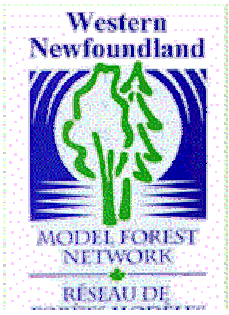
STEADY BROOK WATERSHED MANAGEMENT PLAN



September 2005

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STEADY BROOK WATERSHED

MANAGEMENT PLAN

September 2005

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MESSAGE FROM THE MAYOR

Newfoundland and Labrador has an abundance of rivers, lakes and ponds that supply clean drinking water to the majority of the province's population. It is the provincial government's mandate to ensure that these sources continue to supply safe and secure drinking water for our residents. Municipalities also have a role in the protection of our public water supplies, as they have the power to make regulations controlling the use of their source of water, their watershed.

Vigilance about drinking water quality has existed in the Town of Steady Brook for some time and as early as 2000, residents, with the blessing of Town Council, established the first Steady Brook Watershed Monitoring Committee. This committee however was limited by a lack of resources. So when the Western Newfoundland Model Forest offered to coordinate the development of a watershed management plan in 2003, the Town jumped at the opportunity.

Many months and many meetings later, Steady Brook is proud to present the Steady Brook Watershed Management Plan. We are pleased with the finished product and confident that it has provided us with a decision-making process based on accepted practices and research in watershed management. We're also very proud to have been involved in the pilot project to produce a watershed management methodology for other communities in Newfoundland and Labrador to follow.

As Mayor, I would like to extend my thanks to all the members of the Steady Brook Watershed Management Planning Committee who contributed many hours to this project. The Town looks forward to working with you on the implementation of this plan.

Leona Gillette
Mayor, Town of Steady Brook

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.

As early as 2000, the Town of Steady Brook recognized the need for a formalized plan to help protect the Town's water supply, while allowing, if possible, the sustainable development of the watershed's resources. This Steady Brook Watershed Management Plan has addressed this need by providing a process of informed decision-making in the management of the watershed. A committee of community representatives and resource specialists gathered background information, and assessed the risks of potential contaminants resulting from possible activities in the watershed. From this information, a strategy was suggested to assist the Town in achieving their goal. 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.

The goal of this process was to develop a comprehensive integrated watershed management planning methodology, using Steady Brook watershed as an example. The methodology, to be extracted from this plan and produced separately, will hopefully be used by other municipalities in Newfoundland and Labrador to develop management plans for their protected water supply areas.

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ACKNOWLEDGMENTS

Many individuals have contributed to the development of this management plan, representing governments, industry and other stakeholders in the Steady Brook watershed. Members of the Steady Brook Watershed Management Planning Committee committed many hours to the production of this plan, and in particular, those in the Writing Group* Subcommittee:

Leona Gillette	Mayor, Town of Steady Brook (Chairperson)
Ulah Wilton	Deputy Mayor, Town of Steady Brook
Don Thistle*	Councilor, Town of Steady Brook
Mary Diamond	Councilor, Town of Steady Brook
Fraser Dwyer	Resident, Town of Steady Brook
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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 now *Water Resources Act*, and land and water uses regulated within these areas to protect water quality. However, the *Water Resources Act*, 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, under the *Municipalities Act*, Municipal Councils may make regulations they feel are required to prevent pollution of their drinking water supply source.

The Steady Brook watershed supplies drinking water for the Town of Steady Brook. Historical land uses in the watershed include cottage development, forest harvesting, pits and quarries, roads, snowmobile/ATV trails and transmission lines. Potential future uses include all historical uses plus a proposed substantial expansion of recreational activities. Any combination of these uses allowed to continue without a long-term management strategy could threaten water quality.

The Town of Steady Brook formed its first Watershed Committee early in 2000, but formally received approval under the *Water Resources Act* to form a Watershed Monitoring Committee in April 2002, following a request from the Town Council. But the lack of resources limited the ability of this committee. In 2003, the Western Newfoundland Model Forest approached Steady Brook and offered to coordinate the development of a watershed management plan, with the goal of producing a template which would be available to other communities in Newfoundland. Later the same year, the Watershed Monitoring Committee was revived with new members added, and renamed the Steady Brook Watershed Management Planning Committee. The main purpose of the Committee was to ensure the quality of the Town's drinking water through the development of guidelines for resource utilization. The Committee appointed a Writing Group sub-committee to research and prepare a management plan for approval.

GOALS AND OBJECTIVES

The goal of this process was to develop a comprehensive integrated watershed management planning methodology with specific reference to the Steady Brook basin, which could be used to protect and maintain source water quality and to allow for the sustainable development of natural resources. It is hoped that this methodology will be used by other municipalities to develop watershed management plans for their water supply areas.

Following are the objectives of the proposed process. With the approval of the Steady Brook Watershed Management Planning Committee, they have been revised

slightly from those outlined in the Proposal, as a result of availability of information and resources, and applicability to the process. The specific objectives of the proposed process are to:

1. Collect available information to characterize the watershed in terms of its physiographic characteristics, natural resources, land uses and ownership, management practices, hydrology and water quality, and environmentally- and hydrologically-sensitive areas;

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

3. 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;

4. Test the Forest Water Quality Index (FWQI) model using water quality data from the watershed;

5. Assess the compatibility of various uses and associated operational practices within the basin including but not limited to forestry, agriculture, recreation, transportation, mining, etc.;

6. Evaluate best management practices for compatible land uses in the basin 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;

7. 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;

8. 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; and

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

The process is also to include the identification of medium to high risk causes of contamination, that is, issues that should be addressed first as a matter of priority. A comprehensive report containing the results of the study is to be prepared with appropriate recommendations.

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.
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 and physiographic characteristics, natural resources, hydrology and water quality and quantity, ownership, land and water uses.

LOCATION AND PHYSIOGRAPHIC CHARACTERISTICS

Location

The Steady Brook watershed is located in western Newfoundland, 7 km east of Corner Brook. It feeds into the Humber River which flows into the Bay of Islands (Figure 1). The watershed covers about 76 km^2 (Figure 2), all of which is designated as a protected water supply area (PWSA). PWSAs throughout the province protect sources of public water supplies from adverse effects. A second protected area lies within Steady Brook's PWSA. The Marble Mountain Protected Area was created in 1977 in order to conserve natural amenities of the area and to develop those amenities for public use. Three-quarters of the area allotted to the Marble Mountain Protected Area lies within the Steady Brook protected water supply area. The Steady Brook PWSA supplies drinking water to the Town of Steady Brook (current population ~ 425) and the Marble Mountain Ski Resort, whose winter activities increase the population to about 3000 during the ski season.

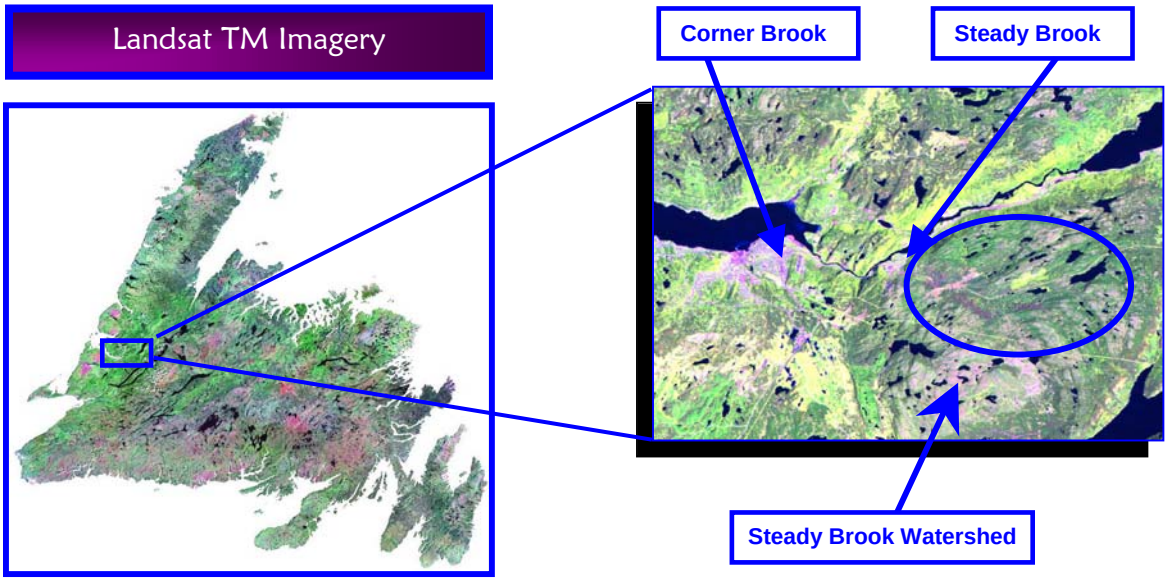


Figure 1 Location of Steady Brook Watershed. (Guy Strickland, NRCAN)

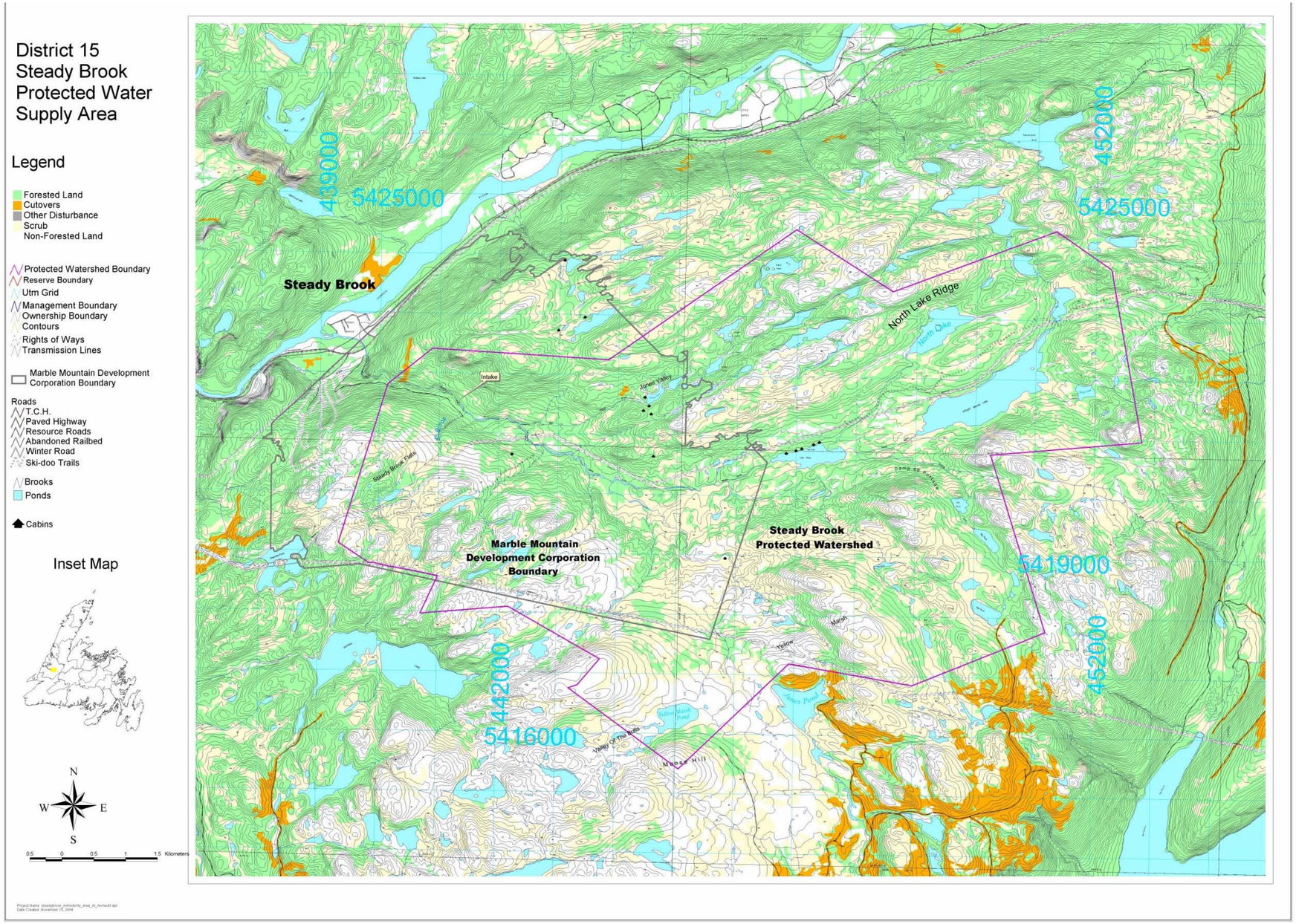


Figure 2. Steady Brook watershed.

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 Steady Brook watershed belongs to the Western Newfoundland Ecoregion (Figure 3), one of nine ecoregion classifications. Some of the ecoregions are further broken down into subregions, based on major variations in climate and rock formation. Steady Brook watershed is located in the Corner Brook 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

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

Figure 3. Ecoregions of Newfoundland.

Hydrology

Steady Brook runs from east to west, originating at Steady Brook Lake. From there it flows into Line Pond, then on for approximately 8 km until it joins the Humber River. Numerous other lakes, ponds and streams contribute to the watershed. North Lake flows into Line Pond from the north, and Aye, Bee, Cee and Dee Ponds feed Crooked Brook which flows into Line Pond from the south. Yellow Marsh Brook enters Steady Brook directly, just west of Line Pond. Jones Pond feeds East Steady Brook which joins Steady Brook about 1 km east of the intake. Forty-five Brook enters Steady Brook less than 0.5 km east of the Intake.

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. And 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 entire Steady Brook watershed area has been shaped by glaciation, as has most of the island of Newfoundland. Parts of the areas are scraped bare and many valleys and low-lying areas have a thick mantle of rocky glacial deposits (DFRA, 2002). Erratic boulders are found at the highest elevations. The bedrock is classified as the Fleur De Lys Supergroup, and is comprised of metamorphosed schists with a minor composition of marble and quartzite (Golder, 1983).

The surficial geology of an area determines the occurrence and movement of water. The surficial geology of almost 75% of the Steady Brook watershed is 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

As was explained in the discussion on geology, water quantity and quality are affected by the hydraulic, chemical and physical properties of the overlying formations, which include soils. Fine-textured soils such as clays have a high water-holding capacity and exhibit slow water movement (Buckman and Brady, 1969). Coarser sandy soils exhibit a low water-holding capacity and facilitate drainage and aeration.

For the most part the watershed is covered by glacial till. Till veneer and moraine deposits of variable thickness overlie the bedrock (Golder, 1983). Tills vary from silty sand to sandy silt, and locally include ice contact sand and gravel. 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

Topography

The topography of the district is generally rugged however the flat, high upland plateaus provide contrast (DFRA, 2002). The landscape is generally undulating and hilly, intersected by numerous ponds, lakes and streams. Forested land is naturally fragmented with bog, barren and ponds.

Climate

The climate in the Western Newfoundland Ecoregion is one of the most favourable 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 C and mean July temperature ranges from 16 C in valleys to 13 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.

Severe windstorms have occasionally caused some blowdown damage, especially in shallow-rooted, over-mature stands. Periodic ice storms have also caused damage to predominantly hardwood stands.

NATURAL AND HISTORIC RESOURCES

There are several ways to classify land use. The forest-based classification was chosen to describe the Steady Brook watershed based on its availability and applicability. Table 1 breaks down the watershed into 4 classes: productive forest (capable of producing > 30 m^3/ha at harvesting age), non-productive forest, non-forested land, and fresh water. The largest class is productive forest at 45% of the area of the watershed. Non-productive forest is the next largest at 29%, followed by non-forested at 22% and fresh water at 6%.

Table 1. Land class distribution in the Steady Brook Watershed.

Land Class	Ha	%
FRESH WATER	**433**	**5**
PRODUCTIVE FOREST	**3355**	**44**
Cutover	9	
Other disturbance	507	
Not sufficiently restocked	16	
Stocked	2823	
NON PRODUCTIVE	**2211**	**29**
Softwood scrub	2189	
Hardwood scrub	22	
NON FORESTED	**1682**	**22**
Rock barren	891	
Soil barren	460	
Bog	236	
Right of Ways	95	
TOTAL ALL CLASSES	**7681**	**100**

Water

Water Supply System

The first water supply system in Steady Brook was a pump system, installed in 1971-72 at the old bridge near the bottom of the falls. A new system was installed well above the falls in 1995, to facilitate the expansion of the Marble Mountain resort area and to protect water quality. This system was installed to provide drinking water for the Town of Steady Brook and water for drinking and snow-making at Marble Mountain. The intake structure is located approximately 1.5 kilometres above the falls. From here water flows through a screen chamber several metres downstream from the intake and discharges to a feeder main. The feeder main runs for ~1600 metres to a junction where a line branches off to provide flow to the water treatment system, and another line services the Marble Mountain snow-making system. A water treatment building, added at the time of installation, houses chlorination (destroys disease-causing microorganisms) and filtration (filters sediment) systems. Table 2 provides further detail about the present water supply system.

Problems have arisen due the pairing of water for domestic purposes (for drinking and fire fighting) and water for snowmaking. During the winter, the larger volume of water required for snow-making stirs up the brook bed and increases the amount of

sediment in the water. This sediment blocks the filtration system and results in a breakdown of the water supply system. In addition, as more water flows to provide a sufficient volume of water for snow-making, the pressure in the operating line drops. This can result in insufficient pressure to push the water through the treatment system, and thus insufficient quantities of water for domestic use.

Table 2. Water Supply System and Treatment.

Feature	Details
Intake location	Steady Brook, approximately 1.5 km above the falls.
Adequacy of supply	Adequate supply in summer, but supply can be a problem in winter when water is also being used for making snow.
Existing structures	The water supply, installed in 1995, consists of an intake structure, a screen chamber, and a feeder main which branches into a line for drinking water and a line for snow making. A water treatment building houses the chlorination and filtration systems.
Treatment methods	Chlorination and filtration
Water quality	The water is often coloured and low in pH. Three boil water advisories have been issued to date, due to microbial pathogens.[1]
Potential for increased supply	Demand for a moderate increase in supply could be handled in the summer months, but not during months when Marble Mountain is making snow.
Daily usage	Town: 1.3 million litres/day Marble Mountain: 6.5 million litres/day (Maximum, when making snow)
Other observations	The increased volume required during snow-making in winter increases the sediment and blocks the filters, shutting down the system.

[1] Reasons for boil orders discussed on page 12.

Water Quality Data

Monitoring of drinking water quality in Newfoundland is the responsibility of the provincial government. Drinking water is monitored for chemical and physical parameters by the Department of Environment and Conservation 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 and Haloacetic Acids, 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. (Jim Wight, Environmental Health Officer, Department of Government Services, Personal Communications). In Steady Brook testing is performed biweekly at two locations, at the entrance to the community, and at the end of the system.

The province uses the *Guidelines for Canadian Drinking Water Quality* (Appendix A) as the standard against which test results for all parameters are compared. Complete reports of all chemical and physical parameters tested for the Steady Brook water supply, for both source and tap water, can be found in Appendix B. These reports show the trends in water quality since testing began, from 1988 for source water and from 2000 for tap water, to 2003. No monitoring of chemical and physical parameters was done in 2004 as the position responsible for monitoring in the Western Region was vacant from January 2004 until May 2005. The results of the June 2005 monitoring for chemical and physical parameters were not available at the time of release of this report.

A discussion of the results of water quality testing of the Steady 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* at:

http://www.gov.nf.ca/Env/env/waterres/Surfacewater/DWS-Report/2003/Report.asp.

Source Water

Sampling results show that in comparison with the *Guidelines for Canadian Drinking Water Quality*, the quality of the chemical and physical parameters of Steady Brook water supply since sampling began, up to and including 2003, has been generally good. The water quality since 2003 cannot be reported although conditions have not changed in the watershed, i.e. no new developments have been initiated. Although two parameters, colour and pH, exceeded the guidelines for almost every sample, these parameters are aesthetically significant parameters and thus are not a safety risk (DOE, 2001). High colour 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.

Other than colour and pH, Steady Brook source water has exceeded the guidelines on only one occasion (October 2003), for three parameters: iron, manganese and turbidity. Iron and manganese are usually high in Newfoundland waters because of the natural surficial geology. As with colour and pH, the guidelines for these parameters are aesthetic, and cause no safety risk. High levels of either, however, may cause unpleasant tastes and staining of laundry. Although exceeding the guidelines, Steady Brook levels of manganese are lower than the provincial average.

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 in October was probably caused by naturally occurring silt and sediment runoff common in the fall, since no development-type activities were occurring in the watershed at the time of sampling. The average turbidity value for Steady Brook is less than the provincial average.

Tap Water

Tap water samples similarly exceeded the aesthetic guidelines in colour, pH, turbidity (two samples), and in iron (one sample). Low pH water combined with chlorine for disinfection produces a weak acid which corrodes pipes. The corrosion of lead pipes and lead saudering is the cause of the observed lead exceedance. The lead level (0.011 mg/L) exceeded the guideline (0.01 mg/L) only slightly. Exposure to lead in drinking water above the guideline level can result in delays in physical and mental development, and learning disabilities in children, and high blood pressure and kidney problems in adults (USEPA, Date Unknown).

Tap water is also tested for Trihalomethanes (THMs), by-products of chlorination, which form when water containing natural organic matter is chlorinated. (See Chlorination and Increased Streamflow in the Potential Contaminants Section.) Sampling is conducted in the spring, summer, fall, and winter to account for seasonal variation and to allow for comparison with the national guidelines (DOE, Date Unknown). Steady Brook THM data (Appendix B) show the guideline was exceeded for two readings in 1998, out of the 26 readings recorded for the period from 1996 to 2003. THM exceedances 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 (DOE, Date Unknown). As with the frequent incidence of high colour and low pH values mentioned previously, the level of THMs is directly related to the presence of organic materials. At certain levels, THMs pose a significant risk for the development of cancer and possibly reproductive and developmental effects (DOE, Date Unknown). The present guideline for THMs 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. HAAs pose health risks similar to THMs.

Microbiological Parameters

Over the last two years, four boil orders have been issued for the Town of Steady Brook (December 2003, October 2004, December 2004 and June 2005), all due to the presence of total coliforms. The December 2004 and June 2005 samples showed the presence of Escherichia coli (E. coli) as well. Total coliform bacteria are common in the natural environment. However, if large amounts of total coliform bacteria are present, the water is more likely to contain disease-causing bacteria. The occurrence of total coliform in a repeat sampling within 24 hours of the first occurrence would require a boil order to be issued. The presence of E. coli is evidence of fecal contamination, animal or human, and one particular strain is a powerful toxin and can cause severe illness (USDH,

2005). E. coli is not uncommon in surface water supplies, where wildlife waste can contaminate the water (Jim Wight, Environmental Health Officer, Department of Government Services, Personal Communications). Thus the first evidence of any E. coli requires the issuance of a boil order. The complete list of reasons for boil orders can be found in *Source to Tap* (DOE, 2001).

Monitoring for chlorine residuals also occurs with bacteriological testing, and the recommended levels are from 0.3 to 0.5 ppm 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. Chlorine residuals in Steady Brook have been low occasionally, probably due to higher than normal chlorine demand, caused by excessive organic and suspended sediment loading to the source water during heavy rainfall/runoff events. The Department of Government Services has recently recommended the Town install a flow proportionate system for chlorine that would dispense the level of chorine proportionate to the flow, and consequently greatly reduce the number of boil orders.

Water Quantity

As there is no hydrometric station located in the Steady Brook watershed, streamflow for Steady Brook had to be estimated using data from a neighboring watershed. Data was taken from station 02YL004, South Brook at Pasadena (drainage area of 58.5 km^2), a nearby watershed of similar size and physiographic characteristics. Average monthly streamflow from South Brook was converted into a simulated hydrograph for Steady Brook by adjusting for watershed drainage area using the following formula:

$$Q_{SteadyBrook} = \frac{DA_{SteadyBrook}}{DA_{SouthBrook}} Q_{SouthBrook}$$

Q is average monthly streamflow (m^3/second) and DA is the drainage area (km^2). The resulting hydrograph of monthly average streamflow is only meant to give a simplified indication of likely flows from Steady Brook.

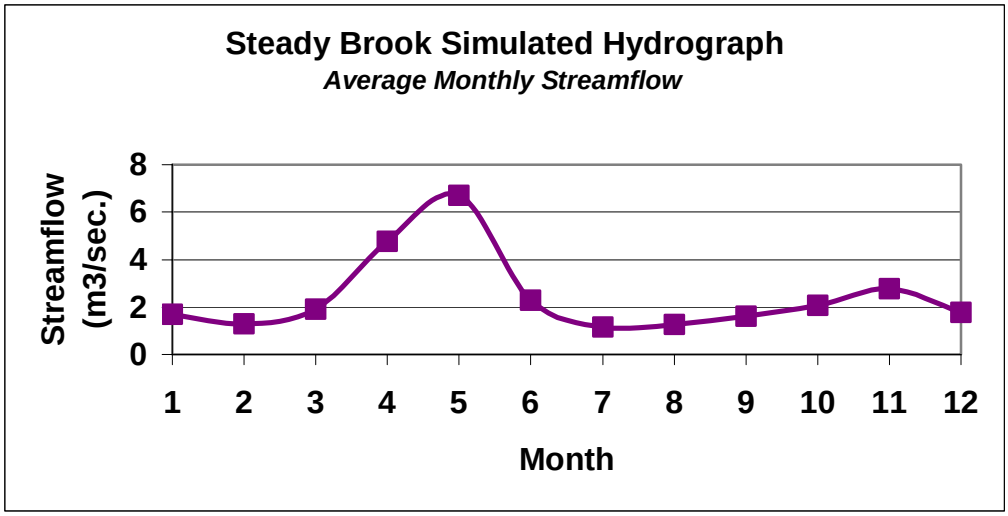


Figure 4. Simulated average monthly streamflow for Steady Brook.

With an area of 76.7 km^2, Steady Brook is the size of the smaller measured drainage basins on the island. From the simulated hydrograph above, mean annual flow from Steady Brook is 2.4 m^3/s. This annual flow, although fairly insignificant compared with other rivers on the island, is more than sufficient to meet the combined water demand of both the town of Steady Brook and Marble Mountain. The combined water demand on Steady Brook only makes up 4% of average streamflow.

As indicated above, there is more than sufficient streamflow to supply the needs of Steady Brook and Marble Mountain. This is confirmed by local residents with the observation that even during the driest summers, the town has never had to restrict water use (Don Thistle, Town Councilor, Personal Communication). In the winter, however, as stated before, the larger volume of water required for snow-making creates a lower operating pressure which can cause insufficient quantities of water for domestic use. But the problem with supply has to do with the way water is siphoned off for snow making, not the amount of water flowing from Steady Brook.

An increase in streamflow occurs on a regular basis in the watershed. The Water Resources Atlas of Newfoundland (1992) shows that most streams in Newfoundland have peak flows in the spring due to melting snow, and in the fall due to rainstorms. Based on information from hydrometric stations at Corner Brook Lake, Humber River (at Humber Village) and South Brook, the spring peak flow occurs anywhere from April to June and the fall peak flow from October to December. Monitoring data suggest that the only effect peak flows have had on water quality is to cause low chlorine residuals, as mentioned under tap water.

Forest

Forest Description

The Steady 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, white spruce, balsam fir, eastern larch, trembling aspen, white birch and jack pine (DFRA, 2002). All of these, with the exception of jack pine, occur commonly in Newfoundland. However, by far the dominant species are black spruce and balsam fir: 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, windthrow, browsing, and insect and disease, succession usually goes to the pre balsam fir type, provided that the disturbance occurs in stands that are of seed-bearing age. Regeneration is typically abundant, as overstocking is a more common problem than understocking in western Newfoundland. Localized regeneration failures can occur in forests with a very dense layer of fern and herb. The Steady Brook watershed is typical of the general area, with the balsam fir dominating on the slopes and lowlands and black spruce common on the drier hilltops.

Tree species occurring in the watershed are shown in “working groups” in Figure 5 (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 5 illustrates that 83% of the watershed is composed of predominantly balsam fir, in association with other species such as black spruce, white spruce or larch. The next most common working group is black spruce at 9%.

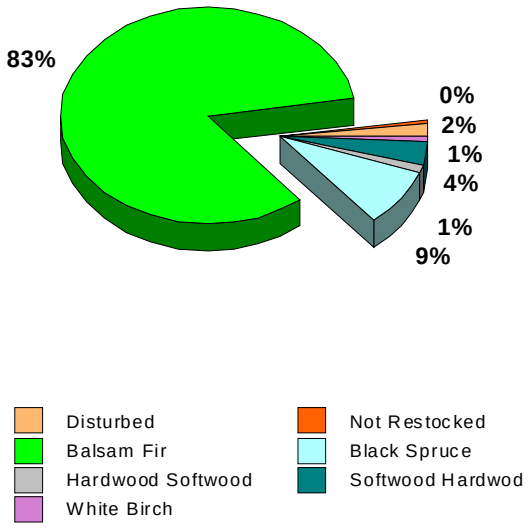


Figure 5. Working groups occurring in Steady Brook Watershed.

The forest present in the watershed falls mostly in the age classes of 61-80 years and 81-100 years (Figure 6). These age classes are categorized by foresters as mature (61-80 years) and over-mature (81-100 years) and would be considered harvestable.

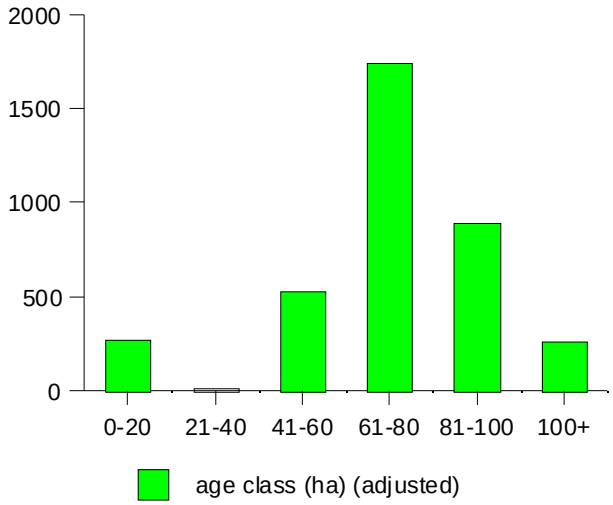


Figure 6. Age classes in the Steady Brook Watershed.

The provincial Department of Natural Resources separates the forest into productive and nonproductive, productive meaning a forest capable of yielding a marketable product, such as sawlogs or pulpwood. The area of the productive forest in the Steady Brook watershed is 3355 hectares, with a gross merchantable volume of 336,700 m^3 of

softwood (balsam fir and black spruce) and 28,000 m^3 of hardwood (mostly birch). The productive forest can be further sub-divided along a gradient of productivity as a poor, medium 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 Steady Brook watershed ranges from poor to good (Figure 7), with no "high" site class.

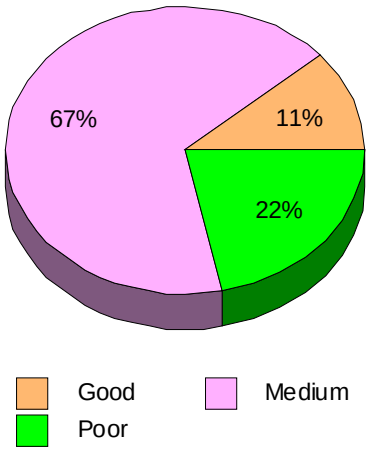


Figure 7. Site classes for the productive forest in the Steady Brook Watershed.

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, however, 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. Currently there are no documented endangered or threatened plant species in the Steady Brook watershed. Nonetheless, 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, Botanist, IFWD, Personal Communication).

Forest Disturbances

The first large-scale harvesting of the Steady Brook watershed started around 1934 and was completed by about 1945. This harvest provided fibre for the pulp and paper mill in Corner Brook, built in 1925. Trees were cut manually with bucksaws, hauled to the nearest waterbody, most likely by horse and tractor, and sent to the Humber River via Steady Brook and its tributaries. Harvesting on a smaller scale may have occurred previous to this, to supply the sawmill in Corner Brook

A more recent history of forest disturbance in the watershed includes mortality caused by a 68 ha burn in 1983. In 1983-85 and again in 1995-97, hemlock looper caused mortality in 446 ha: light mortality (0-25%) in 178 ha; moderate mortality (26-50%) in 97 ha; severe mortality (51-75%) in 21 ha; and severe mortality with break-up (76+ %) in 150 ha. In 2002 and 2003, the balsam fir sawfly caused moderate & severe defoliation, being most severe in the western and south-western part of the PWSA and moderate in the northwest and on the eastern and south-eastern edges (Hubert Crummey, Supervisor, Insect and Disease, Dept. of Natural Resources, Personal Communication). This problem was compounded with further defoliation when the hemlock looper hit again in 2003 and 2004. Results of the 2003 and 2004 insect surveys indicate pockets of severe defoliation with mortality in the north (Jones Valley), southwest (Aye, Bee, Cee and Dee Ponds), south (Yellow Marsh), and east (Steady Brook Flats).

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 Steady 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 Steady Brook watershed (Jana Fenske, Wildlife Biologist, IFWD, Personal Communication).

Big Game

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) (Figure 8). The Steady Brook watershed is located within MMA 7, which runs from Howley to Gillams. The population estimate for MMA 7, based upon aerial (helicopter) survey work done in 1994, is outlined in the table below (IFWD files).

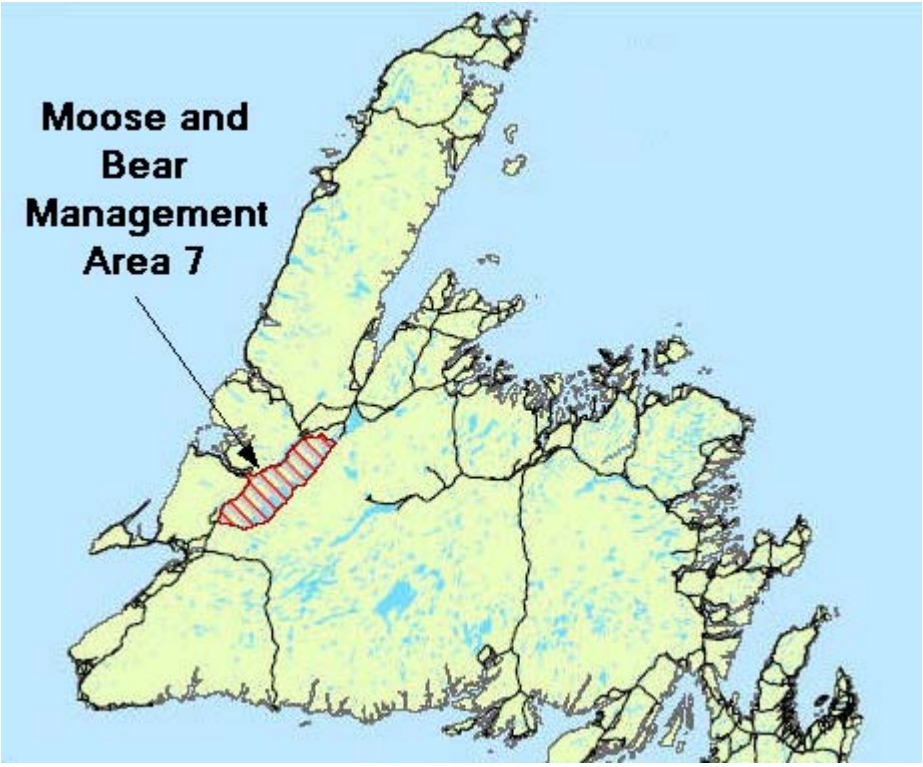


Figure 8. Moose (and Bear) Management Area 7.

Table 3. Population estimate of moose in Moose Management Area (MMA) 7, 1994.

Year Surveyed	Popn Estm.[a]	Mgmt Objective[b]	Popn. Trend[c]	Hunter Trend[d]	Quota Change Since (Year)[e]
1994	2500	Stabilize	Decrease	Stabilized	(1996) 200

[a] Population estimate obtained from the Inland Fish and Wildlife Division reports, Corner Brook
[b] This is the desired population goal. To stabilize the population, managers will set quotas so that the number of animals added to the population equals the number of animals lost annually.
[c] This is what is predicted to happen to the population based on a computer model. If the model predicts a decrease then it is expected that the population will naturally decline due to habitat conditions.
[d] This data is compiled from information provided by hunters over the past few years.
[e] Year is indicated in brackets with increase or decrease following it. In MMA 7 since 1996, there have been 200 more licenses issued.

Caribou is native to the island and may occasionally be found in the Steady 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 (Christine Doucet, Big Game Biologist, IFWD, Personal Communication). It is likely that caribou which have previously been reported in the Steady Brook watershed were part of this Corner Brook Lakes herd. Currently, hunting of these animals is not permitted.

The black bear is native to the island of Newfoundland and is found in forested areas on the island (Northcott 1980). They may occur in the Steady Brook watershed; however, no data is available on the number of black bears in Western Newfoundland (C. Doucet, Big Game Biologist, IFWD, Personal Communication). Generally, the population status of this species is tracked by information provided by hunters and the number of bear problems/sightings in communities.

The Steady Brook watershed is within Black Bear Management Area 7 (Figure 8) and hunting during the spring and fall seasons is permitted under a license. The number of black bears harvested in Management Area 7 for 1996 to 1999 were reported as 5, 3, 2 and 5 consecutively. 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 Steady 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 4 below shows fur harvest in Fur Management Area 10 (Figure 9), of which Steady Brook watershed is a part. Fur harvest data is compiled annually by fur zone by the IFWD and is not available for individual protected watershed areas.

Table 4.Fur harvest by species, as determined from fur ledgers and export permits in Fur Management Zone 10[a], 1991-2001.

Species	**91-92**	**92-93**	**93-94**	**94-95**	**95-96**	**96-97**	**97-98**	**98-99**	**99-00**	**00-01**
Coyote	0	2	4	1	0	2	0	0	2	1
Beaver	184	260	337	642	647	763	681	430	419	345
Colored Fox	205	174	357	340	352	483	246	314	308	265
Lynx	10	10	9	2	7	7	8	3	9	13
Mink	252	200	287	337	265	443	340	436	438	275
Otter	19	25	29	55	42	54	50	43	48	38
Red squirrel	3	5	15	50	110	97	149	275	51	17
Weasel	40	51	148	407	180	319	292	285	264	47
Muskrat	109	155	330	369	258	453	299	139	62	88

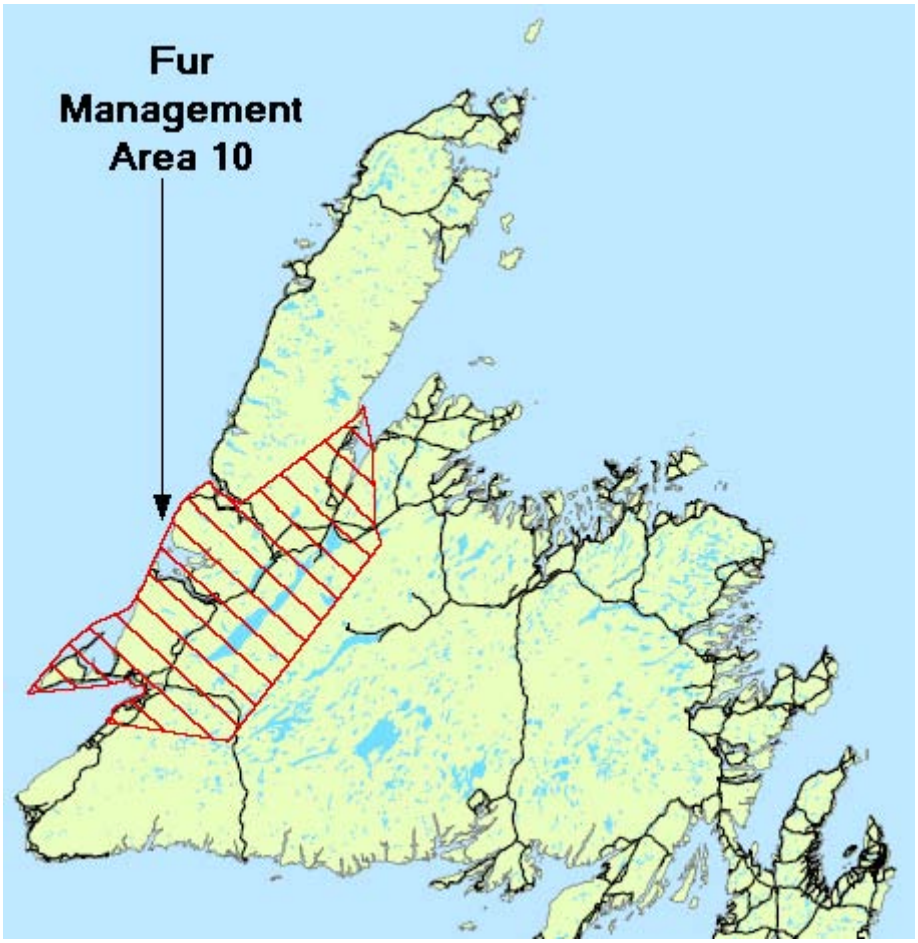


Figure 9. Fur Management Area 10.

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). Although there is no population estimate for the watershed, there have been reported sightings of marten in the area and occasionally they have been accidentally trapped/snared in the general area.

Small Mammals

Meadow voles, masked shrews, and deer mice occur throughout Western Newfoundland and are likely found in the watershed (L Soper, Regional Ecologist, DNR, Personal Communication). In addition, red-backed voles have been found in Western Newfoundland and may now be in the watershed area.

Two species of bats are native to the island: the little brown bat and the Eastern long-eared bat (also called Keen's bat). However, no data is available on their occurrence in the Steady Brook watershed.

Inland Fish Species

Information provided by local residents at an Open House of the Steady Brook Watershed Committee revealed that brook trout is an important recreational freshwater species in the area. Management of all inland fish species is currently the responsibility of the Federal Department of Fisheries and Oceans (DFO), who have available management plans for trout and salmon.

Avian Species

No studies have been carried out for bird species occurring in the Steady Brook watershed; however studies have been done in and around the general area. For example, Montevecchi and Gosse (1995) recorded a total of nine bird of prey species within the WNMF 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, Maunder 1983). Species which have been introduced are the green frog, Western chorus frog, northern leopard frog, mink frog, wood frog and a single species of toad, 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 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 and Colbo 1983).

Mineral Potential

Mineral potential has not been documented for the Steady Brook watershed however; other areas in Newfoundland with the same bedrock (Fleur de Lys Supergroup) have been documented. Minerals in the documented areas include copper/gold in veins and asbestos and titanium occurrences, both related to faults. In Corner Brook Lakes, kyanite-straurolite-garnet deposits (industrial-use garnets e.g. sandpaper) have been found, also in the Fleur de Lys Supergroup. The Steady Brook watershed has the potential to host similar deposits of industrial minerals, as well as the potential for quarries.

Historic Resources

No archeological surveys have been carried out in the Steady Brook watershed, and consequently no archeological sites are registered for the area (Ken Reynolds, Provincial Archives of Newfoundland and Labrador, Personal Communication). The potential for sites to exist within the watershed (where streams enter or leave ponds or in flat areas along streams) would be low to medium.

WATERSHED USE

Water Use

The primary use of the Steady Brook watershed is to provide quality drinking water for the Town of Steady Brook and Marble Mountain. As mentioned previously, Steady Brook has a permanent population of 425. This can increase to as many as 3000 in the winter season when Marble Mountain attracts visitors to its resort and others within the Town boundaries. A secondary use of the water collected at the intake is for snow-making, when artificially-made snow is required to supplement natural snowfall during the ski season. The average daily consumption of water in the summer is 1.3 million litres and in the winter, an additional 6.5 million litres/day are used when water is required for snow-making.

Boating, canoeing and fishing are additional water activities associated with the watershed that were recorded in the Open House survey (Table 5). These activities are enjoyed by cabin owners, Steady Brook residents and other visitors.

Land Use

Historically, utilization of the Steady Brook watershed has centered around natural resources - forestry (commercial and domestic), fishing, hunting, cabins 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, an Open House was held in the Town of Steady Brook in January, 2004, to determine the residents' and public's

interaction with and use of the watershed. All of these uses and any associated management activities are outlined below.

Forestry

Forty-five percent of the watershed, i.e. 3355 ha, is classified as productive forest (Table 1), of which 2823 ha is sufficiently stocked. The Newfoundland Forest Service has a policy to address the oldest and severely insect-damaged timber first, to harvest these trees before they start to deteriorate. Only trees over the age of 60 years are considered harvestable (Darrell Harris, District Ecosystem Manager, Dept. of Natural Resources, Personal Communication). The majority of the Steady Brook watershed falls into the age span of 61-100 years (Figure 6).

As was mentioned before, virtually all of the accessible timber in the watershed was harvested between 1934 and 1945. At present, the majority of the watershed is of harvestable age again, with an estimated 330,000 m^3 of wood available. A portion of this wood, however, cannot be harvested due to steep slopes. Corner Brook Pulp and Paper Ltd. (CBPPL), owning timber rights for the watershed, are interested in harvesting that which can be cut without impairing water quality. Of immediate concern are the trees that will die over the next few years as a result of the recent outbreak of balsam fir sawfly. Because the CBPPL mill requires a timely supply of fresh, green timber, the window to salvage insect-damaged timber is now one to two years after mortality. Under the 2003-2007 Five-Year Operating Plan, CBPPL is interested in harvesting 49,554 – 56,633 m^3, which includes areas recently killed by insects.

Should forest management operations be permitted to occur, they would include harvesting, and possibly silvicultural activities such as planting, precommercial thinning and commercial thinning, all requiring the construction of roads for access. The harvesting system currently used in Newfoundland is clearcutting, recommended for disturbance-generated forests (Smith, 1986); however a minimum number of hardwoods are left standing in compliance with the *Environmental Protection Guidelines for Ecologically Based Forest Resource Management*. These guidelines pertain to all activities in protected water supply areas, including road construction, and will be addressed in the section Management Plan.

In 1999, one kilometer of resource road was approved and constructed in the southeast corner of the watershed. The next year, CBPPL applied to the Dept. of Environment to extend this road by 3.5 km, and to harvest 72 ha (8000 m^3) of timber. Permission from the Steady Brook Town Council was not granted at that time, however, so the application was not approved.

Private industry is not alone in its interest to harvest in the watershed. From information gathered during the Open House (Table 5), domestic cutting for fuelwood and sawlogs presently exists in the area, although no cutting permits have been issued. The frequency and time of year of domestic cutting is included in the activities identified under Recreation and Tourism.

Transportation, Communication and Public Services

A road was built into the watershed in the early 1930's, entering the western boundary at Marble Mountain (see Figure 2). This portage road was built to bring supplies to logging camps, not to transport wood, as timber was still moved by water. It ran more or less parallel and to the south of Steady Brook for 5 kilometers, then crossed and ran north of Steady Brook and Line Pond to Steady Brook Lake. Side roads were built north to Jones Valley, south to Yellow Marsh and southwest to Steady Brook flats. Another portage road ran from the south end of Line Pond to Bee Pond.

These roads are now in various stages of being reclaimed by nature. Some of them are passable only by all-terrain vehicles or snowmobiles. Stretches of the roads occurring on slopes have been washed out to rock and boulders, are difficult to manoeuver, and provide channels for erosion. The main road is barely passable by 4-wheel drive vehicles as far as Line Pond, as is the road north to Jones Pond which continues northwest, outside of the watershed.

The most recently constructed road is one kilometer of resource (logging) road, approved and subsequently built in the watershed in 1999 by Corner Brook Pulp and Paper Limited (mentioned under Forestry). It is an extension of the Copper Lakes Road, entering the watershed near the southeast boundary, and continuing as far as Dee Pond.

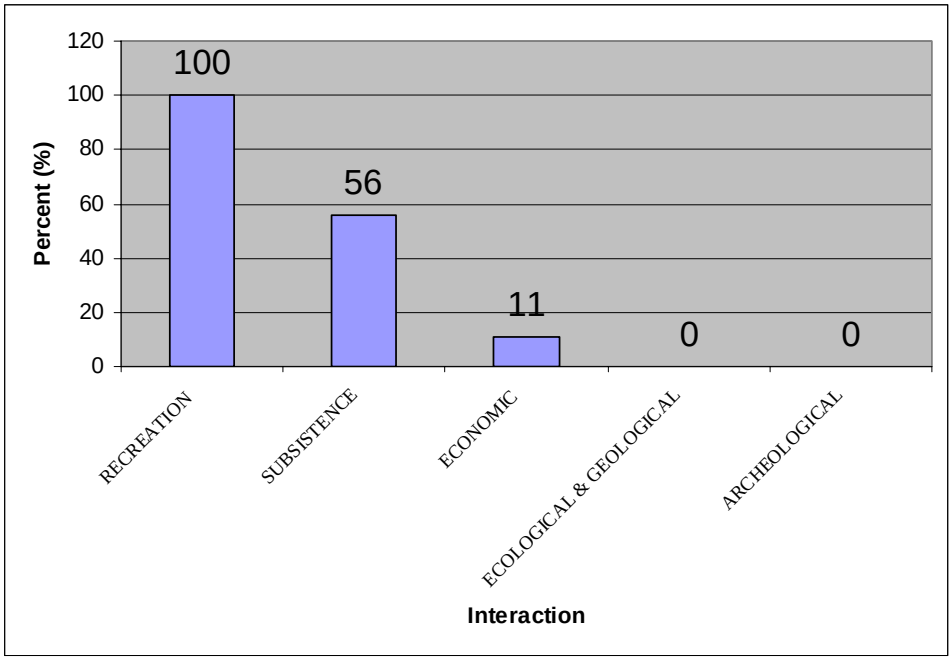
Two transmission lines run through the watershed. The Bay d'Espoir line enters the southeast corner of the watershed and runs northwest close to the southern boundary, leaving the watershed at the southwest corner. The Cat Arm line enters the watershed at the northeastern boundary, running west-southwest, just north of Steady Brook Lake, Line Pond and Steady Brook. It crosses Steady Brook approximately 1.5 km upstream from the intake, and exits the watershed at the southwest corner as well. Combined, the transmission lines run for a length of approximately 16 km in the watershed, at a width of 37 meters (Randy Ralph, Newfoundland Hydro, Personal Communication). Periodically, it is necessary to remove vegetation from the right-of-ways, to ensure access for line maintenance crews. This was last done in 2002. Herbicides are not permitted in protected water supply areas; instead Newfoundland Hydro uses brush saws and chainsaws to remove unwanted vegetation. The Town Council and Dept. of Environment are both notified in advance by Newfoundland Hydro of any work planned for the transmission lines.

A fibre optic line runs in the same right-of-way as the Cat Arm transmission line, and has no energized lines (Dave Lewis, Engineering Technician, Newfoundland Power, Personal Communication). The line was established in 1983, and the poles were installed during the winter to reduce the amount of ground disturbance. The utility poles used to carry the fibre optic line are chromate copper arsenate (CCA) treated, and as a result were identified as a concern by the original Watershed Committee in February, 2001. A subsequent inspection of the location of these utility poles by helicopter was conducted by the Dept. of Environment and Newfoundland Power. A couple of the utility poles observed were questionable as to whether they were within the 30 meter buffer of streams that appear on a 1:50,000 scale map (Paul Barnable, Regional Watershed Management

Specialist, Dept. of Environment, Personal Communication). However, it was decided that the potential damage caused by replacing these questionable poles did not justify their replacement.

Recreation and Tourism

A number of other activities associated with the Steady Brook watershed can be classified as recreation and/or tourism. Information for these activities was obtained almost exclusively from an Open House held specifically to determine the users' interactions with the watershed. In a survey of residents and other users, the 9 respondents were asked to indicate which of five general uses of the watershed applied to them - recreation, subsistence, economic, ecological and geological, and archeological. Figure 10 shows the percent of the public's utilization of the watershed based on these categories, whose definitions are listed below the figure. All of the respondents indicated they use the watershed for recreation, and over half indicated subsistence.



Recreation – any activity that takes place for pleasure;
Subsistence – the food, shelter and energy required to support life;
Economic – any activity that takes place for monetary reasons;
Ecological and Geological – values that relate to living organisms and their interaction with the environment;
Archeological – values that are associated with the material remains of ancient civilizations or cultures.

Figure 10. Percent of watershed use by interaction.

Respondents were next asked to identify their specific uses of the watershed by selecting from a list provided, indicating the time of year of the activity (Table 5). Twenty-eight uses were reported, many of them occurring on a year-round basis. After

identifying their uses, they were then asked to mark the location of their activities on a map. The map in Figure 11 shows the consolidation of all uses specified by all respondents.

Table 5.Time of year and purpose for visiting Steady Brook watershed.

INTERACTION	**SEASON**				
	Winter	**Spring**	**Summer**	**Fall**	**Year-Round**
Animal Watch					
ATV Use					
Berry Picking					
Bird Hunting					
Bird Watching					
Boating					
Camping					
Canoeing					
Cross Country Skiing					
Duck Hunting					
Fishing					
Fuelwood Cutting					
Hiking					
Hunting					
Legal Cabins (Crown)					
Moose Hunt					
Mountain Biking					
Rare Plants					
Salmon Fishing					
Sawlog Cutting					
Sight Seeing					
Skiing					
Snaring					
Snowmobiling					
Snowshoeing					
Trapping					
Trout Fishing					
Crafts & Woodworking					

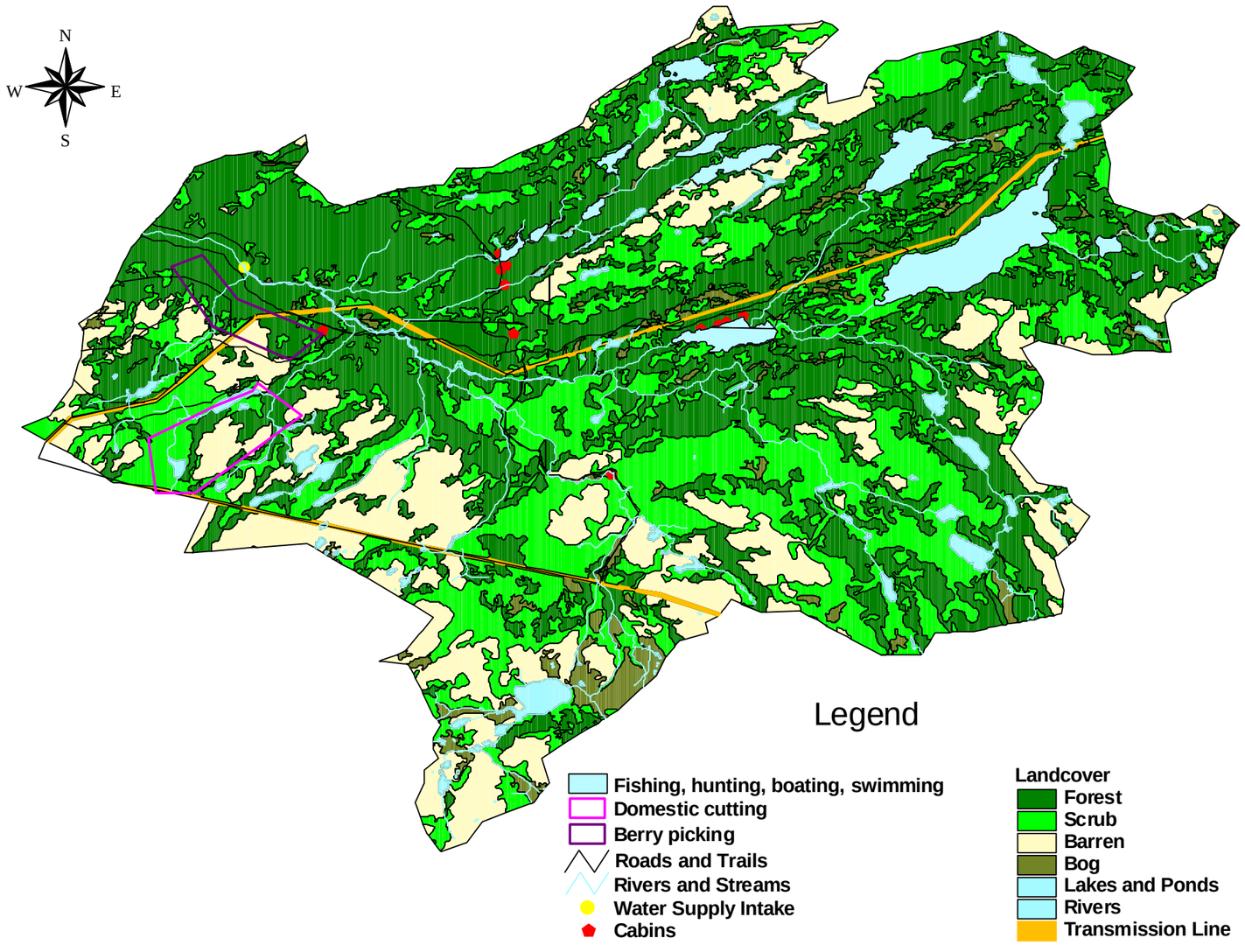


Figure 11. Location of identified uses of the Steady Brook watershed.

Participants of the Open House were also asked to indicate how often they were involved in these activities. Figure 12 illustrates the frequency of the identified activities based on number of times per year. The most frequent activities were all-terrain vehicle (ATV) use, boating, duck hunting, fishing (particularly trout), and hiking. The complete results of the survey administered at the Open House can be found in Appendix C.

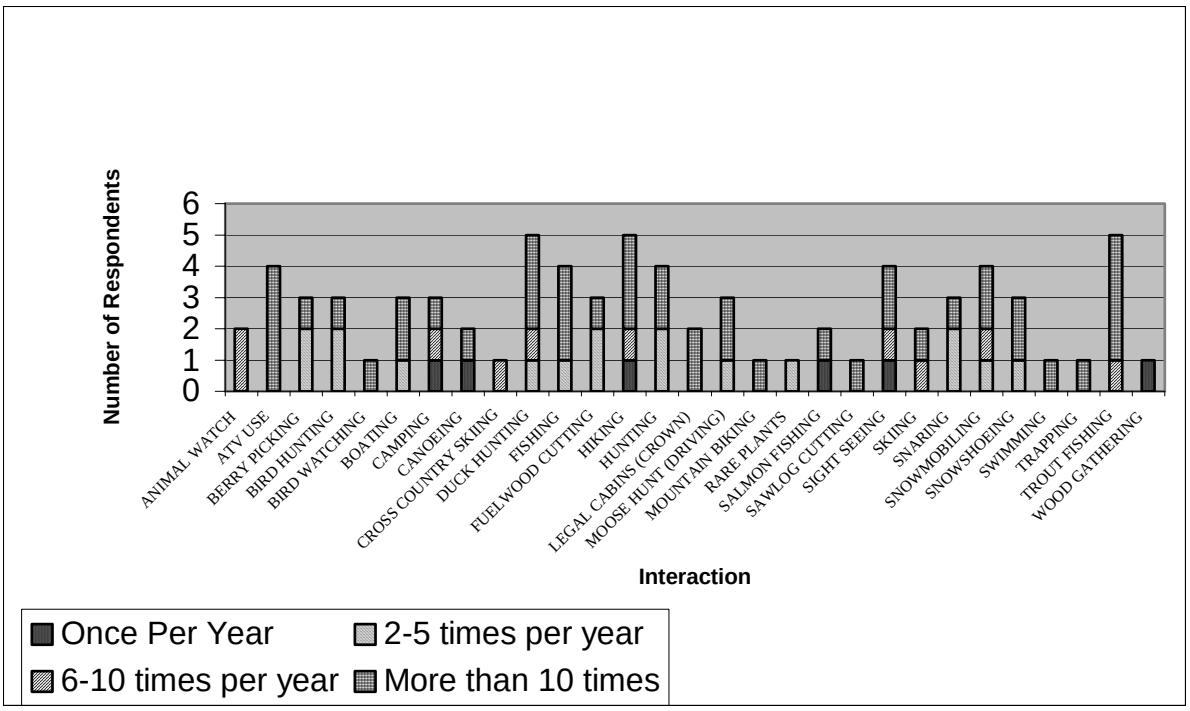


Figure 12. Frequency of use by interaction.

Due to the potentially serious risk associated with cabin use in the watershed, a more detailed discussion concerning legal cabins is required. Owners of remote cabins, in possession of a Permit for Occupancy of Crown Land, are legally entitled to occupy Crown Land as indicated on the Permit. There are twelve cabins currently inside the watershed area (Figure 11), eleven with a *License To Occupy* (Crown land permit) and one with no title (Tim Anderson, Land Management Officer, Dept. of Gov't Services and Land). Of the twelve cabins inside the watershed, five are located on the shores of Line Pond, about 6 km upstream from the intake, and one (a deserted cabin) is on Jones Pond, approximately 4 km from the intake on East Steady Brook. The remaining six are not located near a body of water of any size. In addition to cabins within the watershed, at least seven cabins with a *License To Occupy* are located outside the northern boundary of the watershed, and sole access to these cabins is through the watershed.

A section of the snowmobile trail system connecting Corner Brook and Deer Lake runs through the Steady Brook watershed. The trail and its bridges are maintained by the Western Sno-Riders, a volunteer snowmobile club. This trail is part of the system that connects one end of the island to the other and is therefore the major route when traveling east to west or vice versa. Snowmobiling is very popular in Newfoundland and these

trails, open to anyone, are heavily used (Jason Pond, Vice-President, Western Sno-Riders, Personal Communication). The Humber Valley Resort built a new snowmobile trail in 2004 from just outside the Pasadena PWSA to a lookout point north of the Steady Brook watershed. From this point, by upgrading old existing trails, the Resort has recently obtained access to the Marble Mountain Resort, through the Steady Brook watershed.

Outfitting and adventure tourism both fall into the category of recreation and tourism. At the time of this report, there are no known outfitters operating in the Steady Brook watershed (Dan Chaisson, Acting Manager of Outdoor Product Development, Dept. of Tourism, Culture and Recreation, Personal Communication). In the past, snowmobiles have been rented (but not guided) from the Marble Mountain area, and would have traveled through the watershed. Presently, one adventure tourism group uses the watershed for hiking excursions and orienteering training (Joe Dicks, President, Explore Newfoundland Adventures, Personal Communications).

Mining

There are no existing mines or quarries within the Steady Brook watershed and no mineral grants (EMRC, 1989). At present, potential for development in the mining field looks negligible, but the discovery of new uses for existing minerals could promote development.

Compatibility of Uses

The primary use of the Steady Brook watershed is to supply drinking water for the Town of Steady 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 water quality of Steady Brook watershed has been generally good up to 2003, with no serious water quality problems. Hence the current secondary uses appear to be compatible with the primary use of supplying drinking water. Future secondary uses must also 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. For example, an anticipated future use is the proposed harvesting operation in the watershed. Regulations and management practices pertaining to harvesting operations would have to ensure the integrity of the water supply. Such is the case in other PWSAs in Newfoundland. Peter's River Basin and Gander Lake watershed, presently (and in the past), are able to provide safe drinking water while permitting forest harvesting.

Secondary uses must not only be compatible with the protection of water quality, but with each other. The secondary uses of the Steady Brook watershed as they presently exist are generally compatible, the size of the watershed being a contributing factor. And

potential future uses, such as mining and forestry, 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 Steady Brook watershed is also divided among a number of parties. Table 6 lists the agencies responsible for management of PWSAs, their specific responsibilities, the legislation involved and development regulated.

Department of Environment and Conservation

The Environment and Conservation Minister's first responsibility through the *Water Resources Act (2002)* is to designate the area surrounding the source of public water supply as a PWSA. The Steady Brook watershed was designated a PWSA in 1977, ensuring the protection of drinking water. Further, the Minister also regulates "resource development and other activities to be undertaken" in a PWSA, "and those activities shall not be undertaken without first obtaining authorization from the Minister". The act also prohibits any activity that impairs the quality of the water or diminishes the quantity of water. Additional legislation under this department, 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 legal cabins on Crown land anywhere is regulated by this Division, and can only proceed with a *License To Occupy* (discussed earlier under recreational uses).

Municipality

The municipality operating a water works has the responsibility, under the *Water Resources Act*, to protect the source(s) of public water supply. Steady Brook is the sole municipality dependent upon drinking water from the Steady Brook watershed. The *Municipality Act (1999)* gives further power to the Municipal 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. These two acts allow the municipality along with the Minister of Environment and Conservation to control development in the watershed, even if the watershed boundaries fall outside the municipal boundaries. To date no municipal policies have been developed for the Steady 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 ▫ Policy for Land and Water Related Developments in Protected Public Water Supply Areas	▪ Provides a framework for protection and preservation of water quality ▫ Provides regulations for heating oil storage tank systems ▪ Designations of and enforcements within Protected Water Supply Areas	▪ All Developments ▫ Legal Cabins ▪ All Developments ▫ Transmission Lines ▫ All Developments
Department of Environment and Conservation – Crown Lands Administration Division	▪ Lands Act, 1991 ▫ License to Occupy	▪ Grants permits for occupancy of Crown Land	▫ Legal cabins
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
Town of Steady Brook	▪ Municipalities Act, 1999	▪ Makes regulations to prevent the pollution of, and prohibit and control the use of municipality's water supply.	▪ All Developments

Agency Responsible	Legislation, Regulations / Policies	Responsibilities	Development Regulated
Steady Brook Watershed Monitoring Committee	▪ Water Resources Act, 2002	▪ Committee Terms of Reference	▪ All Developments
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 and domestic cutting, and access road construction; prepares timber management plans	▪ Domestic and Commercial Forest Harvesting
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

The Town of Steady Brook first formed a Watershed Monitoring Committee after a public meeting in 1999 to address concerns about the application for forest harvesting in the watershed. The Steady Brook Watershed Monitoring Committee was endorsed by the Minister of Environment in 2002 under the *Water Resources Act* following a request from the Town Council. The Committee was comprised of representatives of the Town Council, Steady Brook residents, provincial departments of Environment, Municipal Affairs and Government Services and the local MHA. A member of the Marble Mountain Development Corporation was added at a later date. This Committee does not have a Terms of Reference to date.

Department of Natural Resources

Two agencies within the Department of Natural Resources also have responsibilities for the development of resources in the Steady Brook watershed. The Forest Resources Division administers the *Forestry Act (1990)* and oversees forest operations on all Crown lands. The entire Steady Brook watershed is owned by the Crown. 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.

Other Agencies

Fisheries and Oceans Canada 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 regulates the recreational fishery, which is a common activity in the watershed. Through the *Public Health Act* (*1996*) *Sanitation Regulations* the Department of Health and Community Services regulates the standards for disposal of sewage, an 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 Steady Brook watershed

The Marble Mountain Development Corporation manages the Marble Mountain Protected Area established in 1977, three-quarters of which overlaps the western third of the watershed (see Figure 2). Declaration of the Marble Mountain Protected Area places additional restrictions on development in that portion of the Steady Brook watershed. Under the *Urban and Rural Planning Act (2000)* the Minister authorized the preparation of the Marble Mountain Master Plan, to conserve the natural amenities of the area while developing them for public use. Although there are no plans for development in the near future (Perry Butt, Marble Mountain Development Corporation, Personal Communication), longer-term developments could possibly have implications on water quality.

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 areas. 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. The Town of Steady Brook has been aware of the potential for harm to its drinking water supply at least since the first Watershed Monitoring Committee was formed in 1999. Citizens continue to express their concerns for water quality, as at the Open House held in January, 2004. These concerns and some suggestions for management of the watershed are outlined in Part C of the results of the Open House survey, Appendix C.

While water quality data (not monitored for chemical and physical parameters since October 2003) suggests that current uses are having no impact, it is important to identify potential sources and types of pollutants, of 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. The Writing Group sub-committee of the Steady Brook Watershed Management Planning Committee identified the potential contaminants (Table 7), which are expanded upon in the discussion following the table.

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 Streamflow
	E. coli, coliforms, Giardia	Wildlife
Snowmaking	Sediment	Increased volume of water required stirs up sediment
Forestry	Sediment	Forest cover removal (Domestic and Commercial)
		Construction and use of logging roads
	Nutrients	Forest cover removal (Domestic and Commercial)
	Petroleum products	Fuel spills or leaks
	Chlorination by-products from organic loading	Forest cover removal (Domestic and Commercial)
		Construction and use of logging roads

Watershed Use/Activity	Potential Contaminant	Cause
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 Streamflow

As stated before, the primary use of the Steady Brook watershed is to provide safe drinking water for the Town. 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 (DOE, Date Unknown). 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.

A secondary use of the water supply, snow-making, also affects water quality and quantity. The increased volume of water required for snow-making stirs up sediment in the area of the intake, causing more sediment to enter the system. This is good for snow-making, which requires a lot of sediment to assist in the formation of snow crystals, but not for drinking water. This could and does cause clogging of filters, which sets off a breakdown of the water supply system. The quantity of water is affected because the increased volume of water required for snow making reduces the operating pressure, which in turn causes insufficient quantities of water for domestic use.

Increased streamflow can also affect the quality of Steady Brook's drinking water. First, flooding of land adjacent to Line Pond could increase the risk of introducing pathogenic microbes originating from the pit privies of the five cabins on Line Pond, into the water supply. The *Public Health Act, Sanitation Regulations* requires a 30 metre minimum setback of disposal areas to surface water. Measurements taken in May, 2005 indicate that the pit privies range from 20 to 27 metres from what is probably the seasonal high water mark of the pond.

Second, due to the nonporous characteristics of the soil and bedrock, increased streamflow could introduce sediment into the water supply. A natural increased streamflow in the spring and late fall does cause sedimentation of 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, 1997).

Forestry

Different aspects of forestry 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 to 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 (NRC, 1982). Buffer zone widths to negate the affects of these activities have been established in various policies and regulations. Whether they need to be supplemented will be discussed under Management Strategy Components.

Sometimes after a harvesting operation planting is required, and in special cases, the application of herbicides is necessary to remove unwanted vegetation from planting sites. These toxic substances could leach into the water supply. The use of toxic fire retardants to suppress fires could also supply unwanted chemicals. However the application of pesticides (which includes herbicides) and toxic fire retardants are already prohibited in PWSAs under existing legislation.

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, Newfoundland Hydro, Personal Communication). 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. Monitoring of arsenic in the source water since 1983 (five years after the CCA poles were installed) show arsenic levels below the Canadian guidelines (Appendix B). Inorganic arsenic is a carcinogen and poisonous at high levels (ATSDR, 2003). A policy exists for the use of treated utility poles in PWSAs, but the guidelines need to be clarified.

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 drives, 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.

The presence of cabins in the watershed, especially those next to a waterbody, introduces the possibility of contamination of the water supply through two means. First, the storage of any amount of fuel for heating or other purposes creates the potential for f uel spills. Second, as discussed under increased streamflow, the use of pit privies for sewage disposal, if not in compliance with regulations set out under the *Public Health Act*, could introduce bacterial pathogens into the water supply. Pathogens such as coliforms and a specific type of coliform, Escherichia coli (E. coli) can cause serious infections of the digestive tract. Any of the activities listed as recreational uses in Table 5 of the previous section could also contaminate the water supply through fuel spills and/or incorrect sewage disposal.

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, the contamination by human sewage must also be taken into account.

Mining

Quarries and mines do not yet exist in the watershed, but the potential exists for development. Possible issues that could arise in 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, sediments, nutrients, pathogenic microbes (E. coli, Giardia, coliforms), chlorination by-products (THMs, HAAs), and toxins (arsenic, pesticides). These potential contaminants will be assessed and assigned a priority ranking in the following section. Salt as a potential threat has not been discussed, but can be included to ensure all possible categories are listed. However, for the Steady Brook watershed, salt does not have any potential causes at this time.

RISK ASSESSMENT

The previous exercise created six categories of potential contaminants that could be of concern to the drinking quality of the Steady Brook water supply, and these contaminants each have anywhere from three to twelve potential causes, for a total of forty potential causes of 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" (Walter et al, 2000). 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). The second method (Shook, 1993), requires more comprehensive knowledge of the characteristics of the contaminants and of the watershed. Both methods are described.

Method 1 – Risk Matrix Analysis

The section on potential contaminants discusses possible threats to water quality from existing and potential future uses of the watershed. In order to determine the risk of these threats, the first method entailed the following steps: assess each potential contaminant for magnitude of consequences or severity of risk; then evaluate each potential cause of contamination as to its probability of occurrence. This assessment and evaluation was

conducted by the Writing Group sub-committee to the best of their knowledge, and verified by resource people in the appropriate corresponding agencies.

Each potential contaminant was assessed for its severity of risk, and ranked as minor, moderate, critical or catastrophic (Table 8). For example, pathogenic microbes were rated as the most severe risk (catastrophic), because they could be life threatening. Chlorination by-products and toxins were assessed as critical, as they have the potential to cause cancerous, reproductive and developmental effects. Petroleum products and sediments were assessed as moderate, their effects being less serious, and nutrients and salt were rated as minor risks, as the consequences of these contaminants in the amounts possible would be minimal. Next, potential causes for each of the risks were listed and then assessed for the probability of contamination occurring, using a scale of very low, low, medium and high. The assessment for probability of occurrence was a qualitative analysis, based on the worst-case scenario, such as very dry or very wet conditions. It was also based on conditions as are known to exist, such as the fact that the only inhabited cabins situated next to a body of water are those on Line Pond, a distance of 5.5 km from the intake. So to illustrate, the probability of mineral exploration causing an increase in nutrients in the water supply was assessed “low”, whereas the probability that some level of sedimentation will occur as a result of mining was assessed as “high”.

Table 8. Priority ranking for potential threats to water quality.

Potential Contaminant	Severity of Risk	Potential Cause	Probability of Occurrence	Priority Rank
Pathogenic Microbes (E. Coli, Coliforms, Giardia)	Catastrophic	Pit Privies	Medium[3]	High
		Cabins (Swimming)	Low	Medium
		Wildlife	High	High
		Camping	Low	Medium
Chlorination By-Products (THMs, HAAs)	Critical	Domestic Cutting	Low	Medium
		Commercial Harvesting	Medium	Medium
		Forest Road Construction/Use	Low	Medium
		Natural Organic Loading	Medium	Medium
		Treatment (Chlorine)	N/A[3]	N/A[3]
Toxins (Arsenic) (Pesticides)	Critical	Utility Line CCA Poles	Low	Medium
		Forest Protection	N/A[4]	N/A[4]
		Silviculture	N/A[4]	N/A[4]
Petroleum Products	Moderate	Motorized Vehicle Use [1]	High	Medium
		Camping & Recreation [2]	Low	Low
		Domestic Cutting	Medium	Medium
		Cabins (Fuel Storage)	Low	Low
		Commercial Harvesting	Medium	Medium
		Forest Road Construction/Use	Medium	Medium
		Utility Line Structure Maint.	Low	Low
		Utility Line Vegetation Maint.	Medium	Medium
		Silviculture	Low	Very Low
		Mineral Exploration	Low	Very Low
		Quarrying / Mining	Medium	Medium
		Aircraft	Very Low	Very Low
Sediments	Moderate	Motorized Vehicle Use [1]	High	Medium
		Domestic Cutting	Low	Low
		Commercial Harvesting	High	Medium
		Forest Road Construction/Use	High	Medium
		Utility Line Structure Maint.	Low	Low
		Utility Line Vegetation Maint.	Low	Low
		Mineral Exploration	Low	Low
		Quarrying / Mining	High	Medium
		Snowmaking	High	Medium
		Increased Streamflow	High	Medium
		Forest Fire	Medium	Medium
Nutrients	Minor	Commercial Harvesting	Medium	Low
		Domestic Cutting	Very Low	Very Low
		Mineral Exploration	Very Low	Very Low
		Quarrying and Mining	Low	Very Low
		Forest Fire	Medium	Low
Salt	Minor	*No Cause at Present*	N/A	N/A

[1] Includes ATV, snowmobile and motorized boats
[2] Includes animal watch, berry picking, bird hunting, bird watching, canoeing, skiing, fishing, hiking, hunting, mountain biking, rare plants, sight seeing, snaring, snowshoeing, trapping, and wood gathering.
[3] Based on existing distances from pit privies to water; if 30 metres is achieved, probability can be reduced to low.
[3] The amount of chlorine added to the drinking water cannot be controlled by watershed protection practices.
[4] The application of pesticides and toxic fire retardants are not permitted in a public water supply area.

To determine the priority ranking for each potential cause, the severity of the contamination risk was plotted against the probability of that risk occurring using a matrix for priority ranking (Glenn Keays, Birchwood Environmental Management, Personal Communication) illustrated in Figure 13. The matrix assigned each potential cause a ranking of very low, low, medium or high. Figure 13 shows exactly where each potential cause places in the matrix, for each potential contaminant.

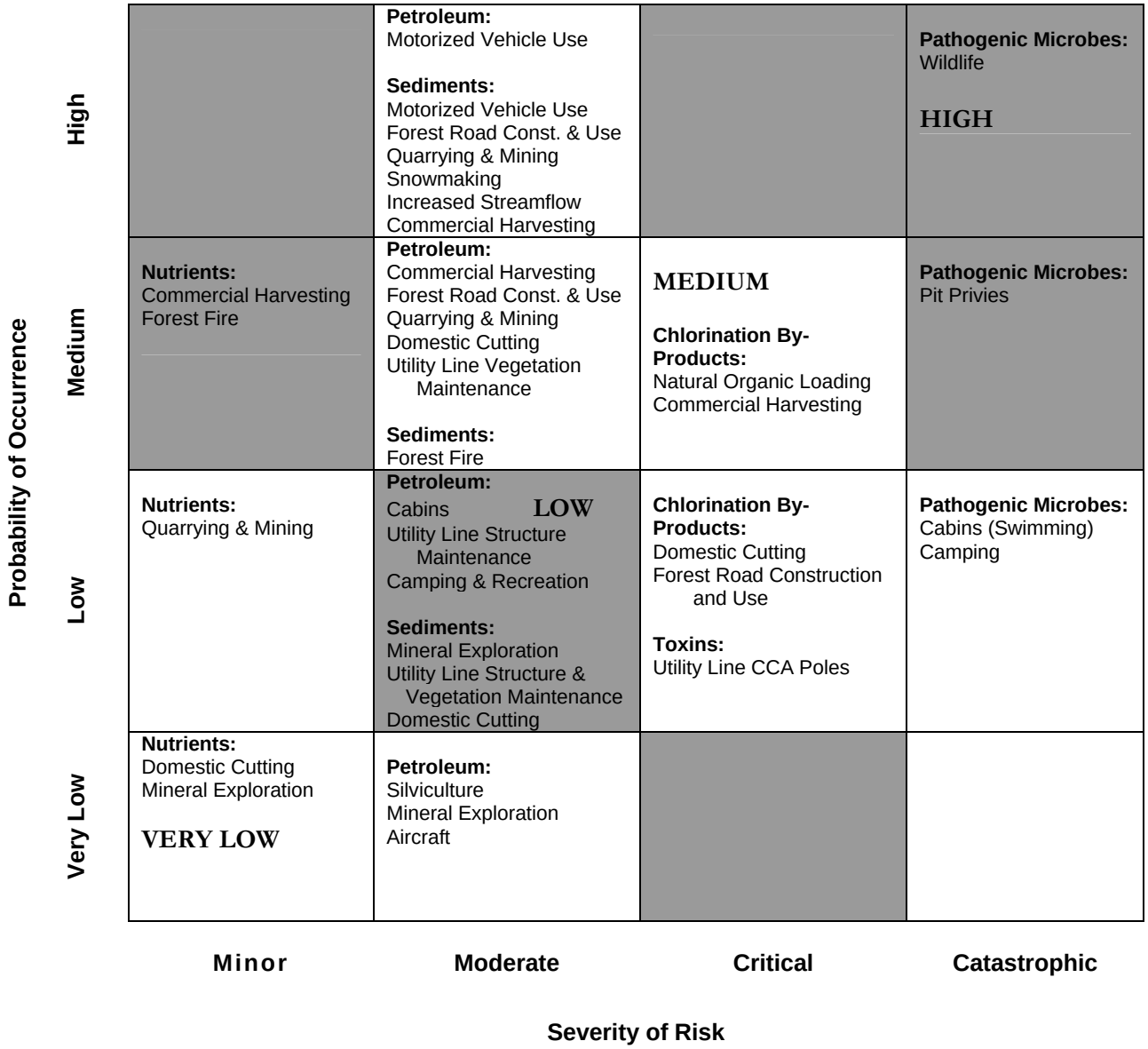


Figure 13. Risk matrix for priority ranking.

As can be seen in the Figure 13, the priority ranking of the risk of contamination to the water supply ranged from very low to high. Two potential causes of pathogenic microbes, wildlife and pit privies, ranked high. The two remaining potential causes of pathogenic microbes (camping and swimming), all potential causes of chlorination by-products, and toxins from CCA poles were ranked as medium. This is not surprising as pathogenic microbes were assessed as catastrophic and chlorination by-products and toxins as critical. The majority of potential causes of petroleum products and sediments also ranked medium. About half of the total number of potential causes of pollutants identified in the watershed ranked as medium. The remainder of the potential causes was divided evenly between low and very low.

Based on the priority ranking, the Steady Brook Monitoring Committee should first concentrate efforts on the two potential causes that ranked high, and then move on to the twenty causes ranked medium. Although this seems like a large number, further scrutiny shows that grouping them by potential contaminant and/or by the use creating the potential cause simplifies the job. For example, all the potential causes of petroleum spills or leaks, regardless of the originating watershed use, might be addressed with one management alternative. Similarly, if a number of contaminants can be caused by recreational users (petroleum and sediment from motorized vehicles and pathogenic microbes from cabins and camping), then they might all be addressed by the same means.

Method 2 - Numerical Risk Index

To supplement the risk matrix analysis, a numerical risk index was also developed for the Steady Brook watershed. This numerically based risk analysis method involves both subjective and qualitative analysis, allows for linkage between water quality parameters, and involves a more 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 9).

Table 9. 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 D) 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.

Comparison of Methods

Table 10 lists the identified potential sources of water contamination, the numerical risk index (RI_{Total}) derived from method 2 and the priority rank from from the risk matrix analysis (method 1). The two risk analysis methods show fairly close agreement. The numerical risk analysis, however, highlights the danger of potential water quality contamination from difficult to control sources (i.e., the top six): wildlife, uncontrolled recreational camping, natural organic loading, recreational motorized vehicle use,

increased streamflow and forest fires. Approaches to dealing with such difficult to control potential pollution sources will have to be given special consideration. Of these top six potential causes of water quality contamination, four are from natural activity-wildlife, natural organic loading, increased streamflow and forest fire. From this analysis, it appears the controlling factor lowering risk index scores is the regulatory adequacy. Any activity that could be regulated received a lower risk index score, which would account for any discrepancy between the two risk analysis methods.

Table 10. Ranking of potential sources of contamination.

Potential Contaminant	Potential Cause	RI total (Method 2: Numerical Analysis)	Priority Rank (Method 1: Risk Matrix)
Pathogens	Wildlife	259	High
Pathogens	Camping	248	Medium
CBP	Natural Organic Loading	241	Medium
Sediments	Motorized Vehicle Use	235	Medium
Sediments	Increased Streamflow	235	Medium
Sediments	Forest Fire	235	Medium
Pathogens	Pit Privies	232	High
Toxins	Forest Protection	225	N/A
Toxins	Silviculture	225	N/A
Petroleum Products	Motorized Vehicle Use	224	Medium
Pathogens	Cabins	220	Medium
Petroleum Products	Camping & Recreation	219	Low
Sediments	Forest Road Construction/Use	219	Medium
Nutrients	Forest Fire	219	Low
Petroleum Products	Domestic Cutting	213	Medium
Toxins	Utility Line CCA Poles	210	Medium
Petroleum Products	Forest Road Construction/Use	205	Medium
Petroleum Products	Utility Line Structure Maintenance	205	Low
Petroleum Products	Mineral Exploration	205	Low
Petroleum Products	Quarrying/ Mining	205	Medium
Petroleum Products	Aircraft	205	Very Low
Sediments	Domestic Cutting	205	Low
Sediments	Utility Line Structure Maintenance	205	Low
Sediments	Utility Line Vegetation Maintenance	201	Low
Petroleum Products	Cabins (Fuel Storage)	199	Low
Petroleum Products	Utility Line Vegetation Maintenance	199	Medium
Petroleum Products	Silviculture	199	Low
Sediments	Commercial Harvesting	199	Medium
Sediments	Snowmaking	199	Medium
Sediments	Quarrying/ Mining	199	Medium
Nutrients	Domestic Cutting	199	Very Low
CBP	Treatment	197	N/A
Nutrients	Commercial Harvesting	195	Low

Potential Contaminant	Potential Cause	RI total (Method 2: Numerical Analysis)	Priority Rank (Method 1: Risk Matrix)
Sediments	Mineral Exploration	194	Low
CBP	Domestic Cutting	194	Medium
CBP	Forest Road Construction/Use	194	Medium
Petroleum Products	Commercial Harvesting	189	Medium
Nutrients	Mineral Exploration	189	Very Low
Nutrients	Quarrying/ Mining	189	Very Low
CBP	Commercial Harvesting	185	Medium
Salt	Forest Road Construction/Use	119	N/A

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*) 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 (Table 17), 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 (Appendix E, Map 1). 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 Steady Brook sensitivity analysis are compared to the other plans in the table below.

Table 11. Slope categories for three watersheds in Newfoundland.

Peter's River WMP	Gander Lake WMP	Steady 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%

Slope was determined using a 1:250, 000 Digital Elevation Model (DEM) from Natural Resources Canada, the only scale available at the time of analysis (Appendix E, Map 2). Using a higher resolution DEM product (e.g., 1:50,000) is preferable for greater accuracy. The watershed boundary and intake location layers were sourced from the Water Resources Management Division. The general methodology used in the sensitivity analysis can be described as follows:

- Watershed Management Specialists determined the guidelines for the four development zones based on buffer widths from provincial regulations, slope and distance from the intake (Table 12);
- The watershed boundary was used as a base and digital water layers were added;
- All waterbodies (river, streams and lakes/ponds) were manually classified by stream order;
- All waterbodies were given a buffer width code (Appendix E, Map 3) based on parameters set by WMS (stream order 3 or larger classified as major tributaries);
- The water supply intake was buffered at 100 meters, 1 kilometer and 8 kilometers (Appendix E, Map 4);
- The slope layer was partitioned into categories: > 20%, 5-20%, and < 5%;

- Classified slope, intake buffer and waterbody buffer layers were overlaid to create the final "Proposed Development Zones" map (Figure 14).

The following tables summarize the criteria used in determining each development zone, and the source for each determining criteria.

Table 12. Development zone criteria.

Zone	Buffer width	Water Body	Slope	Distance from Intake
1. No Development Activity	150m	For a distance of one km upstream and 100 m downstream of intake	N/A	1 km
	75m	Main river channel		
	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. Distance from the intake was also based on stream order, Zone 3 including the main stem of Steady Brook from the outlet of Steady Brook Lake and Zone 4 including only lower order tributaries. Slope recommendations were based on other provincial watershed management findings.

Map Scale

The determination of the proposed development zones in the sensitivity analysis was performed using the best mapping tools available at the time. The coarsest (smallest) map scale used, however, governs the refinement of the development zones and any use of the end product should keep this point in mind and be used at the user's own risk. Slope determined from the 1:250,000 DEM was the coarsest map scale used, and so the development zone map produced is only suitable at the planning or reconnaissance level.

For more intensive resource activities in the Steady Brook watershed such as forest harvesting, finer (larger) scale mapping at the semi-detailed and detailed level will probably be used (Table 13). In order for the sensitivity mapping of proposed development zones to be of practical use to different users of the Steady Brook watershed, the differences in mapping scales will have to be considered. As more refined (larger scale) mapping becomes available, the proposed development zone mapping should be updated to reflect this as far as is practical. Better scale digital maps are expected to become available in March 2006.

Table 13. Generalized categorization of mapping scales (IRECS, 1997).

Scale	Map Refinement
1:1000-1:10,000	Intensive
1:10,000-1:25,000	Detailed
1:25,000-1:100,000	Semi-detailed
1:100,000-1:1,000,000	Reconnaissance

Given the scale of the DEM used, and the original intent to create a paper map for planning purposes, using the produced sensitivity map in a management or operational fashion is not appropriate. Even with a better scale DEM, resource agencies such as Forestry often produce their own mapping at a large scale (e.g. 1:25,000, 1:12,500) than the data available to the Water Resources Management Division (usually 1:50,000). In future Watershed Management Plans, this issue needs to be addressed early in the process as resource management will most certainly be a factor.

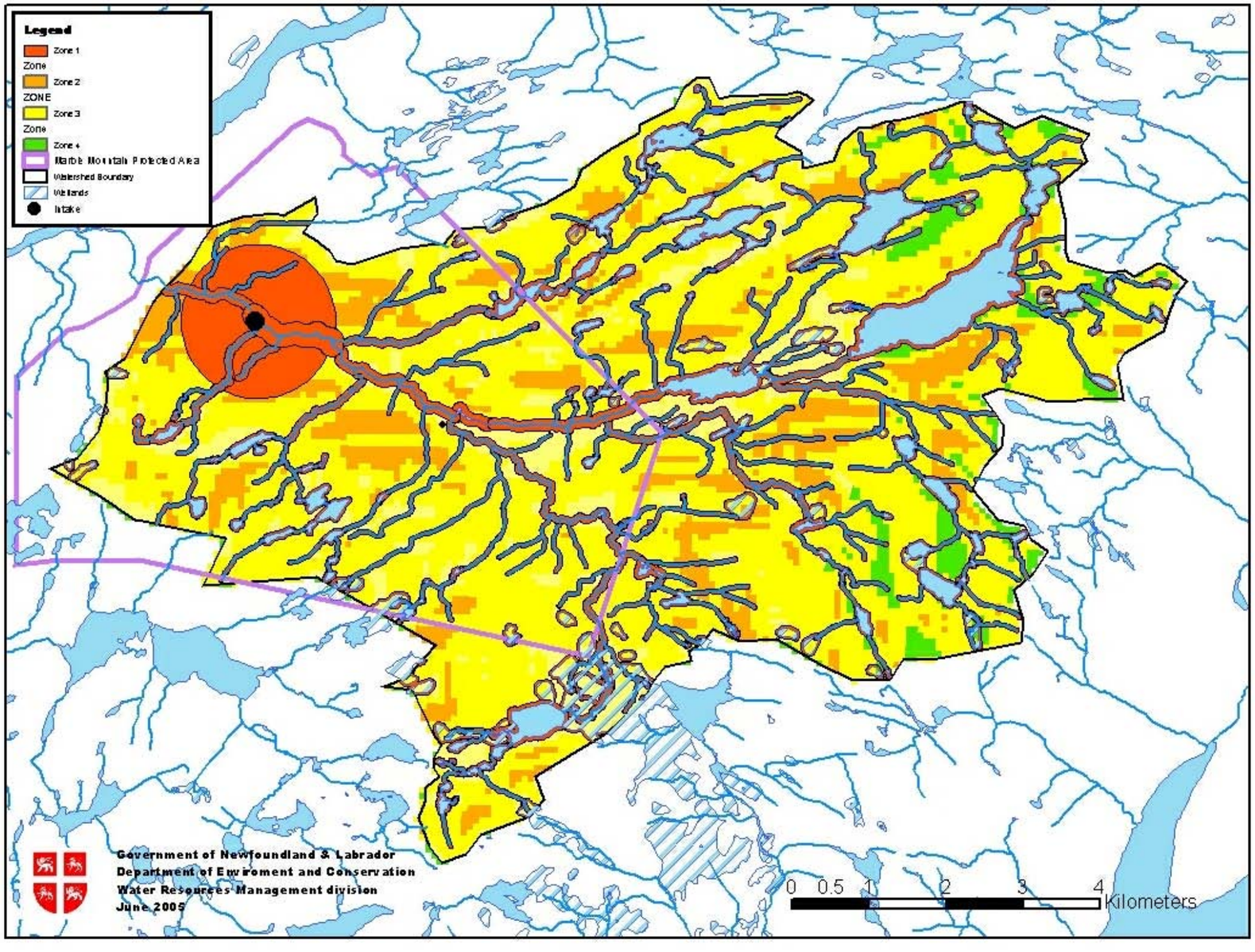


Figure 14. Proposed Development Zones.

FOREST WATER QUALITY INDEX

In 2003, the provincial Department of Environment, Department of Forest Resources and Agrifoods and the Western Newfoundland Model Forest combined resources to develop a new planning tool to assess the impact potential forestry activities may have on the water quality and ecosystem health of protected water supplies in Newfoundland and Labrador. Historical water quality and forestry activity data were analyzed to identify variables that may have changed due to the forestry operations. The variables identified were turbidity, phosphorus, potassium, dissolved organic carbon, temperature, dissolved oxygen and nitrogen. The extent of change of these variables due to the volume and type of forestry activity was determined, and then used to predict potential impacts forestry activities may have on water quality. This Forest Water Quality Index (FWQI) model calculates a score for the data analyzed, and the scores are categorized according to the following table.

Table 14. FWQI Ranking Categories

Ranking Categories	Score
Excellent	95-100
Good	80-94
Fair	65-79
Marginal	45-64
Poor	0-44

Using the Forest Water Quality Index tool, water quality data for Steady Brook (original data) was analyzed for the purpose of supplying drinking water. The same data was analyzed using parameters simulating impacts of forestry operations and worst case scenario conditions, again for drinking water. The results were as follows:

Table 15. Results of FWQI modeling.

	Score	Category
Original Data	80	Good
Post-Forestry Data (Predicted)	78	Fair

The score decreased only two points, but the category changed from good to fair. This was a result of exceedances in turbidity. For an explanation of turbidity and its natural occurrence in Steady Brook drinking water see the section Source Water in Water Quality (page 12).

It cannot be said that these results are absolute but it represents an idea of the basic trend that we might expect based on other watersheds that have been logged to date. The FWQI model is still being modified as more information is gathered from watersheds with logging and historical water data. The model is also looking at incorporating other factors such as topography, proximity to intake, percentage of watershed being harvested, and soil type.

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 Steady Brook Watershed Management Planning Committee:

1. Evaluate best management practices for compatible land uses in the basin 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;

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 can be developed based on the identified potential contaminants that could occur in the watershed from existing and possible uses:

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

2. Continue to keep **chlorination by-products** (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** from entering the water supply.

MANAGEMENT STRATEGY

To address the general and specific objectives of this plan, 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 identified. Table 16 contains these steps including the components of the management strategy recommended to achieve the objectives that address the potential contaminants of concern for the Steady 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
- 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 6. 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 16. Management strategy to address potential contaminants in Steady Brook watershed.

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	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	High	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 and Monitoring Committee Monitoring Committee
	Cabins (swimming)	Medium	220	Educate **cabin owners** about risks of human wastes close to waterbodies	Brochure, Meeting with cabin owners	Monitoring Committee
	Wildlife	High	259	Monitor presence of beaver in watershed	Beaver Briefing Note	Monitoring Committee
	Camping	Medium	248	Educate **campers** about risks of human wastes close to waterbodies	Brochure	Monitoring Committee

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	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 BMPs that minimize increases in organic loading by watershed users.	Domestic Cutting	Medium	188	Educate **domestic cutters** (residents/cabin owners) about organic loading and its consequences, and the role of buffers	Watershed Management Zones, Brochure	Monitoring Committee
	Commercial Harvesting	Medium	177	Adopt buffers and BMPs that ensure little or no increase in organic loading. Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Forest Road Construction/ Use	Medium	188	Adopt buffers and BMPs that ensure little or no increase in organic loading. Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Natural Organic Loading	Medium	216	Monitor natural organic matter indicators (DOC and colour) Investigate necessity of additional treatment infrastructure with appropriate agencies.	Guidelines for Canadian Drinking Water Quality Municipalities Act	Dept. of Environment and Conservation Dept. of Municipal and Provincial Affairs
	Treatment (Chlorine)	N/A	163	Monitor THMs and HAAs	Guidelines for Canadian Drinking Water Quality	Dept. of Gov't Services and Dept. of Health and Community Services
Ensure unacceptable levels of **Toxins** do not enter the watershed by enforcing clear and appropriate policy.	Utility Line CCA Poles	Medium	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
Minimize leaks and spills of **Petroleum Products** and reduce their impact.	Motorized Vehicle Use [1]	Medium	224	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of fuel contamination	Brochure, Information Sessions and Signage	Monitoring Committee

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Camping & Recreation [2]	Low	219	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of fuel contamination	Brochure, Information Sessions and Signage	Monitoring Committee
	Domestic Cutting	Low	213	Educate **residents and cabin owners** about risks of fuel contamination	Brochure, Information Sessions and Signage	Monitoring Committee
	Cabins (Fuel Storage)	Low	199	Educate **cabin owners** about risks of fuel contamination	Brochure, Information Sessions and Signage	Monitoring Committee
	Commercial Harvesting	Medium	189	Adopt buffers and BMPs that eliminate or minimize impacts of fuel spills and leaks Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources

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

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Silviculture	Very Low	199	Adopt buffers and BMPs that eliminate or minimize impacts of fuel spills and leaks Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Mineral Exploration	Very Low	205	Adopt buffers and BMPs that eliminate or minimize impacts of fuel spills and leaks Ensure **mining companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Quarrying	Medium	205	Adopt buffers and BMPs that eliminate or minimize impacts of fuel spills and leaks Ensure **quarry companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Aircraft	Very Low	205	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Monitoring Committee

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
Minimize **Sedimentation** of the water supply and reduce its impact through BMPs and by educating recreational users.	Motorized Vehicle Use [1]	Medium	235	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of sedimentation and the role of buffers	Brochure, Information Sessions and Signage	Monitoring Committee
	Domestic Cutting	Low	205	Educate **residents, cabin owners, SnoRiders, and tourism operators** about risks of sedimentation and the role of buffers	Brochure, Information Sessions and Signage	Monitoring Committee
	Commercial Harvesting	Medium	199	Adopt buffers and BMPs that reduce or minimize sedimentation Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Forest Road Construction/ Use	Medium	219	Adopt buffers and BMPs that reduce or minimize sedimentation Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Utility Line Structure Maintenance	Low	205	Adopt buffers and BMPs that reduce or minimize sedimentation Ensure **utility companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Environment and Conservation
	Utility Line Vegetation Maintenance	Low	201	Adopt buffers and BMPs that reduce or minimize sedimentation Ensure **utility companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Environment and Conservation
	Mineral Exploration	Low	194	Adopt buffers and BMPs that reduce or minimize sedimentation Ensure **mining companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Quarrying and Mining	Medium	199	Adopt buffers and BMPs that reduce or minimize sedimentation Ensure **mining companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Snowmaking[3]	Medium	199	Construct separate intakes for drinking water and snow making		Monitoring Committee
	Increased Streamflow	Medium	235	Monitor water levels in watershed		Monitoring Committee
	Forest Fire	Medium	235	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Monitoring Committee
Minimize the amount of **Nutrients** entering the watershed through BMPs and by educating users, particularly industrial users.	Commercial Harvesting	Low	195	Adopt buffers and BMPs that reduce or minimize nutrients entering waterbodies Ensure **forest company** follows buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Dept. of Natural Resources Monitoring Committee
	Domestic Cutting	Very Low	199	Educate **residents and cabin owners** about consequences of nutrients entering waterbodies and the role of buffers	Brochure, Information Sessions and Signage	Monitoring Committee

Objective to Address Potential Contaminant	Potential Cause	Matrix Rank	Numerical Rank	Task and Audience	Management Tools	Responsible Party
	Mineral Exploration	Very Low	189	Adopt buffers and BMPs that reduce or minimize nutrients entering waterbodies Ensure **mining companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Quarrying and Mining	Very Low	189	Adopt buffers and BMPs that reduce or minimize nutrients entering waterbodies Ensure **mining companies** follow buffers and BMPs	Watershed Management Zones, PWSA waterbody buffers, BMPs, PWSA Policy	Monitoring Committee Dept. of Natural Resources
	Forest Fire	Low	219	Develop Contingency Plan to deal with environmental emergencies.	Contingency Plan	Monitoring Committee

[1] Includes ATV, snowmobile and motorized boats.

[2] 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.

[3] On June 20, 2005 the Steady Brook Town Council was notified that Marble Mountain Resort will construct a separate intake to supply water for making snow.

Existing Strategies

Regulatory

The Minister of Environment regulates resource development in PWSAs through Section 39 of the *Water Resources Act*. No development activity can proceed without first receiving approval from the Minister. In Policy Directive W.R. 95-01, *Policy for Land and Water Related Developments in Protected Public Water Supply Areas* (Appendix F), development is defined as "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". Further, this policy outlines the process required to receive approval for development of activities in PWSAs, and other responsibilities of the proponent, should approval be granted. An application for approval must be completed, and accompanied by a letter of consent from the City, Town Local Service District, operator of the water supply or Watershed Management Committee, providing authorization for the proposed development activity. This process ensures that the activity does not proceed without the knowledge of the municipality. 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.

Policy Directive W.R. 95-01 also establishes guidelines for proposed and existing developments, outlining activities not permitted and activities regulated in PWSAs. For example, activities not permitted in PWSAs that have application in the Steady Brook watershed include: using ice-covered water bodies for riding skidoos, ATVs, etc.; clearcutting of forests in sensitive areas; resorts, hotels/motels and golf courses; specific activities, operations or facilities associated with aggregate extraction and mineral exploration; and application of herbicide in the right-of–way (power line). Activities allowed but regulated in PWSAs of relevance to Steady Brook watershed involve: expansion and upgrading of existing activities, operations or facilities; forest logging, resources road construction and use, stream crossing for controlled access, etc.; recreational activities or facilities including cottage development, fishing, swimming, boating, etc.; mineral exploration and aggregate extraction related activities; and construction of roads, bridges, culverts and other stream crossings. The policy also defines the responsibilities of the municipal authority, and the accountability of proponents to correct harmful conditions.

The most concrete guidelines laid out in the policy are specified buffer zone widths along and around waterbodies (Table 17). These are the minimum buffers to which all developments must adhere and within which all activities are prohibited. These buffer widths 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 metres) 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 m buffer, sediment removal and erosion prevention a 15-30 buffer and moderation of storm flows and run-off a 20-60m buffer, all functions essential to the protection of water quality.

Table 17. 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 PWSAs is Policy Directive W.R. 93-01, *Policy for Treated Utility Poles in Water Supply Areas* (Appendix F). 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 before the Minister can consider approval under the *Water Resources Act* mentioned previously. The types of development requiring registration and environmental review that might occur in the Steady 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*. Anyone wishing to construct a cabin on Crown land must obtain this permit. 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. The main application of this policy in the Steady Brook watershed has been the approval of water crossings for roads and trails.

In 1977, under the *Urban and Rural Planning Act (1965),* a parcel of land surrounding Marble Mountain was declared a protected area. A large segment of the Marble Mountain Protected Area (MMPA) lies within the western portion of the Steady Brook watershed (see Figure 2), so land use zoning regulations developed for the MMPA apply to that portion of the watershed which both share. Two categories of the MMPA land use zones fall inside this shared portion: Watershed 2, which allows controlled development and Mountain Area 1, which allows associated recreation and forestry. Figure 14 shows the MMPA boundary with reference to the Steady Brook watershed management zones. Further work is required to determine exactly what development activities are permitted within the Marble Mountain Protected Area

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 Steady 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 PWSAs (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 G). 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 PWSAs. 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 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" (Appendix H). 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.

Recommended Strategies

Regulatory - Steady Brook Watershed Directives

The Municipalities Act (1999) gives power to municipalities to make regulations to protect their source of drinking water, even if the watershed falls outside of municipal boundaries. In Steady Brook this authority could be expressed in the form of a series of watershed directives. Directives recommended in the plan can be implemented once Town Council has approved the plan, and amended as need arises. New directives can be developed as required.

Steady Brook Watershed Directive 1.0

A regulatory approach that does not exist but that would be most effective in the management of Steady Brook watershed is the designation of watershed management zones. These zones, developed in the sensitivity analysis (Figure 14) and based on slope, waterbody buffers, and distance from the intake, serve to designate areas of permitted and restricted activities. Three zones were suggested to ensure the protection of the Steady 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 17)

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 17);
- 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 17)
- 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 10) are prohibited in Zone 3. Seven potential causes of contamination fall into the prohibited category: wildlife, camping, natural organic loading, motorized vehicle use, increased streamflow, forest fire and pit privies. All other development and recreational activities assessed in the risk analysis are permitted, subject to applicable guidelines. Of the 7 prohibited activities, only three can be influenced or controlled to some degree:

- Camping
- Motorized Vehicle Use
- Cabin Development (pit privies)

Camping in the watershed, although infrequent, is uncontrolled. At present, permission to camp in the watershed is not required and it would be almost impossible to enforce if it were. The only hope of any control is through education of potential campers. Motorized vehicle use is also difficult to enforce and would be inappropriate to prohibit at present even though the main road accessing the watershed passes through the 1-km buffer surrounding the intake. Again, education of users is the best option until access changes.

Although cabin development is prohibited in Zones 1 and 3, the prohibition refers to new applications for cabin development. Existing cabins, with permits obtained before this management plan, are "grandfathered" and therefore are allowed to stay. However, they must still abide by all regulations and guidelines. Those cabins presently in violation of applicable regulations must act to ensure they comply with regulations (see also Steady Brook Watershed Directive 2.0).

The other activities which ranked in the top seven in the numerical rating or "high" in the risk matrix (wildlife, natural organic loading, increased streamflow 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 are permitted in Management Zone 3 and are listed in Table 18. 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. 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 18. Activities permitted in Watershed Management Zones 3 & 4.

Activity	**Regulations / Guidelines**	**Source Agency**	**Permit Required**	**Source Agency**
Cabin Development[1] (Existing cabins in Zone 3, new cabins in zone 4)	Heating Oil Storage Tank System Regulation License to Occupy Sanitation Regulations	Dept. of Environ. & Conservation, Water Resources Div. Dept. of Environ. & Conservation, Crown Land Admin. Div. Dept. of Health & Community Services	"License to Occupy"	Dept. of Environ. & Conservation, Crown Land Administration Division
Wildlife[1]	Giardiasis Briefing Note	Dept. of Environ. & Conservation, Inland Fish & Wildlife Div.	N/A	
Motorized Vehicle Use[1]	Motorized Snow Vehicle & All-Terrain Vehicles	Dept. of Natural Resources, Dept. of	Registration of Vehicle	Dept. of Government Services

Activity	**Regulations / Guidelines**	**Source Agency**	**Permit Required**	**Source Agency**
	Regulations	Government Services		Services
Camping and Recreation[1]	None		None	
Domestic Cutting	Domestic Cutting Regulations	Corner Brook Pulp and Paper Limited	"Domestic Cutting Regulations and Permit"	Corner Brook Pulp and Paper Limited
Commercial Harvesting, Forest Road Construction and Use	Environmental Protection Guidelines for Ecologically Based Forest Resource Management Policy for the Management of Fish Habitat	Dept. of Natural Resources, Forestry Branch Fisheries and Oceans Canada	"Environmental Approval for a Development Activity in a Protected Water Supply Area" "Approval for Water Crossing"	Dept. of Environ. & Conservation, Water Resources Division Fisheries and Oceans Canada
Silviculture	Environmental Protection Guidelines for Ecologically Based Forest Resource Management	Dept. of Natural Resources, Forestry Branch	"Environmental Approval for a Development Activity in a Protected Water Supply Area"	Dept. of Environ. & Conservation, Water Resources Division
Utility Line Structure and Vegetation Maintenance	Policy for Treated Utility Poles in Water Supply Areas	Dept. of Environ. & Conservation, Water Resources Division.	"Environmental Approval for a Development Activity in a Protected Water Supply Area"	Dept. of Environ. & Conservation, Water Resources Division
Mineral Exploration	Environmental Guidelines for Construction and Mineral Exploration Companies	Dept. of Natural Resources, Mines & Energy Branch	"Environmental Approval for a Development Activity in a Protected Water Supply Area"	Dept. of Environ. & Conservation, Water Resources Division
Quarrying and Mining	Environmental Guidelines for Construction and Mineral	Dept. of Natural Resources, Mines & Energy Branch	"Environmental Approval for a Development Activity in a	Dept. of Environ. & Conservation, Water

Activity	Regulations / Guidelines	Source Agency	Permit Required	Source Agency
	Exploration Companies Policy for the Management of Fish Habitat	Branch Fisheries and Oceans Canada	Protected Water Supply Area" "Approval for Water Crossing"	Resources Division Fisheries and Oceans Canada
Snowmaking	Written and verbal agreements concerning notice and timing of start-up of snow guns	Town of Steady Brook Marble Mountain Resort	N/A	
Utility Line CCA Poles	Policy for Treated Utility Poles in Water Supply Areas	Dept. of Environ. & Conservation, Water Resources Division	"Environmental Approval for a Development Activity in a Protected Water Supply Area"	Dept. of Environ. & Conservation, Water Resources Division

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

Finally, 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 are allowed in this zone, due to the great distance from the water supply intake. Again, 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. As with Zone 3, additional regulations, guidelines and permits that apply to specific activities are listed in Table 18.

Steady Brook Watershed Directive 2.0

Pit privies of cabins on Line Pond range from 20 - 27 metres from what is probably the seasonal high water mark of the pond. The Sanitation Regulations state that sewage disposal must be 30 metres from surface water. Surface water level varies during the

year, but it would be logical to measure the required distance from the highest water level which usually occurs during spring run-off. The Monitoring Committee needs to determine the high water mark for all ponds with cabin development, and subsequently ensure that pit privies are a minimum of 30 metres from that determined mark. In addition, the Town Council, on its own and through the Federation of Municipalities, should continue to lobby government to ensure *Licenses to Occupy* existing in Protected Water Supply Areas are valid only for the life of the present permit holder.

Steady Brook Watershed Directive 3.0

During the winter of 2005, forest harvesting was conducted in the Corner Brook watershed. Extra precautions were taken by CBPPL during harvesting operations to ensure compliance with the guidelines for forestry operations within PWSAs. Steady Brook should demand similar precautions to ensure the same level of compliance through whatever means CBPPL deems viable. Examples include: scale of activity (size of clearcut and % of total watershed cut); winter or mid-summer harvesting; extensive pre-planning such as marking of streams and buffers previous to harvest; and pre-work meetings with all employees. These terms should be negotiated for each application.

Non-Regulatory - Best Management Practices

In addition to regulations or directives passed by the Town Council, the Monitoring Committee can also develop or encourage other agencies to develop guidelines or best management practices (BMPs) 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 PWSAs. 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 PWSAs 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)* attempt 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

Although mineral or quarry developments do not exist at present, Steady Brook watershed has the potential to host deposits of industrial minerals, as well as the potential for quarries. The potential for damage from these activities is unknown and may largely depend on the scale of the operation. Currently, guidelines exist for mineral exploration. However, before these activities are approved for operation, more stringent best management practices should be developed and resources found to ensure their enforcement.

Outdoor Adventure Tourism

The recent announcement of a new resort in Steady Brook indicates the popularity of the area as a tourism destination, and one of the biggest draws to western Newfoundland is "outdoor adventure". This could mean increased pressure on the Steady Brook watershed as a venue for adventure tourism. To prepare for this development, guidelines should be prepared to control such activities within the watershed.

Before recommending approval to the Town Council for any activity, commercial or recreational, the Monitoring Committee must be satisfied that regulations, best management practices and the enforcement of both are sufficient to protect water quality.

Contingency Plan

A management plan for a water supply source needs to include a contingency 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. A contingency plan will ensure the damage to life, property and the environment is minimal.

A contingency 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 Watershed Monitoring Committee should develop a contingency plan for the watershed 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 Steady Brook Fire Department all need to work with the Monitoring Committee to develop an effective plan. A contingency plan for the watershed should be incorporated into the Emergency Measures Plan for Steady Brook which is currently being updated.

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 16 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, domestic cutters, tourism operators 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 60% of their activities were ranked medium to high in both risk assessment exercises (Tables 8 and 10). Educating these users should lessen the risk of contamination of the watershed.

Table 16 also indicates the messages that need to be conveyed to each user. The non-industrial users just mentioned could possibly be a cause of five of the six potential contaminants identified for the Steady Brook watershed: pathogenic microbes (human wastes), fuel contamination, sedimentation, nutrients, and chlorination by-products. 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 Steady 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, tell the users 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 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, domestic cutters and ATV users. The same brochure could be hand delivered to the cabin owners and tourism operators, 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

The Town of Steady Brook currently monitors the watershed on a monthly basis, using either ATV or snowmobile. During this time the monitor checks for signs of illegal activity, legal activity that could detrimentally affect water quality and signs of natural occurrences that could similarly affect water quality. Recently, concerns were raised about the contribution cabins could make to the existence of coliform and E. coli in the water supply. This prompted the Town to collect information about the cabins residing

close to water bodies, such as distance of the pit privies from the high water mark and the presence/type of fuel storage.

To ensure the regulations and guidelines in the preceding section are being followed, monitoring of the watershed and of water quality are both necessary. A number of areas that are recommended for monitoring are outlined in the table below.

Table 19. Monitoring activities for the Steady 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.	Steady Brook Town Monitor
Unauthorized development within the Watershed Management Zones. This requires ensuring that permitted activities that are occurring have received a permit to do so, where applicable.	Steady Brook Town Monitor
Approved developments working within their regulations. This monitoring requires that developments that have received approval from the Dept. of Environment and Conservation are complying with the applicable regulations.	Resource Departments of government, in consultation with the Department of Environment and Conservation. The Town can also monitor developments, in consultation with the resource departments.
Chemical and physical parameters for source and tap water.	Department of Environment and Conservation
Microbiological parameters of tap water	Department of Government Services

Monitoring of the watershed by the Town monitor should continue on the existing schedule of once per month, with more frequent visits, if possible, during periods of greater use or development activities. During each visit, the Town monitor should complete a form (Appendix I) to record information such as: 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. This will allow the Town and

Monitoring 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.

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. Town Monitor informs the violator what regulation/policy is being broken and requests the activity be stopped immediately. The Town should notify the Department of Environment and Conservation of the infraction.

2. If the illegal activity is not stopped, then the Watershed Management Specialist with the Department of Environment and Conservation sends notice to the violator requesting the activity be stopped immediately.

3. If the illegal activity is still not stopped, then the Minister of the Department of Environment and Conservation sends notice to the violator requesting the activity be stopped immediately.

4. If the illegal activity continues after repeated notice from the Department of Environment and Conservation, legal action may be taken in accordance with the *Water Resource Act*.

There is no set mechanism for enforcement of violations of the Water Resources Act, and the above steps are generalized. Each infraction tends to play out on a case-by-case basis.

Initially the Monitoring 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 once per year.

The Monitoring Committee should produce a watershed report card annually to compile information about the quality of the water over the previous year. The report card (Appendix J) would include such information as:

- annual Water Quality Index (WQI) value
- number of contaminant exceedances
- number of aesthetic exceedances
- number of boil water advisories issued
- number of permits for development activities in PWSA issued
- number of flooding incidences

The annual report card should be reviewed by the Monitoring 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 Town Council and made available to residents.

IMPLEMENTATION

ACTION PLAN

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

Table 20. Action plan for implementation.

Action Items	Time Frame
Pass Steady Brook Watershed Directives as Municipal Regulations	Year 1
Implement monitoring program as outlined in the section Monitoring and Reporting	Year 1
Ensure pit privies are of sufficient distance from high water mark; educate cabin owners about risks of human wastes close to waterbodies	Year 1
Obtain a revised copy of *Environmental Protection Guidelines for Ecologically Based Forest Resource Management as soon as they are completed.*	When Available
Obtain a revised copy of the Guidelines for Preparing Development Plans for Operations within the Protected Water Supply Area.	When Available
Request clarification of activities permitted in the various land use zones within the Marble Mountain Protected Area.	Year 1
If permission is granted to harvest in the watershed, demand the same or a greater level of compliance that occurred in Corner Brook watershed.	When Applicable
Work with the Western SnoRiders to develop guidelines for snowmobiling in Protected Water Supply Areas.	Year 1
Update existing contingency plan to include the watershed and the supply of water in the event of a prolonged shutdown.	Year 1
Develop a brochure directed at non-industrial users of the watershed to inform them of their role in protecting the watershed.	Year 1
Assess the location, number and condition of existing PWSA signs in the watershed. Repair existing signs and erect	Year 1

Action Items	Time Frame
additional ones as required.	
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	Year 2
Develop best management practices for outdoor adventure tourism operations in the watershed and include appropriate monitoring activities.	Year 2

REVIEW AND AMENDMENTS

The 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 so 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

Appendix B – Water Quality Data for Steady Brook PWSA

Appendix C – Steady Brook Watershed Use Survey - Compiled Results

Appendix D – Numerical Index Component Ratings

Appendix E – Sensitivity Analysis Maps

Appendix F - Policy Directives and Associated Documents Pertaining to Public Water Supply Areas.

Appendix G - Environmental Protection Guidelines for Ecosystem Based Forest Resource Management

Appendix H – Inland Fish and Wildlife Division Position on Removal of Beaver in Municipal Watersheds

Appendix I – Monthly Watershed Monitoring Report

Appendix J – Annual Watershed Report Card

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	
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-	0.0015	

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)
LR) 3		
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	
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	

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)
simazine	0.01	
sodium 10		≤200
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 STEADY BROOK PROTECTED WATER SUPPLY AREA

Chemical and Physical Parameters

Source Data

Sample #	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Fluoride	Potassium	Sodium	Sulphate
1988-7000-00-SI-RE	10	65	25		6.2	28	2	0.4			1.54	4.1	0.03	0.43	3	4
1990-7009-00-SI-RE	1.1	50	18.3		5.7			0.4			1.05	2	0.03	0.2	1.7	2.24
1990-7078-00-SI-RE	1.5	60	27.2		5.8			0.5			1.7	3.55	0.03	0.27	2.2	2.9
1994-7044-00-SI-RE	2.9	54	15.9		5.8	14	2	0.17			0.65	2.3	0.03	0.27	1.57	2.5
1994-7223-00-SI-RE	2.6	58	24.8		6.1	20	2	0.79			1.24	3.8	0.06	0.22	2.22	5.4
1995-7100-00-SI-RE	1.61	70	16.7		6	30		0.5			1.2	1.66	0.03	0.33	1.5	1.34
1995-7223-00-SI-RE	1.59	65	21.7		5.7	30		0.12			1.8	2.67	0.05	0.21	1.7	1.54
1996-7043-00-SI-RE	2.04	60	17.9		6.1	30		0.3			1.28	1.71			1.39	1.45
1996-7162-00-SI-RE	1	85	22.6		5.1	20		0.41			1.4	3.4			1.83	4.6
1997-7026-00-SI-RE	2.4	54	16.2		5.7	16		0.36			1.12	2.4		0.23	1.74	2.8
1998-7103-00-SI-RE	2.8	41	22		6.6	14	2	0.22			1.67	1.8		0.27	1.82	2.4
1999-7050-00-SI-RE	1.1	55	19.2		6.1	13	1	0.32		0.025	1.21	2.1	0.025	0.19	1.61	1
1999-7156-00-SI-RE		38	39.3		6.3			0.18		0.025		2.3				
1999-7261-00-SI-RE	0.5	59	26.2		5.6	20	1	0.59		0.025	1.62	3.3	0.025	0.28	2.16	1.5
2001-4044-00-SI-RE	4.4	34	28	4.04	6.7	18		0.07	0.025	0.025	1.37	2.7	0.005	0.26	1.69	1.5
2001-4941-00-SI-RE*	2.5	71	24	5	6	20		0.5	0.025	0.025	2	4	0.05	0.5	4	4
2003-4932-00-SI-RE	2.5	106	27	0.5	5.1	18		1.7	0.005	0.025	0.5	4	0.05	0.5	2	4

Source Data continued

Sample #	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminium	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron
1988-7000-00-SI-RE			0.027	0.55	0.005	0.06		0.0025		0.0003	0.0025	0.03	0.18
1990-7009-00-SI-RE		5.65	0.005			0.13		0.0003		0.0005	0.0001	0.001	0.18
1990-7078-00-SI-RE		8.6	0.03			0.165		0.0003		0.0005	0.0001	0.001	0.3
1994-7044-00-SI-RE			0.01	0.16	0.01	0.06		0.0025		0.0003	0.0025	0.003	0.13
1994-7223-00-SI-RE			0.019	0.31	0.01	0.11		0.0025		0.0003	0.0025	0.003	0.23
1995-7100-00-SI-RE	0.004	7.8	0.01	0.47	0.002	0.18				0.00005	0.0006	0.0024	0.223
1995-7223-00-SI-RE	0.016	4.2	0.025	0.1	0.006	0.22				0.00005	0.00025	0.005	0.292
1996-7043-00-SI-RE		8.4	0.025			0.14							0.206
1996-7162-00-SI-RE		6.8	0.002			0.18							0.3
1997-7026-00-SI-RE		4.5	0.005	0.08	0.005	0.1						0.005	0.14
1998-7103-00-SI-RE		4.3	0.023	0.27	0.005	0.025						0.005	0.12
1999-7050-00-SI-RE		4.6	0.0025	0.28	0.005	0.025						0.005	0.19
1999-7156-00-SI-RE		5.1											
1999-7261-00-SI-RE		5.6	0.0025	0.17	0.005	0.11						0.005	0.19
2001-4044-00-SI-RE		4.7	0.0025	0.29	0.005	0.025		0.005	0.025	0.001	0.005	0.005	0.09
2001-4941-00-SI-RE *	0.05	8.6	0.05	0.025	0.005	0.17		0.0005	0.005	0.00005	0.0005	0.006	0.21
2003-4932-00-SI-RE	0.18	13.8	0.15	0.39	0.04	0.35	0.0005	0.0005	0.01	0.00005	0.0005	0.0005	0.8

* Sunny, cool, heavy precipitation 48 hours.

Source Data continued

Sample #	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Uranium	Zinc	Temp.-Source
1988-7000-00-SI-RE	0.0005	0.54	0.02		0.0025			0.04	
1990-7009-00-SI-RE	0.001	0.31	0.02	0.00001	0.001			0.005	
1990-7078-00-SI-RE	0.001	0.47	0.03	0.00001	0.001			0.005	5
1994-7044-00-SI-RE	0.003	0.25	0.003		0.0025			0.003	
1994-7223-00-SI-RE	0.0005	0.48	0.003		0.0025			0.003	
1995-7100-00-SI-RE	0.0033	0.3	0.008					0.005	
1995-7223-00-SI-RE	0.0005	0.5	0.027					0.012	
1996-7043-00-SI-RE	0.0005	0.31	0.005						13.7
1996-7162-00-SI-RE	0.0005	0.46	0.003						4.2
1997-7026-00-SI-RE	0.0005		0.02					0.005	4.1
1998-7103-00-SI-RE	0.0005		0.02					0.005	14.3
1999-7050-00-SI-RE	0.0005		0.02					0.005	
1999-7156-00-SI-RE									
1999-7261-00-SI-RE	0.0005		0.02					0.005	
2001-4044-00-SI-RE	0.0005	0.15	0.005	0.0005	0.005	0.005		0.005	13.7
2001-4941-00-SI-RE*	0.0005	0.5	0.02	0.00005	0.005	0.0005		0.005	
2003-4932-00-SI-RE	0.0005	0.5	0.211	0.00005	0.0025	0.0005		0.005	8.2

Tap Data

Sample #	Alkalinity	Color	Conductivity	Hardness	pH	TDS	TSS	Turbidity	Boron	Bromide	Calcium	Chloride	Flouride	Potassium	Sodium	Sulphate
2000-6579-99-TI-RE	1.3	66	20.4		5.7	14	1	0.28		0.025	0.56	2.4	0.005	0.24	0.96	0.9
2000-6682-99-TI-RE	3	78	27.7		6.37	21	1	0.32		0.025	1.62	2.6	0.005	0.23	1.52	1.3
2000-6797-01-TI-RE	0.5	53	31.9		5.19	24	1	0.32		0.025	1.71	4.1	0.005	0.27	2.51	1.5
2001-6500-99-TI-RE	1.9	28	33.1		6.11	23	1	0.1		0.025	2.14	4.7	0.005	0.27	2.88	1.8
2001-4044-02-TI-RE	1.5	26	38	4	5.69	20		0.1	0.025	0.025	1.72	5.1	0.005	0.31	1.99	1.8
2001-4941-02-TI-RE	2.5	42	40	5	5.08	28		0.5	0.025	0.025	2	7	0.05	0.5	5	4
2002-4820-02-TI-RE	2.5	35	32	5	5.25	21		0.3	0.025	0.025	2	6	0.05	0.5	3	3
2002-4070-01-TI-RS																
2002-4070-02-TI-RS																
2002-4214-02-TI-RE	2.5	41	40	18	5.02	26		1.4	0.025	0.025	7	7	0.05	0.5	3	3
2003-4098-02-TI-RE	2.5	37	29	3	4.54	19		0.7	0.025	0.025	1	5	0.05	0.5	2	3
2003-4932-02-TI-RE	2.5	59	45	5	4.57	29		1.2	0.005	0.025	2	8	0.05	0.5	3	5

Sample #	Ammonia	DOC	Nitrate(ite)	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium	Manganese
2000-6579-99-TI-RE		5.9	0.0025				0.001	0.005	0.84	0.005	0.0005	0.24	0.005
2000-6682-99-TI-RE		7.2	0.0025				0.001	0.005	0.005	0.16	0.0005	0.18	0.005
2000-6797-01-TI-RE		7.7	0.0025				0.001	0.005	0.28	0.11	0.0005	0.57	0.02
2001-6500-99-TI-RE		4.2	0.0025				0.001	0.005	0.005	0.18	0.0005	0.67	0.005
2001-4044-02-TI-RE		4.7	0.039		0.005	0.025	0.001	0.005	0.07	0.12	0.0005	0.11	0.01
2001-4941-02-TI-RE	0.01	8.8	0.05		0.0005	0.005	0.00005	0.0005	0.423	0.24	0.003	0.5	0.02
2002-4820-02-TI-RE	0.06	5.6	0.05	0.0005	0.0005	0.005	0.00005	0.0005	0.334	0.22	0.011	0.5	0.02
2002-4070-01-TI-RS											0.003		
2002-4070-02-TI-RS											0.002		
2002-4214-02-TI-RE	0.01	8.9	0.05	0.0005	0.0005	0.01	0.00005	0.001	0.534	0.3	0.007	0.5	0.036
2003-4098-02-TI-RE	0.09	5.2	0.05	0.0005	0.0005	0.005	0.00005	0.0005	0.558	0.17	0.004	0.5	0.009
2003-4932-02-TI-RE	0.07	12.3	0.05	0.0005	0.0005	0.005	0.00005	0.0005	0.755	0.38	0.007	0.5	0.047

Tap Data continued

Sample #	Mercury	Nickel	Selenium	Uranium	Zinc	Temp.-Tap
2000-6579-99-TI-RE	0.0005	0.005			0.005	
2000-6682-99-TI-RE	0.0005	0.005			0.005	
2000-6797-01-TI-RE	0.0005	0.01			0.07	
2001-6500-99-TI-RE	0.0005	0.005			0.005	
2001-4044-02-TI-RE	0.0005	0.005	0.005		0.005	12.2
2001-4941-02-TI-RE	0.00005	0.005	0.0005		0.02	
2002-4820-02-TI-RE	0.00005	0.005	0.0005		0.05	2.5
2002-4070-01-TI-RS						
2002-4070-02-TI-RS						
2002-4214-02-TI-RE	0.00005	0.0025	0.0005		0.0025	
2003-4098-02-TI-RE	0.00005	0.0025	0.0005		0.007	3
2003-4932-02-TI-RE	0.00005	0.0025	0.0005		0.01	9.9

THM Data

Sample#	Site#	Year	Season	Lab	Brom	ChlDi	DiCBr	Chlfm	THM-Total	Free-Chlorine	Total-Chlorine	Temperature-Tap
1996-8022-99-TH-RE	99	1996	1	NB				34	34	0.1		
1996-8069-99-TH-RE	99	1996	2	NB			1	48	49	0		
1996-8174-99-TH-RE	99	1996	4	NB				49	49			
1998-8202-01-TH-RE	1	1998	2	EC			5	154	159			
1998-8203-02-TH-RE	2	1998	2	EC			5	116	121			
1999-8682-01-TH-RE	1	1999	1	EC	0	0	0	56	56	0.2		
1999-8683-02-TH-RE	2	1999	1	EC	0	0	0	65	65	0.05		
1999-8968-01-TH-RE	1	1999	2	EC	0	0	0	76	76	0.05	0.1	8.5
1999-9273-01-TH-RE	1	1999	3	EC	0	0	3	93	96	0.05	0.1	
1999-9528-01-TH-RE	1	1999	4	EC	0	0	0	49	49	0.03	0.02	
2000-8280-01-TH-RE	1	2000	2	AT	0	0	0	17.39999962	17.39999962	0.04	0.11	
2000-8597-01-TH-RE	1	2000	3	AT	0	3.9	0	96.30000305	100.2000031	0.01	0.04	14.5
2000-9056-01-TH-RE	1	2000	4	AT	0	0	0.600000024	48.79999924	49.39999926	0	0.04	
2001-4044-02-TH-RE	02	2001	2	WAL	0	0	5	81	86	0.13	0.25	12.2
2001-4044-01-TH-RE	01	2001	2	WAL	0	0	0	69	69	0.52	0.62	12.1
2001-4941-01-TH-RE	01	2001	4	AT	0	0	0.4	39.5	39.9	0.1		
2001-4941-02-TH-RE	02	2001	4	AT	0	0	0.5	36.1	36.6	0.02		
2002-4018-01-TH-RE	01	2002	1	AT	0	0	0.9	28.7	29.6	0.47	0.59	
2002-4018-02-TH-RE	02	2002	1	AT	0	0	1.3	37.1	38.4	0.13	0.26	
2002-4820-02-TH-RE	02	2002	2	AT	0	0	0	24.5	24.5	0.16	0.16	2.5
2002-4097-01-TH-RE	01	2002	3	AT	0	0	2.3	77.9	80.2	0.2	0.39	13.8
2002-4214-02-TH-RE	02	2002	4	AT	0	0	0.8	54.4	55.2	0	0.2	
2003-4008-02-TH-RE	02	2003	1	AT	0	0	1.5	27.7	29.2	0.04	0.17	3
2003-4098-02-TH-RE	02	2003	2	AT	0	0	0	47.6	47.6	0.16	0.33	3
2003-4237-02-TH-RE	02	2003	3	AT	0	0	1.8	131	133	0.11	0.25	
2003-4932-02-TH-RE	02	2003	4	AT	0	0	0.5	48.7	49.2	0.02	0.15	9.9

APPENDIX C - STEADY BROOK WATERSHED USE SURVEY – COMPILED RESULTS

Part A - Use of the Watershed

The survey seeks to determine the public's interaction with the watershed. Circle any of the following interactions that apply to the respondent.

A. recreation - any activity in the watershed that takes place for pleasure. (example: snowmobiling, camping, walking etc.) **100%**

B. subsistence - the food, shelter and energy required to support life. (example: moose hunting, snaring, berries, etc.) **56%**

C. economic - any activity in the watershed that takes place for monetary reasons. (example: outfitting, etc.) **11%**

D. ecological and geological - values that relate to living organisms and their interaction with the environment, (example: rare plants, etc.) or values that pertain to the earth's crust and strata (example: unique geology, etc.) **0%**

E. archeological - values that are associated with the material remains of ancient civilizations or cultures (example: historical sites, cultural artifacts, etc.) **0%**

Part B - What, Where and How Often?

This section of the survey addresses specific public interactions through the use of a table with 5 columns. Once the table is completed, respondents will be asked to identify their interactions on a map.

1	2	3	4	5
Interaction	**What season?** (See Table 1)	**Frequency* (A, B, C or D)** (See Figure 1)	**Where does the interaction take place?**	**MAP ID**
ANIMAL WATCH				**37**
ARCHEOLOGICAL /HISTORICAL				**26**
ATV USE				**4**
BEAR HUNT				**32**
BERRY PICKING				**23**
BIRD HUNTING				**29**
BIRD WATCHING				**1**

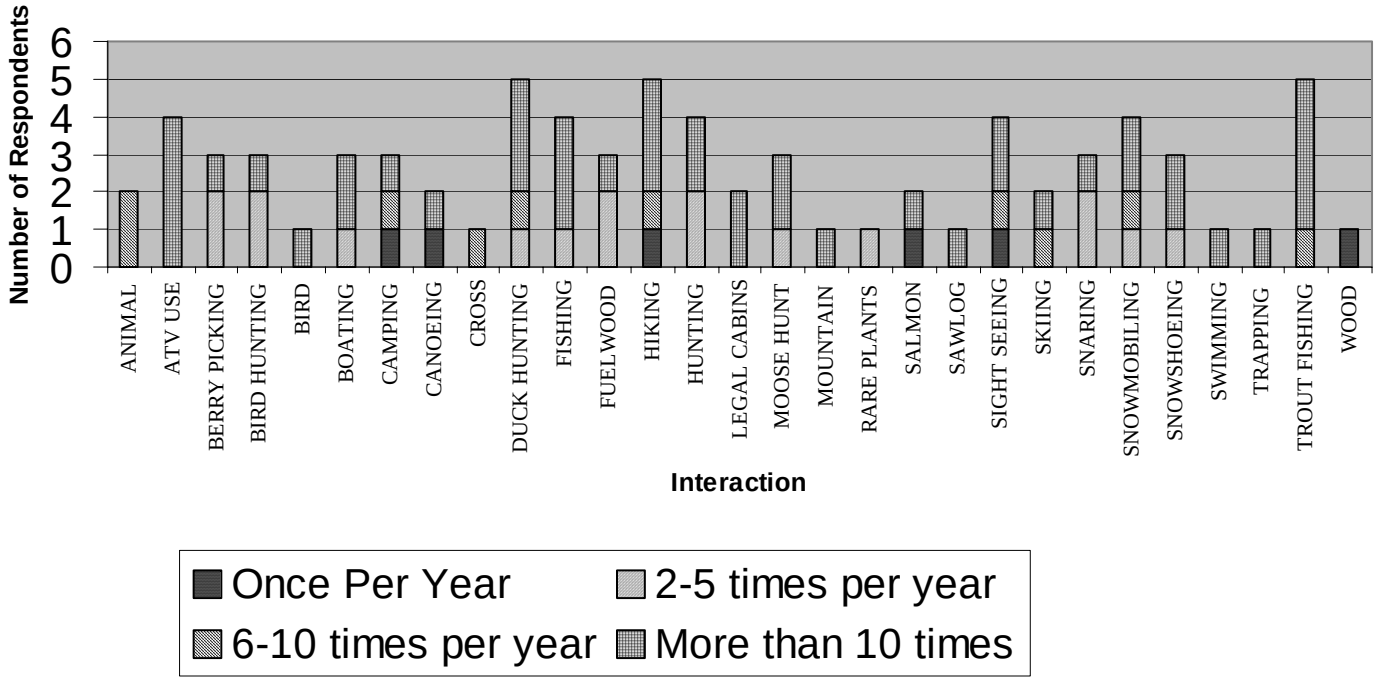
* **A:** once per year; **B:** 2 to 5 times per year; **C:** 6 to 10 times per year; **D:** more than 10 times per year.

1	2	3	4	5
Interaction	**What season?** (See Table 1)	**Frequency• (A, B, C or D)** (See Figure 1)	**Where does the interaction take place?**	**MAP ID**
BOATING				**13**
CAMPING				**19**
CANOEING				**21**
CROSS COUNTRY SKIING				**60**
DOG SLEDDING				**11**
DUCK HUNTING				**27**
FISHING				**39**
FUELWOOD CUTTING				**2**
GEOLOGY				**20**
HIKING				**18**
HORSEBACK RIDING				**12**
HUNTING				**30**
ICE CLIMBING				**6**
LEGAL CABINS (CROWN)				**55**
MOOSE HUNT (DRIVING)				**34**
MOOSE HUNT (HELICOPTER)				**35**
MOUNTAIN BIKING				**59**
RARE PLANTS				**22**
ROCK CLIMBING				**7**
ROCK GATHERING				**5**
SAILING				**14**
SALMON FISHING				**57**
SAWLOG CUTTING				**61**
SIGHT SEEING				**24**
SKIING				**50**
SNARING				**28**
SNOWMOBILING				**56**
SNOWSHOEING				**8**
TRAPPING				**31**
TROUT FISHING				**58**
WIND SURFING				**16**
WOOD GATHERING (CRAFTS AND WOODWORKING)				**3**

Table 1. Time of year and purpose of visiting Steady Brook Watershed.

INTERACTION	SEASON				
	WINTER	SPRING	SUMMER	FALL	YEAR-ROUND
ANIMAL WATCH					
ATV USE					
BERRY PICKING					
BIRD HUNTING					
BIRD WATCHING					
BOATING					
CAMPING					
CANOEING					
CROSS COUNTRY SKIING					
DUCK HUNTING					
FISHING					
FUELWOOD CUTTING					
HIKING					
HUNTING					
LEGAL CABINS (CROWN)					
MOOSE HUNT (DRIVING)					
MOUNTAIN BIKING					
RARE PLANTS					
SALMON FISHING					
SAWLOG CUTTING					
SIGHT SEEING					
SKIING					
SNARING					
SNOWMOBILING					
SNOWSHOEING					
TRAPPING					
TROUT FISHING					
WOOD GATHERING					

Figure 1. Respondents (9) watershed use by interaction by frequency



Part C - Aspatial Values

The respondent should be asked the four questions. These questions are designed to gather information that cannot be spatially defined.

1. Do you feel that you have had an adequate opportunity to comment on how water quality should be protected and resources utilized in the Steady Brook watershed?

9 Yes 0 No

2. How reliant is your activity upon forest access roads? Rate it on a scale of 1 to 5. A "1" on the scale would indicate that your activity is not at all dependent on forest access roads, where as a "5" would indicate that your activity is totally dependent on forest access roads.

1 - 44%, 2 – 11%, 3 – 22%, 4 – 0%, 5 – 22%

3. Were you aware that the Department of Environment permits certain development activities (e.g. utilities, quarries, trails, forest harvesting) in specified areas on protected watersheds, and has developed guidelines for these activities? **6 Yes 3 No**

4. Do you have any suggestions for ways to allow for different (and possibly conflicting) uses of the watershed?

Comments:

- All planning and use must be conservative, resource-preservation minded. All Newfoundlanders have to start protecting and respecting our environment for future generations.

- No more cabins, no cutting wood commercially in area, no mining in area.

- Steady Brook water quality has deteriorated over the past year. There are dirt and black specs in the drinking water. Most of the Town residents will not drink the water.

- I believe that a finite set of guidelines must be established which disallow any cabins or any kind of septic system. All efforts should be made to ensure this is made possible. Also, care should be taken to ensure all POL (petroleum, oils, and lubricants) and their uses have to be controlled.

- Somehow patrol the watershed during the four seasons, to make sure that vehicles using the roads are up to proper working order, i.e. not leaking gas, oil, fluids. Put a stop on cabin development. What will happen when Marble Mountain Resort is sold to a private operator, that wants to develop the land in the watershed? What jurisdiction does Steady Brook have when the Mountain and land are sold?

- Use regular regulations; keep this the way they are. The watershed should be protected! And there should be some kind of bridge on Jones Pond Brook.

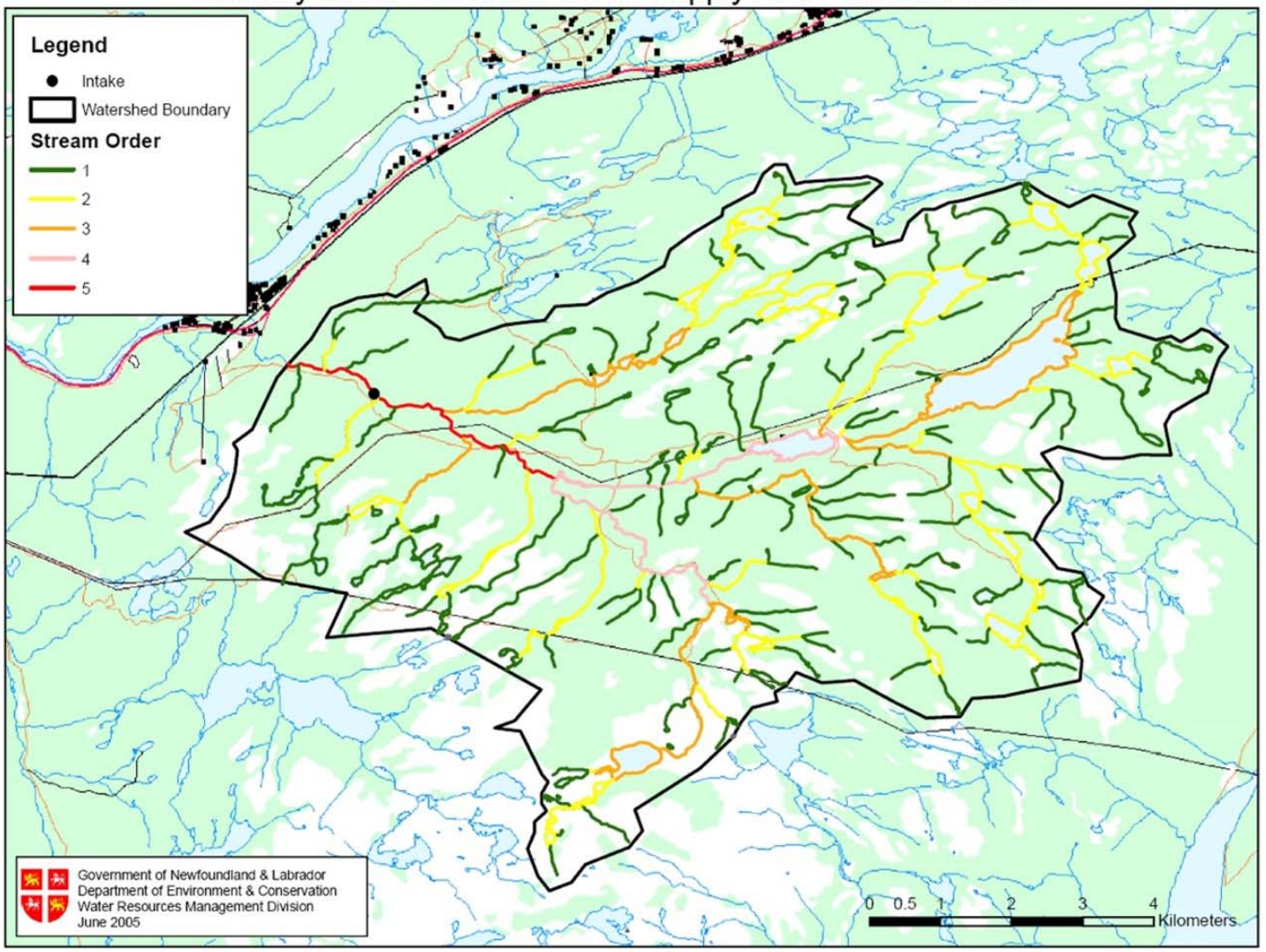
- No Western Riders; must keep area clean.

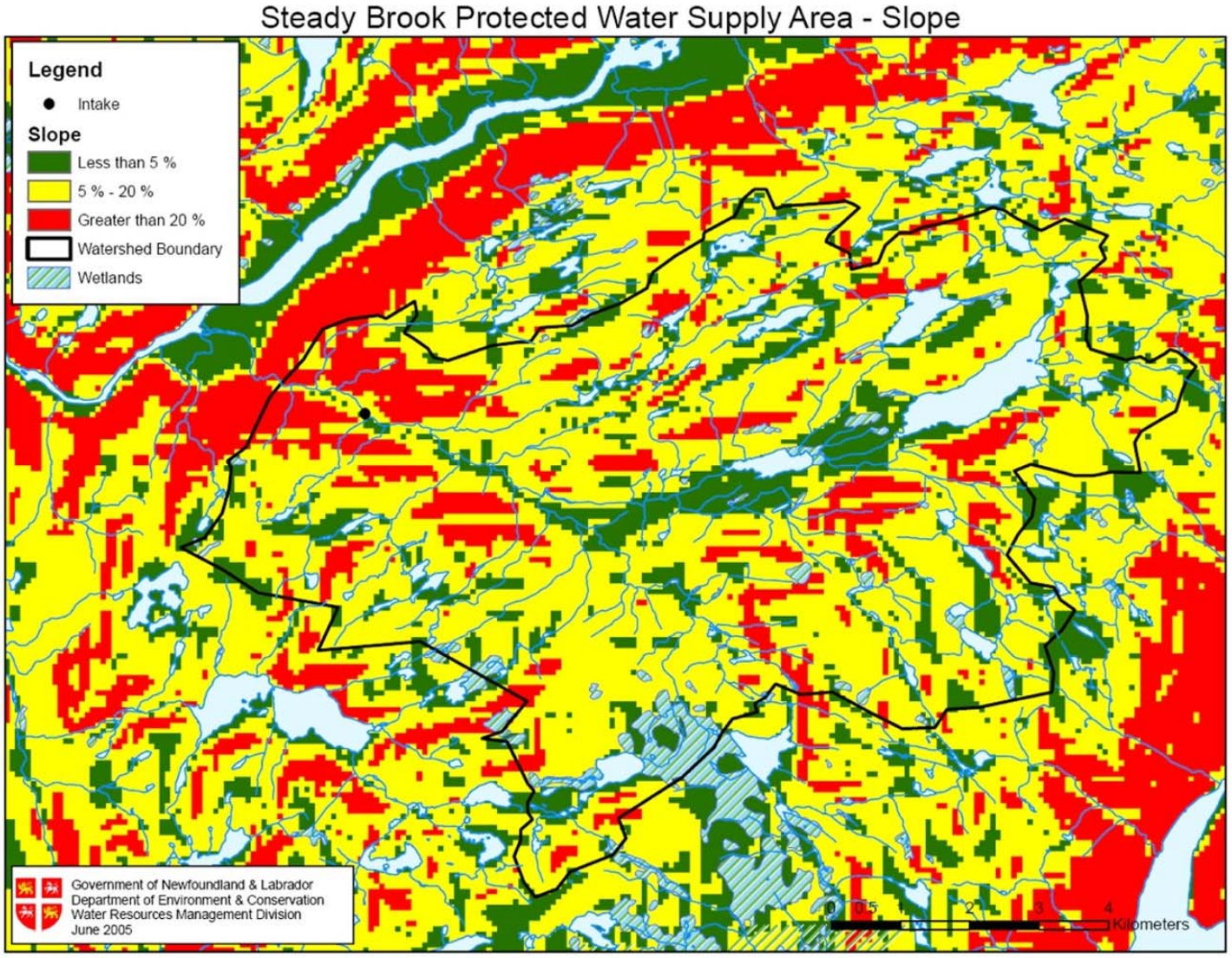
APPENDIX D – NUMERICAL INDEX COMPONENT RATINGS

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	Motorized Vehicle Use	3	1	2	2	1	2	3	2	2	2	3	3	2.7	224
	Camping & Recreation	3	1	2	2	1	1	3	2	1.8	2	3	3	2.7	219
	Domestic Cutting	3	1	2	2	1	1	2	2	1.6	2	3	3	2.7	213
	Cabins (Fuel Storage)	2	1	1.5	2	1	1	2	2	1.6	2	3	3	2.7	199
	Commercial Harvesting	1	1	1	2	1	1	2	2	1.6	2	3	3	2.7	189
	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
	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/ Mining	2	1	1.5	2	1	2	2	2	1.8	2	3	3	2.7	205
	Aviation	2	1	1.5	2	1	2	2	2	1.8	2	3	3	2.7	205
Sediments	Motorized Vehicle Use	3	2	2.5	1	1	3	3	1	1.8	2	3	3	2.7	235
	Domestic Cutting	2	2	2	1	1	1	2	1	1.2	2	3	3	2.7	205
	Commercial Harvesting	1	2	1.5	1	1	3	2	1	1.6	2	3	3	2.7	199
	Forest Road Construction/Use	2	2	2	1	1	3	3	1	1.8	2	3	3	2.7	219
	Utility Line Structure Maintenance	2	2	2	1	1	1	2	1	1.2	2	3	3	2.7	205
	Utility Line Vegetation Maintenance	2	2	2	1	1	1	1	1	1	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	1	1	3	2	1	1.6	2	3	3	2.7	199
	Snowmaking	1	2	1.5	1	1	3	2	1	1.6	2	3	3	2.7	199
	Increased Streamflow	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
Nutrients	Commercial Harvesting	1	1	1	2	1	3	2	1	1.8	2	3	3	2.7	195
	Domestic Cutting	2	1	1.5	2	1	2	2	1	1.6	2	3	3	2.7	199
	Mineral Exploration	1	1	1	2	1	2	2	1	1.6	2	3	3	2.7	189
	Quarrying/ Mining	1	1	1	2	1	2	2	1	1.6	2	3	3	2.7	189
	Forest Fire	3	1	2	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
	Cabins	1	2	1.5	3	1	2	2	1	1.8	3	3	3	3.0	220
	Wildlife	3	2	2.5	3	1	3	3	1	2.2	3	3	3	3.0	259
	Camping	3	2	2.5	3	1	2	2	1	1.8	3	3	3	3.0	248
CBP	Domestic Cutting	2	2	2	3	1	2	2	1	1.8	2	2	2	2.0	194
	Commercial Harvesting	1	2	1.5	3	1	3	2	1	2	2	2	2	2.0	185
	Forest Road Construction/Use	2	2	2	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	2	3	3	2.7	241
	Treatment	1	2	1.5	3	1	2	3	1	2	2	2	3	2.3	197
Toxins	Utility Line CCA Poles	1	1	1	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	3	3	3	3.0	225
	Silviculture	2	1	1.5	3	1	2	2	2	2	3	3	3	3.0	225
Salt	Forest Road Construction/Use	1	1	1	1	1	0	3	1	1.2	0	2	2	1.3	119

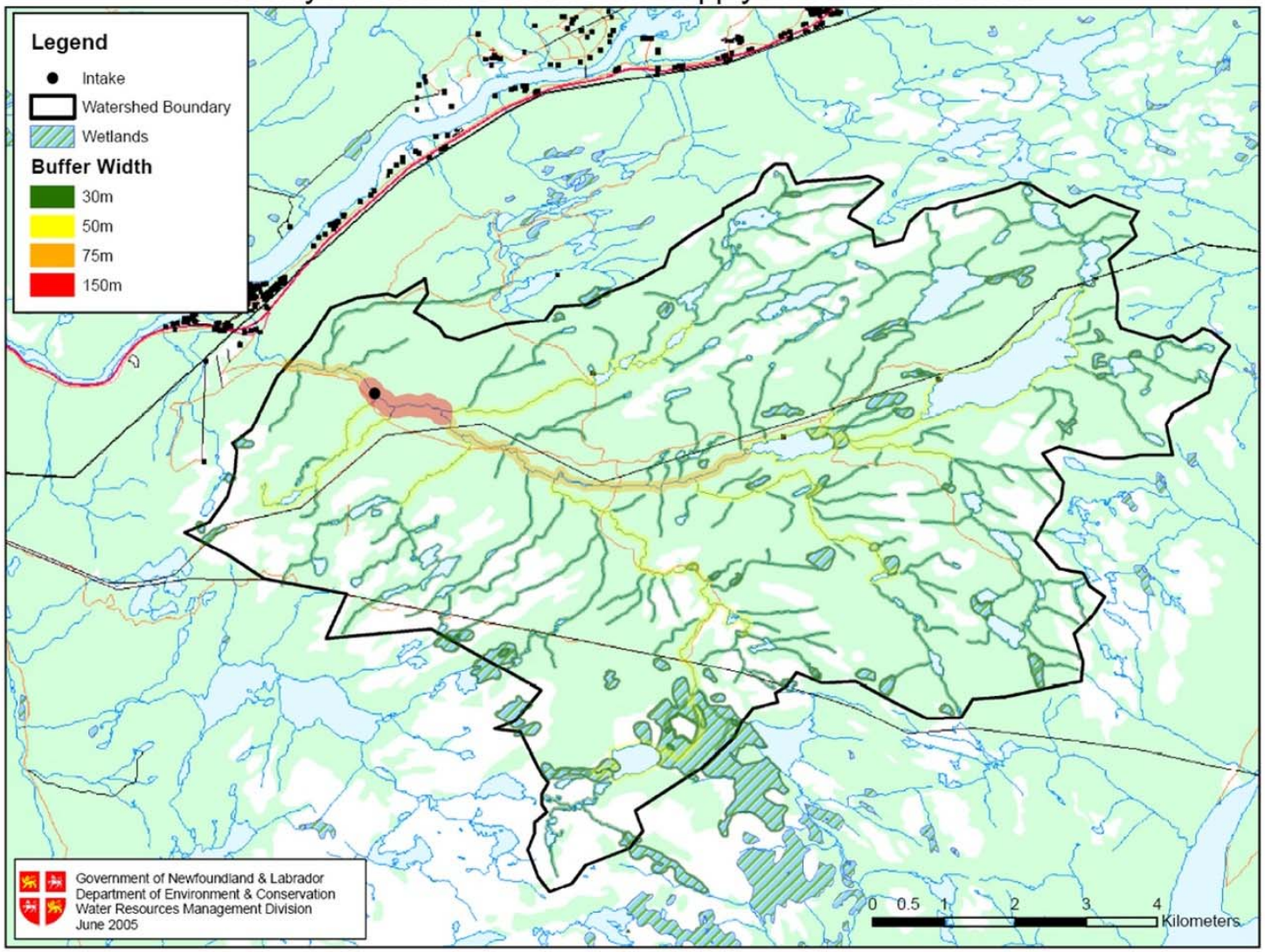
APPENDIX E – SENSITIVITY ANALYSIS MAPS

Steady Brook Protected Water Supply Area - Stream Order

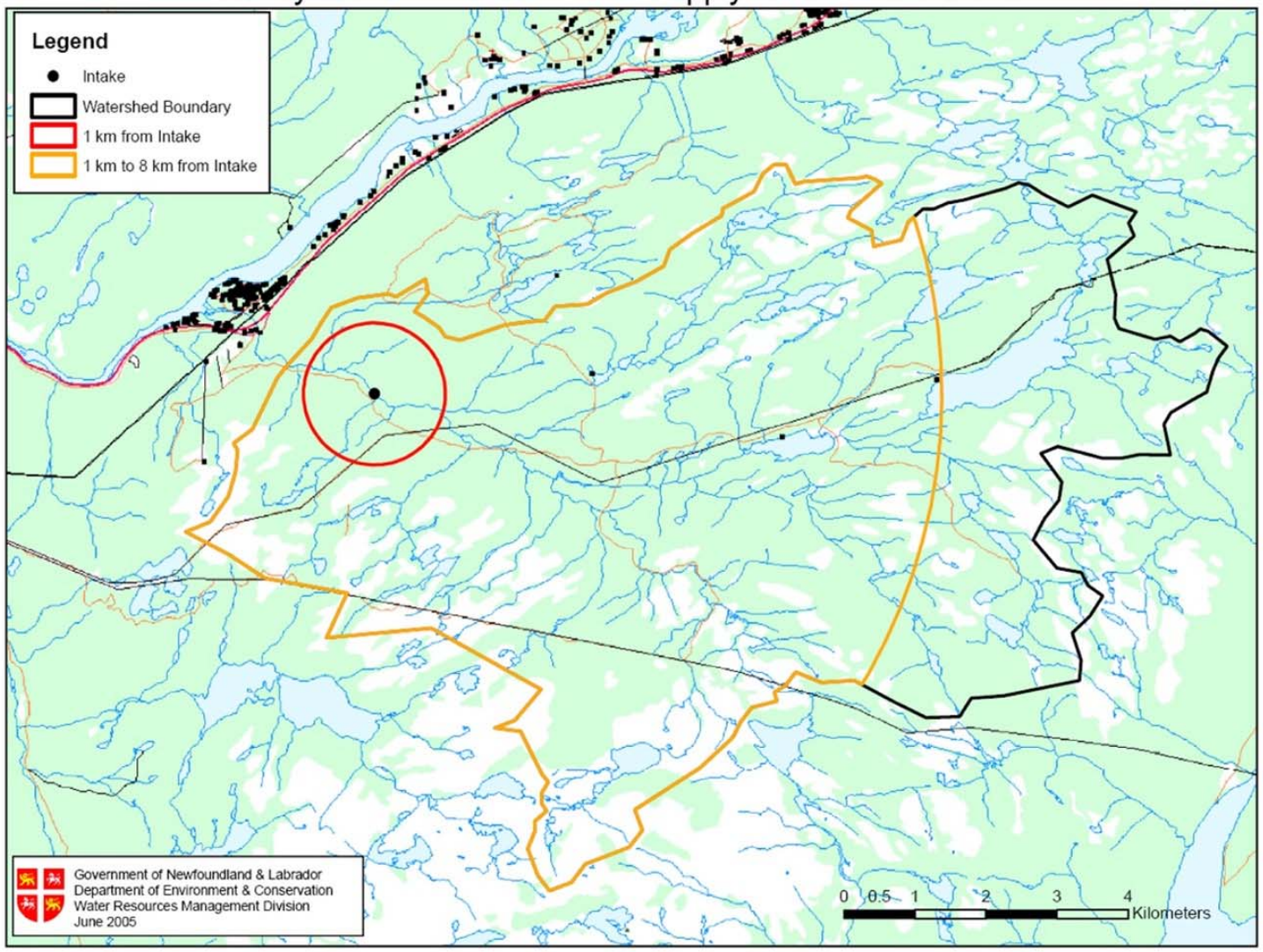



Steady Brook Protected Water Supply Area - Slope
Legend
Intake
Slope
Less than 5 %
5 % - 20 %
Greater than 20 %
Watershed Boundary
Wetlands
Government of Newfoundland & Labrador
Department of Environment & Conservation
Water Resources Management Division
June 2005
0
0.5
2
3
4
Kilometers

Steady Brook Protected Water Supply Area - Buffer Width



Steady Brook Protected Water Supply Area - Intake Buffers



APPENDIX F – 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 downstream
Main River Channel	75 m

Body of Water	Width of Buffer Zone
Major Tributaries/Lakes/Ponds	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.

REFERENCES

Canadian Council of Resource and Environment Ministers, Canadian Water Quality Guidelines, Minister of Supply and Services, Ottawa, 1987.

Canadian Council of Resource and Environment Ministers, Wood Treatment, The Canadian Perspective.

Department of Environment and Lands, Water Resources Management Division, Preservative Treated Wood in Aquatic Systems, 1989.

Health and Welfare Canada, Guidelines for Canadian Drinking Water Quality, Fourth Edition, Federal-Provincial Subcommittee on Drinking Water, Ottawa, 1989.

Konasewich, D.E. and Henning, F.A., AMMONIACAL COPPER ARSENATE WOOD PRESERVATION FACILITIES, Recommendations for Design and Operation, Environment Canada, Environmental Protection Branch, Report EPS 2/WP/4, Ottawa, 1988.

Konasewich, D.E. and Henning, F.A., CHROMATED COPPER ARSENATE WOOD PRESERVATION FACILITIES, Recommendations for Design and Operation, Environment Canada, Environmental Protection Branch, Report EPS 2/WP/3, Ottawa, 1988.

Konasewich, D.E. and Henning, F.A., CREOSOTE WOOD PRESERVATION FACILITIES, Recommendations for Design and Operation, Environment Canada, Environmental Protection Branch, Report EPS 2/WP/1, Ottawa, 1988.

Konasewich, D.E. and Henning, F.A., PENTACHLOROPHENOL WOOD PRESERVATION FACILITIES, Recommendations for Design and Operation, Environment Canada, Environmental Protection Branch, Report EPS 2/WP/2, Ottawa, 1988.

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 G – 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 H – INLAND FISH AND WILDLIFE DIVISION POSITION ON REMOVAL OF BEAVER IN MUNICIPAL WATERSHEDS

BRIEFING NOTES

Issue: Beaver Fever (Giardiasis) - Newfoundland

Prepared by: Oscar Forsey

Date: April 21, 1992

Problem:

The Disease

Giardiasis - one of most common waterborne causes of gastroenteritis and diarrhea of humans in the United States. Usually occurs due to contamination of water supplies by human, domestic animal, or wild animal wastes. Beaver are targeted in the disease more than any other of the parasite hosts because of the name - beaver-fever. Other hosts include muskrat, coyotes, dogs, cats, cattle, rats, mice, humans, to name some.

The parasite responsible for the disease, a protozoan, belongs to the Genus Giardia. There are several species which appear to infect different animals. Some are more pathogenic to humans than others but exactly which species infects which animal continues to be a matter of debate.

Parasite cysts are passed in feces and are immediately infective. Thus, when prevalent in drinking water, a problem develops as has happened recently in Corner Brook.

Newfoundland Status

First of recent reports to Wildlife Division in early summer, 1991, in Botwood. Traced to town water supply. Two beaver taken from that reservoir tested positive for Giardia sp. Understood that upwards of 200 to 300 people in Botwood infected by parasite.

Not aware of other confirmed cases last year, although a number of other towns having heard about Botwood problem, contacted Wildlife Division requesting removal of all beaver from their water supplies. Two or more beavers were taken last year by Wildlife Division from each of the Northern Arm and Harbour Breton water supplies, for testing purposes only, by the Department of Health. Tests were negative in both cases.

This spring, problem arose in Corner Brook - associated with the drinking water - over 100 people affected to this time. Giardia can be killed by boiling drinking water, and a boil order for the city has been in effect since detection of parasite about three weeks ago. One beaver was trapped by a trapper for testing purposes (near the Intake) and tested positive for Giardia. City Council in Corner Brook requested removal of all beaver from its water supply area.

Division's Position:

Indiscriminate trapping of beaver in town watersheds is not permitted:

a) Waste of the resource - totally unnecessary

b) Giardia infection (when present) can be associated with sources other than beaver

c) Division does not have financial or human resources to handle or administer

d) Beaver occupy most town watersheds

e) Some watersheds are quite extensive, eg. Gander Lake (two major rivers feed this system)

Permitted:

a) Where Giardia confirmed, any beaver in close proximity of intake can be removed

b) Where Giardia suspected - a sample of beavers or other wildlife, eg. muskrat, can be removed for testing purposes only

In (a) or (b), trapping may be conducted either by wildlife personnel (as in the case of Botwood last year), by permit to the particular town, or by a trapper who may hold a beaver trapline for the area. Trappers are often encouraged by Division (with a town's permission) to trap out any beaver houses on their traplines that they find in a town reservoir.

Other Agencies Involved:

(1) Municipal Councils

(2) Department of Municipal Affairs

(3) Department of Health

(4) Medical Profession

Addendum:

To date with the Corner Brook problem – beav

er trapping has been limited to area of reservoir intake only. Consideration being given to removal of a sample of muskrat for testing purposes.

Permission has not been given for removal of beaver from Englee, Jackson's Arm and Benton water supplies.

APPENDIX I – MONTHLY WATERSHED MONITORING REPORT

Steady Brook Watershed Monthly Monitoring Report

Month _____

Activities / developments observed:

_____
_____
_____
_____

Applicable permit in possession of operator:

_____
_____

Natural phenomenon of concern noted (e.g. beaver, water levels):

_____
_____
_____

Any roads or trails causing erosion?:

_____
_____
_____

Potential threats to water quality observed?:

_____
_____
_____

Other comments/observations:

_____
_____
_____
_____

Photo #'s _____

Signed _____

Date _____

APPENDIX J – STEADY BROOK WATERSHED ANNUAL REPORT CARD

Year _____

		Value	Grade[1]	Party Responsible
Water Quality				
	Drinking Water Quality Index			Dept of Environment
	No. of Contaminant Exceedences			Dept of Environment
	No. of Aesthetic Exceedences			Dept of Environment
	No. of Boil Water Advisories			Dept of Environment
Water Quantity				
	No. of Flooding Incidences			Town of Steady Brook
Development Activity				
	No. of Permits Issued for Development in a Protected Water Supply Area			Dept of Environment
	No. of Warning Letters Written to Cease Activity			Dept of Environment
	No. of Unauthorized Activities Observed in Watershed			Town of Steady Brook
Forestry				
	km of New Logging Road- Commercial			CBPP
	m3 of Timber Harvested- Commercial			CBPP
	m3 of Timber Harvested- Domestic			Dept of Natural Resources
	No. of Forestry Related Permits Issued			Dept of Environment
Other				
	No. of Beavers Observed in Watershed			Town of Steady Brook
	Condition of Roads/Trails			Town of Steady Brook
	No. of Campsites Observed			Town of Steady Brook
	No. of Cars Abandoned in Watershed			Town of Steady Brook
	No. of Forest Fires in Watershed			Town of Steady Brook
	No. of Mining/Quarrying Permits Issued			Dept of Environment
	No. of Recreational/Cabin Permits Issued			Dept of Environment
	No. of Utility Permits Issued			Dept of Environment
	No of People in the Watershed			Town of Steady Brook

[1] See next page for grading scale

Grading Scale

	Grade				
	A	**B**	**C**	**D**	**F**
Water Quality					
Drinking Water Quality Index	95-100	80-95	65-80	45-65	<45
No. of Contaminant Exceedences	0				>1
No. of Aesthetic Exceedences	0	1-3	3-5	5-10	>10
No. of Boil Water Advisories	0	1	2	3	>3
Water Quantity					
No. of Flooding Incidences	0	1	2	3	>3
Development Activity					
No. of Permits Issued for Development in a Protected Water Supply Area	0	1	2	3	>4
No. of Warning Letters Written to Cease Activity	0	1	2	3	>4
No. of Unauthorized Activities Observed in Watershed	0	1-3	3-5	5-10	>10
Forestry					
km of New Logging Road- Commercial	0	0-1	1-2	2-3	>3
m3 of Timber Harvested- Commercial	0	0-5000	5000-10,000	10,000-15,000	>15,000
m3 of Timber Harvested- Domestic	0	0-500	500-1000	1000-1500	>1500
No. of Forestry Related Permits Issued	0	1	2	3	>4
Other					
No. of Beavers Observed in Watershed	0-2	3-5	6-10	10-15	>15
Condition of Roads/Trails	excellent	very good	good	fair	poor
No. of Campsites Observed	0-2	3-5	6-10	10-15	>15
No. of Cars Abandoned in Watershed	0	1	2	3	>4
No. of Forest Fires in Watershed	0				1
No. of Mining/Quarrying Permits Issued	0	1	2	3	>4
No. of Recreational/Cabin Permits Issued	0	1	2	3	>4
No. of Utility Permits Issued	0	1	2	3	>4
No of People in the Watershed	0-50	50-100	100-150	150-200	>200