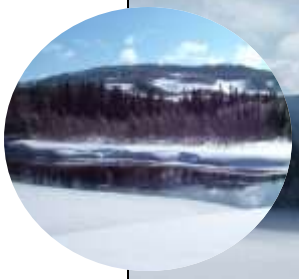
CORNER BROOK SUSTAINABLE WATERSHED MANAGEMENT PLAN



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A Partnership Between:

City of Corner Brook
&
Model Forest of Newfoundland and Labrador
&
Anderson & Yates Forest Consultants Inc.

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Corner Brook Sustainable Watershed Plan

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MESSAGE FROM THE MAYOR

On behalf of the Council of the City of Corner Brook, I would like to present to you this final draft of the City of Corner Brook Watershed Management Plan.

This plan was developed through an extensive public consultation process. It will form the basis for management of all activities within our watershed in the future to ensure a supply of clean and safe drinking water for our residents, and protect future investments in our infrastructure.

I would like to thank the members of the Watershed Management Committee for their countless hours of work on this project, as well as the Western Newfoundland Model Forest, for their leadership and I would also like to thank the residents of Corner Brook who participated in the various consultation sessions.

Neville Greeley
Mayor

ABSTRACT

Multiple uses of protected water supply areas are an issue for many municipalities in Newfoundland and Labrador. Historical uses such as cabins, commercial harvesting, domestic cutting, mining and recreation are well ingrained. Increased pressures on these areas from pre-existing and new users cause concerns as to the potential impairment to the quality of drinking water.

It was decided by city council in 2006 that the City of Corner Brook would undertake the development of a sustainable watershed management plan. The essential founding principal of this plan is to act as a pathway to ensure the supply of clean, safe drinking water to City residents, and possibly allow for the sustainable development of the resources within the water supply areas. Early in January of 2007, the City of Corner Brook partnered with the Model Forest of Newfoundland and Labrador to develop a Watershed Management Plan for the City of Corner Brook. Shortly after, the Corner Brook Watershed Management Committee was formed. This strategy is based on existing and recommended approaches to three management components: regulations, best management practices and education and stewardship. The plan also makes recommendations for monitoring water quality, monitoring of the watershed and implementation of the management strategy.

Following the template created for the Steady Brook watershed in September 2005; the Corner Brook Watershed Plan studies all aspects of the watershed. It reviews all of the natural resources which are present within the watershed boundary, and the way in which they are currently used by residents, major industries and government, as well as the potential uses that may arise in the future. With this in mind, the plan identifies all potential sources of contamination that may occur as a result of watershed use, and evaluates the likelihood and severity of each potential contaminant. In total, six categories of potential contaminants that could be of concern to drinking water quality were identified, along with a total of fifty-one potential causes of contamination. Furthermore, the management plan reviews each potential contaminant and its associated

cause, and makes recommendations about how to prevent such contaminations, and how to deal with them if they do occur.

Finally, the management plan makes recommendations for proceeding with this document. It identifies the next steps that are necessary for the sustainable development of the watershed, and who is responsible to take action for each step to be executed. If understood and followed, this Watershed Management Plan will allow the City of Corner Brook to sustain and provide safe, clean drinking water to its residents with the confidence that no external influences are having, or will have negative effects on the water quality.

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ACKNOWLEDGMENTS

Many individuals have contributed to the development of this management plan, representing government, industry and other stakeholders in the Corner Brook watershed. Members of the Corner Brook Watershed Management Planning Committee committed many hours to the production of this document. Thanks to all of the following committee members for their time and commitment to the preparation of this management plan:

Councilor Charlie Renouf	City of Corner Brook
Paul Barnable	City of Corner Brook
Margaret Winter	City of Corner Brook
Wanda Quilty	Town of Mount Moriah
Sean Dolter	Model Forest of Newfoundland and Labrador
Tina Newbury	Model Forest of Newfoundland and Labrador
Paula Dawe	Department of Environment and Conservation
Christa Ramsay	Department of Environment and Conservation
Steve Balsam	Corner Brook Pulp and Paper Limited
Tim Anderson	Department of Natural Resources
Carl Hann	Department of Government Services
Brian Moores	Department of Health and Community Services
Leonard Vassalo	Citizen's Representative
Llew Hounsell	Citizen's Representative

In addition to those members of the Watershed Planning Committee, a special thanks to Dr. Murray Rudd (Sir Wilfred Grenfell College) and Stewart Combden (Sir Wilfred Grenfell College) who gave their time and input, and who provided the equipment necessary to complete the survey data. Also, thanks to Doug Piercey (Natural Resources Canada) who provided technical expertise for geographical mapping.

INTRODUCTION

BACKGROUND

River basins in Newfoundland and Labrador have always been utilized for human needs and enjoyment. One need that has become increasingly affected by other uses is the supply of drinking water. Because of this, protected water supply areas were first designated in 1974 under the current *Water Resources Act (2002)*, and land and water uses are regulated within these areas to protect water quality. However, the *Water Resources Act (2002)*, and other Acts that pertain to safe drinking water (and their associated regulations, policies and guidelines), may not provide for complete protection in all situations in all watersheds. As such, the *Corner Brook Act. (1990)* (Appendix J) authorizes city council to make regulations they feel are required to prevent pollution of Corner Brook's drinking water supply source.

The City of Corner Brook Watershed Management Committee was established by the Minister of Environment in 1988, initially titled the Forest Harvesting Committee. The stated purpose of this committee at the time was to provide scientific and technical advice and assistance to participants and concerned parties involved in the Lady Slipper Road Forest Harvesting program and to oversee the monitoring efforts undertaken. In 2006, a new terms of reference was prepared for the committee, including the broadening of the focus of the committee to include all potential development activities within the watershed. Now, the ultimate goal of the Corner Brook Watershed Management Committee is to assist the City of Corner Brook in protecting its source water supply, to provide safe, clean drinking water for its citizens. To accomplish this, the committee is responsible to provide scientific advice and technical assistance to the City of Corner Brook and concerned parties to minimize the environmental impacts of the development and/or other activities which are considered by Council, and to ensure that approved undertakings are carried out in an environmentally acceptable manner. In 2006 it was decided by city council that the City of Corner Brook would undertake the development of a watershed management plan. Early in January of 2007, the City of Corner Brook partnered with the Model Forest of Newfoundland and Labrador to develop a Watershed

Management Plan for the City of Corner Brook. The Watershed Management Committee is comprised of multiple stakeholders that include representatives from the following groups/organizations:

- City of Corner Brook (Council and Staff)
- Neighbouring Communities
- Department of Environment and Conservation (Water Resources Management Division)
- Department of Natural Resources (Forestry Branch)
- Department of Government Services (Government Service Center)
- Health and Community Services (MOH)
- Corner Brook Pulp and Paper Limited
- Citizen's Representative (Appointed by Council)
- Model Forest of Newfoundland and Labrador
- Individuals or groups, government agencies or other industry stakeholders may be invited to attend one or more meetings to facilitate or address specific issues or problems

The Corner Brook watershed supplies drinking water to the majority of residents of Corner Brook, Mount Moriah, and to all of the residents of the Town of Massey Drive. It is in close proximity to both communities and is utilized for its recreational qualities and for its resources. Public uses in the watershed include walking/hiking, skiing, snowshoeing, snowmobiling, mountain biking, dog walking, fishing, hunting, ATV riding, berry picking and bird watching. In addition, the land within the watershed has historically been used for forest harvesting, aggregate pits and quarries, roads, mining exploration, and transmission lines. It is expected that all of the current recreational activities will continue to occur within the watershed. Commercial forestry operations will likely continue into the future, however the potential exists for other types of developments to occur as well. Any combination of these uses could threaten water quality if allowed to continue without a long-term management strategy.

The Corner Brook watershed is comprised of two (2) water supply areas, located in two different geographic areas. These include the Corner Brook Lake watershed, which includes the Trout Pond treatment area (supplying a population of approximately 15,000 residents), and the Burnt Pond watershed (supplying a population of approximately 5,000 residents). Both of these watershed areas will be discussed throughout this document, but the focus will be placed on the Corner Brook Lake watershed since it is anticipated that the Burnt Pond watershed area will be closed in the near future with the establishment of a new water treatment facility in the City. In cases where the document refers to the *Corner Brook watershed*, or the *Corner Brook water supply area*, it is referring to both watershed areas as a whole.

GOALS AND OBJECTIVES

The ultimate goal of the Corner Brook Watershed Management Planning Committee is to assist the City of Corner Brook in protecting its source water supply, and to provide safe, clean drinking water to its citizens. To accomplish this, the Committee is responsible to provide scientific advice and technical assistance to the City of Corner Brook via the larger watershed management committee and concerned parties, to minimize the environmental impacts of the development and/or other activities which are to be considered by Council, and to ensure that approved undertakings are carried out in an environmentally acceptable manner. The City of Corner Brook has chosen to take a multi-barrier approach for this watershed management plan. This method is comprehensive, and focuses on prevention of harmful actions within the watershed. Level 1 of this approach addresses protection of the source water. Watershed management plans such as this one also incorporate Levels 2 and 3, which are monitoring and public involvement respectively. In general, the specific objectives for this watershed management plan are as follows:

- The top priority of this watershed management plan is ***to protect the source water quality in the Corner Brook watershed***;

- Test the recently developed watershed management template for the Steady Brook watershed (authored by Debbie Hearn (2005) for the Model Forest of Newfoundland and Labrador);

- Develop an integrated watershed management plan for the City of Corner Brook's drinking water supply;

- Determine the impact of current and potential future activities in the Corner Brook watershed;

- Identify potential contaminants and their sources, and assess the risk of water quality impairment for all contaminants from all sources;

- Conduct a sensitivity analysis of the watershed using land cover, slope, land use and distance from intake, to provide a basis for the designation of land use zones and the management policies for these zones;

- Evaluate best management practices for compatible land uses in the watershed and evaluate/build upon environmental protection guidelines for all recommended land and water uses, which could minimize pollutant loadings from non-point sources including accidental spills;

- Evaluate and build upon long-term water quality monitoring programs as part of the integrated watershed management plan, to assist in establishing a water quality trend and taking appropriate action to protect water quality considering resource use;

- Assess the compatibility of the existing and proposed developments and associated operations in light of legislation and guidelines developed by the City of Corner Brook in accordance with the Water Resources Act and the City of Corner Brook Watershed Management Plan;

- Assess the environmental impacts of existing activities and recommend appropriate actions where warranted, to minimize undesirable effects on water

quality; and,

- Recommend measures to increase public awareness about the protected water supply area through public consultation, ensuring adequate sign posting, public notices, newspaper ads, and other means as appropriate.

REPORT ORGANIZATION

This watershed management report has been organized into the following sections:

Watershed Characterization	Describes the inventory of the natural features of the watershed, land ownership, land and water uses and the potential risks associated with these uses.
Potential Contaminants and Risk Assessment	Assesses the risk of potential contaminants and explains a sensitivity analysis based on land cover, slope, and distance from the intake(s).
Management Plan	Outlines the recommended regulatory and non-regulatory management components and the monitoring and reporting processes.
Implementation	Proposes an action plan for the implementation of the management plan and a process for review and amendment.

WATERSHED CHARACTERIZATION

Characterization of the watershed includes a description of the location, physiographic characteristics, natural resources, hydrology, water quality and quantity, ownership, and land and water uses.

LOCATION AND PHYSIOGRAPHIC CHARACTERISTICS

LOCATION

The Corner Brook water supply is comprised of two (2) different watersheds. These include the Corner Brook Lake watershed and the Burnt Pond watershed. Each of these will be characterized separately in this section of the management plan.

Corner Brook Lake Watershed:

The Corner Brook Lake watershed is located in Western Newfoundland, southeast of the City of Corner Brook (Figures 1 and 2). This is the main system that supplies most of the Corner Brook area (population 20,083), and the community of Massey Drive (population 1,170) (Statistics Canada, 2006). The watershed has a perimeter of approximately 70 kilometers and covers an area of 11,257 hectares (Trout Pond included). This system has a capacity of approximately 570 liters/second but usually operates at 50%. Corner Brook Lake and Eastern Lake are the two main sources of water in the Corner Brook Lake watershed area. Water flows into the lakes and its tributaries from the adjacent landscape, and then eventually flows into the Corner Brook Stream which originates at the north end of Corner Brook Lake. The water enters a diversion pipe along the Corner Brook Stream (approximately 6.5 km downstream from the outlet of Corner Brook Lake) and flows through an underground transmission main to Trout Pond (Figure 3), where the intake is located. This is the entry point for the source water that provides water to most of City. Water is treated at Trout Pond before entering the distribution system.

Burnt Pond Watershed:

The Burnt Pond watershed is located in Western Newfoundland, just west of the city near Lundrigan Drive. The majority of this watershed lies within the Corner Brook municipal boundary. This system supplies a portion of the upper west side of Corner Brook, Curling (population 2,000), and the community of Mount Moriah (population 752) (Statistics Canada, 2006). The main bodies of water that comprise the Burnt Pond watershed are Burnt Pond, Second Pond and First Pond, with a total catchment area of approximately 958 hectares, and a perimeter of approximately 18 km (Figure 4). Burnt Pond is a catchment for water from the surrounding hills. A pumping system at Burnt Pond pumps water into Second Pond which is linked to First Pond via a canal. Water runs by gravity flow from Second Pond to First Pond. The intake for Curling residents is located at First Pond, and the water is treated at First Pond prior to entering the distribution system. This system has a capacity of approximately 95 liters/second but usually operates at 50%. Usage of this system can vary greatly depending on the needs of the local fish processing plants. The pump at Burnt Pond also supplies water to a steel reservoir for a portion of the west side of Corner Brook (Sunnyslope area), and diverts water (just south of Second Pond) to a steel reservoir on Lundrigan Drive. (Keeping, 2004).

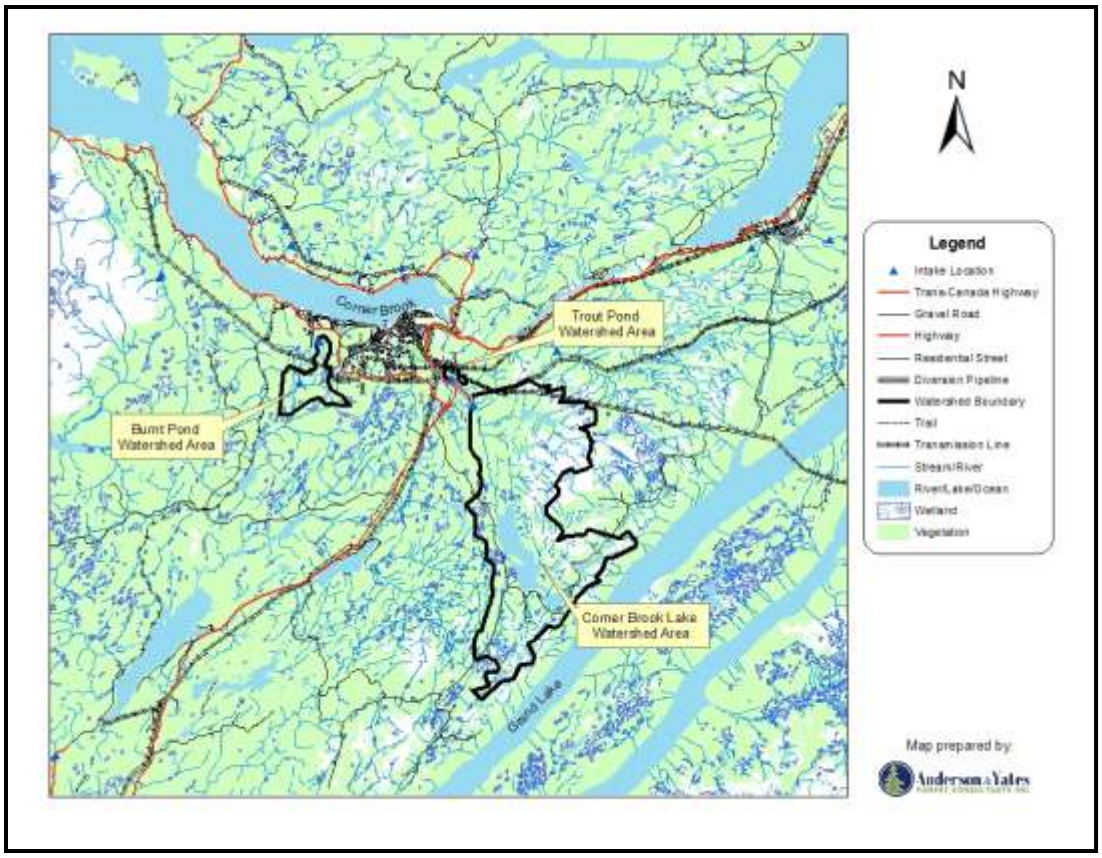

Figure 1. Overview map of the Corner Brook, Trout Pond and Burnt Pond watersheds.

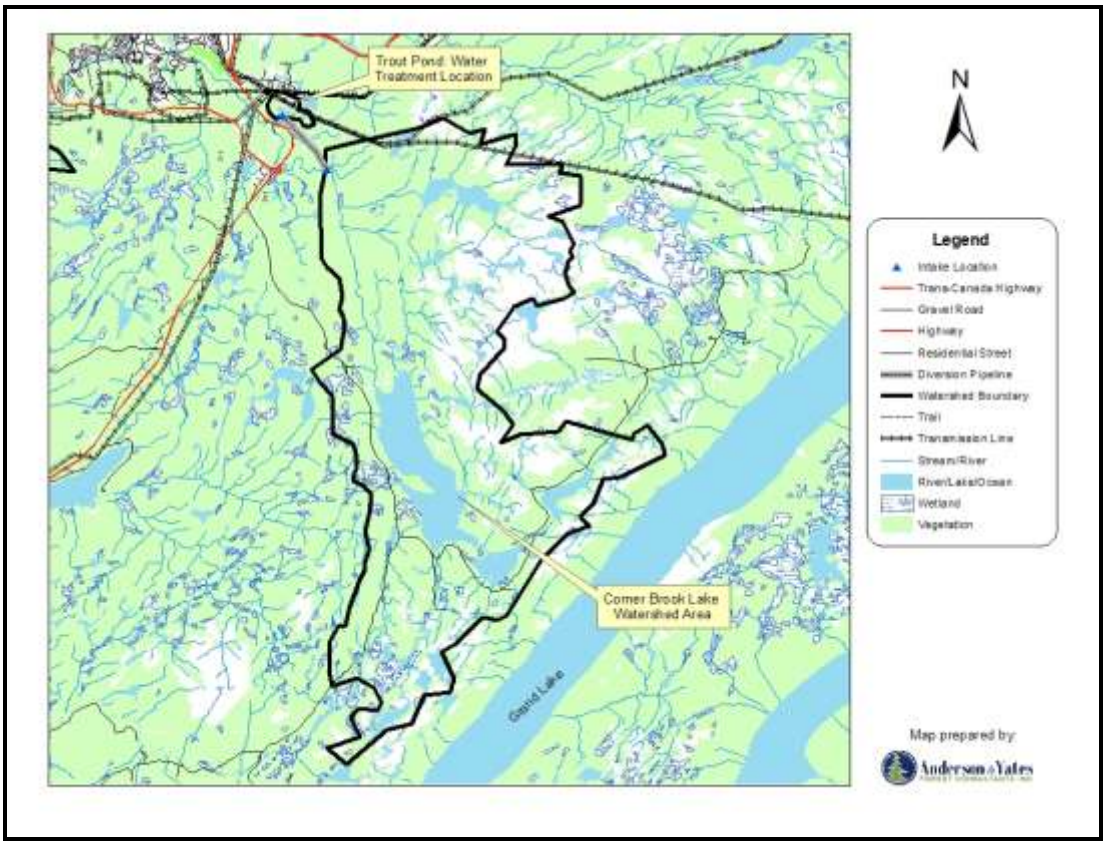

Figure 2. Map of the Corner Brook Lake watershed.

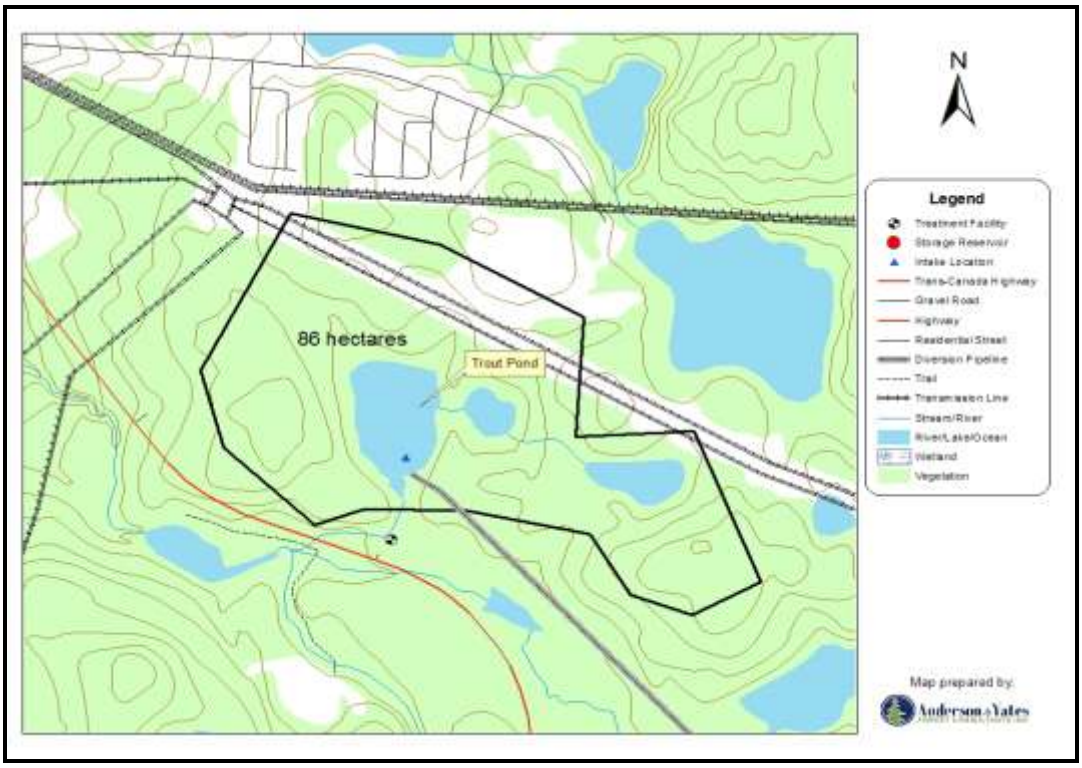

Figure 3.Map of the Trout Pond portion of the Corner Brook Lake watershed.

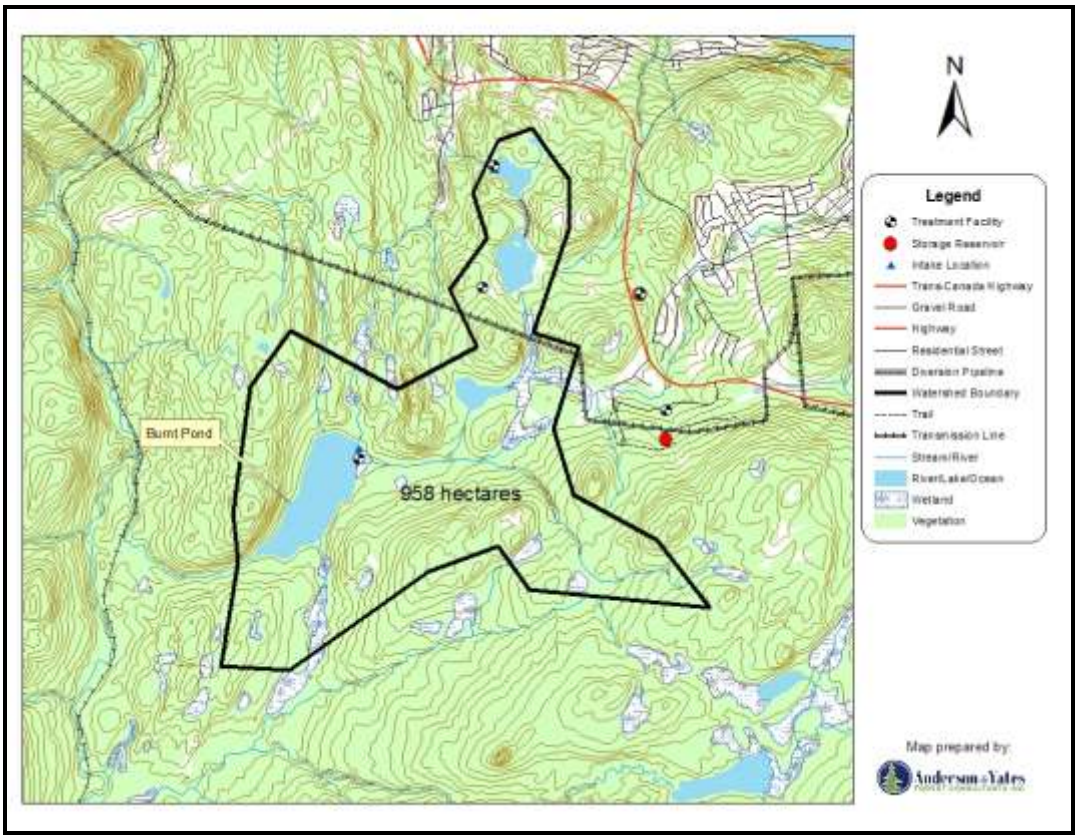

Figure 4.Map of the Burnt Pond watershed.

ECOREGION

Damman, (1983) subdivided the island of Newfoundland into ecoregions to reflect differences in regional climate. Within each ecoregion, the ecological relationship between species and habitat is basically similar. The Corner Brook watershed belongs to the Western Newfoundland Ecoregion (Figure 5), one of nine ecoregion classifications. Some of the ecoregions are further broken down into subregions, based on major variations in climate and rock formation. The Corner Brook watershed is located in the Corner Brook subregion.

The Corner Brook subregion is described as hilly to undulating terrain. The parent materials in this subregion are dominated by slates and limestone till. Areas with calcareous till are distinguished by the occurrence of light colored marl deposits around ponds and in valleys. The parent material consists of shallow, stony silt loam underlain

by limestone bedrock or calcareous basal till. The rugged topography is dominated by the *Taxus-Balsam Fir* and *Dryopteris-Rhytidiadelphus-Balsam Fir* forest types.

The hilly, non-calcareous terrain in this subregion is dominated by shallow loamy soils over shale bedrock. However, the shallowness of the till does not adversely affect forest growth since nutrient rich seepage waters are held in the rooting zone by bedrock or a fragipan layer. The steep topography is dominated by the Dryopteris-Balsam Fir forest and supports some of the most productive forests in Newfoundland.

WESTERN NEWFOUNDLAND FOREST

A. Serpentine Range Subregion
B. Corner Brook Subregion
C. Port au Port Subregion
D. St. Georges Bay Subregion
E. Codroy Subregion
F. Bay d'Espoir Subregion

STRAIT OF BELLE ISLE BARRENS

CENTRAL NEWFOUNDLAND FOREST

A. Northcentral Subregion
B. Red Indian Subregion
C. Portage Pond Subregion
D.Twillick Steady Subregion

NORTH SHORE FOREST

NORTHERN PENINSULA FOREST

A. Coastal Plain Subregion
B. Beaver Brook Limestone Subregion
C. Northern Coastal Subregion
D.Eastern Long Range Subregion

AVALON FOREST

MARITIME BARRENS

A. Northeastern Barrens Subregion
B. Southeastern Barrens Subregion
C. South Coast Barrens Subregion

EASTERN HYPER – OCEANIC BARRENS

LONG RANGE BARRENS

A. Southern Long Range Subregion
B. Buchans Plateau-Topsails Subregion
C. Northern Long Range Subregion

WESTERN NEWFOUNDLAND FOREST

A. Serpentine Range Subregion
B. Corner Brook Subregion
C. Port au Port Subregion
D. St. Georges Bay Subregion
E. Codroy Subregion
F. Bay d'Espoir Subregion

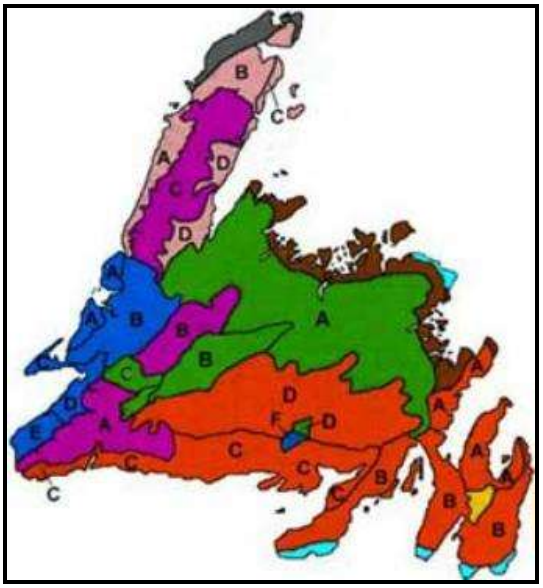

Figure 5. Ecoregions of Newfoundland. (Government of Newfoundland and Labrador; Department of Natural Resources, 2009)

HYDROLOGY

Corner Brook Lake Watershed:

The Corner Brook Stream flows from south to north, originating at Corner Brook Lake. The water within the watershed flows north from the high points of land in the south, and west and north from the high points of land in the east. Water flows into the Corner Brook Stream, which then flows approximately 15 kilometers northwest of Corner Brook Lake until it reaches the Humber Arm of the Bay of Islands in downtown Corner Brook. This stream is fed mainly by Eastern Lake and Corner Brook Lake and forms the main water supply for the City of Corner Brook. At the point where Corner Brook Stream leaves Corner Brook Lake, the stream flows approximately 6.5 kilometers before entering a diversion pipe along the Corner Brook Stream, which diverts the water to Trout Pond.

Burnt Pond Watershed:

Water in the Burnt Pond watershed is collected in Burnt Pond by water runoff from the surrounding hills. From Burnt Pond water is pumped northeast into Second Pond in and east to a steel reservoir near Lundrigan Drive (which supplies a portion of the west side of Corner Brook). Water from Second Pond flows through a gravity forced diversion pipe into First Pond, where the intake for the Curling and Mount Moriah water supply is located.

GEOLOGY

Water is subject to the hydraulic and chemical properties of bedrock and overlying formations, determining its quantity and quality (DEL, 1992). Rocks vary in properties such as porosity and permeability, affecting the rate of infiltration of rainwater into the ground, which determines the amount of surface runoff. The solubility of rocks, for example, determines what chemicals might be leached into the groundwater. The geology of an area influences the location and yield of groundwater resources, which are also the sources of surface water.

The rocks in the Corner Brook watershed area are mostly metamorphic, derived from sediments, with some granitoid gneisses. This is one area which is marble rich. In terms of water, limestone and/or marble will buffer acidity in the water but most of the area indicated is underlain by rocks that would do little to buffer acidity. The chemical properties of the water are in part inherited from the underlying bedrock.

The surficial geology of an area determines the occurrence and movement of water. The surficial geology of the watershed is predominantly exposed bedrock, or bedrock concealed mainly by forest, scrub or peat bog (Batterson, 2001). With little or no surficial sediment, infiltration of rainwater into the ground is poor, resulting in significant surface runoff. Waterways draining these areas rise rapidly with heavy rains.

SOILS

According to Roberts (1983), the dominant soils of the forested uplands and slopes of the Corner Brook Subregion are orthic humo-ferric podzols and orthic ferro-humic podzols, some of which are gleyed in the lower B horizon. This agrees with Wells et al. (1972), who classified soils in the greater Corner Brook area by reconnaissance land classification. Overall the soils are stony, loamy sands or sandy loams, with drainage ranging from moderate and imperfect to good.

The presence of limestone and shale bedrock and tills derived from these calcareous substances and soil seepage (lateral movement of moisture on slopes) are the most important factors for tree growth (Roberts, 1983 and Meades & Roberts, 1992*).* The major site variables are: landform, soils, drainage, moisture and fertility gradients and understory vegetation. A prominent feature of this region is the presence of Marl ponds, sometimes called living limestone ponds. Significant soils in and around these ponds are Orthic Regosols and Rego Gleysols often with a mucky phase with very low trafficability.

TOPOGRAPHY

The Corner Brook Lake watershed is found in a hilly area with very irregular topography due to intense bedrock folding and faulting (Roberts, 1983). It is

mountainous, forested and intersected with a large number of water bodies. Corner Brook Lake is approximately 324 meters above sea level, and the surrounding hills reach as high as 655 meters. These surrounding hills are wind-swept, supporting a limited vegetation cover, mainly barren or tundra-like vegetation interspersed with bedrock exposure. Figure 6 shows slope and elevation maps for the Corner Brook Lake and Trout Pond watersheds, and Figure 7 shows slope and elevation maps for the Burnt Pond watershed.

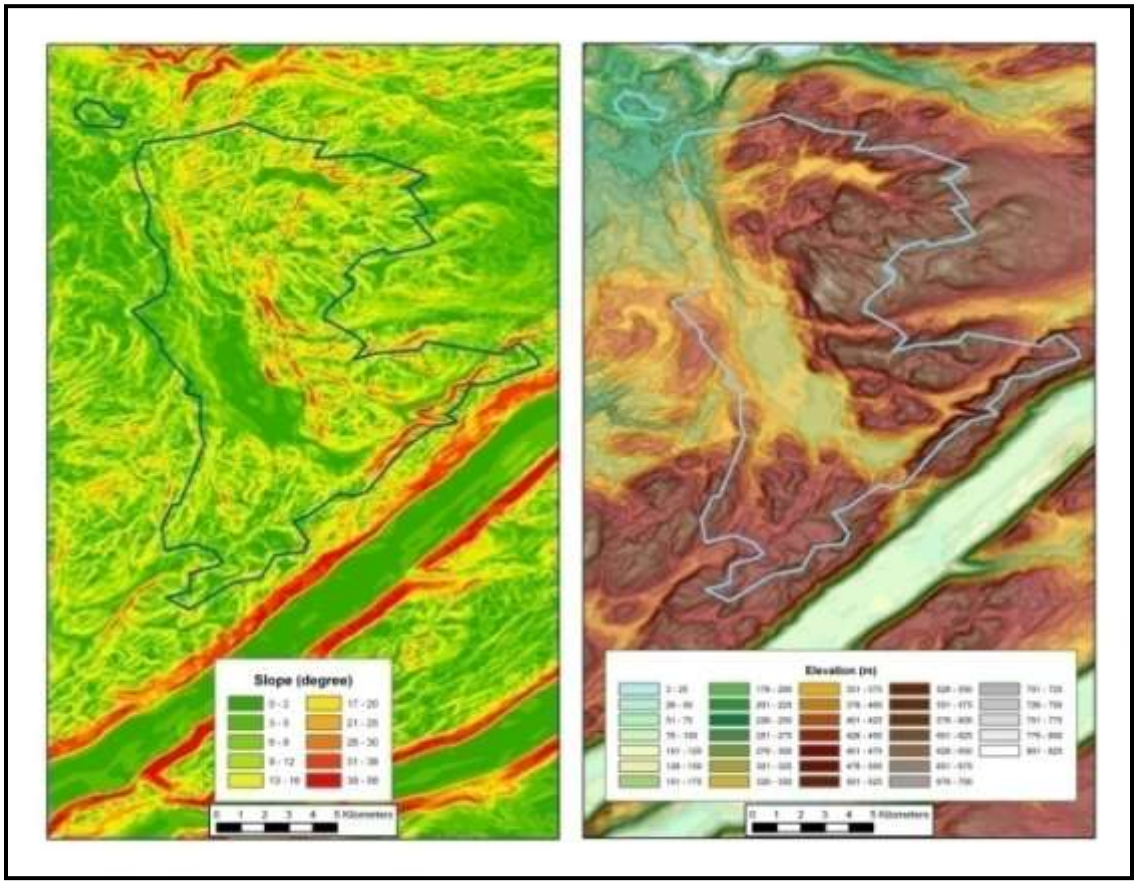

Figure 6. Slope (degrees) and elevation (meters) maps for the Corner Brook Lake and Trout Pond watersheds.

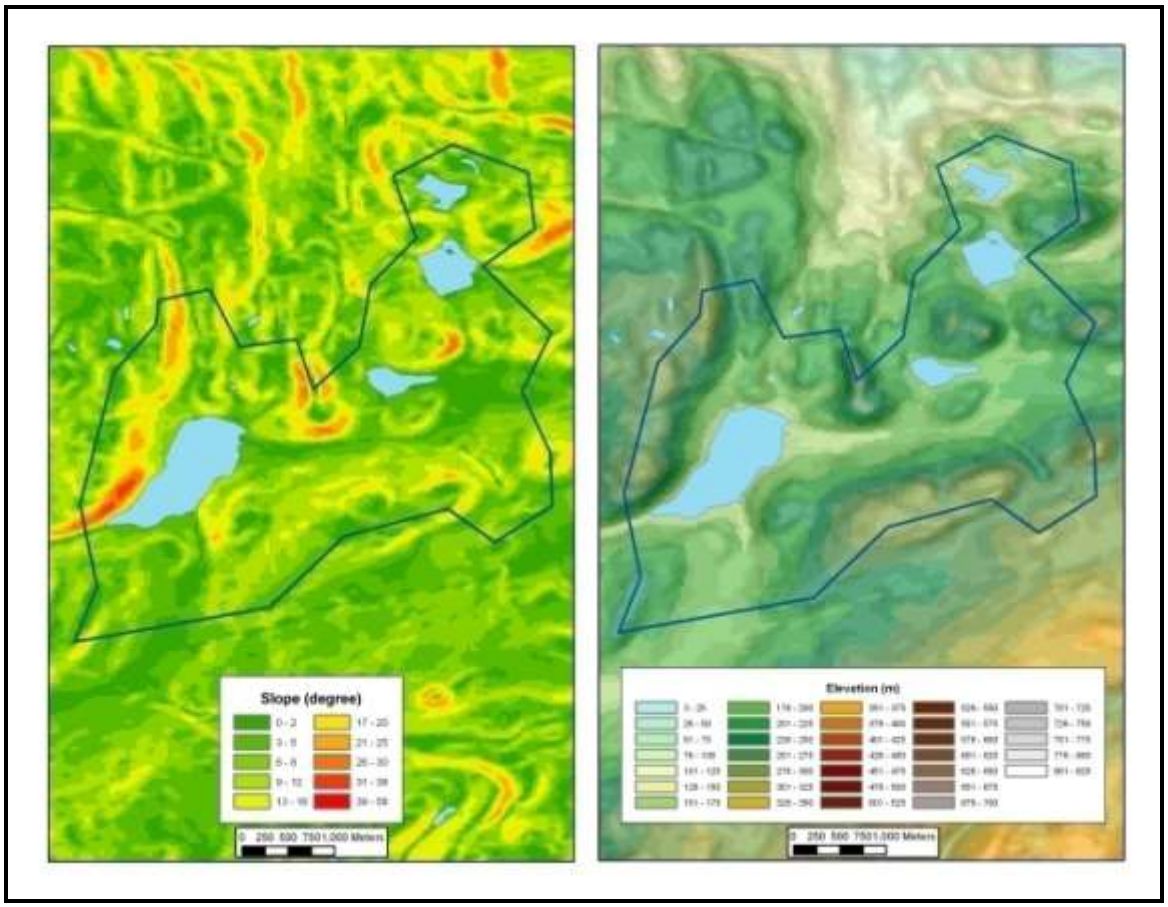

Figure 7. Slope (degrees) and elevation (meters) maps for the Burnt Pond watershed.

CLIMATE

The climate in the Western Newfoundland Ecoregion is one of the most favorable on the island with relatively warm summers and abundant precipitation (Damman, 1983). This temperate, maritime climate is influenced by the Gulf of St. Lawrence and the effects of the Long Range Mountains (Golder, 1983). Annual precipitation is between 125 and 160 cm (49-63 inches), the larger amounts associated with higher elevations (Banfield, 1983). Annual snowfall averages 400 cm (157 inches). Mean January temperature is -10 ^{o}C and mean July temperature ranges from 16 ^{o}C in valleys to 13 ^{o}C in the highlands (DFRA, 2002). The frost free period averages 110 days at the lower elevations and the growing season is between 130 to 160 days.

NATURAL AND HISTORIC RESOURCES

To better describe the land within the Corner Brook watershed, a forest-based classification has been used. Table 1 breaks down the watershed into 4 major classes: fresh water, productive forest (capable of producing > 30 m^3/ha at harvesting age), non-productive forest, and non-forested land. Within the Corner Brook watershed, the largest class is productive forest, at 52.1% of the area of the watershed. Next is non-productive forest (18.2%), followed by non-forested land (15.3%), and fresh water (14.4%).

Table 1. Land class distribution in the Corner Brook watershed.

Land Class:	Area (ha):	%
FRESH WATER:	**1,764**	**14.4**
PRODUCTIVE FOREST:	**6,363**	**52.1**
NON PRODUCTIVE FOREST:	**2,219**	**18.2**
Softwood Scrub:	2,162	
Hardwood Scrub:	57	
NON FORESTED LAND:	**1,869**	**15.3**
Rock Barren	1,111	
Soil Barren	220	
Bog	488	
Right of Ways	35	
Cleared Land	15	
TOTAL:	**12,215**	**100**

WATER

Water Supply System

The water supply distribution system in Corner Brook was first developed in the early 1920's. Much of the infrastructure is still in use in the lower townsite area. The first intake was installed at Three Mile Dam. In 1991, the Trout Pond chlorination building

was installed. In 2006 the system was modified and a new intake was installed at Trout Pond. In 1973 and 1982 Third and Second Pond had chlorination buildings installed respectively; both were upgraded in 2006. These were used to supply the communities of Curling and Mount Moriah (Warford, Personal Communication, 2008).

The Corner Brook water supply consists of three (3) intakes. One is located at Trout Pond and is the entry point for the main Corner Brook water distribution system. Trout Pond has a small catchment area, and is kept full by a diversion pipe running from Corner Brook Stream, approximately 2.3 kilometers southeast of the intake. A second intake is located in Burnt Pond, which is filled by water from the surrounding hills and streams. At this location, water enters the intake, and is pumped to Second Pond. Before reaching Second Pond, a line branches off to the east. This line travels to a treatment facility near Lundrigan Drive, and supplies a portion of the Westside of Corner Brook. Also, after entering the intake at Burnt Pond, water flows past the branch, and into Second Pond. At Second Pond, water flows via gravity down into First Pond, where the third intake is located. Here (at First Pond) water again enters an intake and supplies the communities of Curling and Mount Moriah. At the intake location, there are screen chambers that keep fish and other debris from entering the distribution system.

Within the Corner Brook water supply system, there are five (5) treatment facilities which treat the water prior to it reaching residential areas. These treatment facilities are strategically located around the City. There are three main treatment facilities which treat the source water before entering the distribution system (Figure 8). These are located at (1) Trout Pond, (2) Second Pond, and (3) First Pond. In addition to these main treatment facilities, there are two other post treatment facilities (*Booster Chlorinators*) which further treat the water that is in the distribution system (Figure 9). These are located near each of the two (2) storage reservoirs at Lundrigan Drive.

There are three (3) storage reservoirs located in Corner Brook, which store water to be distributed to the City (Figure 10). One of the storage reservoirs is located at the top of Elizabeth Street, and the other two are located near Lundrigan Drive on the west side of Corner Brook. There are also eighteen (18) pressure regulating systems that regulate the

pressure of the water as it is distributed throughout the City. These pressure regulating systems reduce the pressure of the water at strategic locations to ensure that the pressure does not become too great within the distribution system. Figure 11 shows the location of the storage reservoirs, treatment facilities, and the intakes within the water supply system. Table 2 gives a summary of the water supply system.

Figure 8. Water treatment facility at Trout Pond (photo by Adam Anderson).

Figure 9. Post-water treatment facility near Lundrigan Drive. (photo by Adam Anderson).

Figure 10. Storage reservoir at Elizabeth Street. (photo by Adam Anderson).

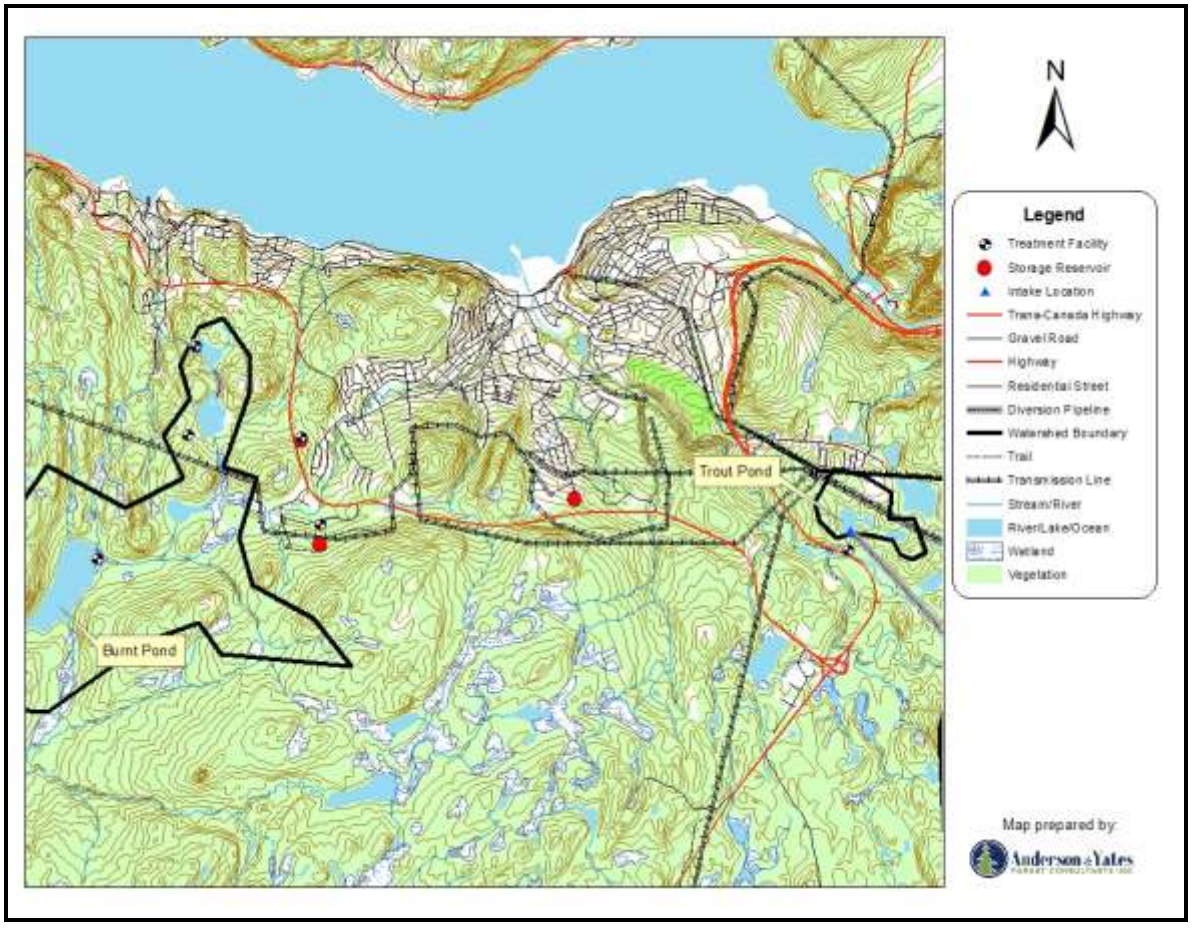

Figure 11. Location of infrastructure for the Corner Brook water supply.

Table 2. Water supply system and treatment details.

Feature	Details
Intake Locations:	Corner Brook Lake: Trout Pond Burnt Pond: - One located at Burnt Pond - One located at First Pond
Supply Area (at present):	Corner Brook Lake: Corner Brook (all of eastside, portion of Westside) and Massey Drive. Burnt Pond: Portions of west side of Corner Brook. First Pond: Curling and Mount Moriah.
Population Serviced:	Corner Brook Lake: 15,077 residents. Burnt Pond: 1,910 residents. First Pond: 3,116 residents.
Adequacy of Supply:	Corner Brook Lake: Adequate supply. Burnt Pond: Adequate supply (but will be decommissioned when the new treatment facility is created).
Existing Structures:	- 3 Intakes - 3 Storage Reservoirs - 5 Treatment Facilities - 18 Pressure Regulating Systems - Series of Diversion Pipes
Storage Reservoirs:	3 Storage Reservoirs: - Top of Elizabeth St. - Route 450 (just south of intersection with O'Connell Dr.) - Lundrigan Drive (Near Family Adventure Park)
Pressure Regulating System:	- There are 18 located at critical points throughout city. They reduce the pressure of the water at strategic locations to ensure that the pressure does not become too great within the distribution system.
Treatment Methods:	- Screen at intake locations keep fish and large debris from entering the system. - Source water is treated with Chlorine when entering the distribution system and while in the distribution system.
Water Quality:	- 69 boil orders since the beginning of 2006. - Only one of these was due to the presence of Total Coliforms. - all others were precautionary boil orders after upgrades and maintenance. - THM's are consistently high.
Daily Capacity:	Corner Brook Lake: 570 liters/second. Burnt Pond: 95 liters/second.
Daily Usage:	Corner Brook Lake: Approximately 280 liters/second (~50%). Burnt Pond: Approximately 50 liters/second (~50%).
Sampling Frequencies:	- Department of Environment and Conservation: Source water and tap water is tested quarterly for chemical and physical parameters. - City of Corner Brook: Tap water has residual checks every Monday/Wednesday/Friday, and Bacteriological sampling every Wednesday. Also daily checks at each chlorination facility; 1-2 patrols of watershed/week; - Department of Government Services and Lands: tap water is monitored for microbial parameters at least twice per month.

Water Quality Data

Monitoring of drinking water quality in Newfoundland and Labrador is the responsibility of the provincial government. Drinking water is monitored for chemical and physical parameters by the Department of Environment and Conservation (Water Resources Division) and samples are taken from the source (lake, pond, river etc.) and from the tap. Chemical and physical monitoring is generally done twice per year, except for Trihalomethanes (THM's) and Haloacetic Acids (HAA's), which are monitored seasonally. Monitoring for microbiological parameters is the responsibility of the Department of Government Services and Lands and samples are taken from tap water only. Bacteriological testing of tap water is conducted in communities across the province routinely, the frequency based on population and number of water supplies per community (White, Personal Communication, 2008).

The City of Corner Brook also conducts its own testing to evaluate the water quality. Municipal staff conducts residual tests every Monday, Wednesday and Friday and bacteriological tests every Wednesday. The chlorine residual testing occurs at the following locations: Corner Brook Works Depot, Canada Games Center, Myles Groceteria, Bud's Auto Body, Pennell's Ultramar, Hunts Convenience, City Hall, St. Gerard's School, Rideout's Tools, Riverside Drive Hydrant #2, Massey Drive Town Hall, Massey Drive Meter Chamber – Crocker's Road, and at Sir Wilfred Grenfell College. Residual testing is completed at the Riverside Drive location five (5) days a week. The increased sampling at this location is because it is at the end of the water distribution system, and it allows the city to ensure that its chlorine residuals are adequate all the way to the end of the system (Kennedy, Personal Communication, 2008). Bacteriological testing occurs every Wednesday at the following locations: Corner Brook Works Depot, City Hall, Massey Drive Town Hall, St. Gerard's School, Bud's Auto Body, Pennell's Ultramar, and Hunt's Convenience.

The province uses the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) as the standard against which test results for all parameters are compared. These guidelines can be seen in Appendix A. Complete reports of all chemical and physical

parameters tested for the Corner Brook Lake (Trout Pond), Burnt Lake and Second Pond water supplies, for both source and tap water, can be found in Appendix B. These reports show the trends in water quality from 1997 for source water and from 2000 for tap water, to 2008.

A discussion of the results of water quality testing for the Corner Brook water supply follows. Although many parameters are tested, only those that have exceeded the *Guidelines for Canadian Drinking Water Quality* will be discussed. For more information about parameters that have exceeded the guidelines, the reader is encouraged to refer to the most recent publication of the annual report *Drinking Water Safety in Newfoundland and Labrador.* This is available for viewing on the Provincial Government website.

Source Water

Source water samples are collected directly from the source such as lake, pond or stream prior to disinfection or other treatment. The source water quality is analyzed to determine the quality of water that flows into the water treatment and distribution system. Monitoring of source water quality is the most important tool to assess the impact of land use changes on source water quality and to ensure the integrity of a public water supply.

The quality of source water is a direct indicator of the health of the ecosystem that makes up the watershed area. Sampling results show that in comparison with the *Guidelines for Canadian Drinking Water Quality*, the quality of the chemical and physical parameters of the Corner Brook water supply since sampling began, up to and including 2008, has been generally good. Although two parameters, color and pH, exceeded the guidelines for many of the samples, these parameters are aesthetically significant parameters and thus are not a safety risk (DOE, 2001). At all three sampling locations (Trout Pond, Burnt Lake and Second Pond) the value for color was consistently higher than the guidelines, and the pH value was occasionally lower than the guidelines. High color and low pH values are typical of waters in Newfoundland and Labrador, due to large amounts of organic materials produced by bogs, swamps and boreal forest.

On one occasion, the concentration of iron exceeded the parameters when sampled at Trout Pond (January, 2000). Also, sampling at Burnt Pond showed high turbidity on three separate sampling occasions (May 2003, November 2004, and August 2006). The same parameter (turbidity) was high on two occasions when sampled at Second Pond (October 2002, and August 2006). Turbidity is a measure of how cloudy water appears and results from suspended solids and materials in the water. Increased turbidity causes drinking water to be less aesthetically pleasing and may interfere with the disinfection process. The slightly increased turbidity was probably caused by naturally occurring silt and sediment runoff. As with color and pH, the guidelines for these parameters (iron and turbidity) are aesthetic, and cause no safety risk. High levels of either, however, may cause unpleasant tastes and staining of laundry.

Tap Water

Tap water and source water samples are collected by the Department of Environment and Conservation (Water Resources Division) semi-annually or quarterly from drinking water faucets of one of more homes, public buildings, or businesses in the City. Tap water testing is conducted approximately three quarters of the way along the distribution system, in accordance with criteria established in the Guidelines for Canadian Drinking Water Quality (GCDWQ). The City also conducts residual checks every Monday, Wednesday, and Friday, and Bacteriological sampling every Wednesday from the taps of homes, public buildings, or businesses within the City. Tap water quality is monitored so that water being consumed at the tap can be compared with the untreated source water quality. Any variations between source and tap water quality represents the effectiveness of the treatment and disinfection system, and the influences of the distribution system due to plumbing in local homes, public buildings, or businesses.

Tap water samples similarly exceeded the aesthetic guidelines in color, pH, and turbidity. As with the source water, color, pH and turbidity are aesthetically significant parameters and thus are not a safety risk.

Tap water is also tested for Trihalomethanes (THMs), by-products of chlorination. THM's are one of many Chlorine Disinfection By-products (CBP) commonly found in treated drinking water. They result primarily from reactions between chlorine or bromine and naturally occurring organic compounds. Sampling is conducted in the spring, summer, fall, and winter to account for seasonal variation and to allow for comparison with the national guidelines. The Guidelines for Canadian Drinking Water Quality, Sixth Edition, recommended an interim maximum acceptable concentration of 100 micrograms per liter (µg/L) for THM's in drinking water, based on a running annual average of quarterly samples. Based upon a report supplied to the City of Corner Brook by the Department of Environment and Conservation for the 2007 fiscal year, the THM levels for each of the sample areas are as follows:

- Trout Pond: 111.8 µg/L

- First Pond: 70.8 µg/L

- Burnt Pond: 142.1 µg/L

Corner Brook THM data (Appendix B) show that the THM concentration is consistently above the guidelines set out in the GCDWQ. This can be attributed to the fact that the City of Corner Brook is "super-chlorinating" the drinking water to maintain the required chlorine residual and lessen the risk of infections caused by *Giardia lamblia* and other micro organisms. Current scientific data shows that the benefits of chlorinating drinking water are much greater than any health risks from THM's and other CBP's.

High THM concentrations in Newfoundland drinking water is not uncommon, as indicated in a Water Resources Division report, where 56% of the province's water supplies having sufficient data for analysis (82), were below the guidelines. As with the frequent incidence of high color and low pH values mentioned previously, the level of THM's is directly related to the presence of organic materials. At certain levels, THM's pose a significant risk for the development of cancer and possibly reproductive and developmental effects. The present guideline for THM's set by Health Canada is currently being reviewed.

Haloacetic acids (HAAs), another group of compounds formed as a result of chlorination, are currently being monitored to help in the development of a national guideline. HAA's pose health risks similar to THM's, but have caused no major problems in Corner Brook drinking water.

Microbiological Parameters

Over the past two years, 69 boil orders have been issued in Corner Brook, Massey Drive, Curling and Mount Moriah (Kennedy, Personal Communication, 2008). Only 1 of these boil orders were due to the presence of Total Coliform counts. The remaining boil orders were issued due to upgrades and maintenance to the water distribution system. Upgrades and maintenance do not necessarily lead to water contamination, but boil orders are issued after work is completed on the distribution as a precautionary measure.

The presence of *Escherichia coli* is evidence of fecal contamination; animal or human. One particular strain (*E. coli* 0157) is associated with livestock and agricultural operations and may cause severe illness (USDH, 2005). Given that there are no agricultural operations in or near the Corner Brook Watershed the probability of occurrence of this strain is low. *E. coli* is not uncommon in surface water supplies, where wildlife waste can contaminate the water (White, Personal Communication, 2007). Any evidence of the presence of *E. coli* requires the issuance of a boil order.

Monitoring for chlorine residuals also occurs with bacteriological testing, and the recommended levels are from 0.3 to 0.5 parts per million at the entrance to the community, with a detectable residual at the end of the system. These recommended levels denote adequate chlorination to safeguard the water supply against elevated bacteriological growth.

FOREST

Forest Description

The Corner Brook watershed, like all of Newfoundland, is a part of the boreal forest region. The boreal forest is a green belt which spans much of the northern hemisphere. It

is characterized, among other things, by the phenomena of periodic, stand-replacement, natural disturbances such as fire and insect outbreaks, which typically result in uniform, even-aged forests dominated by a few tree species.

The tree species which characterize the Canadian boreal forest include black spruce (*Picea mariana*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), eastern larch (*Larix laricina*), trembling aspen (*Populus tremuloides*), white birch (*Betula paprifera*) and jack pine (*Pinus banksiana*) (DFRA, 2002). All of these, with the exception of jack pine, occur commonly in Newfoundland. Black spruce and balsam fir are dominant species among those listed above; together they represent more than 90% of the growing stock on the island. In Western Newfoundland the climate is moist and fires are few, resulting in the ascendance of balsam fir, rather than the fire-adapted black spruce. Following harvesting, regeneration is typically abundant, and overstocking is a more common problem than under-stocking in Western Newfoundland. Localized regeneration failures can occur in forests with a very dense layer of fern and herb.

Tree species occurring in the watershed are shown in "working groups" in Figure 12 (Dept. of Natural Resources Inventory files). A working group describes the dominant tree species present in a forest stand. This species may occupy 100 percent of crown closure of a stand or may be present in association with other species. Figure 12 illustrates that 82% of the watershed is composed of predominantly balsam fir, in association with other species such as black spruce, white spruce and/or larch. The next most common working group is softwood hardwood at 9%, followed by black spruce at 4%.

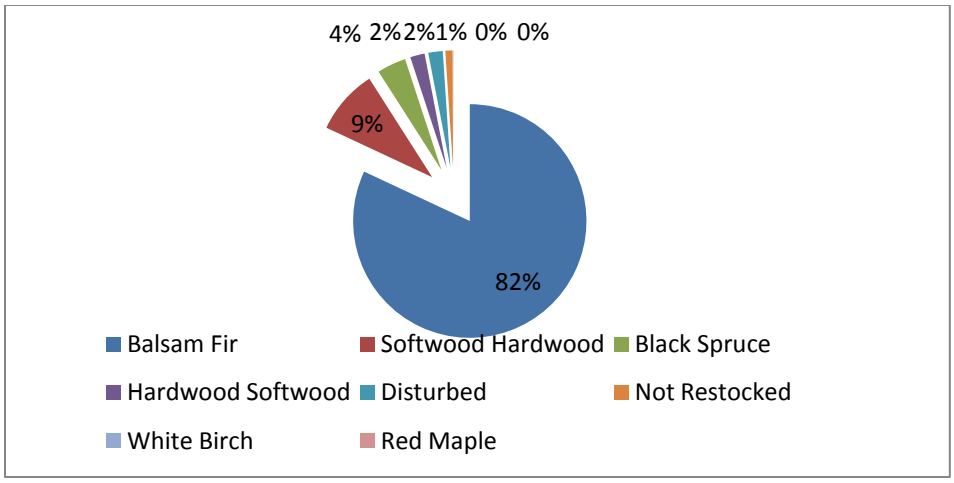

Figure 12. Working groups occuring in the Corner Brook watershed.

Figure 13 shows the forest age class structure in the Corner Brook watershed. The forest present in the watershed falls mostly in the age classes of 0-20, 81-100 and 101-120.

Figure 13. Forest age classes within the Corner Brook watershed.

The provincial Department of Natural Resources separates the forest into productive and nonproductive forest stands. A productive forest is generally a forest capable of

yielding a marketable product, such as sawlogs or pulpwood. The area of productive forest within the Corner Brook watershed is 6,363 hectares. Productive forest can be further sub-divided along a gradient of productivity as poor, medium, good, or high site class. The site class is based primarily on a site's ability to produce timber. Site capability is determined by a number of factors, some of which include soil fertility, moisture regime and geographic (slope) position. The site capability for the Corner Brook watershed ranges from poor to good (Figure 14), with no "high" site classes.

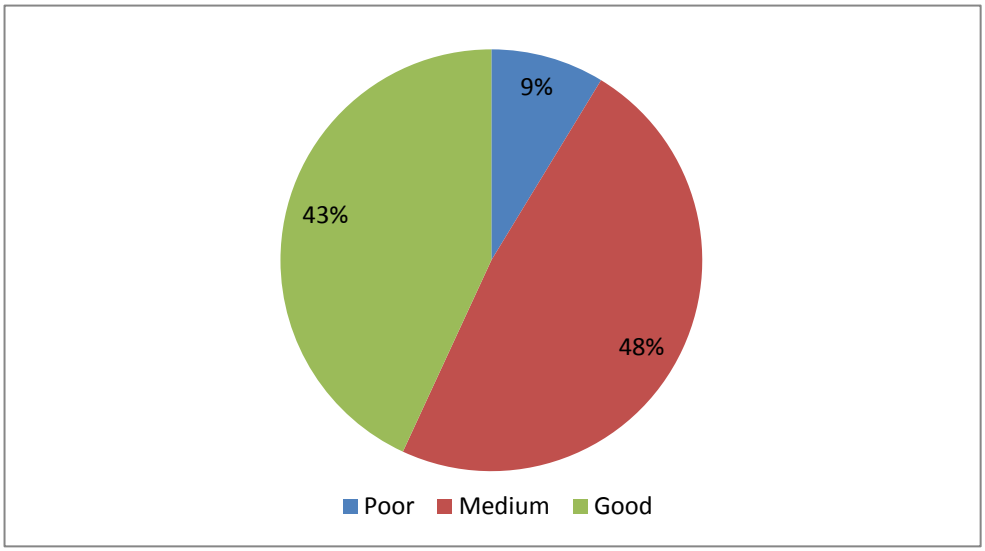

Figure 14. Site classes for the productive forest in the Corner Brook watershed.

Other Vegetation

Although a large number of understory plant species is associated with the existing forest, no field surveys to identify such plants were conducted in the watershed as a part of this project. In 1999, a 3-year Newfoundland Rare Plant Project was initiated by the Inland Fish and Wildlife Division (IFWD), to document distribution and density of, as well as disturbance and threats to, vascular plants of conservation concern. Neither of the two Corner Brook watersheds were visited as part of the Newfoundland Rare Plant Project nor have they been formally searched for rare plants. However, there are records of rare plants in the vicinity of both the Burnt Pond and Corner Brook Lake watersheds. Showy Ladyslippers, with an S2 rank (S= sub-national; and 2 = imperiled;1-5 scale with 1 being most at risk) were found at the edge of the Blow-Me-Down cross-country ski

park close to the Burnt Pond watershed and near Eastern Lakes within the Corner Brook Lake watershed. The plant has also been seen in several rich, wet places with rich soil in the Corner Brook area including the area behind Mt. Moriah near Logger School Road. The region has a large number of plants unique to the area due to the distinctive geology and climatic conditions of the area (Natalie Djan-Chekar, Personal Communication, 2007).

Forest Disturbances

Characteristic of the boreal forest, some disturbances are classified as catastrophic, in which periodic stand replacement occurs as a result of natural disturbances such as insect outbreaks and fire. Forests with these types of disturbances generally result in even-aged stands dominated by just a few species. In addition to these natural disturbances, commercial logging has also taken place within the water supply areas, and will continue into the future. Forest management operations often emulate natural disturbances mentioned above, and create the same types of even-aged stands.

Within the Corner Brook water supply areas, the forests have been managed for their timber resources for many years. Historically, Corner Brook Pulp and Paper Limited (CBPPL) has harvested timber within the watershed boundaries to supply its pulp mill in Corner Brook. The planning process within the water supply areas is the same as that which would occur in the provincial legislation, unless there are any critical issues arising from external parties. Although the entire Corner Brook water supply is not a provincially Protected Water Supply Area (PWSA), all operations within the water supply boundaries are conducted in accordance with the provincial Protected Water Supply Area guidelines (Bruce Yates, Personal Communication, 2008). These guidelines can be seen in Appendix C. According to CBPPL staff, no other roads are planned to be built within the water supply areas in the future, since all road infrastructure is already in place as will be required for future operations. Also, within the water supply areas, there will be no spraying of chemicals for vegetative control, as is consistent with the PWSA guidelines, followed by CBPPL.

The entire Corner Brook Lake watershed is included in long term forest management plans prepared by CBPPL. Harvesting began within the watershed in the early 1920's, north of Corner Brook Lake, and the areas adjacent to Corner Brook Lake and Copper Lakes have since been harvested and regenerated. Many of the stands within the Corner Brook Lake watershed have been harvested twice. Logging within the Corner Brook Lake watershed will continue into the future, but no major logging activities are planned within the watershed boundary in the next 5 years (Bruce Yates, Personal Communication, 2008). Areas that were harvested in recent years may be planted and pre-commercially thinned in coming years.

Portions of the Burnt Pond watershed were also harvested in the past. A small portion of this watershed (southern portion) is also included in CBPPL long term management plans (Bruce Yates, Personal Communication, 2008). No harvesting has taken place here in some time, and none is planned within the watershed in the next 5 years. Forest management operations may however take place in the future in the southern portion of the Burnt Lake watershed.

Insects have had a major impact on forests in Newfoundland and Labrador in the past, and will continue to impact them in the future. There are five main insect species that have a significant impact on the province's forests. They include the Hemlock Looper (*Lambdina fiscellaria*), Balsam Fir Sawfly (*Neodiprion abietis* (Harris)), Spruce Budworm (*Choristoneura fumiferana* (Clemens)), Balsam Woolly Adelgid (*Adelges piceae* (Ratzeburg)), and Birch Casebearer (*Coleophora salmani* (Heinrich)) (Sustainable Forest Management Plan, CBPPL, 2004). Two of these are major defoliators that maintain the dynamics of the Western Newfoundland balsam fir forest: Balsam Fir Sawfly and Hemlock Looper. There was a balsam fir sawfly outbreak in both water supply areas in 2000 and 2001 (southerly in 2000 and more northerly in 2001), and historically there has been hemlock looper present throughout the watersheds. The disturbance regime normally consists of an outbreak every decade. Since more than one hundred years the frequency and the intensity of the outbreaks seems to be stable (Jardon & Doyon, 2003).

Fire is a crucial disturbance factor in the boreal ecoregion. It facilitates the destruction of old, diseased trees along with the pests that are associated with those trees. Many animals are able to escape natural fires and some trees actually require fires to stimulate their reproductive cycles. Furthermore, the nutrient-rich ash left behind helps fuel plant growth. A patchy mosaic of plant communities left in the wake of fire action provides the variety required to sustain different species of wildlife. There is no recorded history of fire within the Corner Brook Lake watershed (Kerry Hutchings, Personal Communication, 2007), but the area within the Burnt Pond watershed was burned in the past.

WILDLIFE

Fourteen species of mammals are native to the island of Newfoundland; one, the wolf, is extinct (Dodds, 1983). All but one (Arctic hare) of the remaining thirteen are thought to be present in the watershed. Although no wildlife field surveys have been carried out in the Corner Brook watershed, information on species found or likely to be found in the area is provided by hunter and trapper license returns, various reports and publications, and personal communication with field staff of the Newfoundland Inland Fish and Wildlife Division (IFWD). A summary of local wildlife species, and in some cases their population status, is provided below. No reserves, sensitive wildlife areas, parks or areas closed to shooting, trapping or snaring occur in the Corner Brook watershed (Jana Fenske, Personal Communication, 2007).

Big Game

There are three species of large mammals that inhabit the forests in the Corner Brook area including moose, caribou, and black bear, with moose being the most abundant.

Moose were introduced to Newfoundland in 1904 to provide an additional food source for residents (Northcott, 1980). Population estimates for moose on the island are calculated by Moose Management Area (MMA). The Corner Brook Lake watershed is located within MMA 7, and the Burnt Pond watershed is located within MMA 6. The

most recent population estimate for moose was carried out in 2007. Tables 3 and 4 show the population estimates from this study. Figure 15 shows the Moose Management Areas within Newfoundland.

Table 3. Moose population estimates for Moose Management Area 6 (encompassing Burnt Pond watershed) (Doucet, Personal Communication, 2007).

	Adjusted population estimate for 1994	**Moose/km^2**	**Observed population estimate for 2007**	**Change**	**Moose/km^2**
Moose	4330 +/- 1015	2.06	7522 +/- 648	74%	3.58

Table 4. Moose population estimates for Moose Management Area 7 (encompassing the Corner Brook Lake watershed) (Doucet, Personal Communication, 2007).

	Adjusted population estimate for 1994	**Moose/km^2**	**Observed population estimate for 2007**	**Change**	**Moose/km^2**
Moose	2084 +/-218	1.42	1913 +/-249	8%	1.39

Caribou are native to the island and can be found in the Corner Brook watershed. Snow and Mahoney (1995) reported that the Corner Brook Lakes area supported a population of caribou with a relatively small home range. In 1998, the population of the herd was estimated to be about 700 animals (Doucet, Personal Communication, 2007). Currently, hunting of these animals is not permitted.

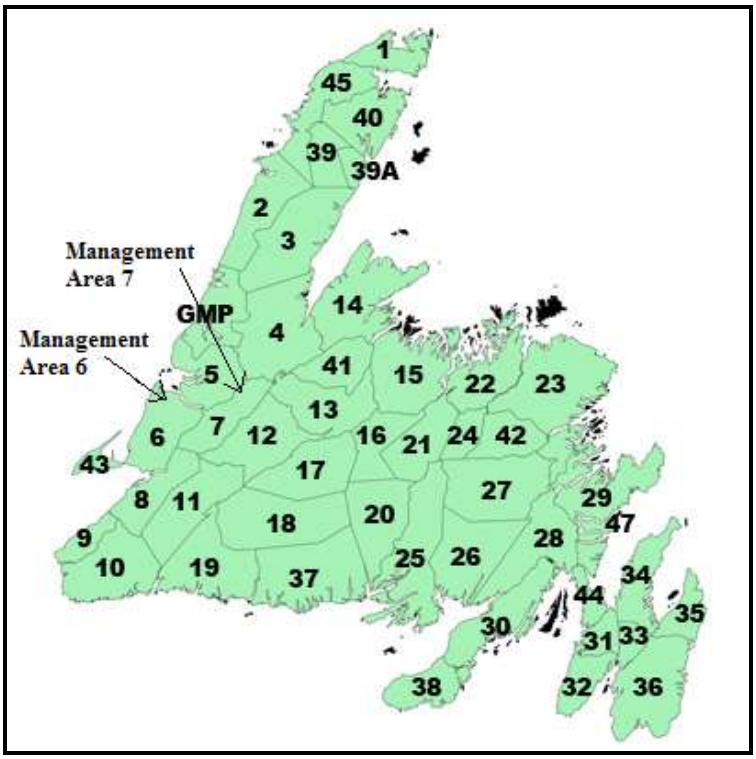

Figure 15. Moose and Bear Management areas in Newfoundland (Conservation, 2008).

Black bear is also native to the island of Newfoundland and is found in forested areas on the island (Northcott, 1980). No data is currently available on the number of black bears in Western Newfoundland (Doucet, Personal Communication, 2007). Generally, the population status of this species is tracked by information provided by hunters and the number of bear problems/sightings in communities. The Corner Brook watershed is located within Black Bear/Moose Management Area 7 (Figure 15). Hunting during the spring and fall seasons is permitted under a license in MMA 7. The number of black bears harvested in Management Area 7 for 1996 to 1999 were reported as 5, 3, 2 and 5 respectively. Actual harvest is probably twice that reported, as not all hunters report their harvest, and additional animals are taken as nuisance bears.

Small Game and Furbearers

Small game species likely to be found in the Corner Brook watershed are snowshoe hare (rabbit), willow ptarmigan, and ruffed grouse. Ten species of furbearers may also

occur: lynx, red fox, beaver, otter, muskrat, pine marten (discussed later), short-tailed weasel, red squirrel, mink and coyote. Of these, red squirrel, mink and coyote are not native. Table 5 below shows fur harvest in Fur Management Area 10 (Figure 16), of which the Corner Brook watershed is a part. Fur harvest data is compiled annually by fur zone by the Inland Fish and Wildlife Division and is not available for individual protected watershed areas.

Table 5. Fur harvest by species for Fur Management Zone 10 from 2001 – 2006.

Year	Beaver	Weasel	Colored Fox	Lynx	Mink	Muskrat	Otter	Red Squirrel	Coyote	Total
2001-2002	125	28	323	19	97	48	22	2	5	**669**
2002-2003	305	291	612	64	231	159	45	55	10	**1772**
2003-2004	321	263	519	27	244	32	57	12	13	**1488**
2004-2005	312	119	368	12	139	31	31	58	14	**1084**
2005-2006	397	116	370	12	279	67	29	176	11	**1457**
	1460	**817**	**2192**	**134**	**990**	**337**	**184**	**303**	**53**	

The Corner Brook Lake and Burnt Pond watersheds lie within Fur Management Zone 10 (Figure 16). There are four trappers with trap lines within the watershed. Fur Zone 10 trap line #302 encompasses the Burnt Pond watershed. Fur Zone 10 trap lines #331, #560 and #298 overlap the Corner Brook Lake watershed. Trap lines #302, 331 and 298 are active trap lines. Trap line #560 is closed for conservation reasons. Maps for these trap lines can be seen in Appendix D.

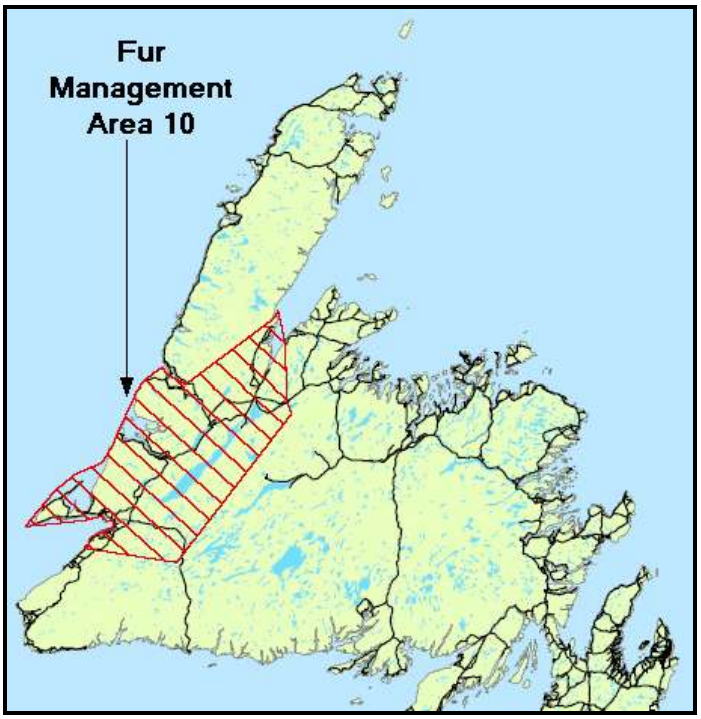

Figure 16. Location of Fur Management Zone 10 (Conservation, 2008) .

In 1996, the Newfoundland pine marten was listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and it was estimated that as few as 300 animals existed on the island (Forsey, et al., 1995). Both watersheds fall within the Western Zone as delineated by the Wildlife Division (the North Shore of Grand Lake modified snaring/trapping area lies within this). The Newfoundland Pine Marten (*Martes americana atrata*) is one of fourteen indigenous mammal species on the island of Newfoundland. A new population estimate was calculated in January 2007 using a compilation of location data collected from 1990 to 2005. The estimate of 'mature' Newfoundland marten (reproducing females and all males older than 12 months) ranges from 320 to 622 (Schmelzer, Personal Communication, 2007). These populations are concentrated in 5 areas with small pockets found in adjacent areas. The largest marten population is in the area of Little Grand Lake (see Figure 17).

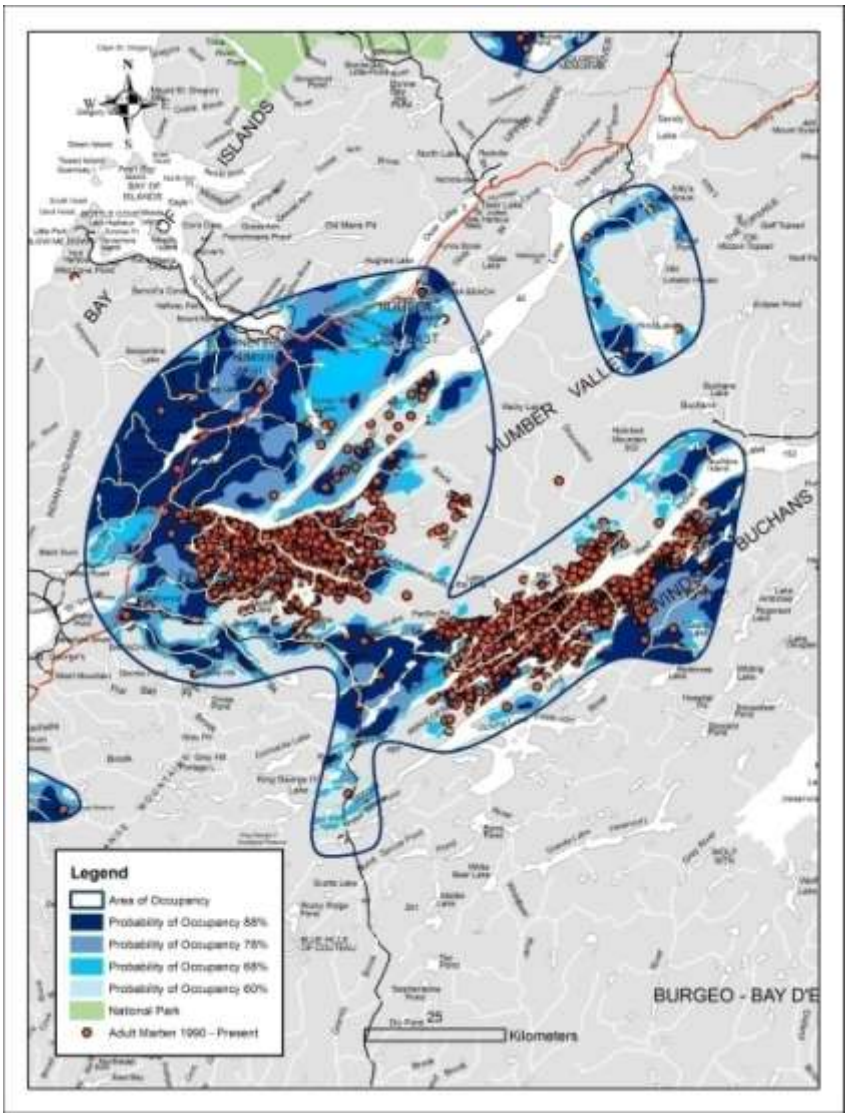

Figure 17. Pine Marten locations in and around the Corner Brook water supply area (Conservation, 2008).

Small Mammals

There are 23 species of small and medium-sized mammals in insular Newfoundland. Twenty of these species are present in the Corner Brook and Burnt Pond watersheds (Rodrigues, Personal Commuication, 2007). These include:

Common Name:	Scientific Name:
Northern Myotis (bat)	*Myotis keeni septentrionalis*
Little Brown Bat	*Myotis lucifugus lucifugus*

Eastern Coyote	*Canis latrans*
Northern River Otter	*Lontra canadensis*
Canada Lynx	*Lynx lynx*
American Marten	*Martes americana atrata*
Ermine	*Mustela ermine*
Mink	*Mustela vison*
Red Fox	*Vulpes vulpes*
Snowshoe Hare	*Lepus americanus*
Masked Shrew	*Sorex cinerius*
American Beaver	*Castor canadensis*
Southern Red-backed Vole	*Clethrionomys gapperi*
Meadow Vole	*Microtus pennsylvanicus*
House Mouse	*Mus musculus*
Muskrat	*Ondata zibethicus*
Deer Mouse	*Peromyscus maniculatus*
Norway Rat	*Rattus norvegicus*
Eastern Chipmunk	*Tamias striatus*
Red squirrel	*Tamiasciurus hudsonicus*

Inland Fish Species

Ouananiche (land-locked salmon), brook trout, rainbow trout, Arctic char, American eel, rainbow smelt, stickleback, banded killifish, mummichog and American shad can be found in inland waters in Western Newfoundland (Keefe, Personal Communication, 2007).

The only surveys that have been carried out for fish species in the Corner Brook watersheds are ‘creel surveys’ which investigate the recreational fishery. Since 2005, creel surveys have been carried out in three water bodies in the Corner Brook Lake watershed and one very near the northwestern corner of the same watershed near the Trout Pond catchment basin. There have been a combined total of seventy visits to these

four ponds in 2005 and 2006. All fish species were surveyed but recreational fishers are primarily interested in brook trout. As a result, only brook trout measurements/samples (N=7) were taken during these visits.

Avian Species

Montevecchi and Gosse (1995) recorded a total of nine bird of prey species within the Western Newfoundland Model Forest area during the spring and summer seasons of 1993 and 1994. They found that old growth balsam fir forests were utilized by more bird of prey species in comparison to second growth, clearcuts and pre-commercial thinnings. Whitaker (1997) reported 34 bird species, in 5 habitat selection guilds in Western Newfoundland (Copper Lakes Study area), and concluded that buffer strips left along riparian areas during harvesting will not protect habitat for interior bird species. Uncut blocks must be left across the landscape. Thompson et al (1999) reported 42 avian species in balsam fir forests in Western Newfoundland (study area ranged from the Upper Humber River valley, southward about 140 km, and west of Little Grand Lake). They found that the greatest number of species occurred in forest stands 40-59 years old, some species showed no preference for forest age or stand type, and two species were found only in the old growth forests.

Amphibian and Invertebrate Species

Amphibians are not native to the island but rather have been introduced at various times (Buckle, 1971 and Maunder, 1983). Species which have been introduced are the green frog, western chorus frog, northern leopard frog, mink frog, wood frog and the American toad. Little data is available on current distribution of these species. However, the IFWD are currently involved in a national program called "Frogwatch" which is relying on volunteers to carry out surveys for these species each spring. Frogs have been recognized to be important indicators of environmental changes and pollution. Decline or loss of frogs from areas they previously thrived in can be an early warning sign of an environment problem.

Meades (1990) reported that in Newfoundland, many groups of insects had not been thoroughly studied. However, those that have (aquatic insects, ground beetles, moths and

butterflies) provide us with clues to understanding the overall fauna. Meades (1990) also noted that the aquatic and terrestrial insect distributions correspond well with Damman's (1983) ecoregions of the island. It is known that there is limited distribution or absence of some boreal insect species which occur in adjacent continental areas, possibly due to the island's cold climate (Larson & Colbo, 1983).

MINERAL POTENTIAL

Within the Corner Brook Lake watershed, there is a known occurrence of kyanite. Kyanite is an anhydrous aluminosilicate mineral that has the same chemical formula (Al_2SiO_5) as alusite, and sillimanite but differ in crystal structure and physical properties. Occurrences of garnet are also known. Garnets are nesosilicates having the general formula $X_3Y_2(SiO_4)_3$. The harder varieties, like almandite, are often used for abrasive purposes.

A map of the surface and bedrock geology in the Corner Brook Lake and Burnt Pond watersheds can be found at http://gis.geosurv.gov.nf.ca. This website is hosted by the Government of Newfoundland and Labrador, Natural Resources Division. It contains an interactive map that allows users to add and remove geological and planning map layers for Newfoundland and Labrador.

HISTORIC RESOURCES

There are no historic archeological sites recorded in the Corner Brook Lake or Burnt Pond watersheds. It is known that palaeo-eskimo people utilized the Bay of Islands area (site near Cox's Cove in Middle Arm), so it is possible that Corner Brook Lake and Eastern Lake may have sites along their shorelines but none have been identified to date (Reynolds, 2007).

WATERSHED USE

WATER USE

The primary use of the Corner Brook watershed is to provide quality drinking water for the City of Corner Brook. The average daily consumption of water from the Corner

Brook Lake water supply area is approximately 24 million liters but has the capacity to supply approximately 50 million liters of water per day. The average daily consumption of water from the Burnt Pond watershed area is approximately 4 million liters but has the capacity to supply approximately 8 million liters of water per day (Warford, Personal Communication, 2008).

LAND USE

Historically, utilization of the Corner Brook watershed has centered on natural resources – forest harvesting (commercial and domestic), mineral exploration, fishing, hunting, and recreation. In more recent history, transmission lines and new recreational activities have added to the list of values. In order to ensure all values were identified, a survey was conducted with City residents to see how people are using the watershed(s). All of these uses and any associated management activities are outlined below.

Forestry

Within the Corner Brook water supply areas, the forests have been managed for their timber resources for many years (since the early 1920's). Historically, Corner Brook Pulp and Paper Limited (CBPPL) have harvested timber within the watershed boundaries to supply its pulp mill in Corner Brook. The planning process within the water supply areas is the same as that which would occur in the provincial legislation, unless there are any critical issues arisen by external parties.

The entire Corner Brook Lake watershed is included in long term forest management plans prepared by CBPPL. Harvesting began within this watershed in the early 1920's, north of Corner Brook Lake, and the areas adjacent to Corner Brook Lake and Copper Lakes has since been harvested and regenerated. Many of the stands within the Corner Brook Lake watershed have been harvested twice. Logging within the Corner Brook Lake watershed will continue into the future, but no major logging activities are planned within the watershed boundary in the next 5 years (Bruce Yates, Personal Communication, 2008).

Portions of the Burnt Pond watershed were also harvested in the past. A small portion of this watershed (southern portion) is also included in CBPPL long term management plans (Bruce Yates, Personal Communication, 2008). No harvesting has taken place here in some time, and none is planned within the watershed in the next 5 years. Forest management operations may however take place in the future in the southern portion of the Burnt Lake watershed.

Mining

There are no existing mines or quarries within the Corner Brook watershed. There is currently one mineral claim within the Corner Brook Lake watershed. Thomas Resources Inc. had exploration rights approved 'in principle' subject to all environmental regulations by the City of Corner Brook. Each of four stages of the exploration requires separate approval. Stage 1 consisted of geological mapping. Stage 2 consists of trenching and removal of material (this is where Thomas Resources are currently, and have not progressed beyond this stage for 2 years). Stage 3 would consist of drilling and the final stage 4 would be a test quarry/pit and the proposed removal of 1,000 tonnes of material. The renewal date for this mineral right is 2011/07/30. Figure 18 shows a geological map of the Corner Brook watershed and surrounding area. The area represented in yellow shows the mineral claim approved for Thomas Resources (008139M). Details of Thomas Resources mineral claim is in Appendix K.

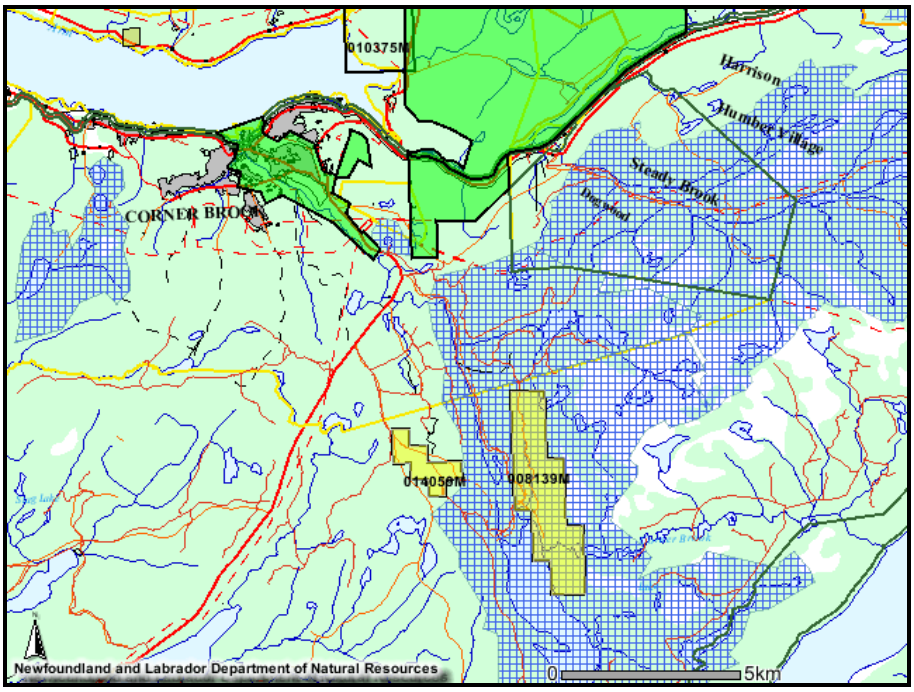

Figure 18. Mining claims located in and around the Corner Brook watershed. The areas in yellow are mineral claim areas.

Transportation, Communication and Public Services

In the past, forest access roads were built into the water supply areas near Corner Brook Lake to access timber. By the mid-1960's, access roads were built into Corner Brook Lake. Since then, the road network has changed considerably as roads were constructed throughout the area to further access timber. Currently there is an extensive road network throughout the entire Corner Brook Lake watershed area. According to Bruce Yates (2008) no other roads are planned to be built within the water supply areas in the future, since all road infrastructure is already in place as will be required for future operations.

In the Burnt Pond watershed, the road network is somewhat less intensive. The road network basically connects all infrastructure required for the distribution system. There are no other forest access roads currently constructed within this watershed. The road network within this watershed has a gate which prohibits public use.

Many of the roads within the water supply areas are maintained by CBPPL, since they are a vital part of current and future forest operations. Some roads are not

maintained if their use is not anticipated in the near future. These roads degrade and wash out due to erosion. In sensitive areas, access is sometimes restricted by removing the bridges/culverts after forest operations are completed. This allows for limited access to certain areas, and helps to reduce the contamination potential for sensitive areas. A short section (approximately 30 metres) of the Massey Drive emergency road passes through the watershed; however a site visit revealed there is little concern for contaminates entering the watershed from the road due to drainage patterns.

Two transmission lines enter the Corner Brook Lake watershed and converge within the watershed boundary. The Bay d'Espoir Line enters the watershed in the northeast corner, and runs west near the northern boundary until meeting the Cat Arm Line. The Cat Arm Line enters the watershed boundary in the north, and runs west until meeting the Bay d'Espoir Line. These lines meet near Breeches Pond, and run parallel along the same Right-of-Way in a northwesterly direction until leaving the watershed. Combined, the transmission lines run for a length of approximately 6.5 kilometers in the Corner Brook Lake watershed at a width of approximately 37 meters (Randy Ralph, Personal Communication, 2007). A single transmission line also crosses the Burnt Pond watershed. A line enters the watershed from the east, just south of Second Pond, and runs southeast for approximately 1.2 kilometers before leaving the watershed.

Hunting/Trapping

Big game and small game hunting and trapping is an activity that occurs within the Corner Brook watershed. The watershed is encompassed by the *Modified Snaring and Trapping Area* of North Shore of Grand Lake (Figure 19). This area is open to select dry land trapping with neck snares for fox, coyote and lynx. Mink, muskrat, beaver and otter trapping are restricted to underwater sets. The watershed lies within Moose and Bear Management Areas 6 and 7, where big game hunting is currently allowed.

There are currently four beaver trap lines within Fur Zone 10. These trap lines cover four different areas of the Corner Brook drinking water supply areas (Appendix D). Beaver are a known host for *Giardia.* When water quality tests indicate a presence of

Giardia in the water supply, the Provincial Wildlife Division handles this by employing local area trappers to remove problem animals.

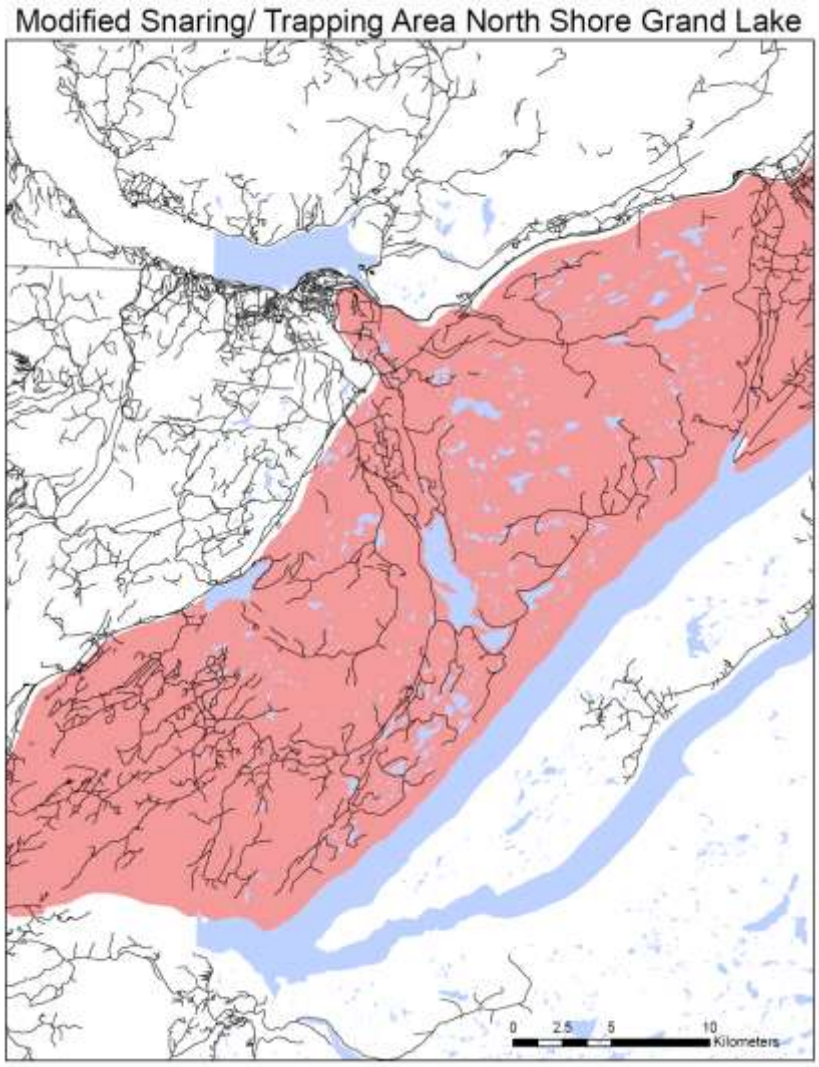

Figure 19. Modified snaring and trapping area surrounding the Corner Brook Lake watershed.

Cabins

There are 8 known cabins within the Corner Brook Lake watershed. Ownership is made up of private individuals as well as the Provincial Government (Wildlife Division). Some other cabins which are currently within the Corner Brook Lake watershed boundary have been erected illegally (Crown Lands, 2007). There are no known cabins within the Burnt Pond watershed.

Recreation and Tourism

A number of other activities associated with the Corner Brook watershed can be classified as recreation and/or tourism. Many of the activities themselves are not seen to pose a potential risk of contamination but associated actions (human and dog waste, accidental fuel spills) may have the potential to cause a contamination problem. However given the amount of activity within the watershed area the risks associated are minimal.

Some of the most popular recreational activities that occur in the Corner Brook watershed include: walking/hiking, dog walking, snowmobiling, cross-country skiing and mountain biking. Figures 20 and 21 show how area residents make use of the Corner Brook Lake and Burnt Pond watersheds, respectively, for recreational activities. These numbers were derived from the public attitudinal survey conducted in the summer and fall of 2007 as part of the watershed management planning process. Appendix E contains the survey which was conducted as well as additional comments that were recorded during the surveys.

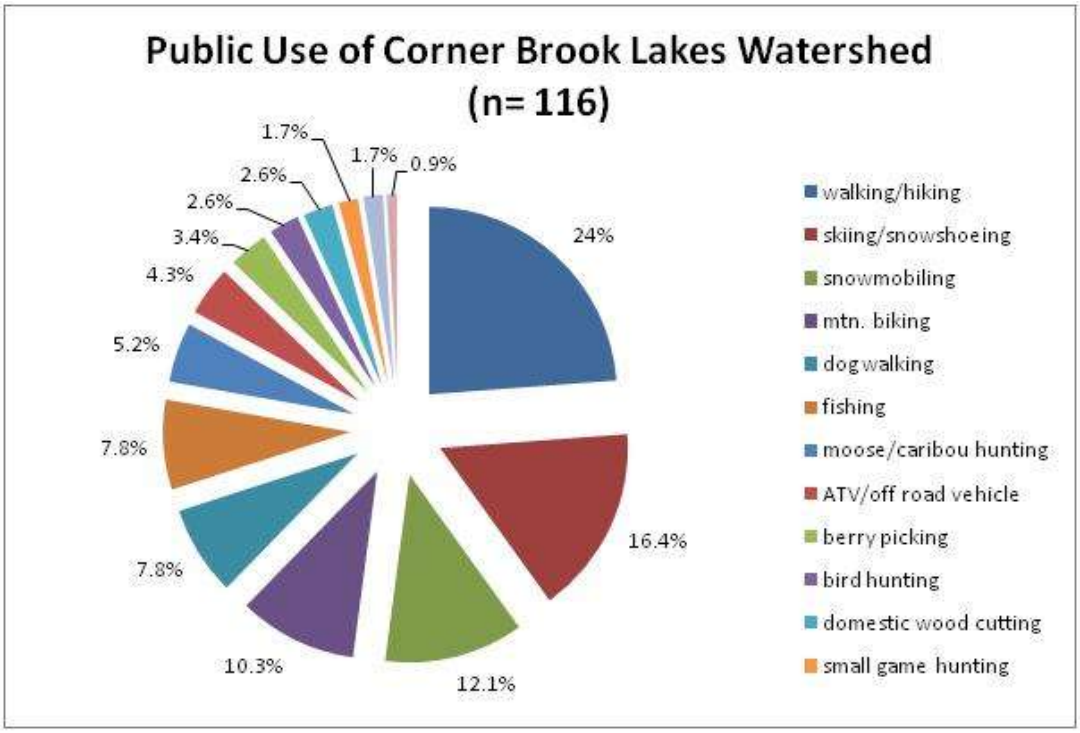

Figure 20. Public use of Corner Brook Lake Watershed (n=116).

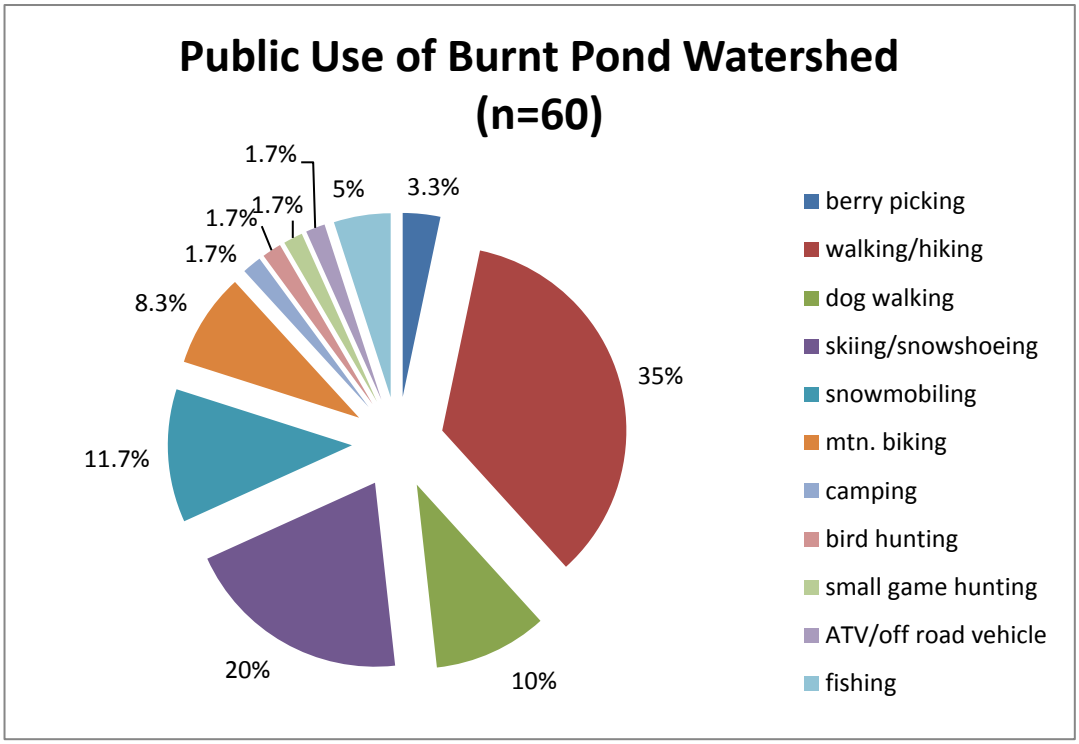

Figure 21. Public use of Burnt Pond Watershed (n=60).

OTHER WATERSHED USES

There are other less frequent ways in which watersheds are used that may result in potential contamination of the water supply. Policies and guidelines have been developed to deal with many of these.

Fire-fighting/Fire Suppression

There are no records of forest fires occurring in the Corner Brook watershed, however there remains the possibility that fire may occur in or near the watershed in the future. Traditionally, when fighting forest fires, or in training drills to fight forest fires, aircraft, including helicopters with buckets have accessed all water bodies in close proximity to the area in question, including water supply areas.

COMPATIBILITY OF USES

The primary use of the Corner Brook watershed is to supply drinking water for the city of Corner Brook. All other uses must be compatible with this primary use. The *Guidelines for Canadian Drinking Water Quality* identify the levels required to supply safe drinking water, but the existing water quality should always be maintained where that quality is better than the guidelines. The *Guidelines for Canadian Drinking Water Quality* can be seen in Appendix A.

The water quality of the Corner Brook watershed has been generally good to present, with no serious water quality problems. The current secondary uses appear to be compatible with the primary use of supplying drinking water. Future secondary uses may arise in the future, and these must not jeopardize water quality. Multiple resource management, which is encouraged by the Department of Environment and Conservation, must allow for ongoing development, but not at the expense of safe drinking water.

Secondary uses must not only be compatible with the protection of water quality, but with each other. The secondary uses of the Corner Brook watershed as they presently exist are generally compatible, however should any future uses such as mining and exploration occur, they will have to be compatible with present uses (recreation for example), compatibility being based on space and time.

JURISDICTION OF WATERSHED PROTECTION AND USE

Uses of the watershed are varied and involve private industry, non-profit organizations and the general public. Jurisdiction of the protection and use of Corner Brook's watershed areas are also divided among a number of parties. Table 6 lists the agencies responsible for management of municipal watersheds, their specific responsibilities, the legislation involved and development regulated.

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

The Department of Environment and Conservation Minister's first responsibility through the *Water Resources Act (2002)* is to designate the area surrounding the source of a public water supply as a Protected Water Supply Area (PWSA). The Corner Brook watershed is not currently designated as a PWSA. However, the *Water Resources Act (2002)* applies to the Corner Brook Watershed except for section 39 (6). Section 39 (6) deals with development activities within a water supply area. The *Environmental Protection Act, (2002)* requires a review of development proposals, policies and plans, and controls pesticide usage. It also regulates the storage of heating fuel in cabins under the *Heating Oil Storage Tank System Regulations.* The Crown Lands Administration Division of the Department of Environment and Conservation grants permits for occupancy of Crown land, through the *Lands Act (1991)*. The construction of cabins on Crown land anywhere is regulated by this Division, and can only proceed with a *License To Occupy*.

MUNICIPALITY

A municipality operating a water works has the responsibility, under the *Water Resources Act (2002)*, to protect the source(s) of public water supply. The *City of Corner Brook Act (1990)* gives power to city council to make regulations: prohibiting and controlling the use of a source of water that is considered dangerous to public health; and preventing the pollution of waters respecting the cutting of timber or the erection or establishment of a building, structure or work within the water catchment area, whether the watershed is wholly or partially within or outside municipal boundaries. This act allows the municipality to control development in the watershed, even if the watershed boundaries fall outside the municipal boundaries.

DEPARTMENT OF NATURAL RESOURCES

Two agencies within the Department of Natural Resources also have responsibilities for the development of resources in the Corner Brook Watershed. The Forest Resources Division administers the *Forestry Act (1990)* and oversees forest operations on all Crown lands. The Mines and Energy Division of the department regulates mineral exploration,

mining and quarrying in the province, through three separate acts. Developments of these types must have the approval of the Mines and Energy Division as well as the Department of Environment and Conservation. Any of the Department of Natural Resources guidelines for developments in PWSA's must be adhered to regardless of conditions imposed by municipalities.

OTHER AGENCIES

The Federal Department of Fisheries and Oceans enforces the *Fisheries Act (1985)*, under which a number of regulations apply to watershed management. The department reviews developments that may affect fish habitat and requires an application for stream crossings and other alterations of fish habitat. Fisheries and Oceans Canada also regulate the recreational fishery, which is a common activity in the watershed. The *Health and Community Services Act* is enforced by the Department of Government Services Centre through a memorandum of understanding with the Department of Health and Community Services. The act regulates the standards for disposal of sewage, and activity associated with legal cabins. Corner Brook Pulp and Paper Limited own the rights to the timber in the watershed. The *Bowater's Newfoundland Act* of 1938 gave then Bowaters Ltd. exclusive ownership of all trees and timber cut within their limits, which includes the majority of the Corner Brook watershed.

Table 6. Legislation, regulatory agencies and their responsibilities for Protected Water Supply Areas.

Agency Responsible	Legislation, Regulations / Policies	Responsibilities	Development Regulated
Department of Environment and Conservation – Water Resources Division	▪ Environmental Protection Act, 2002 ▫ Heating Oil Storage Tank System Regulations ▪ Water Resources Act, 2002 ▫ Policy for Treated Poles in Water Supply Areas	▪ Provides a framework for protection and preservation of water quality ▫ Provides regulations for heating oil storage tank systems	▪ All Developments ▫ Legal Cabins ▫ Transmission Lines
Department of Environment and Conservation – Crown Lands	▪ Lands Act, 1991 ▫ License to Occupy	▪ Grants permits for occupancy of Crown Land	▫ Legal cabins

Agency Responsible	Legislation, Regulations / Policies	Responsibilities	Development Regulated
Administration Division			
Department of Environment and Conservation – Environmental Assessment Division	▪ Environmental Protection Act, 2002 ▫ Environmental Assessment Regulations	▪ Requires review of development proposals, policies and plans under the Act	▪ All Developments
Department of Environment and Conservation – Pesticides Control Section	▪ Environmental Protection Act, 2002 ▫ Pesticides Control Regulations	▪ Controls pesticide usage through licensing applicators, training and emergency response	▪ All Developments
City of Corner Brook	▪ City of Corner Brook Act, 1990 ▪ City of Corner Brook Watershed Protection Regulations ▪ Water Resources Act, 2002 (except section 39(6))	▪ Makes regulations to prevent the pollution of, and prohibit and control the use of Corner Brook's water supply.	▪ All Developments
Department of Fisheries and Oceans Canada	▪ The Fisheries Act, 1985 ▫ Fishery (General) Regulations ▫ Atlantic Fishery Regulations ▫ Policy for the Management of Fish Habitat	▪ Reviews any development which would have an impact on fish habitat. ▫ Describes process to apply for letter of advice or authorization to alter fish habitat. ▫ Regulates recreational fishery. ▫ Guides the application of habitat provisions.	▪ All Developments
Department of Health and Community Services	▪ Public Health Act, 1996 ▫ Sanitation Regulations	▪ Regulates standards for disposal of sewage	▫ Legal Cabins
Department of Natural Resources – Forest Resources Division	▪ Forestry Act, 1990	▪ Controls commercial forest harvesting and access road construction; prepares timber management plans	▪ Commercial Forest Harvesting and access road construction

Agency Responsible	Legislation, Regulations / Policies	Responsibilities	Development Regulated
Department of Natural Resources – Mines and Energy Division	▪ Minerals Act, 1990 ▪ Mining Act, 1999 ▪ Quarry Materials Act, 1998	▪ Governs the acquisition of rights to minerals. ▪ Regulates the operation of mines. ▪ Grants exploration licenses and quarry permits.	▪ Mineral Exploration ▪ Mining ▪ Quarrying

POTENTIAL CONTAMINANTS AND RISK ASSESSMENT

POTENTIAL CONTAMINANTS FROM IDENTIFIED USES

With existing and possible future uses of the watershed identified in the previous section, the next step is to identify potential contaminants from these uses. Potential contaminants are pollutants associated with particular activities that could negatively impact water quality. Any land and water use inside a watershed can potentially be a source of pollutants to the drinking water obtained from that watershed.

While water quality data in the City suggests that current watershed uses are having no impact on water quality, it is important to identify potential sources and types of pollutants from current and possible future uses of the watershed. This is most easily done by examining all water and land uses outlined in the previous section, and determining causes and types of possible contaminants. Table 7 shows the potential contaminants from existing and potential future uses of the watershed.

Table 7. Potential contaminants from existing and possible watershed uses.

Watershed Use/Activity	Potential Contaminant	Cause
Drinking Water	Chlorination by-products	Chlorination
Natural Occurrences	Chlorination by-products	Natural organic loading
	Sediment	Increased stream-flow
	E. coli, coliforms, *Giardia*	Wildlife
Forestry	Sediment	Forest cover removal (Commercial harvesting)
		Construction and use of logging roads
	Nutrients	Forest cover removal (Commercial harvesting)
	Petroleum products	Fuel spills or leaks
	Chlorination by-products from organic loading	Forest cover removal (Commercial harvesting)
	Chlorination by-products from organic loading	Construction and use of logging roads
Transmission Lines	Petroleum products	Line Maintenance
		Vegetation Maintenance
	Sediment	Line Maintenance
		Vegetation Maintenance
	Toxins	Chromate copper arsenate treated utility poles
Recreation/Tourism	Sediment	Motorized vehicle use
	Petroleum products	Motorized vehicle use
		Fuel storage at cabins
	E. coli, coliforms, *Giardia*	Cabin pit privies
		Human-related activities
Mining and Quarrying	Sediment	Mineral exploration, mining and quarrying activities
	Nutrients	Vegetation Removal
	Petroleum products	Mineral exploration, mining and quarrying activities

CHLORINATION AND INCREASED STREAM-FLOW

The primary use of the Corner Brook watershed is to provide safe drinking water for the City. The process of supplying safe drinking water should not in itself affect the quality of the water, but in fact it can. Drinking water is chlorinated to destroy disease-causing microorganisms (coliforms, *Giardia*, etc.), but chlorination of water containing high levels of organic matter, such as Newfoundland and Labrador surface waters, also creates by-products that can be hazardous to human health. Trihalomethanes (THMs) and Haloacetic Acids (HAAs) are two such chlorination disinfection by-products, which at certain levels pose a significant risk for the development of cancer and possibly reproductive and developmental effects. It is therefore important for water regulators to create a balance between proper disinfection of drinking water and low levels of chlorination by-products, and for watershed users to ensure their activities do not increase levels of organic matter in the water.

Increased stream-flow can also affect the quality of the City's drinking water. First, flooding of land adjacent to Corner Brook Lake and Eastern Lake could increase the risk of introducing pathogenic microbes from adjacent land. Second, due to the nonporous characteristics of the soil and bedrock, increased stream-flow could introduce sediment into the water supply. A naturally increased stream-flow in the spring and late fall does cause sediment to enter the water supply, apparent by the "tea" colored water. In addition to discoloration, sediment can transport biological contaminants into the water system, cause problems with the filtration system in its attempt to rid the drinking water of excess sediment, and impair the effectiveness of disinfection (Caux, Moore, & MacDonald, 1997).

FORESTRY

Different aspects of forest operations could possibly affect water quality. Forest cover removal, and construction and use of logging roads may cause an increase in the volume and rate of runoff, and changes in the runoff content, which could eventually find its way into the water supply. Runoff can affect water quality through a change in the following parameters: total dissolved solids, total suspended solids (turbidity), dissolved organic

carbons, dissolved oxygen, and nutrients (potassium, nitrogen, and phosphorus). There is also the potential for fuel spills from harvesting-related or road construction equipment to reach the water supply. Many petroleum products such as gasoline contain benzene, an agent known to cause leukemia (Natural Resources Canada, 1982). Buffer zones have been established in various policies and regulations to negate the effects of these activities.

A Note on Sedimentation in the Corner Brook Watershed

Sedimentation is of grave concern with regard to potable water supplies as it can lead to a decline in surface water quality. Although sedimentation is a natural process it is often accelerated by man-made developments such as road construction, agricultural activities, forest harvesting, and mining.

Sedimentation embodies many processes – *erosion* or detachment of a sediment particle, *entrainment* or incorporation of sediment into water flow, *transportation* or movement of sediment with the flow of water and *deposition* or settling of sediment.

Corner Brook has had issues with sedimentation in the past. On November 29th 1988, forestry activities in the watershed area caused a serious sedimentation event which lead to reassessment of construction practices by the proponent. On August 2nd, 2000, another serious sedimentation event occurred in Corner Brook Stream due to leakage of a woodstave penstock.

Numerous studies and reports have been completed over the years relating to sedimentation. A Sensitivity Analysis conducted in 1989 illustrates how susceptible certain areas of the watershed are to development activity. Corner Brook Watershed Harvesting Guidelines were established in 1991 to accompany already existing operational guidelines and strategies. More recently, a discussion document on Options for Managing Riparian Habitat were published in 2007. Reports such as these exemplify the importance of safeguarding the water resource from concerns such as sedimentation.

Sometimes after harvesting operations, planting is required, and in special cases, the application of herbicides is necessary to remove unwanted vegetation from planting sites. Depending on the type of product used, toxic substances could leach into the water supply. The use of toxic fire retardants to suppress fires could also supply unwanted chemicals. The application of pesticides (which includes herbicides) and toxic fire retardants are already prohibited in Protected Water Supply Areas (PWSA's) under existing legislation, and CBPPL follows the guidelines for PWSA's when working in the Corner Brook water supply areas even though the entire water supply area is not a provincially protected PWSA.

TRANSMISSION AND FIBRE OPTIC LINES

Potential issues concerning transmission lines stem from the maintenance of the vegetation under the lines, and the maintenance of the lines themselves. The application of herbicides in the right-of-way is prohibited, so the potential issue associated with vegetation maintenance would be fuel spills from saws that manually remove unwanted vegetation and vehicles that workers use for transportation. Manual vegetation maintenance is conducted on the right-of-way every 5-10 years, and Newfoundland Hydro tries to extend the cycle as long as possible (Randy Ralph, Personal Communication, 2007). Tracked machines used to access and maintain the lines themselves could potentially cause fuel spills and ground disturbance, although maintenance to the steel towers is infrequent, inspections being necessary only every 10 years. The chromated copper arsenate (CCA) treated poles of the fiber-optic line create an additional issue. Inorganic arsenic leaching from the CCA treated poles could find its way into the water supply if poles are not placed in accordance with current standards. A policy exists for the use of treated utility poles in PWSA's.

RECREATION AND TOURISM

A major concern with recreation and tourism is the mode of transportation used to access the watershed in order to participate in an activity. Most of the activities themselves are already regulated or are relatively safe. For example, lead shot is prohibited in hunting migratory birds under the *Migratory Birds Convention Act, 1994*.

Other activities such as rabbit snaring, are reasonably harmless to water quality. However, transportation vehicles such as 4-wheel drive pickups, ATVs, and to a lesser extent snowmobiles have the potential to pollute the watershed and subsequently contaminate the water supply. ATV use is restricted in wetland areas including bogs, barrens and marshes, but the two main concerns are the potential for fuel spills and the risk of sedimentation. Considering the poor condition of the old portage roads, the probability of both concerns is very much a reality, and perhaps the major issue facing water quality. This applies particularly to 4-wheel drives and ATVs during spring, summer and fall. Although fuel leaks from snowmobiles are not common, the volume of traffic on snowmobile trails in the watershed increases their likelihood.

Giardiasis is a waterborne, intestinal disease caused by the protozoan parasite *Giardia*. The feces of beaver have commonly thought to be the source of giardiasis or "beaver fever" in humans. However, it is now known that other mammals, including humans, can also be responsible for the introduction of *Giardia* cysts to surface waters used as drinking water supplies (WQHB, 1996). As more human-related activities occur in the watershed, contamination by human sewage must also be taken into account.

On March 31, 1992, a boil water advisory was issued to all users of the City of Corner Brook water distribution system in response to a confirmed outbreak of giardiasis. Confirmation was based on an increase number of reported laboratory confirmed cases of giardiasis and a link to the water supply confirmed by water sample results identifying the presence of giardia cysts in the system. Analysis of beavers subsequently removed from the watershed also confirmed that giardia cysts were present in the beaver population.

A water monitoring committee was formed to establish and implement corrective measures to mitigate the presence of giardia cysts in the water supply system. A chlorine concentration and contact time (CT) value of 200 was established as necessary to inactivate giadia cysts that may be present in the water. Chlorine disinfection levels were increased to maintain a CT value of 200 for water entering the distribution system. The boil water advisory was eventually lifted on May 25, 1992 after water samples confirmed

that treatment was effectively inactivating giardia cysts. The city of Corner Brook continues to maintain a chlorine CT value of 200 and regularly analyze water samples for the presence of giardia cysts to prevent further outbreaks of giardiasis.

MINING

Quarries and mines do not exist in the watershed. Possible issues that could arise with respect to mineral exploration, mining and quarrying are the risk of fuel spills and the contribution of sediment and nutrients to the water supply.

All of the potential threats discussed above can be grouped under the following categories: petroleum products, refuse, sediments, nutrients, acid generating rock, pathogenic microbes (*E. coli*, *Giardia*, coliforms), metals, chlorination by-products (THMs, HAAs), toxins (arsenic, pesticides) and other chemicals. These potential contaminants will be assessed and assigned a priority ranking in the following section.

RISK ASSESSMENT

The previous section identified six categories of potential contaminants that could be of concern to the drinking quality of the Corner Brook water supply, and these contaminants each have anywhere from two to fifteen potential causes, for a total of fifty-one potential causes of water contamination. Since it would be impossible to address all the concerns immediately, it is necessary to conduct a risk assessment of the contaminants and their causes, and subsequently prioritize them based on the assessment.

Risk assessment is the process of evaluating the adverse effects caused by a substance, activity, lifestyle or natural phenomenon. The Royal Society defines risk as it pertains to risk assessment as “the combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence” (Royal Society, 1992).

Two methods of risk assessment have been used to prioritize all the potential causes of contamination. The first method requires basic information and knowledge of the watershed and the existing and potential activities, and was adapted from the approach suggested by Nova Scotia Department of Environment and Labour (NSEL, 2004). This

method was also used in the Steady Brook watershed document, created in 2005. The second method (Shook, 1993), requires more comprehensive knowledge of the characteristics of the contaminants and of the watershed. Both Risk Analysis Method 1 and Method 2 were carried out in the same manner followed by the Steady Brook Watershed Management Committee. Due to the subjective nature of Method 1, the Corner Brook Management Planning Committee felt that this method was not robust enough for the factors considered and its results did not compare well with results from Method 2 for the same area. For this reason it was decided that results of Method 2 would be presented in this document. The watershed planning committee expressed concerns over the risk assessment conducted in this plan, and has agreed to revisit the values presented and continually improve upon the system as outlined in this plan.

NUMERICAL RISK INDEX

To access the potential risk of contamination from various sources, a numerical risk index was developed for the Corner Brook watershed. This numerically based risk analysis method involves both subjective and qualitative analysis, allows for linkage between water quality parameters, and involves a holistic view of possible worst-case scenarios (Shook, 1993). This method incorporates three major factors to rank the risk of potential sources of water contamination. The first factor, *regulatory adequacy*, examines the ability of any regulatory program in place to prevent or remedy water contamination from potential sources. The second factor, *public health*, assesses the severity of the potential impact of a pollutant source on public health. The last factor, *watershed vulnerability*, is a measure of the extent to which watershed characteristics in the vicinity of a contaminant source may promote or impede water contamination (e.g. how slope affects sedimentation in the event of extreme rainfall). For each individual factor, a scoring mechanism was developed using a scale from low to high risk. Each factor was evaluated for each potential pollution source, and points were assigned to each parameter according to the scoring mechanism (Table 8).

Table 8. Scoring mechanism table for numerical risk analysis.

Factor	Low risk (1)	Medium risk (2)	High risk (3)
Regulatory Adequacy			
Regulations	Regulations with permits	Regulations or guidelines	No regulations
Water quality monitoring	No samples above guidelines	Some samples above guidelines	Many samples above guidelines
Public Health			
Toxicity	No harm	Reversible harm	Irreversible harm
Population	Low density	Moderate density	High density
Quantity	Low volume	Moderate volume	High volume
Mobility	Immobile	Some mobility	Extremely mobile
Persistence	Low persistence	Moderate persistence	Very persistent
Watershed Vulnerability			
Soil type	Moraine	Till	Bedrock
Slope	Flat	Moderate	Steep
Runoff	Low	Medium	High

The index component ratings (Appendix F) are summarized and averaged to produce a value for each major factor (e.g. $RI_{Regulations}$ = (regulations + monitoring)/2). A total risk score is determined using the following formula:

$$RI_{Total} = \sqrt{\frac{(RI_{Regulations})^2 + (RI_{PublicHealth})^2 + (RI_{Vulnerability})^2}{3}} \times 100$$

There were difficulties trying to evaluate chlorination by-products (CBP) in this method. CBP is a complicated potential contaminant dependent on many dynamics, most significantly organic matter in the water source, dosage of chlorine treatment and water age in the distribution system. Risk for each individual factor ($RI_{Regulations}$, $RI_{PublicHealth}$, $RI_{Vulnerability}$) had to be assigned not to the contaminant, but to the appropriate contaminant precursor generated by the potential cause of water contamination.

Table 9 lists the identified potential sources of water contamination, and the numerical risk index (RI_{Total}) derived from the risk analysis. The numerical risk analysis, however, highlights the danger of potential water quality contamination from difficult to control sources (i.e., the top six): natural organic loading, motorized vehicle use, increased stream-flow, forest fire, pit privies, and forest protection. Approaches to dealing with such difficult to control potential contamination sources will have to be given special consideration. From this analysis, the major controlling factor lowering risk index scores is the regulatory adequacy. Appendix F shows the index component ratings for all potential contaminants and sources for the Corner Brook watershed.

Table 9. Ranking of potential sources of contamination.

Potential Contaminant	Potential Cause	RI total (numerical analysis)
Chlorination By-Products	Natural Organic Loading	241
Sedimentation	Motorized Vehicle Use	235
Sedimentation	Increased Stream-flow	235
Sedimentation	Forest Fire	235
Pathogens	Pit Privies	232
Toxins	Forest Protection	225
Toxins	Silviculture	225
Pathogens	Wildlife	224
Metals	Illegal Dumping	224
Sedimentation	Forest Road Construction/Use	219
Nutrients	Forest Fire	219
Petroleum Products	Aviation / Aircraft Use	218
Petroleum Products	Illegal Dumping	217
Petroleum Products	Cabins (fuel storage)	217
Petroleum Products	Camping and Recreation	217
Toxins	Herbicide application Along TCH	217
Sedimentation	Commercial Harvesting	211
Pathogens	Commercial Harvesting	211
Pathogens	Camping and Recreation	211
Sedimentation	All-Terrain Vehicle Use	210
Sedimentation	Camping and Recreation	210
Toxins	Utility Line CCA Poles	210
Toxins	Illegal Dumping	210
Sedimentation	Utility Line Structure Maintenance	205
Petroleum Products	Mineral Exploration	205
Petroleum Products	Quarrying/Mining	205
Petroleum Products	Forest Road Construction/Use	205
Petroleum Products	All-Terrain Vehicle Use	203
Petroleum Products	Snowmobile Use	203
Petroleum Products	Hunting / Trapping	203
Sedimentation	Quarrying/ Mining	203
Sedimentation	Utility Line Vegetation Maintenance	201

Potential Contaminant	Potential Cause	RI total (numerical analysis)
Petroleum Products	Commercial Harvesting	200
Petroleum Products	Infrastructure Maintenance / Construction	200
Metals	Acid Mine Drainage	200
Petroleum Products	Silviculture	199
Petroleum Products	Utility Line Vegetation Maintenance	199
Chlorination By-Products	Treatment	197
Nutrients	Commercial Harvesting	195
Sedimentation	Mineral Exploration	194
Chlorination By-Products	Forest Road Construction/Use	194
Petroleum Products	Utility Line Structure Maintenance	193
Toxins	Forest Fire Suppression (fire retardant foam)	193
Nutrients	Mineral Exploration	189
Nutrients	Quarrying/ Mining	189
Refuse	Illegal Dumping	188
Refuse	Cabins	188
Chlorination By-Products	Commercial Harvesting	185
Refuse	Aircraft	171
Refuse	Camping and Recreation	171
Refuse	Hunting / Trapping	171

SENSITIVITY ANALYSIS

The purpose of the sensitivity analysis is to map areas in the watershed suitable for different levels of development activity, based on the risk of potential water contamination from that activity, as identified in the previous section. The sensitivity analysis was conducted primarily using a geographic information system (ESRI ArcGIS software). Guidelines for determining the four proposed development zones were based on buffer widths from provincial regulations (*Water Resources Act, 2002*) and recommendations from Watershed Management Specialists (WMS) of the Water Resources Management Division. Four different sensitivity zones were developed based on: 1) regulated buffer widths in protected water supply areas, 2) land slope, and 3) distance from the intake.

In order to apply regulation buffer widths, all waterbodies needed to be classified by stream order. This was accomplished using stream order from a 1:50,000 digital water layers map from the Surveys and Mapping Division of Environment and Conservation. Stream order is a widely used method of classifying streams based on stream hierarchy. Many organizations (e.g. U.S. Environmental Protection Agency) develop stream buffers based on slope and stream order. First-order streams are usually in the headwaters and are the first channel to make up the stream network. Two first-order streams join to form a second-order stream, and so on. Streams of the third order and higher were classified as major tributaries.

Slope steepness is often the major cause of erosion and runoff potential, and by extension, a major contributor of pollutants to a waterbody. Precipitation runs off at higher velocities from steeper surfaces, and so has a greater capacity to erode and transport soil and the associated pollutants. In the Peter's River Watershed Management Plan, ranges of slope steepness were developed to try and determine pollution potential. The highest slope range was for slopes greater than 10% (ACRES, 1995). The Gander Lake Watershed Management Plan also identifies steep slopes as being the most inherently sensitive areas in the watershed, and recommends slope as a good indicator of inherent sensitivity. In this plan, slope values were used in sediment delivery models and were divided into five categories. The most sensitive areas had slopes greater than 15% (EDM, 1996). The recommended slope categories for the Corner Brook sensitivity analysis are compared to the other plans in the Table 10 below.

Table 10. Slope categories for three watersheds in Newfoundland and Labrador.

Peter's River WMP	Gander Lake WMP	Corner Brook WMP
0-1%	0-2%	0-5%
1-4%	3-5%	
4-7%	6-8%	5-20%
7-10%	9-14%	
>10%	>15%	>20%

Within the Corner Brook Watershed, slope was determined using a 1:50,000 Digital Elevation Model (DEM) from Natural Resources Canada, (Appendix G, Maps 1 and 2). The watershed boundaries were provided by the City of Corner Brook, Operational Services. The general methodology used in the sensitivity analysis is described below:

- Watershed Management Specialists determined the guidelines for the four development zones based on buffer widths from provincial regulations, slope and distance from the intake;
- The watershed boundary was used as a base and digital water layers were added;
- All waterbodies (rivers, streams and lakes/ponds) were manually classified by stream order;
- All waterbodies were given a buffer width (Appendix G, Maps 3 and 4) based on parameters set by Watershed Management Specialists;
- The water supply intake was buffered at 100 meters, 1 kilometer and 8 kilometers (Appendix G, Maps 5 and 6);
- The slope layer was partitioned into 3 categories: > 20%, 5-20%, and < 5% (Appendix G, Maps 1 and 2);
- Slope class, intake buffer and waterbody buffer layers were overlaid to create the final "Proposed Development Zones" map (Figure 22, and Appendix G, Maps 7 and 8).

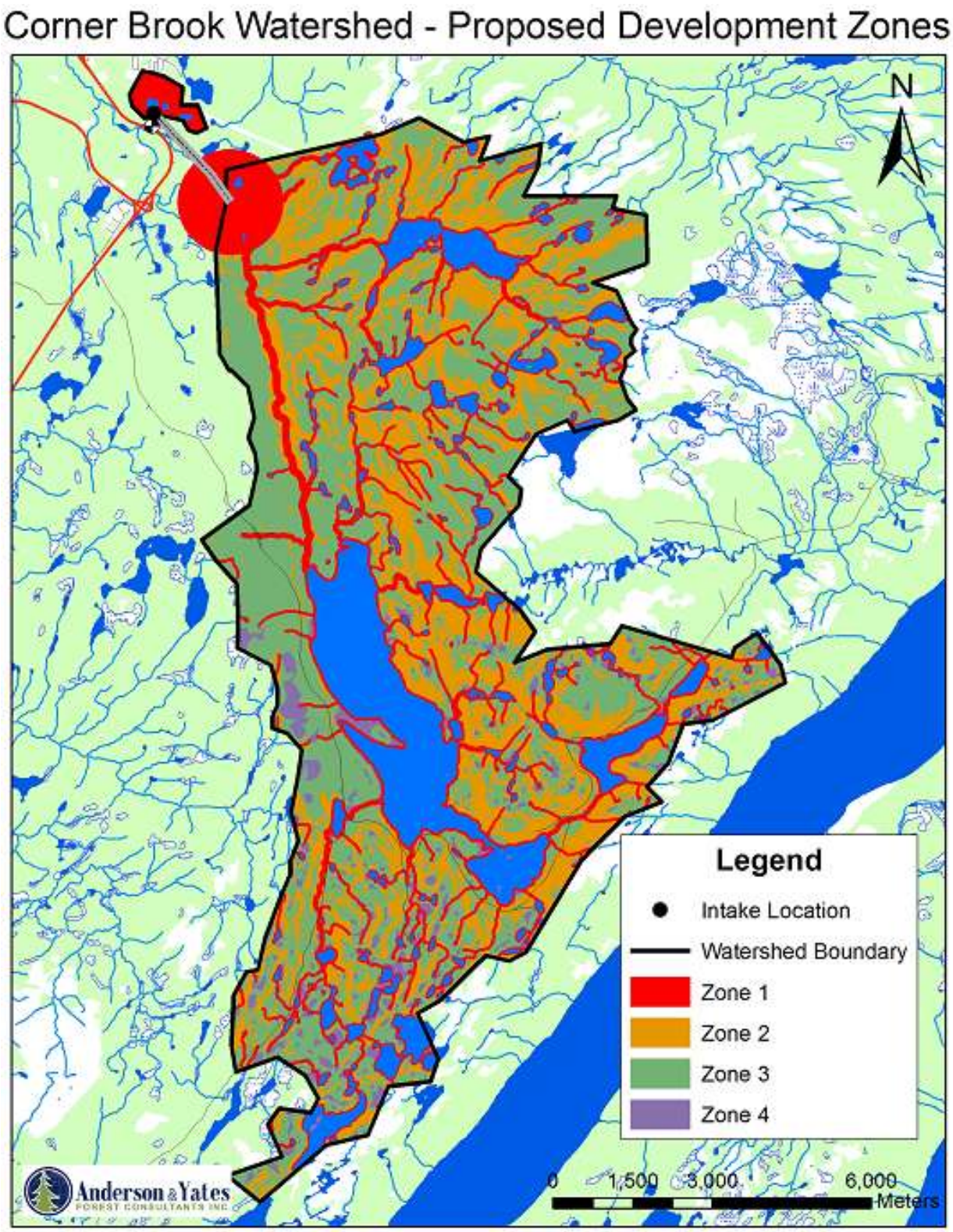

Figure 22. Proposed development zones for the Corner Brook watershed.

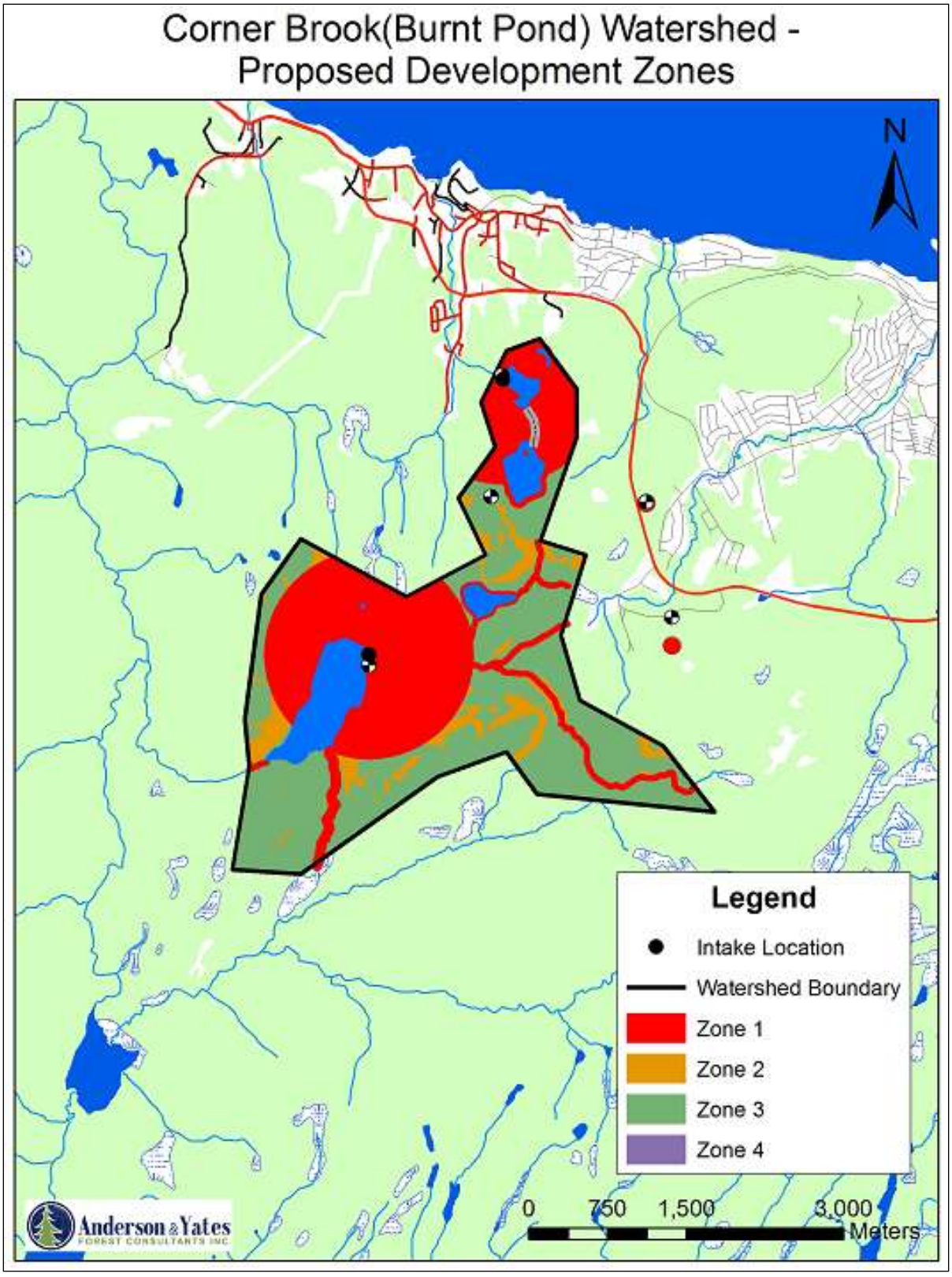

Figure 23. Proposed development zones for the Corner Brook (Burnt Pond) watershed.

The following table summarizes the criteria used in determining each development zone, and the source for each determining criteria.

Table 11. Proposed development zone criteria.

Zone	Buffer width	Water Body	Slope	Distance from Intake
1. No Development Activity	1km	Within 1km of any intake	N/A	1 km
	150m	For a distance of one km upstream and 100 m downstream of intake		
	75m	Main river channel		Anywhere in watershed boundary
	50m	Major tributaries, lakes or ponds		
	30m	All other water bodies		
2. High-Risk Slope Management Areas	Outside Zone 1		> 20 %	> 1 km
3. High-Risk Activities Prohibited, Remaining Activities Regulated	Outside Zone 1		5-20%	> 1 km
4. All activities Permitted and Regulated	Outside Zone 1		< 5%	> 8 km

The precedent for a no development area within a 1 km radius of the intake was based on similar terms and conditions found in Permits for Development Activity for protected public water supply areas in other areas of the province. Slope recommendations were based on other provincial watershed management findings.

MANAGEMENT PLAN

GOAL AND OBJECTIVES

The goal of this management plan is to protect and maintain source water quality and to allow for the sustainable development of natural resources. In order to achieve this goal, the following general objectives have been identified by the Corner Brook Watershed Management Planning Committee.

1. Evaluate best management practices for compatible land uses in the basin and evaluate and build upon environmental protection guidelines for all recommended land and water uses, which could minimize pollutant loadings from non-point sources including accidental spills;

2. Prepare a watershed management plan for the study area, based on the results of the sensitivity analysis, and make recommendations regarding water quality protection of the watershed and resource utilization in the basin;

3. Evaluate and build upon long-term water quality monitoring programs as part of the integrated watershed management plan, to assist in establishing a water quality trend and considering resource use, take appropriate action to protect water quality; and

4. Recommend policy guidelines for the protection of water supply areas through watershed management.

More specific objectives have been developed based on the potential contaminants that could occur in the watershed from existing and potential future uses:

1. Reduce the incidences of **pathogenic microbes** (total coliforms, *E. coli* and *Giardia*) in the water supply;

2. Continue to keep **chlorination by-product** (THM and HAA) levels below the Canadian guidelines by minimizing preventable increases in organic loading;

3. Ensure unacceptable levels of **toxins** do not enter the water supply;

4. Minimize leaks and spills of **petroleum products** into the water supply and reduce their impact;

5. Minimize **sedimentation** of the water supply and reduce its impact;

6. Minimize the amount of **nutrients** entering the water supply.

MANAGEMENT STRATEGY

To address the general and specific objectives of this plan, the tasks required to meet these objectives must be identified. Once this is done, a strategy to perform these tasks can be determined, and the agency responsible for implementing the strategy can be identified. Table 12 contains these steps including the components of the management strategy recommended to achieve the objectives that address the potential contaminants of concern for the Corner Brook watershed. The components of the management strategy have been selected for their ease of implementation for the municipality, and fall into three categories:

- Regulatory,
- Non-Regulatory, and
- Education and Stewardship.

The regulatory component includes any strategies (of any of the governing bodies) that are required by law such as those listed in Table 12. This approach is most effective and useful for conservation measures (i.e. prohibiting development in specific areas). The proposed development zones produced as a result of the sensitivity analysis fall into this category. The non-regulatory component uses best management practices and incentives for the implementation of environmentally friendly land-use activities. This approach works best for activities where work is conducted under application, and guidelines or best management practices are included in the approval. A contingency plan for spills of hazardous materials would also fit in this category. Finally, educating and

instilling a sense of stewardship in the users of the watershed is yet another way to accomplish watershed management goals. This approach is suggested for activities where effective monitoring and enforcement is impossible due to the number of users and the scarcity of funds.

Existing regulatory and non-regulatory approaches will be discussed first, followed by recommended regulatory, non-regulatory and educational approaches.

Table 12. Management strategy to address potential contaminants in the Corner Brook Watershed.

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
Reduce the incidences of **Pathogenic Microbes** (total coliforms, *E. coli* and *Giardia*) in the water supply by ensuring existing regulations are followed and educating watershed users of their potential contribution to this problem.	Pit Privies (cabins)	232	Ensure pit privies are of sufficient distance from high water mark; educate **cabin owners** about risks of human wastes close to waterbodies	Sanitation Regulations Brochure, Meeting with cabin owners	Dept. of Gov't Services Management Committee
	Wildlife	224	Monitor presence of beaver in watershed	Beaver Briefing Note	Management Committee
	Commercial Harvesting	211	Adopt buffers and BMP's that ensure little or no increase in pathogens Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Camping & Recreation [1]	211	Educate **campers** about risks of human wastes close to waterbodies	Brochure	Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
Continue to keep **Chlorination By-Products** (THM and HAA) levels below the Canadian guidelines by requiring BMP's that minimize increases in organic loading by watershed users.	Commercial Harvesting	185	Adopt buffers and BMP's that ensure little or no increase in organic loading. Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy,	Management Committee Dept. of Natural Resources
	Forest Road Construction/ Use	194	Adopt buffers and BMP's that ensure little or no increase in organic loading. Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Natural Organic Loading	241	Monitor natural organic matter indicators (DOC and colour) Investigate necessity of additional treatment infrastructure with appropriate agencies.	Guidelines for Canadian Drinking Water Quality	Dept. of Environment and Conservation Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Treatment (Chlorine)	197	Monitor THMs and HAAs	Guidelines for Canadian Drinking Water Quality	Dept. of Gov't Services and Dept. of Health and Community Services Management Committee
Ensure unacceptable levels of **Toxins** do not enter the watershed by enforcing clear and appropriate policy.	Utility Line CCA Poles	210	Clarify what is considered a waterbody within a watershed, and then determine if any CCA poles should be replaced.	Policy on CCA poles	Dept. of Environment and Conservation Management Committee
	Forest Protection	225	Adopt buffers and BMP's that ensure no increase in toxins Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy,	Dept. of Environment and Conservation Management Committee
	Herbicide Application Along TCH	217	Adopt buffers and BMP's that eliminate impacts of toxins	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Dept. of Environment and Conservation Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Silviculture	225	Adopt buffers and BMP's that eliminate or minimize the impacts of toxins Ensure **forest companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Dept. of Natural Resources Management Committee
	Illegal Dumping	210	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of toxic contamination caused by illegal dumping.	Brochure, Information Sessions and Signage	Management Committee
	Forest Fire Suppression	193	Adopt **Policies** that eliminate or minimize the impacts of fire retardant foam usage in watershed area	Guidelines on water bomber use in PWSA's	Dept. of Natural Resources Management Committee
Minimize leaks and spills of **Petroleum Products** and reduce their	All-Terrain Vehicle Use	203	Educate **residents, cabin owners, and tourism operators** about risks of fuel contamination	Brochure, Information Sessions and Signage	Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
impact.	Snowmobile Use	203	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of fuel contamination	Brochure, Information Sessions and Signage	Management Committee
	Camping & Recreation [1]	217	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of fuel contamination	Brochure, Information Sessions and Signage	Management Committee
	Cabins (Fuel Storage)	217	Educate **cabin owners** about risks of fuel contamination	Brochure, Information Sessions and Signage	Management Committee
	Commercial Harvesting	200	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Forest Road Construction/ Use	205	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Utility Line Structure Maintenance	193	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **utility companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Environment and Conservation
	Utility Line Vegetation Maintenance	199	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **utility companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Environment and Conservation

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Infrastructure Maintenance/ Construction	200	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **utility companies, contractors, onsite workers** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Environment and Conservation
	Silviculture	199	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Mineral Exploration	205	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Quarrying/ Mining	205	Adopt buffers and BMP's that eliminate or minimize impacts of fuel spills and leaks Ensure **quarry/mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Illegal Dumping	217	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of risks of fuel contamination caused by illegal dumping.	Brochure, Information Sessions and Signage	Management Committee
	Hunting/ Trapping	203	Educate **residents, hunters and trappers** about risks of fuel contamination.	Brochure, Information Sessions and Signage	Management Committee
	Aircraft	218	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
Minimize **Sedimentation** of the water supply and reduce its impact through BMP's and by educating recreational users.	Motorized Vehicle Use	235	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of sedimentation and the role of buffers	Brochure, Information Sessions and Signage	Management Committee
	All-Terrain Vehicle Use	210	Educate **residents, cabin owners, and tourism operators** about risks of sedimentation and the role of buffers	Brochure, Information Sessions and Signage	Management Committee
	Camping & Recreation [1]	210	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of sedimentation and the role of buffers	Brochure, Information Sessions and Signage	Management Committee
	Commercial Harvesting	211	Adopt buffers and BMP's that reduce or minimize sedimentation Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Forest Road Construction/ Use	219	Adopt buffers and BMP's that reduce or minimize sedimentation Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Utility Line Structure Maintenance	205	Adopt buffers and BMP's that reduce or minimize sedimentation Ensure **utility companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Environment and Conservation
	Utility Line Vegetation Maintenance	201	Adopt buffers and BMP's that reduce or minimize sedimentation Ensure **utility companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Environment and Conservation

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Mineral Exploration	194	Adopt buffers and BMP's that reduce or minimize sedimentation Ensure **mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Quarrying and Mining	203	Adopt buffers and BMP's that reduce or minimize sedimentation Ensure **mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Increased Stream-flow	235	Monitor water levels in watershed	N/A	Management Committee
	Forest Fire	235	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
Minimize **Refuse** entering the water supply and reduce its impact through BMP's and by educating recreational users.	Illegal Dumping	188	Educate **residents, cabin owners, SnoRiders, and tourism operators,** about risks of refuse in or near waterbodies.	Brochure, Information Sessions and Signage	Management Committee
	Cabins	188	Educate **cabin owners** about risks of refuse in or near waterbodies.	Brochure, Information Sessions and Signage	Management Committee
	Hunting/ Trapping	171	Educate **residents, hunters and trappers** about risks of refuse in or near waterbodies.	Brochure, Information Sessions and Signage	Management Committee
	Aircraft	171	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Management Committee
	Camping & Recreation [1]	171	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of refuse in or near waterbodies.	Brochure, Information Sessions and Signage	Management Committee

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
Minimize the amount of **Nutrients** entering the watershed through BMP's and by educating users, particularly industrial users.	Commercial Harvesting	195	Adopt buffers and BMP's that reduce or minimize nutrients entering waterbodies Ensure **forest company** follows buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy, Forestry Act	Dept. of Natural Resources Management Committee
	Mineral Exploration	189	Adopt buffers and BMP's that reduce or minimize nutrients entering waterbodies Ensure **mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Quarrying and Mining	189	Adopt buffers and BMP's that reduce or minimize nutrients entering waterbodies Ensure **mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Forest Fire	219	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Management Committee
Minimize the amount of **Metals** entering the watershed through BMP's and by educating users, particularly industrial users.	Acid Mine Drainage	200	Adopt buffers and BMP's that eliminate metals entering waterbodies Ensure **mining companies** follow buffers and BMP's	Watershed Management Zones, PWSA waterbody buffers, BMP's, PWSA Policy	Management Committee Dept. of Natural Resources
	Illegal Dumping	224	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of metals in or near waterbodies	Brochure, Information Sessions and Signage	Management Committee

[1] Includes animal watching, berry picking, bird hunting, bird watching, canoeing, skiing, fishing, hiking, hunting, mountain biking, rare plants, sight seeing, snaring, snowshoeing, trapping, and wood gathering.

EXISTING STRATEGIES

REGULATORY

The City of Corner Brook regulates resources through the *City of Corner Brook Act (1990).* Section 180 of the Corner Brook Act states that the City may establish, maintain and regulate a water supply system subject to the regulations made under the *Water Resources Act (2002)* except for section 39(6). In Policy Directive W.R. 95-01 of the *Water Resources Act (2002)*; *Policy for Land and Water Related Developments in Protected Public Water Supply Areas* (Appendix H), development is defined as "any activity or operation on, over, or under land or water for social or economic benefits, or the making of any change in the use or the intensity of use of any land, water, building or premises". Within the City of Corner Brook, development permits issued by the City, must be acquired for any development within the watershed area. The City of Corner Brook requires the same information regarding developments be submitted as is required by the minister (Appendix I). The application for environmental approval of a development or activity can be found online at: www.env.gov.nl.ca/Env/env/waterres/Forms/WRMD-Forms.asp.

The City of Corner Brook regulates all developments within the watershed; however the policies and guidelines used by the provincial government (as in the *Water Resources Act (2002)*) should be adopted by the city as a minimum standard. The most concrete guidelines laid out in policy W.R. 95-01, are the specified buffer zone widths along streams and waterbodies (Table 13). These are the minimum buffers to which all developments must adhere and within which all activities are prohibited. These buffers were based on a review of regulated buffer zone widths from jurisdictions all across Canada and a review of technical information on buffers for forestry, agriculture, etc. From this information and knowledge of local conditions, the Department then developed buffer widths specific to Newfoundland. A recent review of the literature indicates that the buffer widths set in the policy are still valid today. Klapproth and Johnson's (2000) review found that buffers from 50-100 feet (15-30 meters) were recommended, with greater widths for steep slopes and high sediment loads (5 feet/1.5 m) for every 1%

increase in slope). The Chesapeake Bay Watershed Forestry Program (USFS, 2003) recommends buffer widths based on function. Removal of nitrogen requires a 10-30 meter buffer, sediment removal and erosion prevention requires a 15-30 meter buffer and moderation of storm flows and run-off requires a 20-60 meter buffer, all functions essential to the protection of water quality.

Table 13. Widths of buffer zones along and around waterbodies from the high water mark.

Water Body	Width of Buffer Zones
Intake pond or lake	Minimum of 150 metres
River intake	Minimum of 150 metres for a distance of 1 km upstream and 100 metres downstream
Main river channel	Minimum of 75 meters
Major tributaries, lakes or ponds	Minimum of 50 metres
Other water bodies	Minimum of 30 metres

A second policy under the *Water Resources Act* regulating developments in PWSA's is Policy Directive W.R. 93-01, *Policy for Treated Utility Poles in Water Supply Areas* (Appendix H). This policy sets guidelines to be followed by utility companies in order to minimize the risk of water quality impairment and possible impact on public health from existing and new chemically-treated poles. For example, the buffer zone widths outlined above also apply to the installation of specified chemically-treated poles.

Under the *Environmental Protection Act*, the *Environmental Assessment Regulations* require registration and an environmental review of development proposals, the procedure outlined in the Regulations. These development proposals must pass the environmental review as well as meet the minimum requirements set out by the City of Corner Brook. The types of development requiring registration and environmental review that might occur in the Corner Brook watershed are forest harvesting, mining and snowmobile trails. Also under the *Environmental Protection Act*, the *Heating Oil Storage Tank System Regulations* provide for the protection of water quality by regulating heating oil storage tanks. Although most cabins are heated by wood, cabin owners using oil as a

source of heat would have to abide by these regulations. Cabin owners must also possess a *License to Occupy* Crown land, under the *Lands Act*. Finally, cabin owners must also follow the *Sanitation Regulations* under the *Public Health Act*. These regulations state the standard required for sewage disposal at a cabin site (i.e. 30 meters from surface water).

Fisheries and Oceans Canada guides the application of fish habitat provision through the *Policy for the Management of Fish Habitat.* This policy protects fish habitat by administering the federal *Fisheries Act* and incorporating fish habitat protection requirements into land and water use activities and projects. It is based on the principle of no net loss of habitat, that is, to maintain without disruption the natural productive capacity of the habitat.

ATV Regulations under the *Motorized Snow Vehicle and All-Terrain Vehicle Use Act* restrict ATV use in wetland areas including bogs, barrens and marshes. These regulations protect wetlands which provide habitat for many species of plants and animals, reduce flood levels in rivers, and supply environmental, social and tourism benefits.

NON-REGULATORY (BEST MANAGEMENT PRACTICES)

Non-regulatory approaches are mainly guidelines and best management practices. A few such guidelines that are relevant to the Corner Brook watershed already exist.

The Department of Environment and Conservation developed a series of guidelines to assist in the preparation of development plans for various industrial uses within PWSA's (mineral exploration, forest harvesting, aggregate extraction and agriculture). These guidelines are currently being revised.

In 1998 the Department of Natural Resources produced *Environmental Protection Guidelines for Ecologically Based Forest Resource Management (Stand Level Operations)* (Appendix C). These guidelines apply to forestry operations in all areas of Newfoundland and Labrador, and cover timber harvesting, forest access roads, silvicultural practices, regeneration, and forest protection. They also contain a separate section containing more stringent procedures for forestry operations in PWSA's. The

Forestry Branch has indicated that these guidelines will be updated in the future, so the Monitoring Committee should become familiar with the revised guidelines when they are completed.

The Mines and Energy Branch of the Department of Natural Resources have developed Environmental Guidelines for Construction and Mineral Exploration Companies for mineral exploration. These guidelines outline procedures for all aspects of access roads, mineral exploration, blasting, drilling and trenching, and abandonment and rehabilitation. They can be viewed in Appendix L or online at www.nr.gov.nl.ca/mines&en/mqrights/environment.pdf.

The Inland Fish and Wildlife Division (IFWD) has developed a briefing note on the issue of removing beavers during outbreaks of *Giardiasis* or "beaver fever". Removal of beaver dams (and beaver) as the source of contamination from near water supply intake areas is recommended by the provincial Water Resources Management Division (DOE, 2001). However, the position of IFWD is not to allow indiscriminate removal of beaver in town watersheds, for reasons stated in the briefing. They do agree with the removal of "any beaver in close proximity of the intake" where *Giardia* is confirmed, and "a sample of beavers or other wildlife can be removed for testing purposes only" where *Giardia* is suspected.

With the potential for forest fires in the vicinity of watersheds and therefore the potential for contamination of the water supply by sea water, petroleum products or fire retardant foams etc., the provincial Department of Environment and Conservation established the *Guidelines on the use of Water Bombers in Protected Water Supply Areas* in March, 2006 (Appendix H). These guidelines aim to minimize the risk of contamination of drinking water supplies and recommend, in part, that: With the exception of Gander Lake, all PWSA's are off limits for water bombing training drills; during active forest fire fighting, all ponds and lakes in a PWSA, with the exception of the intake water body may be used without restriction for water pickup. With the exception of Gander Lake, all other intake water bodies shall be considered as no water pickup zones. Given the potential for impairment of the drinking water quality, fire

retardant foam and sea water should only be used as a last resort. These guidelines are available from the Department of Environment and Conservation.

RECOMMENDED STRATEGIES

REGULATORY – CORNER BROOK WATERSHED DIRECTIVES

The City of Corner Brook Act (1990) gives power to the City of Corner Brook to make regulations to protect their source of drinking water. In Corner Brook this authority could be expressed in the form of a series of watershed directives. Directives recommended in the plan can be implemented once City Council has approved the plan, and amended as need arises. New directives can be developed as required.

Corner Brook Watershed Directive 1.0

Define the public consultation process for the city of Corner Brook. A clear definition and protocol for a public consultation process for the city of Corner Brook would ensure that the means for obtaining public concerns for any issues would be clearly defined. There is an existing provision for public consultation; however there is no methodology or protocol associated with the regulation. The existing provisions for public consultation in the watershed regulations can be viewed in Appendix M.

Corner Brook Watershed Directive 2.0

Designate watershed management zones. A regulatory approach that does not exist but that would be most effective in the management of the Corner Brook watershed is the designation of watershed management zones. These zones, developed in the sensitivity analysis (Figures 22 and 23) and based on slope, waterbody buffers, and distance from the intake, serve to designate areas of permitted and restricted activities. Three zones are suggested to ensure the protection of the Corner Brook watershed:

Watershed Management Zone 1: (No Development Activities) occurs in the following areas:

- Within 1 km of the intake

- Inside the buffers outlined in *Policy for Land and Water Related Developments in Protected Public Water Supply Areas* (Table 13)

All activities are prohibited in Watershed Management Zone 1.

Watershed Management Zone 2: (High Slope Management Areas) is a restricted-use zone. It includes areas:

- Outside 1 km from the intake;
- Outside the watershed buffers (Table 13);
- Any areas with a slope over 20 % outside Zone 1.

Zone 2 is a high-slope management zone where activities on slopes over 20% are permitted with best management practices specific to the zone.

Watershed Management Zone 3: is a restricted-use zone. High risk development activities are prohibited and other development activities are regulated. It covers the areas:

- Between 1 and 8 km from the intake
- Outside the watershed buffers (Table 13)
- Any areas with a slope between 5 and 20%.

Any high risk potential causes of contamination and/or numerical indices over 230 (as assessed in the risk assessments Table 9) are prohibited in Zone 3. Five potential causes of contamination fall into the prohibited category: natural organic loading, motorized vehicle use, increased stream-flow, forest fire and pit privies. All other development and recreational activities assessed in the risk analysis are permitted, subject to applicable guidelines. Of the five prohibited activities, only two can be influenced or controlled to some degree:

- Motorized Vehicle Use
- Pit privies (cabins)

Motorized vehicle use is difficult to enforce and would be inappropriate to prohibit at present. Education of users is the best option until access changes occur. Pit privies, especially those related to cabin usage is dealt with in Corner Brook Watershed Directive 3.0.

The other activities which ranked in the top five in the numerical rating (natural organic loading, increased stream-flow and forest fires) are natural occurrences, and cannot be controlled; therefore they were not added to the list of prohibited activities.

The remaining activities identified as potential uses may be permitted in Management Zone 3 and are listed in Table 14. All activities in a watershed must adhere to the *Policy for Land and Water Related Developments in Protected Public Water Supply Areas*. In addition, development activities are subject to regulatory approval for development in a Protected Water Supply Area and subject to approval from the City of Corner Brook. The Department of Environment and Conservation defines development as "the carrying out of any activity or operation on, over, or under land or water for social or economic benefits, or the making of any change in the use or the intensity of use of any land, water, building or premises". Some activities require additional regulations, guidelines or permits to those mentioned above, and these are included in the following table.

Table 14. . Activities permitted in Watershed Management Zones 3 & 4.

Activity	**Regulations / Guidelines**	**Source Agency**	**Permit Required**	**Source Agency**
Existing Cabins	Heating Oil Storage Tank System Regulation License to Occupy	Dept. of Environ. & Conservation, Water Resources Div. Dept. of Environ. & Conservation, Crown Land Admin. Div.	"License to Occupy"	Dept. of Environ. & Conservation, Crown Land Administration Division

Activity	**Regulations / Guidelines**	**Source Agency**	**Permit Required**	**Source Agency**
	Sanitation Regulations	Dept. of Health & Community Services		
Wildlife[1]	*Giardiasis* Briefing Note	Dept. of Environ. & Conservation, Inland Fish & Wildlife Div.	N/A	
Hunting (Big Game and Small Game)	Hunting Regulations	Dept. of Environ. & Conservation, Inland Fish & Wildlife Div.	Hunting License Possession and Acquisition License (for use of firearms)	Dept. of Environ. & Conservation, Inland Fish & Wildlife Div
Motorized Vehicle Use[1]	Motorized Snow Vehicle & All-Terrain Vehicles Regulations	Dept. of Natural Resources, Dept. of Government Services	Registration of Vehicle	Dept. of Government Services
Camping and Recreation[1]	None		None	
Commercial Harvesting, Forest Road Construction and Use	Environmental Protection Guidelines for Ecologically Based Forest Resource Management Policy for the Management of Fish Habitat Environmental Protection Act, 2002 Environmental Assessment Regulations	Dept. of Natural Resources, Forestry Branch Fisheries and Oceans Canada Department of Environment and Conservation – Environmental Assessment Division	"Approval for Water Crossing" Development Permit	Fisheries and Oceans Canada City of Corner Brook
Silviculture	Environmental Protection Guidelines for Ecologically Based Forest Resource Management	Dept. of Natural Resources, Forestry Branch Department of Environment and Conservation –	Development Permit	City of Corner Brook

Activity	**Regulations / Guidelines**	**Source Agency**	**Permit Required**	**Source Agency**
	Environmental Protection Act, 2002 Environmental Assessment Regulations	Environmental Assessment Division		
Utility Line Structure and Vegetation Maintenance	Policy for Treated Utility Poles in Water Supply Areas	Dept. of Environ. & Conservation, Water Resources Division.	Development Permit	City of Corner Brook
Mineral Exploration	Environmental Guidelines for Construction and Mineral Exploration Companies Environmental Protection Act, 2002 Environmental Assessment Regulations	Dept. of Natural Resources, Mines & Energy Branch Department of Environment and Conservation – Environmental Assessment Division	Development Permit	City of Corner Brook
Mining	Environmental Guidelines for Construction and Mineral Exploration Companies Policy for the Management of Fish Habitat Environmental Protection Act, 2002 Environmental Assessment Regulations	Dept. of Natural Resources, Mines & Energy Branch Fisheries and Oceans Canada Department of Environment and Conservation – Environmental Assessment Division	"Approval for Water Crossing" Development Permit	Fisheries and Oceans Canada City of Corner Brook

Activity	**Regulations / Guidelines**	**Source Agency**	**Permit Required**	**Source Agency**
Quarrying	Environmental Guidelines for Construction and Mineral Exploration Companies Policy for the Management of Fish Habitat Environmental Protection Act, 2002 Environmental Assessment Regulations	Dept. of Natural Resources, Mines & Energy Branch Fisheries and Oceans Canada Department of Environment and Conservation – Environmental Assessment Division	"Approval for Water Crossing" Development Permit	Fisheries and Oceans Canada City of Corner Brook
Utility Line CCA Poles	Policy for Treated Utility Poles in Water Supply Areas	Dept. of Environ. & Conservation, Water Resources Division	Development Permit	City of Corner Brook

[1] These activities were assessed high risk, but their prohibition would be impossible to enforce.

Watershed Management Zone 4 (Regulated Development Activity) includes the areas:

- > 8 km from the intake and
- < 5% slope

This zone allows all activities identified as potential developments and these activities are subject to regulations and best management practices. Even activities assessed as high risk may be allowed in this zone, due to the great distance from the water supply intake. Again, any activities in a watershed must adhere to the Policy for Land and Water Related Developments in Protected Public Water Supply Areas. In addition, development

activities are subject to regulatory approval for development in a Protected Water Supply Area. As with Zone 3, additional regulations, guidelines and permits that apply to specific activities are listed in Table 14.

Corner Brook Watershed Directive 3.0

Modify City of Corner Brook's municipal planning boundary to cover the entire drainage basin the water supply area. With this designation the City of Corner Brook has the authority to make rules and regulations with regards to the city's water supply.

Corner Brook Watershed Directive 4.0

Create a new zone within the existing development regulations that would cover ***protected water supply areas****, and establish regulations that govern all development activities that fall within the protected water supply zone*. Any development activity will have a rigid set of regulations that council can follow for making permitting decisions. All other activities that are not considered developments will be considered discretionary. This will enable council to seek advice, including public input for decisions made on discretionary activities.

Corner Brook Watershed Directive 5.0

Update City of Corner Brook by-laws. New or revised by-laws should be developed to include all activities that may occur in the protected water supply zone that are not considered development (e.g. recreational activities). This will enable the city to minimize the occurrences of undesirable activities and provide an avenue for enforcement.

Corner Brook Watershed Directive 6.0

Prohibit cabin developments within the Corner Brook Watershed. Three of the potential contaminants that could impair water quality in the Corner Brook watershed are caused by activities related to cabins. Existing cabins, with permits obtained before this management plan, are allowed to stay. However, they must abide by all regulations and guidelines. Those cabins presently in violation of applicable regulations must act to

ensure they comply with regulations. In addition, City Council, on its own and through the Federation of Municipalities, should lobby government to ensure *Licenses to Occupy* existing in Protected Water Supply Areas are valid only for the life of the present permit holder.

NON-REGULATORY - BEST MANAGEMENT PRACTICES

In addition to regulations or directives passed by City Council, the Monitoring Committee can also develop or encourage other agencies to develop guidelines or best management practices (BMP's) that will further assist in the protection of their drinking water supply. Areas requiring guidelines and BMPs are listed below.

Snowmobiling

Snowmobiling is a major non-industrial use of the watershed, and other than regulations concerning vehicle registration and trail permits, very little if any policy exists concerning their conduct on trails, particularly in PWSA's. The Monitoring Committee should work with the Western SnoRiders Club to develop guidelines for snowmobiling in protected water supply areas, to be distributed to anyone purchasing a trail sticker. These could be used in PWSA's all across the province.

Forestry / Utility

Best Management Practices for forestry operations in Zone 2 must be developed to include the following:

- Harvesting on slopes only up to 35%
- Winter or mid-summer harvesting and road construction operations;
- Cut-to-length harvesting practices;
- Use of 8-wheel forwarding equipment.

Issues have surfaced in forest harvesting and in utility operations concerning small streams that do not appear on a 1:50,000 scale map, but can be located on the ground. The present *Environmental Protection Guidelines for Ecologically Based Forest*

Resource Management (Stand Level Operations) attempts to rectify this problem by stating that "Appropriate protection is still required for streams greater than 1.0 m in width (at its narrowest point from the high water mark) not found on the 1:50,000 topographic map." This protection refers to a Certificate of Approval for a water crossing and a minimum 30 m buffer (more if the slope is greater than 30%). However, where the placement of treated utility poles is concerned, the 1:50,000 map is still the deciding factor with respect to identifiable streams.

A provincial Riparian Working Group (RWG) has also recognized problems with identifying 1-metre streams that need to be buffered (Steve Balsom, CBPP Member, RWG). The RWG are working on guidelines to standardize how 1-metre streams are determined and they are developing best management practices for streams not buffered. They also appreciate that the existing "blanket" prescription for streams requiring a buffer needs to be redefined based on specific needs such as water quality, wildlife, and aquatic life. Their goal is to consult with resource specialists in each area and subsequently set buffer widths that will protect these specific needs, making it easier to determine what trees can be harvested

Determining the size of streams that need to be buffered for specific needs is obviously an issue that needs to be addressed. The Department of Environment and Conservation is currently rewriting their guidelines for preparing development plans for development operations in Protected Water Supply Areas. The Department of Natural Resources has plans to revise the Environmental Protection Guidelines for Ecologically Based Forest Resource Management. Both departments should work together to deal with this concern to ensure the protection of water supplies in the province.

Mineral Exploration, Mining and Quarrying

Currently, guidelines exist for mineral exploration, mining and quarrying. However, before these activities are approved for operation, more stringent best management practices should be developed and resources found to ensure their enforcement.

ENVIRONMENTAL EMERGENCY RESPONSE PLAN

A management plan for a water supply source needs to include an environmental emergency response plan to deal with environmental emergencies in the watershed, regardless of the level of development. Environmental emergencies can be natural events such as forest fires or floods or they can be human related, such as industrial or transportation-related accidents. An environmental emergency response plan will ensure the damage to life, property and the environment is minimal.

An environmental emergency response plan should name equipment, materials, procedures and personnel required to respond quickly to an environmental emergency that could threaten the supply of drinking water. Notification procedures, response protocols and methods of containment should also be identified in the plan. Information about the water supply system, such as the location of isolating valves and capacity of the water treatment facilities, is also important. In addition to preparing for environmental emergencies in the watershed, the plan should also include a strategy to supply drinking water in the event of a prolonged shutdown. Finally, provisions for an annual review and update by the participating agencies should complete the plan.

The environmental emergency response plan for the watershed should be developed with the assistance of the players that would be involved. Government agencies are required for their technical expertise in assessing the problem and determining an appropriate clean-up plan. Local groups are required to implement the plan quickly in a coordinated effort. The Emergency Measures Division of the Department of Provincial and Municipal Affairs, the Water Resources Division of the Department of Environment and Conservation, and the Corner Brook Fire Department all need to work with the Watershed Management Committee to develop an effective plan.

EDUCATION AND STEWARDSHIP

Educating users of the watershed about source water, water quality, water pollution issues, and strategies to protect water resources is an important management tool. And often what follows knowledge of water quality issues is a sense of ownership or

stewardship of the watershed. Educating users about their impact on the watershed will cause greater movement towards appropriate behavior than any laws or regulatory requirements. Individuals need to understand how they can protect the quality of their water by being aware of the effect of their actions in the watershed. And by taking ownership of the watershed, they will be effective monitors of all uses of the watershed.

In order to have an effective education program, it is necessary to identify the individuals and groups that impact the watershed and consequently whose support is required. Table 12 identifies the audiences to target under each potential contaminant. Education of companies seeking approval for industrial developments in the watershed is already accomplished through the regulations and guidelines they are required to follow. However other users, such as residents, cabin owners and ATV and snowmobile operators, are audiences that have not been educated about their role in water quality. There are few specific regulations guiding the activities of these users in the watershed, yet many of their activities scored high in the risk assessment exercise (Table 9). Educating these users should lessen the risk of contamination of the watershed.

Table 12 also indicates the messages that need to be conveyed to each user. The non-industrial users just mentioned could possibly be a cause of six of the eight potential contaminants identified for the Corner Brook watershed: pathogenic microbes (human wastes), fuel contamination, sedimentation, nutrients, refuse, and toxins. These users need to be informed, first, what contaminants can be caused by their activities, and how these contaminants affect water quality. It should be emphasized that if they live in Corner Brook, then these potential issues in water quality are also their potential health issues. Next, the user's role in contributing to these contaminants should be explained (i.e. what activities can cause what contaminants). Finally, users should be educated on how they can continue to enjoy their activities in a way that does not contaminate the watershed. Since many of the issues apply to many of the groups, a brochure could be developed to address all groups. Guidelines to address these issues can be found in existing brochures from other provinces and states, and would be a valuable resource to the Watershed Monitoring Committee.

There are a number of ways to deliver this message to the non-industrial users, and each user group may require a different method. Probably the most effective way to reach residents is to distribute a brochure to all households. Residents would make up many of the campers and ATV users. The same brochure could be hand delivered to the cabin owners, giving the opportunity for one-on-one education. Snowmobile users could be addressed at a general meeting of the Western SnoRiders, with a request to hand out copies of the brochures with all trail stickers sold. Additional signage at all entry points to the watershed will remind people that they are in a protected water supply area and that their actions could impact on drinking water quality. Meetings or information sessions with specific groups could be arranged if the need dictates.

MONITORING AND REPORTING

To ensure the regulations and guidelines in the preceding section are being followed, monitoring of water quality and the watershed area are both necessary. Water Quality is currently monitored and reported on regularly by the City of Corner Brook, Dept. of Government Services and Dept of Environment and Conservation as outlined previously in the water quality data section.

Watershed area monitoring includes checks for signs of illegal activity, legal activity and signs of natural occurrences that could detrimentally affect water quality. The Watershed Management Committee should appoint a monitor to visit areas of the watershed on a regular basis. A number of areas that are recommended for monitoring are outlined in the table below.

Table 15 Monitoring activities for the Corner Brook watershed

Monitoring Activities	**Agency Responsible**
Compliance with acceptable uses within the Watershed Management Zones. This requires monitoring of all activities to ensure they are permitted activities within the zone they are occurring.	Management Committee
Unauthorized development within the Watershed Management Zones. This requires ensuring that	Management Committee

Monitoring Activities	Agency Responsible
permitted activities that are occurring have received a permit to do so, where applicable.	
Approved developments working within their regulations. This monitoring requires that developments that have received approval from the Dept. of Environment and Conservation and the City of Corner Brook and are complying with the applicable regulations.	Resource Departments of government, in consultation with the Department of Environment and Conservation. City of Corner Brook
Chemical and physical parameters for source and tap water	Department of Environment and Conservation City of Corner Brook
Microbiological parameters of tap water	Department of Government Services

Monitoring of the watershed by the appointed monitor should occur on a regular schedule of once per month, with more frequent visits, if possible, during periods of greater use or development activities. During each visit, the city monitor should make note of: activities/developments observed; whether permits were required and in possession of the operator/developer; natural phenomenon of concern (beavers, water levels); roads/trails causing erosion; and actions of individuals/groups that threaten water quality. Pictures and/or GPS waypoints are other important tools to use in monitoring the watershed.

These Reports will allow the City and the Management Committee to keep up to date on the progress of activities in the watershed and serve as a record of the date activities and concerns are detected. Appendix N includes a template of the field Monitoring Report form.

In the event of any unauthorized development activity in the watershed, or activity contrary to the terms and conditions of permits allowing activity, enforcement action should adhere to the following general steps:

1. Monitor informs the violator what regulation/policy is being broken and requests the activity be stopped immediately (stop work order).

2. Depending on severity of the violation, an investigation may be required to assess damages.

3. Investigation may result in request for remedial actions or may result in charges being laid against the violator.

Initially the Watershed Management Committee should meet as often as is required to implement the recommendations of the plan in the time indicated. Following that, the Committee should meet as often as is required to monitor activities in the watershed and study possible applications, at a minimum of four times per year.

The Management Committee should produce a watershed report card annually to compile information about the quality of the water over the previous year. A report card is a very useful tool to assess the past years overall monitoring efforts, permitting and water quality information and acts as an easy way to compare progress from year to year.

The report should include three major sections; stressors, condition, and response. The stressors section deals with anything that relay's *stress* on the watershed such as:

- the number of land/water use activities
- percent of watershed area under development
- presence of beavers
- number of unauthorized development activities

The next section deals with the *condition* of the watershed and source water, including water after treatment. This section would include:

- average Drinking Water Quality Index Score
- number of samples collected
- number of exceedences
- number of Boil Water Advisories

- any flood events

Section three deals with any *responses* or actions that have been taken with respect to improving water quality or watershed protection. This would include:

- number of times the distribution system has been flushed
- number of watershed committee meetings
- number of outreach/education initiatives implemented
- number of watershed surveys completed

The annual report card should be reviewed by the Management Committee and compared to previous report cards from Year 2 on. The Committee can then assess if any activities require additional monitoring or if any user group requires information about their impact on water quality. The annual report card should be submitted to the City Council and made available to residents. Appendix N includes an Annual Report Card example template.

IMPLEMENTATION

ACTION PLAN

A number of recommendations have been made in the previous section towards the protection of water quality in the Corner Brook watershed.

Table 16. Action plan for implementation.

Task #	Action Items	Time Frame
1	Incorporate Corner Brook Watershed Directives into Municipal Regulations	Year 2
2	Implement monitoring program as outlined in the section Monitoring and Reporting	Year 2
3	Update existing Emergency Response Plan to include the watershed and the supply of water in the event of a prolonged shutdown.	Year 3
4	Develop a brochure directed at non-industrial users of the watershed to inform them of their role in protecting the watershed.	Year 2
5	Work with the Western SnoRiders to develop guidelines for snowmobiling in Protected Water Supply Areas.	Year 2
6	Assess the location, number and condition of existing Water Supply signs in the watershed. Repair existing signs and erect additional ones as required.	Year 2
7	Work with the Provincial Government to develop more stringent guidelines for quarry and mineral operations in the watershed and lobby for appropriate frequency of monitoring by the Mines and Energy Division of the Dept. of Natural Resources. Develop policies regarding the issuance of new mineral claims within the watershed boundary.	Year 2
8	Ensure pit privies are of sufficient distance from high water mark; educate cabin owners about risks of human wastes close to waterbodies	Year 2
9	Obtain a revised copy of *Environmental Protection Guidelines for Ecologically Based Forest Resource Management as soon as they are completed.*	When Available
10	Obtain a revised copy of the Guidelines for Preparing Development Plans for Operations within the Protected Water Supply Area.	When Available

REVIEW AND AMENDMENTS

This Management Plan should be reviewed every 5 years to determine the effectiveness of the regulations and BMPs in protecting the quality of the drinking water. Amendments can be made at this time if needed. Amendments required between reviews can be made as well. All recommendations for amendments must go through the Monitoring Committee.

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APPENDICES

APPENDIX A – SUMMARY OF GUIDELINES FOR CANADIAN DRINKING WATER QUALITY

SUMMARY OF GUIDELINES FOR CHEMICAL AND PHYSICAL PARAMETERS

Parameters with Guidelines

Guidelines for all chemical and physical parameters, including all new, revised and reaffirmed maximum acceptable concentrations (MACs), interim maximum acceptable concentrations (IMACs) and aesthetic objectives (AOs), are listed in Table 3. For more information on the drinking water guideline for any particular compound, please refer to the Supporting Documentation for the parameter of concern.

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)
aldicarb	0.009	
aldrin + dieldrin	0.0007	
aluminum 1		
antimony	0.0062	
arsenic	0.025	
atrazine + metabolites	0.005	
azinphos-methyl	0.02	
barium	1.0	
bendiocarb	0.04	
benzene	0.005	
benzo[a]pyrene	0.00001	
boron	5	
bromate	0.01	

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)
bromoxynil	0.005	
cadmium	0.005	
carbaryl	0.09	
carbofuran	0.09	
carbon tetrachloride	0.005	
chloramines (total)	3.0	
chloride		≤250
chlorpyrifos	0.09	
chromium	0.05	
colour		≤15 TCU [4]
copper [2]		≤1.0
cyanazine	0.01	
cyanide	0.2	
cyanobacterial toxins (as microcystin-LR) [3]	0.0015	
diazinon	0.02	
dicamba	0.12	
dichlorobenzene, 1,2- [5]	0.20	≤0.003
dichlorobenzene, 1,4- [5]	0.005	≤0.001
dichloroethane, 1,2-	0.005	
dichloroethylene, 1,1-	0.014	
dichloromethane	0.05	
dichlorophenol, 2,4-	0.9	≤0.0003
dichlorophenoxyacetic acid, 2,4- (2,4-D)	0.1	
diclofop-methyl	0.009	
dimethoate	0.02	

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)
dinoseb	0.01	
diquat	0.07	
diuron	0.15	
ethylbenzene		≤0.0024
fluoride 6	1.5	
glyphosate	0.28	
iron		≤0.3
lead 2	0.010	
malathion	0.19	
manganese		≤0.05
mercury	0.001	
methoxychlor	0.9	
metolachlor	0.05	
metribuzin	0.08	
monochlorobenzene	0.08	≤0.03
nitrate 7	45	
nitrilotriacetic acid (NTA)	0.4	
odour		Inoffensive
paraquat (as dichloride)	0.01 8	
parathion	0.05	
pentachlorophenol	0.06	≤0.030
pH		6.5-8.5 9
phorate	0.002	
picloram	0.19	
selenium	0.01	
simazine	0.01	
sodium 10		≤200

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)
sulphate 11		≤500
sulphide (as H2S)		≤0.05
taste		Inoffensive
temperature		≤15°C
terbufos	0.001	
tetrachloroethylene	0.03	
tetrachlorophenol, 2,3,4,6-	0.1	≤0.001
toluene		≤0.024
total dissolved solids (TDS)		≤500
trichloroethylene	0.05	
trichlorophenol, 2,4,6-	0.005	≤0.002
trifluralin	0.045	
trihalomethanes (total) 12	0.1	
turbidity	1 NTU13	≤5 NTU 13,14
uranium	0.02	
vinyl chloride	0.002	
xylenes (total)		≤0.3
zinc 2		≤5.0

Notes:

1. A health-based guideline for aluminum in drinking water has not been established. However, water treatment plants using aluminum-based coagulants should optimize their operations to reduce residual aluminum levels in treated water to the lowest extent possible as a precautionary measure. *Operational guidance values* of less than 100 µg/L total aluminum for conventional treatment plants and less than 200 µg/L total aluminum for other types of treatment systems are recommended. Any attempt to minimize aluminum residuals must not compromise the effectiveness of disinfection processes or interfere with the removal of disinfection by-product precursors.

2. Because first-drawn water may contain higher concentrations of metals than are found in running water after flushing, faucets should be thoroughly flushed before water is taken for consumption or analysis.

3. The guideline is considered protective of human health against exposure to other microcystins (total microcystins) that may also be present.

4. TCU = true colour unit.

5. In cases where total dichlorobenzenes are measured and concentrations exceed the most stringent value (0.005 mg/L), the concentrations of the individual isomers should be established.

6. It is recommended, however, that the concentration of fluoride be adjusted to 0.8–1.0 mg/L, which is the optimum range for the control of dental caries.

7. Equivalent to 10 mg/L as nitrate–nitrogen. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.

8. Equivalent to 0.007 mg/L for paraquat ion.

9. No units.

10. It is recommended that sodium be included in routine monitoring programmes, as levels may be of interest to authorities who wish to prescribe sodium-restricted diets for their patients.

11. There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L.

12. The IMAC for trihalomethanes is expressed as a running annual average. It is based on the risk associated with chloroform, the trihalomethane most often present and in greatest concentration in drinking water. The guideline is designated as interim until such time as the risks from other disinfection by-products are ascertained. The preferred method of controlling disinfection by-products is precursor removal; however, any method of control employed must not compromise the effectiveness of water disinfection.

13. NTU = nephelometric turbidity unit.

14. At the point of consumption.

Parameters without Guidelines

Since 1978, some chemical and physical parameters have been identified as not requiring a numerical guideline. Table 4 lists these parameters.

The reasons for parameters having no numerical guideline include the following:

currently available data indicate no health risk or aesthetic problem (e.g., calcium);
data indicate the compound, which may be harmful, is not registered for use in Canada (e.g., 2,4,5-TP) or is not likely to occur in drinking water at levels that present a health risk (e.g., silver); or
the parameter is composed of several compounds for which individual guidelines may be required (e.g., pesticides [total]).

Table 4. Summary List of Parameters without Guidelines

Parameter	Parameter
ammonia	mirex
asbestos	phenols
calcium	phthalic acid esters (PAE)
chlordane (total isomers)	polycyclic aromatic hydrocarbons (PAH) 2
dichlorodiphenyltrichloroethane (DDT) + metabolites	radon
endrin	resin acids
formaldehyde	silver
gasoline	tannin
hardness 1	temephos
heptachlor + heptachlor epoxide	total organic carbon
lignin	toxaphene
lindane	triallate
magnesium	trichlorophenoxyacetic acid, 2,4,5- (2,4,5-T)
methyl-parathion	trichlorophenoxypropionic acid, 2,4,5- (2,4,5-TP)

Notes:

1. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as $CaCO_3$) are considered acceptable; levels greater than 200 mg/L are considered poor but can be tolerated; those in excess of 500 mg/L are normally considered unacceptable. Where water is softened by sodium ion exchange, it is recommended that a separate, unsoftened supply be retained for culinary and drinking purposes.

2. Other than benzo[a]pyrene.

SUMMARY OF GUIDELINES FOR MICROBIOLOGICAL PARAMETERS

Bacteria (Under Review)

The maximum acceptable concentration (MAC) for bacteriological quality of public, semi-public, and private drinking water systems is no coliforms detectable per 100 mL. However, because coliforms are not uniformly distributed in water and are subject to considerable variation in public health significance, drinking water that fulfills the following conditions is considered to conform to this MAC:

Public Drinking Water Supply Systems

1. No sample should contain *Escherichia coli. E. coli* indicates recent faecal contamination and the possible presence of enteric pathogens that may adversly affect human health. If *E. coli* is confirmed, the appropriate agencies should be notified, a boil water advisory should be issued, and corrective actions taken.

2. No consecutive samples from the same site or not more than 10% of samples from the distribution system in a given calendar month should show the presence of total coliform bacteria. The ability of total coliforms to indicate the presence of faecal pollution is less reliable than *E. coli*. However, this group of bacteria is a good indicator of quality control. The presence of total coliforms does not necessarily require the issuance of a boil water advisory but corrective actions should be taken.

Semi-public and Private Drinking Water Supply Systems

1. No sample should contain *E. coli*. As stated above, the presence of *E. coli* indicates faecal contamination and the possible presence of enteric pathogens; therefore the water is unsafe to drink. If *E. coli* is detected, a boil water advisory should be issued and corrective actions taken.

2. No sample should contain total coliform bacteria. In non-disinfected well water, the presence of total coliform bacteria in the absence of *E. coli* indicates the well is prone to surface water infiltration and therefore at risk of faecal contamination. In disinfected water systems, the presence of total coliform bacteria indicates a failure in the disinfection process. In both disinfected and non-disinfected systems, total coliform detection may also indicate the presence of biofilm in the well or plumbing system. The degree of response to the presence of total coliform bacteria, in the absence of *E. coli*, may be site specific and can vary between jurisdictions.

Protozoa (Under Review)

Numerical guidelines for the protozoa *Giardia* and *Cryptosporidium* are not proposed at this time. Routine methods available for the detection of protozoan cysts and oocysts suffer from low recovery rates and do not provide any information on their viability or human infectivity. Nevertheless, until better monitoring data and information on the viability and infectivity of cysts and oocysts present in drinking water are available, measures to reduce the risk of illness as much as possible should be implemented. If viable, human-infectious cysts or oocysts are present or suspected to be present in source waters or if *Giardia* or *Cryptosporidium* has been responsible for past waterborne outbreaks in a community, a treatment regime and a watershed or wellhead protection plan (where feasible) or other measures known to reduce the risk of illness should be implemented.

Viruses (Under Review)

Numerical guidelines for human enteric viruses are not proposed at this time. There are more than 120 types of human enteric viruses, many of which are non-culturable. Testing is complicated, expensive, not available for all viruses, and beyond the capabilities of most laboratories involved in routine water quality monitoring. The best means of safeguarding against the presence of human enteric viruses are based upon the application of adequate treatment and the absence of faecal indicator organisms, such as *Escherichia coli*.

Boil Water Advisories

General guidance on the issuing and rescinding of boil water advisories is provided. In the event of an advisory, a rolling boil for 1 minute is considered adequate.

APPENDIX B – WATER QUALITY DATA FOR THE CORNER BROOK

Corner Brook Lake (Trout Pond): Source Water Data

Sample #:	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron

Sample #:	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
1997-7101-00-SI-RE	14	**18**	54.6		6.5	44		0.24			6	5.2			3.1	4.5
2000-7003-00-SI-RE	4.2	**39**	51.4		6.94	30	1	0.68		0.025	7.03	3	0.005	0.34	3.11	1.6
2000-7004-00-SI-RE	21.4	**34**	78.1		6.93	54	1	0.5		0.025	11.2	6	0.005	0.24	4.96	2.6
2000-7005-00-SI-RE	11	**26**	64.1		6.61	40	2	0.8		0.025	7.43	5.6	0.005	0.33	4.7	3.5
2002-4821-00-SI-RE	19	**88**	49	22	7.16	32		0.3	0.025	0.025	7	4	0.05	0.5	4	3
2002-4091-00-SI-RE	18	**29**	50	28	6.51	33		0.4	0.01	0.025	11	3	0.05	0.5	2	3
2002-4203-00-SI-RE	14	**33**	46	13	**6.24**	30		0.8	0.025	0.025	5	4	0.05	0.5	2	5
2003-4090-00-SI-RE	18	**48**	44	15	**6.35**	29		0.5	0.025	0.025	6	3	0.05	0.5	2	3
2003-4914-00-SI-RE	16	**33**	43	10	6.57	28		0.5	0.005	0.025	4	5	0.05	0.5	2	5
2004-4934-00-SI-RE	13	**32**	35	10	7.01	23		0.5	0	0	4	3	0	0	2	4
2005-4987-00-SI-RE	15	**25**	38	10	7.23	25		0.4	0	0	4	3	0	0	2	3
2006-4208-00-SI-RE	12	**38**	41	13	6.87	27		0.3	0	0	5	3	0	0	0	3
2007-4106-00-SI-RE	18	**28**	54	24	7.14	29		0.2	0	0	7.8	4	0	0.5	2.6	0
2007-4226-00-SI-RE	16	**38**	46	22	7.28	25		0.3	0	0	7.1	3	0	0.3	2.2	0
2007-4327-00-SI-RE	15	**28**	47	17	7.27	23		0.2	0	0	5.4	3	0	0.5	2.4	0
2008-4150-00-SI-RE	11	**45**	42	16	7.26	21		0.4	0	0	5.1	3	0	0.4	2.2	0

1997-7101-00-SI-RE		5.2	0.003		0.005	0.05						0.01	0.02
2000-7003-00-SI-RE	0.005	3.7	0.0025	0.14	0.005	0.06				0.0005	0.0025	0.005	0.13
2000-7004-00-SI-RE	0.005	4.8	0.0025	0.11	0.005	0.025				0.0005	0.0025	0.005	0.13
2000-7005-00-SI-RE	0.005	3.2	0.0025	0.19	0.005	0.025				0.0005	0.0025	0.005	**0.39**
2002-4821-00-SI-RE	0.02	4.7	0.05	0.22	0.02	0.13	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.1
2002-4091-00-SI-RE	0.01	4.2	0.05	0.13	0.01	0.39	0.0005	0.0005	0.005	0.00005	0.0005	0.001	0.07
2002-4203-00-SI-RE	0.03	6.1	0.3	0.19	0.005	0.09	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.05
2003-4090-00-SI-RE	0.04	4.4	0.05	0.24	0.02	0.12	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.1
2003-4914-00-SI-RE	0.01	3.9	0.05	0.12	0.01	0.09	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.06
2004-4934-00-SI-RE	0	4.5	0	0.13	0.02	0.08	0	0	0	0	0	0	0.04
2005-4987-00-SI-RE	0	4.5	0	0.12	0	0.08	0	0	0	0	0	0	0.03
2006-4208-00-SI-RE	0	4.8	0	0	0	0.08	0	0	0	0	0	0	0.04
2007-4106-00-SI-RE	0	5.1	0.1	0.3	0	0.13	0	0	0	0	0	0	0.1
2007-4226-00-SI-RE	0	5.9	0.08	0.3	0	0.14	0	0	0	0	0	0	0.12
2007-4327-00-SI-RE	0	4.4	0.1	0.2	0	0.11	0	0	0	0	0	0	0.07
2008-4150-00-SI-RE	0	4.1	0.12	0.2	0	0.11	0	0	0	0	0	0	0.1

Corner Brook Lake (Trout Pond): Source Water Data continued

Corner Brook Lake (Trout Pond): Source Water Data continued

Sample #:	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Uranium	Zinc	Source Temperature
1997-7101-00-SI-RE	0.0005		0.01					0.005	20.2
2000-7003-00-SI-RE	0.0005	1.11	0.005		0.0025			0.005	
2000-7004-00-SI-RE	0.0005	1.13	0.005		0.0025			0.005	
2000-7005-00-SI-RE	0.007	1.01	0.03		0.0025			0.08	
2002-4821-00-SI-RE	0.0005	1	0.01	0.00005	0.005	0.0005		0.005	0.4
2002-4091-00-SI-RE	0.0005	0.5	0.006	0.00005	0.0025	0.0005		0.0025	
2002-4203-00-SI-RE	0.0005	0.5	0.005	0.00005	0.0025	0.0005		0.0025	7
2003-4090-00-SI-RE	0.0005	0.5	0.012	0.00005	0.0025	0.0005		0.0025	2.9
2003-4914-00-SI-RE	0.0005	0.5	0.008	0.00005	0.0025	0.0005		0.005	11.1
2004-4934-00-SI-RE	0	0	0	0	0	0	0	0	5.2
2005-4987-00-SI-RE	0	0	0	0	0	0	0	0	17.7
2006-4208-00-SI-RE	0	0	0	0	0	0	0	0	21.8
2007-4106-00-SI-RE	0	1.2	0.012	0.00001	0	0	0	0	4
2007-4226-00-SI-RE	0	1	0.012	0	0	0	0	0	16
2007-4327-00-SI-RE	0	0.8	0.005	0	0	0	0	0	2
2008-4150-00-SI-RE	0	0.8	0.008	0	0	0	0	0.006	8

Corner Brook Lake (Trout Pond): Tap Water Data

Sample #:	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
2000-6506-01-TI-RE	8.3	**19**	54.3		6.72	34	1	0.24		0.025	6.88	5.5	0.005	0.35	2.68	1.5
2000-6507-01-TI-RE	15.7	**22**	80.8		7.07	52	1	0.58		0.025	10.7	8	0.25	0.21	4.5	2.5
2000-6508-01-TI-RE	8.5	15	66.4		6.68	41	1	0.22		0.025	7.74	7.3	0.005	0.23	4.74	3.6
2001-5000-01-TI-RE	21	**19**	67	28	6.66	44		0.5	0.025	0.025	8	7	0.05	0.5	3	4
2002-4821-02-TI-RE	24	**20**	75	37	7.1	49		0.2	0.025	0.025	10	8	0.05	0.5	4	3
2002-4091-02-TI-RE	21	14	69	42	**6.45**	45		0.3	0.01	0.025	15	7	0.05	0.5	3	3
2002-4203-02-TI-RE	20	**18**	68	28	**6.25**	44		0.3	0.025	0.025	8	8	0.05	0.5	3	5
2003-4073-02-TI-RE	18	**26**	60	28	6.57	39		0.7	0.025	0.025	8	7	0.05	0.5	3	3
2003-4090-02-TI-RE	26	**25**	66	28	**6.3**	43		0.5	0.025	0.025	8	7	0.05	0.5	2	3
2003-4218-02-TI-RE	12	12	53	13	**6.21**	35		0.3	0.025	0.025	5	8	0.05	0.5	2	4
2003-4914-02-TI-RE	14	14	55	13	**6.47**	36		0.5	0.005	0.025	5	7	0.05	0.5	2	5
2004-4926-02-TI-RE	17	**22**	66	19	**6.37**	43		0.4	0	0	6	8	0	0	2	3
2004-4934-03-TI-RE	13	**20**	53	19	6.89	35		0.4	0	0	6	7	0	0	2	4
2005-4806-03-TI-RE	19	**21**	71	28	7	46		0.5	0	0	8	9	0	0	2	4
2005-4872-03-TI-RE	27	**20**	78	28	7.53	51		0.4	0	0	8	7	0	0	0	4
2005-4987-03-TI-RE	13	**16**	55	19	6.9	36		0.3	0	0	6	8	0	0	3	3
2005-4080-03-TI-RE	24	**21**	76	31	7.01	49		0.3	0	0	9	8	0	0	0	3
2006-4006-03-TI-RE	30	**16**	72	28	6.89	47		0.7	0	0	8	9	0	0	0	3
2006-4089-03-TI-RE	22	**21**	72	28	6.89	47		0.5	0	0	8	8	0	0	2	3
2006-4208-03-TI-RE	14	**23**	58	19	6.73	38		0.5	0	0	6	7	0	0	0	3
2006-4282-03-TI-RE	25	11	80	33	6.55	52		0.5	0	0	10	8	0	0	0	2
2007-4005-03-TI-RE	22	**25**	73	28	6.75	48		0.4	0	0	8	8	0	0	2	2
2007-4106-03-TI-RE	31	**19**	94	47	7.24	50		0.2	0	0	13	6	0	0.4	3	2
2007-4209-02-TI-RE	18	15	71	32	7.07	35		0.3	0	0	9.5	7	0	0.5	3	0
2007-4209-03-TI-RS	16	13	71	31	6.97	37		0.2	0	0	9.5	8	0	0.6	3.2	2
2007-4226-03-TI-RE	13	14	62	26	7	30		0.3	0	0	8.1	8	0	0.4	2.2	0
2007-4327-03-TI-RE	20	**18**	75	29	7.1	35		0.2	0	0	8.5	7	0	0.5	2.6	0
2008-4023-03-TI-RE	12	**17**	56	20	6.78	27		0.2	0	0	6.3	7	0	0.5	2.7	0
2008-4150-03-TI-RE	20	**24**	77	31	7.1	34		0.2	0	0	9.3	6	0	0.3	2.4	0

Corner Brook Lake (Trout Pond): Tap Water Data continued

Sample #:	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium	Manganese
2000-6506-01-TI-RE	0.025	4.6	0.0025	0.17	0.005	0.025				0.0005	0.0025	0.005	0.06	0.0005	1.13	0.005
2000-6507-01-TI-RE	0.005	4.8	0.0025	0.16	0.005	0.025				0.0005	0.0025	0.12	0.11	0.0005	1.15	0.005
2000-6508-01-TI-RE	0.005	3.9	0.0025	0.18	0.005	0.025				0.0005	0.0025	0.005	0.06	0.0005	1.04	0.005
2001-5000-01-TI-RE	0.04	5.4	0.05	0.16	0.005	0.06	0.0005	0.0005	0.005	0.00005	0.0005	0.165	0.13	0.0005	2	0.005
2002-4821-02-TI-RE	0.06	5.2	0.05	0.14	0.02	0.09	0.0005	0.0005	0.005	0.00005	0.0005	0.109	0.07	0.0005	3	0.005
2002-4091-02-TI-RE	0.01	4.2	0.05	0.11	0.03	0.55	0.0005	0.0005	0.005	0.0006	0.001	0.148	0.12	0.001	1	0.009
2002-4203-02-TI-RE	0.01	5.8	0.05	0.15	0.005	0.07	0.0005	0.0005	0.005	0.00005	0.0005	0.112	0.11	0.0005	2	0.005
2003-4073-02-TI-RE	0.01	5.8	0.05	0.22	0.005	0.11	0.0005	0.0005	0.005	0.00005	0.0005	0.224	0.14	0.0005	2	0.01
2003-4090-02-TI-RE	0.01	4.3	0.05	0.14	0.005	0.09	0.0005	0.0005	0.005	0.00005	0.0005	0.148	0.12	0.0005	2	0.0025
2003-4218-02-TI-RE	0.01	3.7	0.05	0.08	0.005	0.06	0.0005	0.0005	0.005	0.00005	0.0005	0.293	0.09	0.002	0.5	0.005
2003-4914-02-TI-RE	0.01	3.7	0.05	0.12	0.01	0.07	0.0005	0.0005	0.005	0.00005	0.0005	0.089	0.05	0.0005	0.5	0.005
2004-4926-02-TI-RE	0.05	7.8	0	0.63	0.02	0.07	0	0	0	0	0.001	0.208	0.12	0	1	0
2004-4934-03-TI-RE	0	4.5	0	0.12	0.04	0.07	0	0	0	0	0	0.134	0.07	0	1	0
2005-4806-03-TI-RE	0.04	5.3	0	0.08	0	0.09	0	0	0	0	0	0.107	0.12	0	2	0
2005-4872-03-TI-RE	0	4.7	0	0.1	0	0.08	0	0	0	0	0	0.155	0.1	0	2	0
2005-4987-03-TI-RE	0	5.1	0	0	0	0.07	0	0	0	0	0	0.208	0.09	0	1	0
2005-4080-03-TI-RE	0	5.5	0	0	0.02	0.08	0	0	0	0	0	0.178	0.09	0	2	0
2006-4006-03-TI-RE	0	6.1	0.11	0.27	0.01	0.08	0	0	0	0	0	0.128	0.08	0	2	0
2006-4089-03-TI-RE	0	4.8	0	0.15	0	0.09	0	0	0	0	0	0.144	0.08	0.002	2	0
2006-4208-03-TI-RE	0	4.8	0	0	0	0.07	0	0	0	0	0	0.137	0.06	0.001	1	0
2006-4282-03-TI-RE	0	7	0	0.21	0	0.1	0	0	0	0	0	0.208	0.07	0.002	2	0
2007-4005-03-TI-RE	0	6.1	0.11	0.23	0	0.09	0	0	0	0	0	0.097	0.07	0	2	0
2007-4106-03-TI-RE	0	5.1	0.1	0.2	0	0.1	0	0	0	0	**0.24**	0.11	0.07	0.0016	3	0.006
2007-4209-02-TI-RE	0	3.5	0.08	0.2	0	0.08	0	0	0	0	0	0.13	0.08	0.0006	1.9	0.005
2007-4209-03-TI-RS	0	3.6	0.09	0.2	0	0.09	0	0	0	0	0	0.13	0.06	0.0015	1.9	0.007
2007-4226-03-TI-RE	0.08	4.7	0.08	0.2	0	0.08	0	0	0	0	0	0.17	0	0.0019	1.5	0.004
2007-4327-03-TI-RE	0	5.1	0.08	0	0	0.09	0	0	0	0	0	0.049	0.06	0.0006	1.8	0.004
2008-4023-03-TI-RE	0	4.1	0.13	0.1	0	0.1	0	0	0	0	0	0.12	0.07	0.002	1.1	0.002
2008-4150-03-TI-RE	0	4	0.08	0.1	0	0.09	0	0	0	0	0	0.037	0.1	0.0006	2	0.005

Corner Brook Lake (Trout Pond): Tap Water Data continued

Sample #:	Mercury	Nickel	Selenium	Uranium	Zinc	Tap Temperature
2000-6506-01-TI-RE		0.0025			0.005	
2000-6507-01-TI-RE		0.0025			0.005	
2000-6508-01-TI-RE		0.0025			0.005	
2001-5000-01-TI-RE	0.00005	0.005	0.0005		0.005	
2002-4821-02-TI-RE	0.00005	0.005	0.0005		0.01	3.7
2002-4091-02-TI-RE	0.00005	0.0025	0.0005		0.0025	14.5
2002-4203-02-TI-RE	0.00005	0.0025	0.0005		0.0025	7
2003-4073-02-TI-RE	0.00005	0.0025	0.0005		0.0025	3
2003-4090-02-TI-RE	0.00005	0.0025	0.0005		0.0025	4
2003-4218-02-TI-RE	0.00005	0.0025	0.0005		0.0025	
2003-4914-02-TI-RE	0.00005	0.0025	0.0005		0.005	10.8
2004-4926-02-TI-RE	0	0	0	0	0	14.8
2004-4934-03-TI-RE	0	0	0	0	0	7.9
2005-4806-03-TI-RE	0	0	0	0	0	3.7
2005-4872-03-TI-RE	0	0	0	0	0	6.3
2005-4987-03-TI-RE	0	0	0	0	0	17.7
2005-4080-03-TI-RE	0	0	0	0	0	12.1
2006-4006-03-TI-RE	0	0	0	0	0	5.9
2006-4089-03-TI-RE	0	0	0	0	0	11.6
2006-4208-03-TI-RE	0	0	0	0	0	20.6
2006-4282-03-TI-RE	0	0	0	0	0	14.6
2007-4005-03-TI-RE	0	0	0	0	0	4
2007-4106-03-TI-RE	0	0	0	0	0.011	7
2007-4209-02-TI-RE	0	0	0	0	0.009	12
2007-4209-03-TI-RS	0	0	0	0	0.006	10
2007-4226-03-TI-RE	0	0	0	0	0	15
2007-4327-03-TI-RE	0	0	0	0	0.014	7
2008-4023-03-TI-RE	0	0	0	0	0.026	6
2008-4150-03-TI-RE	0	0	0	0	0.01	9

Corner Brook Lake (Trout Pond): THM Data

Sample #:	Site #	Year	Season	Lab	Brom	ChlDi	Bdcm	Chlfm	THM-Total	Free-Chlorine	Total-Chlorine	Tap Temperature
1988-8002-99-TH-RE	99	1988-6-1 12:00 AM	2	HC				89	89			
1988-8012-99-TH-RE	99	1988-10-1 12:00 AM	4	HC				74.8	74.8			
1995-8008-99-TH-RE	99	1995-10-31 12:00 AM	4	NB				150	150			
1995-8013-99-TH-RE	99	1995-11-7 12:00 AM	4	NB				150	150			
1996-8024-99-TH-RE	99	1996-3-11 12:00 AM	1	NB				62	62	0.8		
1996-8025-99-TH-RE	99	1996-3-11 12:00 AM	1	NB				48	48	1.5		
1997-8115-01-TH-RE	1	1997-7-25 12:00 AM	3	EC			6	68	74			
1997-8116-02-TH-RE	2	1997-7-25 12:00 AM	3	EC			9	119	128			
1997-8117-03-TH-RE	3	1997-7-25 12:00 AM	3	EC			7	104	111			
1997-8118-04-TH-RE	4	1997-7-25 12:00 AM	3	EC			8	112	120			
1999-8614-03-TH-RE	3	1999-1-12 12:00 AM	1	EC	0	0	3	100	103			
1999-8623-01-TH-RE	1	1999-2-2 12:00 AM	1	EC	0	0	2	80	82			
1999-8624-02-TH-RE	2	1999-2-2 12:00 AM	1	EC	0	0	0	88	88			
1999-8625-03-TH-RE	3	1999-2-2 12:00 AM	1	EC	0	0	3	100	103			
1999-9516-01-TH-RE	1	1999-11-29 12:00 AM	4	EC	0	0	2	98	100			
1999-9517-02-TH-RE	2	1999-11-29 12:00 AM	4	EC	0	0	3	130	133			
1999-9518-02-TH-RE	2	1999-11-29 12:00 AM	4	EC	0	0	4.5	100	104.5			
1999-9519-03-TH-RE	3	1999-11-29 12:00 AM	4	EC	0	0	3	120	123			
1999-9520-99-TH-RE	99	1999-11-29 12:00 AM	4	EC	0	0	3.2	120	123.2			
1999-9521-99-TH-RE	99	1999-11-29 12:00 AM	4	EC	0	0	2.1	98	100.1			
1999-9522-99-TH-RE	99	1999-11-29 12:00 AM	4	EC	0	0	3.4	130	133.4			
1999-9523-99-TH-RE	99	1999-11-29 12:00 AM	4	EC	0	0	2.2	41	43.2			
2000-8209-99-TH-RE	99	2000-5-8 12:00 AM	2	AT	0	0	0	0.1	0.1			
2000-8210-99-TH-RE	99	2000-5-8 12:00 AM	2	AT	0	0	0	0.08	0.08			
2000-8211-99-TH-RE	99	2000-5-8 12:00 AM	2	AT	0	0	0	0.09	0.09			
2000-8212-99-TH-RE	99	2000-5-8 12:00 AM	2	AT	0	0	0	0.09	0.09			
2000-8213-99-TH-RE	99	2000-5-8 12:00 AM	2	AT	0	0	0	0.14	0.14			
2000-8737-99-TH-RE	99	2000-7-31 12:00 AM	3	AT	0	0	0.01	0.15	0.15			
2000-8738-99-TH-RE	99	2000-7-31 12:00 AM	3	AT	0	0	0.01	0.09	0.1			
2000-8739-99-TH-RE	99	2000-7-31 12:00 AM	3	AT	0	0	0.01	0.15	0.15			
2000-8740-99-TH-RE	99	2000-7-31 12:00 AM	3	AT	0	0	0.01	0.15	0.16			

Corner Brook Lake (Trout Pond): THM Data continued

Sample #:	Site #	Year	Season	Lab	Brom	ChlDi	Bdcm	Chlfm	THM-Total	Free-Chlorine	Total-Chlorine	Tap Temperature
2000-8741-99-TH-RE	99	2000-7-31 12:00 AM	3	AT	0	0	0.01	0.11	0.11			
2000-9009-99-TH-RE	99	2000-10-17 12:00 AM	4	AT	0	0	0.01	0.17	0.18			
2000-9010-99-TH-RE	99	2000-10-17 12:00 AM	4	AT	0	0	0.01	0.16	0.17			
2000-9011-99-TH-RE	99	2000-10-17 12:00 AM	4	AT	0	0	0.01	0.15	0.16			
2000-9012-99-TH-RE	99	2000-10-17 12:00 AM	4	AT	0	0	0.01	0.11	0.12			
2000-9013-99-TH-RE	99	2000-10-17 12:00 AM	4	AT	0	0	0.01	0.06	0.07			
2001-5000-01-TH-RE	01	2001-12-18 12:00 AM	4	AT	0	0	4.6	129	134	0.02	0	
2002-4821-02-TH-RE	02	2002-5-16 12:00 AM	2	AT	0	0	2.3	95.5	97.8	0.94	1.02	3.7
2002-4091-02-TH-RE	02	2002-7-22 12:00 AM	3	AT	0	0	5.8	149	155	0	0.03	14.5
2002-4203-02-TH-RE	02	2002-10-25 12:00 AM	4	AT	0	0	5.2	176	181	0	0.01	7
2003-4073-02-TH-RE	02	2003-2-13 12:00 AM	1	AT	0	0.6	5.8	111	117	0.04	0.06	3
2003-4090-02-TH-RE	02	2003-5-13 12:00 AM	2	AT	0	0	3.7	150	154	0.01	0.1	4
2003-4218-02-TH-RE	02	2003-8-27 12:00 AM	3	AT	0	0	4.6	134	139	0.09	0.19	
2003-4914-02-TH-RE	02	2003-10-21 12:00 AM	4	AT	0	0	2.5	84.7	87.2	1.56	1.68	10.8
2004-4926-02-TH-RE	02	2004-9-28 12:00 AM	3	AT	0	0	5.1	200	205	0.07	0.16	14.8
2004-4934-03-TH-RE	03	2004-11-22 12:00 AM	4	AT	0	0	3	101	104	1.24	1.31	7.9
2005-4806-03-TH-RE	03	2005-1-31 12:00 AM	1	AT	0	0	5.3	142	147	0.01	0.03	3.7
2005-4872-03-TH-RE	03	2005-5-17 12:00 AM	2	AT	0	0	4.5	150	155	0.03	0.04	6.3
2005-4987-03-TH-RE	03	2005-8-18 12:00 AM	3	AT	0	0	5.7	166	172	0.24	0.36	17.7
2005-4080-03-TH-RE	03	2005-11-2 12:00 AM	4	AT	0	0	5.7	157	163	0.03	0.06	12.1
2006-4006-03-TH-RE	03	2006-1-18 12:00 AM	1	AT	0	0	3.4	130	133	1.32	1.45	5.9
2006-4089-03-TH-RE	03	2006-5-24 12:00 AM	2	AT	0	0	2.5	128	131	1	1.06	11.6
2006-4208-03-TH-RE	03	2006-8-7 12:00 AM	3	AT	0	0	4.1	107	111	0.97	1.04	20.6
2006-4282-03-TH-RE	03	2006-11-1 12:00 AM	4	AT	0	0	3.1	162	165	0.5	0.64	14.6
2007-4005-03-TH-RE	03	2007-1-15 12:00 AM	1	AT	0	0	0.6	21.4	22	1.57	1.66	4
2007-4106-03-TH-RE	03	2007-5-29 12:00 AM	2	MX	0	0	2	110	110	0.37	0.44	7
2007-4226-03-TH-RE	03	2007-8-10 12:00 AM	3	MX	0	0	4	150	150	1.12	1.2	15
2007-4327-03-TH-RE	03	2007-11-26 12:00 AM	4	MX	0	0	2	97	99	2.04	2.16	7
2008-4023-03-TH-RE	03	2008-1-29 12:00 AM	1	MX	0	0	2	85	87	1.67	1.83	6
2008-4150-03-TH-RE	03	2008-5-28 12:00 AM	2	MX	0	0	2	110	110	1.58	1.68	9

Burnt Pond: Source Water Data

Sample #:	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
2002-4822-00-SI-RE	20	**17**	66	67	7.03	43		0.5	0.025	0.025	25	6	0.05	0.5	5	5
2002-4090-00-SI-RE	30	**25**	81	27	6.76	53		0.3	0.01	0.025	9	5	0.05	0.5	4	4
2002-4202-00-SI-RE	30	**32**	70	27	**6.29**	46		0.9	0.025	0.025	9	6	0.05	0.5	3	6
2003-4089-00-SI-RE	21	**36**	55	15	**6.36**	36		**1.4**	0.025	0.025	6	5	0.05	0.5	3	3
2003-4913-00-SI-RE	25	**20**	68	18	6.94	44		0.5	0.005	0.025	7	5	0.05	0.5	3	5
2004-4947-00-SI-RE	17	**20**	60	27	**6.46**	39		**4.2**	0	0	9	5	0	0	3	5
2005-4986-00-SI-RE	31	15	79	29	7.54	51		0.8	0	0	10	5	0	0	4	4
2006-4206-00-SI-RE	28	**18**	78	32	7.07	51		**2**	0	0	11	6	0	0	3	4
2007-4231-00-SI-RE	21	10	70	27	7.5	37		0.4	0	0	9.1	6	0	0.2	3.7	3

Burnt Pond: Source Water Data continued

Sample #:	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron
2002-4822-00-SI-RE	0.03	4.1	0.05	0.14	0.03	0.91	0.0005	0.0005	0.005	0.00005	0.0005	0.001	0.1
2002-4090-00-SI-RE	0.01	4.9	0.05	0.17	0.005	0.04	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.06
2002-4202-00-SI-RE	0.03	6.6	0.05	0.28	0.005	0.03	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.08
2003-4089-00-SI-RE	0.02	4.6	0.05	0.3	0.01	0.08	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.12
2003-4913-00-SI-RE	0.01	3.8	0.05	0.29	0.005	0.02	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.04
2004-4947-00-SI-RE	0.08	4.8	0	0.22	0.04	0.11	0	0	0	0	0	0	0.12
2005-4986-00-SI-RE	0	4.3	0	0.12	0	0.01	0	0	0	0	0	0	0
2006-4206-00-SI-RE	0	4.4	0	0.18	0	0	0	0	0	0	0	0	0.05
2007-4231-00-SI-RE	0	3.3	0	0.2	0	0.01	0	0	0	0.0004	0	0	0

Burnt Pond: Source Water Data continued

Sample #:	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Uranium	Zinc	Source Temperature
1997-7101-00-SI-RE	0.0005	1	0.02	0.00005	0.005	0.0005		0.005	2.5
2000-7003-00-SI-RE	0.0005	1	0.008	0.00005	0.0025	0.0005		0.0025	
2000-7004-00-SI-RE	0.0005	1	0.007	0.00005	0.0025	0.0005		0.0025	7
2000-7005-00-SI-RE	0.0005	0.5	0.012	0.00005	0.0025	0.0005		0.0025	2.9
2002-4821-00-SI-RE	0.0005	0.5	0.009	0.00005	0.0025	0.0005		0.005	11.2
2002-4091-00-SI-RE	0	1	0.02	0	0	0	0	0	5.3
2002-4203-00-SI-RE	0	1	0	0	0	0	0	0	20.1
2003-4090-00-SI-RE	0	1	0.01	0	0	0	0	0	21.7
2003-4914-00-SI-RE	0	1.1	0.01	0	0	0	0	0	18

Burnt Pond: Tap Water Data

Sample #:	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
2001-4999-01-TI-RE	23	6	93	34	6.7	61		0.5	0.025	0.025	12	13	0.05	0.5	4	4
2002-4822-02-TI-RE	19	3	96	39	6.94	62		0.6	0.025	0.025	14	14	0.05	0.5	5	4
2002-4090-02-TI-RE	27	11	88	27	6.63	57		0.3	0.01	0.025	9	9	0.05	0.5	4	4
2002-4202-02-TI-RE	22	**17**	82	29	**6.27**	53		0.6	0.025	0.025	10	10	0.05	0.5	4	6
2003-4072-02-TI-RE	18	**23**	71	27	6.53	46		0.8	0.025	0.025	9	10	0.05	0.5	4	4
2003-4089-02-TI-RE	14	**23**	56	15	**6.2**	36		**1.5**	0.025	0.025	6	8	0.05	0.5	3	3
2003-4217-02-TI-RE	23	7	72	23	**6.42**	47		0.3	0.025	0.025	9	10	0.05	0.5	3	4
2003-4913-02-TI-RE	22	10	73	18	6.54	48		0.3	0.005	0.025	7	8	0.05	0.5	3	5
2004-4927-02-TI-RE	18	**22**	70	18	**6.39**	46		0.6	0	0	7	9	0	0	3	4
2004-4947-02-TI-RE	15	15	70	29	**5.99**	46		0.4	0	0	10	10	0	0	3	4
2005-4814-02-TI-RE	18	**90**	83	27	6.91	54		0.9	0	0	9	13	0	0	4	5
2005-4870-02-TI-RE	20	**16**	68	20	6.97	44		**1.2**	0	0	8	9	0	0	2	4
2005-4986-02-TI-RE	364	7	75	27	6.98	49		0.6	0	0	9	11	0	0	4	3
2005-4079-02-TI-RE	22	**20**	74	23	6.99	48		0.8	0	0	9	9	0	0	2	3
2006-4004-02-TI-RE	48	**16**	69	20	6.87	45		**2.3**	0	0	8	9	0	0	2	3
2006-4088-03-TI-RE	18	13	76	20	6.81	49		0.9	0	0	8	10	0	0	0	3
2006-4206-03-TI-RE	16	9	81	29	6.67	53		0.7	0	0	10	12	0	0	3	3
2006-4287-03-TI-RE	18	**18**	80	29	**6.48**	52		0.5	0	0	10	11	0	0	3	2
2007-4003-03-TI-RE	17	**22**	74	27	6.65	48		0.5	0	0	9	9	0	0	3	2
2007-4111-03-TI-RE	15	13	80	29	6.8	35		0.5	0	0	9.8	7	0	0.2	3.8	2
2007-4231-03-TI-RE	17	11	75	30	7.22	39		0.4	0	0	10	10	0	0.2	3.6	2
2007-4329-03-TI-RE	20	**18**	77	27	7.16	34		0.3	0	0	8.9	7	0	0.3	3.6	0
2008-4025-03-TI-RE	21	**19**	76	30	7.1	38		0	0	0	10	8	0	0.3	4.2	0
2008-4151-03-TI-RE	13	15	69	25	6.9	30		0.4	0.005	0	8.3	8	0	0.3	3.4	0

Burnt Pond: Tap Water Data continued

Sample #:	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium	Manganese
2001-4999-01-TI-RE	0.01	5.6	0.05	0.16	0.005	0.025	0.0005	0.0005	0.005	0.00005	0.0005	0.26	0.11	0.003	1	0.005
2002-4822-02-TI-RE	0.02	5.6	0.05	0.18	0.005	0.1	0.0005	0.0005	0.005	0.00005	0.0005	0.115	0.12	0.0005	1	0.005
2002-4090-02-TI-RE	0.01	4.7	0.05	0.17	0.01	0.9	0.0005	0.0005	0.005	0.00005	0.001	0.085	0.14	0.0005	1	0.012
2002-4202-02-TI-RE	0.03	6.7	0.05	0.21	0.01	0.05	0.0005	0.0005	0.005	0.00005	0.0005	0.09	0.14	0.0005	1	0.011
2003-4072-02-TI-RE	0.07	13.7	0.05	0.58	0.01	0.05	0.0005	0.0005	0.005	0.00005	0.0005	0.147	0.16	0.0005	1	0.008
2003-4089-02-TI-RE	0.04	5.3	0.05	0.14	0.02	0.09	0.0005	0.0005	0.005	0.00005	0.0005	0.089	0.15	0.0005	0.5	0.007
2003-4217-02-TI-RE	0.01	4.6	0.05	0.17	0.005	0.02	0.0005	0.0005	0.005	0.00005	0.0005	0.117	0.06	0.0005	0.5	0.0025
2003-4913-02-TI-RE	0.01	4.3	0.05	0.11	0.005	0.03	0.0005	0.0005	0.005	0.00005	0.0005	0.09	0.06	0.0005	0.5	0.005
2004-4927-02-TI-RE	0.23	8.2	0	0.51	0.02	0.04	0	0	0	0	0.001	0.084	0.11	0	0	0
2004-4947-02-TI-RE	0.34	6.6	0	0.35	0.12	0.03	0	0	0	0	0	0.072	0.1	0	1	0
2005-4814-02-TI-RE	0.07	5.9	0	0.4	0.02	0.05	0	0	0	0	0	0.07	0.14	0	1	0.01
2005-4870-02-TI-RE	0	4.7	0	0.17	0	0.04	0	0	0	0	0	0.073	0.11	0	0	0
2005-4986-02-TI-RE	0	4.4	0	0.1	0	0.03	0	0	0	0	0	0.078	0.09	0	1	0
2005-4079-02-TI-RE	0	6.4	0	0	0.02	0.04	0	0	0	0	0	0.074	0.11	0	0	0
2006-4004-02-TI-RE	0	7	0	0.17	0	0.06	0	0	0	0	0	0.063	0.11	0	0	0
2006-4088-03-TI-RE	0	5.3	0	0.1	0	0.03	0	0	0	0	0	0.098	0.09	0	0	0
2006-4206-03-TI-RE	0	4.9	0	0.3	0.02	0.01	0	0	0	0	0	0.16	0.06	0	1	0
2006-4287-03-TI-RE	0	7.2	0	0.17	0.01	0.03	0	0	0	0	0	0.199	0.09	0	1	0
2007-4003-03-TI-RE	0	7.3	0	0.12	0	0.04	0	0	0	0	0	0.162	0.09	0	1	0
2007-4111-03-TI-RE	0	5	0.07	0.2	0	0.05	0	0	0	0	0	0.15	0.11	0.0006	1.1	0.007
2007-4231-03-TI-RE	0	4	0	0.2	0	0.02	0	0	0	0	0	0.12	0	0.0007	1.1	0.003
2007-4329-03-TI-RE	0	5.3	0	0.1	0	0.04	0	0	0	0	0	0.088	0.07	0.0006	1	0.006
2008-4025-03-TI-RE	0	5.3	0.07	0.2	0	0.03	0	0	0	0	0	0.12	0.09	0.0005	1.1	0.005
2008-4151-03-TI-RE	0	4.1	0	0.2	0	0.03	0	0	0	0	0	0.16	0.11	0.0007	0.9	0.008

Burnt Pond: Tap Water Data continued

Sample #:	Mercury	Nickel	Selenium	Uranium	Zinc	Tap Temperature
2001-4999-01-TI-RE	0.00005	0.005	0.0005		0.005	
2002-4822-02-TI-RE	0.00005	0.005	0.0005		0.005	2
2002-4090-02-TI-RE	0.00005	0.0025	0.0005		0.0025	
2002-4202-02-TI-RE	0.00005	0.0025	0.0005		0.0025	7
2003-4072-02-TI-RE	0.00005	0.0025	0.0005		0.009	2.5
2003-4089-02-TI-RE	0.00005	0.0025	0.0005		0.0025	4.3
2003-4217-02-TI-RE	0.00005	0.0025	0.0005		0.0025	
2003-4913-02-TI-RE	0.00005	0.0025	0.0005		0.005	11.2
2004-4927-02-TI-RE	0	0	0	0	0	14.3
2004-4947-02-TI-RE	0	0	0	0	0	6.9
2005-4814-02-TI-RE	0	0	0	0	0	3.8
2005-4870-02-TI-RE	0	0	0	0	0	5.7
2005-4986-02-TI-RE	0	0	0	0	0	17.4
2005-4079-02-TI-RE	0	0	0	0	0	11.9
2006-4004-02-TI-RE	0	0	0	0	0	5.3
2006-4088-03-TI-RE	0	0	0	0	0	13.2
2006-4206-03-TI-RE	0	0	0	0	0	20.8
2006-4287-03-TI-RE	0	0	0	0	0	11.8
2007-4003-03-TI-RE	0	0	0	0	0	4
2007-4111-03-TI-RE	0	0	0	0	0.008	7
2007-4231-03-TI-RE	0.00001	0	0	0	0	17.5
2007-4329-03-TI-RE	0	0	0	0	0.011	7
2008-4025-03-TI-RE	0	0	0	0	0.007	3
2008-4151-03-TI-RE	0	0	0	0	0.009	8

Burnt Pond: THM Data

Sample #:	Site #	Season	Lab	Brom	ChlDi	Bdcm	Chlfm	THM-Total	Free-Chlorine	Total-Chlorine	Tap Temperature
1999-8615-02-TH-RE	2	1	EC	0	0	5	93	98			
1999-9524-02-TH-RE	2	4	EC	0	0	5	100	105			
2001-4999-01-TH-RE	01	4	AT	0	0.3	9.9	253	263	1	1.26	
2002-4822-02-TH-RE	02	2	AT	0	0.3	8.9	201	210	2.2	2.2	2
2002-4090-02-TH-RE	02	3	AT	0	0	7.1	161	168	0.63	0.73	
2002-4202-02-TH-RE	02	4	AT	0	0	5.6	154	160	0.81	1.07	7
2003-4072-02-TH-RE	02	1	AT	0	0.8	6.7	125	133	0.42	0.61	2.5
2003-4089-02-TH-RE	02	2	AT	0	0	3.4	118	121	0.25	0.4	4.3
2003-4217-02-TH-RE	02	3	AT	0	0	7.7	160	168	0.54		
2003-4913-02-TH-RE	02	4	AT	0	0.3	6.8	123	131	0.14	0.28	11.2
2004-4927-02-TH-RE	02	3	AT	0	0.5	7.2	200	208	0.11	0.26	14.3
2004-4947-02-TH-RE	02	4	AT	0	0	7.4	152	159	1.01	1.17	6.9
2005-4814-02-TH-RE	02	1	AT	0	0.3	12.3	186	199	0.65	0.78	3.8
2005-4870-02-TH-RE	02	2	AT	0	0	5	148	153	0.1	0.24	5.7
2005-4986-02-TH-RE	02	3	AT	0	0.5	11.5	164	176	1.2	1.33	17.4
2005-4079-02-TH-RE	02	4	AT	0	0	7.4	138	145	0.05	0.09	11.9
2006-4004-02-TH-RE	02	1	AT	0	0	5.4	126	131	0.52	0.67	5.3
2006-4088-03-TH-RE	03	2	AT	0	0	5.9	144	150	0.91	1.01	13.2
2006-4206-03-TH-RE	03	3	AT	0	0.3	12	170	182	1.58	1.67	20.8
2006-4287-03-TH-RE	03	4	AT	0	0	8.1	179	187	1.12	1.18	11.8
2007-4003-03-TH-RE	03	1	AT	0	0	2.9	88.5	91.4	1.46	1.64	4
2007-4111-03-TH-RE	03	2	MX	0	0	6	140	150	1.01	1.12	7
2007-4231-03-TH-RE	03	3	MX	0	1	8	130	140	0.61	0.68	17.5
2007-4329-03-TH-RE	03	4	MX	0	0	3	87	90	1.14	1.26	7
2008-4025-03-TH-RE	03	1	MX	0	0	3	72	75	0.83	1	3
2008-4151-03-TH-RE	03	2	MX	0	0	5	110	120	1.25	1.34	8

Second Pond: Source Water Data

Sample #:	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
2002-4823-00-SI-RE	10	**21**	49	15	6.93	32		0.5	0.025	0.025	6	6	0.05	0.5	5	4
2002-4089-00-SI-RE	19	15	64	27	**6.48**	42		0.5	0.01	0.025	9	6	0.05	0.5	4	5
2002-4204-00-SI-RE	18	**22**	62	15	**6.27**	40		**1.5**	0.025	0.025	6	6	0.05	0.5	4	6
2003-4088-00-SI-RE	14	**28**	48	10	**6.23**	31		1	0.025	0.025	4	6	0.1	0.5	3	4
2003-4915-00-SI-RE	21	13	59	13	6.56	38		0.6	0.005	0.025	5	6	0.05	0.5	3	6
2004-4946-00-SI-RE	16	**22**	58	22	**6.42**	38		0.5	0	0	7	5	0	0	4	5
2005-4985-00-SI-RE	21	2	63	22	7.45	41		0.6	0	0	7	6	0	0	4	4
2006-4207-00-SI-RE	22	15	67	24	6.95	44		**1.4**	0	0	8	6	0	0	3	4
2007-4230-00-SI-RE	16	12	63	25	7.37	33		0.4	0	0	8.1	7	0	0.2	4.1	3

Second Pond: Source Water Data continued

Sample #:	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron
2002-4823-00-SI-RE	0.02	3.3	0.05	0.14	0.03	0.17	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.09
2002-4089-00-SI-RE	0.01	3.8	0.05	0.21	0.02	0.362	0.0005	0.0005	0.005	0.00005	0.001	0.002	0.15
2002-4204-00-SI-RE	0.01	5.7	0.05	0.81	0.005	0.03	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.09
2003-4088-00-SI-RE	0.01	4	0.1	0.16	0.005	0.08	0.0005	0.0005	0.005	0.00005	0.0005	0.001	0.12
2003-4915-00-SI-RE	0.01	3.8	0.05	0.16	0.005	0.02	0.0005	0.0005	0.005	0.00005	0.0005	0.0005	0.04
2004-4946-00-SI-RE	0.37	5.8	0	0.48	0.02	0.03	0	0	0	0	0	0	0.07
2005-4985-00-SI-RE	0	4.6	0	0.52	0	0.02	0	0	0	0	0	0	0.05
2006-4207-00-SI-RE	0	4.6	0	1.87	0	0	0	0	0	0	0	0	0.05
2007-4230-00-SI-RE	0	4.1	0	0.2	0	0.02	0	0	0	0	0	0	0

Second Pond: Source Water Data continued

Sample #:	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Uranium	Zinc	Source Temperature
2002-4823-00-SI-RE	0.0005	0.5	0.01	0.00005	0.005	0.0005		0.005	1.3
2002-4089-00-SI-RE	0.0005	1	0.021	0.00005	0.0025	0.0005		0.0025	
2002-4204-00-SI-RE	0.0005	0.5	0.014	0.00005	0.0025	0.0005		0.0025	7
2003-4088-00-SI-RE	0.0005	0.5	0.013	0.00005	0.0025	0.0005		0.0025	2.9
2003-4915-00-SI-RE	0.0005	0.5	0.009	0.00005	0.0025	0.0005		0.005	9.9
2004-4946-00-SI-RE	0	1	0	0	0	0	0	0	5.1
2005-4985-00-SI-RE	0	1	0	0	0	0	0	0	20.1
2006-4207-00-SI-RE	0	1	0	0	0	0	0	0	22.3
2007-4230-00-SI-RE	0	1.1	0.012	0	0	0	0	0	19

Second Pond: Tap Water Data

Sample #:	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
2001-4998-01-TI-RE	18	10	66	22	6.52	43		0.6	0.025	0.025	7	10	0.05	0.5	4	5
2002-4823-02-TI-RE	7	15	54	13	6.66	35		0.5	0.025	0.025	5	9	0.05	0.5	5	5
2002-4089-02-TI-RE	13	8	66	22	6.31	43		0.5	0.01	0.025	7	9	0.05	0.5	4	5
2002-4204-02-TI-RE	14	18	62	37	6.17	40		0.7	0.025	0.025	13	8	0.05	0.5	4	6
2003-4071-02-TI-RE	17	18	60	15	6.86	39		0.6	0.025	0.025	6	8	0.1	0.5	4	5
2003-4088-02-TI-RE	12	20	50	10	5.99	33		0.8	0.025	0.025	4	8	0.05	0.5	3	4
2003-4219-02-TI-RE	20	5	63	15	6.22	41		0.6	0.025	0.025	6	9	0.05	0.5	3	5
2003-4915-02-TI-RE	15	6	62	13	6.36	40		0.6	0.005	0.025	5	8	0.05	0.5	4	6
2004-4928-03-TI-RE	12	18	57	13	6.27	37		0.5	0	0	5	8	0	0	3	4
2004-4946-03-TI-RE	14	12	59	18	5.96	38		0.6	0	0	7	8	0	0	4	5
2005-4815-03-TI-RE	14	14	68	19	6.88	44		0.4	0	0	6	11	0	0	4	5
2005-4869-03-TI-RE	19	20	66	13	7.39	43		0.6	0	0	5	8	0	0	3	4
2005-4985-03-TI-RE	16	8	66	22	6.96	43		1	0	0	7	9	0	0	4	4
2005-4081-03-TI-RE	18	19	66	15	7.21	43		0.7	0	0	6	8	0	0	2	4
2006-4003-03-TI-RE	27	12	64	15	6.63	42		0.9	0	0	6	9	0	0	0	4
2006-4087-03-TI-RE	13	16	61	15	6.62	40		0.7	0	0	6	9	0	0	2	4
2006-4207-03-TI-RE	15	6	71	22	6.66	46		1.1	0	0	7	10	0	0	2	4
2006-4283-03-TI-RE	13	26	64	22	6.36	42		0.9	0	0	7	8	0	0	3	3
2007-4002-03-TI-RE	14	15	64	22	6.51	42		0.7	0	0	7	9	0	0	4	3
2007-4110-03-TI-RE	8	11	61	19	6.68	28		0.3	0	0	6	7	0	0.3	4.6	3
2007-4230-03-TI-RE	12	9	66	23	7.04	33		0.4	0	0	7.4	10	0	0.2	3.9	3
2007-4328-03-TI-RE	11	12	65	20	6.92	29		0.6	0	0	6.4	7	0	0.4	4.2	3
2008-4024-03-TI-RE	14	12	68	23	6.85	35		0	0	0	7.4	9	0	0.3	4.4	3
2008-4152-03-TI-RE	7	16	54	17	6.63	26		0.5	0.007	0	5.6	7	0	0.3	4	3

Second Pond: Tap Water Data continued

Sample #:	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium	Manganese
2001-4998-01-TI-RE	0.05	4.5	0.05	0.22	0.02	0.025	0.0005	0.0005	0.005	0.00005	0.0005	0.374	0.05	0.002	1	0.005
2002-4823-02-TI-RE	0.03	4.2	0.05	0.14	0.02	0.08	0.0005	0.0005	0.005	0.00005	0.0005	0.193	0.09	0.001	0.5	0.005
2002-4089-02-TI-RE	0.01	4.3	0.05	0.17	0.02	0.03	0.0005	0.0005	0.005	0.00005	0.0005	0.316	0.09	0.0005	1	0.015
2002-4204-02-TI-RE	0.03	5.7	0.05	0.21	0.01	0.21	0.0005	0.0005	0.005	0.00005	0.0005	0.28	0.15	0.001	1	0.048
2003-4071-02-TI-RE	0.13	12.2	0.05	0.56	0.005	0.04	0.0005	0.0005	0.005	0.00005	0.0005	0.229	0.07	0.0005	0.5	0.005
2003-4088-02-TI-RE	0.01	4.4	0.05	0.26	0.005	0.09	0.0005	0.0005	0.005	0.00005	0.0005	0.4	0.15	0.002	0.5	0.01
2003-4219-02-TI-RE	0.01	3.9	0.05	0.1	0.005	0.01	0.0005	0.0005	0.005	0.00005	0.0005	0.137	0.06	0.001	0.5	0.011
2003-4915-02-TI-RE	0.01	3.7	0.05	0.12	0.005	0.02	0.0005	0.0005	0.005	0.00005	0.0005	0.235	0.07	0.001	0.5	0.006
2004-4928-03-TI-RE	0.09	5.9	0	0.21	0	0.04	0	0	0	0	0.001	0.289	0.08	0.001	0	0
2004-4946-03-TI-RE	0.03	4.8	0	0.21	0.05	0.03	0	0	0	0	0	0.227	0.07	0	0	0
2005-4815-03-TI-RE	0.04	5.1	0	0.17	0.01	0.04	0	0	0	0	0	0.266	0.07	0.001	1	0
2005-4869-03-TI-RE	0	4.3	0	0.09	0	0.06	0	0	0	0	0	0.301	0.11	0.001	0	0
2005-4985-03-TI-RE	0	4.6	0	0.13	0	0.03	0	0	0	0	0	0.172	0.08	0.002	1	0
2005-4081-03-TI-RE	0	5.9	0	0.2	0.01	0.05	0	0	0	0	0	0.235	0.15	0.001	0	0.02
2006-4003-03-TI-RE	0	6.1	0	0.4	0	0.05	0	0	0	0	0	0.289	0.08	0	0	0
2006-4087-03-TI-RE	0	3.9	0	0.14	0	0.04	0	0	0	0	0	0.35	0.11	0	0	0.02
2006-4207-03-TI-RE	0	4.5	0	0.05	0	0	0	0	0	0	0	0.197	0.06	0.004	1	0
2006-4283-03-TI-RE	0	6.1	0	0.26	0	0.05	0	0	0	0	0	0.319	0.13	0	1	0.02
2007-4002-03-TI-RE	0	0	0	0.26	0	0.04	0	0	0	0	0	0.232	0.09	0	1	0.01
2007-4110-03-TI-RE	0	3.8	0	0.3	0	0.05	0	0	0	0	0	0.24	0.08	0.0008	1	0.014
2007-4230-03-TI-RE	0	3.8	0	0.3	0	0.02	0	0	0	0	0	0.1	0.05	0.0005	1.1	0.012
2007-4328-03-TI-RE	0	4.4	0	0.1	0	0.05	0	0	0	0	0	0.25	0.08	0.0011	0.9	0.008
2008-4024-03-TI-RE	0	3.7	0.06	0.2	0	0.03	0	0	0	0	0	0.23	0.07	0.0015	1	0.005
2008-4152-03-TI-RE	0	3.8	0	0.3	0	0.05	0	0	0	0	0	0.31	0.12	0.0016	0.8	0.028

Second Pond: Tap Water Data continued

Sample #:	Mercury	Nickel	Selenium	Uranium	Zinc	Tap Temperature
2001-4998-01-TI-RE	0.00005	0.005	0.0005		0.02	
2002-4823-02-TI-RE	0.00005	0.005	0.0005		0.005	2.8
2002-4089-02-TI-RE	0.00005	0.0025	0.0005		0.009	
2002-4204-02-TI-RE	0.00005	0.0025	0.0005		0.0025	7.2
2003-4071-02-TI-RE	0.00005	0.0025	0.0005		0.0025	2.3
2003-4088-02-TI-RE	0.00005	0.0025	0.0005		0.0025	3
2003-4219-02-TI-RE	0.00005	0.0025	0.0005		0.0025	
2003-4915-02-TI-RE	0.00005	0.0025	0.0005		0.005	9.6
2004-4928-03-TI-RE	0	0	0	0	0	13.5
2004-4946-03-TI-RE	0	0	0	0	0	6.5
2005-4815-03-TI-RE	0	0	0	0	0	4.4
2005-4869-03-TI-RE	0	0	0	0	0	5.9
2005-4985-03-TI-RE	0	0	0	0	0	16.8
2005-4081-03-TI-RE	0	0	0	0	0	10.1
2006-4003-03-TI-RE	0	0	0	0	0	6.2
2006-4087-03-TI-RE	0	0	0	0	0	13.6
2006-4207-03-TI-RE	0	0	0	0	0.02	20.7
2006-4283-03-TI-RE	0	0	0	0	0	11.6
2007-4002-03-TI-RE	0	0	0	0	0	5
2007-4110-03-TI-RE	0	0	0	0	0.006	8
2007-4230-03-TI-RE	0	0	0	0	0.005	18
2007-4328-03-TI-RE	0	0	0	0	0.012	7
2008-4024-03-TI-RE	0	0	0	0	0.005	5
2008-4152-03-TI-RE	0	0	0	0	0.01	10

Second Pond: THM Data

Sample #:	Site #	Season	Lab	Brom	ChlDi	Bdcm	Chlfm	THM-Total	Free-Chlorine	Total-Chlorine	Tap Temperature
1995-8009-99-TH-RE	99	4	NB				76	76			
1995-8014-99-TH-RE	99	4	NB				76	76			
1999-8616-01-TH-RE	1	1	EC	0	0	2	50	52			
1999-9525-01-TH-RE	1	4	EC	0	0	2	41	43			
2001-4998-01-TH-RE	01	4	AT	0	0	2.4	41.2	43.6	1.5	1.8	
2002-4823-02-TH-RE	02	2	AT	0	0	1.4	35.6	37	0.99	1.16	2.8
2002-4089-02-TH-RE	02	3	AT	0	0	4.5	68.7	73.2	1.08	1.17	
2002-4204-02-TH-RE	02	4	AT	0	0	2.6	60.5	63.1	0.59	0.65	7.2
2003-4071-02-TH-RE	02	1	AT	0	0.3	2.4	36	38.7	1.08	1.1	2.3
2003-4088-02-TH-RE	02	2	AT	0	0	1.1	40.2	41.3	1.28	1.44	3
2003-4219-02-TH-RE	02	3	AT	0	0	5.4	79.8	85.2	1.12		
2003-4915-02-TH-RE	02	4	AT	0	0	3	51.4	54.4	1.81	1.88	9.6
2004-4928-03-TH-RE	03	3	AT	0	0	3.9	86.4	90.3	1.05	1.19	13.5
2004-4946-03-TH-RE	03	4	AT	0	0	2.6	52.9	55.5	1.36	1.49	6.5
2005-4815-03-TH-RE	03	1	AT	0	0	6.5	83.6	90.1	1.17	1.35	4.4
2005-4869-03-TH-RE	03	2	AT	0	0	1.3	44.6	45.9	0.77	0.92	5.9
2005-4985-03-TH-RE	03	3	AT	0	0	10.2	131	141	0.52	0.65	16.8
2005-4081-03-TH-RE	03	4	AT	0	0	2.6	58.4	61	0.61	0.71	10.1
2006-4003-03-TH-RE	03	1	AT	0	0	2.8	59.2	62	1.73	1.91	6.2
2006-4087-03-TH-RE	03	2	AT	0	0	2.3	55.1	57.4	0.98	1.05	13.6
2006-4207-03-TH-RE	03	3	AT	0	0	6.7	82.9	89.6	2.2	2.2	20.7
2006-4283-03-TH-RE	03	4	AT	0	0	3	73.9	76.9	1.27	1.43	11.6
2007-4002-03-TH-RE	03	1	AT	0	0	2.3	53.1	55.4	1.72	1.73	5
2007-4110-03-TH-RE	03	2	MX	0	0	3	60	63	1.11	1.21	8
2007-4230-03-TH-RE	03	3	MX	0	0	5	83	88	0.96	1.11	18
2007-4328-03-TH-RE	03	4	MX	0	0	3	59	62	1.31	1.43	7
2008-4024-03-TH-RE	03	1	MX	0	0	3	54	57	1.33	1.52	5
2008-4152-03-TH-RE	03	2	MX	0	0	2	53	55	1.7	1.97	10

APPENDIX C – ENVIRONMENTAL PROTECTION GUIDELINES FOR ECOLOGICALLY BASED FOREST RESOURCE MANAGEMENT

ENVIRONMENTAL PROTECTION GUIDELINES

FOR

ECOLOGICALLY BASED FOREST

RESOURCE MANAGEMENT

(STAND LEVEL OPERATIONS)

November 1998

ENVIRONMENTAL PROTECTION GUIDELINES

"Forests are interconnected webs which focus on sustaining the whole, not the production of any one part or commodity. Trees, the most obvious part of a forest are critical structural members of a forest framework. However, trees are only a small portion of the structure needed for a fully functioning forest." (Hammond, 1991).

This ecologically based approach to forest resource management requires that resource managers shift their focus from managing components of the ecosystem to managing the three-dimensional landscape ecosystems that produce them. Primary concern becomes the maintenance of landscapes and waterways as complete ecosystems because the only way to assure the sustained benefit of forest values, now and in the future, is to keep them and all their parts in a healthy state. This is the foundation for an ecologically based approach to forest management. It means that everyone attends to the conservation and sustainability of ecosystems instead of sharply focussing on the productivity of individual or competing resources which has been our traditional mode of operation.

The Newfoundland Forest Service is committed to the concept of forest ecosystem management which is captured in the twenty-year Forestry Development Plan (1996-2016) vision statement:

"To conserve and manage the ecosystems of the Province which sustain forests and wildlife populations and to provide for the utilization of these resources by the people of the Province under the principles of sustainable development, an ecologically-based management philosophy, and sound environmental practices".

There are five strategic goals in the twenty-year Forestry Development Plan (1996-2016) which provide the foundation upon which ecologically based resource management will be developed.

1. Manage forest ecosystems so that their integrity, productive capacity, resiliency, and biodiversity are maintained.

2. Refine and develop management practices in an environmentally sound manner to reflect all resource values.

3. Develop public partnerships or networks to facilitate meaningful public involvement in resource management.

4. Promote adaptive ecosystem management and conduct research that focuses on ecosystem processes, functions, and ecosystem management principles.

5. Establish and enforce conservation and public safety laws with respect to managing ecosystems.

The environmental protection guidelines provide specific "on the ground" tasks for loggers and gives management direction to planners. Individually, the guidelines appear as specific rules; however, when implemented collectively they will facilitate ecologically-based forest resource management.

1.0 GENERAL GUIDELINES

These guidelines are generated from impacts described in the literature and from discussions with resource managers. As new information and management techniques become available the guidelines will be changed to reflect this improved information base. Consequently, the guidelines will be reviewed on an annual basis to incorporate any necessary changes. The "General Guidelines" apply to all forestry activities (i.e., silviculture, harvesting, road construction). These guidelines form Schedule IV of the Certificate of Managed Land. They are conditions of Crown commercial permits and they form the basis for the voluntary compliance program.

1.1 Planning

1. The location and type of all waterbody crossings must be submitted to the Department of Environment and Labour and the Department of Fisheries and Oceans. Certificates of Approval are required from both departments for waterbody crossings. A waterbody is defined as any water identified on the latest 1:50,000 topographic map. Appropriate protection is still required for streams greater than 1.0 m in width (at its narrowest point from the high water mark) not found on the 1:50,000 topographic map.

2. All waste disposal sites require a Certificate of Approval from the Minister of Government Services.

3. Excessive bulldozing is not permitted and no more than 10% of the total forest within an operating area can be disturbed. In situations where specific operating areas require more than 10% disturbance to capture available timber, the operator is required to rehabilitate the area to reduce the total net disturbance to the 10% maximum. Where disturbance has been excessive, a rehabilitation plan will be developed with the Forest Service District Manager. Disturbance is defined as per the Ground Disturbance Survey Guidelines developed by the Newfoundland Forest Service.

4. When an archaeological site or artifact is found, the *Historical Resources Act* requires that all development temporarily cease in the area and the discovery be reported to the Historical Resources Division (709-729-2462).

   The Historic Resources Division will respond immediately and will have mitigation measures in place within seven days as agreed to by the Historical Resources Division and the operator. Forestry activity can then continue.

   The Historic Resources Division will be contacted during the preparation of five-year operating plans to determine the location of historic resources and appropriate

mitigation measures will be designed. These measures will include such things as buffer zones and modified operations or surveys.

5. Should an oil or gas spill in excess of 70 litres occur, the operator must make every effort to first, contain, and second, clean up the spill after reporting the spill to the appropriate authorities:

Government Services Centre
Spill Report Line
(709) 772-2083 or 1-800-563-2444

6. The Parks and Natural Areas Division will be contacted during the preparation of five-year operating plans. Where operations are within one kilometre of provisional and ecological reserves, wilderness reserves or provincial parks, modified operations maybe necessary.

7. In areas where caribou utilize arboreal lichens during the summer and/or winter, and terrestrial lichens during the summer, a minimum amount of lichen forest must be maintained for the caribou. Forestry activity will be designed in consultation with the Wildlife Division where this situation has been identified.

8. Areas identified as containing rare and/or unique flora (through literature review) are to be protected from forestry activity by avoiding these areas.

9. Where mature stands of timber for moose shelter and moose yards are required, they will be identified in consultation with Wildlife Division.

10. The impacts of forest operations on pine marten have been an ongoing issue. Until appropriate guidelines are developed for pine marten habitat, forestry activities within high density pine marten areas and dispersion areas required for pine marten recovery will require consultation with the Wildlife Division.

11. During the preparation of five-year operating plans, areas identified as "Sensitive Wildlife Areas" in the Land Use Atlas require consultation with the Wildlife Division prior to any forestry activity.

1.2 **Operations**

1. A 20-metre, treed buffer zone shall be established around all water bodies that are identified on the latest 1:50,000 topographic maps and around water bodies greater than 1.0 metre in width that do not appear on the maps. Where the slope is greater than 30% there shall be a no-harvest buffer of 20 m + (1.5 x % slope). All equipment or machinery is prohibited from entering waterbodies; thus, structures must be created to cross over such waterbodies. Every reasonable effort will be made to identify intermittent streams and they will be subject to this buffer requirement. The District Manager of Forest Ecosystems is permitted to adjust the specified buffer requirements in the following circumstances:

- the no-cut, treed buffer can exceed the 20 meters for fish and wildlife habitat requirements.

- a 50-metre, no-cut, treed buffer will be maintained around known black bear denning sites (winter) or those encountered during harvesting. These den sites must be reported to the Wildlife Division.

- no forestry activity is to occur within 800 metres of a bald eagle or osprey nest during the nesting season (March 15 to July 31) and 200 metres during the remainder of the year. The location of any raptor nest site must be reported to the Wildlife Division.

- all hardwoods within 30 metres of a waterbody occupied by beaver are to be left standing.

- a minimum 30-metre, no-cut, treed buffer will be maintained from the high water mark in waterfowl breeding, moulting and staging areas. These sites will be identified by the Canadian Wildlife Service and/or the Wildlife Division.

2. Heavy equipment and machinery are not permitted in any waterbody, on a wetland or a bog (unless frozen) without a Certificate of Approval from the Department of Environment and Labour and without contacting the DFO area habitat coordinator.

3. No heavy equipment or machinery is to be refuelled, serviced, or washed within 30 metres of a waterbody. Gasoline or lubricant depots must be placed 100 metres from the nearest waterbody. All fuel-storage tanks (including JEEP tanks) must be registered with the Department of Government Services and Lands and installed in accordance with the *Storage and Handling of Gasoline and Associated Products Regulations.* Fuel storage within Protected Water Supplies are more stringent. Please refer to "Guidelines for Forest Operations within Protected Water Supplies" for more information.

4. Used or waste oil shall be collected either in a tank or a closed container.
5. Above ground storage tanks shall be surrounded by a dyke. The dyked area will contain not less than 110% of the capacity of the tank. The base and walls of the dyke shall have a impermeable lining of clay, concrete, solid masonry or other material, designed, constructed and maintained to be liquid tight to a permeability of $25L/m^2/d$. There shall be a method to eliminate water accumulations inside the dyke.

6. Wherever possible, place slash on forwarded trails while forwarders are operating in an area. Skidding timber through any waterbody (as defined in Section 1.2.1) is prohibited.

7. Any forestry operation that directly or indirectly results in silt entering a waterbody must be dealt with immediately (A government official must be notified within 24 hours). Failure to comply will result in the operation being stopped.

8. Woody material of any kind (trees, slash, sawdust, slabs, etc.) is not permitted to enter a waterbody. Woody material on ice within the high water floodplain of any waterbody is prohibited.

9. To minimize erosion and sedimentation, waterbody crossings shall:

   i) have stable approaches;
   ii) be at right angles to the waterbody;
   iii) be located where channels are well defined, unobstructed, and straight;
   iv) be at a narrow point along the waterbody;
   v) allow room for direct gentle approaches;
   vi) have all mineral soil exposed during bridge construction and culvert installation seeded with grass.

10. Garbage is to be disposed of at an approved garbage disposal site. Prior to disposal it must be contained in a manner not to attract wildlife. All equipment is to be removed from the operating area where operations are completed.

11. Where safety is not an issue, a minimum average of 10 trees or snags per hectare (average on a cut block) or a clump of trees is to be left on all sites (harvesting and silviculture). Preference will be given to trees over 50 cm dbh.

2.0 TIMBER HARVESTING GUIDELINES

2.1 Planning

1. There will be corridors to connect areas of forest that will not be harvested (isolated stands within cutovers are not considered forested areas). These corridors connect wildlife habitat, watersheds and minimize fragmentation. Acceptable corridor vegetation includes productive forest areas (all age classes) and softwood/hardwood scrub. These corridors do not have to be continuous (i.e., breaks in vegetation are permitted) and will be determined in the five-year operating plan and identified in the annual work schedule.

2. Complete utilization of harvested trees is required. (Complete utilization is harvesting trees to a top diameter of 8 cm and stumps to a height of 30 cm). The District Manager can modify the stump height requirement to accommodate snow conditions. Where markets exist, non-commercial tree species that are harvested should be brought to roadside. This will be determined in consultation with the District Manager.

3. Preplanning is required on all forest operations (Industry/Crown) at the request of the District Manager (for Industry) and the Section Head i/c Management Planning (for Crown). Preplanning will include:

- boundaries of protected water supplies (if applicable);
- existing and proposed access roads;
- skid trails and landing locations;
- areas sensitive to erosion;
- buffer zones around water bodies;
- approved stream crossings;
- fuel storage locations;
- wildlife corridors.

4. Harvesting is not permitted within caribou calving areas from May 15 - June 15 (calving period). Harvesting is not permitted within post-calving areas from June 15 to July 31. These areas will be identified by the Wildlife Division.

5. Harvest scheduling should be modified during the migration of wildlife (e.g., caribou) and during temporary wildlife concentrations (e.g., waterfowl staging). Wildlife biologists will identify the areas of concern, and in conjunction with district or company foresters, aid in the modification of forestry operations.

2.2 **Operations**

1. When skid trails and winter roads are to be constructed, soil disturbance and impacts on waterbodies are to be minimized. The operator will use culverts and/or log bridges depending on the conditions. The objective is to minimize erosion and sedimentation, to avoid restricting streamflow, and to ensure fish passage in fish-bearing streams. Erosion control measures (e.g., laying down brush mats and the construction of diversion ditches for water run-off) are to be maintained while the skid trail is in use. All temporary crossings are to be removed at the end of the operating season unless the District Manager agrees to extend the life of the crossing for more than one season.

2. A minimum 50-metre, no-cut buffer is to be left between operations within approved cabin development areas.

3.0 FOREST ACCESS ROADS GUIDELINES

3.1 Planning

Forest access roads, borrow pits and quarries shall avoid:

i) wetlands, deltas, and floodplain or fluvial wetlands;
ii) terrain with high erodibility potential;
iii) known sensitive wildlife areas such as;
- calving grounds, post calving areas, caribou migration routes, caribou rutting areas, and winter areas,
- waterfowl breeding areas and colonial nesting sites,
- established moose yards by one kilometre,
- eagle and osprey nest sites,
- where site conditions and engineering permits, main haul roads should be one kilometre from permanent water bodies and all other roads by not more than 100 metres,

- endangered or endemic species or sub-species of flora or fauna and other areas to be determined by qualified authorities;

iv) known sensitive fish areas such as:
- spawning and rearing grounds;

v) historically significant areas such as:
- archaeological sites;

vi) existing reserves such as:
- parks (municipal, provincial, national);
- wilderness areas and ecological reserves;
- rare and endangered plant sites and habitats.

2. With respect to borrow pits and quarries, the operator shall:

i) minimize the number of new borrow areas opened for construction and/or maintenance;
ii) use existing borrow areas whenever practical;
iii) be in possession of a valid quarry permit from the Department of Mines and Energy prior to aggregate extraction activities;
iv) not locate pits and quarries in sensitive areas as identified by planning processes.

3. Forest access roads will not obstruct wildlife migration routes. The following guidelines will be followed to ensure the road is as unobstructing as possible:

i) roads should be of low profile (less than 1 m above the surrounding terrain);
ii) slash and other debris shall be removed;
iii) the slope of ditches and road banks should not exceed 1½ horizontal to vertical.

4. Culverts and bridges are to be installed in accordance with the manufacturer's specifications and the specifications attached to the Certificates of Approval received

from the Department of Environment and Labour and from the Department of Fisheries and Oceans. Culvert ends will be properly riprapped.

5. Where road construction is to occur around identified waterfowl breeding, moulting and staging areas, the Canadian Wildlife Service is to be consulted.

6. Road construction is not permitted within any buffer zone except with the permission of the District Manager.

7. When a skid trail is on steep ground and is no longer in use, cut-off ditches and push lanes must be created. The frequency will be determined by the District Manager.

8. When disturbance is over 10%, the conditions in 1.1.3 will apply.

9. There shall be no bulldozing of standing merchantable timber or poor utilization of merchantable softwoods and hardwoods during cutting of the right-of-way.

10. Excavations required for the construction of piers, abutments or multi-plate culverts shall be completed in the dry. (Where exceptions occur, consultation with District manager is required).

11. On a site specific basis, roads can be decommissioned and/or rehabilitated as directed by the District Manager. Decommissioning is defined as barring access; rehabilitation means to re-vegetate the road.

3.2 **Operations**

1. A "no-grub" zone of 30 metres of undisturbed ground vegetation must be maintained around any water body crossing to minimize the damage to the lower vegetation and organic cover, thus reducing erosion potential. Manual clearing at

waterbody crossing sites should be used to remove or control vegetation. Right-of-way widths at waterbody crossings should be kept to a minimum.

2. Fill materials for road building must not be obtained from any waterbody or from within the floodplain of any waterbody.
3. Trees are to be felled away from all waterbodies, and slash and debris should be piled above the high water mark so that it cannot enter waterbodies during periods of peak flow.

4. Equipment activity in water crossing areas is to be kept to a minimum. Whenever possible, any work is to be carried out from dry stable areas.

5. Unnecessary side casting or backfilling in the vicinity of waterbodies is not permitted. Where topographical constraints dictate that the roadbed must be constructed adjacent to a waterbody, road slope stabilization is to be undertaken at the toe of the fill where it enters the water (an area where active erosion is likely). The placement of large riprap or armour stone is recommended in such areas.

6. Side casting must be carried out in such a manner that sediment does not enter any waterbody.

7. Where borrow pit or quarry activity is likely to cause sediment-laden run-off to contaminate a waterbody, sediment control measures such as filter fabric berms or sedimentation ponds are to be installed. Contact is to be made with the District Manager prior to construction where such conditions exist.

8. Stabilize cut banks and fill slopes in the vicinity of waterbodies.

9. When using ditches, especially on long slopes, baffles and culverts are to be used at frequent intervals.

10. When constructing ditches near streams, the ditch itself is not to lead directly into the stream.

11. Keep ditches at the same gradient as the road.

12. In side hill and similar areas, install ditches on the uphill sides of roads to intercept seepage and run-off.

13. Borrow pits are to be located 50 metres from the nearest waterbody.

4.0 SILVICULTURAL PRACTICES AND FOREST REGENERATION GUIDELINES

4.1 Scarification

1. Select scarification methods best suited for preparing the area for planting and for minimizing ground disturbance.

2. Where slash is piled into windrows, ensure the windrows are placed where slash cannot be washed into streams at peak flooding conditions.

3. To minimize erosion, do not direct scarification equipment straight down slope.

4. Where safety is not an issue, a minimum average of 10 cavity trees or snags per hectare, or a clump of trees, will be left on all sites.
5. Whenever possible, white pine regeneration will not be disturbed.

4.2 **Planting**

1. Landings will be stabilized through seeding (grass) or planting at time of plantation establishment.

4.3 Pre-commercial Thinning

1. Where possible, do not carry out pre-commercial thinning in important wildlife areas during the periods of birth and/or hatching. These areas and times will be identified by the Wildlife Division.

2. Where white pine regeneration is present, the District Manager will determine how the pine will be thinned.

3. Trees cut will not be felled into waterbodies.

5.0 FOREST PROTECTION GUIDELINES

1. A pesticide application licence must be obtained from the Department of Environment. This licence will determine planning and operational requirements.

6.0 GUIDELINES FOR FORESTRY OPERATIONS WITHIN PROTECTED WATER SUPPLY AREAS

The primary function of a protected water supply area is to provide the public with an adequate quantity of safe and good quality water on a permanent basis, to meet its present and future demands. Any other activity within water supply areas is considered secondary, and if permitted, must be strictly regulated and monitored to ensure that the water supply integrity is not threatened and the quality of the water is not impaired.

In Newfoundland, forestry operations are permitted in protected water supply areas on a limited and controlled basis provided the proposed operations have no, or minimal, water quality impairment potential.

The following permits and approvals are required prior to the beginning of forestry operations within a protected water supply area:

1) Approval of the forest operating plan by the Newfoundland Forest Service.
2) Approval of the forest operating plan by the provincial Department of Environment and Labour and issuance of a Certificate of Approval under *Section 10* of the *Department of Environment Act*.

3) Quarry permits from the provincial Department of Mines and Energy for all borrow areas and ballast pits on unalienated Crown lands and alienated Crown land (i.e., leased and licensed land).

4) Stream crossing permits under *Section 11* of the *Department of Environment Act* and from the federal Department of Fisheries and Oceans.

5) Other permits or approvals as required by natural resource management and regulatory agencies.

6.1 **Planning**

1. Prior to beginning any work, a forest operating plan must be prepared and approved by the Newfoundland Forest Service and the Department of Environment and Labour, and a Certificate of Approval must be obtained under *Section 10* of the *Department of Environment Act* for site specific activities such as road construction, commercial harvesting, silvicultural operations, and other activities associated with forestry operations.

2. In addition to the information normally contained in a forest operating plan, the plan must include maps to show:

< the boundary of the protected water supply area;

< existing and proposed access roads;

< proposed harvesting areas;

< areas sensitive to erosion;

< buffer zones around water bodies;

< approved stream crossings;

< proposed landing and skid trail locations;

< proposed fuel storage locations;

< peatland and other wetlands;

< nearby communities;

< other relevant information.

The plan must also contain a written section describing the harvesting techniques to be used, the equipment required for the operation, and the schedule of the operation.

3. Locate roads to avoid all waterbodies and areas of sensitive terrain.

4. The forest operating plan must identify an Operations Manager who shall have the responsibility for ensuring that the special protection measures are followed. The Operations Manager is responsible for co-ordinating clean-up efforts in the event of a fuel or oil spill.

6.2 **Forest Access Road Construction**

1. A "no-grub" zone of 30 metres of undisturbed ground vegetation must be maintained around any waterbody crossing to minimize the damage to the lower vegetation and organic cover, thus reducing the erosion potential. Manual clearing at

waterbody crossing sites should used to remove or control vegetation. Right-of-way widths at waterbody crossings should be kept to a minimum.

2. Clear-cutting up to the perimeter of any waterbody is not permitted. In all areas where road construction approaches a waterbody, a buffer zone of undisturbed vegetation must be maintained on both sides of the right-of-way using the buffer zone criteria outlined in section 6.6.

3. Fill materials for road building must not be obtained from any waterbody or from within the floodplain of any waterbody.

4. Provide adequately designed and constructed drainage ditches along forest roads to allow for good road drainage.

5. Take-off ditching can be used on both sides of the road, or in conjunction with culverts, to divert the ditch flow into the woods or into stable vegetated areas above the no-grub zones. Where take-off ditches are unstable or cannot be constructed, the use of check dams and settling basins in the ditches is required until the ditches become stabilized.

6. Trees are to be felled away from all waterbodies, and slash and debris should be piled above the high water mark so that it cannot enter waterbodies during periods of peak flow.

7. Equipment activity in water crossing areas shall be kept to a minimum. Any work will be carried out in dry, stable areas.

8. When working near sensitive areas such as streams or lakes, road building operations causing erosion or siltation are to be followed as per section 1.2.7.

9. Unnecessary side casting or backfilling in the vicinity of water bodies is not permitted. Where topographical constraints dictate that the roadbed must be

constructed adjacent to a water body, road slope stabilization is to be undertaken at the toe of the fill where it enters water, an area where active erosion is likely. The placement of large riprap or armour stone is recommended in such areas. Contact is to be made with the District Manager prior to construction when such conditions occur.

10. Side casting must be carried out in such a manner that sediment does not enter any waterbody.

11. Maintenance support sites must be located outside the protected water supply area.

6.3 Forest Access Road Stream Crossings

1. Stream fording is prohibited in protected water supply areas.

2. All stream crossings, whether culverts or bridges, require written approval under *Section 11* of the *Department of Environment Act.*

3. The operator must comply with all terms and conditions of a Certificate of Approval for stream crossings.

6.4 Harvesting

1. Harvesting or other heavy equipment will not be used on wetlands or bogs.

2. Steep areas with high potential for erosion should not be harvested.

3. Wherever possible, skid trails should run along contours and never cross wetlands and waterbodies.

4. Landings will be few in number with a maximum size of less than 0.25 ha. All landings should be located at least 100 metres from a waterbody.

5. In sensitive areas prone to erosion, equipment must have wide tires, or harvesting must occur during the winter when the ground is frozen.

6. Harvesting equipment shall not enter a buffer zone or any waterbody without permission of the District Manager.

7. The operator must implement erosion control and rehabilitation measures in areas where soils have been unduly disturbed by harvesting activity. In addition to general erosion control measures presented in other sections of these guidelines, the following should also be considered in protected water supply areas:

< undertake contour furrowing;

< construct diversion ditches to lessen the possibility of forming new drainage channels;

< seed or plant areas that are difficult to stabilize by other means;

< plough or rip prior to seeding any surfaces which have been compacted.

6.5 **Buffer Zones**

The Newfoundland Forest Service on unalienated Crown land and the appropriate company on leased, licensed, private or charter land will provide the operator with a map indicating the harvesting area and no-cut treed buffer zones, and will ensure that the operator is familiar with the boundaries.

No forestry activities are permitted within the following buffer zones.

Water Body	Width of Buffer Zone
1. Intake pond/lake/reservoir	A minimum of 150 m
2. River intake	A minimum of 150 m for 1 km upstream and 100 m downstream
3. Main river channel	A minimum of 75 m
4. Major tributaries/lakes/ponds	A minimum of 50 m
5. Other water bodies	A minimum of 30 m

6.6 **Fuel/Oil Handling and Storage**

Fuel storage and the operation of fuel storage equipment is regulated by the *Storage and Handling of Gasoline and Associated Products Regulations (1982)* under the Department of Environment and Lands Act. According to the regulations, the owner or operator of a fuel storage system must submit a Schedule "A" Storage Tank System Application to the Department of Environment. The applicant must be in receipt of a Certificate of Approval for the system before the system is used for fuel storage. Section 9 of the above Act states: "*No owner or operator shall directly or indirectly cause pollution of the soil or water by causing, suffering or permitting leakage or spillage of gasoline or associated products from a storage tank system or vehicle."*

In addition to the above regulatory requirements, the following guidelines are to be followed:

1. Bulk fuel is to be stored outside the protected water supply area. f fuel must be stored in the protected area, it must be in the least sensitive area and be approved by the Water Resources Management Division of the Department of Environment and Labour.

2. Fuel must be stored in self-dyked, above-ground Jeep Tanks which have been approved by the Department of Environment and Labour.

3. A maximum of seven days fuel supply can be stored within a water supply area.

4. Refuelling must not take place within 100 metres of a waterbody.

5. Daily dipping of tanks and weekly reconciliations are mandatory. Visual inspection of the dykes and the surrounding area must be carried out daily and inspection records must be maintained.

6. Each unit must be fitted with a locking valve system for the elimination of water inside the outer tank. The valve must be closed and locked except to drain precipitation.

7. Each person involved with fuel handling must be cautioned that any spillage is to be cleaned up immediately.

8. Each person involved with fuel storage must exercise extreme caution when refuelling equipment.

9. All waste materials and waste oil on the site must be collected in enclosed containers and removed to an approved site at least weekly.

10. Contaminated soil or snow must be disposed of at an approved waste disposal site.

11. Any spill in excess of 70 litres must be reported immediately through the 24- hour Spill Report Number (709-772-2083) or the Government Services Centre (1-800-563-2444).

12. All self-dyked Jeep Tanks must be located at a minimum distance of 500 metres from any major waterbody.

13. A fuel or oil spill clean-up kit must be kept on site within the protected area to facilitate any clean-up in the event of a spill. This kit must include absorbent pads, loose absorbent materials such as dried peat, speedy-dry or sawdust, and a container such as an empty drum for recovering the fuel or oil. If there is a bulk fuel storage facility within the protected area, the clean-up kit must include the following list of fuel or oil spill clean-up equipment:

< Fire pump and 100 metres of hose
< Two hand operated fuel pumps
< Six recovery containers such as empty drums
< Four long handled shovels
< Two pick axes
< Ten metres of containment boom
< Twenty-five absorbent pads
< One hundred litres of loose absorbent material.

When any fuel spill occurs, stop the fuel flow immediately. This may entail repairing a leak, pumping out a tank, or shutting off a valve. If fuel or oil is spilled onto soil, dyking may be necessary. If fuel or oil enters water, absorbent booms or barriers such as fencing or netting with loose absorbent or straw must be used to contain the spill. If necessary, culverts may be blocked off by earth or wooden barriers to contain the fuel or oil provided the threat of flooding is addressed.

All recovered fuel or oil must be stored in containers. Contaminated soil must be removed and placed in containers for transport and disposal. Extensive soil removal may cause problems such as erosion and the subsequent siltation of waterbodies; therefore, the affected area must be backfilled and sloped and revegetated as required by the Department of Environment and Labour.

Recovered fuel or oil should be reused or collected by a waste oil company for recycling. Oily debris and contaminated soils must be disposed of at an approved waste disposal site with the approval of the disposal site owner or operator. Contact must be made with the appropriate regional office of the Department of Environment and Labour before disposal.

6.7 **Support Service and Structures**

1. Storage of any type of pesticide, chemical or other hazardous material isprohibited within a protected water supply area.

2. Dormitory camps, garages or any other structures are prohibited within a protected water supply area.

3. The establishment of new sawmills is not permitted in protected water supply areas.

4. Wherever possible, toilet facilities must be provided in all work areas.

5. Garbage cans must be located in all work areas and garbage is to be collected regularly and disposed of at an approved waste disposal site outside the protected area.

6.8 **Silviculture**

1. Chemicals are to be used within a protected water supply area only under the approval of the Division of Water Resources.

2. Scarification must be minimized and restricted to the trench or spot types.

3. If scarification leads to erosion or sedimentation of small streams or water bodies, scarification operations must be suspended and remedial measures must be taken.

6.9 **Abandonment**

When forestry operations in a protected water supply area have been completed, an abandonment plan for the area should be developed. This will involve input from the Newfoundland Forest Service, the Community involved, and the Water Resources Management Division of the Department of Environment and Labour. In general, the purpose of the plan is: (i) to ensure that the post-harvest conditions do not lead to water quality impairment, and (ii) to discourage activities or use of the area that could lead to water quality impairment.

An important question will be whether access roads will remain open. This will be decided on a case-by-case basis in consultation with the municipality, Water Resources Management Division and the operator. Issues such as the rehabilitation of cutover areas, landing sites, skid trails, and the abandonment of roads are to be discussed during the consultation process to control post-harvesting environmental impacts and activities.

The following are recommended precautionary measures if roads are to be closed to control post-harvesting access to the area:

< Use water bars (trenches 8-10" deep dug across the road) to intercept and deflect surface roadside ditches rather than have it flow into a waterbody. Water bars can be placed 500 metres apart in gentle to moderate terrain (up to 10% slope), but should be no more than 150 metres apart in terrain greater than 10%. In most cases, it is sufficient to limit water bars to one kilometer on each side of a stream crossing.

- Road-side ditches should flow into the woods or into stable, vegetation covered areas.

- Stable bridge abutments and erosion protection works at crossings need not be removed.

- Bridge decking, culverts and other easily removable structures should be transported out of the watershed area.

- All disturbed areas of river banks will be stabilized and seeded.

6.10 Monitoring and Inspection

1. Forestry operations approved under Section 10 of the Department of Environment Act will be inspected from time to time by the staff of the Water Resources Management Division to ensure the operator's compliance with the environmental protection guidelines and the terms and conditions of the approvals.

2. In case of an oil spill, the sedimentation of a water body, or any other water quality impairment related issue, the operator might be required by the Department of Environment and Labour to undertake water quality monitoring to assess the extent of the damage and to select appropriate mitigative measures to correct the harmful conditions.

3. Any water quality impairment problem should be reported to the Water Resources Management Division.

7.0 PROCESSING FACILITIES AND SUPPORT SERVICES GUIDELINES

1. If possible, use previously disturbed sites (e.g., borrow pit).

2. Minimize the size of the area cleared for the establishment of any camp, processing or support structures. Wherever possible, these facilities should not be established within 100 metres of a waterbody.

3. All sumps containing effluent from a kitchen or washroom facility must be properly treated on a daily basis in compliance with Department of Health regulations.

4. Sewage disposal must be carried out in compliance with the Public Health Act.

5. A permit to occupy is required for Crown Land developments.

6. Facilities will not be located within known sensitive wildlife areas. These areas will be identified by the Wildlife Division.

7. A permit is required for a firearm.

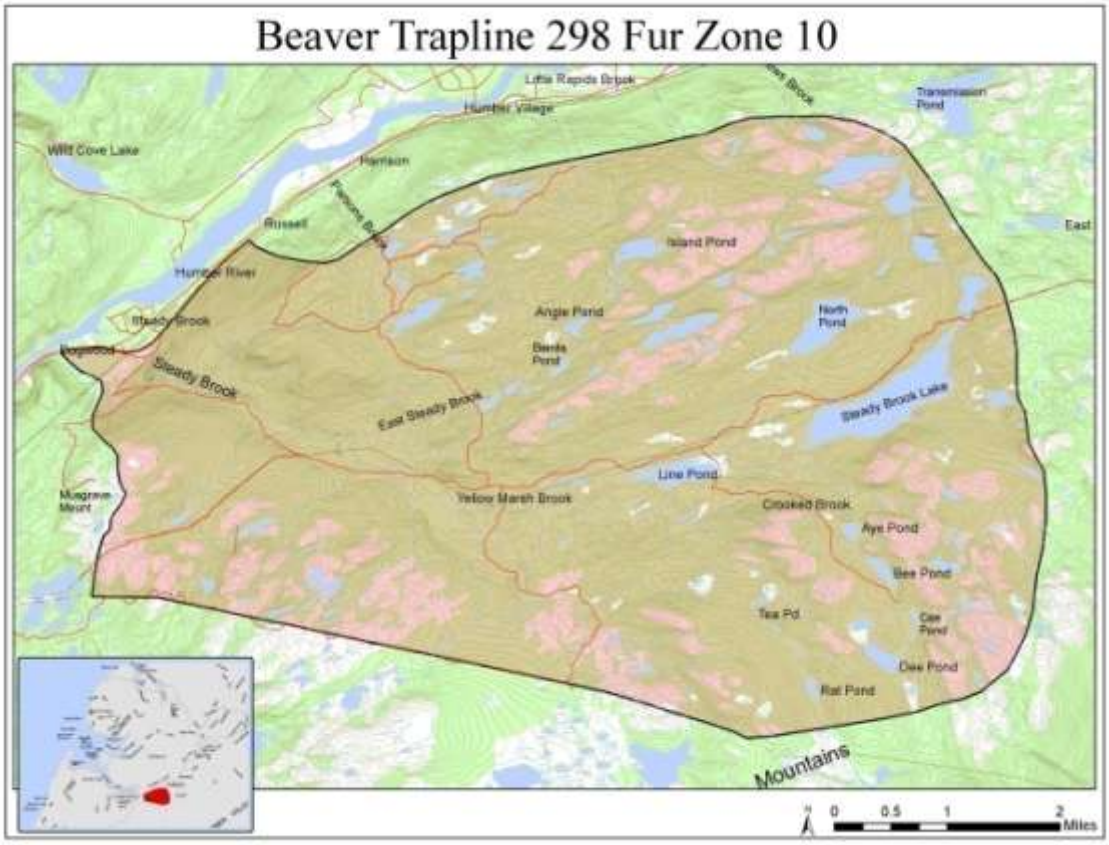
8.0 PLANNING AND MUNICIPAL AREA GUIDELINES

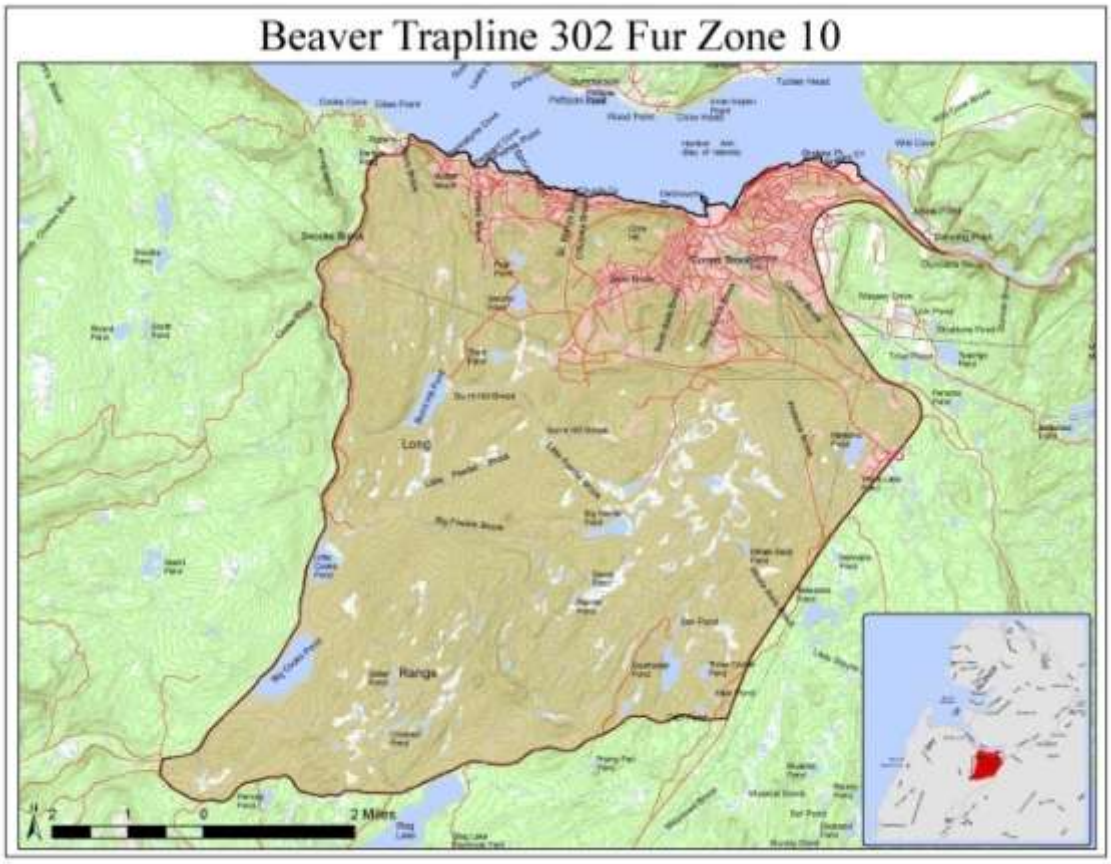
1. Timber harvesting, resource road construction, silviculture, processing facilities, and support services are developments under the Urban and Rural Planning Act. Where these activities occur within a planning area boundary or within 400 metres of a protected road, a development permit is required before any activity takes place.

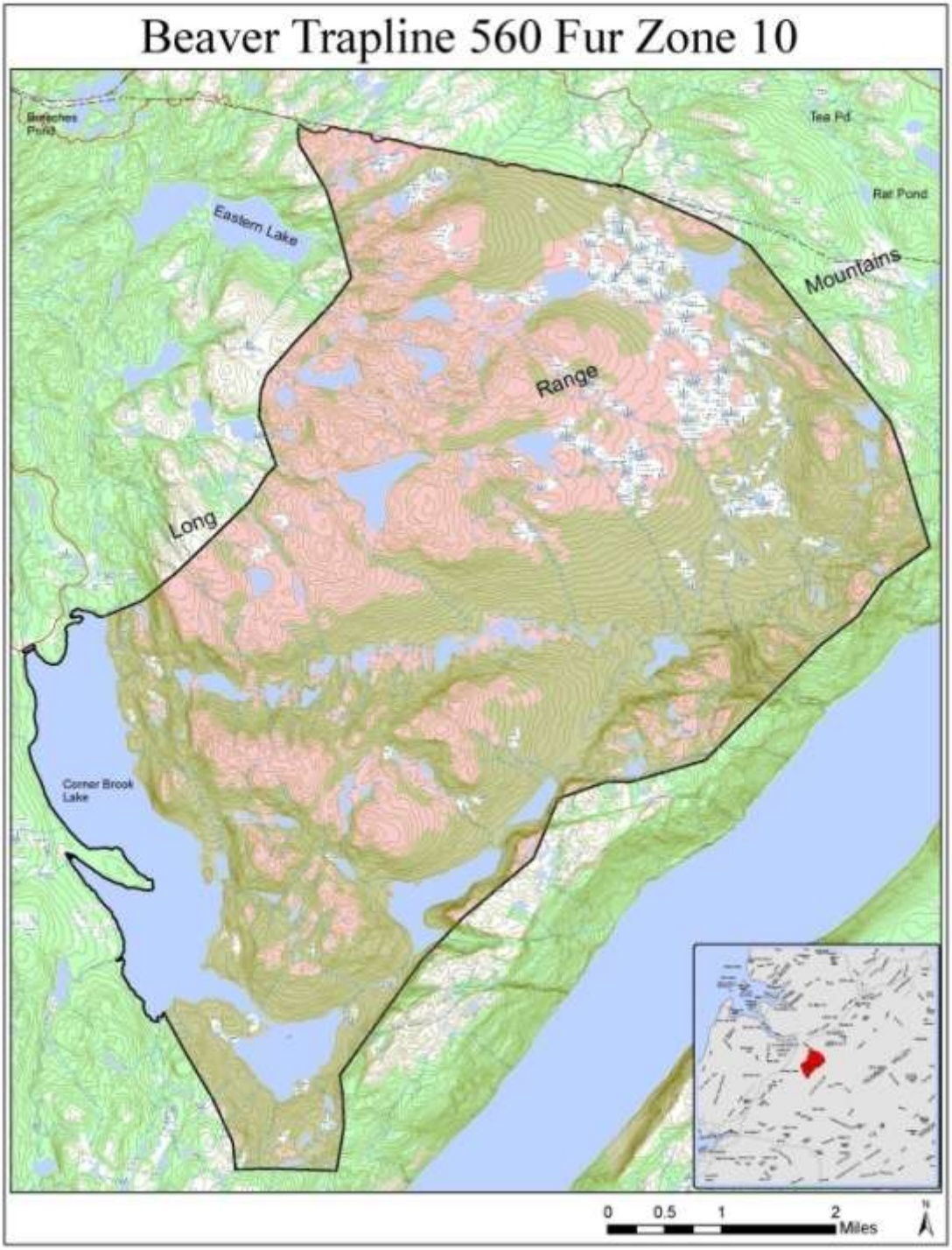
2. Consultation with the planning agency (usually municipality, but also the Development Control Unit of the Department of Municipal and Provincial Affairs) is to be made at the planning stage so that regulatory requirements can be made

known and taken into account. This should occur three months before the desired commencement of the development and the permit obtained about one month before the development is to start.

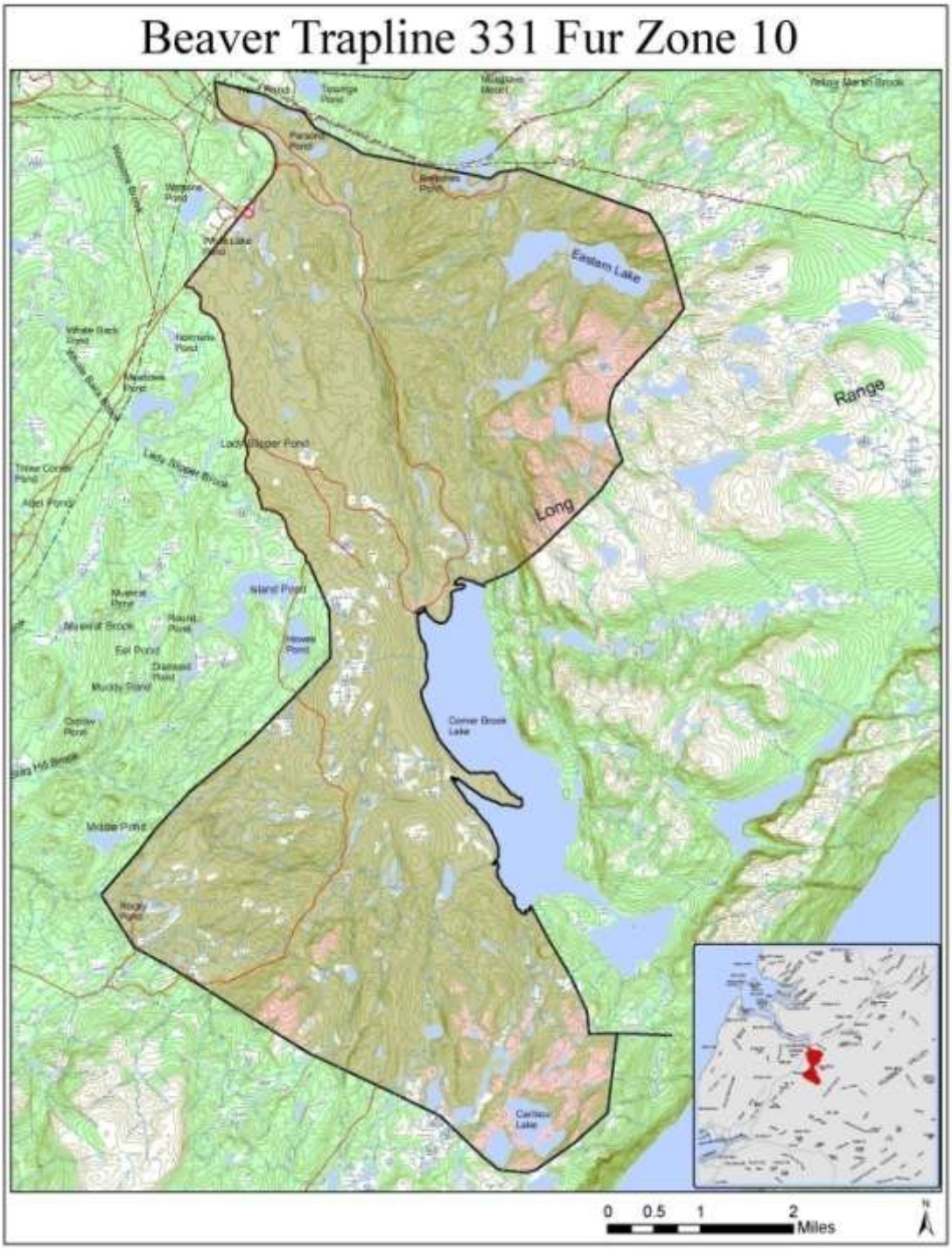
APPENDIX D – MAP OF TRAP LINES WITHIN THE CORNER BROOK WATERSHED




Beaver Trapline 302 Fur Zone 10
Long
Rangs
2 Miles


Beaver Trapline 560 Fur Zone 10
Tea Pd
Rat Pond
Eastern Lake
Mountains
Range
Long
Corner Brook Lake
0 0.5 1 2
Miles
N

Beaver Trapline 331 Fur Zone 10



APPENDIX E – PUBLIC ATTITUDINAL SURVEY FOR WATERSHED USE

Watershed Use Survey Form

1) Do you know where the Corner Brook Lake protected water supply is?

   Yes No

2) Do you know where the Burnt Pond protected water supply area is?

   Yes No

3) How do you currently use the Corner Brook Lake protected water supply area?

Dog walking	I work for the logging industry
Walking	I work for the mining industry
Skiing	Trapping/small game
Snowmobiling /dirt bike	Domestic wood cutting
Berry picking	Fishing
Mountain biking	Other

4) How do you currently use the Burnt Pond protected water supply?

Dog walking	I work for the logging industry
Walking	I work for the mining industry
Skiing	Trapping/small game
Snowmobiling /dirt bike	Domestic wood cutting
Berry picking	Fishing
Mountain biking	Other

5) Approximately how often do you visit these areas (combined)?

   Once/week

   2 or more times/week

   Once /month

   6 times per year

Never

6) What are the most important factors to consider when designing a watershed management plan?

Clean, safe drinking water	Industry and jobs
Recreation	Other

7) What is your level of agreement with the following statements?

a. Forest harvesting should be permitted in the Corner Brook drinking water supply area.

Strongly agree
Agree if protective measures are taken
Strongly disagree
I don't have enough information

b. Snowmobiling should be permitted in the Corner Brook drinking water supply areas.

Strongly agree
Agree if protective measures are taken
Strongly disagree
I don't have enough information

c. Mining activities should be permitted in the Corner Brook drinking water supply areas.

Strongly agree
Agree if protective measures are taken
Strongly disagree
I don't have enough information

d. Dog walking should be permitted in the Corner Brook drinking water supply areas.

Strongly agree
Agree if protective measures are taken
Strongly disagree
I don't have enough information

e. Cross-country skiing should be permitted in the Corner Brook drinking water supply areas.

Strongly agree
Agree if protective measures are taken
Strongly disagree
I don't have enough information

8) What values should the Corner Brook watershed management plan reflect?

Environmental sustainability	Health and safety
Openness and accessibility	Promotion of local resources for local Industry

9) Other ideas/comments?

10) What is your area code?

11) Please enter your name and contact information below if you would like to be contacted about public meetings related to the development of the Corner Brook Watershed Management Plans and receive updates of the process via email. This information is strictly for the purposes of informing you of the watershed management planning process. The City will not share the following information with any other party.

Name: Phone #:

Email:

Thank you for your time.

Comments from Public Attitudinal Survey

Maintaining habitats, protecting ecosystems, and preventing watersheds from misuse/abuse by selfish, ignorant people AND businesses AND government agencies.

Becoming a carbon-offset area that not only prevents environmental degradation, but specifically aims to take steps to counter global warming. As a "centre of environmental excellence", Corner Brook should be acting as a leader in environmental issues. To develop this "claim to fame", the local environment and its contributions to the global environment must take top priority. This watershed management plan is an excellent opportunity for Corner Brook to begin heading in this direction, and truly become and centre of environmental excellence.

Public consultation on decision making if this is not covered under :openness and accessibility

Common Sense to land use.

clean up of area

Get Corner Brook pulp and paper out of the area of our water-supply!!!
safe drinking water

holding industry more responsible

I agree with this sign, but I would also include NO DOGS allowed in water or within 10 meters of water.

Any activity that can be identified as having an adverse effect on the water supply should be assessed against how well that activity can be managed in the area. If an activity cannot be easily managed maybe it should be prohibited from taking place within the watershed area altogether.

If you protect the natural environment around the watershed supply area you will avoid both supply and contamination problems in the future. It is worth sacrificing recreational and commercial opportunities

to preserve the forest which in turn protects the watershed and the water.

For our drinking water to be safe and healthy, it HAS to be environmentally "sustainable"! What is the good in having industry if we don't have safe, good water to drink?!

This watershed is invaluable. Once the soils and waters are contaminated it will cost millions to restore if at all possible. my suggestion is to gate and fence it .Lock it up and only authorize people permitted

I think a total ban on travel would be detrimental. With people actively enjoying the watershed through recreational non motorized activities and with a stewardship mindset these people could help alert the City to inappropriate activities. we become the protectors of our resource!

The Water Supply areas should be strictly off limits to all activities. There are plenty of other wilderness areas close by for recreational use and industrial operations. Have violators ever been prosecuted as the sign below indicates? Is there any enforcement? I suspect that the answer is no to both questions.

I think most of the restrictions should only apply to the intake and reservoirs areas i.e. Trout Pond and Second Pond. In other words....No Activity of any kind in these 2 areas. Remote areas of the watersheds could have activities and depending on the distance from these 2 intakes and reservoirs the amount of activities could increase.

A daily dosage of common sense.
This area should be off limits to anyone . Absolutely nothing or anyone allowed inside the area.

Water Conservation!

It makes sense to design the water treatment system and waste treatment system together. This would make for more efficient implementation and a design that could be more conservative. Conserving water through system design would in turn save money when less water needs to be treated on both ends. Also conservation would minimize the environmental effects making for a more sustainable system. In addition adding an water conservation education element to the process would aid in both

environmental protection and economic savings. I sincerely believe that it is time to implement volume based pricing on water usage. In the long run this will benefit the City of Corner Brook as a whole environmentally economically and socially.

Good idea to prevent fecal pollution- provide garbage bins and perhaps garbage bags for dog waste disposal. Don't encourage logging and or mineral exploration.

should remain pristine natural areas best way to protect for multiple purposes

signs to make it safer for the public(ex: showing where water supply is)

Guided tours with better explanations

Keep it open and accessible. Also keep the public informed on what's happening with that area on a constant basis.

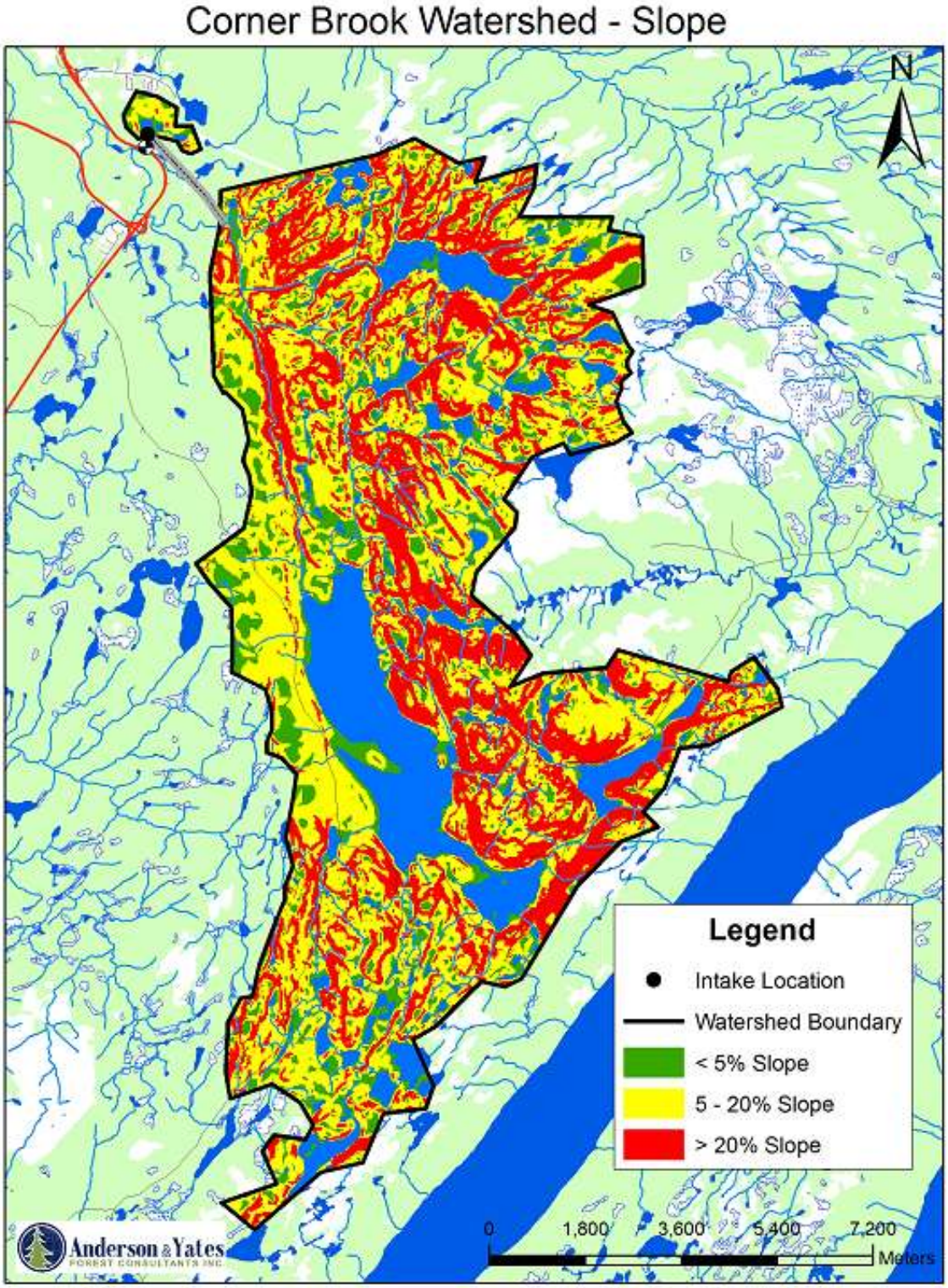
APPENDIX F - NUMERICAL INDEX COMPONENT RATINGS

Potential Contaminant	Potential Cause	Regulatory Adequacy			Public Health						Watershed Vulnerability				RI Total
		Regulations	Water Quality Monitoring	RI Regulations	Toxicity	Population	Quantity	Mobility	Persistence	RI Public Health	Soil Type	Slope	Runoff	RI Vulnerability	
Petroleum Products	Aviation / Aircraft Use	2	1	1.5	2	3	3	3	2	2.6	3	2	2	2.3	218
	Commercial Harvesting	1	1	1.0	2	3	2	3	2	2.4	3	2	2	2.3	200
	Illegal Dumping	3	1	2.0	2	3	1	3	2	2.2	3	2	2	2.3	217
	Cabins (fuel storage)	3	1	2.0	2	3	1	3	2	2.2	3	2	2	2.3	217
	All-Terrain Vehicle Use	2	1	1.5	2	3	1	3	2	2.2	3	2	2	2.3	203
	Snowmobile Use	2	1	1.5	2	3	1	3	2	2.2	3	2	2	2.3	203
	Forest Road Construction / Use	2	1	1.5	2	1	1	3	2	1.8	2	3	3	2.7	205
	Utility Line Structure Maintenance	2	1	1.5	2	1	1	3	2	1.8	2	3	3	2.7	205
	Utility Line Vegetation Maintenance	2	1	1.5	2	1	1	2	2	1.6	2	3	3	2.7	199
	Camping and Recreation	3	1	2.0	2	3	1	3	2	2.2	3	2	2	2.3	217
	Silviculture	2	1	1.5	2	1	1	2	2	1.6	2	3	3	2.7	199
	Mineral Exploration	2	1	1.5	2	1	2	2	2	1.8	2	3	3	2.7	205
	Quarrying	2	1	1.5	2	1	2	2	2	1.8	2	3	3	2.7	205
	Hunting / Trapping	2	1	1.5	2	3	1	3	2	2.2	3	2	2	2.3	203
	Infrastructure Maintenance / Construction	1	1	1.0	2	3	2	3	2	2.4	3	2	2	2.3	200
Refuse	Aviation / Aircraft Use	2	1	1.5	1	3	1	1	2	1.6	3	2	1	2.0	171
	Illegal Dumping	3	1	2.0	1	3	1	1	2	1.6	3	2	1	2.0	188
	Cabins	3	1	2.0	1	3	1	1	2	1.6	3	2	1	2.0	188
	Camping and Recreation	2	1	1.5	1	3	1	1	2	1.6	3	2	1	2.0	171
	Hunting and Trapping	2	1	1.5	1	3	1	1	2	1.6	3	2	1	2.0	171
Sedimentation	Motorized Vehicle Use	3	2	2.5	1	1	3	3	1	1.8	2	3	3	2.7	235
	All-Terrain Vehicle Use	2	2	2.0	2	3	1	3	1	2.0	3	2	2	2.3	210
	Commercial Harvesting	1	2	1.5	2	3	3	3	1	2.4	3	2	2	2.3	211
	Forest Road Construction	2	2	2.0	1	1	3	3	1	1.8	2	3	3	2.7	219
	Utility Line Structure Maintenance	2	2	2.0	1	1	1	2	1	1.2	2	3	3	2.7	205
	Utility Line Vegetation Maintenance	2	2	2.0	1	1	1	1	1	1.0	2	3	3	2.7	201
	Mineral Exploration	1	2	1.5	1	1	2	2	1	1.4	2	3	3	2.7	194
	Quarrying/ Mining	1	2	1.5	2	3	2	3	1	2.2	3	2	2	2.3	203
	Increased Stream-flow	3	2	2.5	1	1	3	3	1	1.8	2	3	3	2.7	235
	Forest Fire	3	2	2.5	1	1	3	3	1	1.8	2	3	3	2.7	235
	Camping and Recreation	3	1	2.0	2	3	1	3	1	2.0	3	2	2	2.3	210
Nutrients	Commercial Harvesting	1	1	1.0	2	1	3	2	1	1.8	2	3	3	2.7	195

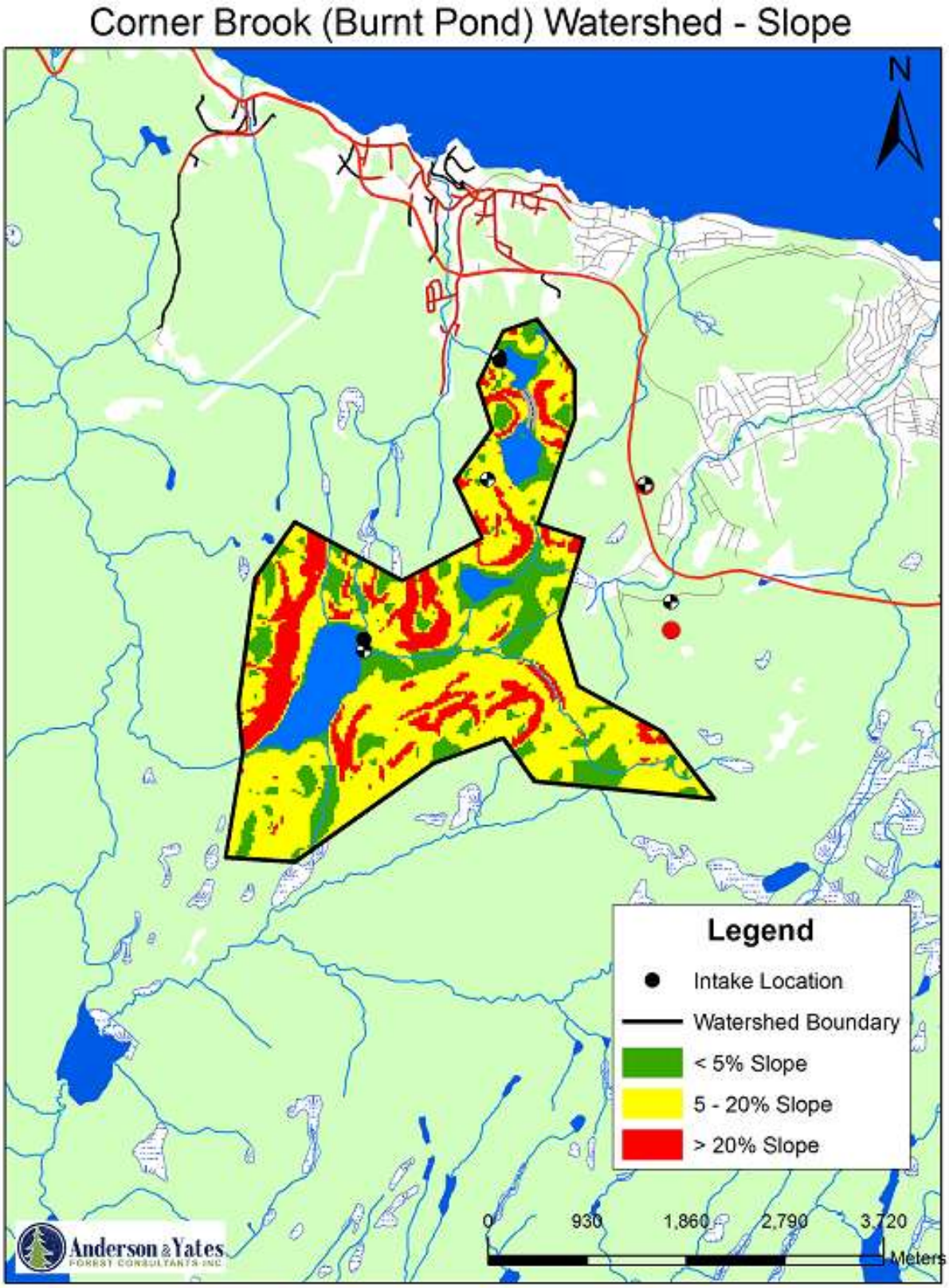
	Mineral Exploration	1	1	1.0	2	1	2	2	1	1.6	2	3	3	3	189
	Quarrying/ Mining	1	1	1.0	2	1	2	2	1	1.6	2	3	3	2.7	189
	Forest Fire	3	1	2.0	2	1	2	3	1	1.8	2	3	3	2.7	219
Pathogens	Pit Privies	1	2	1.5	3	1	3	3	1	2.2	3	3	3	3.0	232
	Wildlife	2	2	2.0	2	3	2	3	2	2.4	3	2	2	2.3	224
	Commercial Harvesting	1	2	1.5	2	3	2	3	2	2.4	3	2	2	2.3	211
	Camping and Recreation	2	1	1.5	2	3	2	3	2	2.4	3	2	2	2.3	211
Metals	Illegal Dumping	3	1	2.0	2	3	2	2	3	2.4	3	2	2	2.3	224
	Acid Mine Drainage	1	1	1.0	2	3	2	2	3	2.4	3	2	2	2.3	200
Chlorination By-Products	Commercial Harvesting	1	2	1.5	3	1	3	2	1	2.0	2	2	2	2.0	185
	Forest Road Construction/Use	2	2	2.0	3	1	2	2	1	1.8	2	2	2	2.0	194
	Natural Organic Loading	3	2	2.5	3	1	2	3	1	2.0	2	3	3	2.7	241
	Treatment	1	2	1.5	3	1	2	3	1	1.0	2	2	3	2.3	197
Toxins	Utility Line CCA Poles	1	1	1.0	3	1	1	2	2	1.8	3	3	3	3.0	210
	Forest Protection	2	1	1.5	3	1	2	2	2	2.0	3	3	3	3.0	225
	Herbicide Application along TCH	3	1	2.0	2	3	2	2	2	2.2	3	2	2	2.3	217
	Illegal Dumping	3	1	2.0	2	3	1	1	3	2.0	3	2	2	2.3	210
	Forest Fire Suppression	1	1	1.0	2	3	2	2	2	2.2	3	2	2	2.3	193
	Silviculture	2	1	1.5	3	1	2	2	2	2.0	3	3	3	3.0	225

APPENDIX G – SENSITIVITY ANALYSIS MAPS

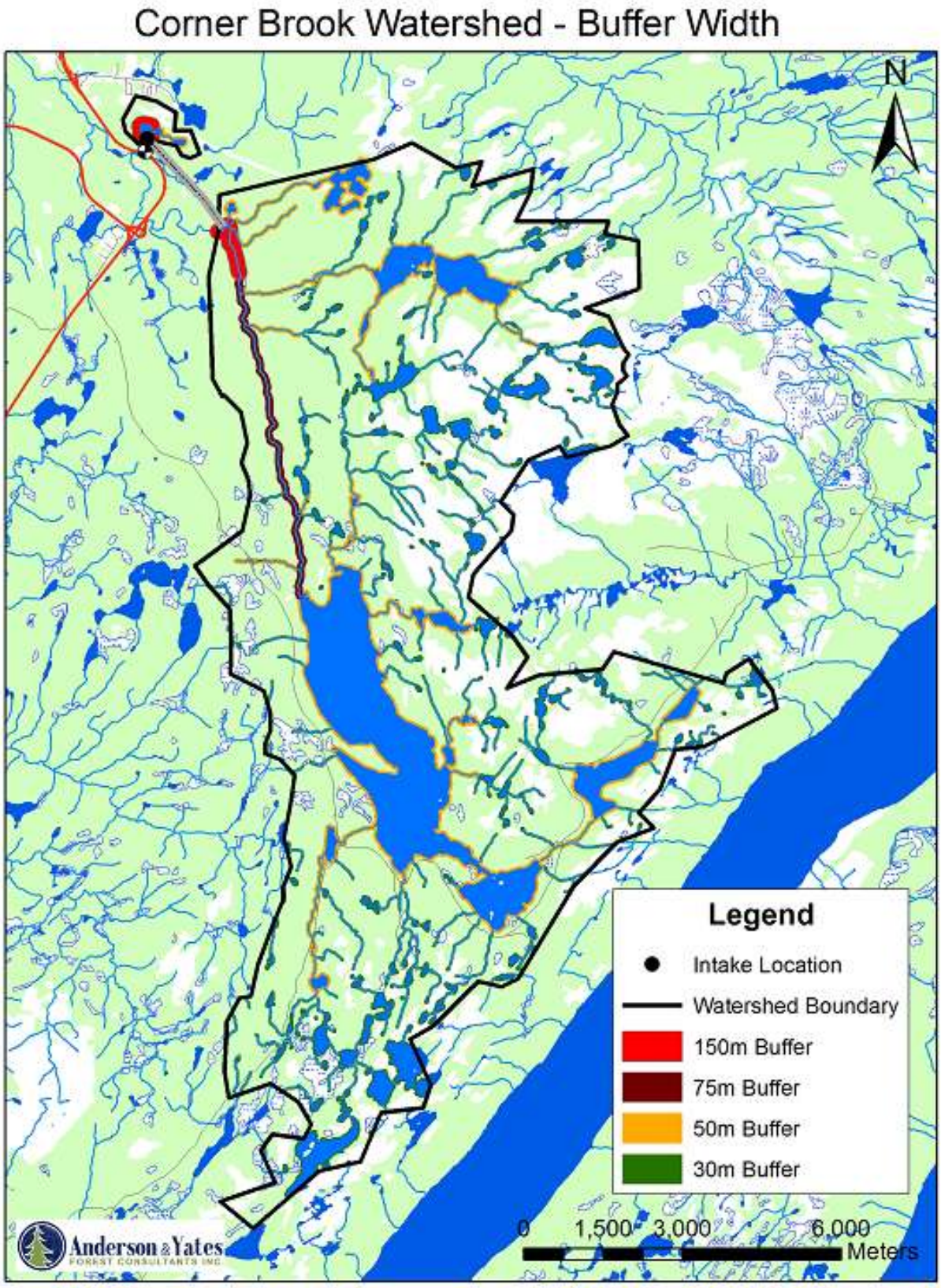
MAP 1



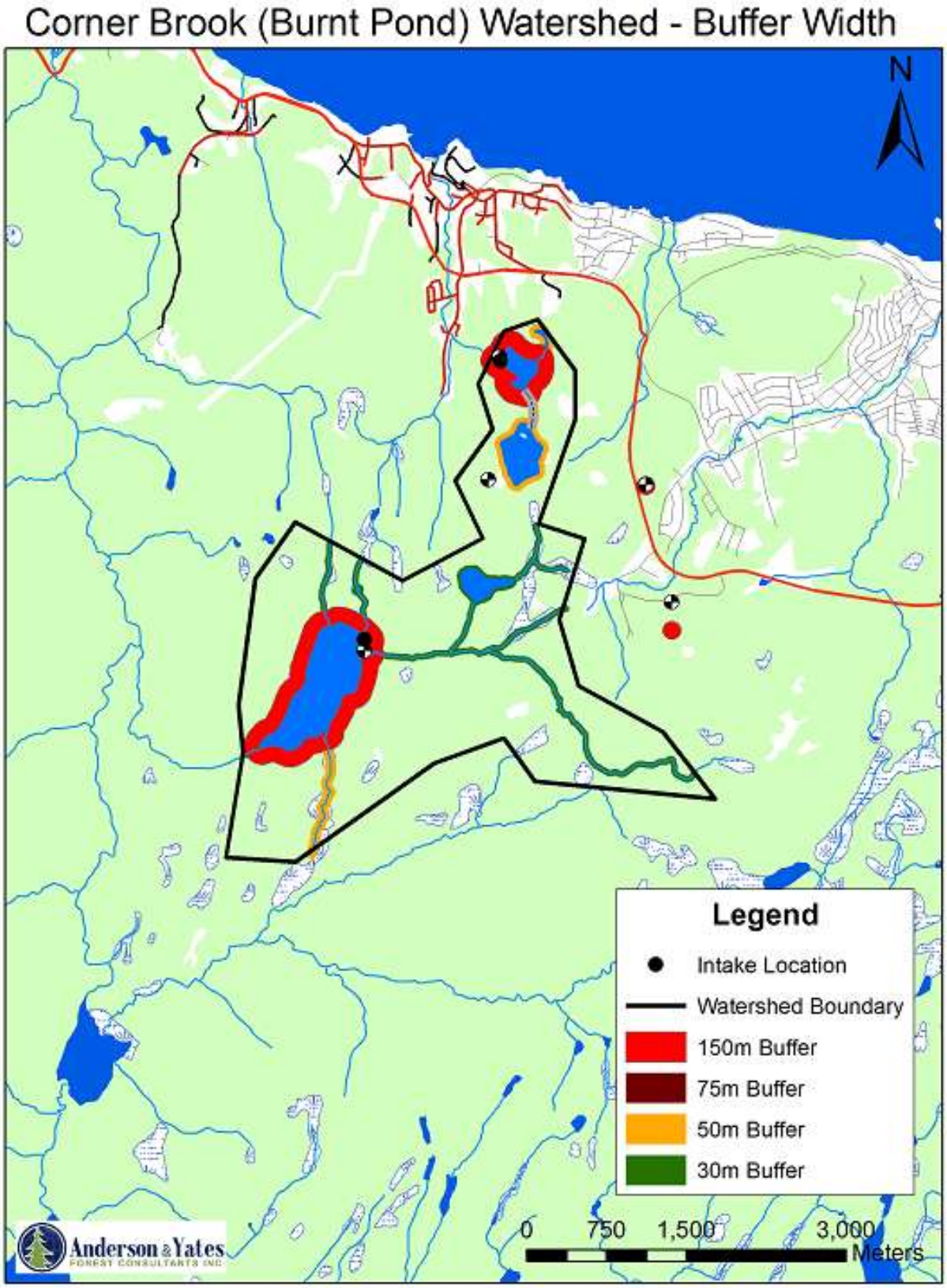
MAP 2


Corner Brook (Burnt Pond) Watershed - Slope
N
Legend
Intake Location
Watershed Boundary
< 5% Slope
5 - 20% Slope
> 20% Slope
0
930
1,860
2,790
3,720
Meters
Anderson & Yates
FOREST CONSULTANTS INC

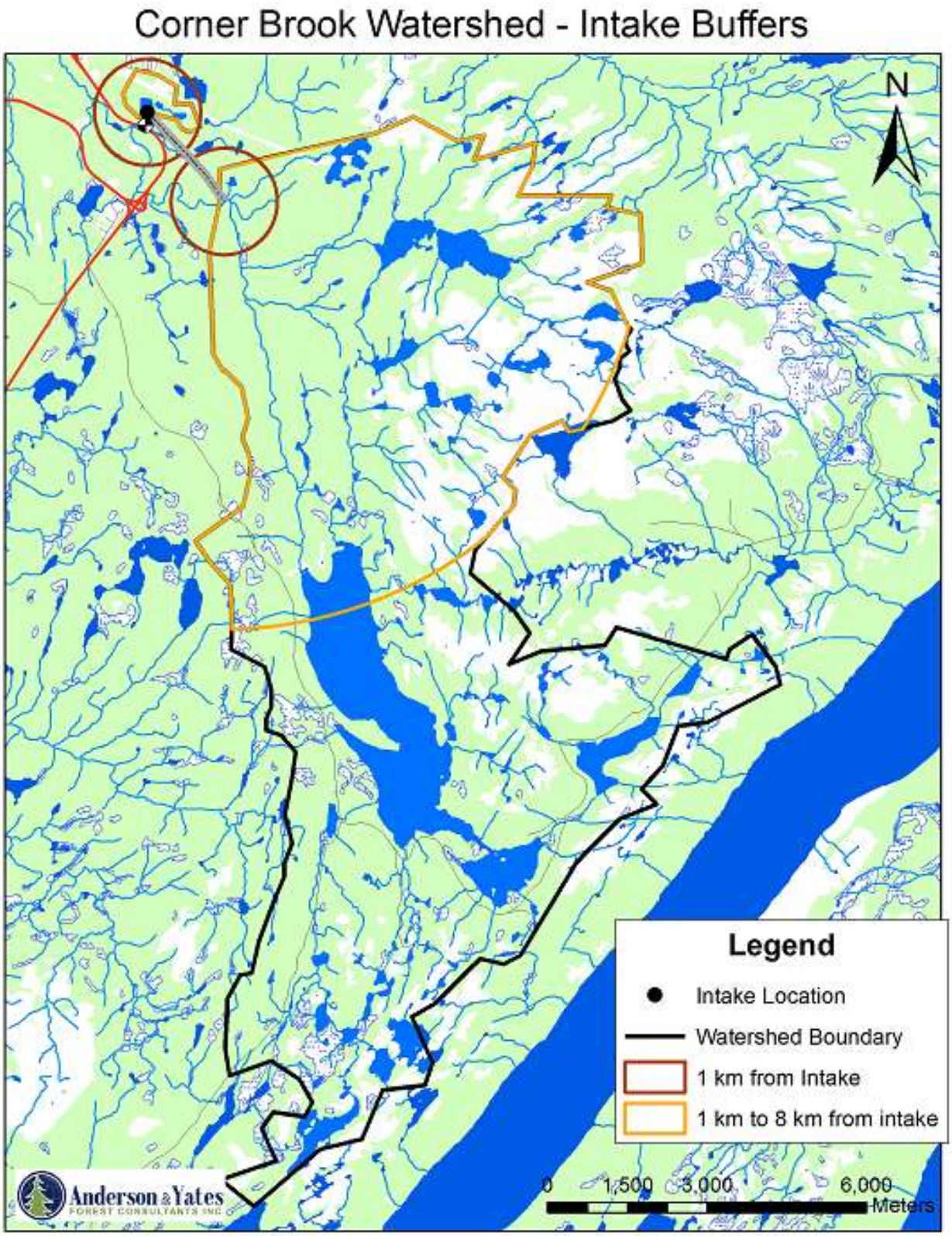
MAP 3


Corner Brook Watershed - Buffer Width
N
Legend
Intake Location
Watershed Boundary
150m Buffer
75m Buffer
50m Buffer
30m Buffer
0
1,500
3,000
6,000
Meters
Anderson & Yates
FOREST CONSULTANTS INC.

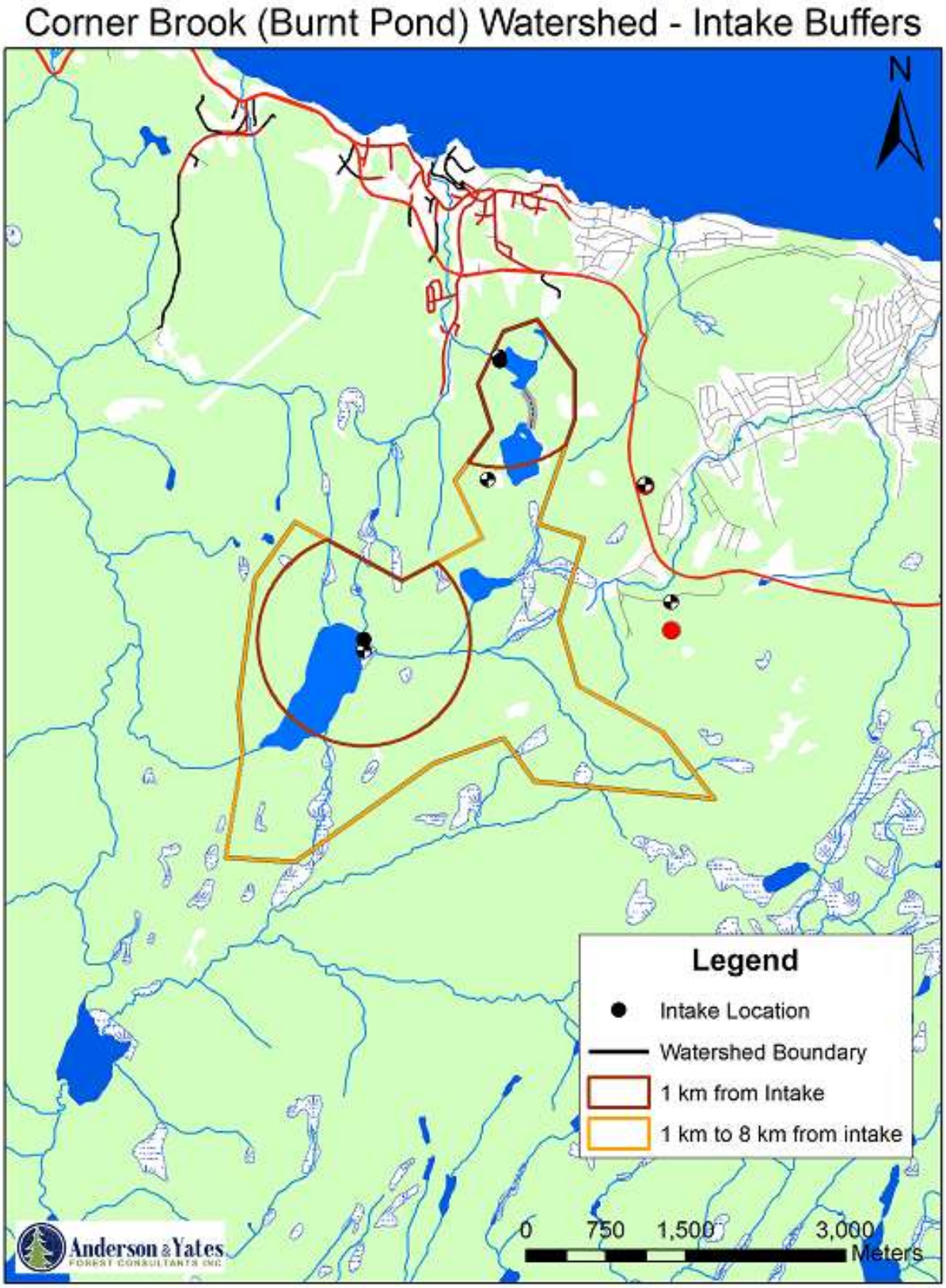
MAP 4


Corner Brook (Burnt Pond) Watershed - Buffer Width
N
Legend
Intake Location
Watershed Boundary
150m Buffer
75m Buffer
50m Buffer
30m Buffer
0
750
1,500
3,000
Meters
Anderson & Yates
FOREST CONSULTANTS INC.

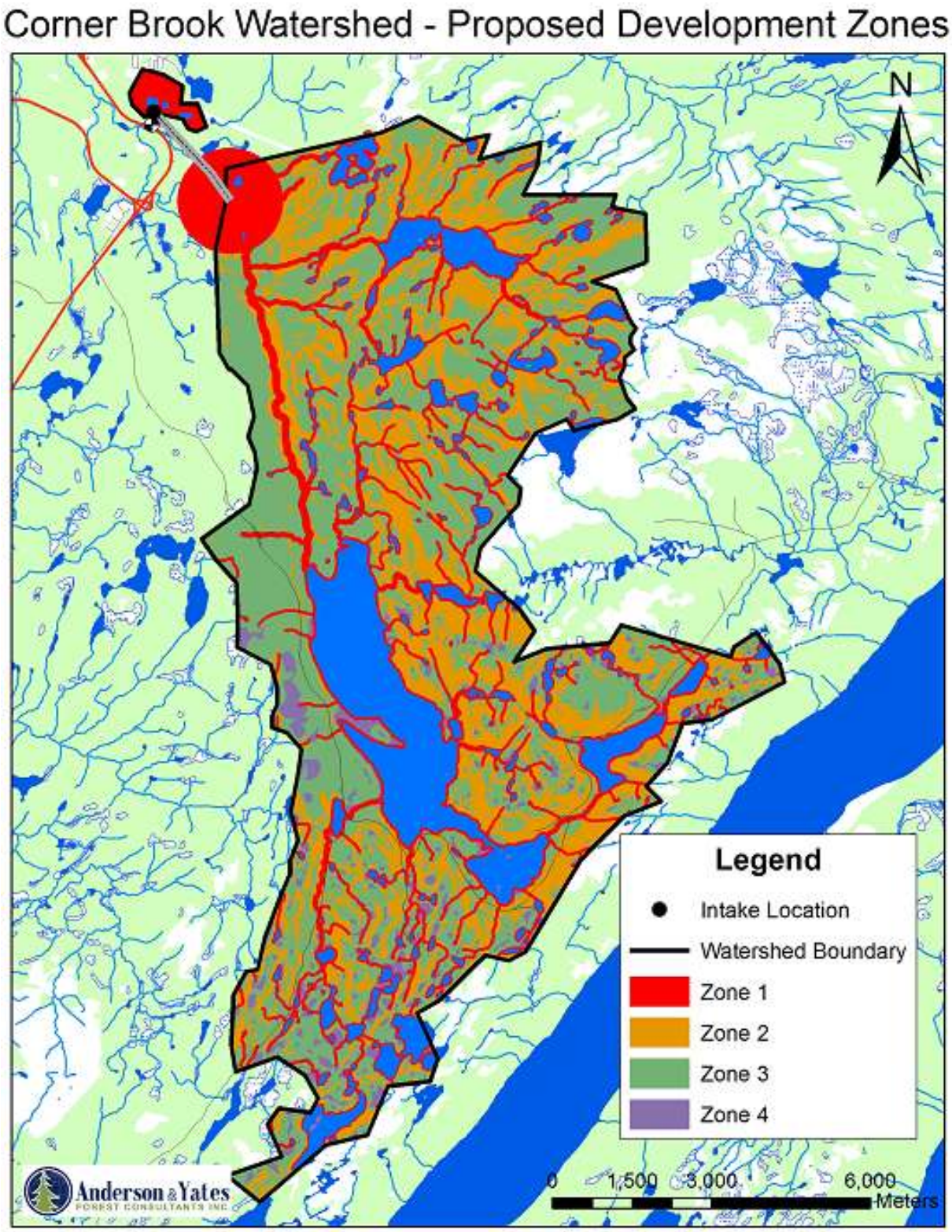
MAP 5


Corner Brook Watershed - Intake Buffers
N
Legend
Intake Location
Watershed Boundary
1 km from Intake
1 km to 8 km from intake
Anderson & Yates
FOREST CONSULTANTS INC
0
1,500
3,000
6,000
Meters

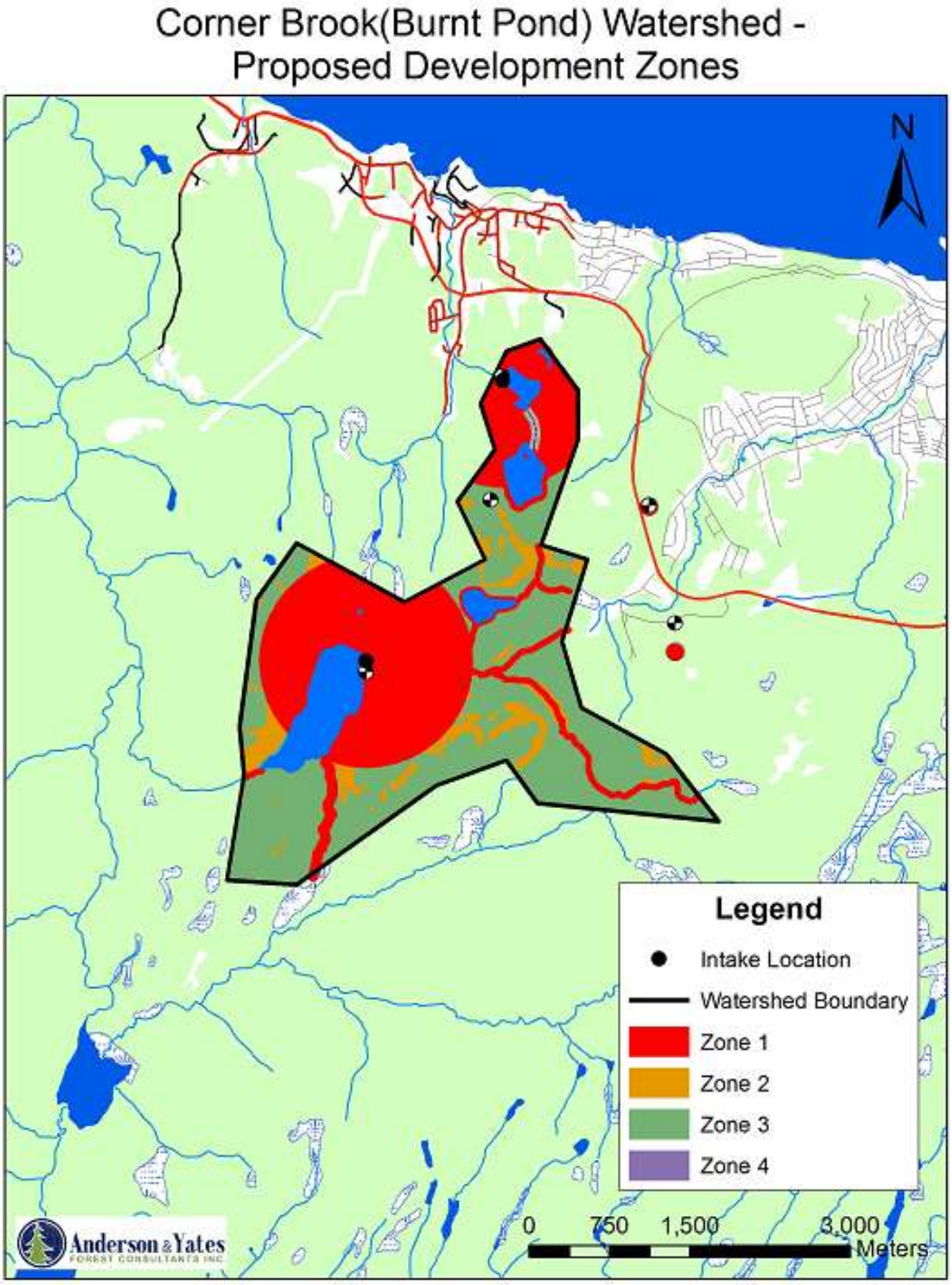
MAP 6


Corner Brook (Burnt Pond) Watershed - Intake Buffers
N
Legend
Intake Location
Watershed Boundary
1 km from Intake
1 km to 8 km from intake
0
750
1,500
3,000
Meters
Anderson & Yates
FOREST CONSULTANTS (NL)

MAP 7


Corner Brook Watershed - Proposed Development Zones
N
Legend
Intake Location
Watershed Boundary
Zone 1
Zone 2
Zone 3
Zone 4
Anderson & Yates
FOREST CONSULTANTS INC.
0
1,500
3,000
6,000
Meters

MAP 8


Corner Brook(Burnt Pond) Watershed -
Proposed Development Zones
N
Legend
Intake Location
Watershed Boundary
Zone 1
Zone 2
Zone 3
Zone 4
0
750
1,500
3,000
Meters
Anderson & Yates
FOREST CONSULTANTS INC

APPENDIX H – POLICIES AND RELATED DOCUMENTS PERTAINING TO PUBLIC WATER SUPPLY AREAS

POLICY FOR LAND AND WATER RELATED DEVELOPMENTS IN PROTECTED PUBLIC WATER SUPPLY AREAS

POLICY DIRECTIVE

Division:	Water Resources Management		P.D.	W.R. 95-01
Prepared By:	Haseen Khan, P.Eng.		Issue Date:	April 7, 1995
Approved By:	Wasi Ullah	Director	Revised Date:	March 10, 1999
Approved By:	David Jeans	ADM	Review Date:	
Authorized By:	John M. Fleming	DM	Superseded:	
	Kevin Aylward	Minister	Cancelled:	

Subject:

Policy guidelines for land and water related developments in protected public water supply areas.

1.0 OBJECTIVES

The policy will establish a mechanism for issuing a certificate of environmental approval under Section 10 of the *Environment Act, SN 1995, c E-13.1* for all development activities in a designated water supply area. The implementation of the policy guidelines will ensure sustainable development of natural resources without adversely affecting water quality.

2.0 LEGISLATION

Environment Act, SN 1995, c E-13.1, Section 10

3.0 POLICY

The existing and proposed development activities in protected water supply areas will be subject to the following policy guidelines established under Section 10 of the *Act*.

4.0 DEFINITIONS

"*Act*" means the *Environment Act, SN 1995, c E-13.1*.

"Development" means the carrying out of an activity or operation on, over, or under land or water for social or economic benefits, or the making of any change in the use of the intensity of use of any land, water, building or premises.

All other definitions appearing in the *Act* shall equally apply to this policy when employed herein.

5.0 APPLICATION OF THE POLICY

5.1 This policy shall apply to public water supply areas designated under Section 10 of the *Act*.

5.2 Existing resource development and other activities will be allowed to continue unless it is established that these are impairing water quality or have potential to impair water quality.

5.3 If it is established that a particular activity is a source of pollution, then appropriate measures as outlined in Sections 11, 12 and 13 of this policy directive will apply.

5.4 The Minister may require proponents of existing activities, which have potential to impair water quality, to obtain his/her approval.

5.5 No development shall be carried out in a designated area except in accordance with this policy.

5.6 No person shall carry out any development in a designated area without obtaining prior approval in writing from the Minister.

6.0 ACTIVITIES NOT PERMITTED IN A DESIGNATED AREA

6.1 Placing, depositing or discharging or permitting the placing, depositing or discharging into a body of water any sewage, refuse, chemicals, municipal and industrial wastes or any other material which impairs or has potential to impair water quality.

6.2 Using an intake pond, lake or specified buffer zones for any activity detrimental to water quality and not permitted in the *Act*.

6.3 Using ice covered water body for transporting logs, riding skidoos/motor vehicles/all-terrain vehicles, leading of animals, or any other activity which impairs or has potential to impair water quality.

6.4 Using or operating existing facilities in such a manner which impairs or has potential to impair water quality.

6.5 Residential development (a sub-division of four or more lots), vehicle maintenance facilities, warehouses, service stations, industries, and chemicals and salt storage depots.

6.6 Storage and disposal of pesticides and manure, application of manure and chemicals in specified buffer zones, extensive land clearing, and peat land drainage without adequate treatment.

6.7 Clear cutting of forest in sensitive areas, establishment of camps and camp facilities, storage of chemicals, application of pesticides, drainage of peat land for afforestation, and application of toxic fire retardants.

6.8 Resorts, hotels/motels, and golf courses.

6.9 Activities, operations or facilities associated with aggregate extraction and mineral exploration such as work camps, vehicle parking and maintenance facilities, washing of aggregates, asphalt plants, discharge or deposit of waste material into a body of water, and significant disturbance to land for mineral exploration purposes.

6.10 Application of herbicides in the right-of-way, and use of chemically treated utility poles and other related structures.

6.11 Aquaculture development and associated activities having potential to impair water quality.

6.12 Processing and manufacturing plants having potential to impair water quality.

6.13 Cemetery, waste disposal facilities, and any other storage or disposal facilities that the Minister considers environmentally unacceptable.\

7.0 ACTIVITIES REGULATED IN A DESIGNATED AREA

In a designated area, no person shall undertake any of the following activities without obtaining prior written approval from the Minister:

7.1 Expansion and upgrading of the existing activities, operations or facilities.

7.2 Construction of residential, commercial, industrial and institutional facilities or any other related activity including land clearing or drainage, construction of access roads, servicing of lands for subsequent use, or extension and upgrading of existing buildings or facilities.

7.3 Development of farm lands for crop production, forage production, vegetable production, and blueberry and other fruit production.

7.4 Forest logging, resource road construction and use, stream crossing for controlled access, preparation of skid trails and landing areas, silvicultural activities, tree farming, and other environmentally acceptable forestry operations.

7.5 Recreational activities or facilities including cottage development, fishing, swimming, boating, hiking, camp grounds, or canoe routes, vacation or other camps, or recreational facilities.

7.6 Mineral exploration related activities and aggregate extraction, or any other construction activity incidental to mining and quarrying including access roads, stream crossings, land drainage with adequate treatment, land clearing and excavation.

7.7 Installation of storm or sanitary sewer pipelines, pipelines for transmission of water for hydroelectric generation, agriculture uses, or any other purposes.

7.8 Construction of roads, bridges, culverts, and other stream crossings, and installation of power and telecommunication transmission lines.

7.9 Modification to intake structures, pumphouse, reservoir, etc. will require approval under Section 11 of *Act*.

7.10 Any other development or activity which, in the opinion of the Minister, has caused impairment or has potential to impair water quality.

8.0 APPROVAL PROCESS

8.1 The proponent shall submit a detailed development plan along with maps, drawings and specifications and other information as required by the Minister for approval.

8.2 The Minister may, on the recommendation of his/her officials, issue a certificate of approval for the proposed development on such terms and conditions as the Minister considers necessary to protect water quality.

8.3 The proponent shall obtain separate approvals from the Minister under Section 11 of the *Act*, for all permanent or temporary stream crossings or for alteration to bodies of water that may be necessary to carry out the approved development.

8.4 The proponent shall also obtain licenses, permits or approvals under other acts and regulations as required prior to commencing the approved work.

8.5 The proponent of the approved development shall notify the municipal authority or the person responsible for the operation and maintenance of the waterworks by providing a copy of the approval issued under this policy before commencing the work.

8.6 The proponent shall maintain adequate liaison and consultation with the person or authority responsible for the operation and maintenance of the waterworks during the implementation and operation of the approved work.

8.7 The Minister may require the inspection of the approved development from time to time by his/her officials to ensure that the development is carried out in an environmentally acceptable manner and the proponent is complying with the terms and conditions of the approval.

8.8 The Minister may require a proponent to monitor water quality according to a monitoring program approved by the Minister in order to evaluate the impact of the approved development on public water supply.

8.9 The Minister encourages the departments and agencies responsible for resource management and affected by this policy to develop environmental protection guidelines for resource utilization in protected water supply areas, for compliance by proponents or developers.

9.0 BUFFER ZONES

9.1 The proponents shall provide the following widths of buffer zones along and around water bodies from the high water mark in a designated area:

Water Body	Width of Buffer Zones
Intake pond or lake	a minimum of 150 metres
River intake	a minimum of 150 metres for a distance of one km

	upstream and 100 m downstream
Main river channel	a minimum of 75 metres
Major tributaries, lakes or ponds	a minimum of 50 metres
Other water bodies	a minimum of 30 metres

9.2 No development activity shall be permitted in buffer zones except those which are intended to promote vegetation.

10.0 RESPONSIBILITIES OF MUNICIPAL AUTHORITY

The municipal authority or person responsible for the operation and maintenance of a waterworks shall:

10.1 Ensure that no development activities are undertaken in a designated area without approval from the Minister.

10.2 Ensure that approved development activities are undertaken in strict compliance with the terms and conditions of the approval.

10.3 Where an approval or this policy is violated, serve a stopping order on the violator after obtaining prior approval from the Minister for stopping any work or operation either permanently or temporarily which is not carried out according to the terms and conditions of the approval and has impaired or has potential to impair water quality.

10.4 Request the Minister for the appointment of a Watershed Monitoring Committee and the development of a watershed management plan, if the designated area is under increasing pressure for multiple development activities.

11.0 CORRECTION OF HARMFUL CONDITIONS

If the quality of water has been impaired by any activity, practice, or action taken deliberately, negligently or accidentally, the Minister may order the proponent

(a) to provide alternate water supply for the affected community for as long as is necessary to restore the existing water supply system;

(b) to restore the water quality to its original condition; or

(c) to take necessary measures including the removal of facilities, undertakings, cabins, etc. and to rehabilitate the affected area at his/her expense in order to rectify the water pollution related problems.

12.0 CERTAIN POWERS OF THE MINISTER

(A) Cancellation of Approval

The Minister may revoke an approval:

12.1 For failure of the proponent of any development or activity to comply with the terms and conditions stipulated in the approval.

12.2 Where the approval was issued in error on the basis of incorrect or incomplete information.

12.3 Where the approved activities or operations are causing or have potential to cause impairment of water quality for reasons not anticipated at the time the approval was issued.

(B) Changing Boundaries

The Minister may change the boundaries of a designated area either to enlarge or reduce its size.

13.0 OFFENCE

A person who undertakes any development or activity in a designated area without prior written approval from the Minister is guilty of an offence under the *Act*.

POLICY FOR TREATED UTILITY POLES IN WATER SUPPLY AREAS

POLICY DIRECTIVE				
Division:	Water Resources Management		P.D.	W.R. 93-01
Prepared By:	Haseen Khan, P.Eng.		Issue Date:	Jan 29, 1993
Approved By:	Martin Goebel	Director	Re-Issue Date:	Jan 17, 2001
Approved By:	Ken Dominie	ADM	Review Date:	
Authorized By:	Paul L. Dean	DM	Superseded:	
	Oliver Langdon	Minister	Cancelled:	

Subject:

Treated utility poles in water supply areas.

1.0 INTRODUCTION

Chemical treatment of wood is a common practice to preserve its structural integrity, extend its lifetime and protect its appearance. The treatment certainly extends the lifetime of wood, but its use may also result in adverse public health and environmental related hazards, especially if the treated wood is not properly used and handled. The degree and extent of hazard will largely depend on location, soil types, climatic conditions and the chemical composition of the wood preservative. The proper use and handling of treated wood is, therefore, extremely important to prevent negative impacts on public health and the environment.

Chemically treated wood has been a preferred building material for many years and its most common uses are in utility poles, railway ties, bridges, dams, retaining walls, guardrails, fences, foundation piling and marine installations. Some of these uses, especially utility poles in water supply areas, have generated increasing level of concern, controversy and debate amongst public, environmental protection agencies and utility companies. Anomalous leaching or dislodging characteristics of wood preservatives, diffusion and solubilizing processes under decreased pH, and the presence of organic

acids, salts and fertilizers in leached water have further aggravated the already existing concern and controversy. The climate and the surface water characteristics (low pH and presence of humic acids) in Newfoundland are a most favourable host environment for leaching of chemicals used in different types of wood preservatives.

In recent years, the use of treated timber utility poles in this province has become an issue of increasing public concern especially in protected water supply areas. Section 10 of the *Environment Act* prohibits all activities in a protected water supply area which have potential to impair water quality. In response to public concern and requests from the utility companies, policy guidelines have been proposed under the provisions of the *Environment Act* for application in protected water supply areas. These guidelines are designed to minimize the adverse impact of treated poles on drinking water quality.

2.0 LEGISLATION

Environment Act, SN1995 c E-13.1, Section 10

3.0 POLICY GUIDELINES

The Department of Environment requires that the following guidelines be followed by all utility companies in this province in order to minimize the risk of water quality impairment and possible impact on public health:

3.1 Existing poles

3.1.1. Existing treated wooden utility poles will be permitted to remain as long as they are not located within the high water mark of the intake pond, or in the case of a river intake, within one kilometre upstream of the intake provided they are not impacting water quality.

3.1.2. Existing treated wooden utility poles which are located within the high water mark shall be replaced with untreated wooden, concrete or steel structures.

3.1.3. The above guidelines shall also apply to anchor boxes used to stabilize poles and/or guy wires.

3.2 New Poles

During the design of any new transmission line, or the placement of any new poles, the following options shall apply in decreasing order of preference:

Option 1. avoid crossing any protected water supply area entirely through re-routing;

Option 2. use untreated wood poles, or steel or concrete structures; or

Option 3. use chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) or copper napthanate (CuNap) pressure treated poles. If this option is approved, poles shall not be placed within the following buffer zones from the high water mark of any body of water:

Body of Water	Width of Buffer Zone
Intake Pond/Lake	150 m
River Intake	150 m for a distance of one km upstream and 100 m
Main River Channel	75 m
Major	50 m
Other bodies of water	30 m

If the poles in question cannot be located outside the above specified buffer zones, then only untreated wood (steel or concrete) poles be used. The above shall also apply to anchor boxes used to stabilize poles and/or guy wires.

4.0 APPROVAL REQUIREMENTS

The utility companies are required to submit a detailed plan for any new transmission line, or the placement of new poles to be located in a water supply area, to this department for approval before undertaking any work. The plan should also include a written letter of consent from the concerned council(s) that they have no objection to the proposed work.

Appendix A

1.0 WOOD PRESERVATIVES

Controlled studies have shown that wood preservation enhances the lifetime of wood by a factor of 5 to 15, depending on the wood species and the efficacy of treatment. It has also been estimated that if wood were not treated with preservation chemicals, timber requirements (in some industrial applications) would increase by three- to six-fold (Konasewich and Henning, 1988).

The value of wood preservation is generally measured in three ways:

1. The preservation of forest resources;

2. The cost effectiveness associated with less frequent utility pole replacement; and

3. Less immediate damage to the environment during replacement of poles and transmission lines.

Unfortunately, long-term environmental and public health hazards associated with the use of treated wood have not been considered in assessing the value of wood preservation.

The wood preservation process deposits or fixes chemicals in the wood, and the toxic nature of the chemicals effectively prevents the attack of living organisms on the wood. The choice of wood preservatives depends upon the character of the wood to be treated, the required service, and the properties of the chemical or formulation. In general, the wood preservation formulations must meet the following requirements:

- be toxic to attacking organisms;
- be able to penetrate wood;
- be chemically stable;
- be safe to handle;

- be economical to use;
- not weaken the structural strength of the wood; and
- not cause significant dimensional changes within the wood.

The chemicals used for wood treatment are generally divided into two major groups: (i) organics - these are oil-born chemical formulations, consisting of an organic preservative dissolved in a suitable petroleum oil carrier and (ii) inorganics - these are water-borne chemical formulations, consisting of inorganic compounds dissolved in a water as a carrier. In Canada, the registered chemicals most often used for wood preservation are:

- PCP (Pentachlorophenol);
- Creosote;
- CCA (Chromated Copper Arsenate); and
- ACA (Ammoniacal Copper Arsenate);

The first two chemicals belong to the organic group and the remaining two to the inorganic group. Other major chemicals used commercially for wood protection in Canada include: Sodium-tetra and pentachlorophenate, copper-8-quinolinolate (Cu-8) and 2-(thio-cyanomethylthio) benzothiazole (TCMTB).

Although other wood preservatives have been used in the past in Canada, the first four chemicals or formulations (PCP, creosote, CCA and ACA) are the only preservatives in use in Canada since 1985 (Konasewich and Henning, 1988). Some of the main characteristics of these preservatives are briefly outlined below:

1.1 Inorganic Wood Preservatives

The most widely used chemcials are CCA and ACA.

CCA

The *"Wolmanized"* branded CCA pressure treated wood products are most popular. *"Wolmanized"* and *"Wolman"* are registered trade marks of Koppers Company, Inc., licenced to many plants in Canada. The components of CCA (copper, chromium, and arsenic) were selected for wood preservation use because of their biocidal properties and their ability to be retained within the wood for long-term protection. The fixation mechanism of CCA within wood is complex and the reactions involved depend on the preservative formulation and concentration, wood species, and temperature (Konasewich and Henning, 1988).

According to producers, the waterborne CCA preservative is permanently fixed in the wood by the full-cell pressure treatment process and soon after treatment, the chemicals are highly leach resistant, non-toxic to human and warm-blooded animals and vegetation if properly used. However, leach resistant and non-toxic characteristics of CCA treated wood is an issue of controversy and debate due to unknown impacts of typical low-level exposure in drinking water on human health.

ACA

Copper and arsenic, two active components of ACA, are used because of their biocidal properties and their ability to be retained by wood for long-term protection. Ammonium hydroxide is used as a solvent carrier for copper arsenate and once the ammonia evaporates from the wood the copper arsenate precipitates in the wood cells. The resultant precipitate is reported to be highly resistant to leaching (Konasewich and Henning, 1988).

There is increasing concern about possible environmental contamination from leaching losses of chromium, copper and arsenic constituents from treated wood. It has been reported that solubilizing and diffusion processes are highly temperature and moisture dependent. Thus, the climatic conditions of an area will have a great effect on leaching losses. The solubility of the fixed CCA and ACA components is also reported to increase with increased acidity (decreased pH) of the leaching water which implies that wood exposed to high rainfall under moderate annual temperature conditions will leach more than wood in colder and drier climates. The presence of other organic acids, such as humic acids and salt content or fertilizers in surface water in significant quantities, has also caused anomalous leaching effects. In most of the cases, losses are highest during the initial years of installation.

1.2 Organic Wood Preservatives

The organic compounds commonly used as wood preservatives include pentachlorophenol and creosote.

PCP

PCP is prepared by reacting chlorine with phenol in the presence of a catalyst at high temperatures. Petroleum oils are used as carriers for PCP. PCP-oil mixtures are used for pressure treatment of wood products, such as telephone and other utility poles, railroad ties, posts and construction timbers. In addition to functioning as a carrier of PCP, the oil also provides

extra protection against moisture-content changes, providing more stability and resistance to splitting (Konasewich and Henning, 1988).

PCP, sold under the trade name Penta, is a registered commercial fungicide and bactericide produced by a few manufacturers worldwide. Commercial preparations of pentachlorophenol contain varying percentages of related chlorophenols such as tetrachlorophenol and a range of chlorinated compounds including dibenzo-P-dioxins and dibenzo-furan micro-contaminants, some of which are highly toxic. There are potentially serious problems associated with dioxin contamination in the chlorinated phenols and creosote. Dioxins accumulate in the food chain, are slow to decay, cause reproductive problems in animals and are suspected of inducing cancer in humans. The most common use of PCP in Canada includes treatment of utility poles and unseasoned lumber.

CREOSOTE

Creosote is one of the oldest types of preservatives used for the protection of wood against all forms of wood destroying agents. Creosote is a distillate of coal tar produced by high temperature carbonization of bituminous coal. Containing over 160 compounds, creosote is primarily composed of liquid and solid aromatic hydrocarbons as well as some tar acids and tar bases which provides protection against destructive insects and organisms. Used in a mixture, creosote is blended with petroleum oil.

Creosotes are traditionally specified by their physical properties (density, water content, distillation intervals, etc.) mainly because their complex chemical composition and variation makes detailed chemical specification almost impossible. Creosote, a commercial product which contains several hundred chemical components, and creosote treated wood are commonly used in marine installations, utility poles, railway ties, bridges, dams, retaining walls, guardrails, fences and foundation pilings. The complex chemical composition of creosote and its widespread use as a building material is of course an issue of serious concern to environmental protection authorities. Leaching and bleeding of creosote, especially in hot weather, is a particular problem noticeable as oil films on affected water bodies and by the odour.

2.0 HAZARDS OF WOOD PRESERVATIVES

Many wood treatment chemicals will leach from treated wood products and may result in both short-term and long-term environmental and human health hazards. The rate of leaching of chemicals and its impact will depend on many factors such as soil, temperature, precipitation,

dosage received and the route of exposure. The possible short and long-term health and environmental effects of chemicals used in wood treatment are listed below:

Chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA)

Although low levels of chromium, copper and arsenic occur naturally in food, they may be dangerous at higher concentrations. The known effects of CCA and ACA include skin irritation and nausea from short-term exposure and death may occur following ingestion. Liver and kidney damage can arise from long-term exposure.

The environmental effects of copper, chromium and arsenic have been studied and it has been shown that in aquatic systems chromium is toxic to species of Daphnia and is accumulated in marine oysters; arsenic causes toxic symptoms in algae and in Daphnia; and copper has been found to be extremely harmful causing lethal effects to various organisms at very low concentration levels (0.08 mg/L). It is also suggested that leachate from wood preserved with arsenic, chromium and copper compounds in aquatic systems is toxic to algae and zooplankton and may pose a hazard to humans.

The above reported public health and environment related hazards of CCA treated wood are not proven, however, because there are not enough available data about the effects of these chemicals in the form or combination in which they occur in the arsenical wood treatment mixes.

Pentachlorophenol and chlorophenates

Short-term exposure through dermal contact and inhalation can result in skin, eye and upper respiratory system irritation; long-term exposure of a similar nature can cause weight loss and damage to internal organs and the nervous system. Long-term ingestion can be fatal to human health. Pentachlorophenol, tetrachlorophenol and their salts are readily absorbed by ingestion, inhalation or skin contact. The higher chlorinated phenols are only slightly soluble in water, but the sodium salts of these compounds, as used in wood protection, are highly soluble in water.

It has been reported that pentachlorophenols or tetrachlorophenols or their salts are potentially fetotoxic and carcinogenic products. Animal studies have shown that penta and tetrachlorophenols can cause birth defects or other adverse effects in the offspring of laboratory animals. They also adversely affect fish reproduction and growth and are persistent in the environment. However, similar types of data on humans are not available.

Creosote

A coal derivative and carcinogen in laboratory animals, creosote can cause skin and eye irritation, sweating, nausea and subsequent convulsions or coma from repeated or prolonged contact, and if ingested in high concentrations, death.

Creosote has been reported to cause cancer in laboratory animals and has also been associated with skin cancer in some workers occupationally exposed to creosote. No consistent data on low level exposure effects to humans are available.

Creosote contains phenolic compounds. Phenols in water are known to cause bad taste in fish for human consumption at concentrations of 1-10 mg/L. Effects on drinking waters which is chlorinated are also evident even at a concentration around 0.001 mg phenol per litre. Some chemicals in creosote, such as the tar acids and the napthalenes, are biodegradable and will soon be decomposed and assimilated by microflora. Other fractions of creosote, including fluorine, chrysene and pyrene, are biodegraded very slowly. The harmful effects of these compounds on a natural microflora in soil close to treated poles are therefore likely to last for a longer period of time.

3.0 WATER QUALITY GUIDELINES

The inorganic elements and chemical compounds used in the formulation of wood preservatives are toxic carcinogenic and mutagenic in nature and reported to cause serious problems to our ecosystem if their concentration levels exceed the maximum permissible levels recommended by health and environmental protection agencies. Some of these inorganic elements, such as chromium and copper, are found naturally in the environment at various back-ground levels. Other elements, such as arsenic and ammonia, while also natural, are typically found in the environment only in the presence of other key elements or compounds. In both cases, background levels of these parameters are usually very low or undetectable, and elevated levels, if detected, are generally associated with anthropogenic sources. Weathering and leaching of soils and rocks and leaching from treated timber utility poles, retaining walls, foundation piling, etc. are some of the natural and anthropogenic sources responsible for increased levels of these chemicals in our environment. Among organic chemicals, benzo (a) pyrene and phenols are components and by-products of many hydrocarbons and could, therefore, be detected in the environment but pentachlorophenol and others are not natural compounds and their concentration levels in the environment should normally be undetectable.

Considering the toxic carcinogenic and mutagenic nature of the aforementioned inorganic elements and organic compounds and their adverse impacts on our ecosystem, every effort must be made to prevent the man-made addition of such chemicals into our drinking water sources. The maximum permissible levels recommended by Health and Welfare Canada and Canadian Drinking Water Quality Guidelines for major components of wood preservatives are presented below:

PRESERVATIVE	MAJOR COMPONENTS	LIMIT	REFERENCE
CCA	Chromium	0.05 mg/l	a
	Copper	# 1.0 mg/l	a
	Arsenic	0.05 mg/l	a
ACA	Ammonia	< 0.1 mg/l (N)	b
	Copper	# 1.0 mg/l	a
	Arsenic	0.05 mg/l	a
PCP	Pentachlorophenol	# 0.03 mg/l	a
CREOSOTE	Benzo(a)pyrene	0.01 µg/l	a
	Phenols	< 2.0 µg/l	b

a: Health and Welfare Canada, 1989

b: Canadian Council of Resource and Environment Ministers, 1987

Our drinking water supply sources must not exceed the above recommended maximum permissible levels.

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GUIDELINES FOR THE USE OF WATER BOMBERS IN PROTECTED PUBLIC WATER SUPPLY AREAS

Department of Environment and Conservation, Water Resources Management Division

Department of Natural Resources, Forestry Branch

Department of Transportation and Works, Air Services Division

March 30, 2006

1. The use of the term AWater Bomber(s)@ will be used generally to refer to all types of aircraft (including helicopters using water buckets) that may be employed to fight forest fires in Protected Public Water Supply Areas.

2. With the exception of Gander Lake, all Protected Public Water Supply Areas will be considered AOff Limits@ for practice water bombing. Given the size and volume of Gander Lake, and the fact that it has traditionally been used as the Provincial practice area due to its ice free spring conditions and proximity to the base of operations at Gander Airport, it is agreed that a minimum 1000 meter ANo Water Pickup@ buffer be maintained around the water supply intake for the Town of Gander and the water supply intake for the Towns of Glenwood and Appleton (The Outflow - Gander River).

3. During a practice session, based upon the composition and toxicological information supplied for the two fire fighting foam products currently being used (***FIRE-TROL FireFoam 104*** and ***PHOS-CHEC WD-881C Class A Foam Concentrate***), neither product should, under any circumstances be intentionally released in a Protected Public Water Supply Area due to the potential for water quality impairment.

4. During a practice session sea water should not be intentionally released in a Protected Public Water Supply Area due to the potential for water quality impairment.

5. During active forest fire fighting, all ponds and lakes in a Protected Public Water Supply Area, with the exception of the intake pond/lake may be used without restriction for AWater Pickup@. With the exception of Gander Lake, all other intake ponds/lakes shall be considered as ANo Water Pickup@ zones. In accordance with Item 2 above, a minimum 1000 meter ANo Water Pickup@ buffer shall be maintained around the water supply intake for the Town of Gander and the water supply intake for the Towns of Glenwood and Appleton (The Outflow - Gander River). Refer also to Item 10 below.

6. If Forestry or Air Services staff identify other large intake ponds/lakes, in areas where no reasonably close alternative water body is available, Water Resources Management Division may agree to these exceptions outside a 1000 meter ANo Water Pickup@ buffer around the intake. Intake ponds/lakes with a major axis length of less than 1000 meters shall not be used for AWater Pickup@ under any circumstances.

7. During active forest fire fighting within a Protected Public Water Supply Area, at the sole discretion of the water bomber pilot, or in consultation with the fire boss, it shall be determine if the eminent risk of the forest fire warrants the use of fire fighting foam and/or sea water. Given the potential for impairment of the drinking water quality, foam and sea water should only be used as a last resort, this being particularly important in proximity to the intake pond/lake and smaller sensitive water supply areas. Use of foam and sea water in remote areas of larger water supply areas poses less immediate risk to drinking water quality.

8. In the event that foam, sea water, fuel, hydraulic oil, or lubricant is intentionally or unintentionally released, or if a water bomber goes down or experiences mechanical failure in a Protected Public Water Supply Area, the incident must be reported immediately by the Department of Natural Resources to the appropriate regional Watershed Management Specialist, who will determine if additional follow-up or water quality monitoring is warranted.

9. Water Resources Management Division will identify all Protected Public Water Supply Areas, intake ponds or lakes and any other sensitive areas where AWater Pickup@ is not permitted. These areas will be identified on the Water Resources Management Division GIS layer as AWater Bomber Exclusions@.

10. Prior to each fire season, Forestry officials should consult Water Resources Management Division GIS layers for latest Protected Public Water Supply Area updates. All Protected Public Water Supply Areas and ANo Water Pickup@ zones must be identified on mapping that is made available to dispatchers, pilots and fire crews at all units.

11. Additions and changes to Protected Public Water Supply Areas, or amendments to the ANo Water Pickup@ zones will be communicated by Water Resources Management Division to appropriate Forestry officials and will be updated as appropriate on the Water Resources Management Division GIS layers.

12. During active forest fire fighting, based upon the mapping information made available to Forestry, Protected Public Water Supply Areas and ANo Water Pickup@ zones can be identified by the dispatcher or fire boss and relayed to the water bomber pilots.

13. At any time, particularly during large forest fires, fires near communities or fires within Protected Public Water Supply Areas, the appropriate regional Watershed Management Specialist, may be consulted with respect to relaxing the ANo Water Pickup@ zones, or any other aspect related to the fire and its potential impact on drinking water quality.

APPENDIX I – APPLICATION FOR A PERMIT FOR A DEVELOPMENT ACTIVITY IN A PROTECTED PUBLIC WATER SUPPLY AREA

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

DEPARTMENT OF ENVIRONMENT

APPLICATION FOR A PERMIT FOR A DEVELOPMENT ACTIVITY IN APROTECTED PUBLIC WATER SUPPLY AREA

As per requirements under **Section 39(6)**of the *Water Resources Act,* SNL 2002 cW-4.01, and Ministerial Policy Directive W.R.95-01 permission is requested to carry out a development* activity in a protected public water supply area.

(1) State the name of the Protected Public Water Supply Area. _____

_____

State the name of the city/town/LSD or operator of the water supply.

_____

(2) **PROPOSED ACTIVITY:** Select the activity to be undertaken:

Forestry	Aggregate Extraction
Mineral Exploration	Recreational Facility
Agricultural Operation	Linear Development

Other_____

Provide specific details on the above activity _____

(3) **LOCATION:** Plot the exact location of your proposed activity on a 1:50,000 scale map.

If available, provide the following: NAD _____ Zone _____

N _____ E _____

* Development means the carrying out of any activity or operations on, over, or under land or water for social or economic benefits, or the making of any change in the use or the intensity of use of any land, water, building or premises.

(4) **ACCESS ROUTES:** On the largest scale available map indicate the exact access route(s) which will be used in order to carry out the proposed activity.

Existing Proposed

(5) **SIZE AND VOLUME:** Indicate the size of the operation and the estimated volume of material to be removed (if applicable).

Size (ha) _____ Volume (m3)_____

(6) **STREAM CROSSING / ALTERATION TO A BODY OF WATER:** If the proposal involves a stream crossing or any other development within 15 metres of a body of water, additional approval may be required under Section 48. Indicate the location of all stream crossings and development within 15 metres of a body of water on the largest scale available map. Describe the type of stream crossings and development proposed, and measures to control erosion and prevent sedimentation. You will be contacted if we require additional information.

_____

_____

(7) **PROJECT DESCRIPTION AND SCHEDULE:** Please provide a brief description of all aspects of the proposed development activity including information on the justification for the project, site preparation work, the equipment to be used, the method of construction and a tentative schedule of the proposed work.

(8) **SITE DRAINAGE:** If the proposed operation requires site drainage work, please describe the nature of drainage work and outline in detail the measures to control erosion and prevent siltation/sedimentation.

(9) **FUEL STORAGE AND HANDLING:** Please provide information on fuel storage and handling to minimize the risk of accidental spills and leaks. Outline contingency plans to contain oil spill or leak. **Bulk fuel storage is not permitted in a protected water supply area.**

(10) **WASTE DISPOSAL:** Outline briefly how waste materials associated with the project will be handled and disposed of. Plans for human waste disposal should also be provided if applicable.

_____

_____

_____

(11) **ENVIRONMENTAL PROTECTION MEASURES:** Outline briefly the proposed environmental protection measures to minimize adverse impacts on water quality.

_____

_____

_____

(13) **SITE CLOSURE, RESTORATION AND REHABILITATION:** If applicable, outline briefly the proposed measures for site closure, restoration and rehabilitation.

_____

_____

_____

_____

(14) **APPLICANT INFORMATION:**

Name: _____

Mailing address: _____

_____

_____

Phone #: _____

Fax #: _____

Signature of Applicant: _____

Date: _____

This information must be forwarded to the appropriate regional office of the Department of Environment. Written permission must be obtained from this Department prior to the commencement of any work.

Eastern Region

Department of Environment
Water Resources Management Division
PO Box 8700
St. John's NL A1B 4J6
Tel: (709) 729-2603
Tel: (709) 729-2535
Fax: (709) 729-0320

Central Region

Department of Environment
Water Resources Management Division
Provincial Building
Grand Falls - Windsor NL A2A 1W9
Tel: (709) 292-4280
Fax: (709) 292-4365

Western Region

Department of Environment
Water Resources Management Division
Brookfield Building
PO Box 2006
Corner Brook NL A2H 6J8
Tel: (709) 637-2431
Fax: (709) 637-2541

APPENDIX J- SECTION 180 (1)-CITY OF CORNER BROOK ACT (1990)

Water and sewage systems

180. (1) The council may, subject to the *Water Resources Act* and regulations made under that Act, construct, acquire, establish, own and operate

(a) a public water supply system for the distribution of water within or, with the approval of the minister, outside of the city;

(b) a public sewage system, either independently of or in conjunction with a public water supply system, for the collection and disposal of sewage within or, with the approval of the minister, outside of the city; and

(c) a storm drainage system within or, with the approval of the minister, outside of the city.

(2) The powers, rights, duties and obligations of the Water and Sewerage Corporation of Greater Corner Brook and the system and all other assets of the corporation vested in and assumed by the council continue to be so vested and assumed.

(3) For the purposes of subsection (1) the council may

(a) acquire waters required for the purpose of providing a sufficient supply of water for the city; and

(b) acquire by purchase or expropriation lands adjacent to the waters to prevent pollution of those waters.

(4) For the purpose of exercising its powers under subsection (1) the council may lay out, excavate, dig, make, build, maintain, repair and improve all the drains, sewers, and water supply pipes that the council considers necessary.

1985 c15 s183; 2002 cW-4.01 s96

APPENDIX K- THOMAS RESOURCES MINERAL CLAIM DETAILS

Mineral Rights Inquiry Report

Monday, January 05, 2009

Last Updated:	2008/10/09		
Licence Number:	008139M		
File Number:	774:4349		
Original Holder:	Mercer, Max		
Licence Holder:	Thomas Resources Inc.		
Address:	P.O. Box 1429 Bay Roberts, NL Canada, A0A 1G0		
Licence Status:	Issued (Extended 2006/07/30)		
Location:	Corner Brook Lake,Western Nfld		
Electoral Dist.:	10 Humber West		
Recorded Date:	2001/06/27		
Issuance Date:	2001/07/30		
Renewal Date:	2011/07/30		
Report Due Date:	2009/09/28		
Org. No. Claims:	29.0000		
Cur. No. Claims:	29.0000		
Recording Fee:	$290.00		
Receipt(s):	013995	(2001/06/27)	$290.00
Deposit Amount:	$0.00		
Deposit:	No related security deposit receipt		
Map Sheet No(s):	12A/13		

Comments:

Reg13;Genuine prospector. Year 1 work report consists of a review of refractory mineral end uses, prospecting and sample beneficiation (missing). Year 1 supplementary work report consists of an exploration and development proposal; expenses preliminary (GN) - Condition 6b (50% credit, late filing) applied, $2400 added 2003.05.08 (GN). Reviewed and accepted 2004.07.08 (PS). Year 2 work report consists of geological mapping (synthesis only, no data). Reviewed and accepted 2004.07.08 (PS). Year 2 supplementary work report consists of a listing of previous work, the geology and structure, sampling (rock) and petrography; $8011.06 added 2003.11.06 (JH). Reviewed and data requested 2004.07.08 (PS). Data received, reviewed and accepted 2005.07.28 (PS). Year 3 report consists of mini bulk sampling (rock) and road upgrade. Reviewed and accepted

2004.07.08 (PS). Year 4 report consists of trenching, rock sampling and processing, and petrography. Expenses preliminary. Additional data (sample testing) received 2009.09.28 - $4,600.00 added (PS). Additional data (garnet extraction) received 2005.10.03 - $290.38 added (PS). Additional data (petrography) received 2005.10.07 - $204.50 added (PS). Reviewed and accepted 2005.12.02 (PS). Year 7 work report consists of crushing, washing and specific gravity testing. Report reviewed, digital data requested 2008/10/03. Data received and report accepted 2008/10/09 (AM).

Mapped Claim Description:

Beginning at the northeast corner of the herein described parcel of land and said corner having U.T.M. coordinates of 5 411 000 N; 440 000 E; of zone 21, thence south 2000 metres, thence west 1000 metres, thence north 1000 metres, thence west 500 metres, thence north 1500 metres, thence west 500 metres, thence north 3500 metres, thence east 1000 metres, thence south 2000 metres, thence east 500 metres, thence south 2000 metres, thence east 500 metres to the point of beginning. All bearings are referred to the U.T.M. grid, Zone 21. NAD 27.

Land Claims (effective 2005/12/01):

LISA: 0.00% LIL: 0.00% VBP: 0.00% Crown: 100.00%

Extensions:

Year	Date	Fee	Receipt Number	Receipt Date	Receipt Amount
5	2006/07/30	$725.00	008560	2006/05/25	$725.00

Work Reports:

Year	Receive Date	Acceptance Date	Actual Expenditure	Claims	Security Deposit	C2 Status
1	2002/03/06	2002/10/07	$8,435.00	29.0000		
2	2003/06/19	2005/07/28	$23,843.63	29.0000		
3	2004/01/12	2004/07/08	$14,540.23	29.0000		
4	2005/09/27	2005/12/02	$24,563.96	29.0000		
5	2006/09/29		$0.00	29.0000		
6	2007/09/28		$0.00	29.0000		
7	2008/08/25	2008/10/09	$9,640.68	29.0000		

$14,676.50 to be expended on this license by 2009/07/30

Licence Transfers:

New Holder	Transfer Date	Fee	Receipt Number	Receipt Date	Volume/Folio

Thomas Resources Inc.	2002/05/17	$10.00	20/148

Partial Surrenders: None

This Licence replaces Licence Number(s): None

This Licence is replaced by Licence Number(s): None

Work Report Descriptions:

Year	GS File No.	Description
1	012A/13/0929	
1	012A/13/1023	Supplementary.
2	012A/13/1044	
2	012A/13/1079	Supplementary
3	012A/13/1093	
4	012A/13/1212	
7	012A/13/1343	

Detailed breakdown of projected required expenditure:

Actual Year	Actual Expenditure	Work Year	Excess Expenditure	Claims
1	$8,435.00			
		1	$2,635.00	29.0000
2	$23,843.63			
		2	$19,228.63	29.0000
		3	$10,528.63	29.0000
		4	$378.63	29.0000
3	$14,540.23			
		5	$3,318.86	29.0000
4	$24,563.96			
		6	$10,482.82	29.0000
5	$0.00			
6	$0.00			
7	$9,640.68			
		7	$2,723.50	29.0000
		8	-$14,676.50	29.0000

APPENDIX L- ENVIRONMENTAL GUIDELINES FOR CONSTRUCTION AND MINERAL EXPLORATION COMPANIES

Enviromental Guidelines for Construction and Mineral Exploration Companies

PREFACE

The following guidelines were prepared to assist construction contractors and mineral exploration companies to carry out their activities so that the least damage to the environment results. The first four sections are aimed primarily at construction contractors who may be building linear facilities such as access roads, but m ay also be of use to mineral exploration companies. Sections 5 to 8 are applicable to both mineral exploration companies and construction companies, while sections 9 to 11 deal specifically with mineral exploration issues such as drilling and trenching. The guidelines presented here are not legally binding; they simply represent good practices that should be followed by construction and mineral exploration companies, although failure to follow these guidelines could result in situations for which legal action could be taken. They are based on current construction practices and should not be regarded as the last word in environmental protection. Under unusual conditions, impacts not covered in these guidelines may occur. Throughout the text, there are other sources and guidelines mentioned. If a procedure is not completely covered, these other publications should be consulted for further details. There are several acts and statutes which may govern certain aspects of mineral exploration. Approval may be required from various agencies depending on the location and nature of the exploration program.

Most of these agencies are mentioned in the guidelines; however, the responsibility for obtaining approval rests with the proponent.

CLEARING AND TIMBER SALVAGE

Planning should include mitigative measures to minimize the number of stream crossings and promote cut-and-fill operations to minimize borrowing operations outside of the right-of-way, buffer zones, etc. Once planning has been completed, all required permits and approvals obtained, and the route flagged, the first step in construction will normally be clearing. The importance of this phase will depend on the type of road being constructed and the nature of the existing vegetation. If an existing right-of-way is being used, clearing may be minimal or not required at all.

WHERE TO CLEAR

Clearing should be carried out only along the approved right-of-way. Trails need only to be cleared to the width of the vehicles travelling the road. Haul roads may require a single lane supplemented by turnouts or a right-of-way wide enough to handle traffic in two directions. In all cases individual farms, regional pastures, blueberry management units, silviculture plots and plant quarantine areas should be avoided. Buffers from 15 to 150 metres must be left along bodies of water for both erosion protection and aesthetic reasons. The width of the buffer zone will depend on soil characteristics (clay rich soil is more susceptible to solifluction), the steepness of the slope leading to bodies of water and the type of road construction. A recommended formula for determining buffer zone width is:

12 metres + 1.5 metres x slope (%)

The following buffer zones must be maintained around protected water supply areas:

Body of Water Width of Buffer Zone

Intake Pond/Lake 150 metres

River Intake 150 metres for a distance of 1 kilometre upstream and 100 metres downstream

Main River Channel 75 metres

Main Tributaries/lakes/ponds 50 metres

Other bodies of water 30 metres

In addition, no clearing activity is to occur within 800 metres of a bald eagle or osprey nest during the nesting season (May 15 to July 31) and 200 metres outside the nesting season. All hardwoods within 30 metres of a body of water occupied by a beaver are to be left standing. For known waterfowl staging areas, a minimum 30 metre buffer from the water's edge with at least 20 metres of forest will be established. These areas will be identified by the Canadian Wildlife Service.

HOW TO CLEAR

Clearing by axe, saw, bulldozer, etc. should be carried out in a manner that will minimize surface disturbance and prevent erosion. Ground vegetation loss should be kept to a minimum and low ground shrubs should be preserved along the right-of-way. This vegetation preserves soil stability and acts as a sediment filter near waterways.

Trees should be felled onto the right-of-way to minimize disturbance to the adjoining forest. Trees should always be felled away from watercourses. A watercourse is defined to include: a. any pond, lake, river, stream, brook, creek or marsh that visibly feeds into a water system; or b. any pond greater than 0.25 hectares in area Debris and brush should not be disposed of within 30 metres of the high water mark of any watercourse or body of water. Care should be taken to ensure that leaners are not left along the right-of-way. Leaners are trees that have been partially knocked over during clearing, but which are left leaning over the right-of-way or hanging in the surrounding forest. Sensitive slopes, unstable soils and water crossings require special clearing procedures - hand clearing instead of machine clearing - to prevent surface disturbance and reduce erosion. Merchantable timber should be cut, trimmed and piled along the right-of-way. A Timber Cutting Permit, obtained from the Department of Forest Resources and Agrifoods, is required. Specific conditions included with the permit are: (1) no cutting within 100 metres of the centerline of a public highway; (2) no cutting within 15 metres of any stream or body of water; (3) the holder of a permit shall not deposit any trees, logs, slash or other logging debris likely to cause pollution in or when frozen on any stream or body of water; and (4) the permit holder shall not operate in or disturb streams or waterways with skidders or other logging equipment unless written permission has been obtained from the Provincial Department of Environment and Labour and the Federal Department of Fisheries and Oceans. Tops and limbs (brush) can be lopped and scattered, windrowed along the sides of the right-of-way or piled for burning. A Burning Permit can be obtained from a local Department of Forest Resources and Agrifoods office. When crossing bogs and wet areas, brush may be spread on the right-of-way before fill is dumped.

STRIPPING AND STOCKPILING

Stripping involves the removal of topsoil and overburden before the construction of the road or facilities. The material that should be stripped is that portion of the soil with the majority of plant roots. This is usually the top 15 to 40 centimetres. Stripping should be done in 2 stages:

1. removal of the organic layer (top soil);
2. removal of the inorganic layer (overburden).

Topsoil and organics must be stockpiled separately from the rest of the overburden for later revegetation purposes and to prevent mixing. All stockpiles must be easily accessible, on well drained ground, away from bodies of water (minimum of 50 metres) and standing timber. A working space of at least 5 metres around stockpiles is recommended. Topsoil and organics should be stored in low (1-2 metre high) stable

piles to decrease compaction effects, and if they are to be stored for extended periods, they should be vegetated to minimize nutrient loss, erosion of fines and structure change.

QUARRIES AND BORROW AREAS PLANNING

Advanced planning by a qualified person, engineer/geoscientist, is essential for a pit operation to run smoothly. The operator must know the type and quantity of material required and where to get it. There should be an understanding of how to search for a new location of aggregate material and why some sources cannot be excavated because of such factors as local drainage patterns, important wildlife areas, present and planned parks and reserves etc. An existing pit should be used if it can meet the requirements. Numerous pits in a small area are unsightly and harmful to the environment.

A Quarry Permit from the Department of Mines and Energy is required to develop a quarry or borrow pit and it contains several specific conditions which must be followed. These include: (1) no quarrying within 50 metres of any roadway, body of water or watercourse; (2) no quarrying within 300 metres of any residential development without the permission of the Minister in writing; (3) no quarrying within 90 metres
of the centerline of Protected Road Zone Areas; (4) no quarrying within 15 metres of private property unless prior written consent of the owner is obtained and a copy of this consent forwarded to the Department of Mines and Energy; and (5) the permit holder shall leave tree screens where they exist between the workings and adjacent roads, highways or other land uses or earthen berms shall be constructed to screen the operation.

DESIGN

To develop a pit in an orderly and efficient manner, it must first be well designed. Remember that boundary edges (which should be flagged) are the absolute limits of the excavation - all work including stockpiling and restoration must take place within these limits. Therefore, a well designed pit will allow for:

- controlled access in and out of the pit;
- work ing space in which to m ove equipment;
- storage areas for stockpiling topsoil and overburden separately;
- space to form a final grade;
- visual screening;

- dust control by washing, etc. when required; and
- space for an acceptable settling pond system(s) to remove suspended solids from any water used.

The best protection that can be given to the environment is to limit the amount of land disturbed. Staking and flagging the boundary is an important first step in containing work activities. Any slash generated from the clearing phase should be placed in a com pact windrow at least 5 m etres away from standing timber. All organics and topsoil must be stripped from the cleared area and saved for restoration purposes. It must be piled in its own separate location and must not be mixed with the overburden. Ample working space should be left behind the pile to allow equipment to re-spread the material at the restoration stage. Excavated material should be stockpiled on well drained ground and a minimum 50 metres away from waterbodies. Open pits should be visually screened if possible. Ideally, the pit should be developed on the downhill side of the road where it is completely concealed from view. Visual screening can be done in a well vegetated area by leaving a buffer strip of a variety of natural vegetation including trees between the road and the pit by doglegging the access to the pit area. If a pit is near a watercourse or a body of water, a 50 metre wide buffer zone of natural vegetation including trees is required, as the natural vegetation serves to filter runoff and protect fish. The pit access road should also be screened from highways. During operations, it is essential that the pit site not be used as a disposal place for oil, oil cans, fuel containers, etc. When engine oil is changed, the spent oil must be completely contained and either removed to an approved waste disposal site or delivered to a reprocessing facility so it does not pollute the soil or water or destroy vegetation. If oil changes have to be carried out in pit, an oil absorbent should be used and removed to an approved waste disposal site. In no case shall oil changes, lubrication and repair of vehicles be carried out within 100 metres of any body of water - Federal Department of Fisheries and Oceans.

RESTORATION

Regardless of location or size, all pits must be restored before abandonment. Restoration steps to be taken before abandonment are:

- clean up;
- drainage and erosion control;
- recontouring;
- overburden replacement;
- revegetation.

Although the pit and surrounding areas should be kept as clean as possible throughout the operation, any garbage or debris must be completely disposed of at an approved waste disposal site prior to pit abandonment. When revegetation is required, adequate drainage control measures must be taken. These might include:

1. constructing a berm at the top of the slope to stop water from running into the pit;
2. laying brush and slash across the slope to slow run-off and hold back sediment; and
3. directing run-off away from the pit by cutting drainage ditches or pumping.

When the pit is totally abandoned, the slopes of the pit should be graded to a suitable angle of repose no steeper than two horizontal to one vertical (2:1). The final shape of the pit should blend into the natural contour of the land. If pit walls cannot be graded to the suitable angle of repose (2:1), the recontoured slope should be gently stepped to help reduce erosion. All overburden removed and stockpiled when the pit was opened up must be spread evenly over the pit floor and the recontoured side walls. If the pit was designed properly, there should have been a space left between the overburden stockpile and the surrounding forest so that equipment can easily get behind the overburden to push it down into the pit. The topsoil stored/salvaged, if any, when the pit was opened, must now be spread over the overburden. The topsoil contains seeds and organic material that will help vegetation regrow. Without any topsoil, natural revegetation is a much slower process. Once the pit has been recontoured and any overburden and topsoil have been replaced, one of the following decisions must be made in consultation with the Department of Environment and Labour keeping in mind the final land use and factors such as climate, type of surface and its moisture holding capabilities:

1. allow natural revegetation with no assistance;
2. allow natural revegetation with some assistance; or
3. completely assist revegetation.

Generally, the best guide is to undertake a revegetation method that encourages a return to conditions as
close as possible to those that existed before operations commenced.

STREAM CROSSINGS

Any stream crossing has the potential to alter the existing natural flow regime for the entire range of low to high flow conditions and to impact on fish habitat. The alteration of natural stream flow, if carried out improperly, can result in many types of serious problems such as flooding, dewatering, reduced ability of the stream to ameliorate natural sedimentation and alteration of

fish habitat, etc. Improperly installed watercourse crossings can result in extensive loss and dam age to property, danger to human life, barriers to fish migration, as well as environmental damage. W hen crossing a stream, there are four environmental goals:

1. the prevention of bank erosion and sedimentation into the stream;
2. the protection of fisheries and wildlife habitat in and along the stream;
3. the preservation of water quality and its physical characteristics; and
4. the prevention of flooding and water diversion.

Proposed stream alterations require approval from the Water Resources Division, Provincial Department of Environment and Labour and the Federal Department of Fisheries and Oceans, i.e. Authorization for Works or Undertakings Affecting Fish Habitat.

In planning linear facilities such as roads, pipelines or transmission lines which require crossing of watercourses, consideration should be given to route selection and corridor location in order to mitigate the impact of the development on water resources. In selecting a crossing site, it is important to examine the physical characteristics of the watercourse and its drainage basin, and to identify the site with the best features and conditions for a crossing. The following points should be kept in mind: Select gentle approaches, whether naturally occurring or constructed. If construction of approaches is necessary, coarse-grained material should be used. Avoid cutting stream banks as this results in stream sedimentation.

Avoid using any machinery in streams. Rubber-tired or broad-tracked vehicles working from streambanks are preferable. Minimize or eliminate in-stream activities as these can stir up sediment, restrict stream flow, impact upon fish and fish habitat, injure or kill beaver and muskrat, disturb nesting waterfowl and divert the course of a stream. If in-stream activities are necessary and unavoidable, rubber tired vehicles should be used and the work should be scheduled between June 1 and September 30 to minimize the effect upon the incubation, hatching and survival of juvenile fish. Prevent the deposition of debris, soil and organic material in the stream. Do not fill an intermittent stream channel or gully with soil to serve as a crossing. Streams can be crossed by creating a ford, by installing a culvert or by constructing a bridge.

FORDS

Carefully selected stream fording sites will serve to minimize the impact to fish and fish habitat provided traffic volume is low. When choosing a fording location, a site with stable bed material such as natural bedrock is preferable. Otherwise, the ford area should be stabilized with coarse material. All vehicles using the site should be mechanically sound and free of mud, and should

approach the watercourse at right angles. If any right-of-way clearing is needed in the stream buffer zone, it should be done by hand and all slash and debris kept from entering the watercourse. Further guidelines can be found in the document "Environmental Guidelines for Fording", by Water Resources Division, Water Investigations Branch, Provincial Department of Environment and Labour. This document is also available from the Federal Department of Fisheries and Oceans.

CULVERTS

On many access roads, culverts are the most common method of crossing smaller streams. They must be installed in such a manner that disruption to the stream bed and stream flow is minimized and fish passage is not obstructed. The culvert should be designed to adequately contain peak flow s and should always maintain the original velocity and direction of streamflow. They should also be of sufficient length to extend a short distance beyond the toe of the fill material and should be protected by rip-rap to prevent blockage of the culvert ends by erosion.
Specific guidelines on culvert design and placement can be found in the publication "Resource Road Construction; Fish Habitat Protection Guidelines" by McCubbin, Case, Rowe and Scruton 1990.

BRIDGES

Larger, faster-flowing streams m ay require the construction of a bridge in order to cross them. It is environmentally desirable, even on small streams, to construct bridges instead of other alternatives such as culverts because only bridges can avoid the alteration of flow regimes. Such problems as flooding, erosion and siltation are avoided through the use of properly designed and constructed bridges. Bridges are recommended for all watercourses supporting fish because there is no need to disturb the streambed and sufficient capacity will ensure that flow velocities are kept to a level where fish passage is maintained. Bridges are also recommended where the natural channel is too steep to accommodte maximum culvert slopes, or where steep banks would necessitate a great deal of infilling if culverts were used. The completed bridge should safely accommodate reasonably predictable levels of flow and ice buildup, as well as the forces of moving water and ice on the structure, without causing any adverse environmental impact at the crossing or in upstream or downstream areas. Further guidelines can be found in the document "Environment Guidelines for Bridges", by Water Resources Division, Water Investigations Section, Department of Environment and Labour, 1989.

MARSHALLING YARDS / LAYDOWN AREAS

Site selection is an important aspect of locating marshalling yards, laydown areas and equipment storage areas. The site should be of low value with respect to its potential for other uses when compared to other lands in the area. Abandoned gravel pits, abandoned commercial enterprises, or other previously disturbed areas are preferred locations. The site should be located to minimize potential traffic hazards.

Incoming and outgoing vehicles should be able to merge safely with other traffic. If no previously disturbed site can be utilized, then an area could be cleared and stripped, providing all organic material and topsoil is stockpiled in a separate, accessible location for future rehabilitation purposes. An adequate buffer zone of at least 30 metres should be maintained between the yard or laydown area and the nearest body of water. Marshalling yards/laydown areas are not permitted within protected water supply areas.

TEMPORARY CAMPS

From an environmental standpoint, selection of an acceptable location for a camp site is of paramount importance and proper planning will reduce the need for future mitigation. The location of the first camp is often the site of all later camps. A Licence of Occupation is required for the purpose of road construction and temporary work camps (Department of Government Services and Lands). Some variables to consider when selecting a campsite are slope, wind exposure, available area, water supply, drainage conditions and access. Available area is a major consideration. Leave enough room so the original camp can form the nucleus from which larger camps grow. When more facilities are needed, all operational and environmental protection measures are simplified if the camp can be expanded, rather than opening a new camp. A flat site facilitates camp construction. When a sloping site must be used, choose slopes facing south or west. These are the warmest and driest locations. Slopes that face north or east are cooler and wetter. Camps should be located on previously cleared sites or areas where other land use possibilities are low. Keeping excavation to a minimum will pay dividends later by reducing restoration costs and problems when work ends. Campsites should be sheltered from strong winds; crew comfort and aircraft safety being the chief reasons. Gusty winds can cause serious problems for aircraft. When camps cannot be located on dry ground, the area should be drained by shallow (30 + centimeter)

trenches/drains to create a dry site. On slopes with substantial near-surface water flows (common on north-facing slopes), it will be difficult to keep the camp dry; these areas should be avoided. Flat but wet areas may be dried by clearing and leveling the area and then letting natural drainage remove excess water. This is the process of surface discharge of water from an area by streamflow and sheet flow and the removal of excess water from soil by downward flow. Clearing the area and building a dry elevated gravel pad is more likely to be successful. In either case, organic matter and topsoil removed from the site should be used later for site restoration. Boardwalks between buildings may be desirable in areas that drain slowly. Besides making camp life more pleasant boardwalks reduce trampling of in-camp vegetation.Access is a major factor in camp location. W here access is overland, camps must be located adjacent to the road. When camps rely on helicopters there must be room to build a helipad nearby. Access to the helipad should be along gentle gradients to facilitate movement of supplies. If float planes provides access, camps must be located near a sheltered lake shore where planes can land and take off without taxiing long distances. A 30 metre buffer zone must be obtained between the camp area and the nearest body of water. A fire break and the appropriate fire-fighting equipment as stipulated by the Department of Forest Resources and Agrifoods should be established around and located on site. Before any actual construction of the camp begins, a Permit-to-Occupy must be obtained from the Department of Government Services and Lands, Lands Branch. (Exception - Fly Camps)

OPERATION

The camp at all times should be operated in a safe, clean and orderly condition. A suitable potable water supply must be chosen and a permit for water withdrawal obtained from the Department of Environment and Labour. A permit is required from the Department of Government Services and Lands, for the installation of on-site sewage disposal systems. Most camps generate a variety of solid wastes most of which is wet or dry garbage. All solid matter must be disposed of in an environmentally acceptable manner approved by the Department of Environment and Labour. The major environmental problem with dry garbage such as paper, wood and packaging materials is one of aesthetics: blowing paper and litter can visually degrade wide areas.
Burning in an incinerator or pit is one way of disposing of this material; however, it should be discouraged wherever possible. Because open burning is usually forbidden during forest fire season, incineration in a screened unit or container is the preferred method. A Burning Permit is required from the Forestry Branch of Forest Resources and Agrifoods during the fire season as

declared by the Minister. This is usually between early May and late September. Wet garbage, which consist mainly of waste food and food packaging may attract wildlife, provide a breeding ground for flies and represent a source of disease. To limit these problems, food wastes must be properly disposed of, preferably by incineration. Burning in an open pit is not recommended and because of fire hazards, it is often not permitted. Also, wet garbage is unlikely to burn completely, and "cooking" it in a fire attracts animals. If garbage cannot be incinerated, it may be backhauled on the return leg of supply flights, if the camp is fly-in. It will need to be carefully packaged and stored so it does not break open in the aircraft. Ordinary garbage bags are not adequate, especially in winter. Heavy duty bags and metal or plastic garbage bins should function well. In summer, ashes and noncombustible material can be placed in a landfill area. Pits should be excavated in deep, stable dry soils. Filling should begin at one end and progress steadily along the pit. Each day garbage should be covered by a thin layer of soil, about 10 centimetres thick. When a pit is full, it must be covered by 1 metre of compacted soil. This will usually be sufficient to prevent animals from burrowing into the pit. When landfill disposal is used, some animals will visit the dump. Every effort must be made to handle and store food and garbage so that animals do not seek food in the camp itself. Animals that visit a camp should not be fed. All predators are a potential threat, and limiting contact with them is the only safe course. Bears are the greatest hazard. At present, there is no truly effective and safe way to scare bears away. Killing them is prohibited except in cases of immediate threat to human safety or property. Camp operators should contact the local office of the Wildlife Division of the Department of Forest Resources and Agrifoods which should be able to provide current information on bear hazards in the area and advise on the best deterrent methods available. A permit for Waste Disposal is required and can be obtained from the Department of Government Services and Lands. The major source of sewage in most exploration camps and small construction camps is washwater and human waste. Except in the largest camps, pit privies are used for human waste. The privy should be downslope of the camp and must be downslope of the water intake. Only human waste and chemicals used to promote decay and/or reduce fly populations should be put in privies. When pits are full, they should be covered with at least 30 centimetres of thoroughly compacted soil. Pit privies require approval by the Department of Government Services and Lands. Washwater from the kitchen and washing facilities must also be disposed of in an approved manner. For small camps, the best method is to discharge the wastewater to a kitchen sump located at least 15 metres from any body of water. Sump capacity should be at least 1.3 times the maximum volume of wastewater to be discharged. The bottom of the pit should be filled with coarse gravel and the sides shored up with board, etc. to prevent erosion and collapse of the pit. Wastewater must not be discharged directly

onto the shore or into a body of water. In large camps (greater than 6 men) washwater can be handled by sewage treatment facilities. Minimize the danger of fire by taking such precautions as mounting spark arresters on stovepipes, incinerator stacks and motorized equipment. Adequate quantities of fire-fighting equipment must be available to deal with accidental fires. Details of the type and amount of equipment required at a camp can be obtained from the local District Office of the Forestry Branch of the Department of Forest Resources
and Agrifoods.

ABANDONMENT

Removal of material is the most basic task. It means taking away everything from tent frames to fuel containers and this applies to all work sites and camps. Many mineral exploration camps are used for only part of the year, and material or equipment may be left on-site for the next field season. If material is properly stored, environmental or property damage is unlikely to occur while the camp is empty. Equipment can be protected from damage by storing it in secure, inaccessible locations. Tents and other structures should be taken down, but tent frames can stay up. Food should be removed and non-perishable items stored in a weather-tight building.
Fuel drums must be secured by removing nozzles and hoses, re-sealing them, and returning them to the main fuel storage area. W hen a camp is closed for the season, all garbage must be properly disposed of. Materials that cannot be burned should be removed to an approved waste disposal site. Diamond drill core left in the field must be properly and securely stored. Owners of drill core must preserve the technical integrity of drill core in their possession. Persons intending to dispose of drill core must contact the Department of Mines and Energy - Core Storage Program and the core will be considered for collection.

FUEL STORAGE

Fuel storage in Newfoundland and Labrador is regulated by The Storage and Handling of Gasoline & Associated Products Regulations, 1982, and a Certificate of Approval for a fuel storage system must be obtained from the Department of Government Services and Lands. Fuel caches in remote areas of Newfoundland and Labrador should abide by the Environmental Guidelines for Fuel Cache Operations as stipulated by the Department of Environment and Labour. A Certificate of Approval may not be required for a diamond drill or trenching program where only one or two barrels are necessary to complete the job - helicopter supported

reconnaissance drill job. Regardless of the size of any fuel caches, all containers should be marked, indicating their content, and must be handled carefully. Fuel caches should be located on flat stable terrain at least 30 metres from the highwater mark of the nearest body of water whenever possible. Exceptions will be considered for approval (if justified). Dyking of fuel caches is required at temporary or permanent sites when:

1. fuel is to be located in sensitive areas (domestic water supply areas, sensitive wildlife areas, ecological reserves, archaeological sites, etc.)
2. where filling/refilling of drums is proposed or carried out.

Dyking is recommended at a fuel cache when:

1. the size of storage is 100 drums or more, and
2. the duration of storage is permanent

Dykes should be built of clay or other impermeable material. A liner may be used if it is protected from punctures during installation. The preferred method for the elimination of water accumulation inside dykes is the use of a portable pump. If a valved system is used, the valve must be padlocked in the closed position when not supervised.

Any spill in excess of 70 litres must be reported through the 24 hour Spill Report Number 709-772-2083.

In addition, a fuel/oil spill cleanup kit must be kept on site within the protected area to facilitate any clean up in the event of a spill.

This kit must include absorbent pads, loose absorbent materials such as dried peat, speedi-dry or sawdust and a container such as an empty drum for recovering the fuel/oil.

If there is a bulk fuel storage facility within the protected area, the clean-up kit must include the following list of fuel/oil spill clean-up equipment:

1. Wajax fire pump and 100 metres of hose;
2. Two hand operated fuel pumps;
3. Six recovery containers such as empty drums;
4. Four long handled shovels;
5. Two pick axes;
6. Fifteen cubic metres of impervious soil (a silt or clay bearing gravel);
7. Fifty metres of low density rope;
8. Ten metres of containment boom;
9. Twenty-five absorbent pads; and
10. Two 60-kilogram packages of loose absorbent material such as dried peat, speedi-dry or sawdust.

When any fuel spill occurs, stop the flow immediately if possible. This may entail repairing a leak, pumping out a tank or shutting off a valve. If oil is spilled onto soil, dyking may be necessary. If fuel enters water,absorbent booms or barriers such as fencing or netting with loose absorbent or straw must be used to contain the spill. If necessary, culverts may be blocked off by earth or wooden barriers to contain fuel, provided the threat of flooding is addressed. All empty fuel containers must be removed from work areas and campsites. When an operation is shut down for the season, all unused fuel must be retrieved and either stored at the main fuel storage area or removed from the site. Contaminated soil or snow must be disposed of at an approved waste disposal site.

MINERAL EXPLORATION AND BLASTING

Blasting is sometimes required in mineral exploration to (1) aid in access route developments and (2) expose fresh rock for sampling.

No person shall be allowed to conduct or direct a blasting operation unless they are the holder of a valid blasters safety certificate issued by the Department of Environment and Labour. Every certificate is normally granted for a period of 5 years. In all cases, explosives shall be stored a distance of at least 22.86 metres from a road and 30.48 metres from an occupied building. Explosives in excess of 68.04 kilograms shall be kept only on premises which have been licensed under the Explosives Act. All transportation of explosives must conform with The Fire Commissioners Act and The Explosives Act (Canada).

In general all trenches and other pits excavated by blasting methods should be backfilled. The material should be replaced in reverse order than it was excavated, the surface area compacted, stabilized and revegetated if natural revegetation appears unlikely. If the trenches have to be left open for a period of time, the piles of excavated material should be contoured and stabilized. Abandoned access roads should have permanent erosion control. All culverts are to be removed and suitable drainage structures installed.

Erosion bars shall be placed at frequent intervals to ensure stability. Permanent access roads shall be maintained annually with cutbacks and fill slopes revegetated.

MINERAL EXPLORATION - DRILL SITES

Drill sites and water lines should be located as much as possible in areas where access to them and their operation will create the least amount of disturbance. Use the smallest drill pad area consistent with safe working practices. If clearing and levelling is required, the areas levelled

should be no larger than necessary. Trees should be felled, bucked and piled neatly. A permit obtained from the Water Resources Division of the Department of Environment and Labour is required before drilling can take place on any watercourse or body of water. Diamond drilling cannot be carried out within buffer zones in protected water supply areas as follows:

Body of Water Width of Buffer Zone

Intake Pond/Lake 150 metres
River Intake 150 metres for a distance of 1 kilometre upstream and 100 metres downstream
Main River Channel 75 metres
Main Tributaries/lakes/ponds 50 metres
Other bodies of water 30 metres

These buffer zones may be broadened at the discretion of Environment and Labour. Buffer zones may also be imposed around sensitive areas such as steep slopes, bogs and marshes and any other area deemed necessary by Environment and Labour.

Careful planning is needed to minimize the length and number of access trails. Fewer trails reduce operational costs and erosion problems and simplify site restoration if an area is abandoned.

An adequate closed circuit facility must be provided for drilling mud and flocculating agents. This facility can consist of a series of settling tanks and/or a small well constructed settling pond or sum p a short distance down slope from the drill. All fuel and hazardous materials present on the site must be handled with care so as to minimize the possibility of spills. The area cleared for a storage site should be the minimum size required, be at least 100 metres from the nearest waterbody and dyked. In general, drilling waste shall not be allowed to enter streams or lakes or to run uncontrolled. If drilling is performed on a frozen waterbody, only sufficient fuel for one refueling shall be brought on the ice at one time. All pump units shall be located on land or shall be contained in a shelter with absorbent pads to absorb any oil, etc. that may leak. In the case of winter drilling, pumps will be allowed on the ice provided there is a provision to collect drippings. These provisions will be stipulated under the Certificate of Approval. All maintenance of a drill rig or any other equipment involving any work other than emergency repairs shall be carried out on land and at least 100 metres from the nearest body of water.

At the termination of exploration all fuel or hazardous materials are to be removed from the area, the site resloped and revegetated only if natural revegetation appears unlikely. All waste

(garbage, sanitary waste, broken tools, drill pipe, scrap, used drill mud, grout, etc.) shall be collected, transported and disposed of at a site approved by Environment and Labour and in no case shall this site be within 100 metres of any body of water.

In the event of a spill of fuel and/or hazardous materials, in excess of 70 litres, it must be reported through the 24 hour Spill Report Number 709-772-2083. Immediate steps should be taken to ensure that the spill is contained in dykes and/or booms and cleaned up by oil absorbent materials.

Drill holes are often inadequately plugged by leaving a piece of drill stem in the hole or by stuffing a branch of convenient size into it. Proper final abandonment of exploration holes should require the use of commercially available high swelling clays such as bentonite. In particular, holes through which water flows and deep drill holes should be plugged. Occasionally a drill hole is deepened after core interpretation or the hole is logged at a future date. Capping the borehole until all work has been completed, and then final abandonment should be the procedure followed.

Racks of drill core should be stored at one central location and must be protected to the extent necessary to preserve the core's original technical value. The necessary protection is going to depend on the nature and physical characteristics of the drill core.

MINERAL EXPLORATION – TRENCHING

Surface disturbance occurs when excavating test trenches or pits. Serious problems that may arise can be minimized if simple precautions are employed.

Hand excavation is preferable to mechanical excavation because disturbance is limited to the trench and its vicinity, however, if mechanical means are necessary backhoes are the most suitable machines as they are more efficient and cause less damage to the local environment than bulldozers. Consideration should be given to selecting the most appropriate type of off-road vehicle for the job and the terrain. Vehicles with the optimum traction and load distribution characteristics can greatly reduce disturbance in travelling from site to site and thereby reduce rehabilitation costs upon completion of the work. Equipment should be brought in on carefully prepared trails (See Section 4). Mechanical excavations and stripping with Wajax water pump cannot be carried out within buffer zones of protected water supply areas.

The first step is to selectively remove and stockpile the topsoil and organic material. If the trenches have to be left open for a period of time, the piles of excavated material should be contoured and stabilized. When a trench is backfilled, the material should be replaced in the reverse order than it was excavated. After backfilling and compaction is completed, the surface

should be stabilized. If natural regeneration appears unlikely, then the entire site should be revegetated. Important geological features - mineral occurrences, fossil sites, etc. - may be left open for future viewing if industry in consultation with officials of the Departments of Mines and Energy and Environment and Labour, deem them to be unique. In the event of the discovery of a possible historic resources or archaeological object, all work should cease in the immediate area of the discovery until Historic Resources Division of the Department of Tourism and Culture advises the contractor, etc. as to the disposition of the discovery and/or authorizes the renewal of the work. A Historic resource is defined as a work of nature or of humans that is primarily of value for its archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest and includes an archaeological, prehistoric, historic or natural site, structure or object. An archaeological object means an object showing evidence of manufacture, alteration or use by humans that is found in or on land and is of value for the information that it may give on prehistoric or historic human activity in the province and includes human remains. Archaeological Investigation Permits from the Historic Resources Division of the Department of Tourism and Culture are required for archaeological surveying, archaeological excavation and historic resource impact assessments.

ALL-TERRAIN VEHICLE USE

Persons wishing to establish ATV trails will be required to obtain a licence of occupation. Areas where ATV use is permitted includes (1) areas underlain by forested mineral soils (2) trails constructed under licence pursuant to the Lands Act (3) abandoned railway corridors, beaches, abandoned highways, forest access roads, roads constructed under licence pursuant to the Lands Act and any other road constructed for the purpose of providing vehicle access to resources where ATV use may be prohibited by virtue of other requirements (in reserved area, etc.) (4) privately owned land less than ten hectares (5) working farms (6) land in Labrador north of latitude 54 and (7) any lands when snow-covered and frozen belowground surface. ATV use in wetland and barren areas is restricted to approved, properly constructed trails. A licence of occupation for trail construction must be obtained from the Department of Government Services and Lands.

ABANDONMENT AND REHABILITATION

The most basic task in abandoning any site is removal of material. All waste and other discarded material should be removed from pits, quarries, laydown areas, camps and any other disturbed

sites to an approved waste disposal area. Camp sites in particular must be carefully cleaned up. Tent frames and out-buildings should be dismantled and removed, along with any fuel or fuel containers. Any oil saturated soil, snow or ice should be excavated and disposed of at a site approved by the Department of Government Services and Lands.

If access roads are to be abandoned, they must have a system of permanent erosion control, with erosion bars placed at frequent intervals to ensure stability. All bridges and culverts should be removed and stream banks restored after obtaining approval from the federal Department of Fisheries and Oceans and the provincial Department of Environment and Labour. The road surface itself should be scarified or ripped to promote natural regeneration, or to provide a suitable site for revegetation. Abandoned roads must be blocked to vehicular access to prevent watercourse fordings which could lead to serious soil erosion problems. When local topography has been disturbed, the original contours should be restored, preferably to grades 2:1 or less. Erosion-prone areas may require revegetation to limit future problems. This begins with providing a fertile surface dressing of topsoil and organic material, which should have been stockpiled when the area was originally cleared. Until new growth is established, erosion can be controlled by using a mulch to stabilize the bare ground. One popular method is hydroseeding, whereby a slurry composed of seed, fertilizer, mulch and water is pumped through a nozzle and sprayed over the ground. When planning any revegetation program, the Departments of Environment and Labour and Mines and Energy should be consulted.

APPENDIX

Permits and approvals that m ay be required for Mineral Exploration Projects.
(This permit/licence list is based on information obtained from the agencies named and is not necessarily complete).

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Department of Environment and Labour

The Occupational Health and Safety Act 1978 - places specific obligations on government, employers, workers and self employed persons to protect the health and safety of workers and all other persons at or near the workplace.

Occupational Health and Safety Act 1990 - requires employers to register prior to construction, any new construction project or industrial enterprise.

Contact: Director of Occupational Health and Safety Services - 729-5548.

Occupational Health and Safety Committees - are required to be established in each workplace where ten or more workers are employed, to monitor the health, safety and welfare of the workers employed at the workplace.

Contact: Director of Education and Committees - 729-2703.

First Aid Regulations, 1986 - requires employers to provide and maintain first aid supplies and services in each workplace.

Contact: Director of Occupational Health and Safety Services - 729-5548.

Right of worker to refuse to work - a worker may refuse to do any work that he has reasonable grounds to believe is dangerous to health or safety, or the health and safety of any other person in the workplace.

Contact: Director of Occupational Health and Safety Services - 729-5548.

The Regulation of Mines Act, Chapter 330 - prescribes standards for the design, use and safe operation of equipment used at mines, in accordance with adopted codes and negotiated national and international agreements.

Contact: Director of Occupational Health and Safety Inspections - 729-5548.

The Mines (Safety of Workers) Regulations 1957 - provides for the occupational health and safety of workers at mines.

Approvals - are required for the use and storage of explosives at mines and the use of internal combustion equipment underground.

Permits - are required for the storage of explosives used at mines and internal combustion equipment used underground.

Contact: Director of Occupational Health and Safety Inspections - 729-5548.

The Radiation Health and Safety Act Chapter R-1 - the purpose of this Act is the protection of persons exposed to radiation and the regulation of the use and installation of radiation equipment.

Approval - is required for permanent installation of radiation equipment.

Registration - is required for all radiation equipment, whether operated or not, and annually thereafter.

Contact: Manager, Medical and Hygiene Services - 729-2644

Surveys - are required for a new installation or modification and every two years thereafter.

Registration - is required by persons selling, supplying or servicing radiation equipm ent.

Certification - as a medical or dental practitioner is required for those who prescribe the use of radiation equipment for the irradiation of human subjects.

Registration - is required before any person is permitted to operate radiation equipment for the irradiation of human subjects.

Certification - by the Canadian Government Specifications Board or registration as a veterinarian is required for any person prescribing the use of radiation equipment for irradiation of other than human subjects.

Asbestos Abatement Code of Practice - the purpose of this code is to regulate the use or removal ofasbestos or products containing asbestos and the protection of the individuals exposed to asbestos fibers.

Contact: Manager, Medical and Hygiene Services - 729-2644

Registration - is required by any person, firm, corporation or other entity before they may engage or work

at the business of asbestos removal.

Contact: Manager, Medical and Hygiene Services - 729-2644.

The Environment Act, 1995 - written approval is required before proceeding with any alterations to anybody of water or flow therein. Eg. Bridges, Culverts, etc.

Contact: Manager, Water Investigations Section - 729-5713.

The Environment Act, 1995 - written approval is required for all development activities within protected as well as unprotected public water supply areas.

Contact: Manager, Surface Water Section - 729-2535.

A water use authorization - will be required for any beneficial use or diversion of SURFACE, GROUND and SHORE W ATERS.

Contact: Water Resources Management Engineer, Water Rights Section - 729-4795.

The Well Drilling Act, 1981 - provides for licencing of w ell drillers, requirements for the location of wells from sources of pollution, well records, construction, testing and abandonment.

Contact: Groundwater Manager - 729-2539.

A Certificate of Approval - is required for any sewage works, with the exception of on site systems.

A Certificate of Approval - is also required for any water distribution system.

Contact: Director of Environmental Management Division - 729-2556.

A Certificate of Approval - may be required for any industrial or processing works.

Contact: Director, Industrial Environmental Engineering Division - 729-2555.

The Pesticides Control Act, RSN 1990, c. P .8 and Regulations, 1984 - a licence is required by individuals or companies involved in the sale, use, and handling of commercial and restricted categories of pesticide products.

Contact: Manager of Pesticides Control Section - 729-3395.

Department of Fisheries and Aquaculture

The Aquaculture Act - a permit is required for any water based activity related to aquaculture.

Contact: Provincial Aquaculturalist - 729-3726.

Department of Finance

Retail Sales Tax (RST) Act - outlines the tax status and responsibilities of a non-resident business entering Newfoundland to perform contracts or engage in other business activities of a temporary nature.

Contact: St. John's - 729-3831; Grand Falls-Windsor - 292-4357; Clarenville - 466-2611; Corner Brook -
637-2470.

Department of Forest Resources and Agrifoods

Meat Inspection Act - A licence is required to establish and operate a slaughtering facility for animals to be consumed as food, unless the facility is operated solely for the provision of food for the operator and the operator's family.

Contact: Director, Animal Health Division - 729-6879.

The Forestry Act, 1990 - a permit is required to light fires out-of-doors during the forest fire season as outlined in the regulations.

The Forestry Act, 1990 - an operating permit is required to carry on logging or sawmill operations on forestland during the forest fire season.

The Forestry Act, 1990 - a permit is required to cut timber on Crown land.

Contact: Regional Director (Eastern) - 729-2641; (Central) - 256-7131; (Western) - 637-2409; and (Labrador) - 896-9377.

The Sawmill Act - a permit is required for the operation of a sawmill.

Contact: Refer to contacts for the Forestry Act.

The Wildlife Act, 1970 and Amendments - a permit is required for the control of nuisance animals.

A permit - is required to collect, import and export any wild animals.

Contact: Director of Wildlife Division - 729-2817.

Department of Government Services and Lands

Urban and Rural Planning Act 1970 - A development permit is required for development alongside all Protected Roads and within Development Control Areas in the Province.

The Crown Lands Act, 1970 - a permit is required to occupy Crown land, including the sea bed and column of water above it, within three miles offshore of the high water mark.

Contact: Customer Support of the Department of Government Services and Lands Offices - St. John's - 729-5392, Clarenville - 466-4060, Gander - 256-1436, Corner Brook - 637-2207, Goose Bay - 896-2661.

The Environment Act, 1995 - a Certificate of Approval is required for any commercial sewage works in an unserviced area and not covered under a municipality.

Boilers, Pressure Vessels and Compressed Gas Act - the purpose of this Act is to regulate the design and installation of boilers, pressure vessels, pressure plants and compressed gas systems.

Approval - is required for the design of boilers, pressure vessels, pressure plants and compressed gas systems.

Contact: Engineering Services, Government Services and Lands - 729-2747

Permits - are required for the installation, alteration or repairs to boilers, pressure vessels and pressure systems.

Licences - are required by persons engaged in the installations, repair, or alteration to boilers, pressure vessels, or compressed gas systems.

Certification - is required for power engineers, gas installers and welders.

Contact: Engineering Services, Department of Government Services and Lands - 729-2747

The Buildings Accessibility Act 1981 - requires that entrance and facilities available to and accessible by members of the public for lawful purposes to be available to and accessible by physically disabled persons.

The Buildings Accessibility Regulations, 1982 - drawings and specifications of design must be submitted for registration and approval to ensure compliance with the applicable Codes and Standards.

The Elevators Act - regulates the installation of an apparatus, appliance or device used for lifting, lowering, or transporting persons or goods from one perm anent level floor, landing or point to another.

Approval - must be granted for drawings and specifications of an elevator before the installation or major alterations commences. If the design meets the requirements of the Act and the applicable Safety Code, a Registration Number is issued.

Contact: Engineering Services, Department of Government Services and Lands - 729-2747.

Boiler, Pressure Vessel and Compressed Gas Act - A Certificate of Inspection is required for the operation of boilers, pressure vessels and pressure systems when the installation or repair work has been completed. The Inspection Certificate is renewed annually. The Electrical (Inspection Fees) Regulations 1986 - establishes the fees to be paid for the inspecting, testing and approval of electrical wiring and equipment.

The Electrical Regulations, 1982 - adopts the Canadian Electrical Code C22.1, as the safety standard for electrical wiring and equipment. In addition, it ensures that only individuals who are qualified to do electrical work are permitted to do so, and restricts the purchase of electrical permits to qualified electrical contractors.

Permit - is required for the installation, alteration or repair and inspection of electrical wiring system or equipment. This perm it is only issued to a Registered Electrical Contractor. Electrical Registration Certificate - required by an individual who performs electrical work and who qualifies in accordance with section 4 and 5 of the Regulations.

Contact: Mechanical and Building Inspections, Department of Government Services and Lands - St. John's - 729 2746, Clarenville - 466-4060, Gander - 256-1428, Corner Brook - 637 2446, Goose Bay - 896-2661

Electrical Contractors Registration Certificate - required by an individual who wishes to purchase an electrical permit and is only issued to individuals who meet the requirements of Section 6 of the Electrical Regulations, 1994.

Contact: Mechanical and Building Inspections, Department of Government Services and Lands - St. John's - 729 2746, Clarenville - 466-4060, Gander - 256-1428, Corner Brook - 637 2446, Goose Bay - 896-2661 The Elevators Act - A Certificate of Inspection is required to be issued and prominently displayed before an elevator is put in use by the owner. Contact: Mechanical and Building Inspections, Department of Government Services and Lands - St. John's - 729 2746, Clarenville - 466-4060, Gander - 256-1428, Corner Brook - 637 2446, Goose Bay - 896-2661

The Waste Material (Disposal) Act, 1973 - a permit is required to establish or alter the boundaries of a waste management and disposal system.

The Storage and Handling of Gasoline and Associated Products Regulations, 1982 and Amendments – a Certificate of Approval is required for the storage and handling of gasoline and associated products.

The Storage of PCB Wastes Regulations, 1988 - a permit is required for the transportation or storage of PCB waste materials.

The Environment Act - A Certificate of Approval may be required for any industrial or processing works.

A Certificate of Approval - is required for Asphalt Plant Set-Up and for Asphalt Plant Operation.

Contact: Regional Operations, Department of Government Services and Lands - St. John's - 729-3084,

Clarenville - 466-4060, Gander - 256-1420, Corner Brook - 637-2204, Goose Bay - 896-2661.

Department of Health Act, 1990

Public Health Sanitation Regulations (1991) - approval is required for the installation of a w ell to supply drinking water.

Sewage Disposal System Regulations (1985) - a permit is required for the installation of on site sewage disposal systems.

Contact: Operations Division, Department of Government Services and Lands - St. John's - 729-0485,

Carbonear - 786-5032, Clarenville - 466-4060, Gander - 256-1428, Corner Brook - 637-2446, Goose Bay - 896-2661.

Swimming Pool Regulations (1978/93) - a license is required for the construction and operation of a swimming pool, waterslide, etc. for any facility that is involved with providing swimming or recreational bathing subject to compliance with pertinent legislation. License is renewed annually.

Food and Drug Act, Food and Drug Eating Establishment Regulations, 1966 - a Food Establishment License may be issued to any premise that is involved in the sale, production, manufacturing, preparation, storage and/or distribution of food subject to compliance with all pertinent legislation.

Department of Health Act, 1990 - Approval is required for the development of all Cemetery Sites.

Public Health (Sanitation) Regulations, 1991 - Bacteriological analysis of private water samples will be performed on a demand basis.

Contact: Operations Division, Department of Government Services and Lands - St. John's - 729-0485, Carbonear - 786-5032, Clarenville - 466-4060, Gander - 256-1428, Corner Brook - 637-2446, Goose Bay - 896-2661.

Salvage Dealers Act - a licence is required by individuals or companies to operate a salvage yard.

Contact: Supervisor of Licencing and Enforcement - 729-2595.

Department of Industry, Trade and Technology

Development Areas (Lands) Act - permission is required for any development activity, whether domestic, industrial or commercial within the Bull Arm Development Area.

Contact: Director, Business Analysis Division - 729-5066.

Department of Justice

The Corporations Act, Section 433 (1) - a domestic or extra-provincial company shall not begin or carry on an undertaking in this province until it is registered under this Act. Note - extra-provincial companies are "registered" and local (Newfoundland and Labrador) companies are "incorporated". Contact: Registrar of Deeds and Companies - 729-3316

Municipal/Community Councils

The Municipalities Act, 1979 - a building permit is required for any building proposal which falls within a municipal jurisdiction.

Urban and Rural Planning Act - a development permit is required for all development within a Regional, Municipal or local planning area or in a protected area.

Contact: Town Clerk of Council concerned.

Department of Mines and Energy

Petroleum and Natural Gas Act, 1970, and Draft Regulations - a permit is required for petroleum exploration, development and production activities on land.

Contact: Director of Petroleum Resource Development - 729-2323.

The Quarry Materials Act, 1976 and Regulations - a permit is required for the removal of any quarry materials.

Contact: Manager of Quarry Materials Administration - 729-6410.

The Mineral Act, 1976 and Regulations - a mining lease is required for all mining activities.

Contact: Manager of Mineral Rights - 729-6418.

The Mineral Regulations 1983, (Amendment) under the Mineral Act (O.C. 95-730) - a person who intends to conduct a detailed systematic search for minerals on areas either licenced or leased under the Mineral Act, or granted or issued by another Act, must subm it a description of the planned exploration before commencing the work.

When mineral exploration work involves heavy machinery, airborne surveys, extensive use of off-road vehicles or establishment of camps or other activities capable of impacting the environment, an exploration approval is required.

Contact: Director of Mineral Lands Division - 729-6425

Department of Social Services

Day Care and Homemaker Services Act, R.S.N., 1990 - a licence is required to operate a day care centre where four or more children are being cared for. A licence is also required to operate Homemaker – Home Support Services.

Contacts:

re: Day Care: Director, Family and Rehabilitative Services Division - 729-2436.

re: Homemaker Service Agency: Nursing Consultant - 729-3113.

Department of Tourism, Culture and Recreation Tourism Establishment Act - Tourist Establishment Regulations. A permit is required to build any accommodations. A licence is required to operate an accommodations facility. Accommodations include hotels, motels, hospitality homes, hunting/fishing camps, trailer parks and cabins. Recent policy requires only

that vessels possess Safety Compliance from Coast Guard. Contact: Director of Tourism Development - 729-2822.

The Wilderness and Ecological Reserves Act, 1980 and Amendments - a permit is required for any travel or proposed activity within an ecological or wilderness area. A Scientific Research Permit is required for any research conducted within an Ecological or Wilderness Reserve.

Provincial Parks Act - A Permit is required for most activities within a Provincial Park.

Contact: Director of Parks Division - 729-2424.

The Historic Resources Act - an archaeological investigation m ay be required for any undertaking. A permit is required for any archaeological investigation on land or under water.

Archaeological Investigations Permit Regulations (1991) - These specify the professional qualifications that an archaeologist must have in order to qualify for a permit to survey for and/or excavate archaeological sites in the province. The regulations also delineate the methods and procedures to be followed by the archaeologist in the field.

Contact: Resource Archaeologist - 729-2460.

Department of Works, Services and Transportation

Transportation of Dangerous Goods Act - those handling, offering for transport or transporting any dangerous goods must comply with the Act. No actual permit issued.

Contact: Manager of Transportation Regulation Enforcement - 729-3454

Department of Transportation and Communications Act, 1983 - a permit may be required for any development within a highway reservation established by the Department of Works, Services and Transportation. Access off any highway under the Department of Works, Services and Transportation's jurisdiction may require a permit.

Contact: District Manager, St. John's - 729-2381, Clarenville - 466-7953, Grand Falls - 292-4300 and Deer Lake - 635-2162.

GOVERNMENT OF CANADA

Agriculture Canada

Plant Protection Act - Plant Protection Regulations: permission is required for any activity which might transport plant debris and soil into an area designated as a disease free area under the Plant Quarantine Regulations.

Contact: Program Officer, Plant Protection - 772-5030.

Environment Canada

The Canadian Environmental Protection Act - Part VI, a permit is required for any ocean disposal. A Letter of Authorization - by the Minister is required for PCB destruction technology and treatment technology. The Dangerous Goods Transportation Act, 1982 - Environmental

Protection is required to inspect any cargo of waste material being shipped out of Canada from Newfoundland and Labrador.

Contact: Manager, Compliance and Enforcement - 772-4047.

The Fisheries Act (Section 36 - 42) - deleterious substances cannot be discharged into fish-bearing waters. Plans and specifications may be required.

Contact: Manager, Pollution Prevention - 772-4005.

Fisheries And Oceans Canada

Newfoundland Fisheries Regulations under Section 35 of The Fisheries Act - development plans may have to be reviewed by Fisheries and Oceans Canada.

Contact: Section Head, Habitat Evaluation Section - 772-4912.

Fisheries Act - an approval may be required for any activity which may impact on fish and/or fish habitat.

Contact: Area Habitat Coordinator; Area 1 (Eastern) 772-5597; Area 2 (Southern) 832-0010; Area 3

(Central) 292-5197; Area 4 (Labrador) 896-2642; Area 5 (Western) 637-4349; or Section Head, Habitat Evaluation, Marine Environment and Habitat Management 772-4912.

Transport Canada

The Transportation of Dangerous Goods Act - those handling, offering for transport or transport of any dangerous goods must comply with the Act. No actual permit issued.

Contact: Department of Transportation - 729-3454 or Transport Canada anutech - 613-992-4642 (Emergencies) - 613-996-6666.

The Navigable Waters Protection Act - a permit is required for any works or construction activity located below the high water mark, either over, under, through or across any navigable coastal waters.

CONTACT: REGIONAL SUPERINTENDENT OF THE Navigable Waters Protection Act - 772-2284.

APPENDIX M - CITY OF CORNER BROOK WATERSHED PROTECTION REGULATION AMENDMENT — PROVISION FOR PUBLIC CONSULTATION

REQUEST FOR DECISION
COMMUNITY SERVICES DEPARTMENT
SUBJECT: City of Corner Brook Watershed Protection Regulation Amendment — Provision for Public Consultation

Description: Presently, all of the City of Corner Brook By-Laws, including the Watershed Regulations are being independently reviewed. As part of this review it is being recommended to amend the current Watershed Regulations to include public participation and public review of requests for development within the watershed. Council recognizes that further amendments may be required to these regulations as part of our overall bylaw review process.
Council is also in the process of restructuring its Watershed Management Committee. One of the main functions of this group will be to oversee the creation of a Watershed Management Plan. Future development in the watershed, if any, will be based upon this plan.

Recommendation: A Notice of Motion was presented at the Regular Meeting of Council on March 06, 2006, and is now being brought forward for consideration. During the Notice period there were no objections received to the proposed amendment. The Community Services Department has completed its review and is recommending that Council approve the amendment to Section 17 of the Watershed Protection Regulations - 1994.

PROPOSED MOTION:
It is RESOLVED that Council adopt the following amendment to the City of Corner Brook
Watershed Protection Regulations - 1994:
Under and by virtue of the powers delegated to the City of Corner Brook in accordance with Section 187 of the City of Corner Brook Act, RSNL 1990, the Watershed Regulations are to be amended as follows:

By adding to Section 2 (Defmitions) Subsection (f) the words "development as defined under the
Urban and Rural Planning Act, SNL 2000".
By deleting all of the words and figures in Section 17 and submitting therefore the words "No person shall undertake a development in the watershed except with the written approval of Council. Where a person makes a request to Council for approval to develop in the watershed, and prior to a decision of Council being rendered, notice of the intent to develop must be advertised and subject to a public review period of not less than 45 days with the exception of those undertakings requiring registration pursuant to the Environmental Protection Act, SNL 2002".

Chief Administrative Officer's Comments: This change provides the opportunity to determine public sentiment of proposed developments which should assist Council in their decision making when compared against other issues.

Approval Recommended:

IMPLICATION OF RECOMMENDATIONS:
Organizational:
Financial:
Policy: Similar process followed for discretionary uses.
Implementation / Communication:
Other Comments:

POLICY ADVISORY COMMITTEE COMMENTS:
Implications:

ALTERNATIVES / IMPLICATIONS:
Background: City of Corner Brook Watershed Protection Regulations
Report/Document: Attached: X Available: Nil:
Submitted by:
Received by:
Paul Barnable Date: March 14, 2006
Chief Administrative Officer Date:
Approved by Council: Date:

Rosemary O'Reilly Chairperson
Rod Dwyer Member
Ervin McCurdy Member
Scott Shears Member
Don Winsor Member
MOTION CARRIED.
06-51 BYLAW REGULATIONS AMENDMENTS
1. Swimming Pool Regulations
On motion by Councillor L. Bruce, seconded by Councillor D. Luther, it is RESOLVED to approve the Swimming Pool Regulations as presented.
MOTION CARRIED. (Copy attached to official minutes).
2. Watershed Protection Regulations
On motion by Councillor L. Bruce, seconded by Councillor J. Carey, it is RESOLVED to adopt the following amendment to the City of Corner Brook Watershed Regulations, under and by virtue of the powers delegated to the City of Corner Brook in accordance with Section 187 of the City of Corner Brook Act, RSNL 1990, as follows:
By adding to Section 2 (Definitions) Subsection (/) the words "development as defined under the Urban and Rural Planning Act, SNL 2000".
By deleting all of the words and figures in Section 17 and submitting therefore the words "No person shall undertake a development in the

watershed except with the written approval of Council. Where a person makes a request to Council for approval to develop in the watershed, and prior to a decision of Council being rendered, notice of the intent to develop must be advertised and subject to a public review period of not less than 45 days with the exception of those undertakings requiring registration pursuant to the Environmental Protection Act, SNL 2002".

MOTION CARRIED.

3. Garbage and Refuse Regulations

Councillor D. Luther served a Notice of Motion that amendments will be presented at the next Public Council meeting for Council's consideration with respect to introducing mandatory recycling measures to the Garbage and Refuse regulations. A summary of the amendments are as follow:

1. Adding Section 1(j) — Listing divertible material which can be recycled by members of the industrial, commercial and institutional sectors.
2. Adding Section 2.2 which place a limit on the quantities of household solid being disposed of on a weekly basis.

APPENDIX N - REPORT CARDS FOR WATERSHED MONITORING PROGRAMS

Monthly Corner Brook Watershed Monitoring Report

Month: _____ Watershed: _____

New activities/developments observed:

_____

_____

_____

Applicable permit in possession of activity/development operator: _____

Natural phenomenon of concern (e.g. beaver activity, high water levels, etc.)

_____

_____

_____

Any roads or trails causing erosion?

_____

Potential threats to water quality observed?

_____

_____

Other Comments/Observations

_____

_____

Photos/GPS waypoints_____

Signed _____ **Date** _____

Corner Brook Watershed Report Card- 2009

Drinking Water Sources:
Total Watershed Area: km^2
Population Serviced:
Percent of Watershed Protected:
Watershed Protection Date:
Watershed Committee Representatives:

	Indicator	Value	Comments
	Stressors		
1	Number of Existing Land/Water Use Activities		
2	Number of Permits Issued for Development Activities in the PWSA		
3	Number of New Environmental Permits Issued (Section 48)		
4	Percent of Watershed Area Under Existing Development		
5	Percent Change in Watershed Area Under New Development		
6	Number of Major Incidents/Investigations in Watershed		
7	Presence of Beavers		
8	Condition of Roads/Trails		
9	Unauthorized Development Activity in Watershed		
10	Estimate of Number of times the wateshed is accessed		
	Condition		
11	Drinking Water Quality Index Score		
12	Number of Chemical/Physical Water Samples Collected		
13	Number of Bacteriological Water Samples Collected		
14	Number of Source Water Contaminant Exceedences		
15	Number of Source Water Aesthetic Exceedences		
16	Number of Tap Water Contaminant Exceedences		
17	Number of Tap Water Aesthetic Exceedences		
18	Number of Boil Water Advisories Issued		
19	Number of High Flow/Flood Events		
	Response		
20	Number of Times Distribution System Flushed		
21	Watershed Management Plan		
22	Number of Watershed Committee Meetings		
23	Number of Watershed Outreach Initiatives		
24	Estimate of Monetary Value of Watershed Management Activity		
25	Number of Watershed Surveys		