Municipality of the District of St. Mary's
Guysborough County

Source Water Protection Plan
Sherbrooke, Nova Scotia

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1. INTERPRETATION

1.1 Definitions

Act means the Environment Act;

Anticline means a large fold in the layers of rock caused by deformation of the earth's crust. The older strata are found towards the centre of the fold;

Basal Area is a measure of stand density developed by foresters. It is the total cross-sectional area of the trees in a stand, at breast height (4.5 feet above the ground), measured in square feet per acre;

Bedrock means any solid rock exposed at the surface of the earth or overlain by unconsolidated material;

Buffer is a spatial separation or setback between two defined uses;

Built footprint means the amount of land that is covered by impermeable surfaces;

Canopy means the top layer formed by the tallest trees in a forest;

Clear-cutting means to completely remove all trees and mature vegetation from a site, whether it be in the form of a patch cut, line cut, or any other pattern of clear-cutting. An area is considered to be in a clear cut condition when it is less than sixteen (16) years old, with an approximate stand height measure of between two and four (2-4) meters.

Cold air drainage occurs in low areas of the landscape where water tends to accumulate naturally. Warm air rises up while cold air drains downslope, making low lying areas colder;

Committee means the Sherbrooke Source Water Advisory Committee;

Deactivated means no longer active, no longer in use;

Discharge means to release, eject, dispel, emit, or leak any substance into the natural environment;

Drumlin means a smooth hill formed from deposits of glacial till; the long axis parallels the direction of flow of the former glacier;

Ecosystem means the relationships among a particular assemblage of living organisms and the environment in which they live;

Environmentally sensitive area describes an area that may have one or more of the following traits that are especially susceptible to damage when altered:

- erodible soils can erode away;
- steep slopes can erode or slump;
- poorly drained soils can drown or rot tree and plant roots, destroying the plant;
- soils with excessive drainage dry quickly and starve the roots of water;
- endangered species habitat can be destroyed with unregulated activities;
- shorelines can cause sedimentation, exposure of mineral soils, and allow flooding

Erosion means a wearing away and removal of material on the earth's surface by forces such as running water, wind, wave action, or moving ice. This process can be sped up when there are human activities in the area that are impacting the landscape;

Filtration is a term generally applied to the removal of pollutants and suspended solids, such as sediment, with the passage of water through soil, organic and/or fabric medium;

Floodplain means the land bordering a stream, built up of sediments from stream overflow and subject to inundation when the stream floods;

Forestry operation means any activity related to the use of the forest for the production of timber, wood fibre or Christmas trees and includes the following activities, as well as any other activity related to that use:

- forest management planning;
- silviculture;
- harvesting;

- road construction;
- operation, storage, use of equipment and supplies used in any aspect of the forestry operation;

Grubbing means to dig or poke in the ground; to dig up or out;

Habitat means the natural home or environment of a plant or animal;

Hardwood refers to a forestry term for deciduous, broad-leaved trees such as oak, maple, and birch and the forests they form;

Herbicide means any chemical or mixture of chemicals intended to prevent the growth of or promote the removal of targeted trees, bushes, and/or herbaceous vegetation;

Highwater mark means the level of highest water on a shore; the high-tide line of the sea and the high-flood line of streams or lakes;

Hydraulic tank float switch is a device that is automatically activated when the hydraulic tank level decreases to a point where a leak may be suspected. The switch will shut off the hydraulic pump if activated (in there was a broken line, the tank would normally be drained empty otherwise).

Infiltration rate means the maximum rate at which soil can absorb surface water;

Low impact activities means activities that have minimal impact on the natural environment. This includes passive uses like walking, hiking, and camping, as well as canoeing and kayaking;

Nutrient means any substance required by organisms for normal growth and maintenance;

Old-growth or mature forest means a phase in forest development characterized by a multi-layered structure, old climax tree species, snags, and large amounts of coarse woody debris;

Organic matter means the organic fraction of the soil; includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population;

Patch cut is a tree harvesting method whereby all trees in a relatively small area are removed;

Peat is a dark brown or black organic material produced by the partial decomposition and disintegration of mosses, sedges, and other plants which typically grow in marshes and wetlands;

Pesticide application means the application and use of pesticide for the maintenance of outdoor trees, shrubs, flowers, or other ornamental plants and turf on the part of a property used for residential purposes or on property of the municipality;

Pesticide, insecticide or pest control product means
a) any substance that is intended, sold or represented for use in preventing, destroying, repelling, attracting or mitigating, directly or indirectly, and pest;
b) any substance that is a pest control product within the meaning of the *Pest Control Products Act* (Canada) or is intended for use as a pest control product;
c) any substance that is a plant growth regulator, a defoliant or a plant desiccant;
d) a fertilizer within the meaning of the *Fertilizer Act* (Canada); or
e) any other substance designated as a pesticide in the regulations made pursuant to the *Environment Act;*
but does not include a substance that is intended for sale, sold or represented for use in potable water to prevent or destroy bacteria, parasites or viruses if the substance is not a pest control product within the meaning of the *Pest Control Product Act* (Canada);

Professional Forester means a graduate of a recognized university or college with at least a bachelor's degree or diploma in forestry;

Release means to spill, discharge, dispose of, spray, inject, inoculate, abandon, deposit, leak, seep, pour, emit, empty, throw, dump, place, drain, pump or exhaust;

Remote engine shut-down refers to a switch that allows the operator to stop the truck engine (and hydraulic pump) immediately from the seat of the loader. In the event of a main pressure or return line hose failure on a truck or trailer centre mounted loader considerable oil can be lost before the operator can reach the truck cab to stop the engine;

Runoff is the portion of rainwater or any other liquid on a drainage area that is not absorbed into the ground but flows over land and is typically discharged into streams. Components of runoff include overland flow (sheet flow), open channel flow and ground water flow;

Sedimentation means the movement of finely divided solid particles through a fluid, under the influence of a gravitational or other force;

Selective cut means harvesting only selected mature trees of a desired species;

Selection cut means using smaller patch cuts that do not remove *only* the best trees;

Small residential garden is a personal garden not meant for commercial purposes;
Softwood means a forestry term for coniferous, needle-leaved trees such as pine, fir and spruce and the forests they form;

Special management zone is an area with environmentally sensitive attributes where extra precaution is necessary to carry out any activity that could potentially disturb the landscape in order to ensure the environment and/or water quality is not negatively impacted;

Suspended solid means a solid particle that is floating or being held on or in a fluid;

Syncline means a fold in layers of rock caused by deformation of the earth's crust. Synclines are basin-shaped and have the younger strata (rock layer) towards the centre of the fold;

Town means the built up area of Sherbrooke, Nova Scotia;

Treated property means a property upon which a pesticide application has taken place;

Understory means the intermediate layer of trees and shrubs within a forest structure;

Water Utility means the Sherbrooke water treatment plant;

Watercourse means the bed and shore of every river, stream, lake, creek, pond, spring, lagoon, swamp, marsh, wetland, ravine, gulch, or other natural body of water, and the water therein, including groundwater and seasonal and ephemeral drainages, within the jurisdiction of the Province;

Watershed is a term that refers to the area from which surface water drains into a common lake or river system or directly into the ocean.

2.1 Summary

The Walkerton and North Battleford Inquiries (2000 & 2002, respectively) prompted nation-wide action on improving and regulating standards for municipal water supplies across the country. As a result, the Nova Scotia Department of Environment and Labour is requiring all Nova Scotia municipal water utilities to have an approved source water protection plan.

In Sherbrooke, Nova Scotia, the Sherbrooke Lake Watershed Advisory Committee (SLWAC) defines the overall health of the Sherbrooke Lake Watershed as essential in maintaining clean and healthy lake water. When guiding and managing activities in the watershed, general landscape sensitivity is the basis for conservation, with an emphasis on hydrology.

Based on community input, the Committee was able to compile a list of activities that currently occur in the watershed and the risks associated with them. Considering the various ways that help reduce the risks associated with such activities, the Committee decided on a multi-layered approach that would incorporate several of the following management techniques:

- Municipal acquisition of land in the watershed;
- Land-use By-laws specific to the watershed;
- Best Management Practices guiding activities in the watershed;
- Contingency plans that ensure protection of public health;
- Designation of the watershed to regulate activities therein;
- Education and awareness for the community and stakeholders;

The Committee agreed to support Best Management Practices coupled with a contingency plan that will allow continued protection of public health. They are also working with the Land-use Planner on policies and by-laws that regulate land uses permitted in the watershed. Acquisition of properties in the watershed is an alternative when opportunity arises, and education and awareness for the community is an on-going practice. While Designation would ensure the highest level of protection for the

watershed, the Committee agreed guidelines would be more easily accepted than regulations by the community.

2.2 Context

In the fall of 2002, the Nova Scotia Government released *A Drinking Water Strategy for Nova Scotia, a comprehensive guide to the management of drinking water*. (Nova Scotia Department of Environment and Labour, fall, 2002). The report outlines the challenges, responsibilities, and barriers that government regulators are being faced with when protecting public drinking water sources. The release of this document brought awareness to many municipalities throughout Nova Scotia of the importance and risks associated with their municipal water supplies.

2.2.1 Sherbrooke Watershed

Until 1969, residents of Sherbrooke drew their drinking water from on-site wells. Traces of petroleum product residue were detected in the water in 1968, forcing Government officials to identify and designate a new source of drinking water for the community - Sherbrooke Lake. The supply system and intake pipe was subsequently constructed in 1969 and further extended in 1975. The system presently services all residences on both the east and west sides of the St. Mary's River, all businesses in the area, Historic Sherbrooke Village, St. Mary's Hospital, St. Mary's Elementary School, St. Mary's Rural High School, and a Nova Scotia Department of Transportation and Communication Depot.

The watershed of Sherbrooke Lake is defined by the extent of all land area, lakes and streams that drain into Sherbrooke Lake. The lakes include Tates Lake, Little Lake, T Lake, Rocky Lake, Second Lake, Third Lake, Fourth Lake, and Fifth Lake. (See Hydrology Map, p. 51).

The landscape in the watershed is forested with some areas in different stages of re-growth after clear-cutting. Existing land uses in the watershed include several residential homes (some with on-site septic systems), a recreation complex, a gas station and convenience store, water treatment plant, recycling depot, CBC transmission tower, public transportation corridors and active logging roads. The Crown owns over half of the

forested land in the watershed; the rights to harvest timber have been granted to StoraEnso.

Sherbrooke Location Map

Watershed location map

2.2.2 Purpose

In the summer of 2002, following the Walkerton and North Battleford Inquiries on contaminated municipal water sources, the Sherbrooke Planning Advisory Committee expressed interest in ensuring the protection of Sherbrooke's water supply. Following guidelines set forth in the provincial document titled *A Drinking Water Strategy for Nova Scotia* (Nova Scotia Department of Environment and Labour), a source Water Advisory Committee was formed and sworn in by St. Mary's Municipal Council on May 5, 2003. The purpose of the Source Water Advisory Committee was to prepare a watershed protection plan that would outline guidelines and recommendations for activities within the source water watershed. The protection plan would provide long-term protection of the water quality in Sherbrooke Lake in order to ensure a safe and healthy water supply for all residents in the Sherbrooke area.

The intention of the strategy was also to promote public understanding and awareness about the ecological character and sensitivity of the watershed to ensure safe, non-destructive activities in the area.

2.2.3 Terms of Reference

The Watershed Advisory Committee agreed on specific terms of reference for the purpose and management of the committee:

Purpose

The Sherbrooke Watershed Advisory Committee (the Committee) shall:

a) assist the Municipality of St. Mary's in developing a comprehensive water supply watershed management strategy;

b) provide ongoing advice to Sherbrooke's superintendent of public works on all aspects of implementing the strategy;

c) provide a forum for stakeholder involvement and for reporting to stakeholders on matters of water resource and watershed protection;

d) continue to educate the public on environmental and land use issues in order to encourage protection of water quality;

e) identify a secondary source to be used in the event the primary source gets

contaminated.

To achieve its purpose, the protection plan shall address the following:
a) Defining the water supply protection area for Sherbrooke Lake;
b) Identifying sources of contamination;
c) Preparing regulations guiding activities which impair water quality;
d) Encouraging public education, awareness and understanding of the nature and importance of a water supply watershed;
e) Water quality monitoring and reporting;
f) Planning for emergency measures to protect the water supply;
g) Liaisons with all stakeholders in the watershed; this includes ensuring best practices are being followed for forestry, construction, maintenance and recreational activities;
h) By-laws controlling land use under the Municipal Government Act;
i) All other matters pertaining to the protection of the lake and its drainage basin.

The Committee

1. As advised by the Nova Scotia Department of Environment and Labour and the *Municipal Government Act*, the Source Water Advisory Committee shall be recognized by the Municipal Council;
2. The Committee is ultimately responsible to the Municipal Council who will make the final decision of acceptance of the plan;
3. In order to develop and implement a comprehensive watershed protection plan, the following will be included as members of the committee:
    a) two members of Council;
    b) water utility operator;
    c) at least one resident of Sherbrooke;
4. In order to ensure communication links among stakeholders and interested individuals, the Committee shall invite the following to appoint one representative to join the committee and assist in meeting the goals an objectives set out and defined by the community at large:
    a) Municipality of the District of St. Mary's - Councilor District 4;
    b) St. Mary's River Association;
    c) StoraEnso Ltd.
    d) Sherbrooke Provincial Museum;

e) Local residents;

f) Ministry of Natural Resources;

g) St. Mary's River South Planning;

5. The following shall be invited to assist the Committee in an advisory capacity:

a) Nova Scotia Department of Labour;

b) Service Nova Scotia;

6. The Committee shall be chaired by a member of Council;

7. All members noted above shall serve for a term that is to be determined by the Committee;

8. Secretarial services shall be provided by Sherbrooke;

9. The committee shall endeavour to conduct business by consensus, but should voting be necessary, all motions require support from quorum (50 + 1) of the committee members;

10. The Committee shall meet every two to three weeks as necessary while the committee is being established with terms of reference and regulations. After that they shall meet when necessary, but no less than three times in each calendar year. All meetings shall be open to the public;

11. These terms of reference may be amended by Council;

12. The Committee shall prepare an annual report at the end of each calendar year and circulate it to all members of the committee, all assisting groups listed in section 4 above, the municipal clerk, and the public.

2.2.4 Goals and Objectives

The goals and objectives were formulated by the Sherbrooke Lake Watershed Advisory Committee in the summer of 2003:

vision statement

To have a protected source water area, to maintain the existing aesthetic and physical qualities and to maintain clean drinking water for the surrounding land owners, local businesses and visitors.

goals

- Protection of the Sherbrooke Watershed and source water area, including water

bodies, wetlands, watercourses and their functions;

- Identification of environmentally sensitive landscapes through land use inventory mapping;
- Protection of environmentally sensitive areas including all water features and functions, steep slopes, exposed barren lands, thin and erodible soil deposits, older and mature forest stands, and protection of cultural and heritage sites;
- Encouragement of community planning to determine the rate and direction of growth within the watershed based on identification of new threats to the water supply;
- Encouragement of active and passive recreational opportunities within the Sherbrooke Watershed;
- Protection of water quality in the Sherbrooke Watershed through management of land use activities such as active and passive recreation, forestry and agriculture;
- Investigation of various alternatives and planning tools to regulate activities in the watershed;
- Encouragement for the Municipality to develop a storm water management plan for Sherbrooke to further protect the source water area;
- Promotion of education for land owners on maintaining clean water sources and septic tanks so that the Sherbrooke water supply is not compromised;
- Ensuring access to wilderness areas for all residents.

objectives

- Identify and designate areas of environmental sensitivity so that a management strategy may be implemented to direct future development that ensures protection of water quality, natural open spaces, back lands, wildlife habitats, and ecologically, culturally, and aesthetically valuable natural features;
- Encourage responsible development proposals that acknowledge and protect environmental features and functions;
- Undertake a program of acquisition to obtain through purchase, exchange, easement, or land owner agreement, all privately owned land in the watershed;
- Encourage implementation of a Source Water Zone that regulates activities within the watershed, to be enforced through Land-use By-laws;
- Encourage and enforce the use of alternative methods of pest control in order to discontinue the use of pesticides and herbicides specifically within the source

water watershed;

- Work with the Department of Natural Resources and StoraEnso on a forestry management plan for timber management on the crown lands in the watershed;
- Work with the Department of Natural Resources and StoraEnso on a forestry management plan for timber management for private land owners in the watershed;
- Implement a management plan that regulates activities in the watershed;
- Host open houses to inform the public of environmental issues in the watershed regarding recreational activities as well as land use activities;
- Host a seminar or workshop on septic systems and maintenance;
- Look for funding to update old or damaged septic systems.

2.3 Approach

To create a Source Water Protection Plan that protects water quality while taking into consideration existing and traditional uses in the watershed. The plan will be based on a combination of the most appropriate management practices for the water supply area. Options include:

- Municipal acquisition of land in the watershed. The direct ownership of land in the source water supply area affords one of the highest levels of water quality protection;
- Land-use By-laws specific to the watershed. Adopt or amend land-use by-laws or develop a new municipal planning strategy. these instruments allow regulation of land uses permitted in source water supply areas;
- Best Management Practices guiding activities in the watershed. The use of best management practices and guidelines will aid in managing activities that take place in the source water supply area;
- Contingency plans that ensure protection of public health. If there is a spill or other event that threatens the quality or quantity of the source water, a well-prepared contingency plan will allow continued protection of public health;
- Designation of the watershed to regulate activities therein. The Environment Act allows for the designation of Protected Water Areas. Designation allows a water utility or municipality to regulate activities like swimming, fishing and logging

within a delineated area;

- Education and awareness for the community and stakeholders. Working with stakeholders in the source water supply area teaches them about drinking water and water resource stewardship;

(Nova Scotia Department of Environment and labour, Water and Waste Water Branch, 2004)

2.4 Method

The following steps were taken to inform the planning process in the creation of the watershed management plan:

- Identification and delineation of the boundary of the source water protection area;
- Preparation of an inventory of existing landscape features in the watershed using topographic and resource maps of the area;
- Identification of all current land uses in the watershed that might affect water quality, including residential and commercial land uses, septic systems, roads dissecting the watershed, patterns of forestry practices, hunting/fishing grounds, trails, and camp sites;
- Survey distribution to every residence in the serviced area. In the summer of 2002, a similar survey was sent to all residents of Sherbrooke, as well as all land owners in the watershed;
- Preparation of a Terms of Reference that outlines the purpose, strategy, and requirements needed to direct the actions of the Committee;
- Preparation of a vision statement with goals and objectives to inform the watershed plan;
- Creation of a landscape sensitivity map showing all possible sources of contamination as well as landscapes with characteristics that make them sensitive to development;
- Organization and participation of a watershed field trip by all committee members;
- Identification of the most appropriate management practices for the Sherbrooke Lake watershed;

- Preparation and revision of several drafts of guidelines regulating land uses and activities in the watershed that have the potential to contaminate the drinking water;
- Preparation and revision of several drafts of a management plan guiding forestry practices in the watershed;
- Presentation of forestry guidelines to StoraEnso for review and response;
- Preparation of final watershed management plan;
- Presentation of final watershed plan to Council for review.

3. ANALYSIS OF SENSITIVITY

The goal of this plan is to preserve the natural health and character of the watershed and ensure that what activities do take place in the watershed do so in ways and places that do not compromise the ecological health of the water and the watershed in full. The overall health of the watershed is essential to maintaining clean and healthy water, therefore general landscape sensitivity is the basis for conservation, with an emphasis on hydrology.

Using input gathered from the community, possible sources of contamination were highlighted. The watershed guidelines have been written to regulate these uses and to have the least amount of negative impact on the water quality.

certain forestry practices

Forest management activities have the potential to cause more damage to landscapes than the actual removal of the trees. Certain practices can have severe effects, while others may have little to no negative impacts on water quality and ecosystem health.

- Logging roads have proven to be one of the most detrimental aspects of timber harvesting to overall forest health. If not properly built or maintained, logging roads can increase the risk of soil erosion. This is especially hazardous where roads cross waterways and where drain diverters are not in place. Contaminants from trucks and machinery can enter the drainage system this way and pollute the lake system all the way to the final drainage area - Sherbrooke Lake.

The more logging roads present in a forest, the more risk is involved. Further, once a harvest is finished, logging roads often continue to be used as ATV trails. If roads are not properly maintained during and after a harvest, severe damage can occur from these recreation vehicles.

- Skid trails have the potential to compact soil and create ruts and channels in the trail. They remove the necessary organic detritus that comprises the top layer of soil in a forest. Proper harvesting techniques that include tree delimbing and removal in place will reduce the amount of damage to the forest floor.

- Site preparation is intended to remove any existing vegetation on a site so that desirable trees (for the market) can be planted and encouraged to grow without the threat of competing species. It is designed to modify soil conditions and clear planting sites, sometimes to the detriment of the health of soil and remaining vegetation.

- Stand tending refers to the maintenance of forests with the intention of harvesting timber. This can include both chemical applications and manual pre-commercial thinning.

  Chemical applications destroy all unwanted vegetation and tree species in a stand. The chemical then seeps into the ground and is filtered and drained into the primary waterway.

  Pre-commercial thinning requires periodic maintenance of a tree stand in order to remove diseased or insect-infested trees, as well as to open the tree canopy to allow for sunlight penetration. However, it can produce monocultures which is breeding only one type of tree in an area, weakening the stand by removing mixed vegetation.

- Clear cutting is potentially one of the most destructive forestry prescriptions. Transpiration (percolation of precipitation into the soil) is greatly reduced when most of the vegetation is removed. This is especially harmful on steep slopes. Wet, poorly drained areas are also easily damaged after a clear-cut prescription because

growth of new stands may be impeded with increased water collection.

- Vegetated buffer zones are necessary in order to protect the shorelines of lakes and waterways in the watershed. They act as a filter cleaning overland flow, helping to keep pesticides, sedimentation, and any other pollutant from entering the water column.

  In order to maintain a healthy buffer zone, some management should be allowed within the buffer. Limited harvesting that takes into account basal area and canopy opening ensures a healthy stand of un-even aged trees that is available for reproduction, shade, and wind barriers for younger trees.

  Specially managed zones ensures a jagged line of vegetation which, according to Dramstad, encourages wildlife movement along the buffer and creates a better wind barrier where wind avoids hitting a straight line of trees with full strength. (Dramstad, Wenche, Olson and Forman, 1996 p.30)

Environmentally sustainable forestry management plans are currently being worked on with the cooperation of Committee members, StoraEnso, the Department of Natural Resources and the Department of Environment and Labour.

Forestry sensitivity map

development and trails too close to shorelines

Results are comparable when development is too close to shorelines and when roads or ATV trails cross streams. These activities are relatively harmless elsewhere, but shorelines are especially sensitive. Repeated soil compaction can damage existing roots and remove healthy topsoil. Any mechanized activity near water is risky as it allows the possibility for contaminants from shoes, machinery, and wheels to enter the water way.

motorized boats in the lakes

Depending on certain variables like water temperature, wind direction and speed, and location of contamination, the risk of a gas spill in the water system could destroy the water source and cost the municipality time and money to extract water from the secondary source (Michel, n.d). One reference (Mosquito Creek Watershed Profile, 2000) stated that a standard 200 litre drum of trichloroethylene would need to be diluted with 60 billion litres of water to make it harmless.

- the entire watershed including all lakes and streams contain approximately 3 271 770 cubic meters of water;
- one litre of gas requires 300 000 000 litres of water to dilute it;
- 11 litres of gas can be safely diluted in the watershed only if it goes through every bit of water in the watershed. That is 2.91 gallons;
- Sherbrooke Lake itself has approximately 1 571 185 cubic meters of surface water. That is 1 571 185 000 litres. From the furthest point possible form the intake pipe within Sherbrooke Lake, 5.25 litres of gas can be safely diluted. That is 1.38 gallons.

Other sources give varying statistics depending on water temperature, wind speed and direction, as well type of gas or oil that is spilled. Another source states that light oils like gasoline and jet fuel are highly volatile and should evaporate within 1-2 days. It also states that light oil has high concentrations of toxic (soluble) compounds and the result is localized, severe impacts to water column and intertidal resources.
(Energy Educators of Ontario, 1993)

septic systems

New and existing septic systems could contaminate the water source if they are not properly maintained. There have been no indications of problems to date, however, regular cleaning (once every four years) is recommended. New septic systems would have

to be approved and owners must follow the guidelines as well.

FireTrol fire suppressant

It was identified that the current fire suppressant to be used in the watershed in the case of a fire includes the chemical Hexlene Glycol which has negative health implications for both humans and wildlife. This was pointed out to the department of Natural Resources and the Shubenacadie Provincial Fire Department, and a list of alternative fire suppressants was requested in the summer of 2003, but none has been forthcoming.

RecPlex and designated parking area

A dry stream bed runs through the cleared area adjacent to the RecPlex and the land slopes directly into Sherbrooke Lake. There are plans to expand the current parking lot area by filling in the stream bed. One alternative suggestion is to move the designated parking area to a cleared piece of land across the street. Another is to grade the parking area so that it slopes away from the lake and towards the road, and to direct the drainage into ditches along the road side.

pesticide and herbicide use in the watershed

The use of pesticides and herbicides in the watershed can potentially contaminate the drinking water; because the land in the watershed slopes down towards Sherbrooke Lake, any time it rains pesticides and herbicides that have been applied on fields or gardens will wash off the plants and into the overland flow that drains directly into streams and lakes at the bottom of the watershed. Small amounts are diluted, but frequent applications and large amounts can heighten the risk of contaminating the water to such a degree that it could prove detrimental to the health of the community.

livestock

When livestock animals have uncontrolled access to waterways, several things can occur:

- they can erode banks and destroy plant life and trees;
- they can crush the aquatic vegetation that wildlife and marine wildlife depend on;
- they can destroy fish and wildlife habitat;
- bacteria in the water can increase, resulting in having to close the lake as a drinking source;
- animal wastes have the potential to contaminate the water by being washed

downhill with overland flow or seeping through the soil and draining down to the lake through fissures in the bedrock or through natural drainage patterns.

Activity Sensitivity map

4. RECOMMENDATIONS

In order to maintain clean, healthy water for the residents of Sherbrooke, Nova Scotia, it is recommended that all activities in the watershed follow best management practices written and approved by the members of the Sherbrooke Source Water Advisory Committee. This includes forestry guidelines as well as any other activity that should occur within the watershed.

A recommended contingency plan will allow continued protection of public health. Land-use policies and by-laws that regulate land uses permitted in the watershed are being developed concurrently.

Council is recommended to develop a program of acquisition of properties in the watershed as an option when opportunity arises and support for education and awareness for the community is recommended as an on-going practice.

While Designation would ensure the highest level of protection for the watershed, it is recommended that best management practices be implemented first, guiding residents in an environmentally friendly way to protect their water supply. Where BMPs are not successful in reducing risks to the watershed, designation of specific parts of the watershed is recommended.

The following are proposed best Management Practices for activities in the Sherbrooke Source Water Watershed which have been reviewed and revised by all members of the Watershed Advisory Committee:

4.1 Application

Unless otherwise stated, these regulations apply to activities within the Sherbrooke Source Water Watershed.

The water supply watershed of Sherbrooke Lake in the district of St. Mary's is defined by the extent of all land area, lakes and streams which drain into Sherbrooke Lake. These lakes include Tates Lake, Little Lake, T Lake, Rocky Lake, Second Lake, Third Lake, Fourth

Lake, and Fifth Lake.

All agreements made by the Committee shall be in written form.

4.2 Best Management Practices

4.2.1 Recreational Activities

4.2.1.1 No person should bathe, wash, or cut ice in any lake or watercourse in the Sherbrooke Source Water Watershed;

4.2.1.2 No person should swim in Sherbrooke Lake;

4.2.1.3 No person should fish, including ice fishing, from the shoreline or bank of Sherbrooke Lake within three hundred thirty (330) feet or 100 metres of the intake pipe for the water supply;

4.2.1.4 No person should wash a vehicle in any watercourse in the watershed;

4.2.1.5 No person should operate or cause or permit to be operated any motorized vehicle, boat or vessel on Sherbrooke Lake, Second Lake or Third Lake. Exceptions would be made for battery operated vehicles, so long as the battery is held in a sealed and waterproof container.

4.2.1.6 No person should place, deposit, discharge or permit or cause to be placed, deposited or discharged any rubbish, litter, refuse, woody debris or any other waste material of any kind within the watershed.

4.2.1.7 No person should remove more than 23 000 l/day or more of water from Sherbrooke Lake without Water Withdrawal Approval, issued by the Department of Environment & Labour.

4.2.1.8 No person should place, deposit, discharge, or allow to remain in Sherbrooke Lake any material of any kind that may impair the quality of the water therein.

4.2.1.9 No person should operate or cause or permit to be operated any self-propelled or motorized vehicle or vessel (ATV, Skidoo, Four Wheeler etc.) within one hundred sixty four (164) feet or 50 metres of any shoreline (except at designated stream crossings), and should avoid steep slopes in order to reduce erosion. Stream crossings should be made to connect with existing roads and bridges.

4.2.2 Posting of Signs

4.2.2.1 The Municipality should post interpretive signs around the periphery of the Sherbrooke Source Water Watershed providing information of the stewardship and ecological significance of the watershed.

4.2.2.2 The Municipality should replace any signs posted pursuant to subsection 4.2.2.1 that have been damaged or removed.

4.2.2.3 The Municipality should take reasonable measures to advertise and provide notice to the general public of these recommendations.

4.2.2.4 No person should remove or alter any sign, notice, or advertisement posted pursuant to this section.

4.2.3 Fire Guidelines

4.2.3.1 No person should set, start, maintain, or be responsible for an open fire in the Sherbrooke Source Water Watershed between April 15 and October 15 of each year, except for an open fire in a barbecue or fire place designated for cooking purposes at a residential dwelling in the watershed.

4.2.3.2 Despite subsection 4.2.3.1, during the period from April 15 to October 15 of each year, a person may set, start, maintain or be responsible for a fire in the watershed if the person has a valid permit to burn issued pursuant to the *Forest Fire Protection Regulations* made under the *Forests Act.*

4.2.3.3 No person should fail to comply with the provisions of the *Forest Fire Protection Regulations*.

4.2.3.4 As the fire suppressant *Class A FireTrol®* is a proven health hazard to both humans and wildlife, every effort should be made to find an alternative fire suppressant.

4.2.4 Forestry Operation

4.2.4.1 No person owning private property in excess of five (5) hectares should undertake a forestry operation within the Sherbrooke Source Water Watershed unless the operation is conducted pursuant to a forest management plan that is prepared in accordance with the objectives and policies approved by the Committee.

4.2.4.2 All professional forestry operations and management should be certified by an accredited forestry certification program.

4.2.4.3 All professional forestry operations should be conducted pursuant to a forest management plan that has been approved by the Committee.

4.2.4.4 All forestry operations in the watershed should retain naturally vegetated buffers and special management zones surrounding all lakes, waterways and environmentally sensitive areas. These include:

a) land directly adjacent to Sherbrooke Lake, Second Lake and Third Lake, as measured from the high water mark:

- Forty five (45) metre or 150 ft. protection and management area
- inner thirty (30) metres or 98 ft. - no-cut zone
- outer fifteen (15) meters or 50 ft.- special management zone with selective cutting using hand-held machinery with biodegradable oil only;

b) land directly adjacent to all other lakes and waterways, as measured from the high water mark:

- thirty (30) metre or 98 ft. protection and management area
- inner twenty(20) metres or 65 ft.- no-cut zone
- outer ten (10) metres or 33 ft.- special management with selective cutting

using hand-held machinery with biodegradable oil only.

4.2.5 Construction

4.2.5.1 No person should construct or extend a forest access or wood lot road or a paved road within the Sherbrooke Source Water Watershed unless the route location is approved in writing by the Committee.

4.2.5.2 No owner, user or person responsible for a forest access or wood lot road constructed pursuant to subsection 4.2.5.1 should fail to maintain it.

4.2.5.3 The Committee shall be consulted prior to any private construction or maintenance of railways, highways, communication lines, power lines, waterworks (except the Sherbrooke Water Treatment Plant) and other works of like nature within forty-five (45) metres or 148ft. From Sherbrooke Lake .

4.2.5.4 No person should construct a gravel pit, pit or quarry in the watershed.

4.2.5.5 Sediment diverter trenches should be built traversing all gravel roads within thirty (30) metres or 198 ft. of a waterway or watercourse.

4.2.6 Watercourse Alteration

4.2.6.1 No person or Municipality should alter the natural features of any watercourse or the natural movement of water therein without a permit from the Minister of Environment and Labour as required by the *Environment Act.*

4.2.6.2 No person should construct a bridge or culvert or otherwise alter a watercourse within the Sherbrooke Source Water Watershed unless:
a) an approval has been issued by the Department of Environment and Labour; and
b) the Committee has approved the construction or alteration in writing.

4.2.6.3 No owner, operator or person responsible for a bridge or culvert approved pursuant to subsection 4.2.6.2 should:

a) fail to maintain or repair the bridge or culvert; or
b) remove the bridge or culvert without obtaining an approval from the Department of Environment and Labour.

4.2.6.4 No person should remove or allow the removal or alteration of soils, within forty five (45) metres or 150 feet of Sherbrooke Lake unless it is to protect or restore the health of the waterway. All proposals for soil removal or filling should be considered through Council and the Committee.

4.2.6.5 The construction of a forest access or wood lot road, trail, stream crossing culvert or other watercourse alteration within the watershed should be in accordance with the *Wildlife Habitat and Watercourse Protection Regulations* made under the *Forests Act* and the publication *Wood Lot Roads, Stream Crossings* issued by the Department of Natural Resources, or its successor document or codes of practice, as amended from time to time.

4.2.6.6 All culverts that pose a potential threat to both the environment and to personal safety should be removed or replaced with an open-bottomed culvert to avoid unnecessary maintenance.

4.2.7 Chemical Application

4.2.7.1 No person should carry out or permit or suffer to be carried out any pesticide or herbicide application anywhere in the Sherbrooke Source Water Watershed, either for commercial or residential use, without approval and advice from a professional and from the Watershed Planning Committee.

4.2.7.2 Pursuant to subsection 4.2.7.1, a pesticide and herbicide application may be carried out according to specifications defined by the inspector to control or destroy plants or insects if such plants or insects constitute a danger for human beings or to control or destroy insects which have infested a property. Any pesticide or herbicide application specifically permitted by the inspector for that purpose should be carried out subject to such terms and conditions as shall be prescribed by a pest control specialist, and with approval of the Committee.

4.2.7.3 The owner of a property, prior to carrying out a pesticide or herbicide application on the owner's property pursuant to subsection 4.2.7.2, should notify the Source Water Committee, water works superintendent, and the owner of any property all or a part of which is within a fifty (50) metre or 164 feet radius of the property to which the pesticide or herbicide application is to be made. Notice should be received within five days of the proposed application.

4.2.7.4 Notification of a pesticide or herbicide application should be in writing and should contain the following information:

a) the location of the pesticide or herbicide application;

b) the date and approximate start time of the pesticide or herbicide application, within a 24 hour period and, in the event of inclement weather, an alternate date or dates on which the pesticide or herbicide application may occur;

c) the brand name and registration number of the pesticide or herbicide product which will be used;

d) the name and telephone number of the person or company making the pesticide or herbicide application;

e) Emergency numbers:

- Department of Natural Resources Pest Management: (902) 758-2232
- Environment Canada, Environmental Protection Branch: (902) 426-7231
- Environmental Emergencies: 1-800-565-1633

4.2.8 Waste and Discharge Guidelines

4.2.8.1 No person should install an on-site sewage disposal system within the Sherbrooke Source Water Watershed without having first obtained an approval from the Department of Environment and Labour.

4.2.8.2 No person should construct or install or cause the construction or installation of an on-site sewage disposal system contrary to the *On-Site Sewage Disposal System Regulation* as amended from time to time and the terms and conditions of an approval issued by the Department of Environment and Labour.

4.2.8.3 All on-site sewage disposal systems in the watershed should be inspected at least once every two to three (2-3) years according to the policy described in the Sherbrooke Land-Use Planning Strategy, approved by the Committee.

4.2.8.4 The Municipality should make available instructions on proper maintenance of their on-site sewage disposal systems for all residents and landowners.

4.2.9 Release of Substances

4.2.9.1 No person should release, or cause or permit the release of oil, petroleum products, soap, detergent, toxic chemicals, pest control product waste, garbage, litter, solid or liquid waste, or any other material that causes or may cause pollution to a watercourse or any other area within the Sherbrooke Lake Watershed.

4.2.9.2 No person who is using mechanical equipment or transporting or storing gasoline or oil within the watershed should release, or fail to take precautions to prevent the release of a petroleum product onto the ground or into a watercourse or the runoff of the area.

4.2.10 Landfills

4.2.10.1No person should establish a dump, landfill or waste disposal site within the Sherbrooke Source Water Watershed.

4.2.11 Agriculture

4.2.11.1 No person should permit or cause any cow, sheep, horse, pig or any other domesticated farm animal to drink or take water from Sherbrooke Lake.

4.2.11.2 No land within forty-five (45) metres or 150 ft. of Sherbrooke Lake, Second Lake or Third Lake should be used for commercial agricultural purposes. Small residential gardens are permitted.

4.2.11.3 The piling or accumulation of agricultural refuse or farm waste and wood processing waste including sawdust, bark, chips, [or] shavings is discouraged within ninety point three meters (90.3) or 300 ft. from environmentally sensitive areas.

4.2.11.4 Manure application and spreading on any personal garden should be done no more than twice per year and must be at least sixty (60) metres or 196 feet from Sherbrooke Lake and at least thirty (30) metres or 98 feet from any other lake or waterway in the watershed.

4.2.12 Construction for Development

4.2.12.1 No owner, occupier, contractor or person responsible for a construction operation or an activity within the watershed requiring grubbing or earth moving that would expose more than two hundred fifty (250) square metres or 2690 square feet of subsurface soil or till at any time should proceed unless they have:
a) developed an erosion and sedimentation plan as described in the *Erosion and Sedimentation Control* Handbook for Construction sites, published by the Department of Environment and Labour; and
b) obtained a written approval from the Committee.

4.2.12.2 No person should permit water that has a suspended solid concentration greater than 25mg/l to be discharged from a construction site within the watershed.

4.2.12.3 If sedimentation occurs in a watercourse within the watershed, no operator or person responsible for the sedimentation should fail to undertake immediate action to repair damage, to install erosion and sedimentation control measures, and to immediately notify the Sherbrooke Lake Water Works Superintendent and the Committee.

4.2.12.4 All new developments within the watershed should comply with building guidelines and restrictions detailed in the Sherbrooke Land-Use Planning Strategy.

4.2.12.5 All new construction sites on land directly adjacent to Sherbrooke Lake should

comply with the policy and zoning by-law stating that there shall be a forty-five (45) metre or 150 foot naturally vegetated buffer directly surrounding Sherbrooke Lake. Exceptions are outlined in the Land-Use Planning Strategy.

4.2.12.6 Any developments in the watershed should maintain naturally vegetated buffers and special management zones surrounding all lakes, waterways and environmentally sensitive areas.

4.2.13 Home Heating Tanks

4.2.13.1 No person should install a home heating tank within the Sherbrooke Source Water Watershed unless the tank is supported by concrete footings and, if not located inside a dwelling or other building, equipped with a fuel line guard.

4.2.13.2 No person should install a petroleum holding tank within the watershed unless the tank is surrounded with either a concrete bladder tank or any other leak-proof container capable of holding 110% of the volume of the tank.

4.2.13.3 No person should install or construct a petroleum holding tank that
a) holds more than two hundred fifty (250) gallons or 946 litres; or
b) is located underground.

4.2.14 Permitted Activities

4.2.14.1 Passive recreation is permitted in the Sherbrooke Source Water Watershed. This includes, but is not limited to:

- walking and hiking trails separate from and smaller than active ATV and Skidoo trails;
- low impact camping and picnicking;
- low impact canoeing and kayaking;
- bird watching.

4.3 Forestry Plan

To increase protection and to ensure the health of the water source, enhanced timber harvesting regulations are encouraged in the watershed. Clean water is the priority and harvested timber yields should be a lesser concern. Representatives of StoraEnso have stated that due to the fact that this is a municipal water supply, they will maintain water quality as a principle objective while planning harvesting treatments in the area.

Enhanced practices as defined in the Nova Forest Alliance Best Management Practices Manual are a first step in ensuring the health of the water source, although because the watershed is a water source, further enhanced practices are recommended, specifically guiding road placement, skid trails, buffer zones, and stream crossings.

Recommendations are guided by the following principles:

- Clean water as the priority regulating any activity within the watershed;
- A healthy, diverse, and sustainable forest for future generations; and
- A visually acceptable forested watershed for various recreational activities that currently occur within the watershed.

4.3.1 Best Management Practices

Many of the best management practices that have been set forth in the Watershed Forestry Management Plan for the James River Watershed, Nova Scotia (Department of Environment and Labour, 2003), could be applied in the Sherbrooke Watershed:

4.3.1.1 Forest treatments should follow prescriptions in the operating plan.

4.3.1.2 Stream buffers should be ribboned off, as well as environmentally sensitive and culturally significant areas.

4.3.1.3 Wildlife regulations in the *Nova Scotia Forest Act* must be followed.

4.3.1.4 Natural regeneration should be considered in all harvesting applications.

4.3.1.5 Wood extraction machines should be located where impacts on soil and

understory will be minimal.

4.3.1.6 There should be no travelling through watercourses; temporary bridges must be used and removed once operation is complete.

4.3.1.7 The installation of culverts should in no way alter or disturb natural water flow.

4.3.1.8 Felling debris should be kept out of waterways, roads, immature stands, boundary lines, and no-cut areas.

4.3.1.9 Skidding and dragging should be carried out either when the ground is dry in the summer or when frozen/protected with snow in the winter.

4.3.1.10 Garbage should be removed from the site and all hazardous substances should be disposed of properly, outside of the watershed.

4.3.1.11 Power saws should have the following guidelines:

- vegetable based oil should be used to lubricate chains;
- fuel should be stored in approved containers and labelled clearly;
- fuel containers should be removed from the site when work shift is over;
- power saws should be fuelled over a spill pad and all fuels should be kept on the spill pad;
- fire retardant pouches should be used with each saw.

4.3.1.12 Use of machinery should follow these precautions:

- vegetable based oil should be used to lubricate chains;
- machines should be kept clean and leak-free;
- machines should be equipped with industry approved fire extinguishers;
- machines should carry a spill kit.

4.3.1.13 Fuel tanks for machinery should be clean, leak-free, have a locking device, a no-drip nozzle, used with a spill kit, and should be stored on mineral soil as far away as possible from watercourses (at least one hundred (100) metres or 330 feet).

4.3.1.14 No fuel or oil should be stored within the boundaries of the watershed.

4.3.1.15 There should be no chemical applications anywhere in the watershed.

4.3.1.16 Re-fuelling should take place on spill pads outside of all buffer zones.

4.3.1.17 All fuel leaks over five (5) litres should be reported to Utility and Department of Environment and Labour within one hour.

4.3.1.18 Fire extinguishers should be available during all harvesting operations.

4.3.1.19 All trucks with loaders should have remote engine shut-down.

4.3.1.20 All trucks with loaders should have a hydraulic tank float switch.

Additional requirements are recommended for roads and skid trails, buffer zones and water crossings:

4.3.2 Roads and skid trails

4.3.2.1 Extensions of existing logging roads within the watershed are discouraged unless otherwise approved by the Committee.

4.3.2.2 Notwithstanding subsection 4.3.2.1, roads and landings should be located away from streams.

4.3.2.3 Notwithstanding subsection 4.3.2.1, when necessary, roads should be built on grades less than 10% when possible.

4.3.2.4 Notwithstanding subsection 4.3.2.1, there should be minimal road width and curve radius to reduce road erosion.

4.3.2.5 Roads should be gravelled where they approach streams. Gravel should be as clean as possible.

4.3.2.6 Grass cover should be planted on slopes and ditches adjacent to roadways.

4.3.2.7 Water turnouts should be used on all roads where they approach streams to divert storm runoff from roads onto the forest floor.

4.3.2.8 Notwithstanding subsection 4.3.2.1, roads should be properly planned to reduce the length and amount of skid trails.

4.3.2.9 Trees should be felled downhill during skidding operations and limbed and topped in place.

4.3.2.10 Trees should be skidded butt end first uphill.

4.3.2.11 Water diverters should be used on skid trails.

4.3.2.12 Logging slash should be kept in place except in streams.

4.3.2.13 After the harvest, roads and trails should be smoothed of ruts and channels.

4.3.3 Special Management Zones

streams greater than 50 cm

4.3.3.1 Special Management Zones (SMZs) should be applied within forty-five (45) metres or 150 feet of each side of Sherbrooke Lake, Second Lake and Third Lake. The inner forty (30) meters or 98 feet of the SMZ should be a no-cut zone, with limited management in the outer fifteen (15) meters or 50 feet.

4.3.3.2 Special Management Zones (SMZs) should be applied within thirty (30) metres or 98 feet of each side of streams greater than 50 cm or 19 inches, except for stream crossings. The inner twenty (20) meters or 65 feet of the SMZ should be a no-cut zone with limited management in the outer ten (10) meters or 33 feet.

4.3.3.3 Within the outer sections of all SMZs, selective management should occur, but there should be no harvesting machinery within the area.

4.3.3.4 Canopy openings should be less than ten (10) metres or 33 feet at the biggest dimension.

4.3.3.5 Basal area of living trees should be a minimum of twenty-four (24) square metres per hectare or 258 ft^2/ha.

4.3.3.6 Site preparation should be restricted from entire Special Management Zones.

streams less than 50 cm

4.3.3.7 Special Management Zones should be applied within fifteen (15) metres or 49 feet of each side of stream less than 50cm. The inner eight (8) metres or 26 feet should be a no-cut zone with limited management in the outer seven (7) metres or 22 feet.

4.3.3.8 Within the outer sections of all SMZs, selective management should occur, but there should be no harvesting machinery within the area.

4.3.3.9 Canopy openings should be less than ten (10) metres or 33 feet at the biggest dimension.

4.3.3.10 Basal area of living trees should be a minimum of twenty four (24) square metres per hectare or 258 ft^2/ha.

4.3.3.11 All slash and scrub should be left in place within the SMZ, except in a waterway.

4.3.4 Stream crossings

4.3.4.1 Stream crossings should be minimal.

4.3.4.2 Crossings should be placed at the narrowest section of the stream when possible.

4.3.4.3 Bridges, either temporary or permanent, should be installed where necessary.

4.3.4.4 Culverts should be installed where necessary.

4.3.4.5 Open bottomed culverts should be used when possible.

4.3.4.6 Culverts should be the appropriate size to ensure stream flow is not compromised and fish passage is not hindered.

4.3.4.7 Placement of bridges and culverts should create the least amount of disturbance as possible.

4.3.5 Harvesting

4.3.5.1 No clearcuts should be greater than five (5) hectares unless less than fifty percent (50%) of the lot is being harvested, where ten percent (10%) will be allowed. There should be a buffer of at least one hundred (100) meters between all cleared areas.

4.3.5.2 All harvesting prescriptions should be reviewed by the Source Water Advisory Committee before implementation.

4.3.5.3 No more than 15% of the crown land in the watershed should be harvested within a three year term.

4.3.5.4 Application of pesticides and herbicides should be prohibited.

4.3.5.5 All scrub and debris should be left on the forest floor after harvesting.

4.3.5.6 Pre-treatment conditions should be recorded.

4.3.5.7 Long-term management plans should be drafted.

4.3.5.8 Treatments should encourage an uneven-aged forest.

4.3.5.9 Native tree species should be encouraged when thinning and managing.

5. CONTINGENCY PLAN

5.1 Purpose of Contingency Planning

The purpose of the emergency response plan is to define a predetermined set of actions and communications to be initiated after the occurrence of an incident or an event which may contaminate or has the potential to cause contamination to the fresh water supply in Sherbrooke Lake, to the area surrounding the lake, or the residences in that area. The emergency response plan also includes telephone numbers of key personnel, and other resource people, as well as information on the availability of specialized equipment in the area.

5.2 Description of Possible Hazards

Potential contamination of the lake can occur from various from various situations and land uses, some may occur immediately, like an oil spill, while others may occur over long periods of time, like chemical fertilizer infiltration. Many of these activities are defined in section 3 of this document, *Analysis of Sensitivity*, and are further guided by recommendations in section 4.2 *Best Management Practices*.

Specific land use activities/hazards that have been identified for potential contamination include:

- Logging roads
- Un-paved road used by through-traffic
- Residential septic systems adjacent to lake (approximately 6)
- Open fires to burn refuse or for personal use

Emergency problems that would require immediate response include:

1) Power outage
2) Break in chlorine line
3) Septic spill/leak
4) Chemical spill
5) Oil spill
6) Failure at sewage pump stations causing sewage backup

5.3 Options for Emergency Preparedness

Being prepared with a list of options is important to ensure a fast and efficient response to emergencies. Making an inventory of existing and required equipment allows the Municipality to document what options exist in an emergency.

1) Power Outage

- Diesel generator (existing)
- Gas pump in old pump-house (existing)

2) Break in chlorine line

- Minimum of 2 spare lines (existing)

3) Septic spill/leak

- Ensure residents are aware of risks involved with private septic systems and are familiar with maintenance and emergency procedures

4) Chemical and oil spill

- Inventory of all materials and/or chemicals that travel through the watershed on a regular basis
- EMO fan out list (existing)
- Confirm contacts for emergency excavators and booms (existing)
- Use of generator (existing)
- 2nd option use of gas pump in old pump-house (existing)
- Acquire charcoal filters in case of oil spill
- Ensure residents are aware of risks involved with private oil tanks and are familiar with maintenance and emergency procedures
- Currently have 32 000 gallons clean water stored under plant in case of emergency

5.4 Action Plan

1. Shut water system down

Sherbrooke Water Works Supervisor is to immediately block all water lines to the public.

2. EMO Notification

The notification procedure will be operational 24 hours/day. The EMO Co-ordinator, Robert Robichaud, has a list of all people, agencies, and groups that must be called and their telephone or pager numbers, for any type of emergency.

Robert Robichaud	Home: (902) 522-2095
	Work: (902) 522-2400 Sherbrooke Village Office
	Cell: (902) 870-4147
Assistant:	
Maryann Cameron	Home: (902) 522-2853
	Work: (902) 522-2049 Municipal Office
	Cell:

Anyone responsible for a spill or release of dangerous goods or hazardous wastes, or anyone witnessing such an incident is responsible for reporting such to the proper agencies.

All calls should be directed first towards the Sherbrooke Water Utility Plant at 902-522-2156.

The pager for the Water Works Superintendent is 1-902-558-7510 (4444). The Water Utility Operator backup can be reached at 1-902-558-7510 (3333).

The EMO Co-ordinator and Committee will be responsible for ensuring the proper agencies, groups and people are notified in an emergency. They will authorize the commitment of any resources that may be required, act as focal points for information exchange, and be responsible for communication with government personnel.

Callers should be prepared to report:

- The substance, if known, and the amount
- Location of the spill
- Time of the spill
- Source of the spill

Other agencies and people that must be contacted through the EMO Director:

- Department of Environment and Labour

Coast Guard Environmental Emergencies 1-800-565-1633

- Department of Fisheries and Oceans

EMO contact list

- Canadian Transport Emergency Centre (CANUTEC)

Emergency Information Line (613) 996-6666
This line can be used to request information and provide emergency actions appropriate to the dangerous goods involved in the accident, for protection of personnel and property.

- Excavator

EMO contact list

- Booms

EMO contact list

3. Communicate information to the public

- Alert on TV
- Info line 1-866-424-5620 (toll free)
- Ricky's pager 1-902-558-7510 (4444)
- Mike's pager 1-902-558-7510 (3333)

4. Provide options for alternative water supply to residents

- Emergency water stored under plant
- Attach chlorine feed to new pump (Water Works Superintendent)
- Option of boil order

5. Begin clean-up procedure and emergency water provision

- Use of booms or excavator

6. Remember to do annual review of the emergency plan

- Has anything changed?
- Are there new people living in the watershed or otherwise affecting it?
- Are there new industries either in the watershed or using roads or in any other way affecting the watershed?
- Post accident review should be documented for suture reference and to alert the public in case such an emergency should recur.

5.5 List of Emergency Contact Numbers

EMO Co-ordinator Robert Robichaud	Home:	(902) 522-2095
	Work:	(902) 522-2400 Sherbrooke Village Office
	Cell:	
EMO Assistant Maryann Cameron	Home:	(902) 522-2853
	Work:	(902) 522-2049 Municipal Office
	Cell:	(902) 870-0597
Sherbrooke Water Utility Plant:		1-902-522-2156
Pager for Superintendent		1-902-558-7510 (4444)
Superintendent Operator Assistant		1-902-558-7510 (3333)
Coast Guard Environmental Emergencies		1-800-565-1633
CANUTEC Emergency Information Line		(613) 996-6666

In order for these recommendations to be implemented, several actions must be taken. Education and awareness for local land owners and residents on the impacts of their actions is the first and most important step.

6.1 Activities in the Watershed

- All land in the watershed should be zoned as a Source Water Zone that regulates activities within the watershed, to be enforced through Land-use By-laws;
- Council should undertake a program of acquisition to obtain, through purchase, exchange, easement, or land-owner agreement, all privately owned land in the watershed;
- Sections of this plan should appear regularly in the monthly newsletter to ensure residents of the area are aware of regulations and have the opportunity to ask questions and discuss the recommendations;
- The Sherbrooke Watershed Advisory Committee should work cooperatively with the water works superintendent to ensure recommendations are being encouraged.

6.2 Forestry

- The Sherbrooke Watershed Advisory Committee should work with StoraEnso on an appropriate and acceptable long-term forest management plan;

- The Committee should host an open house evening with representatives from StoraEnso to educate and bring awareness to interested individuals of current timber harvesting activities in the watershed;
- All timber harvesting prescriptions should be reviewed by the Source Water Advisory Committee prior to implementation;
- The Committee should work with the Department of Natural Resources and StoraEnso on a forest management plan for private land owners;
- Council should undertake a program of acquisition to obtain, through purchase, exchange, easement, or land owner agreement, all privately owned land in the

watershed.

A. LANDSCAPE INVENTORIES

The Sherbrooke Watershed is defined by the extent of all land area, lakes and streams that drain into Sherbrooke Lake and finally into the St. Mary s River via was has been referred to here as the Sherbrooke Brooke. These lakes are Tates Lake, Little Lake, T Lake, Rocky Lake, Second Lake, Third Lake, Fourth Lake, Fifth Lake, and Sherbrooke Lake. For the purpose of this report, Second Lake and Third Lake have been identified as separate lakes even though they are only divided by a narrowing of one body of water. The area covers approximately 1500 ha.

A.1 Hydrology

The hydrology of the area describes what regions are prone to flooding and direction of overland flow. The Sherbrooke Lake Watershed is comprised of numerous marshes and swamps, with eight streams flowing through nine lakes which make up nine sub watersheds.

The entire drainage area is approximately 1500 ha. Water drains from higher elevations to one of nine lakes before ultimately flowing into Sherbrooke Lake. From there it is discharged out of the watershed in three ways. One is from a natural brook known locally as Sherbrooke Brook, which flows from the northwestern shore of the lake into St. Mary's River. Another is from a constructed rock lined historic sluice in the southwestern corner of the lake. The other is from a water intake valve located at the mouth of Sherbrooke Brook. This pumps water to the water treatment centre before releasing it to the serviced areas within the community.

Marshes are located along meandering streams where the terrain is relatively flat. There are a total of 16 marshes or swamps within the Sherbrooke watershed, 11 of which are associated with the lakes, rivers and streams, and the remaining five are isolated.

The overland flow collects from up on the ridges and drains down to the lakes in natural paths. There are several flood zones in the area which are generally adjacent to bogs and marshes.

Hydrology presents several opportunities and constraints to land-use activities in the watershed. With such an extensive water system, most activities are more likely to impact on at least one lake or stream in the site. However, because the system is so extensive, any contaminant will likely be naturally filtered out before reaching the intake valve in Sherbrooke Lake.

Hydrology Map

A.2 Elevation

The entire area rises from sea level along the banks of Sherbrooke Lake to approximately one hundred five (105) meters above sea level (asl) in the northern point of the watershed, locally known as *The Hill*. Second and Third Lake both sit fifteen (15) metres above sea level (asl) with Sherbrooke Lake. Rocky Lake is more elevated at thirty (30) metres asl, Fourth Lake sits forty five (45) meters asl, and both Tates Lake and Fifth Lake are at sixty (60) metres asl. T Lake sits at the highest elevation of ninety (90) meters asl.

The areas of highest elevation include small regions along the northern boundary, the south eastern and south western ridges, and one hill in the central region of the site. Moving east from Sherbrooke Lake, the land is relatively flat with broad plains between elevations, with the exception of the hill in the centre of the site.

The topography of the land suggests possible opportunities and constraints for conservation. Elevated points in the centre and outer edges of the site afford great views of the watershed and beyond.

However, most of the crown land currently being harvested is at a higher elevation than the rest of the site, which could ruin natural viewscapes. It could also be a constraint for drainage patterns of overland flow moving down into the lower regions of the site.

Elevation Map

elevation cross sections

A.3 Slope

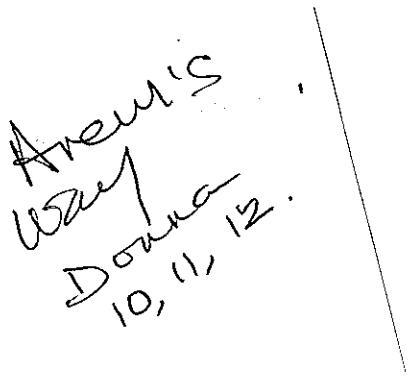
In general, the watershed tends to be fairly flat. There are a few slopes that are quite steep (15% - 25% +), mainly to the south, east, and north of Sherbrooke Lake. There are a few moderate to steep slopes (8%-15%) concentrated mainly in the southern portion of the site.

Most of the terrain is composed of gently sloping hills at 3%-8% interspersed with moderately steep slopes throughout.

Most of the eastern half of the watershed is sloped by 0 to 3%, with flat terrain extending across large areas, in the general vicinity of lakes, meandering streams, marshes and swamps.

The landscape offers great opportunity for views overlooking Third Lake, Rocky Lake and Sherbrooke Lake.

Any development or land-use activity on steep slopes (15%-25% +) can potentially cause erosion, especially on poorly or excessively drained soils. Slopes 0%-03% steepness are also at risk during land-use activities due to their susceptibility to flooding, especially on poorly drained soils. This poses problems during winter months when wet areas freeze, making walking and ATV driving more dangerous.



Slope Map

A.4 Geology

Rock formations from the lower Cambrium period dominate in most of the structural and surficial geology throughout the central portion of the watershed. Quartzite is found in the central portion of the watershed from the western third of Sherbrooke Lake east to the eastern edge of Fifth Lake and from the northern boundary to the southern boundary of the entire watershed. The remainder of the watershed along the far eastern and western boundaries is Granite.

A syncline runs along an east-west axis in the north end of the watershed northeast of Tates Lake. An anticline runs along an east-west axis in the lower third of the watershed transecting Rocky Lake and Fifth Lake, between the St. Marys River and Fifth Lake.

The surficial deposits found in any landscape reflect the subsurface bedrock. In the Sherbrooke Lake Watershed, surficial deposits consist of Quartzite (pebbles and angular stones) and Granite (coarse grained), with patches of Lawrencetown till (silty) deposits throughout. Quartzite till extends across the area from the western boundary to the eastern boundary and along the majority of the southern region. The north-eastern portion of the watershed is covered in Granite Till. The Lawrencetown till drumlins are located west of Second and Third Lake as well as south of Tates Lake. The orientation of these drumlins indicate the glaciers were retreating in an eastern direction when climatic temperatures increased.

These landscape features prove beneficial for land-use activities in the watershed because coarse-textured till provides a stable base for hiking and ATV trails.

Geology Map

A.5 Soils

Soil is derived from the till in the area. Most of the soils in the Sherbrooke Watershed consist of well drained, moderately course textured parent material, followed by smaller areas of poor drainage and some pockets of organic materials with very poor drainage.

More than half of the Sherbrooke Watershed consists of Halifax soil, which is fertile, with good to excessive drainage. Peat and Aspotogan soil are found in low-lying areas, adjacent to small lakes, marshes and swamps where ground water levels are high. Both drain poorly.

Halifax soil

Halifax soil supports healthy stands of mixed wood namely red spruce, white spruce, fir, maple, birch and pine. This soil is often very stony and coarse textured. Previously burned areas often regenerate with laurel and healthy vegetation.

Gibraltar soil

Gibraltar soil is primarily found in areas underlain by granite. It supports mixed stands of white and red spruce, hemlock, white birch, yellow birch, maple and beech. This soil is not suited for agriculture due to the large number of boulders on the surface. It also makes logging practices other than selective logging difficult and costly.

Aspotogan soil

Aspotogan soil has poor drainage and is often found in low-lying areas with exposed bedrock. These soils generally support only black spruce and have little to no value for agriculture.

Peat

Peat is often found in old lake beds that have re-vegetated with swamp grasses and sedges. Stunted black spruce, alder and tamarack are often found growing in these areas. Peat has little value in terms of forestry or agriculture.

Soil Map

A.6 Climate

The watershed is located in the Atlantic Interior of Nova Scotia, with an inland, lowland climate that is sheltered from direct marine influences. It is characterized by cold winters and warm summers. Average winter temperature is -4 C as the daily mean, but does get as low as -11 C. Summer average is 18 C as the daily mean, although temperatures can reach 24 C. Average precipitation is 1517.2 mm. November is the wettest month, and July is the driest. It typically snows from November to May, with January receiving the most snow. It rains every month.

The land is predominantly flat; however, there are a few south facing slopes in the northern area, above Sherbrooke Lake and directly above Fourth Lake. There are very few north facing slopes, mainly in the southern region of the site, south of Sherbrooke Lake, Rocky Lake, and Fifth Lake. There is a large ridge of western facing slopes in the centre of the site, backed by an eastern facing ridge along Fourth Lake.

During the colder months, winds blow from the north west, blowing through the entire eastern side of the site. Sherbrooke Lake is exposed to this wind, as is the western facing slope of the large hill in the interior of the site. For this reason, the south eastern portion of the site is well sheltered from the wind.

Summer winds come from the south, blowing straight through the watershed, again hitting the large hill in the centre of the site. However, the south facing slopes in the northern part of the site are situated to receive the full force of the wind.

Cold air drainage occurs in low areas where water tends to accumulate naturally. Warm air rises up while cold air drains down slopes, making low lying areas colder and less inviting for activities, especially if the slope is in direct line of wind. This could be a constraint for hiking trails through the site, especially if they traverse areas that have been cleared of vegetation.

slope aspect map

A.7 Vegetation and Land Use

Most of the watershed is wooded. The woodlands are comprised of softwood trees interspersed with mixed wood and hardwood stands. The softwoods in the area include balsam fir, black and red spruce, hemlock and pine. Tamaracks and white spruce are found primarily along existing trails and adjacent to previously disturbed areas such as clear cuts. Stands of black spruce occupy the low areas, close to bogs and marshes, where drainage is poor.

Mixed woods including balsam fir, red spruce, white spruce, maple, birch and pine are found along side slopes and at higher elevations throughout the watershed. White Pine and Hemlock are found on well drained soils on side slopes and along lakes. Hardwood forest stands including red and sugar maple, white and yellow birch, and beech are found on hill tops where soils are well drained and sun exposure is significant.

The forest is being actively logged in various sections of the watershed, mainly in the central and north-eastern regions. The forested areas are in various stages of re-growth after past clear-cutting and natural succession. A few large patches of clear cuts are located in the southeast and southwest regions of the watershed along logging roads. Many of these clear cuts and cut overs cross streams. One recent cut-over located at the south end of Fourth Lake extends to the shoreline.

An active logging road approximately 6 km long extends from Old Road and runs south along the eastern boundary to the southern side of Fourth Lake where it splits. One road continues up the western side of Fourth Lake to the central region of the watershed, while the other one extends southwest towards T Lake. Recent cut overs extend 1 km from a newly constructed road along the west side of Fourth Lake as well as approximately 1km southeast of a new branch of the old Trout road. The majority of these clear cuts and cut overs have crossed several streams and rivers while staying away from most major bodies of water. The exception is a recent cut over located at the south end of Fourth Lake where cutting is directly adjacent to the Lake.

Development in the interior is very limited and has occurred mainly in the western side of the watershed, along Sherbrooke Lake. There are several homes uphill directly adjacent

to the northwest corner of Sherbrooke Lake, most of which have on-site septic systems. There is also a recreation complex, a water treatment plant, a recycling depot, and a CBC tower northwest of the watershed, uphill.

There are a few trails in the watershed, for both hiking and for all-terrain vehicles. These are mainly found on the western side of the watershed, close to lakes and streams.

Habitat Map

A. 8 Land ownership

Land ownership in the watershed is either private or public. Large parcels in the eastern side of the watershed are primarily Provincially owned, with a few corporate owners, and smaller lots are owned by private individuals. West of Sherbrooke Lake parcels are smaller and land is divided between Federal, Provincial, and Municipal governments, and several private owners.

There are large parcels of publicly owned land between Sherbrooke Lake and Fifth Lake, north of Fourth Lake and east of Fifth Lake. The Province owns the majority of the public land and manages it through the Ministry of Natural Resources.

Most of the privately owned lands are undeveloped and include large properties north and south of Sherbrooke Lake as well as along the northern and eastern borders of the watershed. The largest corporately owned lands are undeveloped along the western shore of Fourth Lake, the eastern shore of Sherbrooke Lake and the southern shore Rocky Lake.

Because the crown owns a large portion of the watershed, there is greater potential for conservation and protection of water quality. With the exception of timber harvesting, there is little development activity within the watershed. However, lands adjacent to Fourth Lake and Rocky Lake are corporately owned, which could put these waterbodies at risk of shoreline development.

Land swaps provide an opportunity to protect these ecologically sensitive lands by trading municipally owned land outside the watershed with sensitive land inside the watershed.

Land Ownership Map

B. EFFECTS OF TIMBER HARVESTING ON WATER QUALITY

Harvesting timber can affect water supplies in two ways: water quality and water yield. Heavier cutting generally provides a higher yield of water, especially on steep slopes. Trees naturally absorb water and release it into the atmosphere as evapo-transpiration, thereby soaking up a good portion of the precipitation that otherwise might have increased water yield. By removing trees, that precipitation either soaks into the ground slowly or runs over the soil and into the water supply to increase the amount of water. The only benefit of this is that it increases water quantity immediately after rainfalls. However, this option is still attractive to many municipal watershed managers when faced with potential water shortages, especially during the summer months. Water quantity is not an issue in Sherbrooke Lake, which is 1500 ha, more than sufficient to provide water to the 240 residents serviced in the community. Water quality has been defined as one of the main concerns by the members of the Source Water Advisory Committee in Sherbrooke, Nova Scotia.

There are several aspects of water quality that certain forest management activities have the potential to influence: temperature, sediment loads, toxic metals, and organic compounds (Binkley and Brown, 1993).

B.1 Forest Management Activities

B.1.1 Logging Roads

Road Scar
Conservation Council of New Brunswick, n.d

Logging roads pose one of the biggest threats to water quality through both direct and indirect forces (Brathwaite, 1992). Indirectly they fragment forests and extend access to

more remote wilderness areas. This encourages exploration by all-terrain-vehicle (ATV) users who sometimes do more harm to waterways than do harvesting equipment or practices.

Directly they affect water quality in several ways. Proper road placement is critical; there are specific elements related to road placement that must be considered - proximity to streams, crossing streams, maximum grade, and placement on contours. Material for roads affect water quality and must be considered as well - permeability of gravel, cleanliness of gravel, and type of gravel near stream crossings. Details like sediment and storm water diverters on roadways, the use of either bridges or culverts, proper sizing for culverts, and reseeding ditches and steep slopes also impact water quality.

One study in 1963 compared water quality impacts from four harvesting methods: commercial clear-cut, intensive selection (trees over 5 inches diameter breast height (d.b.h) were cut), extensive selection (trees over 11 inches d.b.h. were cut), and diameter limit (trees over 17 inches d.b.h. were cut). Furthermore, each harvesting method was combined with various road designs to determine overall effectiveness in retaining high quality water. What the researchers concluded was that the amount of trees removed and the harvesting method were not the principal factors influencing water quality, as measured by turbidity. The water quality impacts were directly related to the care taken in logging and planning skid roads (Fulton and West, 2002).

The extensive selection method (trees over 11 inches d.b.h.) combined with non-point source controls (20% road grade limits, no skidding in streams, water bars on skid roads) produced higher levels of turbidity than did intensive selection (trees over 5 inches d.b.h.) with additional control practices (10% road grade limits, skid trails located away from streams). When harvesting by diameter without any restriction on road grades or stream crossings, maximum turbidity was raised 200 times over intensive selection. Commercial clear-cutting without controls increased maximum turbidity by over three orders of magnitude compared to harvesting by diameter limit (Fulton and West, 2002).

Coweeta scientists conducted one of the earliest evaluations of effects of practical forest treatments on water quality between 1956 and 1957. A logging operation was conducted in the Stamp Creek drainage of the Tallulah Ranger District on the Chattahoochee

National Forest, North Carolina (Fulton and West, 2002). Road management and logging practices were designed to control runoff into the adjacent streams. Roads and landings were located away from streams, broad-based dips were strategically located to divert storm runoff from roads onto the forest floor, roads were constructed on the contours, and no roads were built on grades more than 10%. Stream crossings were minimized, culverts and bridges were installed where necessary, and roads were gravelled where they approached streams. Trees were felled downhill and limbed and topped in place, they were skidded butt end first uphill by a cable, and logging slash was kept in place except in streams. After the harvest, roads and trails were smoothed of ruts and channels.

Sediment loads were monitored throughout the watershed during the harvest and after. Sediment concentrations averaged 5 parts per million (ppm) as opposed to 4 ppm in an adjacent control watershed, and 31 ppm in a watershed that was logged without any operational standards. (Fulton and West, 2002)

Good road location can reduce the source and transportation of sediment. Generally roads should be designed to minimize the number of road miles per acre, the size and number of landings, the number of skid trail miles, and the number of watercourse crossings. Seasonal harvesting is also a good practice, avoiding wet seasons due to higher chance of erosion, and removing trees when the ground is frozen to reduce damage to soils and undergrowth (Fulton and West, 2002).

Minimize drainage problems when locating roads by avoiding clay beds, seeps, springs, concave slopes, ravines, draws and stream bottoms (Fulton and West, 2002).

B.1.2 Skidder Trails

Several studies have shown that tree cutting alone does not cause soil erosion because soil is normally protected with a thick layer of detritus and organic matter which absorbs and slows the movement of water. Disturbance and removal of this layer may result from winching (dragging) tree stems from where they were felled to the skidder (tractor). Typically most if not all organic material is removed and mineral soils are compacted on common skid trails. At the log landing where stems are bucked (cut) into logs and put

onto trucks for transport to the mill, additional surface soil is removed and compacted. Truck accesses to log landings also remove and compact surface soils (Fulton and West, 2002). Tests in eastern Canada have shown that mechanical harvesting and forwarding logs, which is transporting them without dragging them on the ground, to the roadside causes less disturbance than manually felling and skidding them out (Nova Scotia Forest Action Plans, 1997).

In regions with steep slopes, like the Appalachian Mountains and western Canadian landscapes, a comparison study was done between a skidder logging system and a cable yarder to define effects each system had on soil disturbance and erosion, thus impacting water quality. Using the cable yarder disturbed less than 1% of the soil, with the original litter still covering the mineral soil. After logging with the skidder, 37% of the soil was disturbed (Fulton and West, 2002). Unfortunately, east coast forestry practices do not include cable yarders as they are costly and generally only necessary on steep slopes typically found in areas other than the east coast.

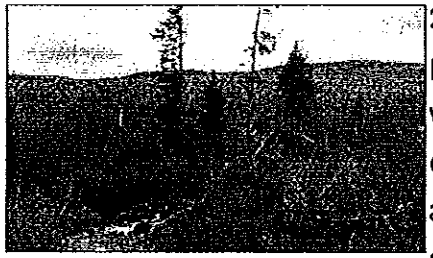
Luckily in eastern North America where the weather tends to be humid, regeneration occurs naturally and rapidly. It normally takes approximately 1-2 years for grass, weeds, shrubs, and trees to become established. Use of Best Management Practices and careful planning of skid and truck roads, placement of temporary bridges or correctly sized culverts at stream crossings, water diversion on skid trails and reseeding of trails and roads after use are all effective methods of avoiding or eliminating the risk of soil erosion and compaction.

B.1.3 Animal Logging

Horses yarding wood in the Maritimes

Conservation Council of New Brunswick, n.d

Although animal logging was generally replaced by tractor logging in the 1930's (Rummer, 2002), it is seen today as a more ecological and visually pleasing alternative, even though production tends to be very low. With most animal logging operations, felling, delimbing, and processing are done with a chainsaw. Trees are bucked at the stump in order to allow for primary extraction with the animals. Most crews use two animals and work them as singles rather than as a team. Systems vary in extraction and loading. Following tradition, animal logging crews skid logs to a loading point where a self-loading truck can access the logs. Some crews use a front-end loader to increase productivity. Another method is to use a hybrid system that combines animal prebunching with subsequent extraction by a conventional skidder or forwarder (Rummer, 2002).



The primary advantages of animal logging are minimal soil disturbance and residual tree damage, suitability to small tracts and selective cutting, and minimal noise and pollution. Disadvantages to this system include the low overall production rate, a significant reduction in productivity with small diameter pieces, stand disturbance associated with loading and woods roads, and the need to minimize skidding distance.

B.1.4 Buffer Zones

Buffer Zones, or Special Management Zones (SMZs), are useful for a variety of reasons. Leaving a vegetated strip around all waterways provides stream bank stability and shade for shorelines which helps to stabilize water temperature. It also provides protection from excessive sediment loads being eroded into the water along with nutrients, logging debris, and forest chemicals. The vegetated buffer acts as a filter to clean impurities from precipitation and eroded soils.(North Carolina State University Water Quality Group, n.d)

Lack of buffer zone surrounding a stream
Conservation Council of New Brunswick, n.d

The width of the Special Management Zone generally depends on the width of the waterbody it surrounds. Typically the minimum width is five (5) metres or 16 feet, but can be as wide as one hundred (100) metres or 330 feet or more. Generally there is a no-cut zone within the special management zone. This is the area directly adjacent to the stream or waterbody and is meant to ensure no unnatural disturbance will affect shorelines and aquatic habitat. The specially managed area outside of the no-cut zone acts as a buffer and wind break between managed and naturally forested areas.

Certain forest management practices are restricted or discouraged within the SMZ, and generally these include logging roads (except at stream crossings), the use of heavy machinery, fertilization, application of pesticides, mechanical site preparation, loading decks or landings, and log bunching points. Specified basal areas should be maintained, and canopy openings are also regulated (Florida Forestry Information, n.d).

B.1.5 Site Preparation

Site preparation is designed to modify soil conditions, clear planting sites, and control competing vegetation. Different types of operations are designed to address specific site conditions. One operation is drum chopping, which knocks down standing material and breaks it into pieces using large rolling cylinders fitted with blades. Shearing a site means using an angled blade on the front of a crawler tractor to split stumps, move debris, and expose mineral soil. Raking also uses a special blade on a crawler tractor to move and pile slash. Surface soil can be disked to reduce vegetative competition. Bedding loosens and moves soil to create raised planting areas. Finally, subsoiling or ripping fractures heavy or compacted soils. Different sites require different treatments, some require more than one treatment, or a combination of treatments, while others may only require a single type of treatment (Rummer, 2002).
Prescribed fire is the least expensive way to prepare the forest floor for regeneration. It controls herbaceous competition, exposes mineral soil for seed catch, and minimizes logging debris. Prescribed fire is used in prescriptions for natural regeneration by the

Manual pre-commercial thinning

Many prescriptions call for manipulation of vegetation in established stands: thinning, removal of diseased or infested trees, regeneration cuttings in shelterwood or group-selection systems, and harvest of crop trees. All of these treatments involve some type of felling and, in most cases, processing and extraction (Rummer, 2002).

Thinning is a common silvicultural technique used to concentrate growth on fewer trees. Stands are commonly thinned in the early stages of regeneration and are sometimes thinned again later in the rotation. Thinning temporarily reduces canopy coverage and allows light to reach the forest floor, promoting growth of understory plants. This process is used to remove trees that are less desirable because of their species, form, or health. Although these cuts allow sunlight into the stand, in many cases they remove individual trees that are beneficial to wildlife due to their form or the presence of cavities (Baker and Hunter, 2002).

B.1. 7 Clear-Cutting

Clear Cut
Conservation Council of New Brunswick, n.d

A clear-cut is the most basic technique for initiating even-aged stands. In clear-cutting, the entire stand is removed in one harvesting operation, and a new stand of trees takes its place. Clear-cut areas may be regenerated naturally from sprout reproduction, from seeds from surrounding stands, or from seeds that were in place before mature trees were removed (Baker and Hunter, 2002). The benefit of clear-cutting is the provision of maximum amounts of sunlight reaching the ground encouraging the growth of herbaceous plants. However, the risk of erosion is greatest with clear-cuts, especially on steep slopes. In wet areas, clear-cutting may raise the water table excessively because

In one study done in Quebec in 1982, large amounts of logging debris were put into a low-gradient stream. The debris impounded the stream and lowered the dissolved oxygen concentrations to almost 0 mg/l (Binkley and Brown, 1993). This can be avoided by ensuring that logging debris does not get put into or left in streams or waterways.

In another study, at the Goshen Swamp in North Carolina, seasonal dissolved oxygen concentrations after intense harvesting remained similar to previous years. However, immediately after clear-cutting, concentrations dropped from 6.9 to 0.4 mg/l (Ensign and Mallin, n.d), most likely due to the added load of organic material that was released as a result of forest disturbance. Concentrations stabilized soon afterwards.

B.2.3 Nitrates

Concentrations of Nitrate become unacceptable in drinking water when it rises above 10 mg/l (U.S Environmental Protection Agency, 2003). Often the silvicultural application of nitrogenous fertilizers increases the concentration of nitrate in streams, but typically not enough to raise the levels beyond drinking water standards (Binkley and Brown, 1993).

Several studies have examined nitrate concentrations in streamwater after timber harvesting in north-eastern forests. The effects were examined after clear-cutting took place in 38 watersheds in New England. Vegetation types included white, red, and black spruce, and balsam fir, and northern hardwoods that include oaks, hickories and red maple (Binkley and Brown, 1993).

In unharvested watersheds, nitrate concentrations were between 0 mg-N/l and 1.0 mg-N/l, depending on the forest type. Clear-cutting between 20 and 100 per cent of the watersheds showed no increase in nitrate in streamwater draining from central hardwoods and conifer forests. Northern hardwood forests showed no increase in nitrate concentration in areas that were up to 70% clear-cut. However an increase to 2.0 mg-N/l was documented in the northern hardwood forest watersheds that were completely clear-cut. None of the studies showed an increase in nitrate concentration that went above the drinking water standard of 10 mg-N/l (Binkley and Brown, 1993).

is currently doing a follow-up study before recommending changes to forestry practices throughout Canada (Garcia and Carignan, 2000).

B.2.5 Organic Matter

Organic compounds are comprised of particles of vegetation or other biological material. (North Carolina Department of Environment and Natural Resources, n.d) High organic matter lowers the concentration of dissolved oxygen in streams, thereby affecting fish and other aquatic wildlife.

To again refer to the study done in Quebec in 1982 where large amounts of logging debris were put into a low-gradient stream, the debris impounded the stream and lowered the dissolved oxygen concentrations to almost 0 mg/l (Binkley and Brown, 1993).

A study in Alberta's conifer and deciduous-dominated mixed-wood boreal forest examined effects of partial and clear-cut harvesting on the physical, chemical, and biological properties of the forest floor. Samples were taken from the forest floor 2.5 years after harvest from clear-cuts, strip cuts, green tree retention patches in a partial cut, and uncut control sites.

Results from the study showed that canopy removal associated with clear-cutting can increase the amount of solar radiation and precipitation reaching the soil surface. This in turn increases soil temperature and promotes growth of organic matter (Lindo and Visser, 2002). When riparian zones are cleared, solar radiation reaching water surfaces increases temperature and promotes excessive growth of organic matter.

B.2.6 Suspended Sediment

High concentrations of suspended sediment can degrade water quality in a variety of ways. High turbidity, a result of erosion and sedimentation, degrades the quality of drinking water. Turbidity is a measure of suspended matter (silt, clay, and finely divided organic and inorganic matter), soluble coloured organic compounds, plankton and other microscopic organisms.

Through the provincial Department of Natural Resources, certain regulations are set forth to guide forestry on public land. The aim is to ensure sustainable and safe water quality, wildlife habitat, and overall forest health.

B.3.1 Wildlife Habitat and Watercourses Protection Regulations

Legacy trees (section 4)

Included in the Wildlife Habitat and Watercourse Protection Regulations are instructions on leaving legacy trees as habitat structure. Harvest sites that are larger than three (3) hectares must retain at least ten (10) standing living or partially living trees for each hectare of forest land cut. Trees left standing must represent, proportionally, the species that made up the forest before it was cut, be larger than the average height and diameter of trees within the stand being cut, and be clumped together with no fewer than 30 trees.

There should be at least one clump for every eight 8 ha, clumps should be no further than two hundred (200) metres or 660 feet apart, but more than twenty (20) metres or 65 feet apart, and should be no more than 200 m but more than 20 m away from the edge of the remaining forest. No timber harvesting is allowed within any clumps, and snags and woody debris are to remain on the forest floor in natural patterns. The trees in the clumps are not to be removed before the next harvest.

Determining average width of watercourse (section 5)

The average width of a watercourse is measured by the width of the bed of the watercourse taken at ten different locations, spaced evenly apart. The measurements are then averaged. This measurement is used to designate different practices on different sized streams.

Special Management Zones (section 6)

Special Management Zones of 20 m in width are applied along all boundaries of streams greater than 50 cm bed width. On slopes greater than 20% within 20 m of the stream, special management zones shall be increased by 1 m for every 2% increase in slope to a maximum of sixty (60) metres or 196 feet in width.

unique context of Nova Scotia's Acadian Forest ecosystems (Nova Forest Alliance, 2002). They are part of the Canadian Model Forest Network which is supported by Natural Resources Canada. This program encourages local foresters and organizations to create partnerships and work together to meet local forest values.

They currently have a defined landbase in Nova Scotia of 458,000 hectares, owned by a variety of landowners, including the Crown, small private and non-industrial landowners, pulp companies, lumber companies, and Mi Kmaq lands (Nova Forest Alliance, 2002).

The goal of the manual is to go above and beyond basic regulations defined by the government in an effort to improve current standards of forest management. It is not mandatory to comply with these best management practices, however, it is becoming more valuable to be recognized with more socially and environmentally conscious designations.

The manual outlines principles and codes of practice that are to be applied when operating and harvesting timber in a forest. They include standard practices and then encourage enhanced practices:

woodlot assessment

Identifying the potential for prescriptions other than clear cutting is recommended. It is also recommended to identify areas of special management before harvesting, such as old growth forests, unique or endangered plants, and areas of significant wildlife habitat.

road construction

Foresters are encouraged to consider the sight distance for landscape / aesthetic values, and road construction staff should be prepared to implement Best Management Practices.

applying road construction tools and techniques

Seeding roadsides or using brush mats is encouraged. It is also recommended to use advanced construction techniques such as using a rock apron at the culvert outlet.

temporary stream crossings for forwarding wood

C. FORESTRY CHECKLIST

- ☐ Garbage should be removed from the site and all hazardous substances should be disposed of properly, outside of the watershed.

- ☐ Portable bathroom facilities should be used.

- ☐ Power saws should have the following guidelines:
  - ☐ vegetable based oil should be used to lubricate chains;
  - ☐ fuel should be stored in approved containers and labelled clearly;
  - ☐ fuel containers should be removed from the site when work shift is over;
  - ☐ power saws should be fuelled over a spill pad and all fuels should be kept on the spill pad;
  - ☐ fire retardant pouches should be used with each saw.

- ☐ Use of machinery should follow these precautions:
  - ☐ vegetable based oil should be used to lubricate chains;
  - ☐ machines should be kept clean and leak-free;
  - ☐ machines should be equipped with industry approved fire extinguishers;
  - ☐ machines should carry a spill kit.

- ☐ Fuel tanks for machinery should be clean, leak-free, have a locking device, a no-drip nozzle, used with a spill kit, and should be stored on mineral soil as far away as possible from watercourses (at least one hundred (100) metres or 330 feet).

- ☐ There should be no chemical applications anywhere in the watershed.

- ☐ Re-fuelling should take place on spill pads outside of all buffer zones.

- ☐ All fuel leaks over five (5) litres should be reported to Utility and Department of Environment and Labour within one hour.

- ☐ Roads should be gravelled where they approach streams. Gravel should be as clean as possible.

- ☐ All slash and scrub should be left in place within the SMZ, except in a waterway.

- ☐ No clearcuts should be greater than five (5) hectares unless less than fifty percent (50%) of the lot is being harvested, where ten percent (10%) will be allowed. There should be a buffer of at least one hundred (100) meters between all cleared areas.

- ☐ Application of pesticides and herbicides should be prohibited.

- ☐ Pre-treatment conditions should be recorded.

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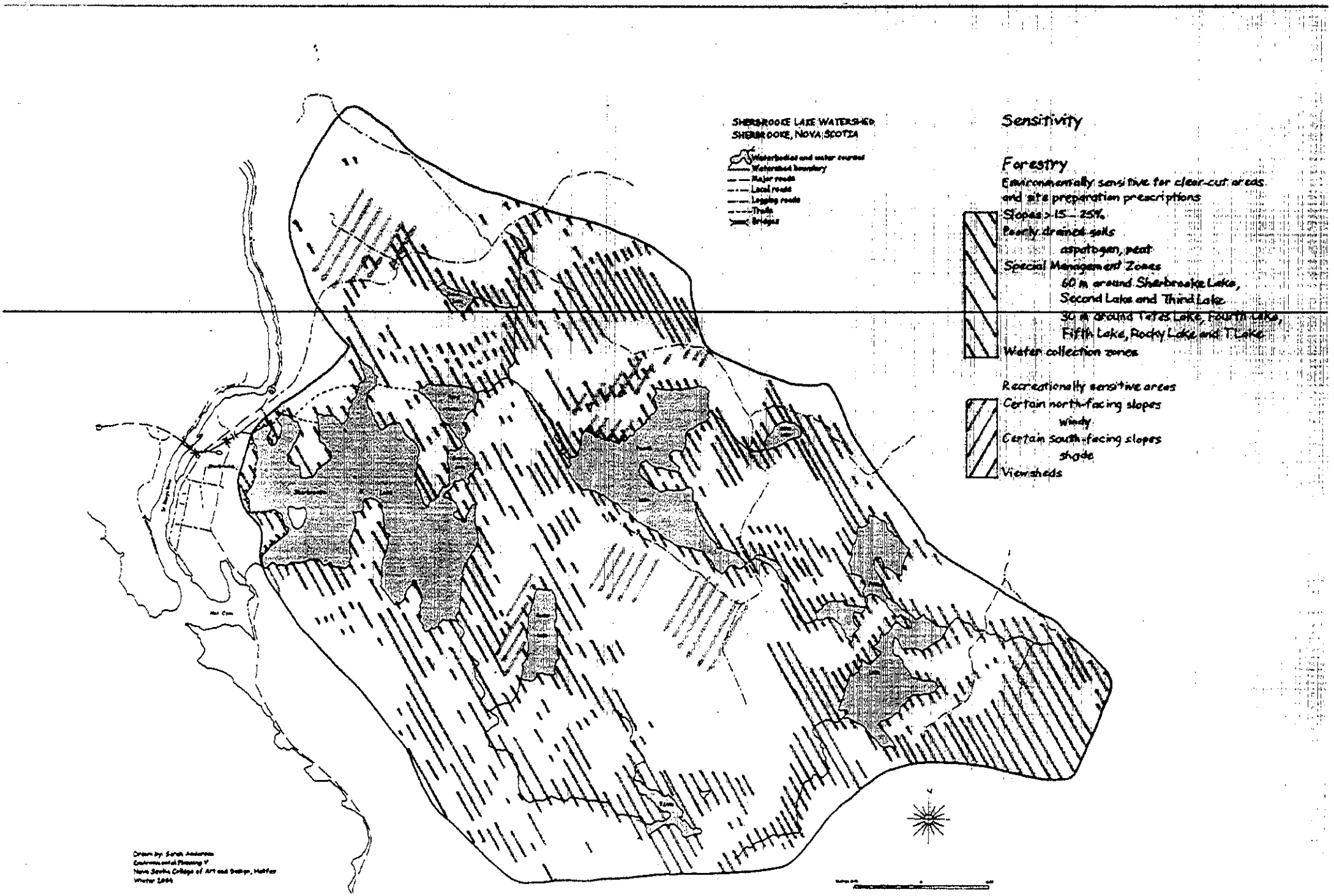
SHERBROOKE LAKE WATERSHED
SHERBROOKE, NOVA SCOTIA
Waterbodies and water courses
Watershed boundary
Major roads
Local roads
Logging roads
Trails
Bridges
Sensitivity
Forestry
Environmentally sensitive for clear-cut areas and site preparation prescriptions
Slopes > 15 - 25%
Poorly drained soils
aspatogan, peat
Special Management Zones
60 m around Sherbrooke Lake, Second Lake and Third Lake
30 m around Tates Lake, Fourth Lake, Fifth Lake, Rocky Lake and T Lake
Water collection zones
Recreationally sensitive areas
Certain north-facing slopes
Windy
Certain south-facing slopes
shade
Viewsheds
Drawn by: Sarah Anderson
Environmental Planning V
Nova Scotia College of Art and Design, Halifax
Winter 2004