed ample evidence for high archaeological potential following the pre-fieldwork overview research, and the field survey confirmed this, recovering 20 sites attesting to recent and late historic Métis land use (on the Kenamu) and Innu land use (on both the Kenamu and Uinikush). These two areas also yielded the two precontact sites recorded during the field survey. Area 6 was identified in informant interviews as an important settlement area in the late historic period and field investigations confirmed this (seven sites). Area 8 also yielded a relatively large number (five) of Innu and Métis sites.

- Areas 7, 9 and 10 appear to have Reduced Archaeological Potential. Land use indicators identified in Areas 7 and 10 were, on the whole, not confirmed in field surveys.

- Area 11 appears to have Low Archaeological Potential. Informant interview data indicating substantial settlement were not confirmed in the field, though a single site was recorded.

- Areas 3 and 12 appear to have Indeterminate Archaeological Potential. Both components have only seen limited sampling to date, and their potential cannot be confirmed or denied at this point.

- Areas in the central and Eastern plateau appear to have reduced potential, but this does not necessarily hold for other central plateau locations, such as, for instance, *Nekuanikau* or *Iatuekupau*.

In summary, the project area intersects broad areas of high archaeological potential encompassing Areas 4, 5 and 6 on the Kenamu and the western plateau. Important travel routes traverse this area linking the Kenamu to the western plateau and to the lakes of the central plateau. It is likely that the whole project area between the Kenamu and the western plateau is an area of enhanced potential. Further east, the proposed highway route appears to pass through sections of the central and eastern plateau that have much lower archaeological potential. The Churchill River crossing area is known to belong to an area of high potential, while archaeological potential remains indeterminate on the margins of the Lake Melville Plain to the south, as well as the Paradise River crossing at the eastern end of the project area (IELP 2002).

6.11.3.5 Data Gaps

The overview research identified the following data gaps:

- lack of access to data on land use by Innu from the Québec North Shore, which extends as far as the Eagle Plateau;
- limited access to data on land use by Métis from the south coast of Labrador;
- Innu land use data are sparse for the eastern portions of the Eagle Plateau, the lower Eagle River and Paradise River;
- interview information covers a relatively narrow time period, and includes certain geographic limitations;
- due to geomorphological data limitations, the date of deglaciation in the western Lake Melville Area or the archaeological potential of high-elevation terraces around the Lake Melville Plain remain undetermined; and
- fine-scale aerial photo coverage was not available during the Study (IELP 2002).

The archaeological field survey identified the following data gaps:

- the field survey does not represent a detailed assessment of the TLH - Phase II Phase III route, only of selected high-potential areas distributed along that route;

- surveyed areas can only be considered sampled in most cases and the 2002 field survey represents only a preliminary investigation of the area;
- the scarcity of evidence for sites dating prior to the twentieth century;
- few sites were recorded on the central and eastern plateau outside of the Eagle Forks area; and
- limited sampling effort of certain areas at the Kenamu, Eagle, and Paradise Rivers watercourse crossings due to difficulties of weather and river currents (IELP 2002).

6.11.4 Potential Interactions

All aspects of highway construction have the potential to interact with historic resources. Surveying, vegetation clearing and grubbing, excavating and borrow pit extraction, constructing the sub-grade and watercourse crossings, establishing camps and lay down areas, rehabilitating work sites and the presence of personnel all involve some level of ground disturbance. Any disturbance of the ground surface can disturb or destroy archaeological sites or artifacts. Increased or more extensive human use of the area, resulting from improved access created by highway operation, may also lead to interactions with archaeological sites or artifacts. An accidental event, such as an on-site fire or forest fire, may also interact with historic resources.

The results of the overview research suggest that, for the most part, the proposed highway route avoids many of the areas of greatest traditional Innu land use, particularly the principal lakes of the Eagle Plateau. However, the proposed route does skirt or intersect several high-potential zones, particularly at the major watercourse crossings. The results of the field survey appear to confirm these suppositions (IELP 2002).

The results of the historic resources component study indicate that the proposed corridor passes through some broad zones of high archaeological potential, particularly the Churchill River and the area between the Kenamu River and the western Eagle Plateau. In the central and eastern portions of the plateau, the proposed route appears to pass through areas of lesser potential, with the possible exception of the Eagle River crossing. Archaeological potential remains indeterminate on the Paradise River and on the margins of the Lake Melville Plain, south of the Churchill River. In general, the study results reflect particularly intensive Innu and Métis land use on the Kenamu River, with Innu settlement extensive as well on the western plateau, on the travel routes leading from the Kenamu River to the large plateau lakes (IELP 2002).

6.11.5 Issues and Concerns

The main concern is that ground disturbance during construction or an accidental event such as a fire may alter or destroy archaeological artifacts or sites. Improved access created by the highway and any subsequent disturbance can also be viewed as concerns with respect to archaeological resources. Interviews conducted to date with Innu and Settler respondents focussed on obtaining information about the location of campsites, harvesting areas, and other areas of interest that would be used to facilitate the selection of survey areas (IELP 2002). However, concerns regarding the protection of historic resources were not presented in the Historic Resources Component Study report. Based on previous interviews conducted with residents of southern Labrador (JW 1998a), it is anticipated that knowledge of archaeological resources in the project area are limited. Nevertheless, it is very likely that most interviewees would indicate any sites encountered should be studied and properly documented. Indeed, archaeological sites are valued by Innu and other aboriginal people. Sites contain the only physical information on how aboriginal people lived before the arrival of

Europeans. They are particularly important for the Innu and other Aboriginal people of Labrador because the information they contain is a record of their past.

6.11.6 Mitigation

The goal of historic resources management is to protect historic resources and mitigate potentially adverse effects to reduce loss or alteration of archaeological, historic and contemporary sites and objects. WST will have in place a Historic Resources Contingency Plan to address historic resources protection during all project phases. Specific mitigation measures to protect historic resources will include the following:

- while the centreline for the TLH - Phase III is being surveyed and cut, an archaeological aerial and field survey will be conducted to ensure the correct corridor was assessed for historic resources;
- in the event alterations to the original corridor occur, affected areas will be assessed for historic resources potential;
- when the centreline for the TLH - Phase III has been surveyed and cut, areas where thick forest cover or other factors limited the field survey will be reinvestigated;
- when locations for laydown areas, construction camps, borrow pits and maintenance depots are identified, they will be assessed by an archaeologist prior to any ground disturbance;
- should Settler and Québec Innu land use data become available, this information will be considered in any further archaeological assessment;
- design and implement an EPP in consultation with the PAO and appropriate Aboriginal authorities, including procedures on what to do if archaeological sites or artifacts are encountered;
- personnel will be informed of their responsibility to report suspected findings of historic resources during environmental awareness sessions;
- archaeological materials encountered will be reported to the PAO, including the nature of the activity resulting in the find, nature of the material discovered and precise location of the find;
- if historic resource sites are encountered, construction activity will halt until an archaeologist from the PAO authorizes the work to resume;
- develop, in consultation with the PAO, appropriate measures for excavating a site or possibly re-routing the highway if an important archaeological site is encountered on the 40-m right-of-way during future historic resources field assessment or construction; and
- contractors will take all reasonable precautions to prevent personnel from disturbing or destroying any archaeological sites or artifacts encountered.

6.11.7 Existing Knowledge

It is known that activities involving the disturbance of existing ground cover, such as project construction, may result in the unearthing, alteration and/or destruction of known or unknown archaeological artifacts or sites. It is also known that human activity and improved access increase the likelihood that adverse effects on historic resources will occur.

6.11.8 Environmental Effects Analysis

Effects on historic resources may occur during the construction phase, as a result of an accidental event or improved access to the project area.

6.11.8.1 Construction

There are 41 archaeological and ethnographic sites within a 10 km-wide corridor along the preferred route, 37 of which were found during the 2002 field survey (Figure 6.30). Existing information on the people that inhabited this region indicates that Métis lived on the coast and commonly travelled in the hinterland, particularly along selected habitable shoreline of major rivers and lakes, where they established camps and conducted subsistence activities such as hunting, fishing, harvesting firewood and collecting berries. However, it appears that the homeland of certain groups such as the Intermediate Indian and the historic Innu was the hinterland.

The field assessment yielded evidence of precontact use of the project area at two sites, both dating to the Intermediate Indian period (3,500 to 2,000 BP). In addition, 35 sites dating to the late historic and/or contemporary period were also identified. Several Innu camp locations and Settler tilts used during the early part of the twentieth century were also recorded. However, the cultural affiliation of a number of ethnographic sites and particularly cutting locations and trails remain undetermined and could indicate activities conducted by either group. Most of the sites discovered in 2002 are located in the western portion of the project area. However, the Historic Resources Component Study cannot be considered to be entirely thorough given the sampling effort to date in relation with the size of the project area sampled. The field survey conducted to date is distinct from more precise effects assessment along the 40 m construction corridor and project features which may only commence once the route and features are surveyed, marked and delineated (IELP 2002). Therefore, additional historic resources may be present along the precise route. These data gaps can be rectified during subsequent pre-construction surveys. Until such further assessments are completed, there is a possibility that artifacts or other historic resources may be unearthed during construction.

It is estimated that approximately 15 percent of the sites located to date are situated on or at short distances from the proposed route and would be directly affected by construction. In addition, 85 percent of the sites located within the corridor may be indirectly affected by the project due to improved access to the project area during construction and operation. WST will consult the PAO to obtain the approval of proposed mitigative measures (Section 6.6) before proceeding with construction at or in the vicinity of any of these sites.

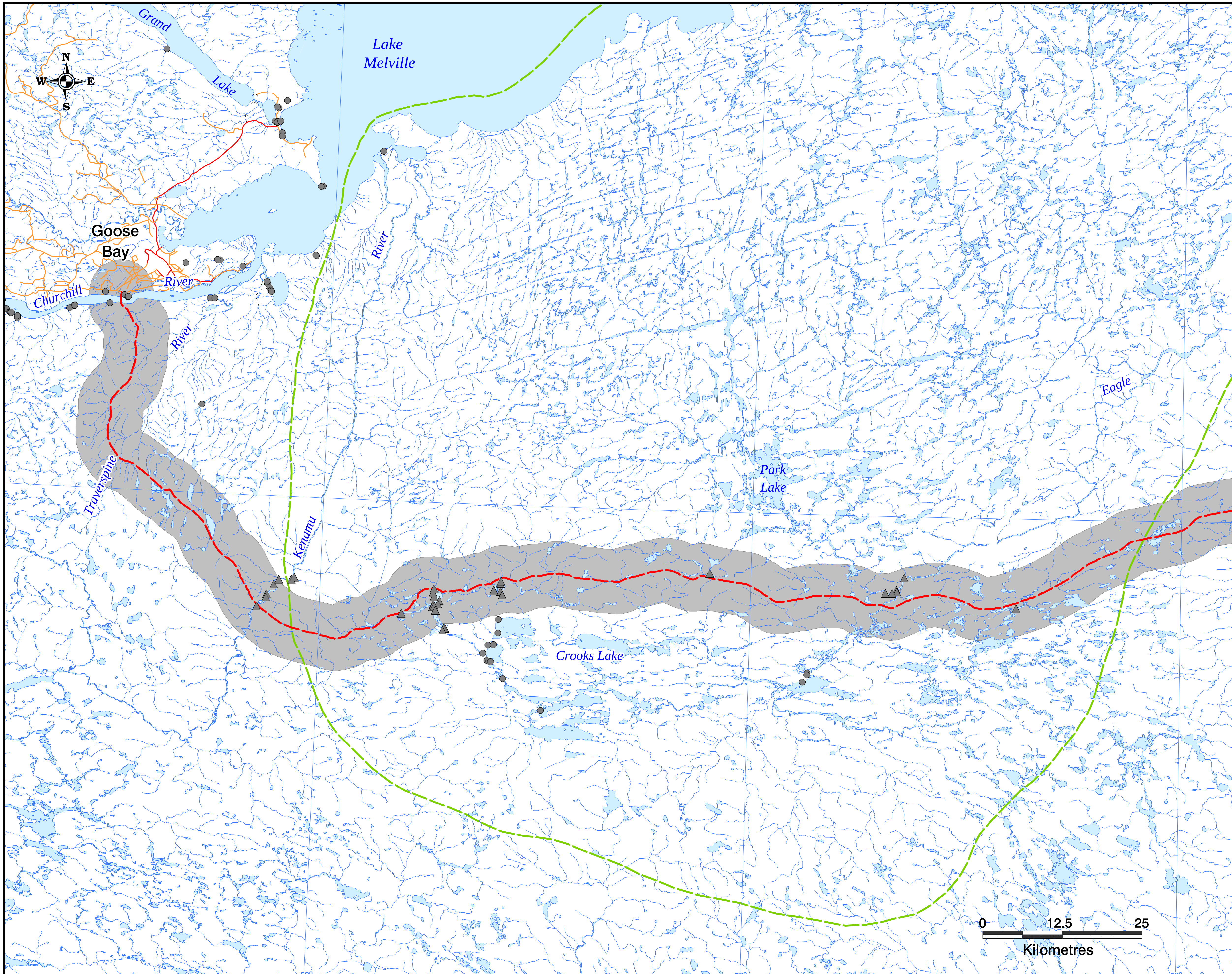


Figure 6.30

Archaeological Site Distribution Within and in the Vicinity of the Project Area (corridor)

Based on the existing conditions, the potential for historic resources to be present within the project area is high in six areas investigated during the 2002 field survey (e.g., river junctions and preferred sections of shorelines such as points and constrictions). Of these, five lie in the western portion of the project area. Elsewhere, the potential varies from low (one area) to moderate or reduced (three areas) or remains indeterminate (two areas). Therefore, the probability of encountering archaeological resources during construction or inadvertent discovery is highly variable across the project area. Based on the best information available at this time, it is anticipated that the shoreline of major streams and lakes have the highest potential to yield important historic resources and that the overall potential of the western portion of the study area appears to be the highest.

The area of ground disturbance during construction will be localized. Procedures for handling historic resources encountered during project construction will be outlined in the EPP.

6.11.8.2 Operation

There is potential that known and unknown historic resources could be affected as a result of improved access to the study area and project area. There are currently 41 archaeological and ethnographic sites registered for the project area. The anticipated effects associated with operations will affect these sites to various degrees. The indirect effect of increased human presence is one of the most difficult to predict and control. Human access to archaeological remains is not only a function of accessibility. Its effects may also depend on how visible and recognizable a site is and how attractive its contents are to potential collectors.

6.11.8.3 Accidental Events

There is potential an accidental event, such as forest fire, could have an adverse effect on historic resources (such as destroying standing structures and contaminating organic materials at a site). A large area of ground could be disturbed during an accidental event, although this is considered unlikely. Such an event could occur during any phase of the proposed project. Accidental events could occur during all phases of the project. Sources of potential effects include discovery of historic resources through operation of heavy equipment and infrastructure failure (e.g., highway washout). The risk of environmental effects on historic resources caused by accidental events is low as a result of the protection measures included as mitigation (Section 6.6).

6.11.9 Environmental Effects Assessment

Environmental effects significance criteria for historic resources is largely defined by the *Historic Resources Act*. Historic resources are not assigned a value relative to each other, either within the WST project area or with other historic resources known from elsewhere in the province. The following definitions are used to rate the residual environmental effects on historic resources:

A **major (significant) effect** is the loss of an historic resource without salvage or retrieval of the information it contains.

A **moderate (significant) effect** is partial alteration of an historic resource and loss of some of the information it contains.

A **minor (not significant) effect** is any loss or alteration of an historic resource considered to be acceptable by the Department of Tourism, Culture and Recreation, including loss or alteration of an historic resource resulting from salvage archaeology where information is retrieved.

A **negligible (not significant) effect** is any discovery of an historic resource that does not result in loss or alteration of that historic resource or the information it contains, but increases the risk of future loss or alteration of that historic resource.

The significance of residual environmental effects for construction, operation and accidental events are highlighted in Table 6.54, along with ratings for the established environmental effects significance criteria. The significance ratings in Table 6.54 assume that the PAO will approve the necessary mitigative actions. Mitigation measures for historic resources are also outlined. Application of the mitigative measure discussed in Section 6.6 will reduce the probability that historic resources will be lost or altered within the project area. Therefore, the residual effects are negligible to minor.

Given the probability of encountering historic resources and the mitigation measures identified, the residual environmental effects during construction are assessed as minor (not significant). Any effect would be limited to the project area (i.e., right-of-way). The specific frequency cannot be predicted at this stage. However, it is anticipated that the frequency may be higher in the western portion of the project area. The magnitude of the effect is rated as high because historic resources would be permanently altered. The residual environmental effects would not be reversible.

Given the probability of encountering historic resources and the mitigation measures identified, the residual environmental effects during operation are assessed as minor (not significant). During operation, activities will be limited to the highway, ditches and back slope. These areas will have been disturbed by construction and then rehabilitated. Any new disturbance will result from human use of the area due to the improved access. The extent of such residual environmental effects will be from 1,001 to 10,000 km^2, and they could occur year-round. However, the frequency is expected to be low. The magnitude of the residual environmental effects is rated as low because any changes in historic resources will be within the range of natural variability. Residual environmental effects will not be reversible.

Table 6.54 Residual Environmental Effects Summary - Historic Resources

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • conduct an archaeological field survey while the centre line is being surveyed and cut to ensure that the correct area was investigated during the archaeological field study; • conduct more detailed investigation in areas where forest cover or other factors limited the original survey; • conduct an archaeological survey of laydown areas, construction camps, borrow pits and maintenance depots locations prior to any ground disturbance; • if information on Settler and Québec Innu land use become available, to WST, it will be considered in any further archaeological study; • consult with the PAO regarding necessary mitigative measures for the sites discovered within the project area; • design and implement an EPP in consultation with the PAO, including response procedures for inadvertent encountering of archaeological sites or artifacts during construction; • inform personnel about procedures for handling and reporting archaeological sites and artifacts will be part of environmental awareness sessions delivered to any construction personnel; • the contractors will take all reasonable precautions to prevent personnel from disturbing or destroying archaeological sites; • inform the PAO of any archaeological findings; • halt construction activity until an archaeologist from the PAO authorizes work to continue; and • if required, develop, in consultation with the PAO, appropriate measures for excavating a site or possibly re-routing the highway if an important archaeological site is encountered on the 40-m right-of-way during future historic resources field assessment or construction.			
Environmental Effects Criteria Rating			
Magnitude	High	Low	Low
Geographic Extent	11-100 km^2	1,001-10,000 km^2	1,001-10,000 km^2
Frequency	<10	<10	<10
Duration	>72	>72	Unknown
Reversibility	Irreversible	Irreversible	Irreversible
Ecological/Socio-economic Context	Low	Low	Low
Environmental Effects Evaluation			
Significance	Not significant (Minor)	Not significant (Minor)	Significant (Major)
Level of Confidence	Moderate	High	Moderate
Likelihood[1]	n/a	n/a	Low
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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). In the case of historic resources, sustainable use of resources is not applicable.			
Environmental Monitoring and Follow-up: No monitoring has been identified.			
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			

Residual environmental effects on historic resources due to accidental events could occur during construction or operation. Significant effects (i.e., loss of historic resources) could occur in the event of a fire. The timing and duration of an accidental event is not known and the frequency of such events is expected to be low. However, the likelihood of this occurring is low. The magnitude of the residual environmental effects will vary from low to high, and the effect will not be reversible. Implementation of a Historic Resources Contingency Plan will reduce the probability and magnitude of residual environmental effects on historic resources.

6.11.10 Cumulative Environmental Effects

It is possible that historic resources in the project area may already be disturbed. At present, such activities as all-terrain vehicle travel, commercial ventures (e.g., outfitters) or industrial undertakings (e.g., mineral exploration) may result in some disturbance of the ground cover. Previous development of the TLH - Phase II, as well as the development associated with the creation of the Akamiuapishku/Mealy Mountains National Park, may also affect historic resources in the project area. In addition, any increase in land and resource use activities in the area, such as forestry operations or mineral exploration/mining may also disturb or destroy historic resources. However, all development activities are subject to the *Historic Resources Act*.

Details such as the likelihood, nature, location and timing of any actions induced by the TLH - Phase III are not known and the control of most potential induced actions and related effects are beyond the jurisdiction of WST. Control depends on appropriate enforcement and management and planning on the part of relevant regulatory agencies. As a result, a number of assumptions were made in 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.

With the implementation of these mitigation measures, particularly appropriate planning and enforcement, the project and other activities can likely be undertaken without resulting in significant adverse cumulative effects on historic resources.

6.11.11 Monitoring

A pre-construction historic resources survey of the final cut/marked route will be conducted by WST.

6.12 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 resource use activities are carried out in the area in which the TLH – Phase III will be located. Activities include hunting, trapping, fishing, forestry, mineral exploration, military activities, parks and other special areas, and cabins, trails and recreational use. Resource users include the Innu, Settler/Métis, other residents of Labrador and tourists to the area. This section provides an overview of existing resource use and users, except for innu land and resource use, and a discussion of the potential environmental effects and analysis carried out for this VEC. Innu land and resource use and potential environmental effects are considered in detail in Armitage and Stopp (2003).

6.12.1 Boundaries

The spatial project boundary for resource use and users encompasses the 40 m right-of-way for the TLH - Phase III between Happy Valley-Goose Bay and Cartwright Junction for an approximate distance of 250 km (Figure 2.2), as well as areas of associated physical disturbance, including watercourse crossings, borrow pits, temporary construction camps and laydown areas. The boundary also extends beyond the highway right-of-way to include areas of current resource use and areas of potential resource use due to the improved access that the highway will provide. Temporal project boundaries for resource use and users are defined by the timing and duration of construction (i.e., the period from 2003 to 2008), operation (i.e., in perpetuity) and accidental events (which may occur at any time during construction or operation, but the duration will vary depending on the event).

The proposed route for the TLH – Phase III passes through Regional Economic Zones 3 and 4 (Figure 2.3). Zone 3 encompasses the area surrounding the portion of the proposed highway route closest to Happy Valley-Goose Bay (i.e., Central Labrador), while Zone 4 encompasses the eastern portion of the route towards Cartwright Junction (i.e., Southern Labrador). These zones comprise the socio-economic boundary for resource use and users. Note that in Zone 4, the focus is on resource use activities carried out in the western and northern portions of the zone. Temporal socio-economic boundaries for resource use and users extend through construction, operation and accidental events. These zones also represented the study area for the component study on resource use and users prepared by JW (2003c).

Various aspects of resource use and users are defined by more specific administrative boundaries as determined by political, social, cultural and economic factors. Resource use and users in Central and Southern Labrador are administered by a number of government departments and agencies, including the provincial departments of Municipal and Provincial Affairs, Environment, Government Services and Lands, Forest Resources and Agrifoods, Tourism, Culture and Recreation, and Mines and Energy, and federally DFO, Canadian Heritage (i.e., Parks Canada) and DND. Management areas established by these departments set the spatial administrative boundaries for resource use (e.g., wildlife management zones, scheduled salmon rivers or municipal planning areas). The TLH - Phase III will also cross land area that is subject to a land claim by Innu Nation, which is currently being negotiated between Innu Nation and the governments of Canada and Newfoundland and Labrador. Other organizations, such as the Labrador Métis Nation, and economic development and tourism organizations also play a role in the administration of resource use and users in Central and Southern Labrador. Resource use activities, services and infrastructure are also the responsibility of the various private-sector organizations and individuals which provide them.

Temporal administrative boundaries are defined by the time periods associated with the various management plans and activities identified for the area. These boundaries will be in effect through TLH - Phase III construction, operation and any accidental events.

6.12.2 Methods

The environmental assessment of resource use and users draws on the background information provided by the component study on resource use and users completed by JW (2003c) for the TLH - Phase III environmental assessment. Information for this study was gathered from existing literature and database sources, as well as interviews with individuals from various organizations.

Informant interviews were held to collect information on hunting, fishing, trapping, forestry, commercial and industrial, recreational and other activities. Contacts included individuals in departments and agencies such as the Department of Forest Resources and Agrifoods, Department of Tourism, Culture and Recreation and DFO. Data on watercourse crossings gathered through aerial and ground surveys conducted for the fish and fish habitat component study (JW/IELP 2003) provided information on waterway characteristics and use in the area, which was supplemented by interviews with local authorities in the Happy Valley-Goose Bay and Cartwight areas to obtain local knowledge of current and past use of local waterways. All outfitters in the area were contacted for information to obtain information on the location and nature of the operations. Issue scoping interviews with municipal, tourism, economic development and business organizations were also carried out to obtain information on experience with previous sections of the TLH. In addition, the study team had access to information from interviews with Settlers carried out by Armitage and Stopp (2003).

A separate study and analysis of environmental effects on Innu land and resource use was carried out by Armitage and Stopp (2003). This study included gathering information on Innu land and resource use through a series of interviews with Innu informants.

The environmental effects analysis of resource use and users is based on a review of existing resource use activities in the area, and an analysis of the effects that the project may have on resource use and users. Each project phase and activity was considered in relation to the baseline, including potential direct, indirect and induced changes that may result from the project.

6.12.3 Existing Environment

The principle resource users in the study area are the Innu (discussed in Armitage and Stopp 2003), Settler or Métis, other Labrador residents and visitors/tourists to the area (in particular visitors to outfitting operations). While much of the use is for subsistence or recreational purposes, there are also commercial/business interests (e.g., commercial caribou harvest, trappers and adventure and nature tourism operators) and industrial and government users (e.g., forestry companies and the military). Resource use activities considered in this VEC are Settler or Métis land use, municipal/community land use, waterway navigability, hunting, trapping, fishing, outfitting operations, parks and special areas, cabins, trails and recreational areas, forestry, mineral exploration and quarries, hydro power development and military activities. The proposed Akamiuapishku/Mealy Mountains National Park and tourism and recreation are also considered in greater detail in Sections 6.13 and 6.14, respectively. These aspects of resource use and the users are considered separately due to the importance placed on them by regulatory agencies and the public.

6.12.3.1 Settler and Métis Land and Resource Use

The Settler/Métis are people of European and/or Aboriginal origin whose ancestors resided in Labrador as early as the historic period (JW/INEN 2001). Land areas historically used by the Settler/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/Métis from the Happy Valley-Goose Bay area primarily used the Traverspine and Kenamu rivers, the Mealy Mountains and eastward towards the Eagle Plateau, while Settlers/Métis from Cartwright and Paradise River naturally tended to use the Paradise and Eagle Rivers, as well as the Great Meshes (Stopp 2002).

Furbearers trapped included beaver, fox, lynx, pine marten, otter and mink. Subsistence activities carried out while trapping included hunting caribou, when available, porcupine, partridges and hare for immediate needs. Food and equipment caches were sometimes placed at key locations along travel routes and traplines (Stopp 2002). In the 20th century a growing number of factors led to the eventual downfall of the Settler/Métis traditional way of life including lumbering operations in the Mud Lake area, the depression of the 1930s, the construction of the Goose Bay air base in the 1940s and the advent of snowmobiles and other means of modern transportation (JW 2003a).

In recent years, the land and resource use by Settlers/Métis has changed in the following manner:

- fewer trappers harvest resources in the interior;
- trappers spend less time in the interior;
- areas of utilization have increased;
- traditional series of tilts spread along the route were eliminated;
- transportable canvas camps and occasional main (built) camp are used; and
- trappers return to community on a regular basis instead of remaining at a winter camp or on a trapline for three months (IELP 2002).

6.12.3.2 Settlement and Development

There are 15 communities in the study area: four in Regional Economic Zone 3 (Central Labrador) and 11 in Regional Economic Zone 4 (Southern Labrador) (Figure 3.16) . However, there are no communities in the immediate vicinity of the proposed highway route. Communities in Zone 3 include Happy Valley-Goose Bay, North West River, Sheshatshiu and Mud Lake. Communities in Zone 4 include Cartwright, Charlottetown, Port Hope Simpson, St. Lewis, Mary's Harbour, Paradise River, Black Tickle-Domino, Norman Bay, Pinsent's Arm, Williams Harbour and Lodge Bay. Of the four communities in Central Labrador, Happy Valley-Goose Bay and North West River are incorporated municipalities with municipal plans and development regulations. Similarly, in Southern Labrador, Cartwright, Charlottetown, Port Hope Simpson, St. Lewis and Mary's Harbour are incorporated towns with municipal plans.

In Central Labrador, Phase I of the TLH (Route 500) extends from the intersection with Hamilton River Road in Happy Valley-Goose Bay to the Quebec-Newfoundland and Labrador border. This route is also rated as a Class II protected road. All Central Labrador communities have a network of roads. There is also a series of resource roads located in the vicinity of Happy Valley-Goose Bay and North West River.

Within Southern Labrador, the Phase II portion of the TLH (Route 510) extends from the intersection of the highway at the airstrip road in Cartwright to Red Bay, where it links with the highway through the Labrador Straits and to the island of Newfoundland via a ferry connection. This highway is also rated as a Class II protected road. The Charlottetown (Route 514) and St. Lewis (512) access roads constructed in conjunction with Route 510 are both rated as Class III Protected Roads. Route 514 extends from Route 510 to the airstrip access road in Charlottetown, while Route 512 extends from Route 510 to the western municipal boundary in St. Lewis. All towns have a network of roads, as well as a road connection with the local airstrip, which were upgraded when they were connected to the TLH - Phase II. There are resource roads in Cartwright and Port Hope Simpson. There are no formal road networks in many of the smaller, unincorporated communities.

There are no municipal water supplies in the immediate vicinity of the proposed TLH - Phase III route and its right-of-way. The water supply (i.e., a series of deep wells) for Happy Valley-Goose Bay, which is located 6.5 km west of the town, is the closest to the route at a distance of 2.5 km.

6.12.3.3 Waterway Navigability

There are 95 identified watercourse crossings along the route of the proposed TLH - Phase III (Figure 6.21). These crossings are located within five watersheds covering the route: Churchill River; Traverspine River; Kenamu River; Eagle River; and Paradise River. Of the 95 watercourse crossings, only the Churchill River crossing location is considered navigable by traffic larger than canoes or kayaks. For the remaining crossings, it is possible that canoes or kayak are the only vessels that would likely use these watercourses (C. Froude, pers. comm.). All of the watersheds experience a certain level of resource use activity throughout the year (Table 6.51), with much of the use possibly being concentrated in the lower reaches of the Kenamu, Traverspine, Eagle and Paradise rivers (JW 2003c).

6.12.3.4 Hunting

Wildlife hunting has played a key role in both historical and contemporary land use in Labrador. Various Aboriginal groups, dating back to 8,000 BP, relied on the wildlife resources throughout the region for food, clothing and shelter, and later for trading with the French and English fur traders. The emergence of the fur trade in the late 16th century was the beginning of commercial wildlife harvesting in the area. Labrador residents continue to make use of wildlife resources (in particular moose, caribou, black bear, small game, waterfowl and seabirds) for subsistence, and to a limited extent for commercial purposes.

Table 6.55 Resource Use in Area Watersheds

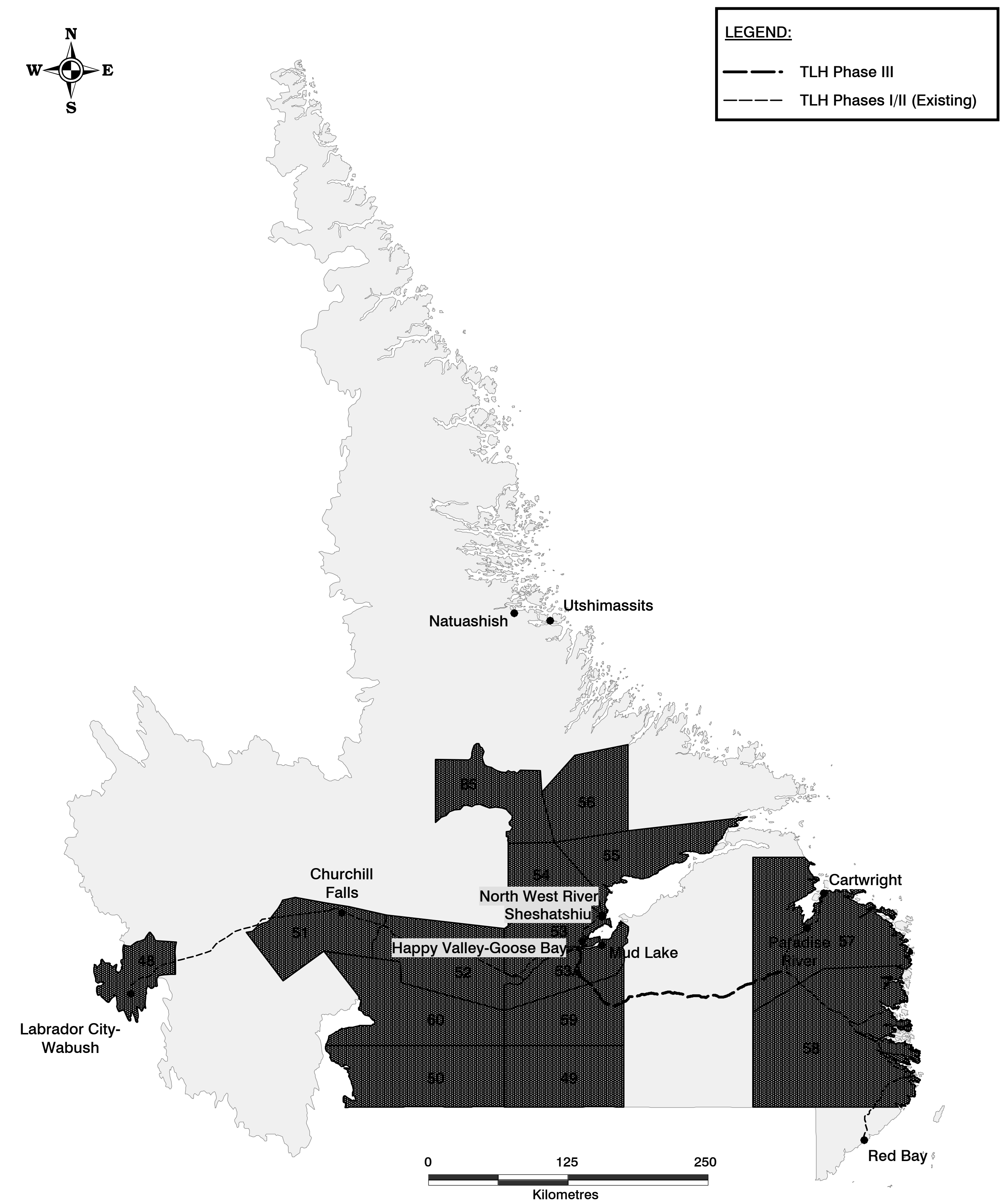
Watershed	Period of Use and Common Activities
Churchill River	• May to November - sightseeing, fishing and recreational boating. • Fall - hunting. • January to April - recreational snowmobiling, trapping, hunting and gathering firewood.
Traverspine River	• Summer and Winter - fishing. • Winter - trapping and snowmobiling on lower sections of river.
Kenamu River	• Summer and Winter - fishing. • Fall - moose hunting. • Winter - snowmobiling on lower sections of river, trapping and ice fishing.
Eagle River	• Summer - recreational fishing. • Fall - moose hunting. • Winter - snowmobiling and trapping.
Paradise River	• Summer - fishing. • Fall -hunting. • Winter - snowmobiling and trapping.
Source: JW 2003a.	

Moose Management and Hunting

Established moose management areas (MMA) are located at the western and eastern portions of the proposed TLH - Phase III (Figure 6.31). MMA 57 is located on the eastern portion of the proposed highway, around Paradise River. MMAs 53 and 53A are centred around the Muskrat Falls area, on the western end of the proposed highway. The area directly south of Lake Melville (between MMA 53A and MMA 57) is not zoned for moose hunting. Most moose hunting within MMA 57 occurs along the Paradise River valley as this is where moose numbers are highest in the area (H. Martin, pers. comm.). No information is available on specific hunting locations within MMAs 53 and 53A.

Moose densities are considered low in Labrador, ranging from 0.013 to 0.168/km^2 in Southern Labrador, and low productivity rates imply that continued growth of the moose population in Labrador is likely limited (Chubbs and Schaefer 1997). The moose population has not increased in recent years, mainly due to predation by wolves and some poaching (H. Martin, pers. comm.). During the critical winter period, moose tend to concentrate in river valleys or other areas of forest habitat, where browse is available and lower relative snow depths are less likely to restrict movement.

For the 2002-2003 season, the hunting period varies, with MMAs 53 and 57 open from September 14, 2002 to January 4, 2003 and MMA 53A open from September 14, 2002 to March 15, 2003. Quotas for the 2002-2003 season are 25 moose in MMA 53 and five moose in each of MMA 53A and MMA 57. Five licenses per year have been issued for MMA 57 since 1990. In 2001, 355 moose licence applications were submitted for MMA 53, 178 applications for MMA 53A and 53 applications for MMA 57. No non-resident moose licenses are available in Labrador (W. Barney, pers. comm.). No special harvesting provisions are in place for Aboriginal persons. Moose have not been traditionally harvested by Aboriginal peoples and do not appear to be of primary importance as a resource (W. Barney, pers. comm.).



Source: DTCR 2002a.

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Figure 6.31

Moose Management Areas in Labrador

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Caribou Management and Hunting

Caribou numbers are generally low in southern Labrador. The most recent population estimate for the MMCH is 2,585 animals (±1,596) (Otto 2002a), with a range extending south from Lake Melville east from the Kenamu River headwater to the Labrador coast. The range of the neighboring Red Wine Caribou Herd is centred around the Red Wine Mountains to the west of Lake Melville. This herd is estimated to number less than 200 animals (Schaefer et al. 1999). Both of these herds are woodland caribou, which have recently been designated as threatened by COSEWIC. Caribou management zones in Labrador have been designed to avoid any hunting activity in areas where woodland caribou are present. Therefore, there are no caribou management zones south of Lake Melville or in the vicinity of the proposed TLH - Phase III route. Due to the current COSEWIC status of woodland caribou, it is unlikely that any caribou management zones will be established south of Lake Melville.

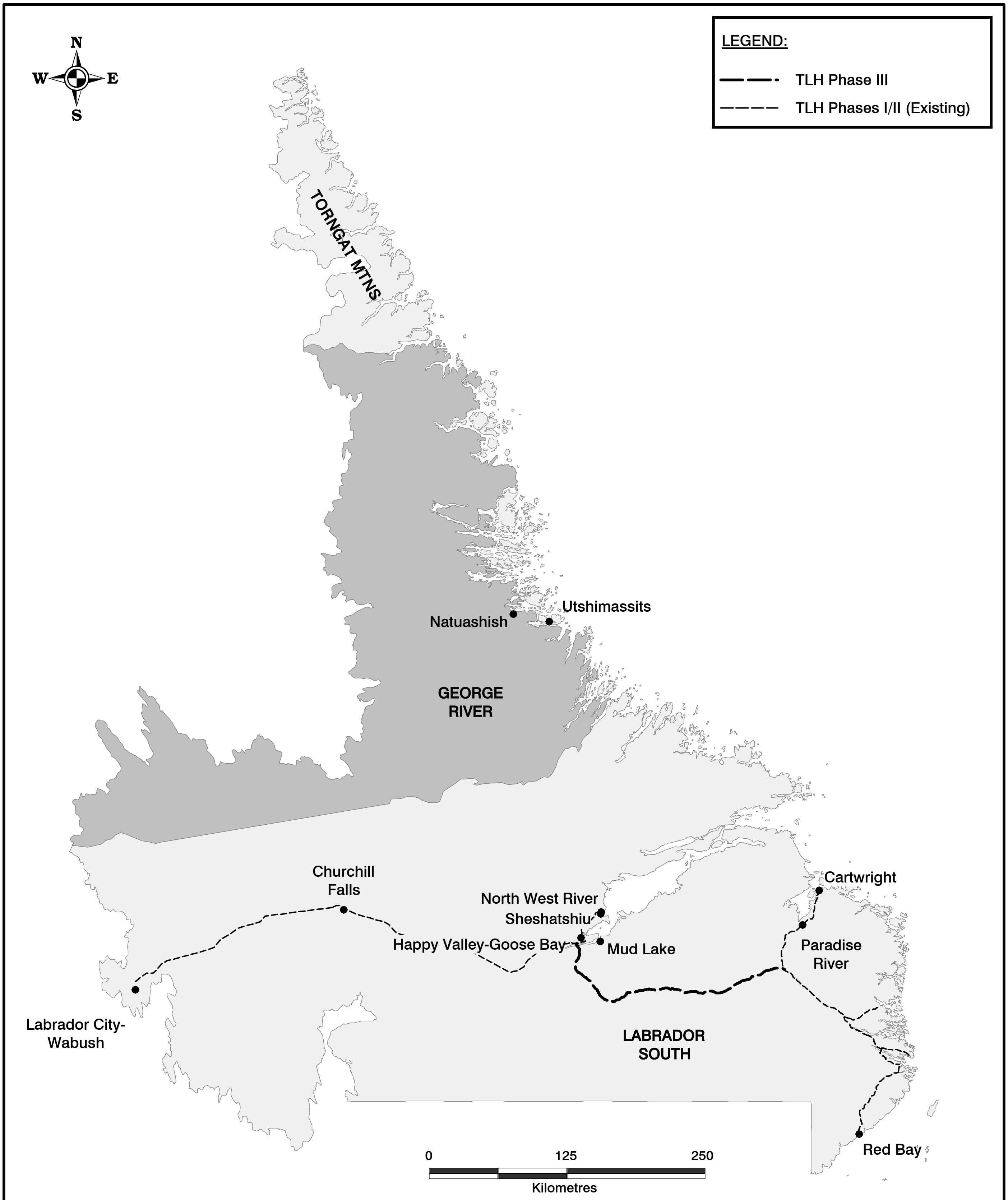
Hunting of caribou from the Mealy Mountains and Red Wine herds is not permitted. The only legally hunted caribou herds in Labrador are the barren-ground George River (approximately 450,000 animals) and Torngat Mountain (approximately 5,000 animals) herds, both of which range north and west of the Lake Melville area. All residents of Labrador, holding a resident caribou license, are entitled to harvest two caribou of either sex per year. Non-resident licenses are available only though licensed outfitters and a registered guide must accompany all non-resident hunters. There are also three commercial caribou operations licensed in Labrador and all require a Commercial Caribou Licence which is renewed annually. This activity is regulated by the Inland Fish and Wildlife Division.

Black Bear Management and Hunting

Black bears are found throughout the Quebec-Labrador peninsula, occupying a variety of habitats, including barrens, forests, coastal islands and sea ice (JW 1997). The Labrador South Black Bear Management Area covers all of Central and Southern Labrador, including the area of the proposed TLH - Phase III (Figure 6.32). There is a spring and fall bear hunting season; the spring season occurs between April 1 and July 13 and the fall season occurs from September 1 to November 30 (JW 2003a).

Labrador residents must obtain a resident black bear hunting license and non-resident hunters must obtain a license through licensed outfitters and be accompanied by a registered guide for the hunt. Both resident and non-resident hunters are limited to two bears of either sex per license. Female bears accompanied by cubs may not be taken. There are no special provisions for hunting by Aboriginal people; they are required to obtain a resident hunting license (JW 2003a). From 1997 to 2001, resident black bear license sales averaged 47 annually and non-resident sales averaged 43 annually. Historical harvesting data and hunter success rates for black bear in Labrador are not available (W. Barney, pers. comm.).

The incidences of nuisance black bears in communities along the coast have increased by approximately 80 percent in the last decade and more black bears are probably destroyed for nuisance reasons than are harvested (H. Martin, pers. comm.). There is no access to inland areas except in winter; therefore, hunting for black bear only occurs around communities. Two reasons the harvest of black bears is low are: they are no longer eaten because of their habits of foraging in local dumps; and pelts do not have a high value (H. Martin, pers. comm.).



Source: DTCR 2002a.

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Figure 6.32

Black Bear Management Areas in Labrador

Small Game Management and Hunting

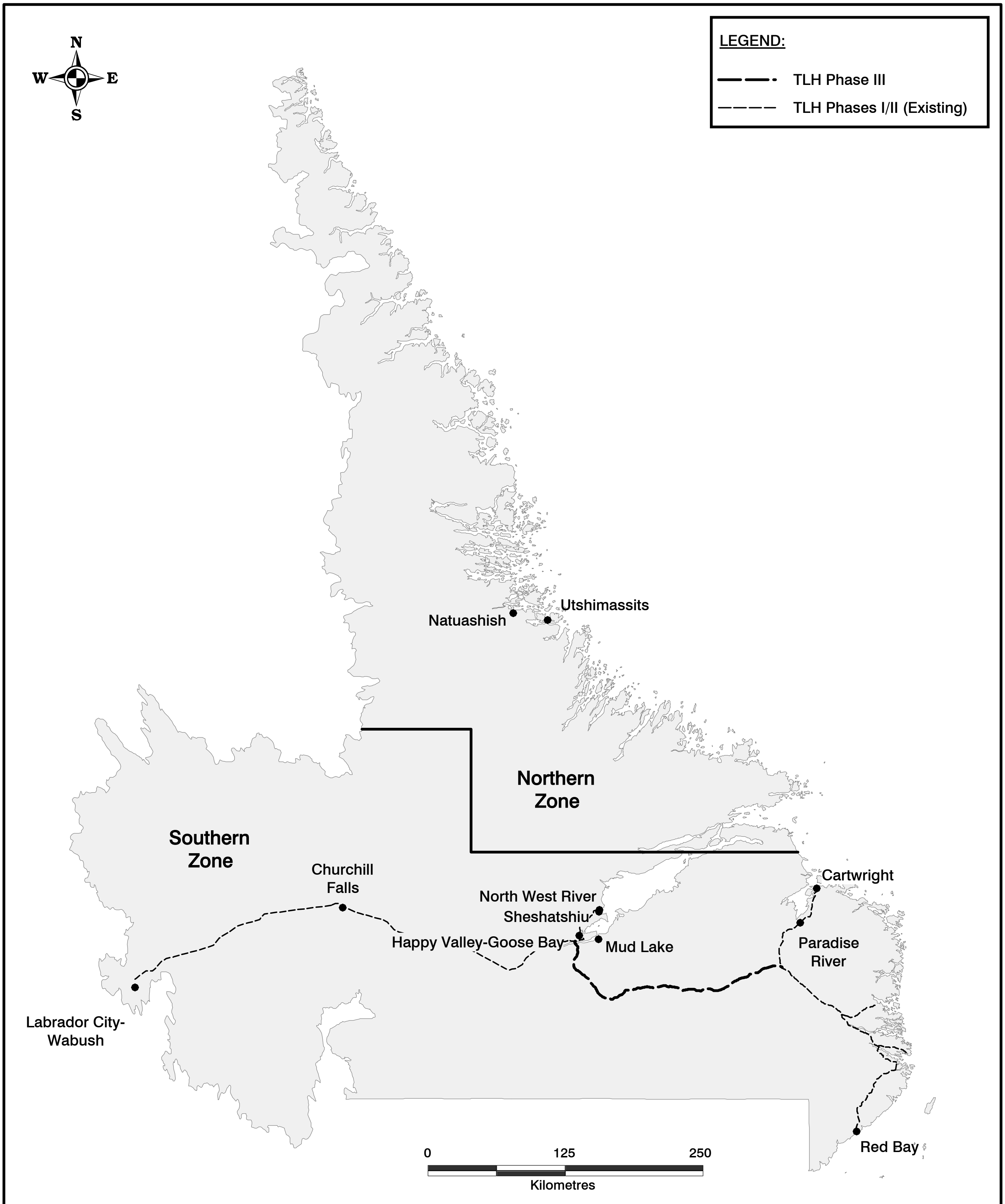
The proposed TLH - Phase III is located in the southern Small Game Management Zone (Figure 6.33). Willow ptarmigan, ruffed grouse, spruce grouse, snowshoe hare and Arctic hare are all managed species in this zone. Depending on the species, seasons for shooting and snaring vary. For the 2002-2003 season, shooting is permitted between October 1 and April 20 and snaring between October 1 and March 31 (JW 2003a). The bag and possession limits for rock and willow ptarmigan during the 2002-2003 season are 25 and 50, respectively, for all of Labrador. For grouse, the bag limit is 20 and possession limit is 40. There are no bag or possession limits for snowshoe and arctic hare in all of Labrador.

As with caribou and black bear, Labrador residents must obtain a small game license. Non-resident hunters are not required to be accompanied by guides for small game hunting. In 2001, approximately 3,500 small game licenses were sold in Labrador. In 2001, an estimated 59,000 snowshoe and Arctic hares (combined), 49,000 ruffed and spruce grouse (combined) and 59,500 ptarmigan (both willow and rock) were harvested (W. Barney, pers. comm.). However, license sales and harvest records do not distinguish between the Northern or Southern Zones.

Waterfowl and Seabird Management and Hunting

The central migratory game bird hunting zone (Central Zone) encompasses the area of the proposed TLH - Phase III, while the Southern Zone encompasses the remainder of the study area (Figure 6.34). Open season for ducks (other than harlequin duck and eider duck), geese and snipe in this zone is the first Saturday in September to the second Saturday in December. In the Southern Labrador Zone, the open season begins one week later (i.e., second Saturday in September) and runs for one week longer (i.e., third Saturday in December). The eider duck season in the Southern Zone is varies depending on the hunting zone. In the Northern Labrador Zone, the season runs from the last Saturday in September to the second Saturday in January. In the Southern Labrador Zone, the season is from the fourth Saturday in November to the last day of February.

The most commonly hunted waterfowl species in Labrador are Canada goose and American black duck. Other waterfowl harvested include mallard, green-winged teal, ring-necked duck, and mergansers. The eastern population of harlequin duck is listed as a species of special concern by COSEWIC and are considered vulnerable under the provincial *Endangered Species Act*. Therefore, there is no legal hunting of this species. Daily and possession limits for ducks (other than mergansers, harlequin, eider and scoter) is 6 and 12, respectively. Merganser, scoter and eider have a daily and possession limit of six (not more than three may be eiders after the first Monday in February) and 12 (not more than six may be eiders after the first Monday in February). Geese and snipe have daily limits of 5 and 10, respectively, with a possession limit of 10 and 20, respectively (JW 2003a).



Source: DTCR 2002a.

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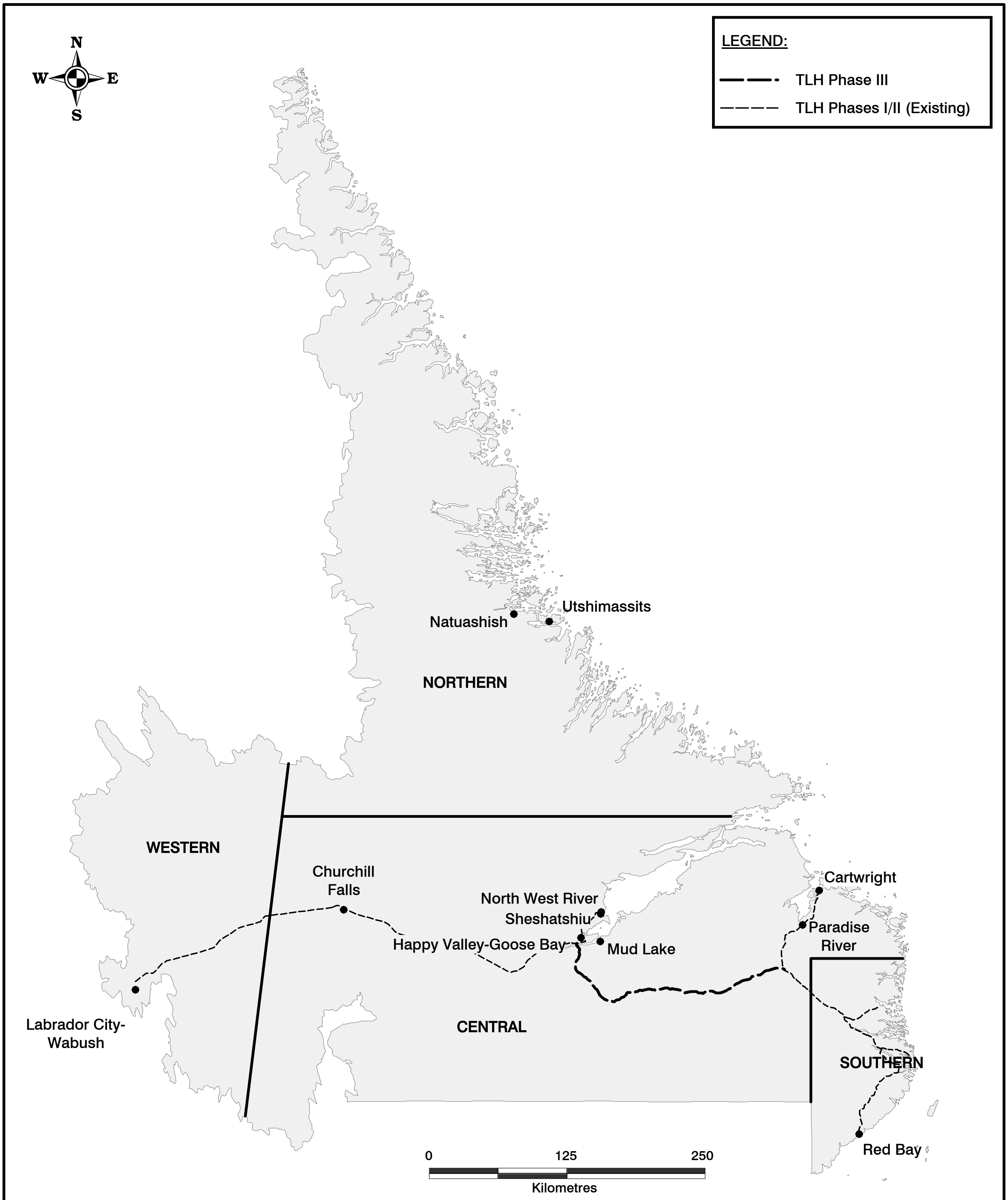
Figure 6.33

Small Game Management Zones in Labrador



Source: DTCR 2002a.

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Figure 6.34

Migratory Bird Hunting Zones in Labrador

Resident and non-resident hunters must hold a migratory game bird license, and non-resident hunters are not required to have a guide for waterfowl hunting. There are only approximately 1,000 waterfowl hunters in Labrador (S. Gilliland, pers. comm.). Similar to black bear hunting, waterfowl hunting by area residents currently does not occur along the proposed TLH - Phase III route, as there is only access in winter and waterfowl have migrated from the area by this time. Rather, residents tend to concentrate waterfowl harvesting along coastal areas (J. Goudie, pers. comm.). Some harvesting of waterfowl by clients of outfitters probably occurs, as the salmon fishing season overlaps with the migratory bird hunting season for a two-week period in September (H. Martin, pers. comm.). Approximately 29,000 Canada geese and 135,000 ducks were harvested in Labrador between 1990 and 2001 (CWS unpublished data).

Murres (locally known as turrs) are the only seabirds that can be legally hunted in Labrador. All other seabird species are protected under the *Migratory Birds Protection Act*. All of Labrador lies within murre hunting Zone 1 and a migratory game bird license is required to harvest murres. The season is open from September 2 to December 18. Hunters are limited to 20 murres per hunter per day, with a possession limit of 40 murres at any one time. Non-residents of Newfoundland and Labrador are prohibited from hunting murres. Aboriginal persons may harvest murres without a permit. Murre hunting occurs in coastal areas. There are no data available on the total number of murres taken annually. However, the murre population in Canada appears to be stable or increasing.

6.12.3.5 Trapping

The Labrador South Fur Zone encompasses the area of the proposed TLH - Phase III (Figure 6.17). There are no registered traplines in Labrador. Trappers are required to submit an application to the Inland Fish and Wildlife Division to obtain a trapping license, which permits the trapper to trap anywhere in Labrador. However, traplines have historically been and continue to be linked to specific family groups, which are commonly known and respected by other trappers (J. Goudie, pers. comm.). A number of species are trapped (Table 6.56).

Trapping periods for the Labrador South Fur Zone for the 2002-2003 are provided in Table 6.56, along with the number of pelts harvested in Labrador in 2001-2002, as data are not available for individual furbearer management zones. Over 4,800 pelts were harvested in Labrador during the 2001-2002 trapping season, and an additional 426 silver fox, one mink and 133 lynx pelts were harvested from ranched animals (I. Pitcher, pers. comm.).

Up to six individuals from the Cartwright area travel inland, as far as the headwaters of the Eagle River, to trap in winter. The main species currently targeted is marten, due to the continued higher value of marten pelts (W. Lethbridge, pers. comm.). Trappers from the Cartwright area have been less active in the last few years, as the market price for fur pelts has been low and fuel prices have made the trip inland less economical (W. Lethbridge, pers. comm.). Trappers from Happy Valley-Goose Bay have been trapping in the Kenamu River and Traverspine River areas for many years. These areas are only accessible in mid-winter and all trapping takes place January through April. Similar to trappers from Cartwright, these trappers target marten, but will take mink, otter and the occasional wolf (J. Goudie, pers. comm.).

Table 6.56 Labrador South Fur Zone Trapping Seasons for 2002-2003 and Furbearer Species Harvested in 2001-2002

Species	Labrador South Fur Zone	Number of Pelts (from Labrador Fur Ledger and Export Permit Records)
Black Bear	n/a (see Section 6.12.3.5)	36
Beaver	October 15 - May 31	183
Ermine	November 1 - March 20	None recorded.
Weasel	n/a	304
Red Fox	November 1 - March 20	543
White (Arctic) Fox	November 1 - March 20	12
Silver Fox	n/a	30
Cross Fox	n/a	90
Coyote	November 1 - March 20	None recorded.
Lynx	November 1 - March 20	33
American Marten	November 1 - March 20	2328
Mink	November 1 - March 20	408
Muskrat	October 15 - May 31	551
River Otter	October 15 - May 31	150
Red Squirrel	November 1 - March 20	114
Wolf	November 1 - March 20	47
Fisher	No open season	None recorded.
Wolverine	No open season	None recorded.
Source: DTCR 2002a; Inland Fish and Wildlife Division, unpublished data.		

6.12.3.6 Fishing

Inland waters are defined as all waters above spring tide low water mark or above DFO caution signs set at the mouth of an estuary (DFO 2002). In southern Labrador, inland waters are home to a number of fish species, of which Atlantic salmon, Arctic char, brook trout, lake trout, northern pike and smelt are most important from a recreational or subsistence perspective.

All rivers along the proposed TLH - Phase III route are located within Atlantic Salmon Fishing Zone (SFZ) 2, which has a salmon angling season extending from mid-June to mid-September. Of the five watersheds crossed by the TLH - Phase III route, only two have scheduled salmon rivers (i.e., portions of the Eagle River and Paradise River watersheds). There are 16 scheduled rivers within SFZ 2 and all are located in the Eagle River and Paradise River watersheds (Figure 6.35). Nine of these rivers were recently scheduled following construction of the Phase II portion of the TLH. There are also three scheduled salmon rivers in the Labrador Straits region (Forteau River, L'Anse au Loup Brook and Pinware River) (DFO 2002).

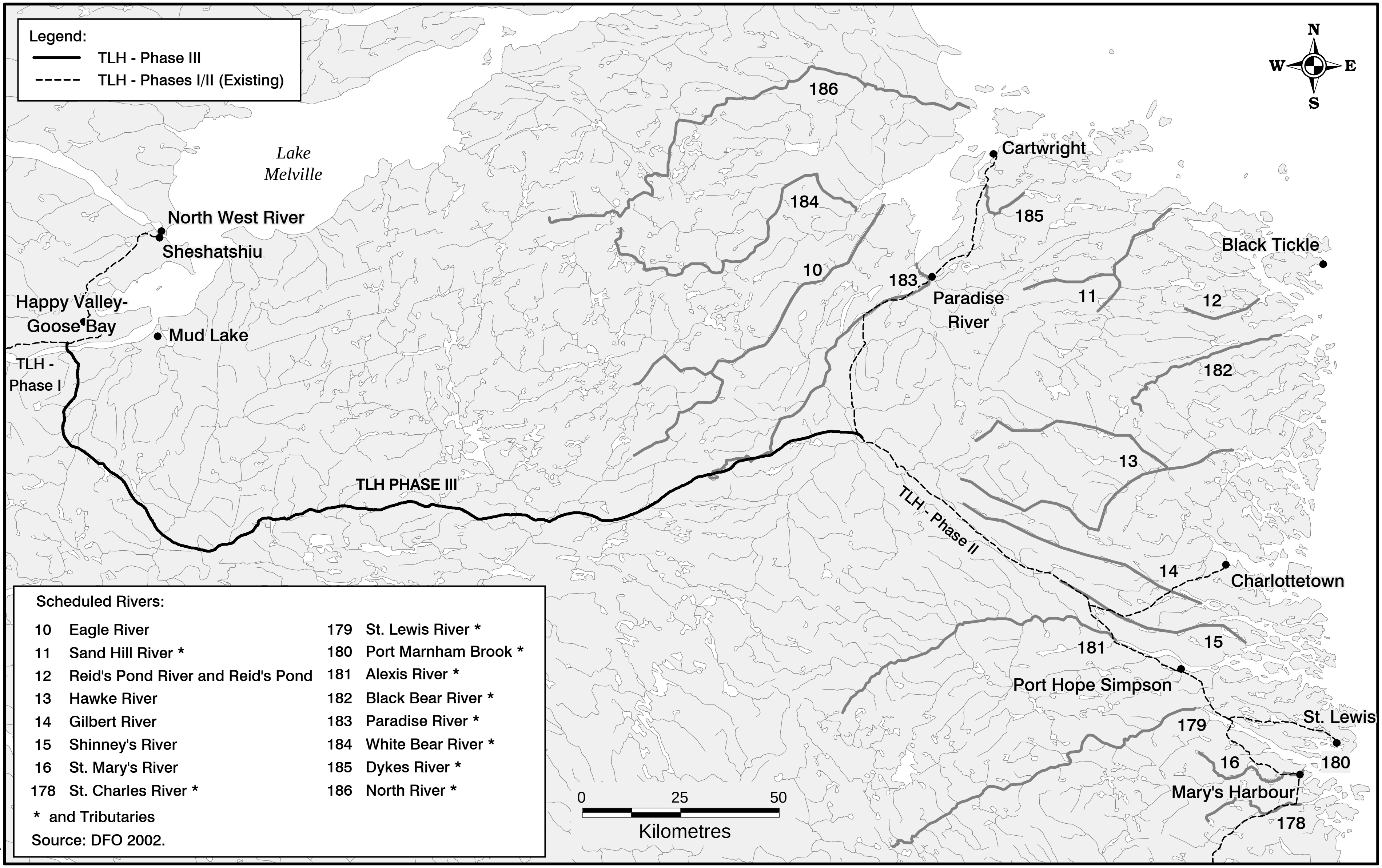

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Figure 6.35

Scheduled Salmon Rivers in Salmon Fishing Zone 2

Ten of the 16 scheduled rivers are unclassified (i.e., lack rating on the river's capability of sustaining angling activity, which affects the season bag limit); therefore, anglers can retain a maximum of four fish per season, only one of which may be a large (> 63 cm) salmon. The remaining six rivers are Class III rivers, in which a maximum of two fish may be retained per season (neither of which may be large). Class III designations were implemented on previously unclassified scheduled rivers in Southern Labrador in 2001 to ensure the conservation of salmon stocks with the expected influx of anglers to the region as a result of the opening of the Phase II portion of the TLH between Red Bay and Cartwright (DFO 2002). There are also a number of unscheduled rivers which contain Atlantic salmon. For the purpose of retaining salmon, all unscheduled rivers are rated as Class III.

A salmon license is required by both residents and non-residents to fish for salmon (or any other species) in scheduled waters. Anglers can fish non-scheduled inland waters without a salmon license. However, salmon caught in non-scheduled waters by an angler not holding a valid salmon license must be released. Anglers can fish for salmon in coastal waters without a salmon license. However, all salmon caught must be released, even if an angler possesses a valid salmon license and tags. In Labrador south of 52º N, a non-resident angler cannot fish scheduled salmon waters unless accompanied by a licensed guide or by a direct relative who is a resident. Non-residents may only fish unaccompanied on non-scheduled waters within 800 m of a provincial highway (DFO 2002). Therefore, the proposed TLH - Phase III will open a number of watercourses to angling under this condition.

Trout refers to brook trout, brown trout and ouananiche. The TLH - Phase III route is located in Trout Management Zones 3 and 5 (Figure 6.36). A special trout management plan is also in place for Gilbert's Lake and Chateau Pond in Zone 3, which was put in place in response to the anticipated increase in angling pressure associated with completion of Phase II portion of the TLH (B. Slade, pers. comm.). Zones 3 and 5 have a winter (February 1 to April 15) and summer (May 15 to September 15) trout angling season. The daily bag limit for trout in these zones is 12 fish or five pounds plus one fish, whichever comes first, and the possession limit is two times the daily bag limit. There are no seasonal possession limits for trout. In the special trout management areas, the daily bag limit is six fish or two pounds plus one fish. The possession limit is equal to the daily bag limit, and season opening and closing dates are consistent with those for the rest of Zones 3 and 5.

The licensing requirements for trout fishing depends on whether angling takes place on scheduled waters and whether an angler is resident or non-resident. A salmon license is required by resident or non-resident trout fishing anglers on scheduled waters. Non-residents wishing to retain trout on scheduled waters must also possess a trout license. In non-scheduled waters, there is no license requirement for resident anglers. However, non-resident anglers must possess a valid trout license to fish in non-scheduled waters. Trout fishing in coastal waters is not subject to season closures or licensing requirements, but is subject to the provincial bag limit.

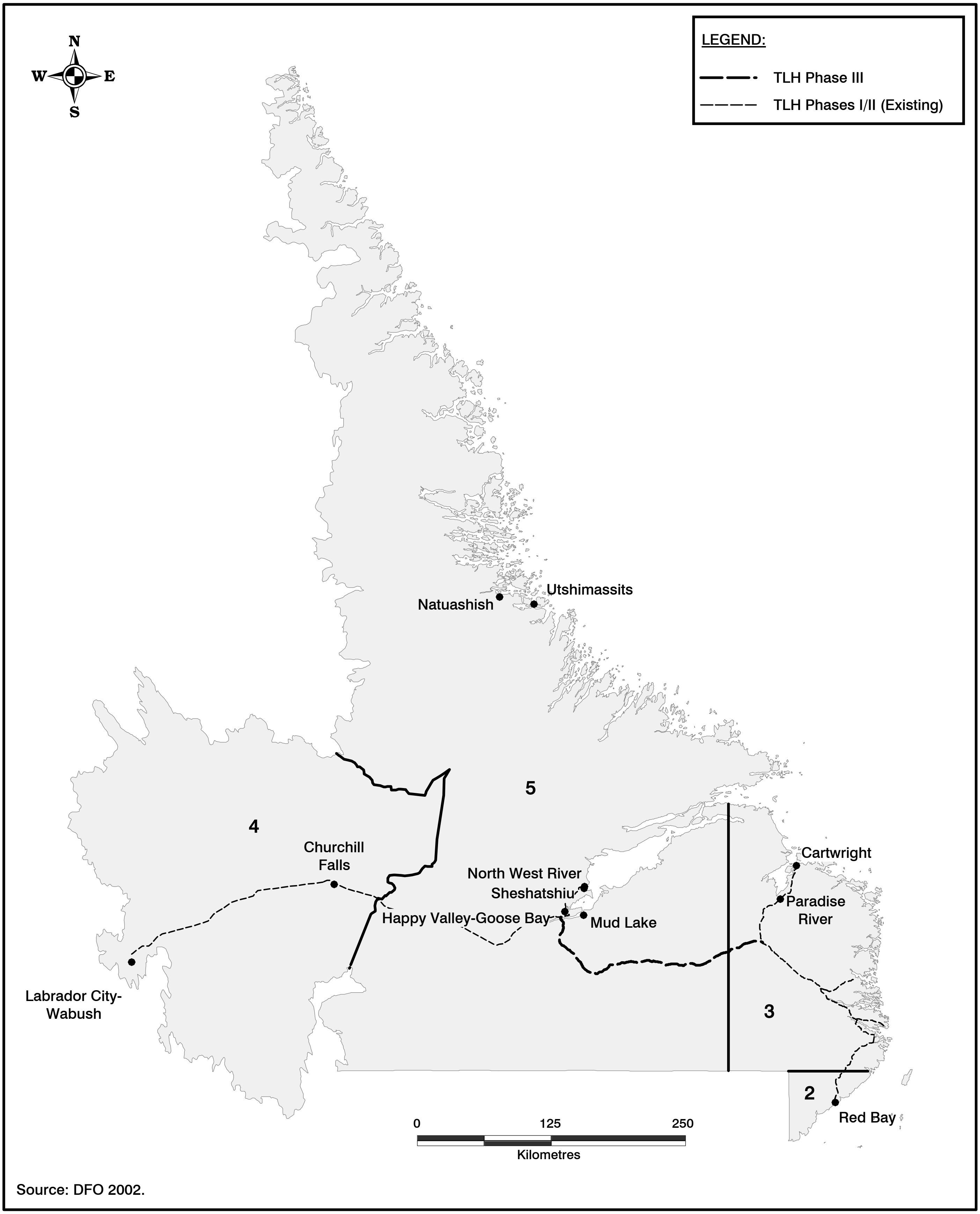

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Figure 6.36

Trout Management Zones in Labrador

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Various other game fish are pursued in the recreational fishery. Some of these species have a specified bag limit, while others do not. Northern pike, Arctic char and lake trout are subject to a daily bag limit of two fish and a possession limit of twice the daily bag limit. Whitefish and smelt do not have any limit associated with them. The season for fishing these species in inland waters is the same as the trout fishing season (i.e., February 1 to April 15 and May 15 to September 15). There is no specific license required for any of these species. However, if these species are fished in scheduled waters, anglers (resident and non-resident) must carry a salmon license. Non-residents fishing in non-scheduled waters also require a trout license. Any of these species can be fished year round in coastal waters without a license, but the bag limit applies.

Labrador residents (Aboriginal and non-Aboriginal) can also participate in a subsistence fishery for salmon and trout. Licenses are free and limited to one per household. The season extends from mid-July to mid-August, with a limit of 100 trout and/or char or four Atlantic salmon, whichever comes first. Nets (mesh size of 7.5 to 9.0 cm) can only be used in coastal waters and are not to exceed 27 m in length. Harvest arrangements with Aboriginal groups are determined annually and outlined in an Aboriginal fisheries agreement. The Innu have a co-management arrangement with DFO, while the Inuit have a communal license arrangement.

Along the proposed TLH - Phase III route, resident angling activity is currently concentrated near the communities of Happy Valley-Goose Bay and Cartwright. Near Happy Valley-Goose Bay, anglers fish a variety of species with the most common being brook trout (also known as 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 popular fishing areas. Salmon angling in the Happy Valley-Goose Bay area is limited. The number of people participating in recreational angling, in particular for smelt and rock cod, in the study area appears to be increasing. Ice fishing is also common in the Happy Valley-Goose Bay area, in particular on Lake Melville (W. Maclean, pers. comm.).

Near Cartwright and Paradise River, salmon fishing is probably the most common activity (G. Bird, pers. comm). Salmon fishing takes place in a number of the rivers in the area (Eagle River, White Bear River, Paradise River and North River), but is probably most concentrated on the lower portion of the Eagle River (H. Martin, pers. comm.; G. Bird, pers. comm.). In recent years, with the closure of the commercial salmon fishery, there appears to have been an increase in the number of local and non-resident people involved in salmon angling particularly on the Eagle River (G. Bird, pers. comm.; H. Martin, pers. comm.). Smelt fishing and, to a lessor degree, trout fishing are also common activities in the area (G. Bird, pers. comm.). The amount of recreational angling for brook trout and Arctic char is limited by the fact that residents in the area can obtain a license to net these species as part of the subsistence fishery (H. Martin, pers. comm.).

In 2000, 390,069 angler days of effort were expended by anglers in Labrador with approximately 86 percent of this effort being expended in freshwater. There were an estimated 23,567 freshwater anglers in 2000, with resident anglers accounting for 95 percent of total freshwater anglers and contributing approximately 98 percent of the total effort (Table 6.57). Between 1990 and 2000, the total number of anglers (resident, non-4resident Canadian and non-resident foreign) fishing in Labrador more than doubled. This increase is mainly attributable to resident anglers, who have almost tripled in number since 1990. The numbers of non-resident anglers, both Canadian and foreign, fluctuated over the same time period (Table 6.57).

Table 6.57 Number of Anglers by Angler Category and Days Fished in Labrador, 1990, 1995 and 2000

	Freshwater			Saltwater			Total		
Angler Category	**No. of Anglers**	**Mean Days Fished**	**Total Days Fished**	**No. of Anglers**	**Mean Days Fished**	**Total Days Fished**	**No. of Anglers**	**Mean Days Fished**	**Total Days Fished**
1990									
Resident	n/a	n/a	118,879	n/a	n/a	9,934	7,700	n/a	128,113
Non-resident (Canadian)	n/a	n/a	2,804	n/a	n/a	71	413	n/a	2,875
Non-resident (Foreign)	n/a	n/a	6,532	n/a	n/a	167	1,078	n/a	6,699
Total	n/a	n/a	127,515	n/a	n/a	101,172	9,191	n/a	137,687
1995									
Resident	n/a	n/a	123,525	n/a	n/a	30,329	9,590	n/a	153,854
Non-resident (Canadian)	n/a	n/a	6,843	n/a	n/a	76	1,162	n/a	6,919
Non-resident (Foreign)	n/a	n/a	3,575	n/a	n/a	22	560	n/a	3,597
Total	n/a	n/a	133,943	n/a	n/a	30,427	11,312	n/a	164,370
2000									
Resident	22,392	14.52	325,160	7,644	7.37	56,325	22,906	16.65	381,484
Non-resident (Canadian)	392	8.51	3,334	18	7.79	144	402	8.64	3,478
Non-resident (Foreign)	784	6.48	5,078	18	1.58	28	794	6.43	5,107
Total	23,567	14.15	333,572	7,680	7.36	56,497	24,102	16.18	390,069

n/a = Data not available.
Source: DFO 1990; 1995; 2000.

DFO (2000) indicates that in terms of numbers of fish caught, smelt were most numerous due to the nature of the fishery. In total, 2,453,416 fish were angled in fresh and salt water in 2000, of which 1,007,134 were smelt, accounting for 41 percent of the total catch. Of the remaining freshwater catch, brook trout comprised 45 percent, followed by landlocked salmon (14 percent), sea trout (9 percent), arctic char (5 percent), lake trout (5 percent), northern pike (3 percent) and Atlantic salmon (3 percent). Approximately 17 percent of the catch is comprised of other freshwater fish, which includes a wide array of freshwater species (DFO 2000).

Angling data are available for 10 of the 16 scheduled rivers in SFZ 2 (Table 6.58). In 2001, there were a combined 4,247 rod-days for these 10 rivers, with rod-days for individual rivers ranging from 47 on the Gilbert River to 2,301 on the Eagle River. A total of 4,715 fish were caught in the 10 rivers that year (including both retained and released), ranging from 0 on the Gilbert River to 3,071 on the Eagle River. Catch per unit effort (CPUE) rates in 2001 ranged from 0 on the Gilbert River to 2.19 on the Hawke River, with an overall CPUE of 1.11 for the 10 rivers (Table 6.58).

Table 6.58 Angling Effort and Catch Rates for Scheduled Salmon Rivers, 1995-2001

Year	Eagle River			Sand Hill River			Hawke River			Gilbert River			Shinney's River		
	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE
1995	1,724	2,196	1.27	426	671	1.58	63	58	0.92	26	21	0.81	238	254	1.07
1996	2,189	2,738	1.25	739	1,079	1.46	117	101	0.86	41	0	0.00	438	294	0.67
1997	1,998	1,494	0.75	629	799	1.27	121	97	0.80	n/a	n/a	n/a	352	211	0.60
1998	2,321	2,361	1.02	594	724	1.22	152	135	0.89	41	2	0.05	231	170	0.74
1999	2,329	3,057	1.31	694	904	1.30	268	172	0.64	98	0	0.00	124	44	0.35
2000	2,272	3,450	1.52	644	995	1.55	291	548	1.88	67	9	0.13	168	254	1.51
2001*	2,301	3,071	1.33	651	800	1.23	166	364	2.19	47	0	0.00	136	109	0.80

Year	St. Mary's River			St. Charles River			St. Lewis River			Port Marnham Brook			Alexis River		
	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE	Rod Days	No. of Fish	CPUE
1995	352	56	0.16	184	38	0.21	257	66	0.26	159	20	0.13	44	52	1.18
1996	764	131	0.17	355	49	0.14	764	257	0.34	269	43	0.16	370	339	0.92
1997	576	58	0.10	272	42	0.15	359	58	0.16	165	36	0.22	502	351	0.70
1998	610	249	0.41	182	147	0.81	192	221	1.15	97	11	0.11	374	312	0.83
1999	718	114	0.16	205	33	0.16	312	180	0.58	125	2	0.02	477	364	0.76
2000	430	139	0.32	133	30	0.23	243	235	0.97	79	22	0.28	224	291	1.30
2001*	310	91	0.29	159	42	0.26	148	77	0.52	155	24	0.15	174	137	0.79

Notes:
No. of Fish — The total number of fish caught (retained and released).
CPUE — Catch Per Unit of Effort (i.e., number of fish caught per rod day).
n/a — Data not available.
* Data for 2001 are preliminary.
Source: N. Cochrane, pers. comm.

6.12.3.7 Outfitting Operations

While hunting and fishing in central and southern Labrador are undertaken by local residents, visitors from elsewhere in the province, Canada and other countries also participate in wildlife harvesting and fishing. Non-resident big game hunters (caribou and black bear) in Newfoundland and Labrador are required to be accompanied by a licenced guide (those hunting small game and waterfowl do not require guides) (DTCR 2002a). As noted above, in Labrador south of 52ºN, a non-resident angler cannot fish scheduled salmon waters unless accompanied by a licensed guide or by a direct relative who is a resident. Non-residents may only fish unaccompanied on non-scheduled waters within 800 m of a provincial highway (DFO 2002). The *1991 Labrador Sport Fishing Survey* indicated that approximately 57 percent of the non-resident anglers visiting Labrador in that year used the services of an outfitter (LGL 1994).

There are currently approximately 70 commercial outfitting camps throughout Labrador that offer fishing and/or big game hunting adventures (DTCR 2002a). Of these, 19 are located in Central and Southern Labrador near the TLH - Phase III route (Table 6.59; Figure 6.37). The TLH - Phase III route is over 10 km from the closest outfitting camp and comes within approximately 12 to 15 of several other camps. In addition, there is also a private fishing camp at Byrne Lake, located south of Park Lake (J. Smith, pers. comm.). 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. Most if not all, of the angling undertaken at these camps is hook and release only.

There are also a number of outfitting camps to the east of or adjacent to the existing TLH - Phase II (Red Bay to Cartwright) in Southern Labrador, as well as several camps in the Labrador Straits (DTCR 2002a).

Table 6.59 Commercial Outfitting Camps

No.*	Operator	Lodge	Location	Species Fished	Approximate Distance from Route (km)
1	Adventure North Ltd.	Crooks Lake	Crooks Lake	Northern pike and brook trout.	8.1
2	Camp 1155 Ltd.	Camp 1155	Upper Eagle River	Northern pike and brook trout.	11.9
3	Coopers' Minipi Camps	Anne Marie Lake Lodge	Upper Minipi River	Atlantic salmon, northern pike, Arctic char and brook trout.	53.1
4	Coopers' Minipi Camps	Minipi Lake Lodge	Upper Minipi River	Atlantic salmon, northern pike, Arctic char and brook trout.	66.9
5	Coopers' Minipi Camps	Minonipi Lodge	Upper Minipi River	Atlantic salmon, northern pike, Arctic char and brook trout.	44.5
6	Department of National Defence	No Name Lake (Family Wilderness Camp)	No Name Lake	Information not obtained.	23.3
7	Eagle Lake Sport Fishing Ltd.	Eagle Lake Lodge	Eagle Lake	Northern pike and brook trout.	19.1
8	Goose Bay Outfitters Ltd.	Lower Eagle River Lodge	Lower Eagle River	Atlantic salmon and brook trout.	52.7
9	Igloo Lake Lodge Ltd.	Igloo Lake Lodge	Igloo Lake	Northern pike and brook trout.	18.5
10	Labrador Angling Adventures Ltd.	Awesome Lake Lodge	Awesome Lake (English River)	Eastern brook trout.	93
11	Labrador Interior Outfitters Ltd.	St. Paul's Lodge	St. Paul's River (Headwaters)	Northern pike and trout.	58.8
12	Labrador Outdoors Inc.	Little Minipi Lake Lodge	Little Minipi River	Northern pike, landlocked char and brook trout.	49.2
13	Labrador Sportsfish Ltd.	Eagle's Nest	Eagle River	Atlantic salmon and brook trout.	36.4
14	Labrador Venture Ltd.	Birchy Lake Lodge	Birchy Lake, Upper St. Paul River	Information not obtained.	43.4
15	Osprey Lake Lodge	Osprey Lake	Osprey Lake (Eagle River watershed)	Brook trout.	13.7
16	Park Lake Lodge Inc.	Park Lake Lodge	Park Lake	Atlantic salmon, northern pike and brook trout.	19.6
17	Rifflin' Hitch Lodge Limited	Rifflin' Hitch Lodge	Eagle River	Atlantic salmon and brook trout.	39
18	Six North Fishing Lodge	Lac Mercier Lodge	Lac Mercier	Northern pike, lake trout and brook trout.	21.1
19	Warrick Pike	Whitey's Lodge	Whitey's Lake	Information not obtained.	11.1

* See Figure 6.37 for approximate camp locations
Sources: DTCR 2002a; T. Kent, pers. comm.; P. Dawe, pers. comm.; Personal communications and interviews with outfitters.

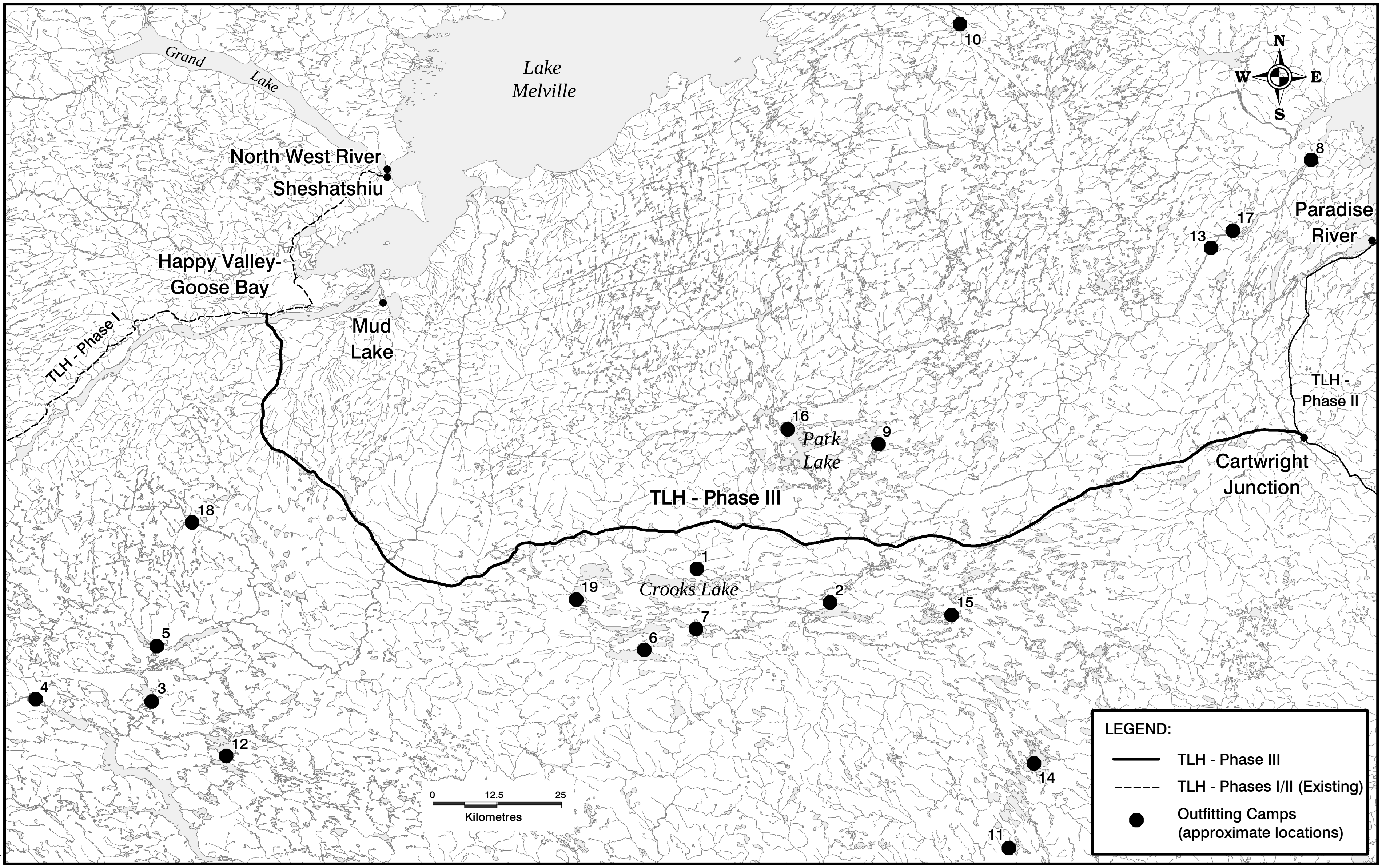

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Figure 6.37

Outfitting Camps

6.12.3.8 Parks and Special Areas

There are no existing provincial or federal parks in Central and Southern Labrador. However, the Mealy Mountains have been identified by Parks Canada as a candidate for national park status. The proposed Akamiuapishku/Mealy Mountains National Park is located in central Labrador. The study area for the proposed 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 (Figure 6.38). The proposed highway will cross the southern portion of the park study area, south of Park Lake. A detailed discussion of this proposed national park and potential environmental effects are provided in Section 6.13.

There are no proposed provincial parks and reserves in Central or Southern Labrador, and there has been no indepth study of candidate sites in Labrador to date (S. French, pers. comm.). Pinware River Provincial Park, in the Labrador Straits, is Labrador's only provincial park (Parks and Natural Areas Division n.d.). A municipal park has been proposed for the Cartwright area (JW 1998a).

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. The timing of the study is to be determined by the provincial government (CHRS 2001).

There are five International Biological Programme (IBP) sites in Central Labrador (Figure 6.38): Site 48 - Lower Churchill River (20 km^2); Site 50 - Gull Island Lake (73 km^2); Site 66 - No Name Lake (6.5 km^2); Site 53 - Eagle River Headwaters (520 km^2); and Site 56 - Mealy Mountains (1,040 km^2). There are also two IBP sites located on small islands east of Cartwright: Bird Islands (0.18 km^2); and Devil's Lookout Island (0.81 km^2). The International Biological Programme (IBP) was an international effort of government and academic institutes to select areas of biological importance in various parts of the world. Sites were classified as major, supplemental or special based on biophysical features. The Parks Division of the provincial Department of Tourism, Culture and Recreation now manages the IBP database.

There are no wildlife or wilderness reserves in Labrador; however, 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. The islands host important breeding populations of razorbills (5,400 pairs), Atlantic puffins (50,000 pairs) and common murres (63,000 pairs) (CEC 1999). Large flocks of molting harlequin ducks from the eastern population of special concern are also present around the islands in summer (CEC 1999). The site is also considered an Important Bird Area (IBA). In Canada, the IBA program was initiated in 1996, in conjunction with the launch of parallel programs in the United States and Mexico. The goal of the IBA program is to identify and conserve a worldwide network of sites necessary to ensure the long-term viability of naturally occurring bird populations (IBA 2001). The Hamilton Inlet area in Labrador has been identified as a potential national marine conservation area. Analysis of the site is ongoing (Parks Canada 2001).

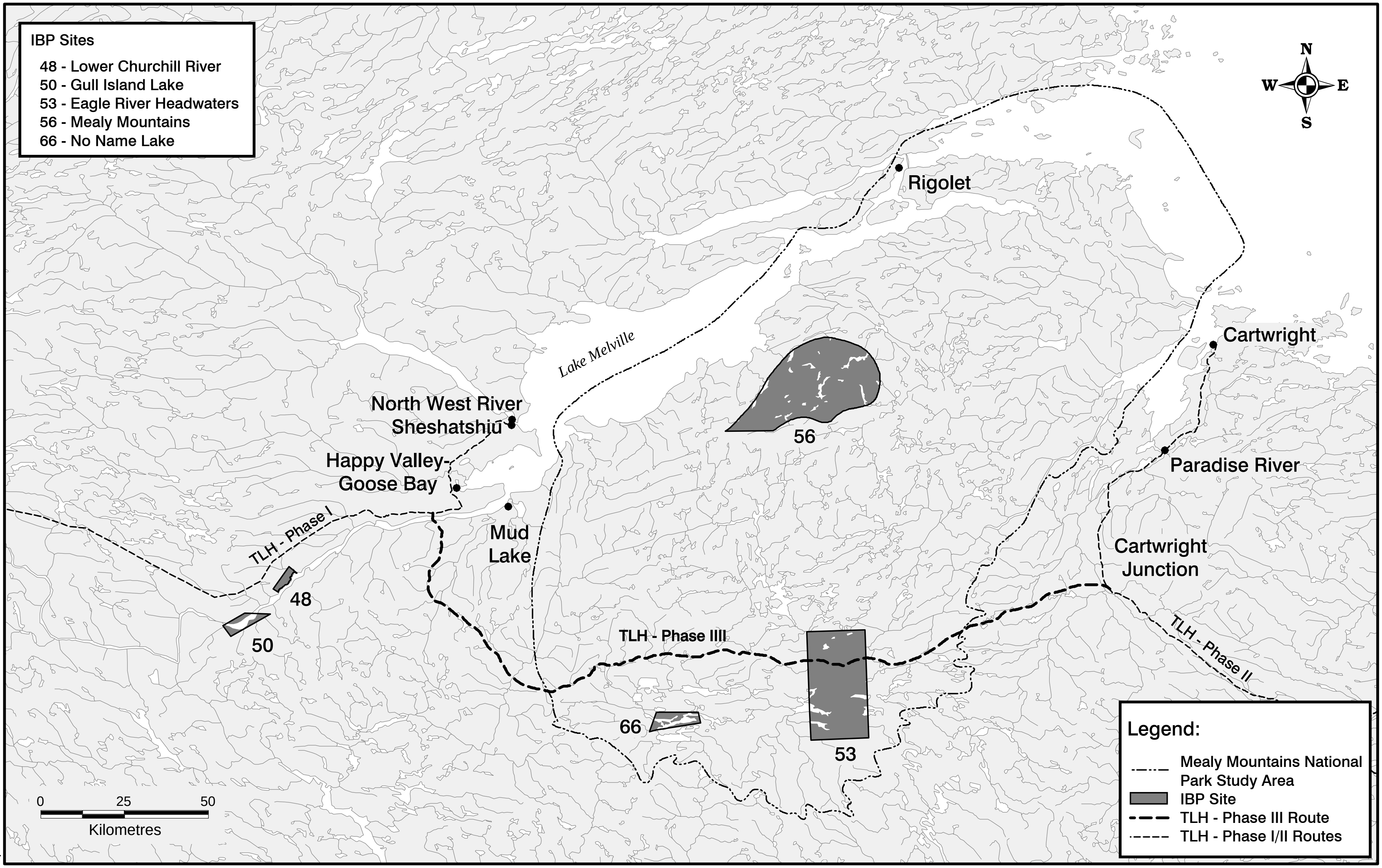

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Figure 6.38

Mealy Mountains National Park Study Area and International Biological Programme Sites

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6.12.3.9 Cabins, Trails and Recreational Areas

Local trails extend around communities throughout Central and Southern Labrador, and are used by local residents primarily for hunting, fishing, trapping and berry-picking activities. Berries, in particular bakeapples and partridge berries, are picked throughout the area during the months of August and September. Berry picking typically occurs near the communities. 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, with many area families owning one or more cabins. On the Phase II route, cabins are concentrated primarily between Port Hope Simpson, St. Lewis (along the inlet area) and Mary's Harbour, and along the highway route between Red Bay and Lodge Bay. The cabins are used mainly for hunting, trapping, fishing and gathering activities, but are also used for general recreational purposes.

6.12.3.10 Forestry

The TLH - Phase III route lies within Forest Management Districts (FMD) 20 and 19, which cover an area of 7.1 million ha and 2.2 million ha, respectively (Figure 6.39). Black spruce and balsam fir are the most common tree species in the districts, with black spruce accounting for approximately 91 percent of the productive forest in FMD 19 and approximately 70 percent in FMD 20. Small quantities of other softwoods and hardwoods are also found throughout the districts (T. Schlossek, pers. comm.; DFRA 2002b). Forests in the area are managed primarily for fuelwood and lumber. The bulk of the commercial timber in these FMDs is located in the Paradise River/Cartwright and Lake Melville areas (Figure 6.41).

FMD 19 contains Labrador's most productive forests and is sub-divided into three sub-districts, 19A (including 19A-S and 19A-N), 19B and 19C (Figure 6.39). FMD 19A covers an area of approximately 23 million ha and contains approximately 60 percent of Labrador's most productive forest land (1.1 million ha), and has traditionally been the centre of Labrador's forest industry. Of the estimated 1.1 million ha of productive forest in FMD 19A, approximately two-thirds (i.e., 744, 560 m^3) of that is located in FMD 19A-S (i.e., south of the Churchill River). Approximately 75 percent of the overall commercial volume of timber (approximately 65 million m^3) in FMD 19A is located south of the Churchill River. However, only approximately 24 million m^3 of the total commercial volume is considered as the net volume of wood that could be removed from FMD 19A-S. Both FMD 19B and 19C have not been subject to commercial forestry operations due to their location on the south side of the Churchill River (DFRA 2002).

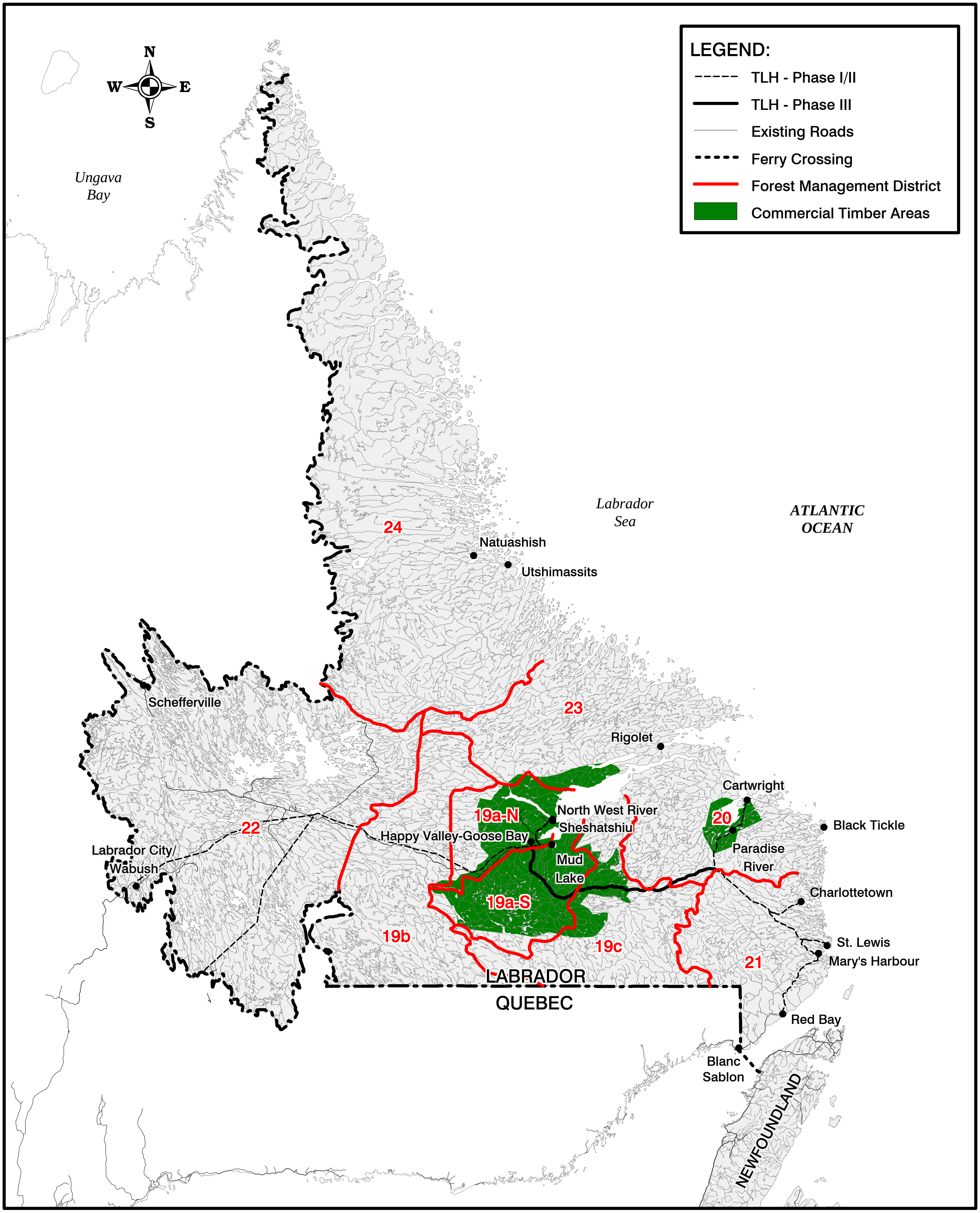

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Figure 6.39

Forest Management Districts and Commercial Timber Areas

All commercial harvesting activities in FMD 19A have occurred north of the Churchill River, in an area 15-80 km northwest of Happy Valley-Goose Bay (DFRA 2002b). As a result, all existing forest access roads in FMD 19A are located north of the Churchill River. Between 1977 and 1992, after Labrador Linerboard ceased operations, harvesting continued at low levels. Since 1990, 10 commercially-licensed sawmills have operated in FMD 19A and combined, have produced an average of 1.7 million board feet (mbf) annually. The combined potential capacity of these sawmills is much higher (DFRA 2002a). Timber harvesting in FMD 19A has increased steadily since 1995. During this period, the volume of commercially harvested timber increased from less than 10,000 m^3 in 1995 to approximately 40,000 m^3 in 2001 (DFRA 2002a). As well, between 1997 and 2002, approximately 1,300 ha of forest area was harvested and 37 km of access road was constructed (DFRA 2002b). Between 2002 and 2007, 375,000 m^3 of timber in FMD 19A has been allocated for harvesting, including commercial and domestic harvesting (DFRA 2002b).

Current commercial forest operations in FMD 20 are located in the White Hills area, approximately 15 to 20 km southwest of Cartwright. These operations are relatively small in scale, harvesting a total average of 6,000 m^3 of softwood per year and producing lumber for sale locally (T. Schlossek, pers. comm.). Most of the wood is harvested during the winter, when the area is accessible by snowmobile.

While commercial harvesting rates are increasing in both Central and Southern Labrador, domestic harvesting rates are relatively low and stable. Domestic timber harvesting is an important activity for local communities in both FMD 19A and FMD 20, with harvesting activity typically occurring near communities. Timber cutting is not permitted within 100 m of a road. In FMD 19A, an average of 300 domestic cutting permits have been issued annually since 1991 and an annual average of less than 7,000 m^3 of wood has been harvested (DRFA 2002a). Between 150 and 175 domestic cutting permits are issued annually in FMD 20, with a total harvest volume of 3,500 m3 being harvested annually (T. Schlossek, pers. comm.).

6.12.3.11 Mineral Exploration and Quarries

At present there are no producing mines or developing properties in Central and Southern Labrador (Department of Mines and Energy n.d.). However, there are eight mineral occurrence sites identified in the vicinity of the TLH - Phase III: four mica, two pyrite, one titanium and one copper (Figure 3.3). While mineral exploration activity in recent years has been concentrated in northern and western Labrador, some exploration has and continues to occur in Central and Southern Labrador. In 2002, for example, there were mineral claims staked for platinum-palladium in the Alexis River area and for unspecified resources in the general vicinity of the Pinware River (Department of Mines and Energy 2002). Other noteworthy mineral occurrences in the area include sapphires south of Port Hope Simpson near St. Lewis Inlet, muscovite around Hawkes River near Norman Bay, garnets on the Alexis River near Port Hope Simpson and traces of gold near Cape Bluff. Except for the western and eastern portions of the TLH - Phase III route, much of the area is not open for staking due to the proposed national park (Ash and Hinchey 2002). There is also potential for petroleum resources off the Southern Labrador coast, but there has been limited investigation and research conducted with respect to these resources (Southeastern Aurora Development Corporation 1997). There are some rock quarries, gravel pits and sand or minor gravel sites located throughout parts of Central and Southern Labrador, particularly those established as part of construction work associated with Phases I and II of the TLH. However, there are no existing quarries in the vicinity of the TLH - Phase III route.

6.12.3.12 Hydroelectric Power Development

The White Rock Falls generating facility (0.135 MW) is currently the only hydroelectric generating project within the study area. The facility is located on the St. Mary's River near the community of Mary's Harbour in Southern Labrador (WRMD 1992; Ah-You and Leng 1999). The 5,428 MW hydroelectric power generating facility at Churchill Falls, the largest hydroelectric development in the province, is located west of the study area. This facility provides power to the communities in the Lake Melville area by a 138 kV line from Churchill Falls, as well as to communities in western Labrador. A 730 kV line also extends from the Churchill Falls facility south to Quebec, with the majority of the power produced at the facility being sold to Hydro-Quebec. In addition to these hydroelectric power facilities, NLH also operates a gas turbine (27 MW) and a diesel facility (11.7 MW) in Happy Valley-Goose Bay and 17 rural isolated diesel facilities (producing approximately 20 MW combined) servicing communities in coastal Labrador. NLH is currently exploring the development of a new dam and a 2,000 MW generating facility on the lower portion of the Churchill River at Gull Island. Negotiations between NLH and Hydro-Québec are ongoing (Department of Mines and Energy n.d.).

6.12.3.13 Military Activities

Military flight training forms the basis for the economy of Happy Valley–Goose Bay and the Central Labrador region. From April to October each year, Allied air forces conduct low-level flight training operations from Canadian Forces Base (CFB) Goose Bay. Approximately 50 flights daily (an average of 7,000 annually) involving jet aircraft are flown at low altitudes (between approximately 30 and 300 m) within a designated LLTA, measuring approximately 130,000 km^2 over Labrador and Quebec (DND n.d.). Approximately 92 km of the proposed TLH - Phase III route will be located within the LLTA (Figure 6.40).

The highest average flight intensity at any point within the LLTA is less than five flights per day, but this involves less than one percent of the total training area (DND 2001). On average, less than three percent of the entire LLTA is subject to one or more overflights per day. Within the larger LLTA, a practice target area (PTA) is used to conduct weapons training through the release of non-explosive practice weapons onto defined targets. This is the only restricted area within the LLTA. The PTA, which has a radius of four nautical miles, is located approximately 120 km south of Happy Valley-Goose Bay and 84 km southwest of the TLH - Phase III (Figure 6.40). Happy Valley–Goose Bay and Churchill Falls are the only communities within the LLTA, and both are protected from disturbance by an exclusion buffer of 20 nautical miles in diameter (DND n.d.).

6.12.4 Potential Interactions

The TLH - Phase III will pass through an area that experiences varied levels of resource use, involving a number of user groups. Both construction and operation activities for the TLH - Phase III have the potential to generate direct, indirect and induced effects on resource use and users.

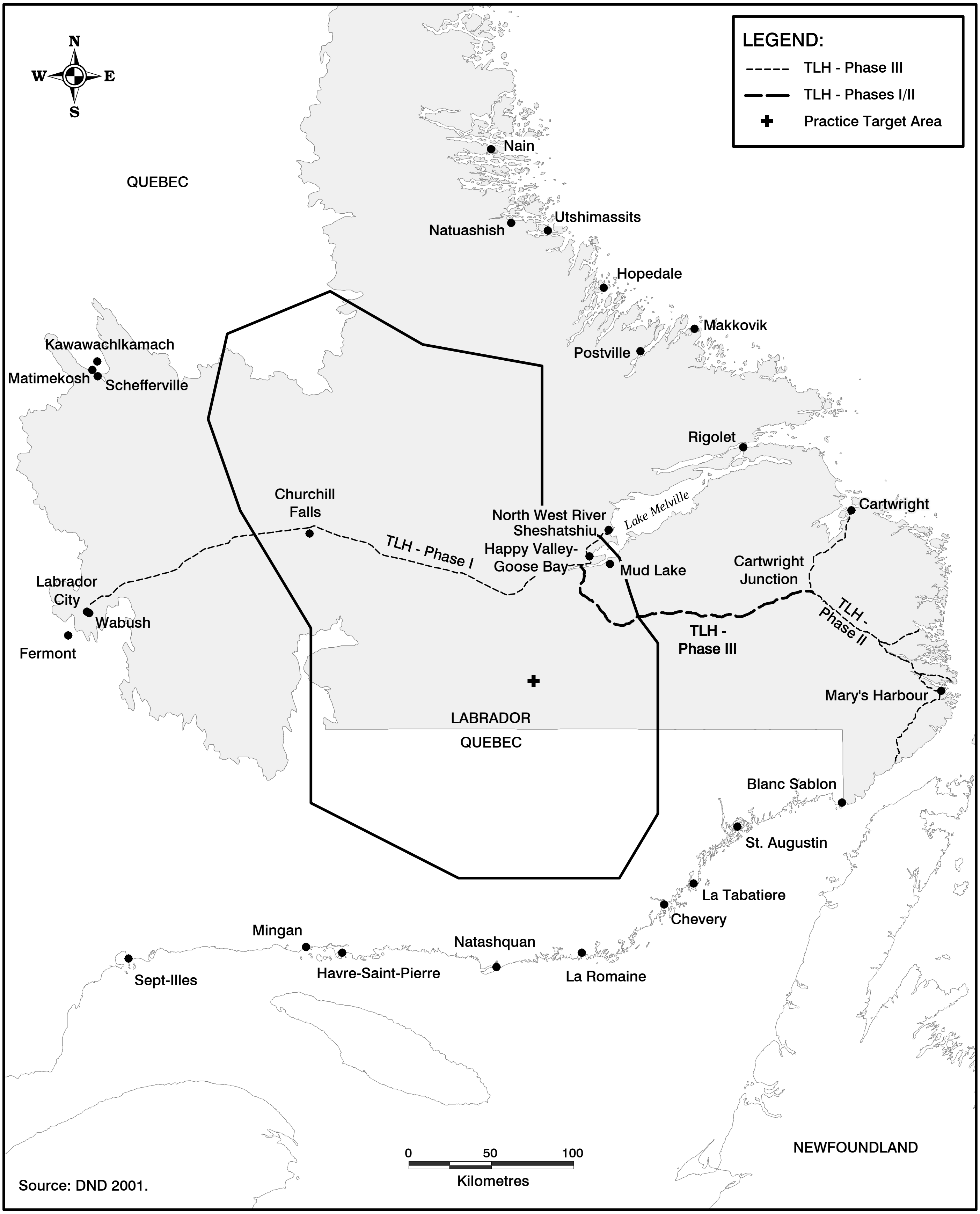

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Figure 6.40

Low-Level Flight Training Area

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Construction activities in or adjacent to watercourses and waterbodies have the potential to alter fish habitat and, subsequently, affect fish, which could indirectly affect resource use. Similarly, the physical disturbance, noise, dust and human presence associated with construction activities may cause wildlife to avoid areas subject to construction and, as a result, indirectly affect hunters and trappers. These disturbances may also disrupt resource use activities by causing resource users to avoid areas subject to construction or related areas such as temporary construction camps, laydown areas and borrow pits. Constructing watercourse crossing structures may affect the ability of resource users to navigate rivers. As well, some resource users may experience a decline in the aesthetic quality and/or wilderness character of an area. Established resource use patterns of Settlers/Métis, other Labrador residents and outfitters may be affected by the presence of the highway.

Improved access to the area provided by the completed TLH - Phase III may lead indirectly to increased use of the area, including increased waterway use, fishing, wildlife harvesting, cabin development, recreational activities, overland travel on snowmobile and all-terrain vehicles, timber harvesting and mineral exploration. These activities may subsequently affect current resource use practices and users. As sections of the highway are constructed, access to new fishing areas will be facilitated. As a result, there may be increased fishing activity (legal and illegal), increased use of certain rivers or lakes and potential congestion. Increased harvesting of wildlife and fish resources may lead to resource depletion, resulting in indirect effects on resource populations and resource use and users. New resource use activities may also be introduced to the area, and new user groups may start using the area. Any increased resource use activities may affect existing resource activities and practices, such as Innu land and resource use activities, outfitting operations and resource use by other Labrador residents.

Activities induced by the presence of the highway, such as mineral exploration and forestry operations, may also affect resource use and users directly or indirectly through any effects that these induced activities may have on fish or wildlife resources. An increase in outfitting lodge development may also result in further crowding, resource depletion and competition.

An accidental event, such as a forest fire or fuel or chemical spill, occurring during project construction or operation could affect fish and wildlife resources and their habitat, which in turn would affect resource users. The ability of resource users to carry out resource use activities may be disrupted, and the aesthetic and wilderness character of the area may be destroyed, which is of particular importance to tourism operators. Similarly, failure of a crossing structure or section of the highway may disrupt resource use patterns and/or affect fish and wildlife resources, in turn affecting resource users.

6.12.5 Issues and Concerns

Chapter 4 provides details on the issue scoping process conducted for the environmental assessment. Issues and concerns relating to the resource use and users include:

- effects of the project on current resource use activity and users, including Aboriginal people and other Labrador residents;

- increased use of the area, including 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;
- potential for increased use of the area for forestry activities, including forest access roads, removing forest resources and taking the resources to the island for processing;
- improved access to rivers and congestion on the rivers;
- effect of the project on waterway navigability;
- effect on traplines in the vicinity of the Eagle River crossing area;
- potential resource depletion resulting from improved access;
- access from watercourse crossings will lead to over-harvesting of fish;
- proximity to Eagle River and crossing on the river, as well as proximity to other major rivers;
- proximity of highway to outfitting operations and effect of improved access on outfitting operations, including vandalism at camps;
- potential for more fish camps to be constructed;
- construction of secondary roads, providing further access throughout the area;
- year-round access created to an area that was previously accessed primarily in the winter;
- loss of wilderness character;
- illegal hunting and fishing activity;
- enforcement of resource harvesting activities;
- adequacy of current regulatory controls to protect resources;
- cumulative effects of induced resource use activities; and
- waste disposal at cabins and littering along the highway.

6.12.6 Existing Knowledge

6.12.6.1 Planning and Development

There are a number of planning processes in place to address various of aspects of resource use. The municipal planning process under the *Urban and Rural Planning Act, 2000* provides the means for incorporated municipalities to prepare municipal plans outlining land use designations and defining the manner in which development may occur within the municipality. The municipal plan and development regulations are legal documents and are binding on the municipality, council and others using or proposing to use land in the municipality. Public consultation in the municipal planning process is required under the act. A development permit is required for any development within the municipality and the development must be carried out according to the municipal plan and associated development regulations.

Similarly, a development permit is required for any development within the building control lines established for a protected road. Building control lines for protected roads are 400 m on either side of the highway as measured perpendicular from the highway centreline, except for the following:

- within the municipal boundary of an incorporated municipality, the building control line is 100 m from the centreline;
- outside the municipal boundary, but within the municipal planning area, the building control line is 150 m from the centreline; and

- within an unincorporated municipality, the building control line is 400 m from the centreline or as set by an interim or approved protected road zoning plan.

Protected road zoning plans are currently being prepared for Routes 500 (Phase I of the TLH) and 510 (Phase II of the TLH) (A. Goulding, pers. comm.). These plans will identify the type of development permitted and locations where it is permitted along the highway corridor. Public consultation is also required for these plans. In addition, the *Protected Road Zoning Regulations* also outline the type of development that may be considered within the building control lines of a protected road.

Protection of water supply areas in Newfoundland and Labrador is the responsibility of the Water Resources Management Division of the provincial Department of Environment. The area around a public water supply can be designated as a public water supply area, and use of the water body and designated protected area may be regulated. Detailed development plans for any proposed development in a public water supply area must be submitted to the Department of Environment for approval. A certificate of approval, with terms and conditions, is issued for approved developments. Any existing or proposed development activities within a protected water supply area are subject to the *Policy for Land and Water Related Developments in Protected Public Water Supply Areas*, which is administered by the Water Resources Management Division.

With respect to outfitting operations, there is currently a freeze on the development of new lodges on rivers in Labrador (T. Kent, pers. comm.). There are also formal processes in place for establishing national parks and heritage rivers, both of which are coordinated by Parks Canada. Recognition of a park under the *National Parks Act* brings with it defined management responsibilities and rules regarding resource use. Similarly, management plans for heritage rivers outline resource protection measures, appropriate resource use activities, strategies to maintain ecological integrity and monitoring. Both of these planning processes provide opportunity for public involvement and consultation.

Provisions for establishing Special Management Areas are outlined in the provincial *Lands Act*. This measure was used to protect lands within the area of the proposed Torngat Mountain National Park, until the part is officially established (Government of Newfoundland and Labrador 2000). The Special Management Area for the Torngat Mountains was established through a MOU between the Government of Newfoundland and Labrador and the Labrador Inuit Association. Under the agreement, commercial and industrial development are prohibited. The Special Management Area is administered by the Department of Tourism, Culture and Recreation.

The forestry management planning process involves various user groups in the planning process, including industry representatives, the general public, government resource managers and non-governmental organizations. In addition, forestry management plans are also required to be registered under the *Environmental Protection Act* and, as a result, are subject to public review under this process.

These planning processes (municipal planning, protected road zoning plans, forest management planning, national park planning and CHRS management planning) all require some form of public consultation (JW 2003a). Thus, there is further opportunity for Labrador residents and others, in the case of national parks and heritage rivers, to have input into further planning and development.

6.12.6.2 Innu Land Claim

The TLH - Phase III will also be subject to the terms and conditions of the Innu land claim settlement, currently being negotiated between Innu Nation and the governments of Canada and Newfoundland and Labrador. The Labrador Innu land claim area is shown in Figure 2.5. Innu Nation is currently negotiating an Agreement-in-Principle with the federal and provincial governments, and following this agreement a final agreement will be negotiated (Armitage and Stopp 2003). When the Innu land claim is settled it will establish a framework for land and resource management in the settlement area, which will offer a protection mechanism for area resources and set rules for users within the claim settlement area. Resource users in the area will be subject to the terms and conditions set out in the agreement and any subsequent management plans that might be established during implementation of the final agreement.

6.12.6.3 Experience with TLH - Phases I and II and Others Roads in Labrador

Experience with previous highway development in Labrador provides some indication of the type of activities that may result from the TLH - Phase III. For example, both the Phase I and Phase II portions of the TLH have been designated as protected roads and protected road zoning plans are being prepared for both sections of highway. As noted above, this designation and associated management plans provide a means for controlling development along the highways.

Cabin development in Labrador has also been facilitated by road development in Labrador. In the section of Churchill River from Gull Island to Churchill Falls (along the Phase I portion of TLH), many private cabins are being built and anglers are experiencing good fishing for brook trout and ouananiche (W. Maclean, pers. comm.). Armitage and Stopp (2003) indicate that, of a total 1,248 cottages in Labrador, 462 were located within 1 km of a road. Increasing trapping activity has been noted along the Phase I portion of the TLH, as well as dust covering vegetation along the route (Innu Nation 2002). Increased incidences of trapping along roadways has occurred around other roads in Labrador, including the Grand Lake Road and Orma Road located along the eastern edge of the Smallwood Reservoir. Wooden top boxes have been set for marten every 2 to 5 km along many of these roads (JW 1999).

There has also been an increase in the number of anglers fishing newly accessible areas associated with the construction of the Phase II portion of the TLH. C. Poole (pers. comm.) notes that angling activity has increased (as much as tripled) with the completion of Phase II. Correspondingly, the number of patrols by conservation officers and the number of charges laid have probably doubled. Anglers frequenting the area are mainly from communities in southern Labrador. However, anglers from the island of Newfoundland, the maritime provinces and Quebec are also common and anglers from outside Canada have also been noted.

Due to expected influx of anglers as a result of the TLH - Phase II, a number of previously unscheduled rivers in Southern Labrador were scheduled and given Class III designations in 2001 for salmon conservation purposes (DFO 2002). In addition, special trout management plans were put in place for Gilbert's Lake and Chateau Pond in Southern Labrador. These plans were put in place in response to the anticipated increase in angling pressure that may result from the completion of the Phase II portion of the TLH (B. Slade, pers. comm.).

Past experience in the Labrador Straits also illustrates the potential effects of road access on recreational fisheries. This region saw an influx of anglers from the island of Newfoundland when Atlantic salmon quotas were changed to permit fishers in Labrador to retain one large salmon, resulting in overcrowding along the Pinware, Forteau and other rivers in the region. This eventually resulted in a requirement to implement fish quotas and retention regulations for the Labrador Straits similar to those for the island of Newfoundland (JW 1998a).

Highway access will also increase the potential for developing new lodges along the TLH - Phase III route. This has occurred along the Phase I portion of the TLH between Happy Valley-Goose Bay and Western Labrador. In the Labrador Straits, a number of outfitting operations currently exist in very close proximity to the highway, and the ability to access these camps directly by road has allowed these operations to offer fishing packages at somewhat lower prices than those who rely on air transportation (JW 1998a).

6.12.6.4 Noise

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. 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.

Noise is measured on a logarithmic scale, and it is useful to present “benchmarks.” A difference of 3 dBA represents a doubling in noise energy, but is a barely perceptible increase to humans. A 5 dBA difference is distinctively heard and a 10 dBA difference is perceived as a doubling or halving of the noise level USDOT 1995).

The proposed highway is anticipated to have a low volume of traffic. The noise from the traffic will be most accurately depicted as a moving point source, rather than a line source that better represents the steady-state traffic of busy urban roads. The noise levels in the vicinity of the highway will be characterized by sustained levels of background noise broken periodically by a pass-by of a vehicle. Noise will rise to a maximum depending on the type of vehicle, speed, highway characteristics and local grade, and then will decrease as the vehicle departs. The peak levels of noise at the edge of the highway (an average of 15 m from the vehicle) will be approximately 80 dBA for heavy trucks, and 76 dBA for medium trucks (Wayson and MacDonald 1999). Therefore, over flat ground, the passage of a heavy truck may be detected against background for a distance of approximately 4 km. If the line of sight between the truck and the receiver is broken by topography, this distance would be reduced to approximately 2 km.

As it is likely in the average situation that the line of sight is broken by sustained trees or by hills, it may be assumed that the zone of influence for the highway, where the highway noise peaks are greater than background noise, will be 2 km on either side. During the day, with wind-induced noise likely to be of the order of 35 to 40 dBA, the zone will be smaller, approximately 1 km on either side. At these distances, humans may be able to just discern the trucks against background noise, although there may be a distinctive tonal quality to the noise that facilitates the perception. The sensitivity and response of wildlife to the traffic noise may depend on day or night.

Another factor that may cause noise effects to extend further is the use of compression braking (i.e., often called Jake Brakes, after the company that developed the technology, but not the only source of the braking systems). At certain parts of the highway, typically approaching streams, this noisier braking system will be used to control vehicle speed on the downhill grade. As the streams may represent zones of greater sensitivity, it may be appropriate to widen the zone of influence in those areas where compression braking is used. In summary, a zone of influence of approximately 2km is anticipated along flat sections, and approximately 4 km at watercourse crossings where the grade will result in the use of compression brakes.

6.12.7 Mitigation

Environmental protection measures incorporated into environmental management planning initiatives for the project will help in mitigating some project effects on resource use and users. In addition, mitigation measures identified for mitigating project effects on the biophysical environment will also indirectly reduce effects on resource use and users. Similarly, mitigation measures for project effects on the proposed Akamiuapishku/Mealy Mountains National Park and tourism and recreation activities (as they are elements of resource use) are also applicable to resource use and users.

Specific measures designed to mitigate project effects on resource use and users include:

- committing to meeting relevant terms and conditions of an Innu land claim settlement;
- implementing the environmental protection measures for construction and operation, including contingency and emergency response measures, identified in Section 2.10.3;
- complying with relevant WST Specifications (Appendix D), and relevant provincial and federal legislation and regulations (Table 2.1) when carrying out construction and operation activities;
- prohibiting harassment and feeding of wildlife during construction;
- requiring that all hunting, fishing or trapping activities by project personnel be carried out according to applicable legislation;
- maintaining buffer zones around all watercourses and waterbodies, where possible;
- minimizing the area disturbed by the project (i.e., limiting vegetation clearing to 30 m);
- requiring construction vehicles to remain in the right-of-way and all-terrain vehicles to use designated routes that avoid wetland areas, where possible;
- properly storing and disposing of waste from construction camps and maintenance depots, as approved by regulatory agencies; and
- notifying commercial operators (e.g., outfitters) and other resource users about planned project activities.

Many of the potential adverse effects on resource use and users are linked to the improved access that will be provided by the TLH - Phase III, and any resulting associated increase in human presence and activities in this relatively isolated area. Mitigating these potential effects is, for the most part, beyond the responsibility of WST. Managing these actions and their potential effects is the responsibility of various regulatory and resource management agencies, which are responsible for ensuring that legislation and regulations are adequately enforced and that future activities are undertaken in a responsible and sustainable manner. This environmental assessment, by identifying environmental aspects, provides opportunity for appropriate measures to be identified and implemented by the relevant agencies in an effective and timely manner.

6.12.8 Environmental Effects Assessment

The area in the vicinity of the TLH - Phase III route experiences varying levels of resource use activities, with the greater proportion of resource use activities (and plans for future resource use activities) being concentrated at the western and eastern ends of the highway, in particular around watercourses and waterbodies in these areas. The highway will provide an improved means of access to this area and opportunities for increased use and new resource use activities and user groups.

Potential environmental effects that may result due to the TLH - Phase III are associated with both the construction and operations phases of the project. However, it is during the operations phase that potential environmental effects associated with project-VEC interactions may be more evident. The analysis of project-VEC interactions takes into consideration the mitigation described above and existing knowledge.

6.12.8.1 Construction

As Happy Valley-Goose Bay is the only community located along the route, with the intersection between the western portion of the TLH - Phase III and TLH (Route 500) being located within the planning area for the town, it is the only community that will experience direct effects on municipal land use. However, given that the intersection is located approximately 9 km west of the built up area of the community and approximately 2.5 km west of the town's water supply, the town and residents are not likely to be affected by construction activity. No other communities will experience direct effects on municipal land use due to highway construction activities, as none are located on the route.

During construction, areas of resource use will be subject to disturbance associated with project construction activities, such as vegetation removal along the right-of-way, excavations and laying subgrade material, and temporary construction camps, laydown areas and borrow pits being established. The noise, dust, increased human presence and other disturbances associated with these construction activities may lead to resource users avoiding or reducing their use of resource areas near the construction sites. Some resource users may feel that the overall wilderness experience and aesthetic quality of the area is diminished as a result of the disturbances from construction activity, which may cause resource users to avoid or reduce use of the area. As well, depending on the nature of the activities being carried out, access around the construction area may be restricted for safety reasons. Any hunters, trappers, anglers, cabin owners or others normally engaging in subsistence or recreational activities in the vicinity of the construction sites may be affected by construction activities. However, resulting effects will likely be localized (approximately 20 km of highway will be constructed annually at each end of the highway) and have a short duration (the construction season will extend from around May to November each year between 2003 and 2008). While some resource users may use other areas during construction and others may chose to not participate in resource use activities, no decrease in the overall level of resource use in the area is anticipated during this period.

A number of the waterways used by area residents and other resource users will be crossed by the TLH - Phase III to access hunting and fishing areas, as well as cabins. Final design of the crossing structures will take into consideration the current type of use and navigability of the waterway; however, construction and placement of these crossing structures may limit or disrupt waterway navigation for a period. This is not expected to be a concern for the larger waterways, where only a portion of the waterway will be under construction at any one time. For smaller crossing locations, potential navigability may be disrupted for a short period; however, this disruption would be restricted to one construction season or less. Any disruption of waterway navigability will also affect resource users that use watercraft to travel to the areas that are used for hunting, fishing or other activities.

Hunters and trappers will be affected if wildlife avoid construction areas due to the noise and habitat disturbance or are displaced due to habitat loss. This applies to moose, black bear, other furbearers, small game and migratory birds. Hunting of Mealy Mountains caribou is not permitted. While some temporary displacement of moose may occur as a result of construction disturbance, moose are typically dispersed between the spring and fall, minimizing the effect on moose (Section 6.2.7.1) and, subsequently, on hunters. Also, construction will not affect critical wintering areas for moose (Section 6.2.7.1), further minimizing the effect on hunters. Waterfowl habitat will be altered or removed by right-of-way clearing; however, waterfowl are expected to continue using areas near the highway (Section 6.2.8.1). Therefore, there will be little effect on waterfowl hunting. Similarly with furbearers, habitat will be lost and noise and other disturbance from construction activity may cause furbearers to avoid construction areas for a short period, but the various furbearers will continue to use the area near the highway (Section 6.4.8.1). Also, only the first month of the trapping season overlaps with the annual construction period. Therefore, there will also be little effect on trapping activity.

Construction activities around watercourses that affect fish and fish habitat will indirectly affect angling activity. Standard construction activities have built-in environmental protection procedures that will minimize effects on fish and fish habitat during construction (where effects will be limited to one construction season at any location). Therefore, there will be no discernable effect on fishing activity. In addition, construction workers choosing to hunt or fish while at site will be required to adhere to all laws and regulations pertaining to these activities. Non-compliance will not be tolerated by WST or the contractor.

Commercial outfitting operations in the immediate vicinity of the project area (Figure 6.39) may have to adjust their operations during project construction in order to minimize the effects of any disturbance from construction activities (e.g., by having their guests fish in alternate areas during the construction of some highway segments). With the closest outfitting operation being approximately 8 km from the TLH - Phase III route, outfitting lodges in the area will be outside the zone of influence for noise (estimated to be approximately 4 km) and will not likely experience any noise effects from construction. WST will inform tourism operators and other relevant organizations and individuals about the location and timing of construction activities to ensure that any potential conflicts are identified and addressed through appropriate planning.

The highway route passes through the study area for the Akamiuapishku/Mealy Mountains National Park, which is considered in detail in Section 6.13, and IBP Site 53 (Eagle River Headwaters), which encompasses 520 km^2. Habitat loss or alteration from highway construction, and increased human access and development activities, as a result of the highway are the key potential effects on these areas. The project is not likely to result in significant adverse environmental effects that will preclude establishment of the Akamiuapishku/Mealy Mountains National Park (Section 6.13). While the TLH - Phase III route passes through IBP Site 53 and it will be subject to disturbance from construction activity, with the proposed mitigation measures in place the site is not likely to be adversely affected. The proposed highway also does not intersect or pass in close proximity to existing snowmobile trails in the area.

While the TLH - Phase III passes through two forest management districts, currently there is no forestry activity occurring along the route that would be affected by construction activity. At the western end of the route, with current forestry operations located north and west of Lake Melville, construction activity at the Black Rocks area will not interfere with forestry operations in this area. In the east, there will be no interaction between the current limited amount of forestry activity in the Cartwright and Paradise River areas and highway construction activities due to the distance between the two activities. Similarly, there are no mineral exploration claims, mining operations or hydro power developments located along the route and, subsequently, no opportunity for conflicts with construction activity. However, as sections of the highway open, forestry and mineral exploration activities may be initiated in the area. In the case of forestry, operations are most likely to be concentrated along the western portion of the route, as this area contains some of Labrador's most productive forest resources. To avoid problems or conflicts with these resource user groups, WST and/or the contractor will notify any forestry operators or mineral claim holders that begin operations in the area during construction about planned construction activities.

Approximately 92 km of the TLH - Phase III route lies within DND's LLTA and the annual period of highway construction (approximately May to November) will overlap with DND low-level flight training activities (April to October). Construction activities will not affect the flying activities or vice versa. Likewise, the PTA is located approximately 120 km south of Happy Valley-Goose Bay and 84 km southwest of the TLH - Phase III route, so there is no interaction between the PTA and construction activities. As with other user groups, public notices about construction activities, in particular any planned blasting operations, will be made by the contractor.

6.12.8.2 Operation

During highway operation, noise, dust, increased human presence and other disturbances can be expected to result from regular maintenance activities and highway use. Any hunters, trappers, anglers, cabin owners or others normally engaging in subsistence or recreational activities in the vicinity of the highway may be affected by maintenance activities and highway use. For some resource users, these disturbances may deter them from participating in resource use activities near the highway. Also, the visual effect of the highway itself may affect the wilderness and aesthetic character of the area and, subsequently, cause resource users to avoid or reduce their use of areas that they previously used and are now near the highway. However, the disturbances associated with highway operation will be limited to a short time period and be concentrated in a localized area. Similarly, disturbances associated with highway use will be of a short duration, as traffic levels for the highway are expected to be low. With an estimated 4 km zone of influence for noise, it is not likely that noise associated with regular highway use will be heard at any of the outfitting lodges. As the locations of area cabins are not known, it is possible that highway operation activity will be audible at some cabins in the area.

While resource users may alter their patterns of use or choose other areas to carry out their activities, no decrease in the overall level of resource use in the area is anticipated during highway operation. Given the vastness of the region, resource users will have the opportunity to pursue resource use activities in other areas. Also, it is expected that resource use in the vicinity of the highway will increase over the course of highway operation due to the improved access provided by the highway. Resource users, who would not have used the area if they had to travel by boat or a charter aircraft, will have a cheaper and easier means of access into the area. As portions of the highway are completed, access to areas currently used for resource activities will be improved and other areas will become accessible. As public access will be permitted to each highway section as construction of that section is complete, an increase in resource use activities can be expected to occur immediately following completion of each construction phase. By the time the highway is complete, this increased level of use can be expected along the entire highway route.

While the highway provides improved access for resource users, various aspects of area resources and the resource management regime currently in place for the area act to limit resource use in the area. Hunting of the MMCH is restricted, because the species is designated as threatened by COSEWIC. The area immediately south of Lake Melville is not zoned for moose hunting. Moose hunting is a regulated activity and zones are limited to the eastern (Paradise River area) and western end (Muskrat Falls area) of the highway. While black bear hunting is permitted throughout Central and Southern Labrador, the harvest of black bears is low and not expected to increase because bears are no longer eaten due to their habitats of foraging in dumps and pelts currently not having a high value. Bear hunting is also restricted to a spring and fall season. Small game (e.g., grouse, ptarmigan and hare) and migratory bird hunting are permitted in Central and Southern Labrador. Small game hunting is restricted to October to April and migratory bird hunting is restricted to September to December, and both are subject to bag and possession limits. There is no legal hunting of harlequin ducks. Trapping is also a fall and winter activity, restricted to the period from October or November (depending on the species) to March.

These factors act to limit the resource use activities that could potentially be carried out in the vicinity of the TLH - Phase III. Unless a moose hunting zone is established for the area, furbearers (over the fall and winter), small game (over the fall and winter) and migratory birds (in the fall) will likely be the principle species trapped or hunted in the area. The fact that these hunting and trapping activities are restricted to the fall and winter will mean that they will most likely be carried out by area residents; thus, participation in these activities by non-residents will be limited. Also, the fact that navigability of area waterways is possibly limited to travel by small vessels such as canoes and/or kayaks, will also act to limit access from the highway. However, despite the fact that there are regulations and policies governing resource use in the area, illegal harvesting and other activities may occur.

For resource management measures to be effective in protecting area resources and limiting activity, increased enforcement resources or new management initiatives may be necessary. The departments and agencies responsible for managing wildlife resources will need to review existing policies. Should the proposed Akamiuapishku/Mealy Mountains National Park be established, hunting and trapping will not be permitted within the boundaries of the park and Parks Canada would apply enforcement resources to the area. Also, the designation of any of the area rivers as heritage rivers will also bring with it restrictions on resources use activities. The planning processes for both national parks and heritage rivers include opportunities for public input, and both processes would provide further controls on hunting and trapping activity in the area. In the absence of a national park, establishing a Special Management Area under the provincial *Lands Act* would be a means implementing controls on resource use and development in the area.

As the watercourses crossed by the TLH - Phase III, except for the Churchill River, are likely to only be navigable by vessels of the size of canoes or kayaks, the use of many of these waterways to access areas distant from the highway will likely be limited. The Churchill River is already immediately accessible from the Happy Valley-Goose Bay area and its use is expected to continue. An increase in resource use activities may result if there is an increase in nature tourism activities. The Eagle River and its tributaries currently receive a high level of use and this is likely to continue, and possibly increase after the highway is operational. Similarly, given that the Kenamu, Traverspine and Paradise rivers are currently being used for various resource activities, it is expected that resource use will likely also increase in these watersheds. However, resource users would likely rely on foot or vehicles, such as all-terrain vehicles (ATV) or snowmobiles, to gain access from the highway. In addition, there are a number of lakes in the vicinity of the highway that will become accessible to watercraft users and may facilitate access throughout the watershed.

Of the resource use activities occurring in the area, recreational fishing on area rivers and lakes is the most likely activity to be subjected to increased participation following completion of the TLH - Phase III. Current angling activity is concentrated near Happy Valley-Goose Bay and Cartwright. However, improved access to watercourses and bodies that is provided by the highway will provide increased opportunity for recreational fishing activity throughout Central and Southern Labrador. While this may be viewed as an improvement for the recreational fishing industry, any overfishing (whether legal or illegal) may adversely affect fish resources and, subsequently, the recreational fishing industry. Likewise, any increase in fishing activity that results in overcrowding and congestion on area rivers and lakes, will affect the perceptions that resource users have of the wilderness character of the area and overall quality of the recreational fishing experience. However, the size of the area and potential fishing locations will act to minimize any congestion and help maintain the overall quality of the fishing experience.

As with hunting and trapping, should the proposed Akamiuapishku/Mealy Mountains National Park be established or heritage rivers designated, restrictions would be put in place on resources use activities (e.g., snowmobile and ATV use are prohibited and special fishing licences are required in national parks) that would aid in protecting area resources. Similarly, the Special Management Area designation under the *Lands Act*, would see the implementation of measures that may control resource use or development activities. The planning processes for both national parks and heritage rivers include opportunities for public input, including input from resource users in the area. While a park and heritage river designation would offer some protection for fish resources in the area, changes to current fisheries management and enforcement may also be necessary to address issues surrounding increased fishing activity. This may include changes to existing regulations and policies (e.g., changes to bag limits and retention levels or having some lakes and steams designated as hook and release only). There may also be a need for more fisheries officers to patrol the area and enforce these regulations. Outfitters have also noted the importance of ensuring that policies and regulations related to outfitting operations in Labrador (e.g., buffer areas between camps, and outfitter licencing and regulation) are strictly enforced.

Any adverse effect on fish stocks and the overall wilderness experience may also affect operations in the high-value, non-resident outfitting industry. The TLH - Phase III route is approximately 8 km from the closest outfitting camp, and comes within approximately 12 to 15 km of several others (Figure 6.39). Of the 19 outfitting camps, all are located beyond the 4 km zone of influence identified for noise. As well, the distance from the highway will limit direct effects from highway operation. However, the improved access to the area provided by the highway, and associated increase in human presence and fishing activity in this previously remote area will have implications for the outfitting industry. ATV and snowmobile use will mean that any increase in human presence and resource exploitation will likely not be confined to the immediate vicinity of the highway. The highway may detract from the wilderness character that forms the basis of the Labrador angling experience sought by many non-resident anglers. A decrease in fish stocks due to overfishing would adversely affect these operators. This, along with the migratory nature of most of the fish species upon which these outfitters depend, means that the effects of highway operation would likely affect these operations. Increased human access will also increase the potential for vandalism at these camps.

In addition, the presence of a provincial highway through the area will reduce the need for non-resident anglers to retain the services of a licenced guide, as non-residents are permitted to fish unaccompanied on unscheduled waters within 800 m of any provincial highway. Highway access will also increase the potential for developing new lodges along the TLH - Phase III route, similar to that which has occurred along the Phase I portion of the TLH between Happy Valley-Goose Bay and Western Labrador and in the Labrador Straits. An increase in lodge development may cause further crowding on area rivers, resource depletion and competition. While the current freeze on the development of new lodges on Labrador rivers would act to limit the development of new outfitting operations, it would not preclude unlicenced and unregistered operations being established or carried out in the area after the highway is operational.

While forestry is not currently occurring along the TLH - Phase III route, it is considered to be the most likely resource use to be initiated in the area as a result of the highway. With forest management planning efforts currently in place for the area south of Lake Melville (i.e., FMD 19A-S), the access to the area provided by the bridge on the Churchill River and the highway will facilitate the development of forestry operations in the area south of the river. The fact that FMD 19 contains Labrador's most productive forests, from a commercial perspective, also indicates that new forestry development is most likely to occur in this district. Expansion of forestry operations in this area will likely require development of forest access roads, resulting in a network of roads being built in the area. These access roads would also facilitate access to the area by other resource users, creating further opportunity for increased resource use and resulting in further pressure on resources and effects on other resource users. Also, any negative effects of forestry operations on wildlife or fish would also indirectly affect resource users. As well, a growing network of forest access roads will have implications for the aesthetic and wilderness character of the area, with subsequent implications for resource users.

Similarly, mineral exploration may be facilitated by the highway and any forest access roads built in the area. Again, increasing use of the area and potential interaction with other resource users may result from mineral exploration activities or any subsequent mining developments (pending discovery of any economically viable mineral prospects).

While the Cartwright and Paradise River area has potential for additional forestry development, the potential is not considered to be as great as that in the Lake Melville area. However, overall growth in Labrador's forestry industry will stimulate the development of further forestry activity in other areas. Domestic timber harvesting will likely continue to be focused around communities and cabin areas as resource users will not likely travel long distances to obtain wood for fuel or house/cabin construction. It is also expected that there may be some increase in domestic timber harvesting as people will have access to areas of good timber supply. However, as noted, cutting is not permitted within 100 m of a road.

As noted, the highway does not pass through any existing parks in Central or Southern Labrador. However, it does pass through the study area for the Akamiuapishku/Mealy Mountains National Park, which is considered in detail in Section 6.13, and passes through IBP Site 53 (Eagle River Headwaters). Project operation is not likely to result in significant adverse environmental effects that will preclude establishment of the Akamiuapishku/Mealy Mountains National Park (Section 6.13.8.2). The fact that IBP Site 53 is located within the proposed national park study area means that the area will be subject to any measures imposed for the national park. The proposed highway also does not intersect or pass in close proximity to existing snowmobile trails in the area. However, as noted, the highway will facilitate access for snowmobile use in the area, resulting in potential increased use of the area during the winter.

With approximately 92 km of the TLH - Phase III route lying within DND's LLTA, highway operation will overlap with DND low-level flight training activities (April to October). The PTA is located about 120 km south of Happy Valley-Goose Bay, and approximately 84 km southwest of the TLH - Phase III route, so there is no interaction with highway operation.

6.12.8.3 Accidental and/or Unplanned Events

A forest fire could destroy wildlife and habitat, forests, cabins, outfitter operations and other natural or human-made aspects important to resource use and users. In addition, a forest fire would have a negative effect on the aesthetic quality of the affected area, reducing its appeal to some resource users. While the potential for a forest fire occurring as a result of the project is low, the magnitude and extent of any forest fire that might occur is not known.

A spill of fuel or other hazardous material into waterbodies could affect water quality, aquatic life and wildlife resources, causing indirect effects on resource use and users. Resource use and users may be affected by any real or perceived decrease in the availability or quality of these resources. However, any such event that would arise from a highway accident or leak from equipment would be relatively small and localized.

Vehicle accidents or highway failure could also restrict or delay resource use activities. Mortality to wildlife species due to collisions with vehicles could affect resource availability. However, the volume of traffic anticipated to occur on the proposed highway is relatively low; therefore, it is likely that the number of vehicle/wildlife collisions will also be low.

With implementation of environmental protection planning, the potential for such accidental events occurring is extremely low. If such an accident should occur, the significance of its potential effects will depend on the location and timing of the event and its nature and magnitude. WST's contingency planning and emergency response plans will ensure that any adverse effects are reduced during construction.

6.12.9 Environmental Effects Evaluation

Residual environmental effects are those effects remaining after all appropriate mitigation measures have been applied. The environmental effects of the project on resource use and users due to project construction, operation and accidental events are summarized in Table 6.60, as are the mitigative measures designed to minimize effects. Ratings for the established environmental effects evaluation criteria are also presented ion Table 6.60. The following definitions are used to rate the significance of the predicted residual environmental effects of the project on resource use and users:

A **major (significant) environmental effect** to resource use and users is one affecting an entire definable group of people in such a way as to cause disturbance of established activity patterns (related to reduced opportunities for resource use and users) that will not return to pre-project patterns within several generations.

A **moderate (significant) environmental effect** to resource use and users is one affecting a definable group of people in such a way as to cause disturbance of established activity patterns for one or two generations.

A **minor (not significant) environmental effect** to resource use and users is one of short-term duration affecting a specific group of people in a localized area.

A **negligible (not significant) environmental effect** to resource use and users is one occurring in a localized area and in a manner similar to short-term random changes due to natural irregularities.

The environmental effects associated with the TLH - Phase III construction primarily related to physical disturbance (e.g., vegetation removal along the right-of-way, excavations and laying subgrade material, and temporary construction camps, laydown areas and borrow pits being established), noise, dust, increased human presence and other disturbances associated with construction activities. Starting during construction, but most evident during operation, are the induced effects resulting from improved access provided by the highway. While the increased opportunity for resource use activities due to the improved access provided by the highway may be a positive effect for some resource users (i.e., they will now have easier access to a large area in which to carry out various resource use activities), for other users increased use of the area will be an adverse effect (i.e., their activities may be restricted or altered or the overall wilderness experience may be compromised). For example, induced activity during operation may adversely affect existing cabin owners, and commercial (outfitting operations) and recreational fishing activity.

Table 6.60 Environmental Effects Summary - Resource Use and Users

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • committing to meeting relevant terms and conditions of an Innu land claim settlement; • implementing the environmental protection measures for construction and operation, including contingency and emergency response measures, identified in Section 2.10.3; • complying with relevant WST Specifications (Appendix D), and relevant provincial and federal legislation and regulations (Table 2.1) when carrying out construction and operation activities; • prohibiting harassment and feeding of wildlife during construction; • requiring that all hunting, fishing or trapping activities by project personnel be carried out according to applicable legislation; • maintaining buffer zones around all watercourses and waterbodies, where possible; • minimizing the area disturbed by the project (i.e., limiting vegetation clearing to 30 m); • requiring construction vehicles to remain in the right-of-way and all-terrain vehicles to use designated routes that avoid wetland areas, where possible; • properly storing and disposing of waste from construction camps and maintenance depots, as approved by regulatory agencies; and • notifying commercial operators (e.g., outfitters) and other resource users about planned project activities.			
Environmental Effects Criteria Ratings			
Magnitude	Low	Medium	Unknown
Geographic Extent	11-100 km^2	1,001-10,000 km^2	Unknown
Frequency	Continuous	Continuous	<10
Duration	37-72	>72	<1
Reversibility	Reversible	Irreversible	Unknown
Ecological/Socio-economic Context	Low/May be affected by effects on wildlife, fish and fish habitat, water resources, national park, tourism and recreation, employment and business, and community life.		
Environmental Effects Evaluation			
Significance	Not Significant (Minor)	Not Significant (Minor)	Not Significant to Significant (Minor to Major)
Level of Confidence	High	Medium	High
Likelihood[1]	n/a	n/a	Low
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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: • Monitoring for biophysical resources will indirectly benefit resource use and users. • WST will cooperate, by providing project-related information, to government departments and agencies responsible for managing biophysical resources and resource use activity.			
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 Level of Confidence: High, Medium, Low Likelihood: High, Medium, Low or Unknown Sustainable Use of Resources: High, Medium, Low or Unknown			

The environmental effects associated with the TLH - Phase III construction primarily related to physical disturbance (e.g., vegetation removal along the right-of-way, excavations and laying subgrade material, and temporary construction camps, laydown areas and borrow pits being established), noise, dust, increased human presence and other disturbances associated with construction activities. Starting during construction, but most evident during operation, are the induced effects resulting from improved access provided by the highway. While the increased opportunity for resource use activities due to the improved access provided by the highway may be a positive effect for some resource users (i.e., they will now have easier access to a large area in which to carry out various resource use activities), for other users increased use of the area will be an adverse effect (i.e., their activities may be restricted or altered or the overall wilderness experience may be compromised). For example, induced activity during operation may adversely affect existing cabin owners, and commercial (outfitting operations) and recreational fishing activity.

The environmental effects evaluation focuses on the potential adverse effects associated with the project. The potential adverse environmental effects of highway construction are rated as minor (not significant), meaning that any effects on resource use and users will be of short-term duration and affect a specific group of people in a localized area. Potential adverse environmental effects of highway operation are also rated as minor (not significant); however, the magnitude of such effects are likely to be higher, irreversible and extend over a larger area. Effects associated with any accidental or unplanned events are rated from minor (not significant) to major (significant), because the magnitude and geographic extent of an accidental event is unknown and established activities may not return to pre-project patterns within several generations.

6.12.10 Cumulative Environmental Effects

Several ongoing and potential projects and activities may accumulate and/or interact with those of the TLH - Phase III to result in cumulative environmental effects on resource use and users. These existing, planned or potential projects and activities are described in Section 5.5. Consideration of these projects and activities assumes appropriate planning and management are in place and regulatory requirements and mitigation measures are fulfilled.

The existing sections of the TLH (Phases I and II) will influence the nature of the effects of the proposed project on resource use and users. Not only will the TLH - Phase III provide year-round access to a previously remote area, but through connections with the Phase I and II portions of the highway, the area will be open to residents from Western Labrador and Labrador Straits and visitors traveling the highway.

Resource use activities in the area have traditionally been limited due to the remoteness of the area. Improved access to, from and within the region as a result of the TLH - Phase III will likely provide new opportunities for development activities such as forestry, mineral exploration and possibly mining, as well as increased recreational resource harvesting, cabin development and other resource use activities. Each of these activities could, to varying degrees, affect resource use and users in the area and, when carried out in combination with the TLH - Phase III, could result in cumulative environmental effects.

The proposed Akamiuapishku/Mealy Mountains National Park would encompass approximately half of the highway route. While a park may draw more users to the area, the creation of this park would also provide a greater level of protection for resources and bring with it a set of rules regarding resource use. Thus, the cumulative environmental effects of the TLH - Phase III in combination with a park may have both positive and negative effects on resource use and users. A similar situation may arise with any rivers designated as heritage rivers.

Ongoing low-level military flight training, when combined with construction and operation of the TLH - Phase III, has implications for the wilderness character of the area which may affect some resource users and their activities. Similarly, hydroelectric power development at Gull Island, should it proceed, and associated transmission infrastructure in Labrador will mean additional disturbance in the area and possible disruption of resource use and users.

The likelihood, nature, location and timing of these potential induced actions and their potential environmental effects are not known at this stage. The control of most of these potential induced actions and their effects is beyond the responsibility of WST. Managing these actions and their effects will require the efforts of resource management and other relevant regulatory agencies to ensure that applicable legislation and regulations are in place and are adequately enforced, and that future projects and activities are undertaken in a responsible and sustainable manner. Therefore, assumptions have been made in 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;
- the level of 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.

With the implementation of these measures, in particular appropriate planning and enforcement, the TLH - Phase III in combination with other projects and activities that have been or will be carried out is not likely to result in significant adverse cumulative environmental effects on resource use and users.

6.12.11 Environmental Monitoring and Follow-up

Measures designed to monitor project effects on biophysical resources also apply indirectly to resource use and users. No specific monitoring programs are identified for this VEC. Monitoring and addressing any changes in the distribution and intensity of resource use activities is the responsibility of the provincial and federal government departments and agencies that administer and manage these activities. WST will cooperate with such organizations by providing project-related information as required. Monitoring and careful planning on the part of these departments and agencies will ensure that issues can be identified and addressed in an effective and timely manner.

6.13 Akamiuapishku/Mealy Mountains National Park

The proposed Akamiuapishku/Mealy Mountains National Park is located in central Labrador. The study area for the proposed 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 portion of the park study area, south of Park Lake (Figure 6.38).

6.13.1 Boundaries

The project boundary is the cleared right-of-way and areas of associated physical disturbance. Currently, the land under consideration for national park status is crown land under the jurisdiction of the Province of Newfoundland and Labrador. Should the proposed park be acclaimed, the land would fall under federal government jurisdiction and would be under the mandate of the Parks Canada Agency (Parks Canada) and subject to federal laws and regulations.

The study area for the Akamiuapishku/Mealy Mountains National Park is the basis on which the environmental effects analysis will be conducted.

The area of the highway that affects the proposed national park is the area that encompasses the direct disturbance corridor of the highway and the areas affected by the increased human access to natural areas that the highway will provide.

6.13.2 Methods

Information used in conducting the assessment of the Akamiuapishku/Mealy Mountains National Park include published reports and unpublished information from various public and private sector organizations. The environmental effects analysis is based on a review of existing information and an assessment of the degree to which the various phases and components of the project may affect the potential for establishment of a national park.

6.13.3 Existing Environment

6.13.3.1 History of the Proposed Akamiuapishku/Mealy Mountains National Park

The creation of a national park in the Mealy Mountains was first suggested in the early 1970s and the site was established as a preferred candidate in 1976. The project was put on hold in 1979 following public concern and opposition from Aboriginal groups. In 2000, the Government of Newfoundland and Labrador announced that federal and provincial governments and representatives of Labrador Aboriginal peoples would embark on a joint feasibility study to examine the potential impacts and benefits of establishing a national park in the Mealy Mountains (Government of Newfoundland and Labrador 2000).

A steering committee was put in place to lead public involvement and a public consultation process to determine whether or not a national park is feasible for the Mealy Mountains area.

The goal of Parks Canada with respect to the proposed national park is to protect ecosystems and important landscape features while providing opportunities for enjoyment by humans. To accomplish this, it is understood that there will be some level of development within the national park (Blackmore 2001). Park boundary targets have not been defined. However, Parks Canada would like to see protection for river systems, wildlife, unique alpine vegetation and a large area of forest to allow the natural cycle of the forest to evolve without interference (Blackmore 2001).

6.13.3.2 Biophysical Environment of the Akamiuapishku/Mealy Mountains National Park Study Area

The Mealy Mountains represent an area of Arctic tundra surrounded by boreal forests and coastal seascapes and is within the home range of the threatened MMCH (Nature Federation 2000). The proposed park boundary would encompass five ecoregions, including Lake Melville, Kingurutik-Fraser River, Mecatina River, Eagle Plateau and Paradise River (ESWG 1996). The park is a candidate to represent Natural Region 21 - East Coast Boreal within the national parks system.

The topography of the area is varied, a result of the underlying bedrock and structural geology as well as influences of glacial erosion and deposition. Features include steep, glacially-scoured mountainous terrain, and flat plateaus with numerous lakes and wetlands. Other landforms found in the area include eskers, glaciofluvial terraces and raised marine beaches, plateau bogs, patterned fen complexes, coastal and alpine barrens, and boreal conifer forest (Keith 2001).

The Mealy Mountains are the highest in southern Labrador, with elevations that exceed 1,150 m. Vegetation at these higher elevations includes some Arctic alpine species, typical of vegetation found in more northern latitudes (Keith 2001). South of the Mealy Mountains, the interior lowland region has some of the most productive forest in Labrador.

Lake Melville, which extends inland 240 km from the mouth of Groswater Bay, forms the northern boundary of the proposed park study area. This large salt water inlet is the inland extension of Hamilton Inlet, the largest fiord complex along the Labrador coast (Keith 2001).

Several large rivers bisect the study area, including the Kenamu and Eagle Rivers, both important Atlantic salmon rivers. The Eagle Plateau is dominated by lakes and wetland complexes which provide nesting habitat for osprey and bald eagle. Mammals typical of the boreal forest are found in the study area, including woodland caribou, moose, black bear and a variety of furbearer species including river otter, beaver, muskrat, lynx, wolf and red fox. Similarly, songbirds typical of the boreal ecosystem, a large percentage of them migratory, can be expected to use the study area. Waterfowl densities are generally low; however, an important segment of the Atlantic flyway population of ducks and geese nest in the region due to the large amount of wetland habitat in the study area.

Further discussion on elements of the biophysical environment of the Akamiuapishku/Mealy Mountains National Park study area is provided in Sections 3.1 to 3.3 and 6.1 to 6.10.

6.13.4 Potential Interactions

The potential interactions of the highway with the proposed Akamiuapishku/Mealy Mountains National Park would be 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.

6.13.5 Issues and Concerns

Issues and concerns relating to the proposed Akamiuapishku/Mealy Mountains National Park and the proposed highway include:

- potential for degradation of the ecological integrity of various ecosystems through fragmentation or invasion of exotic species or pollution as a result of highway construction and operation; and
- disturbance to wildlife populations and their habitat within the proposed park through increased human access and activity as a result of the highway.

6.13.6 Existing Knowledge

Since the early 1900s, managers and developers of national parks in Canada have struggled with two conflicting ideals: one of ensuring that national parks are accessible to citizens and provide opportunities to spend time in the natural environment and the other of ensuring that ecological integrity and wilderness in national parks is maintained. In recent years, Parks Canada's mandate has evolved from primarily providing worthwhile visitor experiences to a position where there is a greater concern for ecological integrity. Subsequently, human use of national parks has become the secondary consideration and ecological integrity has come to the forefront when developing park management plans (Neufield 2001).

Prior to the 1970s, most national parks established in Canada were located in relatively populated areas in the south. In the last 30 years, numerous parks have been established in the Canadian north, most in areas of little or no development (i.e., Aulavik in 1992, Auyuittuq in 1993). Kluane National Park in the Yukon was established in 1972 and much of the 129-km northern boundary of the park is made up of the Alaska Highway and the Haines Road (Canadian Parks 2000). Visitors to Kluane National Park can enter the park at two locations; however, most park access is by foot, raft or horseback. When the boundaries of Kluane National Park were defined, the Alaska Highway, constructed in 1942, remained outside.

Banff National Park is an instructive example of the conflict between preservation and development in national parks. The park was established in 1885 to preserve a 26 km^2 area encompassing thermal springs located on Sulphur Mountain (Pacas 1997). In the years since Banff was established, visitors have grown from 3,000 in 1887 to more than five million in 1995, with more than 20,000 vehicles entering the park each day (Pacas 1996, cited in Pacas 1997). The high visitation numbers and the accompanying development have placed pressure on many environmentally sensitive areas, particularly in the last 45 years. Vermillion wetlands, montane forest and linkage zones (particularly important to wolves and grizzly bears) between

Banff National Park and surrounding areas have all been compromised by town, highway, railway, trail and other facility developments in the area (Green et al. 1996, cited in Pacas 1997). Similarly, aquatic biodiversity has been greatly altered through modification of wetlands and regulation of water flows and water levels (Schindler and Pacas 1996, cited in Pacas 1997). Studies in Banff have indicated the ecological integrity is compromised for various indicator species, suggesting that Banff may not meet the criteria for a national park in the future (Pacas 1997).

Ecological integrity is the capability of an area to maintain ecological processes and species, and to withstand changes and stresses (NRC 1998). Placing boundaries around an area will not ensure ecological integrity if human activities are not controlled. The introduction of exotic species can have a profound effect on the ecological integrity of an area (NRC 1998). For example, the introduction of an invasive plant species that can take advantage of areas of disturbance (such as along the sides of a new road) may disrupt the normal ecological range of variability to the point of endangering the viability of the existing regime, and thus the ecological integrity of an area (NRC 1998). Similarly, species may be introduced that prey on other species that have no natural resistance or have not developed mechanisms to avoid predation. As well, food species such as alien grasses and forbs along highway rights-of-way and other disturbed areas in a park may attract native animals and thus affect their population levels in the protected area.

In Canada, as in other parts of the world, certain habitats and ecosystems are far more susceptible to invasive plant species than others. As a generality, the problem of alien invasive species in natural systems is sometimes serious in parts of southern Canada but is essentially non-existent in tundra ecosystems of the North (Mosquin no date). However, where invasive plants from more southern regions are present, they will likely only occur in places heavily disturbed by human settlement, such as roadsides, docks, settlements and trails (Mosquin no date).

During a backcountry monitoring program in Riding Mountain National Park, Manitoba, analysis of backcountry campsites found that the dominant vegetation types were non-native species, generally those that prefer disturbed sites (MacKay and Campbell 2001). Backcountry areas were considered most susceptible to impact when moisture levels were high in the early spring and following periods of intense sustained precipitation. However, visitor levels during these sensitive periods were low. Overall, the study concluded that at current levels of use (14 backcountry campgrounds had 1,367 visitors in 1995), effects of human activity were minimal and were generally limited to trail erosion and braiding (in wet and muddy sections), social trail development at campsites and increased soil compaction at heavily used campsites (MacKay and Campbell 2001).

In general, large and mid-size mammals that are otherwise protected within a national park may be at increased risk of mortality through vehicle collisions when roads are situated within park boundaries. For example, from 1971 to 1995, 73 grizzly bear mortalities were recorded in Banff National Park, of which 90 percent occurred within 500 m of a roadway or site of human activity. In recent years, Banff has made efforts to rectify problems associated with development, including removal of facilities in areas that are critical corridors for wildlife (Leeson 1997). A road density of approximately 0.6 km/km^2 appears to be the maximum to maintain a naturally functioning landscape that supports viable populations of large predators such as wolves (Forman and Alexander 1998). Further discussion on the potential for direct mortality of various species groups through vehicle collisions is provided in Sections 6.1 (Raptors), 6.2 (Waterfowl and Passerine Birds), 6.3 (Caribou) and 6.4 (Furbearers).

In 1979, approval was given for twinning (i.e., creating four lanes) of the Trans Canada Highway through the Bow Valley (representing an area encompassing Banff and Yoho National Parks). Much effort has been expended to mitigate the effects of the highway on wildlife, including roadside fencing and underpasses (Leeson 1997). Parks Canada has stated that, while constructing a four-lane highway through a national park is not a desirable prospect, the environment has shown itself to be able to accommodate most stresses if care is taken to understand ecological integrity and minimize disturbance (Leeson 1997).

Vehicles emit exhausts such as oxides of carbon, nitrogen and sulphur as well as minute particles of carbon and oil droplets (Bennett 1991). Gases emitted by vehicles contribute to acid rain that is known to cause forest decline and acidification of waterbodies in the northern hemisphere. Road construction can affect the hydrology of the local environment, both within the right-of-way and beyond. Drainage from roads may also cause erosion and transportation of soil particles and pollutants (Bennett 1991). In particular, erosion may affect aquatic communities by altering micro-habitats of invertebrates and spawning sites for fish. This will have secondary effects on the organisms higher up in the food chain (Bennett 1991).

Ecosystem fragmentation occurs when 'islands' or fragments of natural areas are created due to natural catastrophes and human activities. Plants and animals within these islands may be separated from the next nearest populations of those species, thus limiting opportunities for dispersal and gene flow between populations. Fragmentation also occurs within these areas on a smaller scale when roads, trails, golf courses and other human developments isolate portions of the natural landscape from other similar habitats. In general, species living within isolated forest fragments tend to be more vulnerable to biotic and abiotic influences than those that live within large contiguous habitat types (Perry 1994). Further discussion on habitat fragmentation is provided in Section 6.2.

Maintenance of ecological integrity in a protected area such as a national park can be achieved through complete protection from all human activity. However, complete protection of a large area is often not practical due to competing land uses or the desire to meet tourism and recreation objectives (NRC 1998). Another way to preserve ecological integrity is to define an area that is divided into zones with varying levels of protection (i.e., a central or core zone of complete protection surrounded by a series of zones with decreasing levels of protection). These zones would be administered through management plans that would also outline controlled (or no) development policies along an existing road corridor.

6.13.7 Mitigation

Mitigation measures that could be applied to limit the effects of a highway on the ecological integrity of the proposed Akamiuapishku/Mealy Mountains National Park include:

- no harassment or feeding of wildlife by project personnel;
- minimize removal of vegetation to 30 m within the right-of-way;
- maintenance of 20 m buffer zones around all waterbodies, where possible;
- maintenance of drainage to and through wetlands to preserve the natural hydrological regime;
- construction vehicles to remain in the right-of-way and all-terrain vehicles will use designated routes that avoid wetland areas; and

- design and implementation of fuel and other hazardous material spill contingency plans and emergency response in the event of an accident.

Many of the potential adverse effects stem from the improved access provided by the highway, and the associated increase in human presence and activities in this previously remote area. Mitigating these potential effects is, for the most part, beyond the ability and responsibility of WST. Managing these actions and their potential effects within a national park will be the responsibility of Parks Canada in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented in an effective and timely manner.

6.13.8 Environmental Effects Assessment

6.13.8.1 Construction

Construction of the highway will result in removal or alteration of vegetation in a linear east-west orientation through the southern portion of the Akamiuapishku/Mealy Mountains National Park Study Area. The amount of forest vegetation that will be removed within the Akamiuapishku/Mealy Mountains National Park study area as a result of highway construction is approximately 397 ha. The amount of wetland or otherwise unforested area that will be removed is approximately 30 ha. However, the vegetation types that will be affected by construction are not considered unique within the region, and are well represented in the surrounding area.

Species may avoid habitat in close proximity to construction areas; however, this avoidance will be temporary, lasting for one construction season or less in any one area.

6.13.8.2 Operation

Determining the ecological integrity of an area is difficult as it cannot be measured directly, rather, it must be measured using indicators at various scales. Highway access and road density can provide an indicator of human access to a large area, while the status and population trend of a particular species can be an indicator of the viability of an ecosystem at a regional or site-specific scale (NRC 1998). It is generally accepted that road density is a key predictor that can be used to estimate the effects of disturbance and habitat fragmentation. In the Akamiuapishku/Mealy Mountains National Park study area, the proposed highway will be the only existing road; therefore, the effects of the 30-m wide corridor on fragmentation of forest or wetland habitat will be restricted to the local area. As well, the area is a natural mosiac of forested and non-forested patches and the species living in the area are adapted to this variable pattern of vegetation distribution.

Within a protected area, management of human activities is an important facet of protecting and maintaining ecological integrity. Under *Parks Canada's Guiding Principles and Operational Policies*, ecological integrity is one of the factors considered in the selection of national parks, and management plans for each park must specify the types of resource protection and management needed to maintain that integrity (NRC 1998).

No additional habitat will be removed or altered as a result of highway operation and no chemicals deleterious to vegetation or water quality will be used during highway maintenance. As well, the highway will be a two-lane gravel road with relatively low traffic levels expected. The highway itself is likely to have only a minimal effect on the ecological integrity of the proposed Akamiuapishku/Mealy Mountains National Park. The potential for degradation of the ecological integrity of the park will arise from human access and subsequent use of lands surrounding the highway corridor. Establishment of stringent development restrictions by Parks Canada along the portion of the highway within the Akamiuapishku/Mealy Mountains National Park study area, and development and implementation of park-specific management plans that define the limits of human activity within the national park will be required to minimize these effects.

6.13.8.3 Accidental and/or Unplanned Events

An accidental spill of fuel or other hazardous materials into waterbodies or in riparian zones in the project area could cause mortality to wildlife or result in reduced foraging opportunities that influence survival and reproductive success. However, any such event that would arise from a highway accident or leak from equipment would be relatively small and localized.

A forest fire could destroy habitat for a variety of species and may actually cause changes in vegetation succession such that forest regeneration may not occur in some areas following fire. A large fire may destroy hundreds of hectares of vegetation, which could result in a decrease in densities of certain species within the region affected. However, boreal flora and fauna have adapted to a cycle of naturally occurring fires and the proportion of a population affected during any one fire would be small. Wetland habitats are less susceptible to fire due to the moisture regime.

With implementation of environmental protection planning, the potential for such accidental events occurring is extremely low. If such an accident should occur, the significance of its potential effects will be dependent upon the location and timing of the event and its nature and magnitude. WST's contingency planning and emergency response plans will ensure that any adverse are reduced during construction.

Mortality to wildlife species may occur through collisions with vehicles and studies have shown that such mortality is influenced by the number of vehicles that travel the highway daily. The volume of traffic anticipated to occur on the proposed highway is relatively low; therefore, it is likely that the number of vehicle/wildlife collisions will also be low.

A summary of the environmental effects associated with each project phase is presented in Section 6.13.8.

6.13.9 Environmental Effects Evaluation

The key potential interactions between project activities and maintenance of the ecological integrity of the Akamiuapishku/Mealy Mountains National Park Study Area include habitat loss or alteration from highway construction and increased human access and development activities as a result of the highway. The following definitions are used to rate the significance of the predicted residual environmental effects of the project on the ecological integrity of the Akamiuapishku/Mealy Mountains National Park study area:

A **significant environmental effect** is one affecting the ecological integrity of the Akamiuapishku/Mealy Mountains National Park Study area in such a way as to preclude selection of the area as a National Park based on *Parks Canada Guiding Principles and Operational Policies*.

A **not significant environmental effect** is one affecting the ecological integrity of the Akamiuapishku/Mealy Mountains National Park Study area in such a way as to not preclude selection of the area as a National Park based on *Parks Canada Guiding Principles and Operational Policies*.

The proposed highway is a linear development that will have relatively low levels of traffic due to its location and the low human population of Labrador. The environmental effects will be restricted to removal of habitat in the immediate highway corridor and the indirect effect of improved access to areas along the highway. Based on the preceding discussion and proposed mitigations, the residual effects of the project on the Proposed Akamiuapishku/Mealy Mountains National Park Study Area are assessed to be not significant for construction, operation, and accidental events (Table 6.61). Overall, the project is not likely to result in significant adverse environmental effects that will preclude establishment of the Akamiuapishku/Mealy Mountains National Park.

Table 6.61 Environmental Effects Summary - Akamiuapishku/Mealy Mountains National Park

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • no harassment or feeding of wildlife during construction; • minimize removal of vegetation to 30 m within the right-of-way; • maintenance of 20 m buffer zones around all waterbodies, where possible; • maintenance of drainage to and through wetlands to preserve the natural hydrological regime; • construction vehicles to remain in the right-of-way and all-terrain vehicles will use designated routes that avoid wetland areas; and • design and implementation of fuel and other hazardous material spill contingency plans and emergency response in the event of an accident.			
Environmental Effects Criteria Ratings			
Magnitude	Low	Low	Low
Geographic Extent	<1 km^2	1-10 km^2	100 km^2
Frequency	Continuous	Continuous	<10
Duration	37-72	>72	>72
Reversibility	Irreversible	Irreversible	Unknown
Ecological/Socio-economic Context	Low/May be affected by land and resource use.		
Environmental Effects Evaluation			
Significance	Not Significant	Not Significant	Not Significant
Level of Confidence	High	High	High
Likelihood[1]	n/a	n/a	n/a
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: No monitoring or follow-up required			
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
Level of Confidence:	High, Medium, Low
Likelihood:	High, Medium, Low or Unknown
Sustainable Use of Resources:	High, Medium, Low or Unknown

6.13.10 Cumulative Environmental Effects

Within the exception of recreational and subsistence resource harvesting activities such as hunting, trapping and angling, human activity within the Akamiuapishku/Mealy Mountains National Park study area has been relatively limited. Snowmobile trails and traffic also cross portion of the park study area, and provide access to parts of the region. Low-level flying of military aircraft has been occurring in the general region since the 1980s. However, the Akamiuapishku/Mealy Mountains National Park study area is located outside of the training area. Therefore for the most part, the region represents a relatively pristine environment at present. Other past, on-going and potential future development activities in Labrador, such as the Voisey's Bay Mine/Mill and potential hydroelectric development, have and will affect the natural and socioeconomic environment of Labrador, although there is limited potential for direct interaction with the Akamiuapishku/ Mealy Mountains National Park study area.

In terms of future projects and activities, the most important development activity that may occur following highway construction is commercial forestry. Other land and resource activities, such as mineral exploration, hunting, angling and cabin development may also increase due to enhanced access provided by the proposed highway. Therefore, each of these activities can result in effects to the natural and socioeconomic environments that may result in cumulative environmental effects in combination with the proposed highway and each other. However, as discussed previously, legislation and regulations are in place to control these projects and activities and their potential environmental effects. Appropriate enforcement, management and planning on the part of relevant regulatory agencies will ensure that any such effects are avoided or reduced.

The establishment of the Akamiuapishku/Mealy Mountains National Park itself would be an important means of addressing the potential environmental effects of future development activity in the region. Development activities and human access would be controlled through management plans and park regulations that would define the acceptable levels of activity within the park. Following highway construction, and prior to establishment of the park, development controls will be required to ensure that the ecological integrity of the Akamiuapishku/Mealy Mountains National Park study area is not compromised.

6.13.11 Environmental Monitoring and Follow-up

No monitoring has been identified for this VEC.

6.14 Tourism and Recreation

Tourism and recreation are an integral part of the economy of Labrador, and the lifestyle of its residents. The following sections provide an overview of existing and potential tourism and recreational activities, services and infrastructure, as well as the potential effects of the project on these components.

6.14.1 Boundaries

Project boundaries for tourism, as defined by the spatial and temporal extent of project activities and zones of influence, extend beyond the highway right-of-way to include areas of existing and potential tourism and recreation activity. Temporal project boundaries encompass the project's construction and operations phases. An accidental effect could occur during either of these phases, and may also have an effect on tourism.

In terms of socioeconomic boundaries, the proposed highway will pass directly through parts of Southern and Central Labrador (Regional Economic Zones 3 and 4), as well as indirectly providing improved access to Western Labrador, the Labrador Straits and beyond.

The development and regulation of tourism and recreation falls within the jurisdiction of a number of organizations. Tourism and recreation in the province is within the mandate of the Newfoundland and Labrador Department of Tourism, Culture and Recreation. Other government departments and agencies also have direct or indirect responsibilities for managing aspects of tourism and recreation (e.g., the federal Departments of Canadian Heritage and Fisheries and Oceans; the provincial Departments of Forest Resources and Agrifoods and Industry, Trade and Rural Development). Regional economic development boards and economic development associations are also involved in the development and promotion of tourism and recreation, as are a number of local and provincial tourism-related associations and societies. Tourism and recreational activities, services and infrastructure are also the responsibility of the various private-sector organizations and individuals which provide them.

The environmental effects analysis for tourism and recreation focusses on Central and Southern Labrador (Figure 2.3), as the proposed highway will pass directly through these regions. It also includes consideration of the other regions of Labrador, Labrador as a whole, island of Newfoundland and other areas, as applicable.

6.14.2 Methods

Information used in conducting the assessment for tourism and recreation include published reports, unpublished information from various public and private sector organizations, information gathered through interviews with government officials and tourism operators and the Tourism and Recreation Component Study prepared as part of the EIS (JW 2003b). The environmental effects analysis is based on a review of existing and potential tourism activity and infrastructure, and an assessment of the degree to which the various phases and components of the project may affect these activities and facilities.

6.14.3 Existing Environment

The tourism industry is an important part of the economy of Newfoundland and Labrador. Tourism-related expenditures in the province exceed $620 million annually, and directly represent approximately 2 percent of the provincial gross domestic product (Department of Finance 2002).

Tourists are defined as individuals who travel over 80 km from their place of residence for any purpose other than commuting to work (DTCR 1994). Tourists are typically characterized according to their origin (i.e., resident or non-resident) and the purpose of their trip (e.g., sightseeing, business travel). A resident tourist is one travelling within Newfoundland and Labrador, while a non-resident tourist travels to the province. Non-resident visitation to the province has increased steadily in recent years, with approximately 427,700 visitors to the province in 2001. During that year, non-resident expenditures in Newfoundland and Labrador ($289.1 million) comprised approximately 47 percent of tourism-related spending in the province, with resident travel accounting for the remaining 53 percent (DTCR 2002c; 2002d).

Some of the more popular tourism activities in Labrador at present include fishing and hunting, nature tourism (e.g., bird, whale and iceberg watching), adventure tourism (e.g., hiking, boating), and cultural and heritage tourism (e.g., visiting historic sites and festivals). Local residents also participate in these and other recreational activities.

The following sections provide an overview of existing tourism and recreation activities, services and infrastructure. The focus is on those activities which are undertaken primarily by tourists. Recreational pursuits undertaken primarily by local residents which may be affected by the proposed project have been discussed in Section 6.12.

6.14.3.1 Fishing and Hunting

Sports fishing and hunting have traditionally been the primary contributors to Labrador's tourism industry (DDRR 1996).

Scheduled salmon rivers in Newfoundland and Labrador are assigned a classification (Class I to Class IV), based on their ability to sustain angling activity. Fishing activity on scheduled waters is described in Section 6.12.3.6.

Anglers may also fish for salmon in non-scheduled inland waters, provided they have a valid salmon licence and tags. For the purpose of retaining salmon, all non-scheduled inland waters are rated Class III, with a season and daily bag limit of two fish retained. Anglers may also fish year-round for salmon in coastal waters, but cannot retain these salmon (DFO 2002). Recreational fishing for other species such as trout and pike also occurs in numerous brooks, rivers, lakes and ponds throughout Labrador (Section 6.12.2). Angling typically occurs between approximately May and September, and ice fishing between February and April (DFO 2002).

Hunting is also an important recreational activity throughout Labrador. Moose hunting takes place each year in portions of Central, Southern and Western Labrador, although there is no moose hunt in most of the area through which the proposed highway will pass. Caribou are also not hunted in the area. Black bear are hunted each spring and fall throughout Labrador (Inland Fish and Wildlife Division 2002). A range of waterfowl, upland game birds and small mammals are also hunted in season. A detailed overview of hunting and trapping is provided in Section 6.12.2.

6.14.3.2 Natural Areas and Activities

Southern and Central Labrador

There are no existing provincial or federal parks in Southern or Central Labrador. The Mealy Mountains have been identified by Parks Canada as a candidate for national park status. A detailed discussion of this proposed national park is provided in Section 6.13.

Hunting and fishing activities are widely undertaken throughout Southern Labrador by both local residents and non-resident tourists (Sections 6.12.2 and 6.4.2.1). Non-consumptive outdoor activities such as hiking and cross-country skiing have traditionally not been widely undertaken in Southern Labrador (JW 1998a), although improved access to, from and within the region due to the recently completed TLH - Phase II may result in an increase in these activities in the future. Adventure tours and guided excursions are also offered throughout the region. For example, sea kayaking, whale watching and traditional craft tours are available from Cartwright, and whale and iceberg watching boat tours are offered at Mary's Harbour. There are also individual certified guides in several communities. Several tour operators based elsewhere in Labrador and on the island of Newfoundland also offer tours in the area (DTCR 2002e).

A number of sites in Southern Labrador have been identified as having development potential for nature and adventure tourism activities. Several of these are currently visited by tourists in the region, but do not yet have developed infrastructure or interpretative facilities. For example, "Iceberg Alley" is a term given to the region's coastline, which provides viewing opportunities for icebergs, marine mammals and sea birds. Similarly, the Wonderstrands, a 56-km long stretch of golden sandy beach to the immediate north of Cartwright recorded in the Viking sagas, is a potential tourist attraction. Southern Labrador's economic plan also identifies several potential protected areas and reserves (e.g., St. Peter's Bay), as well as the potential for such activities as canoeing and camping along the Eagle and Paradise Rivers, sea kayaking, white-water rafting and salt water fishing, coastal hiking, geological tours, and organized bird, whale and iceberg viewing tours in various areas (Southeastern Aurora Development Corporation 1997). Again, the recently completed highway will likely result in increased visitation to the area, which will increase the feasibility of developing new services and facilities.

Trail systems exist throughout the Southern Labrador area, and are currently used primarily by local residents for hunting, fishing, trapping and berry-picking activities (Section 6.12.2). There is also an extensive snowmobile trail through Southern Labrador, which extends from Paradise River to Cartwright, from Cartwright to Black Tickle-Domino, and south along the coast to Red Bay. This winter road is used extensively by local residents, and has considerable tourism potential (JW 1998a). The nearly completed Labrador Winter Trail is a 1,500-km long groomed Labrador snowmobile trail. It extends from Western Labrador, through Churchill Falls, Happy Valley-Goose Bay, and Rigolet, and then branches off in two directions. Snowmobilers can travel the north coast through Postville, Makkovik, Hopedale and up to Nain, or south through coastal communities, ending in the community of L'Anse au Clair. There are also shorter branch trails throughout the system. The trail system includes signage and emergency shelters (Access North Labrador 2002).

Central Labrador residents and visitors take part in a wide range of outdoor recreational pursuits. There are several well-developed hiking routes in Central Labrador, including an extensive biking and walking trail within the Town of Happy Valley-Goose Bay, cross-country ski and hiking trails, as well as trailways in and around the communities of North West River and Sheshatshiu. Other outdoor tourism and recreational facilities in the region at present include a golf and sports club, a downhill ski facility, a marina, and a wilderness resort. Hiking, canoeing, kayaking, and snowmobile excursions are also available to tourists, as are boat tours and charters (DTCR 2002e; Town of Happy Valley-Goose Bay n.d.).

Other Regions

Pinware River Provincial Park, Labrador's only provincial park, is located in the Labrador Straits. The park was established in 1974, and typically operates from approximately mid-June to early September. It covers an area of 68 ha, and contains 15 campsites and 25 picnic sites, as well as a 1.2 km long hiking trail (Parks and Natural Areas Division no date). There are several other well developed hiking trails in the Labrador Straits area. A number of operators also offer whale, iceberg, and bird watching boat tours in the region (Labrador Straits Network no date; Labrador Straits Development Corporation no date; DTCR 2002e).

Western Labrador has a wide range of tourism and recreation facilities and services, including a golf course, hiking trails, ski trails, an alpine ski facility, and campgrounds. Snowmobiling, boating and outdoor sports are very popular activities in the region, and there are guided snowmobile and boating excursions available for tourists (Labrador West n.d.; DTCR 2002e).

6.14.3.3 Cultural Attractions and Events

Southern and Central Labrador

There are a number of existing and potential historic and heritage sites in Southern and Central Labrador, as well as various events which celebrate the culture and heritage of these regions.

The Battle Harbour National Historic District is the most developed and visited heritage site in Southern Labrador. Founded in the 1770s, Battle Harbour is one of the oldest European settlements on the Labrador coast and was a major centre for "floater fishermen" from Newfoundland who sailed to Labrador to take part in the summer cod fishery. It comprises the province's last intact traditional outport mercantile fish premises, with some buildings more than 200 years old. This restored fishing community is located on an island which is accessible by boat from Mary's Harbour, and operates from June to September (Battle Harbour Historic Trust no date; DTCR 2002e).

A number of other historic and heritage sites in Southern Labrador have been identified as having development potential. These include: Fort York, near Henley Harbour; the remains of whaling stations at Grady Harbour, Hawkes Harbour, Henley Island, and Antles Cove; ballast material on Castle Island and at

Table Head; churches at Dove Brook and Seal Islands; the site of George Cartwright's house; and the Loder Premises in St. Lewis (Southeastern Aurora Development Corporation 1997; JW 1998a). Again, the recently completed highway will likely result in the development of new tourist attractions in the region.

The Mary's Harbour Crab Festival occurs each year in July or August, and features a variety of crab dishes, traditional music and activities. Other events include an Easter festival held annually in Port Hope Simpson, an annual fun day at Battle Harbour, and sled dog racing events in several communities. There are also various other sporting events and tournaments and other celebrations which occur throughout the region at various times of the year (DTCR 2002d).

A number of coastal Labrador communities and areas are visited by cruise ships each year. In 2001, there were 18 port calls by cruise ships in Labrador, including visits to the communities of Cartwright and Battle Harbour in Southern Labrador (DTCR 2002d).

There are a range of historic and heritage attractions in Central Labrador, including the:

- Labrador Interpretation Centre (North West River);
- Labrador Heritage Museum (North West River);
- Labrador Institute of Northern Studies (Happy Valley-Goose Bay);
- Moravian Church (Happy Valley-Goose Bay);
- Labrador Military Museum (Happy Valley-Goose Bay); and the
- Northern Lights Military Museum (Happy Valley-Goose Bay) (Town of Happy Valley-Goose Bay no date; Town of North West River no date).

Festivals and events in the region include the annual North West River Beach Festival, which occurs in late July, the Labrador Canoe Regatta held on Gosling Lake in early August, and the Sheshatshiu summer festival, which is held in August and features traditional Innu food, crafts and music (Town of North West River n.d.). In recent years, cruise ships have also visited the towns of Happy Valley-Goose Bay and North West River (DTCR 2002d).

Other Regions

The Red Bay National Historic Site is located in the Labrador Straits. Historical and archaeological research at the site revealed its status as the world's largest 16th century whaling port, and resulted in it being designated a site of national historic importance. The Red Bay site typically operates from June to October, and had a total of 7,961 visitors in 2001 (DTCR 2002d; 2002e). Other heritage and historic sites in this region (Labrador Straits Network no date) include the:

- Maritime Archaic Funeral Monument National Historic Site (near L'Anse Amour);
- Labrador Straits Museum (located between Forteau and L'Anse au Loup);
- Point Amour Lighthouse Provincial Historic Site (near L'Anse Amour at Forteau Bay);
- the Gateway to the Straits Visitor Centre (L'Anse au Clair);
- L'Anse au Cotard Jersey Rooms (near L'Anse au Clair); and
- the Wreck of the H.M.S. Raleigh (near Point Amour).

The Labrador Straits Bakeapple Folk Festival is an annual event which takes place in Forteau in August, and features folk music, crafts and bakeapple dishes (DTCR 2002e). A considerable portion of the visitors to this region travel in groups on tour busses (VBNC 1997).

Cultural attractions and facilities in Western Labrador include a museum operated by the Labrador West Heritage Society, an Arts and Culture Centre, and an exhibit describing the history of the Royal Newfoundland Constabulary (Labrador West no date). Guided tours are also offered of the mines in Labrador City and Wabush and the Churchill Falls hydroelectric facility. There are also various winter sporting events and festivals which take place in the region (DTCR 2002e).

6.14.3.4 Tourism-Related Services

The events and attractions described above are complemented by transportation, accommodation, food and beverage, and other related goods and services.

Transportation

Ground Transportation

Until very recently, there was no road access to and within Southern Labrador. In 1999, construction began on the Trans Labrador Highway (Red Bay to Cartwright), a 325-km long, two-lane, all-season, gravel surface highway. Completed in late 2002, the highway provides a direct link to six communities (Red Bay, Lodge Bay, Mary's Harbour, Port Hope Simpson, Paradise River and Cartwright), with access roads connecting the communities of Charlottetown and St. Lewis to the main highway. This highway extends the highway network in coastal Labrador, linking these communities with those further south (the Labrador Straits) and along the Québec North Shore, as well as with the island of Newfoundland via the ferry link between Blanc Sablon, Québec and St. Barbe, Newfoundland.

Phase I of the Trans Labrador Highway (Route 500) provides year-round highway access between Central Labrador and Western Labrador. This high standard, all weather, gravel-surface highway extends from Happy Valley-Goose Bay to Churchill Falls (approximately 290 km), and from there to Wabush (approximately 240 km) and on to the North American highway network via Baie Comeau, Québec.

Within Central Labrador, the communities of Happy Valley-Goose Bay, North West River and Sheshatshiu are connected by a paved highway (Route 520). Mud Lake is accessed via a small gravel road that extends from Happy Valley-Goose Bay to the Churchill River, and from there by boat in the summer and fall and by snowmobile in the winter and spring.

Western Labrador is accessible year-round by road and by rail. An all-season 600-km highway to Baie Comeau, Québec connects Labrador City and Wabush with the national highway system. As described above, the Trans Labrador Highway connects Labrador City and Wabush to Happy Valley-Goose Bay via Churchill Falls. A spur line of the Québec North Shore and Labrador Railway connects Wabush and Labrador City to the port of Sept-Îles, Québec. This rail service is maintained by IOC, and is used primarily to transport iron ore concentrate. Regular passenger and freight services are also provided year-round.

Communities in the Labrador Straits are connected by an 80-km paved highway which extends between Red Bay, Labrador and Blanc Sablon, Québec, connecting with the Québec North Shore highway to Vieux-Forte, Québec.

Marine Transportation

A coastal boat service operated by WST is currently the primary means of delivering supplies and transporting passengers to the Labrador coast during the ice-free season (typically June to November). The *Sir Robert Bond* currently transports passengers, freight and automobiles between Lewisporte (Newfoundland), Cartwright and Happy Valley-Goose Bay. The *Northern Ranger* provides passenger and freight transportation services to numerous ports between St. Anthony, on the island of Newfoundland and Nain, on Labrador's North Coast.

As a result of the near completion of the Trans Labrador Highway (Red Bay to Cartwright), in March 2002, the Government of Newfoundland and Labrador announced a reconfiguration of the existing Labrador coastal marine service. The existing marine terminal at Lewisporte will close in 2003, with Cartwright becoming the southernmost marine terminal on the shipping route. Beginning in the 2003-2004 season, Labrador communities will be served by four vessels. One will carry passengers, cargo and vehicles between Cartwright, Rigolet, and Happy Valley-Goose Bay (approximately a two-day round trip). A second will carry passengers and freight between Cartwright, Rigolet, Happy Valley-Goose Bay, and all ports to Nain and return on a weekly basis. A third, smaller vessel will serve the communities south of Cartwright not connected by the highway. It will carry passengers and vehicles between Charlottetown, Williams Harbour, Pinsent's Arm, Norman Bay, Black Tickle and Cartwright.

A ferry service between Blanc Sablon, Québec and St. Barbe, Newfoundland links the Labrador Straits with the island of Newfoundland, and typically operates from May to late December. The crossing time is approximately 105 minutes, but varies depending on weather conditions.

Air Transportation

There are seven operational airstrips in Southern Labrador administered and maintained by WST, which provide year-round air access to the communities of Cartwright, Black Tickle, Charlottetown, Port Hope Simpson, St. Lewis, Williams Harbour and Mary's Harbour. An airstrip at Paradise River is no longer operational. The airstrip at each location consists of a gravel surface runway, and can accommodate small single and twin-engine aircraft. Scheduled air service is provided between Southern Labrador and Happy Valley-Goose Bay and St. Anthony, Newfoundland. Chartered air services are also available in the area. A number of these airstrips will likely close as a result of the completion of the Trans Labrador Highway (Red Bay to Cartwright), and there are plans to establish a regional airport at Port Hope Simpson.

The Happy Valley-Goose Bay airport, located at CFB Goose Bay, is used by both civilian and military aircraft. The airport typically handles approximately 85,000 passengers a year, and is served by commercial air carriers which provide scheduled and cargo flights (direct and indirect) to destinations throughout Labrador and Newfoundland, as well as Québec. The airport also serves as an operations base for a number of aircraft charter and helicopter companies. There is also a float plane base located at Otter Creek, approximately 7 km from the airport (GBAC no date).

In Western Labrador, Wabush Airport lies midway between Labrador City and Wabush. This modern airport complex has scheduled and charter air services which provide flights (direct and indirect) to destinations throughout Labrador, Newfoundland and Québec. A small airport at Churchill Falls is owned by the Government of Newfoundland and Labrador and operated by CF(L)Co. It can accommodate jet aircraft, and has scheduled air service several times per week.

Air access to and from the Labrador Straits is via Lourdes-de-Blanc Sablon Airport at Blanc Sablon, Québec, which accommodates scheduled daily flights from Québec, Labrador and Newfoundland. There is also a privately-owned airstrip at Red Bay.

Accommodations, Restaurants and Craft Shops

Tourist accommodations are available in several Southern Labrador communities, including hotels/motels at Mary's Harbour, Battle Harbour, Port Hope Simpson and Cartwright. Bed and breakfasts and cabins/efficiency units are available in these and other communities in the region. Many of these establishments operate on a year-round basis (DTCR 2002e). There are also one or more food establishments and service stations in each of the larger communities in the region (JW 1998a).

Happy Valley-Goose Bay offers a range of accommodations, including several hotels, bed and breakfasts, and cottages, as well as numerous restaurants. There is also a bed and breakfast in North West River (Central Labrador Economic Development Board no date).

The Labrador craft industry was valued at approximately $2.5 million in 1999 (AMEC 2000). There are craft shops throughout Southern Labrador, including one or more shops in William's Harbour, Mary's Harbour, Battle Harbour, Lodge Bay, St. Lewis, Port Hope Simpson, and Cartwright. These shops typically feature handicrafts and artwork created by local individuals and organizations. In Central Labrador, local arts and crafts are available in various shops and galleries in Happy Valley-Goose Bay, as well as from retail establishments or local artists in North West River and Sheshatshiu.

There are hotels, cabins, bed and breakfasts and restaurants throughout the Labrador Straits (Labrador Straits Development Corporation n.d.; Labrador Straits Network no date). In Western Labrador, there are accommodations and food establishments available in each community. There are also craft and gift shops in each of these regions.

6.14.4 Potential Interactions

Construction activity can have both direct and indirect effects on tourism and recreation. Access to some areas and attractions may be restricted during construction activities (e.g., for safety reasons). In addition, the noise, dust and human presence associated with construction activities may affect the aesthetic quality of an area (particularly those which were previously isolated and pristine) and, thus, its use for certain tourism and recreational activities. Construction activities may also affect fish and wildlife, which can indirectly affect the outfitters and other establishments which depend upon these resources. The use of existing services and infrastructure (e.g., transportation services, accommodations) by construction personnel could also affect their use by tourists, especially as construction seasons will coincide with peak tourism periods.

Once operational, highways increase the mobility of local residents, as well as increasing visitation by non-resident tourists. The highway will provide improved access to existing tourism services and facilities, and may increase the viability of developing additional attractions and facilities. Improved access may also have adverse effects on certain aspects of the tourism industry, particularly those which depend on the remoteness and pristine nature of the Labrador wilderness. Any effects to fish and wildlife as a direct result of the highway and/or due to increased hunting and fishing can also affect those tourism establishments which use these resources. Therefore, the effects of highway operation can vary considerably between different aspects of the tourism industry.

Tourism and recreation may also be affected in the case of an accidental event, such as a forest fire, or a fuel or chemical spill. Such an event could occur during project construction or operations, and may affect fish and wildlife populations, and thus, fishing and hunting activities. A forest fire could also destroy tourist attractions and recreational areas, and reduce the aesthetic appeal of the area for some types of activities. During operations, vehicle accidents or highway failure could also affect visitor travel by restricting movement to and within an area.

6.14.5 Issues and Concerns

Tourism and recreation is discussed as a separate VEC due to the issues and concerns raised by tourism operators, regulatory agencies and other issues scoping regarding the potential adverse effects of the project on the tourism industry, as well its potential contribution to further development of this sector once the highway is operational.

Specific issues related to tourism and recreation raised during the issues scoping exercise (Section 4.2) include:

- degradation of the pristine nature of the Labrador wilderness (real and perceived), which forms the basis for much of the tourism industry;
- improved access to fish, wildlife and forest resources as a result of the highway, which may result in their depletion;
- the close proximity of the highway to existing outfitting camps and to the Upper Eagle River Watershed;
- improved access to inland waterways through snowmobile and ATV use;
- the potential establishment of snowmobile and ATV trails extending from the highway;
- increased cabin development;
- influx of anglers from the island of Newfoundland and elsewhere once the highway is completed;

- the effectiveness of fishing and hunting regulations, and policies for increased protection of these resources;
- overcrowding and congestion in key recreational areas (e.g., prime fishing pools) due to improved access;
- increased vandalism of outfitting camps;
- increase in unlicenced outfitting and guiding operations;
- littering along the highway, and the difficulty of controlling it;
- potential opportunities for further development of the tourism industry once the highway is complete;
- the importance of adequate maintenance once the highway is operational;
- the identification and development of roadside pull-offs (for safety and scenic purposes);
- a current lack of readiness by communities to take advantage of the opportunities offered by the highway; and
- the potential for some communities to be by-passed completely once the highway is complete.

The public information sessions and interviews conducted as part of the environmental assessment revealed that many people recognize the positive effects which the highway may have on tourism. However, some tourism operators and local residents expressed concern that the proposed project would negatively affect some tourism operations, particularly the existing outfitting camps located in close proximity to the proposed highway route.

6.14.6 Existing Knowledge

Recreational fishing is currently an integral component of Labrador's tourism industry. Angling is undertaken by both local residents and tourists, with numerous commercial outfitting camps throughout Labrador. Improved access to a previously isolated area may result in the over-harvesting of resources, which may indirectly affect related tourism operations. The presence of a highway development itself and the associated increase in human activity may reduce the aesthetic appeal and wilderness image so important to anglers in Labrador. In a 1991 survey of Labrador anglers, 94.2 percent of respondents indicated that Labrador sports fishing is as good as or better than angling in other areas visited with regard to its *clean and unspoiled environment* (cited in LGL 1994). Another survey indicated that 64 percent of Labrador fishing outfitters felt that improved accessibility was an impediment to their business, while only 18 percent thought it enhanced it (Tucker 1995).

Past experience in the Labrador Straits illustrates the potential effects of highway access on recreational fisheries. This region saw an influx of anglers from the island of Newfoundland when Atlantic salmon quotas were changed to permit fishers in Labrador to retain one large salmon, resulting in overcrowding along the Pinware, Forteau and other rivers in the region. This eventually resulted in a requirement to implement similar fish quotas and retention regulations for both Newfoundland and the Labrador Straits (JW 1998a). In addition, a number of previously unscheduled rivers in Southern Labrador were scheduled and given Class III designations in 2001, in order to ensure the conservation of salmon stocks with the expected influx of anglers as a result of the TLH - Phase II (DFO 2002).

However, there are also cases which illustrate the potential positive effects of highway development on tourism. The Labrador Straits highway, for example, has also been a key factor in the development of that region’s very successful tourism industry. Year-round highway access has resulted in relatively high levels of visitation, with an estimated 8,000 to 10,000 tourists visiting the area each year (JW 1998a).

6.14.7 Mitigation

Measures designed to mitigate effects on fish and wildlife resources (Sections 6.1 to 6.6) will also help to reduce or eliminate indirect effects on the tourism operations which depend on these resources.

Specific mitigation measures related to tourism and recreation include:

- WST will consult regularly with tourism operators regarding project-related activities and scheduling;
- where possible, the transportation of personnel, equipment and materials will be scheduled to take place during non-peak periods;
- local administrators will be consulted regularly regarding transportation plans and requirements;
- project personnel will be prohibited from harassing or feeding wildlife;
- any hunting, trapping and fishing by project personnel will be carried out according to applicable legislation; and
- contingency plans and response measures will be in place for handling any spills of fuel or other hazardous materials.

As indicated above, many of the potential adverse effects of the project on tourism and recreation stem from the improved access provided by the highway, and the associated increase in human presence and activities in this previously remote area. Mitigating these potential effects is, for the most part, beyond the responsibility of WST. Managing these actions and their potential effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future activities are undertaken in a responsible and sustainable manner. In this regard, the purpose of the environmental assessment is to identify these potential issues well in advance of their occurrence, so that appropriate measures can be identified and implemented by the appropriate agencies in an effective and timely manner.

Recent changes to recreational fishing regulations in Southern Labrador by DFO to reduce the potential effects of increased angling in that region following completion of the TLH - Phase II are an example of such measures. During the course of this environmental assessment, a number of stakeholders commented on the importance of revising existing regulations and policies, and careful planning on the part of resource management agencies. These stakeholders also gave specific examples of potential measures, such as changes to fish retention limits, and designating certain lakes and streams as hook and release only.

Many also indicated that the establishment of the Akamiuapishku/Mealy Mountains National Park would be an important means of protecting and preserving the area’s natural environment, and its existing tourism industry. It was noted that development controls within the park, as well as restrictions regarding resource harvesting, ATV and snowmobile use would serve to alleviate many of these potential effects. Stakeholders also commented that it will be important that the Upper Eagle River be included within the park boundaries, and that the existing outfitters be “grand fathered” into final park planning and permitted to continue their operations. It was also noted that the designation of the Eagle River under the Canadian Heritage Rivers System would be a possible means of protecting the river.

In terms of the potential positive effects of the project on tourism, it is the responsibility of local individuals and businesses to identify and respond to the tourism opportunities generated by the project in an effective and timely manner. The ability of local business groups, development organizations and relevant government agencies to identify these opportunities, and to assist local individuals and firms in responding to them, will also affect the level of success achieved in this area.

6.14.8 Environmental Effects Assessment

6.14.8.1 Construction

The potential effects of project construction on tourism relate primarily to project-related disturbance associated with this phase of the project (e.g., noise and dust), as well as the use of existing services and infrastructure by construction personnel and contractors.

As noted previously, the pristine nature and remoteness of the Labrador wilderness forms the basis of much of the existing tourism and recreation industry in Southern and Central Labrador. Construction-related activities will result in disturbance, such as noise and dust, increased human presence and landscape changes, which will affect the aesthetic quality of the project area. For tourists visiting the area to experience the pristine nature of this environment (e.g., anglers and hikers), this will likely detract from the quality of their visit, causing some to avoid certain areas, or in some cases, choose not to visit or return to the area. In addition, public access to some sites may be restricted during construction activities for safety reasons. For example, the construction of watercourse crossings will limit access to some recreational fishing areas during this phase of the project.

Although there is potential for some minor interference with tourism and recreation activities during project construction, any such effects will likely be quite localized and of relatively short-term duration. Given the vastness of the region, and the relatively small area which will be under construction at any one time, no measurable decrease in these activities is anticipated. The potential effects to commercial outfitting operations are discussed in Section 6.12.8.1.

In terms of other types of tourism, there is a relatively limited amount of activity along the proposed highway route at present. Road construction will not likely interfere directly with other types of tourism and recreation activities in Central and Southern Labrador. The proposed highway does not intersect or pass in close proximity to the existing snowmobile trails.

During the construction phase, equipment and materials will be transported to Cartwright and Happy Valley-Goose Bay by boat or barge. Some supplies and equipment will also be brought to Happy Valley-Goose Bay from Western Labrador and beyond via the existing TLH - Phase I (Route 500), as well as to the eastern portion of the project area via the TLH - Phase II and Labrador Straits Highway (using the existing ferry service between Blanc Sablon, Québec and St. Barbe, Newfoundland). Non-resident construction personnel will also use scheduled air services.

The use of existing transportation services to move construction personnel, equipment and materials, could disrupt tourist travel to and within the area. The potential for such disruption is further increased because the construction seasons will coincide with the main tourism season (i.e., the summer months). However, overall, the use of existing ferry and air transportation services by construction contractors and personnel is expected to be low. Depending on the success of local firms in obtaining construction contracts (Section 6.15), it is anticipated that a considerable portion of the equipment and labour required for project construction will be available locally. This will reduce the need to use existing transportation services and infrastructure to move workers, equipment and supplies to the area. Scheduling the movement of equipment and materials to non-peak travel periods where possible will further minimize or eliminate any conflict with other users, including tourists.

In order to minimize costs and to optimize local benefits, it is expected that much of the construction labour force will be comprised of local residents. Non-resident construction personnel may be accommodated in the local communities when construction activity is being conducted near them, and will be housed in construction camps as highway construction progresses. This will minimize project-related demand for local accommodations and, thus, effects to the use of these accommodations by tourists. Therefore, any such demands will also occur primarily in the early stages of the construction period, and decrease as construction progresses. The use of local retail outlets and food establishments by construction workers which also benefit the area's economy (Section 6.15).

6.14.8.2 Operation

Recreational Fishing and Outfitters

Angling activity will likely increase considerably when the highway is operational, due to improved access to previously remote rivers and waterbodies (Section 6.12.7). This will be a positive effect for the recreational fishery in general, at least in the short-term, as it will provide better angling opportunities throughout the region. However, this could also adversely affect fisheries resources and the existing tourism industry.

The highway will result in an increase in human presence and resource exploitation throughout the area, including lakes and streams along and directly adjacent to the highway route, as well as those further inland through snowmobile and ATV use. The highway will reduce the perceived aesthetic quality of the area through the presence of the highway itself, as well as any noise, dust and litter associated with its use. Angler overcrowding along some high quality rivers and ponds may also result, although the size of the area and the number of fishing areas available will minimize the potential for such congestion. However, of primary concern, is that the improved access may lead to the depletion of fish stocks through overfishing (both legal and illegal) (Sections 6.5.7 and 6.12.7).

Any decrease in fish stocks and the overall quality of the angling experience will have a detrimental effect on the recreational fishery, including the high-value non-resident fishery upon which the existing commercial outfitters in the area depend. The highway will not come in direct contact with the existing commercial outfitters and their operations. The proposed route is approximately 8 km from the closest outfitting camp, and comes within approximately 10 to 15 km of three others (Table 6.59 and Figure 6.37). However, the potential effects of the proposed highway on outfitting operations relate primarily to the access provided by the highway, and the associated increase in human presence and angling activity in this previously remote area.

The likely increase in fishing effort will necessitate increased enforcement and management to address potential effects in fish resources and the resulting effect on the tourism industry. This may include changes to existing regulations and policies (e.g., changes to bag limits and retention levels and having some lakes and steams designated as hook and release only). There will also be a need for more fisheries officers to patrol the area and enforce these regulations (Section 6.12). Outfitters have also noted the importance of ensuring that policies and regulations related to outfitting operations in Labrador (e.g., buffer areas between camps; outfitter licencing and regulation) are strictly enforced.

The proposed Akamiuapishku/Mealy Mountains National Park would also help to protect and preserve the area's natural environment and resources, and its existing tourism industry. Restrictions on snowmobile and ATV use within national parks, the need for special fishing licences and enforcement by Parks Canada personnel, would help to alleviate many of these potential issues. Other potential measures suggested by stakeholders include the possibility of including the Upper Eagle River within the park boundaries, having existing outfitters be "grand fathered" into final park planning and permitted to continue their operations, and the possible designation of the Eagle River as a Canadian Heritage River.

Other Tourism Attractions and Services

Once operational, the highway will alter the spatial and temporal patterns of transportation in Labrador, with implications for the tourism industry.

Although there are no communities located along the highway route itself, it will provide year-round road access between Southern and Central Labrador, thereby connecting the two existing sections of the TLH. The highway will provide Southern Labrador and Labrador Straits residents and visitors with direct road access to Central Labrador, as well as Western Labrador, Québec and beyond. Similarly, residents of and visitors to Central Labrador and Western Labrador will now be able to drive to Southern Labrador and the Labrador Straits, and on to the island of Newfoundland via the existing ferry service. The completion of the TLH - Phase III will likely bring about an overall increase in visitation to Labrador. Visitors will be able to take a circular route from the island of Newfoundland, through the Labrador Straits, Southern Labrador, Central Labrador, Western Labrador, and onto Québec and back to island of Newfoundland or elsewhere (or vice versa), without having to "retrace their steps".

An increase in resident and non-resident tourist travel throughout these regions of Labrador will increase the use of tourist attractions and related services (such as accommodations, restaurants and craft shops). The opportunity to travel the highway will in itself likely attract tourists, and the highway has been designed to include various roadside "pull-offs" at scenic areas. The feasibility of developing new tourism sites and activities (e.g., the establishment of new parks and adventure tourism activities such as hiking and boating) will increase due to increased visitation. As indicated previously, a number of potential natural and heritage tourism attractions and activities have been identified in the area (particularly in Southern Labrador). In addition, development opportunities will occur in the services sector (e.g., service stations, restaurants).

These positive effects will occur primarily in Southern and Central Labrador, but the tourism industries of the Labrador Straits and Western Labrador will also benefit from tourists "passing through" these regions.

Notwithstanding these positive effects, concern has also been raised that visitation to some communities may decrease once the highway is complete, as visitors will be able to travel directly to larger communities (such as Happy Valley-Goose Bay) or certain areas, thereby bypassing some completely. However, this is not likely to be an issue given the distances and routes involved. Most, if not all, tourists who drive the approximately 400 km though the Labrador Straits and Southern Labrador will do so because of their desire to visit these regions. It is unlikely that tourists will do so just to travel on to Happy Valley-Goose Bay (an additional 250 km) and beyond, without visiting the tourist activities and facilities in these regions. Again, the ability to travel through the Labrador Straits, Southern Labrador and on the Central Labrador and beyond will likely serve as an incentive for tourists to visit these regions, rather that resulting in a decrease in visitation to any one area.

The proposed location of Cartwright Junction is approximately 90 km south of the Town of Cartwright (Figure 2.2). Therefore, concern has been raised by residents and business owners that travellers may bypass this community altogether. However, this is not likely to be the case as Cartwright is the largest community in Southern Labrador, and offers accommodations, restaurants, and other tourist attractions and services. The communities of Charlottetown and Port Hope Simpson are nearly 150 km south of the junction, and travellers who wish to drive on to Central Labrador will have an additional 250 km before reaching Happy Valley-Goose Bay, with no communities in between. Therefore, Cartwright and Paradise River will likely be seen as rest-stops, providing accommodations, food and other services to highway travellers. In addition, as much of the existing highway south of Cartwright and all of the proposed highway pass through from the interior, tourists will likely welcome an excursion to the coast at Cartwright. Visitation to this community will also likely increase when it becomes the southernmost marine terminal on the Labrador coastal shipping route in 2003, as well as the access point for the ferry service carrying passengers and vehicles to those Southern Labrador communities not connected by the TLH - Phase II.

6.14.8.3 Accidental and/or Unplanned Events

An accidental event could also affect tourism and recreation. A forest fire may destroy wildlife resources and habitat, natural areas, heritage or historic sites, outfitting camps, or other tourism facilities and recreational areas, and could disrupt tourist travel. In addition, a forest fire would have a negative effect on the aesthetic quality of the affected area, reducing its appeal for various types of tourism activities. A fuel or chemical spill could contaminate water, fish and wildlife. Tourism and recreation may be affected by any real or perceived decrease in the availability or quality of these resources. Vehicle accidents or highway failure could also restrict or delay tourist travel.

With the implementation of EPPs and associated plans, the potential for such an accidental event occurring is extremely low. If such an accident were to occur, the significance of its potential effects is obviously dependent upon the nature, magnitude, location and timing of the event. However, the proponent's emergency response and contingency plans will ensure that any such effects are minimized.

6.14.9 Environmental Effects Evaluation

The following definitions are used to rate the significance of the predicted adverse residual environmental effects of the project on tourism and recreation:

A **major (significant) effect** is one which affects established tourism and recreation activity in multiple industry sectors, such that there is a detectable and sustained adverse effect on the industry in Southern Labrador and/or Central Labrador, and to the economy of the affected area(s) as a whole, that would not return to pre-project conditions within several generations. The overall integrity of the industry is compromised.

A **moderate (significant) effect** is one which affects established tourism and recreation activity in multiple industry sectors such that there is a detectable adverse effect on the overall industry in Southern Labrador and/or Central Labrador for several generations. The overall integrity of the industry may be compromised.

A **minor (not significant) effect** is one which affects established tourism and recreation activity in one or more industry sectors, but which does not have a detectable and sustained adverse effect on the overall industry in Southern Labrador and/or Central Labrador. The overall integrity of the industry is not compromised.

A **negligible (not significant) effect** is a localized change in established tourism and recreation activity in a one or more industry sectors, similar to small random changes due to natural variability, but not having a detectable and sustained effect on the overall industry in Southern Labrador and/or Central Labrador. The overall integrity of the industry is not compromised.

The environmental effects evaluation focusses on any potential adverse effects which may be associated with the proposed project. Residual environmental effects on tourism associated with construction, operation and accidental events are outlined in Table 6.62, along with the ratings for the established environmental effects significance criteria.

Table 6.62 Environmental Effects Summary - Tourism and Recreation

	Construction	Operation	Accidental/Unplanned Events

Mitigation:

- WST will consult regularly with tourism operators regarding project-related activities and scheduling;
- where possible, the transportation of personnel, equipment and materials will be scheduled to take place during non-peak periods;
- local administrators will be consulted regularly regarding transportation plans and requirements;
- project personnel will be prohibited from harassing or feeding wildlife;
- any hunting, trapping and fishing by project personnel will be carried out according to applicable legislation; and
- contingency plans and response measures will be in place for handling any spills of fuel or other hazardous materials.

Environmental Effects Criteria Ratings	Construction	Operation	Accidental/Unplanned Events
Magnitude	Low	Medium	Unknown
Geographic Extent	11-100 km^2	1,001-10,000 km^2	Unknown
Frequency	11-50	Continuous	<10
Duration	37-72	>72	>72
Reversibility	Reversible	Reversible	Unknown
Ecological/Socio-economic Context	Low	Low	Low
Environmental Effects Evaluation			
Significance	Not Significant (Negligible)	Not Significant (Minor)*	Not Significant to Significant (Negligible to Major)
Level of Confidence	High	Medium	Medium
Likelihood[1]	n/a	n/a	Low
Sustainable Use of Resources[1]	n/a	n/a	n/a

[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).

* With appropriate enforcement and planning by relevant agencies, effects will not be significant.

Environmental Monitoring and Follow-up:

- No specific monitoring program is required for Tourism and Recreation.

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
Level of Confidence:	High, Medium, Low
Likelihood:	High, Medium, Low or Unknown
Sustainable Use of Resources:	High, Medium, Low or Unknown

During construction, the residual environmental effects on tourism are recreation will be negligible (not significant). Effects will be limited to the construction season, and will occur primarily in the immediate vicinity of the area under construction at any given time.

TLH - Phase III operation will have both positive and negatives effects on tourism and recreation. An increase in resident and non-resident tourist travel will increase demand for some existing tourist attractions and related services, as well as increasing the feasibility of developing new facilities. However, improved access will also negatively affect some aspects of the tourism industry, particularly the existing commercial outfitters in the area. Mitigating these effects will depend on increased enforcement and management by appropriate government agencies to address potential effects on fish resources and the resulting effect on the tourism industry. Other potential measures, such as the establishment of the proposed Akamiuapishku/Mealy Mountains National Park, the potential designation of the Eagle River under the Canadian Heritage Rivers System, and increased enforcement of policies and regulations related to outfitting operations in Labrador, would also help to reduce any such effects. With appropriate enforcement and planning, significant effects will not likely occur.

If an accident should occur, the significance of its potential effects is obviously dependent upon the nature, magnitude, location and timing of the event. Due to the potentially devastating effect of a forest fire, the environmental effects of an accidental event on tourism could be significant. A forest fire has the potential to disrupt tourism activity for several seasons, and could potentially affect the integrity of the entire industry in Southern and Central Labrador. These effects would be felt over the long-term and experienced year-round.

6.14.10 Cumulative Environmental Effects

The effects of several ongoing and potential projects and activities may accumulate and/or interact with those of the TLH - Phase III to result in cumulative environmental effects on tourism and recreation.

The existing sections of the TLH (Phases I and II) will influence the nature of the effects of the proposed project on tourism and recreation. As described above, the proposed highway will provide year-round road access between Southern and Central Labrador, thereby connecting these two existing sections of the TLH. The highway will provide Southern Labrador and Labrador Straits residents and visitors with direct road access to Central Labrador, as well as Western Labrador, Québec and beyond. Similarly, residents of and visitors to Central Labrador and Western Labrador will now be able to drive to Southern Labrador and the Labrador Straits, and on to the island of Newfoundland via the existing ferry service. Therefore, the completion of TLH - Phase III will likely bring about an overall increase in visitation to the area, as well as Labrador in general. Phases I and II of the TLH have been considered in the environmental effects analysis described above.

It is unlikely that the Voisey's Bay Mine/Mill development and on-going low-level military flight training have had or will have an effect on tourism and recreation in the assessment area. Similarly, the proposed Gull Island hydroelectric facility and associated transmission infrastructure in Labrador will not likely affect tourism and recreation in the area.

Land and resource use activities in the area have traditionally been limited as a result of its isolation. Improved access to, from and within the region as a result of the TLH - Phase III will likely provide new opportunities for development activities such as forestry, mineral exploration and possibly mining, as well as increased recreational resource harvesting, cabin development, and other land and resource use activities. Each of these could, to varying degrees, affect tourism and recreation in the area, and thus result in cumulative environmental effects in combination with the TLH - Phase III and each other.

Details such as the likelihood, nature, location and timing of these potential induced actions are not known and the control of most of these potential induced actions and their effects is beyond the ability and responsibility of WST. Managing these actions and their effects will require the efforts of regulatory and resource management agencies, in order to ensure that applicable legislation and regulations are adequately enforced, and that future projects and activities are undertaken in a responsible and sustainable manner. With appropriate enforcement and planning, the cumulative effects of these projects and activities on tourism and recreation will not be significant.

6.14.11 Environmental Monitoring and Follow-Up

Measures designed to monitor project effects on fish and wildlife also apply indirectly to tourism and recreation. No specific monitoring programs are required for this VEC. Monitoring and addressing any changes in the distribution and intensity of resource use activities is the responsibility of the provincial and federal government departments and agencies that administer and manage these activities. WST will cooperate with such organizations by providing project-related information as required. Monitoring and careful planning on the part of these departments and agencies will ensure that issues can be identified and addressed in an effective and timely manner. Local development organizations, relevant government departments and local individuals and businesses should work to monitor potential tourism opportunities which may arise as a result of the highway.

6.15 Employment and Business

The following sections provide an overview of existing and potential employment and business activity, as well as the potential economic benefits and effects which may be associated with the proposed highway.

6.15.1 Boundaries

Project boundaries for employment and business, as defined by the spatial and temporal extent of project activities and zones of influence, extend beyond the highway right-of-way to include areas of existing and potential employment and business activity. Temporal project boundaries encompass the project's construction and operations phases. An accidental effect could potentially occur during either of these phases, and may also have an effect on employment and business.

In terms of socioeconomic boundaries, the proposed highway will pass directly through parts of Southern and Central Labrador (Economic Zones 3 and 4), as well as indirectly providing improved access to Western Labrador, the Labrador Straits and beyond.

Employment and business activity is within the jurisdiction of several government departments, including the provincial Departments of Human Resources and Employment and Industry, Trade and Rural Development. Relevant federal government departments include Human Resources and Development Canada, Industry Canada and the Atlantic Canada Opportunities Agency. Economic development in the province is also the responsibility of regional economic development boards established under the province's economic zone system. Southern Labrador corresponds with Zone 4 of the system and is administered by the Southeastern Aurora Development Corporation, while Central Labrador (Zone 3) is administered by the Central Labrador Economic Development Board. There are also a number of regional development associations which serve these regions.

The environmental effects analysis for employment and business focusses primarily upon Central and Southern Labrador (Figure 3.16), as the proposed highway will pass directly through these regions. It also includes consideration of the other regions of Labrador, Labrador as a whole, the island of Newfoundland and other areas, as applicable.

6.15.2 Methods

Much of the information used to describe the existing environment is derived from the 1996 Census of Canada, which provides socioeconomic information by province, census division, and community (employment and income data from the 2001 Census have not yet been released). Other information sources, such as the published literature and unpublished data from public and private-sector sources, was also used to develop the baseline description of employment and business. The environmental effects analysis for employment and business considered each project phase and activity in relation to the baseline, including potential direct, indirect and induced changes which may result from the project.

6.15.3 Existing Environment

6.15.3.1 Employment

Labour Force

In 1996, Southern Labrador had a total labour force of 1,040 persons (Table 6.63). The labour force participation rate in the region during that year was 48.3 percent, which was considerably lower than that for Labrador as a whole (65.5 percent) and Newfoundland and Labrador (56.3 percent). Participation rates in 1996 varied between individual communities, ranging from 35.4 percent (Charlottetown) to 63.0 percent (St. Lewis). The unemployment rate in Southern Labrador in 1996 was 52.4 percent, which was considerably higher than that for Labrador as a whole (23.5 percent) and the province (25.1 percent) (Table 6.63). Unemployment rates in the region ranged from 35.3 percent in Charlottetown to 65.5 percent in St. Lewis.

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 and/or on a part-time basis. This reflects the predominantly seasonal nature of employment in the region, especially when compared to Labrador and the province, where proportions of the employed labour force who were employed full-time, year-round were 45 percent and 41 percent, respectively (Statistics Canada 1998).

Central Labrador had a total labour force of 5,320 persons in 1996, of which 90.5 percent resided in Happy Valley-Goose Bay, 5.0 percent in North West River and 4.5 percent in Sheshatshiu/Mud Lake (Table 6.63). Overall, the region had a participation rate of 72.4 percent, ranging from 43.2 percent in Sheshatshiu/Mud Lake to 75.8 percent in Happy Valley-Goose Bay. The overall unemployment rate for the Central Labrador region in 1996 was 18.0 percent, which ranged from 15.9 percent in Happy Valley-Goose Bay to 43.8 percent in Sheshatshiu/Mud Lake. The region's participation rate in that year was higher than that for Labrador as a whole, and its unemployment rate was lower. Of those persons in the region who received employment income in Central Labrador in 1995, 50.3 percent worked full-time for the entire year (Statistics Canada 1998).

Education and Qualifications

There were 2,165 persons aged 15 years and over in Southern Labrador in 1996. Of these, nearly half (46.0 percent) had not completed high school, 9.7 percent had attained a high school diploma, 12.2 percent possessed a trades certificate or diploma, 18.5 percent held some other non-university certificate and 3.7 percent had a university degree. Another 9.2 percent had begun a university or other training program, but had not completed the degree or certificate. Formal education levels in this region are relatively low compared to Labrador and the province. However, the proportion of the area's population with a trades certificate or diploma is over twice that for Labrador (5.2 percent) and much higher than that for the province (2.9 percent) (Table 6.64).

Of the total of 7,350 persons aged 15 years and over in Central Labrador in 1996, 39.5 percent had attained less than a high school education, 9.2 percent had graduated from high school, 5.0 percent had a trades certificate or diploma, 23.5 percent had completed some other sort of other non-university certificate, and 8.1 percent had a university degree (Table 6.64).

Table 6.63 Labour Force Characteristics, 1996

	Subd. B, SUN*	Port Hope Simpson	St. Lewis	Mary's Harbour	Cartwright	Charlottetown	Southern Labrador
Population ≥ 15 Years	420	425	230	350	490	240	2,155
In Labour Force	165	190	145	215	240	85	1,040
Employed	75	110	45	80	115	55	480
Unemployed	90	75	95	135	120	30	545
Not in Labour Force	255	235	85	135	250	155	1,115
Participation Rate (%)	39.3	44.7	63.0	61.4	49.0	35.4	48.3
Unemployment Rate (%)	54.5	39.5	65.5	62.8	50.0	35.3	52.4

	Happy Valley - Goose Bay	NW River	Sheshatshiu / Mud Lake**	Central Labrador	Labrador	Newfoundland & Labrador
Population ≥ 15 Years	6,350	445	555	7,350	21,950	437,340
In Labour Force	4.815	265	240	5,320	14,385	246,065
Employed	4,045	170	135	4,350	11,005	184,330
Unemployed	765	90	105	960	3,385	61,735
Not in Labour Force	1,540	185	315	2,040	7,565	191,285
Participation Rate (%)	75.8	59.6	43.2	72.4	65.5	56.3
Unemployment Rate (%)	15.9	34.0	43.8	18.0	23.5	25.1

*The unincorporated communities of Southern Labrador.
** The communities of Sheshatshiu and Mud Lake are reported together in the census information (as Census Division 10, Subdivision C, SUN.)
All data from the Census of Canada are randomly rounded to the nearest 0 and 5.
Source: Statistics Canada 1998.

Table 6.64 Population ≥ 15 Years of Age by Highest Level of Schooling, 1996

	Total Population ≥ 15 Years	Less than Grade 9	Grade 9-13, Without certificate	Grade 9-13, With certificate	Trades Certificate or Diploma	Other Non-University, Without Certificate	Other Non-University, With Certificate	University, Without Degree	University, With Degree
Southern Labrador									
Subd. B, SUN*	420	110	70	25	75	40	75	10	15
Port Hope Simpson	430	155	100	35	35	15	55	15	20
St. Lewis	230	70	35	20	10	20	50	20	10
Mary's Harbour	350	80	70	25	20	15	100	15	20
Cartwright	490	145	110	85	35	25	65	0	15
Charlottetown	245	35	15	20	90	10	55	15	0
Southern Labrador	2,165	595	400	210	265	125	400	75	80
Central Labrador									
Happy Valley - Goose Bay	6,350	640	1,690	625	340	320	1,595	605	540
NW River	445	75	75	35	10	30	100	60	55
Sheshatshiu / Mud Lake	555	265	160	15	15	30	35	20	0
Central Labrador	7,350	980	1,925	675	365	380	1,730	685	595
Labrador	21,950	3,060	5,495	2,395	1,150	1,025	5,020	2,335	1,465
Newfoundland & Labrador	437,345	76,465	122,065	43,040	12,810	17,360	83,440	46,645	35,520

*The unincorporated communities of Southern Labrador.
Source: Statistics Canada 1998.

Employment Type

There were 270 Southern Labrador residents (or 26 percent of the labour force) employed in the manufacturing sector in 1996 (Table 6.65). This category employed more persons than any other during that year. Apart from handicraft production, it is assumed that most of these workers were involved in processing fish. "Retail Trade" employed 10.6 percent, and "Educational Services" and "Other Service Industries" employed 10.1 percent and 9.6 percent of the region's labour force, respectively (Table 6.65). Primary sector activities accounted for only a relatively small portion of Southern Labrador's labour force activity in 1996 (Table 6.65). There were no individuals involved in commercial agricultural operations, only 10 persons employed in mining and quarrying activities, and 30 employed in forestry operations. Forestry operations were concentrated around Port Hope Simpson and Cartwright, with 20 and 10 persons employed in each community, respectively. Of the primary sector activities, fishing and trapping had the highest employment (65 persons, or 6.3 percent of the labour force). As the fur industry has been a negligible part of the area's economy in recent years (Section 6.12.3.5), it is assumed that most of these individuals were fishers. Between 1991 and 1996, there was a substantial decline in the proportion of the region's labour force involved in fishing and trapping. In 1991, there were 485 persons, or 37.7 percent of the area's labour force, involved in these activities (Statistics Canada 1994).

In Central Labrador in 1996, the Government, Educational and Health and Social Service sectors employed by far the largest portion of the labour force, collectively employing a total of 2,505 persons (or 47.1 percent). Other important industry divisions in the region in 1996 included Retail Trade (13.0 percent), Transportation and Storage (8.1 percent), Accommodation, Food and Beverage Services (4.3 percent), Construction (3.9 percent) and the Other Service Industries (5.7 percent). These percentages primarily reflect the nature of employment activity in Happy Valley-Goose Bay, which has a relatively well-developed and diversified economy. Employment activity in North West River, Sheshatshiu and Mud Lake is primarily related to the provision of Government, Educational and Health and Social Services, although there is some employment related to such industries as Transportation and Storage, Communication and Other Utilities, Retail Trade, and Other Service Industries (Table 6.66).

Table 6.65 Labour Force by Industry Division - Southern Labrador, 1996

	Subd. B, SUN*	Port Hope Simpson	St. Lewis	Mary's Harbour	Cartwright	Charlottetown	Southern Labrador	Labrador	Newfoundland & Labrador
Total Labour Force	165	190	145	215	240	85	1,040	14,385	246,060
Not Applicable	25	20	0	0	10	10	65	730	16,815
All Industries	140	170	135	215	230	80	970	13,660	229,245
Agriculture & Related Services	0	0	0	0	0	0	0	10	2,130
Fishing & Trapping	15	15	10	15	10	0	65	300	9,375
Logging & Forestry	0	20	0	0	10	0	30	100	3,300
Mining, Quarrying & Oil	0	10	0	0	0	0	10	2,225	4,640
Manufacturing	30	0	70	100	70	0	270	565	22,090
Construction	10	10	0	10	0	10	40	545	17,215
Transportation & Storage	10	0	0	10	0	0	20	690	10,215
Communication & Other Utilities	10	0	10	10	15	10	55	570	7,300
Wholesale Trade	0	10	0	0	0	0	10	300	8,110
Retail Trade	10	20	10	20	35	15	110	1,750	31,765
Finance & Insurance	0	0	0	0	0	0	0	130	4,250
Real Estate Operator & Insurance Agent	0	0	0	0	0	0	0	80	2,715
Business Services	0	0	0	0	10	0	10	185	7,320
Government Services	0	0	15	15	20	0	50	2,200	21,485
Educational Services	25	25	10	15	20	10	105	1,210	20,715
Health & Social Services	10	15	10	10	10	0	55	1,000	26,465
Accommodation, Food & Beverage Services	10	15	0	10	15	0	50	810	14,045
Other Services Industries	20	25	10	15	20	10	100	985	16,110

*The unincorporated communities of Southern Labrador.
Source: Statistics Canada 1998.

Table 6.66 Labour Force by Industry Division - Central Labrador, 1996

	Happy Valley - Goose Bay	NW River	Sheshatshiu / Mud Lake	Central Labrador	Labrador	Newfoundland & Labrador
Total Labour Force	4,815	265	240	5,320	14,385	246,060
Not Applicable	140	45	65	250	730	16,815
All Industries	4,675	220	170	5,065	13,660	229,245
Agriculture & Related Services	0	0	0	0	10	2,130
Fishing & Trapping	35	0	0	35	300	9,375
Logging & Forestry	65	0	10	75	100	3,300
Mining, Quarrying & Oil	25	15	0	40	2,225	4,640
Manufacturing	100	0	0	100	565	22,090
Construction	200	10	0	210	545	17,215
Transportation & Storage	400	20	10	430	690	10,215
Communication & Other Utilities	115	15	10	140	570	7,300
Wholesale Trade	135	0	0	135	300	8,110
Retail Trade	655	35	0	690	1,750	31,765
Finance & Insurance	50	0	0	50	130	4,250
Real Estate Operator & Insurance Agent	15	0	0	15	80	2,715
Business Services	75	10	0	85	185	7,320
Government Services	1,525	30	60	1,615	2,200	21,485
Educational Services	350	15	30	395	1,210	20,715
Health & Social Services	425	40	30	495	1,000	26,465
Accommodation, Food & Beverage Services	230	0	0	230	810	14,045
Other Services Industries	275	15	15	305	985	16,110
Source: Statistics Canada 1998.						

Income

In 1995, average individual incomes in Southern Labrador ranged from $16,565 in Port Hope Simpson to $18,630 in Charlottetown. Average individual incomes in Southern Labrador during that year were, in all cases, lower than those for Labrador ($24,325) and the province ($19,710). Approximately 36.8 percent of Southern Labrador residents aged 15 years and over with income in 1995 had annual incomes of less than $10,000, while less than 17 percent had incomes of $30,000 or over. The majority (54.9 percent) had annual incomes in the range of $7,000 to $19,999 in 1995 (Table 6.67).

Average household incomes in Southern Labrador in 1995 ranged from a low of $36,970 in Cartwright to a high of $49,992 in St. Lewis. Average household incomes in all communities were less that those for Labrador ($52,004), but in almost all cases were greater than that for the province ($41,064). Approximately 45 percent of Southern Labrador households had incomes of less than $30,000 in 1995, while 32.3 percent had incomes of $50,000 and over. The majority of households in the region (54.9 percent) had incomes in the range of $10,000 to $39,999 (Table 6.67).

In 1995, the proportion of total income that came from employment in Southern Labrador ranged from 49.4 percent in Port Hope Simpson to 68.6 percent in St. Lewis, compared with rates of 83.3 percent and 68.1 percent for Labrador and the province, respectively (Table 6.68). Government transfer payments accounted for a relatively large portion of the total income, ranging from 30.7 percent in St. Lewis to 48.1 percent in Port Hope Simpson. The proportion of total income derived from such transfer payments was higher in all of these Southern Labrador communities in 1995 than in Labrador and the province as a whole.

Average individual incomes in Central Labrador in 1995 ranged from $11,452 in Sheshatshiu/Mud Lake to $24,436 in Happy Valley-Goose Bay. Approximately 28.6 percent of Central Labrador residents had an annual income of less than $10,000 in 1995, while 34.8 percent had incomes of $30,000 and over. Average household incomes in 1995 ranged from $29,687 (Sheshatshiu/Mud Lake) to $51,160 (Happy Valley-Goose Bay). Individual and household incomes in Happy Valley- Goose Bay were similar to those for Labrador as a whole in 1995, and higher than those for the province. Mean incomes in North West River were comparable to those in Newfoundland and Labrador as whole, while average individual and household incomes in Sheshatshiu and Mud Lake were considerably lower (Table 6.69)

The proportion of total income which came from employment in Central Labrador communities in 1995 ranged from 57.8 percent in Sheshatshiu/Mud Lake to 84.2 percent in Happy Valley-Goose Bay, compared to values of 83.3 percent and 68.1 percent for Labrador and the province as a whole, respectively (Table 6.68).

The preceding discussion of income excludes the portion of their livelihood that residents obtain through subsistence activities. It must be noted that many of the residents of these regions, particularly in the smaller communities, derive a considerable portion of their livelihood in this manner. A variety of game, fish, and berries, as well as firewood, are harvested at various times of the year (Section 6.12.3). These activities are an integral part of residents' lifestyle and, while they do not enter into any official calculation of individual and household incomes, it is likely that they make an important contribution to annual income.

Table 6.67 Individual and Household Income - Southern Labrador, 1995

	Subd. B, SUN*	Port Hope Simpson	St. Lewis	Mary's Harbour	Cartwright	Charlottetown	Southern Labrador	Labrador	Newfoundland & Labrador
Individual Income									
Persons ≥15 Years With Income	395	400	220	340	460	235	2,050	19,140	387,825
< $1,000	20	20	10	0	10	10	70	1,210	27,145
$1,000 - $2,999	35	25	25	25	35	15	160	1,575	27,605
$3,000 - $4,999	20	15	20	15	25	10	105	1,005	20,640
$5,000 - $6,999	15	20	25	15	30	15	120	960	21,725
$7,000 - $9,999	80	45	25	45	70	35	300	1,675	38,685
$10,000 - $14,999	115	120	50	100	130	65	580	2,745	69,320
$15,000 - $19,999	45	65	20	40	50	25	245	1,595	40,075
$20,000 - $24,999	20	25	10	30	35	20	140	1,185	33,080
$25,000 - $29,999	10	15	10	15	20	10	80	830	25,140
$30,000 - $39,999	20	15	20	20	25	30	130	1,725	35,615
$40,000 - $49,999	10	20	10	20	20	10	90	1,505	22,525
≥ $50,000	25	25	20	10	30	10	120	3,110	26,270
Average Income ($)	16,723	16,565	18,015	18,315	17,682	18,630	n/a	24,325	19,710
Median Income ($)	10,960	12,192	10,432	12,288	11,819	12,800	n/a	16,008	13,972
Household Income									
Number of Private Households	145	150	80	135	220	90	820	8,920	185,500
< $10,000	15	0	0	10	25	0	50	555	16,420
$10,000 - $19,999	30	25	15	20	55	15	160	1,020	36,220
$20,000 - $29,999	30	30	10	25	45	20	160	1,000	29,455
$30,000 - $39,999	20	25	20	25	30	10	130	975	25,475
$40,000 - $49,999	15	10	15	20	15	10	85	940	21,165
$50,000 - $59,999	15	10	10	15	10	10	70	975	16,640
$60,000 - $69,999	10	15	0	0	15	10	50	1,095	12,835
≥ $70,000	10	30	20	20	45	20	145	2,360	27,290
Average Income ($)	44,424	43,772	49,992	46,821	36,970	48,853	n/a	52,004	41,064
Median Income ($)	31,296	33,472	39,680	39,360	27,520	40,576	n/a	49,587	34,036

*The unincorporated communities of Southern Labrador.
n/a Data Not Available
Source: Statistics Canada 1998.

Table 6.68 Composition of Total Income, 1995

	Employment Income (%)	**Government Transfer Payments (%)**	**Other Income (%)**
Southern Labrador			
Subd. B, SUN*	55	43.5	1.5
Port Hope Simpson	49.4	48.1	2.5
St. Lewis	68.6	30.7	0.7
Mary's Harbour	62	36.1	1.9
Cartwright	67.3	31.7	1
Charlottetown	55.3	41.7	3.1
Central Labrador			
Happy Valley-Goose Bay	84.2	11.8	4.0
NW River	74.6	19.7	5.6
Sheshatshiu / Mud Lake	57.8	39.9	2.3
Labrador	83.3	13.3	3.3
Newfoundland & Labrador	68.1	24.6	7.3

*The unincorporated communities of Southern Labrador.
Source: Statistics Canada 1998.

Table 6.69 Individual and Household Income - Central Labrador, 1995

	Happy Valley - Goose Bay	NW River	Sheshatshiu / Mud Lake	Central Labrador	Labrador	Newfoundland & Labrador
Individual Income						
Persons ≥15 Years With Income	5,820	395	465	6,680	19,140	387,825
< $1,000	235	45	60	340	1,210	27,145
$1,000 - $2,999	375	45	65	485	1,575	27,605
$3,000 - $4,999	205	35	40	280	1,005	20,640
$5,000 - $6,999	205	25	35	265	960	21,725
$7,000 - $9,999	455	25	60	540	1,675	38,685
$10,000 - $14,999	820	40	75	935	2,745	69,320
$15,000 - $19,999	490	20	30	540	1,595	40,075
$20,000 - $24,999	485	25	35	545	1,185	33,080
$25,000 - $29,999	370	15	15	400	830	25,140
$30,000 - $39,999	845	65	30	940	1,725	35,615
$40,000 - $49,999	810	25	10	845	1,505	22,525
≥ $50,000	520	20	0	540	3,110	26,270
Average Income ($)	24,436	19,801	11,452	n/a	24,325	19,710
Median Income ($)	20,818	11,380	7,920	n/a	16,008	13,972
Household Income						
Number of Private Households	2,750	200	175	3,125	8,920	185,500
< $10,000	125	30	15	170	555	16,420
$10,000 - $19,999	285	30	45	360	1,020	36,220
$20,000 - $29,999	300	15	40	355	1,000	29,455
$30,000 - $39,999	285	65	35	385	975	25,475
$40,000 - $49,999	445	10	15	470	940	21,165
$50,000 - $59,999	375	0	10	385	975	16,640
$60,000 - $69,999	290	10	10	310	1,095	12,835
≥ $70,000	635	25	10	670	2,360	27,290
Average Income ($)	51,160	39,482	29,687	n/a	52,004	41,064
Median Income ($)	49,052	34,639	25,280	n/a	49,587	34,036
Source: Statistics Canada 1998. n/a Data Not Available						

6.15.3.2 Business

Southern Labrador

Economic activity in Southern Labrador was traditionally based primarily on the inshore fishery, particularly the harvesting and processing of 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. There are currently six fish processing plants operating in the region. Coastal Labrador Fisheries Limited's plant at St. Lewis processes crab and shrimp (JW 1998a), while a plant operated by Labrador Sea Products Inc. in Black Tickle processes shrimp and, most recently, crab (JW 1998a; DFA 2001). Fish plants operated by the Labrador Fishermen's Union Shrimp Company Limited in Mary's Harbour, Pinsent's Arm, Cartwright and Charlottetown process a range of species, including crab, shrimp, cod, salmon, capelin and/or whelk (DFA 2001; 2002; Labrador Fishermen's Union Shrimp Company Limited 2002).

The number and type of businesses in the Southern Labrador region is relatively limited at present, although this varies considerably between communities. There are accommodations, restaurants, lounges, convenience and grocery stores, service stations and garages, hardware stores, and other commercial establishments in the area, particularly in the larger communities such as Cartwright, Port Hope Simpson and Mary's Harbour. Some of these communities are also home to the offices of various transportation, utility, communication and finance companies (Southeastern Aurora Development Corporation n.d.). Schools, clinics, municipal governments and the offices of federal and provincial agencies also employ a portion of the local labour force. The range of goods and services offered in the smaller communities in the region is much more limited, with residents of these communities relying on adjacent centres for many products and services. Several natural and heritage attractions also exist in the region, as well as a number of adventure tour operators and fishing camps (Section 6.14.3).

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 Trans Labrador Highway (Red Bay to Cartwright) will likely provide opportunities for future economic growth.

Central 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. The military base at Happy Valley - Goose Bay directly employed about 487 Canadians in 1999. Allied air forces maintained 245 permanent positions at the Base in 1999, with an additional 8,000 transient personnel stationed at Happy Valley - Goose Bay during that year (Department of Finance 2002). Approximately 16,000 military personnel passed through the Base in the summer of 2001. DND has traditionally been the largest employer in the Town, and in recent years has employed approximately 21 percent of the community's labour force. Management of the Base is the responsibility of a private company, SERCO Facilities Management Inc. (Town of Happy Valley-Goose Bay n.d.). The Base also generates a substantial amount of indirect and induced employment and business activity.

Happy Valley-Goose Bay offers a wide range of commercial goods and services, with over 100 businesses located in the town (Labrador North Chamber of Commerce 2002). It also 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. Some of the major employers in Happy Valley-Goose Bay at present are outlined in Table 6.70.

Table 6.70 Major Employers: Happy Valley-Goose Bay

Company / Agency	Employees	Company / Agency	Employees
SERCo. Facilities Management Inc.*	329	College of the North Atlantic	98
Labrador School Board	200	Paddon Memorial Home	84
Woodward's Group of Companies	178	Provincial Government	75
Grenfell Regional Health Services	168	Canada Catering	53
Allied Countries	159	Glenn Corporation	50
Labrador Airways/Aviation	152	Town of Happy Valley - Goose Bay	42
Department of National Defence**	111	Terrington Co-op	39
Federal Government	110	Newfoundland and Labrador Hydro	31
North Mart	100	Warr's Pharmacy	28
		Newfoundland Telephone	25

Notes:
* includes full-time and seasonal workers and sub-contractors
** military and civilian personnel
Source: Town of Happy Valley-Goose Bay n.d.

The communities of North West River and Sheshatshiu are located approximately 25 km northeast of Happy Valley-Goose Bay. Businesses in these communities include food and accommodations establishments, retail stores, a service station, taxi service, and a number of tourism-related businesses. A considerable portion of the labour force of these communities is employed in the provision of government services, such as education, postal services, and health care. The smaller settlement of Mud Lake located 5 km to the east of Happy Valley-Goose Bay. Some Mud Lake residents are employed in Happy Valley-Goose Bay (Central Labrador Economic Development Board n.d.).

Many residents of these communities also still practice traditional, “non-wage” activities such as hunting, trapping and fishing for subsistence purposes and/or to supplement their incomes.

Other Regions

In Western Labrador, the economies of Labrador City and Wabush are based primarily on iron ore mining. The Iron Ore Company of Canada (IOC) currently operates a mine, concentrator and pellet plant at Carol Lake in Western Labrador, with mine workers and their families residing primarily in Labrador City. In addition, Wabush Mines operates its Scully Mines in Western Labrador, with a concentrating plant located in Wabush (Department of Mines and Energy 2001). Labrador City and Wabush are among the most affluent communities in Newfoundland and Labrador at present, and have relatively well-developed and diversified economies. The Churchill Falls (Labrador) Company (CF(L)Co) operates an extensive 5,428 MW hydroelectric generating plant and related transmission infrastructure at Churchill Falls in Western Labrador.

Churchill Falls is a “company town” that was established to accommodate the workers of CF(L)Co and their families. Newfoundland and Labrador Hydro is also exploring the development of a new 2,000 MW dam and power plant on the lower portion of the Churchill River and associated transmission infrastructure in Labrador.

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 communities in the area are connected by a paved road, which has served to expand the market area and labour pool for local businesses. In addition, the ferry service between St. Barbe, Newfoundland and Blanc Sablon, Québec has allowed for greater integration with the provincial economy. There are convenience and grocery stores, accommodations, restaurants and other retail outlets throughout the region. Larger communities such as L’Anse au Loup and Forteau offer a range of goods and services, including: construction, heavy equipment and trucking, welding, building supplies, repair services, wholesaling companies, automobile dealerships and rental agencies, financial and consulting services and others (Labrador Straits Development Corporation n.d.).

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, with fish plants at Nain, Hopedale, Postville, Makkovik and Rigolet (DFA 2001; 2002). The Torngat Ujaganniavingit Corp. also operates an anorthosite quarry at Ten Mile Bay, near Nain. Businesses in the North Coast communities include accommodations, restaurants and retail outlets, with the larger community of Nain offering a much wider range of goods and services (e.g., building contractors, heavy equipment operations, and trucking and shipping services) (Nanuk Development Corporation 2002). A considerable portion of the region’s wage economy is also based on the provision of government, health and education services.

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 approximately 35 km southwest of Nain. This $2.9 billion project consists of an integrated mine and mill/concentrate processing plant, with the ore transported to Argentia (on the island of Newfoundland) for smelting. This project will provide considerable direct, indirect and induced employment and business opportunities throughout Labrador and the province as a whole.

6.15.4 Potential Interactions

The project will generate direct employment activity during its design and engineering, construction and operation phases. In addition, expenditures made during these various phases (e.g., equipment and supplies) will provide business opportunities for local companies. Any job creation will also indirectly benefit commercial establishments through increased spending. During project operation, improved access to and within Southern and Central Labrador and elsewhere will have implications for existing and potential businesses and industries and, consequently, for employment levels. The highway will expand the market area for local businesses, as well as providing improved access to previously undeveloped natural resources.

Any changes to traditional movement patterns may affect the use of some services and infrastructure, which could indirectly affect employment and business activity, as well as affect local businesses through increased competition with those in other, now accessible areas.

6.15.5 Issues and Concerns

Discussions and consultation with local individuals and groups throughout the course of this environmental assessment indicated that most area residents view the proposed project as a positive development which will result in considerable employment and business benefits. The Southern Labrador strategic economic plan (Southeastern Aurora Development Corporation 1997: 32) reflects this view by stating that:

> *The Trans-Labrador Highway is the top priority for the residents of Zone 4 ... In order for us to ... produce a more viable, stable economy which will offer our people a higher standard of living and a better quality of life, we must see the Trans Labrador Coastal Highway constructed. There is no disputing the fact that the future of all coastal Labrador is hinged on transportation networks...The people of Labrador...have clearly expressed a need for an all-weather Trans Labrador Highway which includes a highway linking coastal communities with the highway at Red Bay, and connecting Cartwright to Happy Valley - Goose Bay.*

However, there are concerns regarding the potential distribution of the employment and business opportunities which will be created by the project. Residents are concerned that jobs and contracts will go to individuals and companies from elsewhere with little or no consideration given to local workers and businesses. In addition, while the potential economic opportunities associated with improved access to the natural resources of the region are recognized, there are also concerns that the highway will be a means for companies from elsewhere to exploit resources such as timber, with these raw materials being transported elsewhere for processing.

There is also concern that improved access could have a negative effect on some communities and businesses. It was noted that communities such as Cartwright may be by-passed completely once the highway is complete, as people may travel directly to larger centres such as Happy Valley-Goose Bay. Other specific questions and comments related to employment and business raised during the issues scoping exercise (Section 4.2) include:

- highway design (which should allow for eventual paving) will influence the potential economic benefits of the highway;
- the importance of adequate maintenance once the highway is complete;
- the need to consult with Labradorians regarding project planning, construction and operation, and on the future development of natural resources in the region;
- potential business opportunities for Aboriginal people and companies; and
- a current lack of readiness by communities to take advantage of the opportunities offered by the highway.

6.15.6 Existing Knowledge

Generally, highway construction projects tend to generate a substantial amount of economic activity. The effects of expenditures on highway construction are both immediate and highly localized, and bring about considerable local employment and business activity (FGA 1993). In short, *highway construction tends to satisfy an urgent need to employ highly underemployed, seasonal skilled and unskilled workers in the short term, while providing long term infrastructure to facilitate economic growth and business savings thereafter* (FGA 1993: 7.12).

Recent experience with the construction of the TLH-Phase II (Red Bay to Cartwright) from 1998 to 2002 gives an indication of these potential economic benefits. Capital expenditures ranged from approximately $27.4 million to $57.2 million per year. Direct employment during the construction phase ranged from approximately 335 to 800 workers annually (including both WST and contractor personnel), with approximately 40 percent of these being residents of Labrador, and over 95 percent comprised of Newfoundland and Labrador residents (Section 2.5.3). As the highway has only recently been completed, and the nature and extent of its economic benefits are not yet clear. However, comments made during the public open houses conducted as part of this environmental assessment (Section 4.2) revealed that many residents were generally pleased with the benefits offered by the TLH - Phase II, and were looking forward to seeing this portion of the highway completed as well.

The Labrador Straits has traditionally been characterized by a stronger and more diversified economy than Southern Labrador, as its highway and ferry service have served to expand the market area and labour pool for local businesses, and better integrate the region's economy with that of the island of Newfoundland and elsewhere. However, the Labrador Straits highway also serves to illustrate the potential negative effects of improved access. For example, businesses in the area have been subject to competition with those in other communities in the region, as well as those along the Québec North Shore and elsewhere (JW 1998a).

6.15.7 Mitigation/Optimization

No mitigation measures specific to employment and business are proposed. In most cases, the positive effects of the project on employment and business activity will compensate for any potential negative effects.

WST supports employment and gender equity in its hiring and contracting practices, and is committed to workplace diversity and to maximizing the use of the local workforce and companies to the extent possible. Highway construction will be carried out through the public tendering process.

WST will consult with relevant provincial and federal government agencies, the Innu Nation, local town councils, educational institutions and other relevant organization prior to the start of construction and regularly throughout the course of the project. The purpose of these discussions will be to provide information on on-going and upcoming project activities, including the contractor(s) involved, potential jobs for local residents (including specific occupations and training requirements), and possible business opportunities for local firms, so that local residents and groups can identify and prepare for these opportunities in an effective and timely manner.

During project operation, local economic development organizations, business groups and government departments and agencies should also work to identify economic opportunities and provide assistance to local individuals and firms to take advantage of them. Ensuring that local residents and companies benefit from resource development activities which may be induced by the proposed highway (e.g., forestry and mining) will also depend on the policies and practices of the various agencies and organizations included in developing and managing the region's natural resources.

6.15.8 Environmental Effects Assessment

The effects analysis for employment and business considers potential direct, indirect and induced changes resulting from the project. Potential effects on tourism have been discussed in detail in Section 6.14.

6.15.8.1 Construction

The project will generate direct employment during its design and engineering and construction phases. The design and engineering phase will employ civil engineers, structural engineers, engineering technicians and draftspersons. As indicated, the construction phase of the project will entail six construction seasons from 2003 to 2008. Skilled workers will be required for each construction period and phase, including engineers, technicians and draftspersons, brush cutters, highway surveyors, heavy equipment operators and mechanics, drillers and blasters, electricians, carpenters, labourers, truck drivers, concrete finishers and technicians and steel erectors, as well as various support personnel such as cooks and assistants. The precise number of workers which will be required for highway construction is not known at present. However, as discussed in Section 2.5.3, the required workforce is expected to be less than that for the Phase II construction.

As discussed previously, workers will be hired for specific construction phases at the discretion of the contractors; therefore, it is unclear what proportion of these positions will be filled locally. This will depend on such factors as the location and specific hiring practices of the contractor, and unionization. It is anticipated that local hiring will be preferred in order to minimize costs. The construction phase of the project will require skills and trades that generally available in Labrador. Again, WST supports employment and gender equity in its hiring and contracting practices, and is committed to workplace diversity and to maximizing the use of the local workforce and companies to the extent possible. Regular consultation with relevant government agencies, the Innu Nation, local town councils, educational institutions and other applicable organizations will help local residents and firms identify and respond to the employment and business opportunities generated by the project in an effective and timely manner.

There is little possibly of labour force displacement and wage inflation as a result of the project. These occur when individuals leave existing jobs for project-related jobs, and when local firms are forced to increase wages in order to attract and maintain staff. Given the relatively high unemployment rates and availability of labour (particularly in Southern Labrador), labour force displacement and wage inflation will not occur as a result of this phase of the project.

Local businesses will likely benefit as a result of direct and indirect expenditures made during project construction. Depending on results of the competitive bid process, local construction companies may obtain construction contracts. Spending by construction companies, such as that on transportation or supplies, will also likely benefit Labrador businesses. The actual proportion of direct spending that will occur is difficult to forecast, as it depends on such factors as the purchasing practices of the successful contractors, as well as the particular goods and services required. Optimization will depend on the ability of local individuals and firms to identify the required goods and services, and meet the demand. During the construction phase of the project, the local economy will be stimulated through the introduction of additional income. Again, the extent of such benefits depends on the degree to which local individuals and firms are successful in obtaining project-related work.

There will be some use of existing transportation infrastructure and services to move construction personnel, equipment and materials to the area. In addition, non-resident construction personnel will be accommodated in the local communities when construction activity is being conducted near them, and later in construction camps. This will result in some benefits to local businesses, although much of the construction labour force will likely be comprised of local residents. Any demand for local accommodations will occur primarily in the early stages of the construction phase, and decrease as construction progresses. The use of local retail outlets and food establishments by construction workers will also benefit the local economy.

6.15.8.2 Operation

Project operation will affect employment and business through the creation of employment and potential business opportunities, improved access to natural resources and their markets, and changes in the movement of people and goods to, from and within the area.

During operation, the highway will require maintenance and periodic repair, which will create some local employment. However, personnel requirements for this phase are expected to be low compared to construction, and will include such positions as a maintenance supervisor, a maintenance foreman, truck drivers, heavy equipment operators and mechanics, and labourers. Summer maintenance may be conducted by WST directly, or through a contract company. Winter snow clearing and ice control will likely be done on a contractual basis. As a result, the extent to which highway operation will create employment, and the number and specific types of jobs, are not known. The cost savings associated with local hiring and the more permanent nature of these positions will likely encourage local hiring.

Although project-related expenditures will also be considerably lower during operation, local firms may benefit by providing equipment and supplies to WST or the contractor carrying out summer and winter maintenance. Any employment generated by highway maintenance activities will benefit local businesses in the area through expenditures made by local residents successful in obtaining such positions.

As discussed in Section 6.14.8.2, the highway will alter the existing transportation system and patterns in Labrador considerably. Although there are no communities located along the highway route itself, the project will provide reliable, cost-effective and year-round road access between Southern and Central Labrador. By connecting the two existing sections of the TLH, the highway will provide Southern Labrador and Labrador Straits residents and visitors with direct road access to Central Labrador, as well as Western Labrador, Québec and beyond. Similarly, residents of and visitors to Central Labrador and Western Labrador will now be able to drive to Southern Labrador and the Labrador Straits, and on to the island of Newfoundland via the existing ferry service.

The ability to travel between these regions year-round by road will benefit existing businesses and provide new development opportunities. Improved access to Southern Labrador will increase the level of visitation to this region by Central Labrador residents and visitors (Section 6.14.8). Therefore, the project will expand the market area for local businesses, which has traditionally been constrained by limited access. Similarly, residents of Southern Labrador and the Labrador Straits will now be able to travel to Happy Valley-Goose Bay and other communities in Central and Western Labrador and beyond to obtain required goods and services.

An increase non-resident tourist travel throughout these regions of Labrador will increase the use of existing commercial infrastructure and services (e.g., accommodations, restaurants, tourist attractions) (Section 6.14.8). Vehicular travel through this previously inaccessible area will also create a demand for services such as gas stations and garages, restaurants, and accommodations along the highway route itself. Increased visitation will also result in an increase in the use of some existing services and infrastructure in Labrador (e.g., the St. Barbe-Blanc Sablon ferry). As discussed in Section 6.14.8, this is not expected to result in interference with other users. However, the use of some transportation infrastructure may be reduced once the highway is operational (e.g., air travel from Happy Valley-Goose Bay to Southern Labrador communities), although any such reduction will be minor and not have a measurable economic effect.

The highway will provide access to the natural resources of this previously remote area, and allow commercial operators more reliable and cost-effective access to markets. This will likely increase the feasibility of developing or expanding commercial land and resource use activities in the region, such as forestry, mineral exploration, and possibly, mining activity (Section 6.12.7). The degree to which local communities will benefit from the development and/or expansion of these industries will depend on the policies and practices of the various agencies and organizations involved in developing and managing the region's natural resources, and the ability of local individuals and firms to identify and respond to these opportunities.

Improved access will not only allow consumers from other areas access to local businesses, but will give local residents better access to commercial establishments elsewhere, which could result in increased competition for local businesses. Residents of Southern Labrador, for example, will now be able to travel to larger centres such as Happy Valley-Goose Bay to purchase goods and services, which could have a negative effect on local firms. However, this is not unlikely to be an issue, given the distances involved. Happy Valley-Goose Bay will be over 300 km by road from the closest community Southern Labrador. Although residents may travel to Happy Valley-Goose Bay and beyond to obtain "higher-order" goods and services which are not available locally (e.g., furniture and appliances and automobiles), it is unlikely that they will regularly travel these distances to obtain goods and services which can currently be purchased from local businesses. Year-round road access as a result of this project and the recently completed TLH-Phase II (Red Bay to Cartwright) will also likely allow existing businesses in Southern Labrador to obtain and sell their products at lower prices than at present, as well as diversify the goods and services they offer, thereby becoming more competitive.

Concern has also been raised that tourist visitation to some communities may decrease once the highway is complete, as visitors will be able to travel directly to larger communities (such as Happy Valley-Goose Bay) or certain areas, thereby bypassing some completely. It is unlikely that this will be the case, given the distances and routes involved. This issue has been discussed in detail in Section 6.14.8.2.

6.15.8.3 Accidental Events

An accidental event such as a fire, fuel or chemical spill or a vehicle/equipment accident may have negative effects on employment and business, especially if it results in the destruction and/or closure of any businesses and subsequent loss of employment. If construction work is halted, project workers and firms supplying goods and/or services to the contractors will be negatively affected. A fire, vehicle accident or highway failure during operations could interrupt transportation, indirectly affecting economic activity in the region.

With the implementation of EPPs and associated plans, the potential for such an accidental event occurring is extremely low. If such an accident should occur, the significance of its potential effects is obviously dependent upon the nature, magnitude, location and timing of the event. The proponent's emergency response and contingency plans will ensure that any such effects are minimized.

6.15.9 Environmental Effects Evaluation

The significance of the potential adverse residual environmental effects of the project on employment and business are evaluated on the basis of the following definitions:

A **major (significant) effect** is a detectable and sustained change in established employment and business activity in multiple industries, such that there is a measurable adverse effect on the economy of the affected area(s) that would not return to pre-project conditions within several generations.

A **moderate (significant) effect** is one which affects employment and business activity in multiple industries such that there is a detectable adverse effect on the economy of the affected area(s) for several years.

A **minor (not significant) effect** is one which affects employment and business activity in one or more industries for several years, but which does not have a measurable adverse effect on the economy of the affected area(s).

A **negligible (not significant) effect** is a short-term localized change in employment and business activity in one or more industries, similar to small random changes due to natural variability, but having no measurable adverse effect on the economy of the affected area(s).

As described above, the potential effects of the proposed highway on employment and business are largely positive. The environmental effects evaluation focusses on any potential adverse effects, which are summarized in Table 6.71, along with ratings for the established environmental effects significance criteria. In most cases, the positive effects of the project on employment and business will compensate for any potential negative effects.

Table 6.71 Environmental Effects Summary - Employment and Business

<table>
<tr><th></th><th>Construction</th><th>Operation</th><th>Accidental/Unplanned Events</th></tr>
<tr><td colspan="4">Mitigation/Optimization:
• Highway construction will be carried out through public tendering process.
• Relevant agencies and organizations will be informed about ongoing and upcoming activities.</td></tr>
<tr><td colspan="4">Environmental Effects Criteria Ratings</td></tr>
<tr><td>Magnitude</td><td>Nil</td><td>Low</td><td>Unknown</td></tr>
<tr><td>Geographic Extent</td><td>n/a</td><td>1,001-10,000 km^2</td><td>Unknown</td></tr>
<tr><td>Frequency</td><td>n/a</td><td>Continuous</td><td><10</td></tr>
<tr><td>Duration</td><td>n/a</td><td>>72</td><td>Unknown</td></tr>
<tr><td>Reversibility</td><td>n/a</td><td>Reversible</td><td>Unknown</td></tr>
<tr><td>Ecological/Socio-economic Context</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td colspan="4">Environmental Effects Evaluation</td></tr>
<tr><td>Significance</td><td>n/a</td><td>Not Significant (Negligible)</td><td>Not Significant (Minor)</td></tr>
<tr><td>Level of Confidence</td><td>High</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Likelihood[1]</td><td>n/a</td><td>n/a</td><td>n/a</td></tr>
<tr><td>Sustainable Use of Resources[1]</td><td>n/a</td><td>n/a</td><td>n/a</td></tr>
<tr><td colspan="4">[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). However, Sustainable Use of Resources is not applicable for socio-economic VECs.</td></tr>
<tr><td colspan="4">Environmental Monitoring and Follow-up:
• WST will monitor project-related expenditures and labour during the construction phase of the project, including providing numbers on occupations, gender and period of employment for each year of construction.
• Monitoring any changes in employment and business activity and identifying potential opportunities for growth during the operations phase of the highway is the responsibility of provincial and federal government departments, local economic development agencies, and other applicable public and private-sector organizations.</td></tr>
<tr><td colspan="4">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
Level of Confidence: High, Medium, Low
Likelihood: High, Medium, Low or Unknown
Sustainable Use of Resources: High, Medium, Low or Unknown</td></tr>
</table>

As indicated, the proposed project is not likely to result in significant adverse environmental effects on employment and business.

6.15.10 Cumulative Environmental Effects

The effects of several existing or imminent projects may accumulate and/or interact with those of the proposed highway to bring about cumulative environmental effects on employment and business.

The existing sections of the TLH - Phases I and II will influence the nature of the effects of the proposed project on employment and business. As described above, the proposed highway will provide year-round road access between Southern and Central Labrador, thereby connecting these two existing sections of the TLH. The highway will provide Southern Labrador and Labrador Straits residents and visitors with direct road access to Central Labrador, as well as Western Labrador, Québec and beyond. Similarly, residents of and visitors to Central Labrador and Western Labrador will now be able to drive to Southern Labrador and the Labrador Straits, and on to the island of Newfoundland via the existing ferry service. Therefore, the proposed project will likely bring about an overall increase in visitation to Labrador (Section 6.14.8.2). Therefore, the TLH - Phase III will act in combination with these existing highway sections to alter the spatial and temporal movement of people throughout Labrador. As a result, Phases I and II of the TLH have been considered in the environmental effects analysis described above.

Improved access to, from and within the region as a result of the TLH - Phase III will likely provide new opportunities for resource development activities in Southern and Central Labrador, such as forestry, mineral exploration and possibly mining, which will have a positive effect on the area’s economy. Again, the degree to which local residents, communities and companies benefit from these induced projects and activities will depend on the policies and practices of the various departments responsible for managing the region’s natural resources, and the ability of local individuals and firms to identify and respond to these opportunities.

The construction and operation phases of the Voisey’s Bay Mine/Mill project will result in considerable employment and business activity throughout Labrador and the province as a whole. From 2002 and 2006, approximately 1,700 person-years of employment will be created during the construction of the mine and concentrator at Voisey's Bay. Once operations begin, it is expected that the mine and concentrator at Voisey's Bay will employ approximately 400 people. Underground mine development and the expansion of the concentrator is expected to begin around 2018, subject to the completion of a successful underground exploration program. An additional 400 people are expected to be employed at the mine and concentrator during the underground mining program, increasing total employment there to a peak of 800. Considerable employment and business opportunities are also expected during the design, engineering, construction and operation of the hydrometallurgical processing demonstration plant and commercial scale processing facility in Argentia, Newfoundland (VBNC n.d.).

As indicated in Section 6.15.3.2, low-level military flight training forms the basis for the economy of the Central Labrador region, generating considerable direct, indirect and induced employment and business activity in Happy Valley-Goose Bay and other parts of Labrador. In addition, existing land and resource use activities in the project area are also an integral part of the local economy, in terms of their contribution to the wage economy (e.g., the outfitting industry), and particularly, as a means for local residents to supplement other sources of income through hunting, fishing, berry-picking, cutting firewood, and other recreational and subsistence activities. Any increase in these activities as a result of the proposed highway (Section 6.12) would also increase their contribution to the livelihood of local residents.

Therefore, the overall, cumulative effect of the proposed highway in combination with these other projects and activities will be a positive one for the economy of Labrador, as these developments will generate considerable employment and business activity. The proposed highway will also likely serve to expand the labour pool for projects such as the Voisey's Bay Mine/Mill and the Gull Island Hydroelectric Development, by giving residents of Southern Labrador and the Labrador Straits more reliable and cost-effective access to Happy Valley-Goose Bay, which will likely serve as a key centre for the employment and business activity associated with these projects.

6.15.11 Environmental Monitoring and Follow-Up

WST will monitor project-related expenditures and labour during the construction phase of the project. Monitoring of construction employment will be detailed and specific numbers by occupation, gender and period of employment during each year of construction will be provided to the Minister of Environment at the conclusion of each construction season.

Monitoring any changes in employment and business activity and identifying potential opportunities for growth during the operations phase of the highway is the responsibility of provincial and federal government departments, local economic development agencies, and other applicable public and private-sector organizations.

6.16 Community Life

Community life is defined to include the social characteristics of communities and families, health, and infrastructure and services. The construction and operations of the TLH - Phase III may affect the nature, functioning and health of the socio-economic environment. Changes in transportation infrastructure will influence the movement of people and goods to, from and within the region, resulting in effects on the social characteristics of communities and families, health, and local infrastructure and services.

6.16.1 Boundaries

Project boundaries for community life are defined by the spatial and temporal extent of project activities and zones of influence. The spatial boundaries extend beyond the highway right-of-way to include the areas that are defined by existing local communities. Temporal project boundaries encompass the project's construction and operations phases. Construction will occur over a six-year period, from 2003 through 2008, on a seasonal basis. Assuming that the highway will be operated in perpetuity, the long-term effects of the operational phase of the highway are also assessed. An accidental effect could potentially occur during either of these phases, and may also have an effect on community life.

Aspects of community life are within the jurisdiction of several departments, including the Department of Health and Community Services, the Department of Human Resources and Employment, the Department of Tourism, Culture and Recreation, the Department of Forest Resources and Agrifoods, and the Department of Education. In addition, a number of other organizations have particular knowledge of, or responsibility for, the social, health or service sectors in Labrador. Administrative boundaries include municipal planning areas, local service districts, regional economic zones, health regions, policing districts, social service districts and school board districts. These boundaries are reflected in the discussion that follows, as defined by the jurisdiction of individual government and service agencies.

The environmental effects analysis focuses primarily upon Central and Southern Labrador (Figure 2.3) and the communities within these regions. It also includes consideration of the other regions of Labrador, Labrador as a whole, and the island of Newfoundland, as applicable.

6.16.2 Methods

The following sections provide an overview of existing community life. This description is presented in more detail in the Component Study on Community Life, Employment and Business prepared as part of the EIS (JW 2003c). The information provided was collected from a number of sources, including Statistics Canada, the Newfoundland Statistics Agency, government agencies, crown corporations, regional economic development corporations, and community service organizations.

6.16.3 Existing Environment

6.16.3.1 Settlement and Demographics

Southern Labrador includes the towns of Cartwright, Charlottetown, Port Hope Simpson, St. Lewis (Fox Harbour), Mary's Harbour, and various other smaller communities. The region of Central Labrador encompasses the Town of Happy Valley-Goose Bay and North West River, and the communities of Mud Lake and Sheshatshiu. Happy Valley-Goose Bay is one of the largest centres in Labrador. The population in these areas is a mix of aboriginal (i.e, Innu, Innuit, and Métis) and non-aboriginal peoples. 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 growth (Section 3.4.3).

In 2001, the total population for Southern Labrador was 2,771 and the total population for Central Labrador was 9,103, together equaling 2.3 percent of the total for the Province of Newfoundland and Labrador. In Southern Labrador, the largest community is Cartwright, with a population of 629. In Central Labrador, the largest community is Happy Valley-Goose Bay. With a population of 7,969, it contains 87.5 percent of the population in Labrador’s central region.

In Southern Labrador communities, the median age of the population ranges from 31 to 39 years of age. In Central Labrador, the median age of Happy Valley-Goose Bay’s population is 33, while the communities of North West River and Sheshatshiu have the youngest median population of both regions (18.5 years of age). In Southern and Central Labrador, the proportion of youth (25 years of age or less) remains under 50 percent of the total population.

In 2001, there were 825 families in Southern Labrador, of which 490 were married-couple families, 160 were common-law families and 155 were lone-parent families. Of the lone-parent families, 105 were female-headed families, while 60 were male-headed. In Central Labrador, there were a total of 2,625 families, of which 1,645 were married-couple families, 480 were common-law, and 485 were lone-parent families. The total number of female lone-parent families was 365, while there were 130 male lone-parent families.

6.16.3.2 Infrastructure and Services

In Southern Labrador, Cartwright, Charlottetown, Port Hope Simpson, St. Lewis and Mary's Harbour are incorporated towns. All five towns have municipal plans that define land use designations and the manner in which development may occur. In Central Labrador, the towns of Happy Valley-Goose Bay and North West River are incorporated, while the community of Sheshatshiu is administered under the Band Council. Happy Valley-Goose Bay serves as the main administrative centre for Central Labrador. Each municipality is in charge of providing and maintaining infrastructure such as roadways and waste management.

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, all-terrain vehicles (ATVs) 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 Trans Labrador Highway, extend from western Labrador to Happy Valley-Goose Bay and Red Bay to Cartwright. Both sections of the highway are two-lane, all season gravel roads.

Newfoundland and Labrador Hydro provides electricity to the communities of Southern and Central Labrador with diesel generating stations and power supplied from Churchill Falls. Aliant Telecom (formerly NewTel Communications) provides telephone service via a network of microwave towers. Canada Post has offices or outlets in each of the communities. CBC television and radio are available to all the communities. Newspapers that serve the communities include the *Labradorian* (weekly) and the *Northern Pen*.

All towns have piped water supply systems. Many communities rely on private wells. All towns have piped sewer systems serving a portion of the community, and in all cases, raw sewage is discharged directly into the sea. Buildings in the smaller and unincorporated communities and summer fishing stations typically have septic or "honey bucket" sewage systems or private septic systems. Within towns, solid waste is collected and disposed of at each town's waste disposal site. In small communities and fishing stations, responsibility for garbage disposal rests with the individual.

Health care services and infrastructure in Central and Southern Labrador fall under the jurisdiction of Health Labrador Corporation and Grenfell Regional Health Services (GRHS), respectively. 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 part of Southern Labrador and in the Labrador Straits. Transportation services are provided to coastal residents who need to travel for secondary medical reasons and emergencies. In Happy Valley-Goose Bay, a road ambulance service is operated by private contractors and an air ambulance is operated by the Government of Newfoundland and Labrador. All community clinics have holding beds, basic trauma and resuscitation equipment. The stations do not have cardiac monitoring or defibrillation capabilities. Stations normally have two nurses, a nurse's aide and a maintenance person. Physicians from the Labrador Health Centre or GRHS make community visits every six to eight weeks, and are always available to regional nurses by telephone.

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 in Port Hope Simpson and Red Bay.

6.16.3.3 Social and Health Characteristics

The culture of Southern and Central Labrador is based on a combination of geographic, economic and historical issues. There is a long history of aboriginal peoples in the area – the Innu, Inuit and Métis groups. There is also the presence of European settlers and other immigrants who have come to work and live in northern communities over the last centuries. The major factors influencing life in these regions is isolation, proximity and reliance on industries related to the land and the marine environment, seasonal work patterns and social relationships between different cultural groups.

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.

Following provincial health trends, many modifiable risk factors such as physical inactivity, obesity and smoking are at relatively high rates in the communities of Labrador. Often there are dietary problems for communities in Central and Southern Labrador. Mental health is also tied to the overall physical health of residents. Of the social problems that have been noted in northern communities, substance abuse is prominent and is a critical contributory factor in family violence and other crimes.

6.16.4 Potential Interactions

The potential interactions of the project with community life include the effects that may occur on the social characteristics of communities and families, and the health of individuals. The capacity and ability of infrastructure and services to accommodate any changes in demand must also be assessed.

6.16.4.1 Social Characteristics of Communities and Families

There are no communities along the highway route. However, the highway will provide a new connection between the communities of Central Labrador (Happy Valley-Goose Bay, North West River and Sheshatshiu) and the communities of Southern Labrador (Cartwright, Charlottetown, Port Hope Simpson, St. Lewis, Mary's Harbour and other smaller communities). Currently, travel between Central and Southern Labrador is primarily by air, snowmobile and boat. The highway will provide a lower-cost, easier means of travel.

The completion of the TLH – Phase III highway will further reduce the isolation of the communities of Central and Southern Labrador. This may reduce the level of social cohesion, as there is more travel across the region and transient visitors. However, it may also increase the social interaction between communities. This latter positive effect may be important in light of the family connections that exist across much of Labrador and the Island of Newfoundland.

As with many parts of Newfoundland and Labrador, the region has experienced an overall decline in population levels. Whether or not this is reversed will depend largely on the economic health of the region. The highway may encourage regional economic diversification and growth. This would stabilize the populations in local communities and, with further economic growth, lead to an increase in the number of people living and working in the region.

For the construction of the highway, contractors will have hiring discretion. It is anticipated that local workers will be used rather than bringing in individuals from outside the region, but at this point, it is not possible to estimate the number and scheduling of hires over the six-year construction period. There certainly is a local work force available from which the personnel needs for the construction and operation of the project can be at least partially satisfied (see Section 6.15).

The regional population is a mix of aboriginal and non-aboriginal peoples. It is difficult to say how the highway may affect the two groups differently. Efforts will need to be made to ensure that culturally compatible benefits are enjoyed by aboriginal peoples.

6.16.4.2 Health

In general, only positive effects on the health of individuals within Central and Southern Labrador are anticipated as a result of the construction and operation of the TLH – Phase III (potential negative effects associated with accidental events are discussed later in this section). With an increase in employment and income, the health of individuals can be anticipated to improve. Improvements in employment and income are expected to result in decreases in social stresses and increases in the means to live healthier lives. For residents in Southern Labrador in particular, access to social and cultural services provided in Central Labrador are anticipated to enhance levels of care and personal development.

6.16.4.3 Infrastructure and Services

As discussed in the project description, temporary camps will be established during construction of the highway. The camps will be designed to accommodate 40 to 50 workers, and provide administration, sleeping, shower and kitchen facilities in mobile trailers. Where construction takes place near a community, local existing facilities may be used. The specific locations of camps will be determined during the preparation of the construction plans. An influx of construction personnel can affect community infrastructure and services.

During the operation of the highway, maintenance depots will be established for storing equipment and sand, and maintaining heavy equipment. At this point in the planning of the project, the number and location of the depots have not been determined. Typically, maintenance depots are located outside of communities, in an area appropriate for light industrial use. Workers at the facilities will be based out of the nearest community.

The two winter camps established along the route for winter work crews are not anticipated to affect community life. Again, the specific locations have yet to be determined, but potential locations are at Cartwright Junction and a point halfway between Cartwright Junction and Happy Valley-Goose Bay.

Ground transportation will be the primary means of moving equipment, materials and supplies to site. For moving equipment not obtained locally into the Happy Valley-Goose Bay area, non-commercial shipping services may be used. Near Cartwright Junction, equipment and supplies may be brought to site via ferry or barge, and the Phase II portion of the TLH. Commercial shipping services will be used for all transportation by sea. Transportation to construction sites from local communities will be by vehicle and air. The use of local transportation services can have both positive (increased revenue) and negative (congestion) effects.

The air and marine transportation services provided in southeastern Labrador are currently scheduled to change due to the completion of the TLH – Phase II. The highway will provide an all-season, ground transportation link between the local communities in the southeast. With the completion of the highway, the number of airstrips will be reduced and marine services to communities connected to the highway will cease. Ferry services between Cartwright and Happy Valley-Goose Bay and the north coast of Labrador are anticipated to continue. Air service is also anticipated to continue, although at reduced service levels due to the alternative provided by the highway.

6.16.4.4 Accidental Events

There are different types of accidental events associated with the project that have the potential to affect community life. A collapse or failure of part of the highway could occur during construction or operation. During construction, the burning of brush and slash will increase the risk of forest fire. Collisions and increased human activity along the highway route during operation will also increase the risk of forest fire. Highway failure and forest fires may isolate communities that have grown dependent on the transportation connections made possible by the new highway. Forest fires may also physically threaten communities and human lives. Episodic highway failure could threaten the safety of highway travellers.

Personal vehicles and tractor trailers will routinely travel the TLH - Phase III during its operation. With use of the highway, there will be an increased risk of vehicle-related fires, vehicle collisions (with other vehicles, wildlife or pedestrians), and fuel or chemical spills. During construction, injury to workers or others resulting from equipment accidents may also occur. The personal lives of workers and individuals within local communities may be affected by the occurrence of these accidental events, and such events have the potential to increase the demand on local health care, and safety and security services.

6.16.5 Issues and Concerns

Discussions with key informants have identified some concerns over the potential effect of the project on aspects of community life. There is general concern over the readiness of the communities in dealing with the changes associated with the completion of the TLH – Phase III. The following issues were raised:

- conflicts and social problems (e.g., alcohol abuse) associated with the construction crews brought in to the region, if crews made up of local people are not used;
- disruption of local families if workers are required to be away from home for extended periods of time;
- increases on the demand for policing services, both during construction and during operation of the highway, due to potential increases in crime and the need for enforcement along the length of the highway;
- increases in the incidences of forest fires along the highway, and an associated increase in the need to quickly extinguish fires;
- a lack of safety and security along the length of the highway (e.g., no means of communication available if there is a vehicle accident or breakdown);
- increases in the demand for emergency services. Current local service levels and emergency equipment on hand will be inadequate to deal with increases in accidents; and
- demand for local infrastructure and services, such as garbage disposal, sewage treatment and commercial services, will not be able to be met in the short term.

Individuals contacted also commented on potential positive effects on business, employment and income that may occur as a result of the completion of the highway (see Section 6.15). This would, in turn, have a positive effect on a number of aspects of community life. It is anticipated that local infrastructure and services would expand and develop. There would be a reduced reliance on social assistance programs, and the general health and well being of people would improve.

6.16.6 Existing Knowledge

There have been few large construction projects in the region, especially in Southern Labrador. As the TLH – Phase II has only recently been completed, it is too early to drawn any conclusions on the effects of that highway development on local community life. Previous experience has been limited to airstrip construction between 1979 and 1989, local wharf and building construction, and other limited road construction between local communities.

In Southern Labrador, direct experience with road access to other communities within and outside the region is limited. As a result, there is little existing knowledge regarding the potential effects of year-round highway access on community life. Individuals contacted as part of the research for this report emphasized this point.

The construction of the TLH – Phase III will generate economic activity (see Section 6.15). An increase in local employment and business activity will certainly affect communities (FGA 1993). Specifically, highway construction in Labrador tends to employ underemployed, seasonal workers. The construction of the TLH-Phase II from Red Bay to Cartwright directly employed from 250 to 825 workers annually, with approximately 40 percent of these being residents of Labrador, and 95 percent being residents of Newfoundland and Labrador (see Section 6.15). Given the relatively large population and the dominant role played by the Happy Valley-Goose Bay economy within the region, it is possible that the smaller local communities may “feel” the effects of the highway more. But again, direct comparable experience has been limited.

6.16.7 Mitigation

Mitigation measures are identified for the project that will reduce or eliminate the potential adverse effects on community health and infrastructure and services. The potential effects on social characteristics of communities and families are not specifically addressed as the residual negative effects are expected to be minor. Many effects will be positive. Various government agencies are currently responsible for providing assistance to communities and families for existing social issues.

With regard to the effect of construction camps on community infrastructure and services, operators will comply with legislation and regulations governing sanitation and food premises. Camps will have basic first aid equipment and supplies, but will rely on the medical services provided in the nearest town through a medical evacuation request. If there is a need to locate a camp near the Town of Happy Valley-Goose Bay, approval by the town will be sought.

All industrial and domestic wastes generated during the construction of the highway will be collected, properly stored and disposed of as approved by regulatory agencies. Temporary sewage disposal systems will be installed, also in accordance with regulatory requirements and WST Specification 825 requirements. Domestic garbage will be disposed of at approved waste disposal sites. Community waste disposal sites will be used only if municipal approval is received. Where camps are not near communities or local municipal approval is not granted for domestic and industrial waste disposal, waste may be incinerated or landfilled according to appropriate regulatory and permit requirements.

To reduce the potential adverse effects of an accidental event during construction of the TLH – Phase III, including forest fires and vehicle collisions, prevention and response procedures will be established to address emergency situations. These procedures will be incorporated into the construction EPP, with which all contractors will be required to comply.

During the operation of the highway, the risk of vehicle-related fires, vehicle collisions and fuel or chemical spills will be reduced with the proper maintenance of the highway, and enforcement of the posted speed limit and existing regulations governing the operation of motor vehicles. WST will consult with the Inland Fish and Wildlife Division concerning potential vehicle-wildlife collision locations, and erect warning signs and conduct appropriate public awareness activities. The highway will be regularly inspected and maintained to guard against failure of any section of the highway.

6.16.8 Environmental Effects Assessment

The effects analysis for community life considers potential direct, indirect and multi-order changes resulting from the project after mitigation measures have been implemented. Environmental effects are discussed by project phase: construction, operation and accidental events.

6.16.8.1 Construction

As mentioned previously, the hiring practices of the contractors responsible for the construction of the highway will be at their discretion. Thus, it is not possible to determine the proportion of the positions that will be filled locally. Skills and trades will be required that are generally available in Labrador (see Section 6.15). It is anticipated that preference will be given for local residents (the experience from TLH-Phase II suggests 40 percent local hires).

Unemployment rates are relatively high in the region (JW 2003b). The construction of the highway is anticipated to improve the economic health of communities, as local individuals are directly hired to fill construction jobs and local businesses are hired to provide goods and services to contractors. This will serve to stabilize population levels within the communities, at least in the short term. The extent to which this will occur is difficult to predict (see Section 6.15).

Existing transportation services and infrastructure will be used to move construction personnel, services and materials to the area. As previously discussed, non-resident personnel will be housed either within the nearest community or in construction camps. Use of local services will have a positive effect on communities. There is some question as to the ability of local infrastructure to accommodate the demands from the construction of the highway. This may be particularly true for sewage and garbage disposal. Any such effects will be reduced through the mitigation measures discussed previously.

6.16.8.2 Operation

The proposed highway will alter the existing transportation patterns in Labrador (see Section 6.14). The characteristics of communities will be affected with the introduction of a year-round road access between Central and Southern Labrador. In particular, Southern Labrador and the Labrador Straits region will have substantially improved access to central and western areas of Labrador and Québec. Residents of Central and Western Labrador would now be able to travel to Newfoundland using the existing ferry service.

This increased "connectedness" between communities is anticipated to further reduce the isolation of these communities. The positive effect of this will be the ability of individuals and families to develop social and cultural links across Labrador and the island of Newfoundland. The anticipated residual negative effect will be a reduction in the social cohesion of the communities that would come with more people having access to and travelling through the area. There may also be more crime as more people move in and out of the region. However, the likelihood of any such effects is predicted to be low, both in magnitude and extent.

The highway will generate a direct demand for policing because regular patrols will be required to ensure proper highway use and traveler safety. This will be require over the life of the highway.

The highway will provide communities and individuals with improved access to routine health care and other social services. It will also improve educational opportunities. This is especially true for the communities of Southern Labrador. With economic growth, an overall reduction in poverty-related health and social problems is predicted.

With the further economic development of the region that is anticipated as a result of the completion of TLH – Phase III, there will be an expanded reliance on the wage economy. The greater involvement in markets will represent an influx of money into communities. This improved access to cash may change the levels of alcohol and substance abuse within the communities, but it is not possible at this point to say what the magnitude or direction of that potential effect may be. With the improved transportation infrastructure between communities, it is possible that these problems will become more prominent. However, the overall effect is predicted to be low.

6.16.8.3 Accidental Events

The likelihood of an accidental event, either a forest fire or vehicle collision, occurring during the construction of the highway is low. During the operation of the highway, there will be a greater risk of vehicle-related forest fires, accidents, and fuel or chemical spills. This is an inevitable result of the construction of a new highway and the resulting increases in vehicle travel. This will increase the demand on forest fire suppression services, policing services, medical services and emergency response. It will be the responsibility of the appropriate agencies to ensure that the levels of service are adequate. Overall, the effect of the highway on emergency services is predicted to be low.

Although such an accidental event is unlikely, flames and smoke from a forest fire could threaten the health and safety of area residents and site personnel. Air emissions of concern include carbon dioxide, carbon monoxide, nitrogen oxides, sulphur dioxide, volatile organic compounds and polyaromatic hydrocarbons. Reduced air quality due to high particulate levels could occur over distances greater than 10 km, although the duration of the event would likely be relatively short.

6.16.9 Environmental Effects Evaluation

The significance of the potential adverse residual environmental effects of the project on community life are evaluated on the basis of the following definitions:

A **major (significant) effect** is a detectable and sustained change in community life (including the characteristics of communities and families, health, and infrastructure and services) across many aspects, such that there is a measurable adverse effect on the affected community that would not return to pre-project conditions within several generations.

A **moderate (significant) effect** is one that affects several aspects of community life such that there is a detectable adverse effect on the affected community for one or two generations.

A **minor (not significant)** effect is one which affects an aspect of community life for less than one generation, but which does not have a measurable adverse effect on the affected community.

A **negligible (not significant)** effect is a short-term, localized change in community life in one particular aspect similar to small random changes due to natural variability, but having no measurable effect on the affected community.

As described above, many potential effects of the proposed highway on community life are positive, and any negative effects are predicted to be minor and not significant. The environmental effects evaluation focuses on any potential adverse effects, which are summarized in Table 6.72, along with ratings for the established environmental effects significance criteria.

6.16.10 Cumulative Environmental Effects

The effects of several existing or imminent projects may accumulate and/or interact with those of the proposed highway to bring about cumulative environmental effects on community life. As described above, the proposed highway will provide year-round road access between Southern and Central Labrador, thereby connecting these two existing sections of the TLH. Therefore, Phase III of the TLH will act in combination with these existing highway sections to alter the spatial and temporal movement of people throughout Labrador, which will have implications for community life in southern and central Labrador and beyond. Improved access to, from and within these regions as a result of the TLH - Phase III will likely provide new opportunities for economic development. This will, in turn, have largely positive effects on communities and families and infrastructure and services in the area. Other projects such as the Voisey's Bay development will contribute further to these potential benefits. Any potential adverse effects of these projects and activities on particular aspects of community life (e.g., increased demands for services and infrastructure) will be minor and typically, localized and of short-term duration. Appropriate planning on the part of relevant agencies and organizations will ensure that any such effects are addressed in an effective and timely manner. Therefore, the proposed projects is not likely to result in significant adverse cumulative effects in combination with other projects and activities that have been or will be carried out.

Table 6.72 Environmental Effects Summary – Community Life

	Construction	Operation	Accidental/Unplanned Events
Mitigation: • WST will commit to meeting relevant terms and conditions of an Innu land claim settlement. • Environmental protection measures for construction and operation, including contingency and emergency response measures, as identified in Section 2.10.3 will be implemented. • Posted speed limits will be lower than the design standards. • Local administrators and other relevant agencies will be regularly informed about project activities and progress. • Measures will be put in place for fire and spill prevention. • Appropriate health and safety planning, measures and equipment will be put in place for construction and operation. • Fuel and other hazardous material spill contingency plans and emergency response measures will be in place and implemented in the event of an accident.			
Environmental Effects Criteria Ratings			
Magnitude	Low	Low	Unknown
Geographic Extent	1,001-10,000 km^2	1,001-10,000 km^2	Unknown
Frequency	11-50	Continuous	<10
Duration	32-72	>72	Unknown
Reversibility	Reversible	Reversible	Unknown
Ecological/Socio-economic Context	Low	Low	Low
Environmental Effects Evaluation			
Significance	Not Significant (Minor)	Not Significant (Minor)	Not Significant (Minor)
Level of Confidence	High	Medium	Medium
Likelihood[1]	n/a	n/a	n/a
Sustainable Use of Resources[1]	n/a	n/a	n/a
[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). However, Sustainable Use of Resources is not applicable for socio-economic VECs.			
Environmental Monitoring and Follow-up: • WST will cooperate with the various departments and organizations responsible for aspects of community life. by providing project-related information as required.			

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
Level of Confidence:	High, Medium, Low
Likelihood:	High, Medium, Low or Unknown
Sustainable use of Resources:	High, Medium, Low or Unknown

6.16.11 Environmental Monitoring and Follow-up

Monitoring changes to the characteristics of communities and families, as well as tracking community health and social issues, is the responsibility of provincial and federal government departments. In addition, there are a number of non-government organizations that are active in the region. WST will cooperate with these departments and organizations by providing project-related information as required.