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Municipality of the County of Annapolis

Lake Cady Source Water Protection Plan

Approved by Council July 21, 2015

Table of Contents

Executive Summary.....	1
1.0 Introduction	5
1.1 Description of the Source Water Protection Area	5
1.2 Delineation of the Area for Protection	6
1.3 Process of Management Plan Preparation	7
1.4 The Need for Management.....	7
1.5 Source Water Protection Advisory Committee.....	8
2.0 Water Quality Issues	9
2.1 Activities within the Source Water Supply Area	9
2.2 Potential Sources of Contamination	9
2.3 Pathways of Contamination and Prioritization Based on Risk.....	12
3.0 Goal and Objectives	17
3.1 Goal and Objectives	17
3.2 Risk Management Practices	17
4.0 Management Recommendations	19
4.1 Acquisition of Land.....	20
4.2 Best Management Practices.....	20
4.3 Municipal By-Laws.....	24
4.4 Contingency Planning.....	25
4.5 Designation.....	25
4.6 Education and Stewardship.....	25
5.0 Implementation Plan	26
5.1 Re-Designation of the Lake Cady Protected Water Area	29
5.2 Contingency Planning.....	30
5.3 Education and Stewardship.....	31
5.4 Review Existing Lake Cady Water Supply Area MPS & LUB	32

5.5 Acquisition of Land	32
5.6 Nova Scotia Power Infrastructure	33
6.0 Monitoring Program	34
6.1 Purpose.....	34
6.2 Monitoring Parameters and Locations.....	34
6.3 Sampling Procedures.....	35
6.4 Monitoring Schedule	35
6.5 Contingency Monitoring	36
6.6 Monitoring Records and Reporting.....	36

Tables

Table 2.1 Potential Contaminant Sources
Table 2.2 Rationale for Contaminant Risk Ranking
Table 4.1 Management Options
Table 4.2 Best Management Practices
Table 5.1 Initiatives
Table 6.1 Source Water Monitoring Sampling Parameters and Locations

Figures

Figure 1 Cornwallis Park Water Supply System and Source Water Area
Figure 2 Water Protection Area Boundary
Figure 3 Existing Land Use

Appendices

Appendix A. Lake Cady Water Supply Area Land Use By-law Zoning Maps
Appendix B. Terms of Reference for the Advisory Committee

Executive Summary

The following Lake Cady Source Water Protection Plan was prepared by the Lake Cady Source-Water Protection Advisory Committee (the Committee) and presented to the Annapolis County Municipal Council in fulfillment of a condition of the Water Utility's Approval to Operate. The Plan is composed of several parts: the delineation for the Source Water Protection Area; an inventory of contaminants of concern and associated activities that might introduce them; a general strategy and outline of management practices; initiatives to provide greater protection for water quality than is presently employed; and a monitoring program for the purpose of providing data that would allow an evaluation of the effectiveness of the Lake Cady Source Water Protection Plan.

The Lake Cady Source Water Protection Area (SWPA) includes all of the catchment basin above the head-pond dam on West Moose River (as shown in Figure 2). Lake Cady and its tributaries only make up a small portion of the catchment basin. The SWPA also includes Potter Lake, Mud Lake, Shell Camp Lake and their tributary streams, covering a total area of 2,260 hectares. The Cornwallis Park treatment plant receives water from the head pond via a 10.8-kilometer raw-water transmission main. The Water Utility does not distribute water to any part of the SWPA.

Much of the SWPA was included in the Protected Water Area designated by the Nova Scotia Water Authority in 1965, pursuant to Section 16 of the Water Act. Unfortunately, this designation does not follow the topographic divides very well and most significantly omits the area surrounding Shell Camp Lake. The Committee recommends that Council request a repeal of the existing Lake Cady Protected Water Area Designation and request a new Provincial Water Area designation via the Environment Act that coincides with the Lake Cady Source Water Protection Area as outlined in this Plan so that the Water Utility may oversee regulated activities that may impair water quality within the Lake Cady Source Water Supply Area.

In order to establish the recommended management options, the Committee, after delineating the boundary of the SWPA, undertook to identify the potential sources of contamination that could affect the quality of water that enters the transmission line that originates in the Head Pond. The principal potential sources of contamination are:

- fuel spills related to the delivery of fuel oil, leakage from residential fuel storage tanks, and recreational use of gasoline in motorized boats and all-terrain vehicles;

- nitrogenous compounds and pathogens introduced by septic systems and overabundant waterfowl;
- PCBs from NSPI pole-top transformers and wood preservatives from the utility poles;
- sediment influx due to logging, development-related construction, and forest fires;
- herbicides and pesticides from logging, utility right-of-ways, and residential uses; and
- contaminated runoff from road salting and forest fires.

The Committee considered various management options to address these potential threats, with prevention and mitigation as the principal focus. It was recognised that the high-quality water currently produced by the watershed is related to the low number of residential units within the catchment basin. This is a direct result of land-use by-laws that limit construction, or impose a minimum lot size, in vulnerable parts of the SWPA, which greatly limits the sediment influx due to development-related construction, contamination from leaking residential fuel storage tanks, and nitrogenous compounds and pathogens generated by septic systems. Contaminants from all three of these sources can be further reduced by the adoption of best management practices and modifications or additions to by-laws.

Improved contingency planning was considered the most effective management option only where forest fires and commercial fuel spills are the source of contamination. In both cases, providing information to responders and fuel-delivery personnel about the presence of the SWPA and promotion of best management practices was considered essential second and third initiatives. Requiring the application of best management practices was the primary management option in the case of contamination related to road salting and NSPI infrastructure, where nothing more than institutional policies were needed to assure compliance. In the case of control of sediment influx from forestry operations, it was recognised that best management practices would be more likely to be adopted, when preceded by regulations and by-laws that would require and monitor them. Education and stewardship programs were considered the most effective means of reducing contamination in the case of herbicides and pesticides, but regulations restricting use within the Protected Water Area, the adoption of best management practices, and the promulgation of by-laws that restrict the land uses in sensitive areas were considered important secondary management options. The acquisition of land in sensitive areas was considered as a way to reduce the potential of contamination only for commercial fuel spills and herbicides and pesticides. Even in these cases, it was considered the least effective option because of the size of the SWPA and the relatively much greater protection provided by other management options.

The Source Water Protection Plan involves the implementation of six initiatives, recommended by the Committee, in addition to a monitoring program that would track their effectiveness. The initiatives are broken down into tasks with estimated costs that are summarized in Table 5.1 and described in detail in Sections 5.1 through 5.6. The initiatives include:

1. Provincial designation of the Lake Cady Protected Water Area to make it coincide with the SWPA and promulgating regulations to better protect water quality.
2. Improvements in contingency planning to address emergencies precipitated by events (e.g. forest fires, fuel spills) or the unexpected increase of a monitored contaminant;
3. The funding, development, and presentation of Education and Stewardship programs for fuel purveyors, residents, property owners, recreational visitors, and other users of the SWPA to: make the public aware of the regulations and by-laws; to promote best management practices for the use of pesticides/herbicides, prevention of forest fires, recreation-related fuel spills, residential fuel storage, septic-system operation and maintenance; and to stimulate a sense of personal responsibility in all whose activities might affect quality of the water that ultimately reaches the users in Cornwallis Park.
4. Review and modify the existing municipal planning strategy and land-use by-laws and any other municipal by-laws that would help protect the SWPA through zoning and planning strategies that would preclude placing potential sources of contamination in critical areas, limit the number of residential units adjacent to water bodies within the SWPA, and otherwise facilitate the official designation as a Protected Water Area and the enforcement of the regulations that accompany designation.
5. Identify and maintain a list of parcels in the SWPA that are especially critical to source water protection to the extent that municipal ownership would provide significantly greater protection than designation or by-laws, develop the financial means to acquire the lands, and establish a database for each property to facilitate acquisition and negotiation with the current owner.
6. Establish a liaison with NSPI in order to determine what chemical preservatives they use for utility poles and whether their pole-top transformers contain PCBs and to help track progress in eliminating these possible hazards from the SWPA.

The Source Water Protection Plan also includes a Monitoring Program for the purpose of tracking the concentrations of potential contaminants and establishing the efficacy of the initiatives and to determine whether modifications are needed. The Monitoring Program includes taking water-quality samples on several dates that are coordinated with the seasons of the year and with periods of drought and normal precipitation, in addition to the current sampling schedule, so that a baseline can be established for individual water-quality parameters, and for combinations of water-quality parameters, under a wide range conditions. The program includes a list of parameters, most of which are included in the current raw-water monitoring program, but also has schedules for sampling to establish water-quality baselines at the outfalls of Lake Cady and three other surface-water bodies in the SWPA.

First-Year Action Items on each of these initiatives include the following:

1. Begin the process of requesting a repeal of the existing Lake Cady Protected Water Area and applying a for Protected Water Area designation that coincides with the SWPA, draft new regulations, and submit the application to NSE for review and comment.
2. Complete revised contingency planning, including notification of fuel purveyors, residents, emergency responders, and the Annapolis County Water Utility.
3. Developing educational materials relating BMPs, Protected Water Area regulations, and any pertinent municipal by-laws for dissemination, through selected media, to the targeted groups, which would include fuel purveyors, residents, and recreational visitors.
4. Review and propose modifications to the Lake Cady Municipal Planning Strategy and Land-Use By-Laws and submit the proposed modifications to the Municipal Council for approval.
5. Identify any critical parcels for acquisition, initiate the database, and establish sources of funding for land acquisition.
6. Establish a liaison with NSPI, determine whether they use pesticides/herbicides in their right-of-ways and whether PCBs are currently in use in their pole-top transformers within the SWPA, and begin the process of discussing infrastructure upgrades.

In addition to action items related to the initiatives, most of the sampling for the Monitoring Program water-quality baselines should also take place during the first year. However, it is unlikely that all of the combinations of seasonal and precipitation conditions would occur in any given year, but may require multiple years to show a full range.

1.0 Introduction

This section provides an introduction to the history of the system that currently supplies the source water to the Cornwallis Park treatment plant and the current Lake Cady Water Protection Area, the need for management, the role of the Source Water Protection Advisory Committee, and the deliverables and timeframe for the Source Water Protection Plan.

1.1 Description of the Source Water Protection Area

The Lake Cady water supply area is located within District 8 of the Municipality of the County of Annapolis (hereinafter referred to as the Municipality). The Lake Cady water source is unique in that it is the sole potable water supply for Cornwallis Park, which is located in District 6 of the Municipality, as shown in Figure 1. Only a small portion of the water in the system actually passes through Lake Cady itself. The source of water actually includes all of the headwaters of West Moose River above the Cornwallis Park Water Supply System's head pond. In addition to Lake Cady and its catchment basin, the headwaters include Potter Lake, Mud Lake, Shell Camp Lake, and their tributary streams, as well as some minor tributaries that flow directly to West Moose River, downstream of the lakes. A constructed dam on West Moose River maintains the head pond, which has a storage capacity of approximately 75,600 cubic metres. Between the head pond and the treatment works in Cornwallis Park, the flow is piped through the transmission main under pressure maintained in the head pond. The total catchment area flowing to the head pond, based upon GIS analysis of topography received from the Municipality, is approximately 2,300 hectares. This area is shown on figure 2 is proposed as the Lake Cady Source Water Protection Area (SWPA).

Although Lake Cady contains nearly all of the surface water storage in the basin, the drainage area above its outlet only represents about one-sixth of the catchment basin. Consequently, approximately five-sixths of the water supplied to Cornwallis Park theoretically originates from other parts of the basin. However, during periods of low precipitation, lake levels fall and baseflow to streams and wetlands decreases. During these times, the relative contribution of larger reservoirs increases significantly. Nevertheless, for purposes of source water protection, it is important to consider the portions of the catchment basin outside of Lake Cady and its tributaries, especially where they are more vulnerable, such as stream crossings.

Raw water flows 10.8 km from Head Pond through a gravity fed transmission main to the raw water storage reservoir located off South Broadway Avenue in Cornwallis Park. There is no back up source water supply, but the system is equipped with additional capacity that is

available when needed. The raw water reservoir has a capacity of 27,000 cubic metres, which is sufficient to maintain water supply system needs for three to four weeks, based on average daily demand. This untreated storage is back up supply, in case some part of the system upstream experiences problems, and would hopefully provide adequate time for repairs to be made to system components.

The Cornwallis Park Water Supply System was originally owned and operated by the Canadian Forces, until CFB Cornwallis closed in 1995. The water system is currently owned and operated by the Municipality of the County of Annapolis, which holds The Water Supply System's current Approval to Operate (Approval No. 2009-065804, expiry date: April 1, 2018). According to the Lake Cady Water Supply Area Municipal Planning Strategy, the Lake Cady Protected Water Area was designated in 1965 by the Nova Scotia Water Authority, pursuant to Section 16 of the Water Act. One of the initiatives herein contained is the repeal of this 1965 Protected Water Area designation.

1.2 Delineation of the Area for Protection

The effectiveness of any Source Water Protection Plan depends upon the careful definition of the water-protection-area boundary. Knowledge of the boundary location facilitates the determination of land uses and industrial, commercial, and recreational activities in the SWPA that could introduce contaminants or otherwise impact water quality. The 1965 Protected Water Area designation did not include any specific regulations, nor did it include approximately 500 hectares of the head pond catchment basin that are in the vicinity of Shell Camp Lake. The extents of the 1965 Protected Water Area are shown on Figure 2.

To provide an interim protection measure to the entire topographical divide catchment basin, Annapolis County Council adopted the Lake Cady Water Supply Area Municipal Planning Strategy (MPS) and Land Use By-Law (LUB). The effective date of this MPS and LUB was November 10, 2004. The MPS and LUB primarily address restrictions on development within the four residential zones found in the Lake Cady Water Supply Planning Area (specifically, LCR-1, LCR-2, LCR-3, and LCR-4). The locations of these zones are represented on the Zoning Maps. These maps are included in Appendix A. The restrictions include minimum setbacks from water features of 30 metres for any land use or structure (except in LCR-1, where this setback was adjusted to 15 metres, due to the presence of pre-existing structures), and requirements that these setback zones be properly vegetated, according to specified criteria. The By-law greatly restricts the number, type, and placement of buildings and accessory buildings (including fuel tanks) placed on a lot, effectively maintaining the watershed as a low-density residential area.

The adoption of the MPS and LUB removed or reduced the vast majority of threats to water quality that are commonly associated with urbanization, thereby greatly decreasing the risks applicable to the Lake Cady Water Supply Area. However, the remaining risks, if unmanaged, could pose significant threats to water quality, and therefore constitute the focus of this Source Water Protection Plan.

There was some concern by the Committee regarding whether the drainage from Shell Camp Lake actually should be included in the catchment basin for the head pond. Accordingly, a planning technician from the Municipality was asked to undertake a confirmatory field visit. The reconnaissance established that Shell Camp Lake was indeed in the catchment basin. In addition, they found that approximately 30 hectares on the south side of Potter Road, which had not been included in the Planning Area delineation. These additional areas are included in the Lake Cady Source Water Protection Area; making the total catchment area to be approximately 2,260 hectares (see Figure 2).

1.3 Process of Management Plan Preparation

In 2002, the province of Nova Scotia released *A Drinking Water Strategy for Nova Scotia*, which outlines a multiple-barrier approach to clean, safe drinking water. Subsequently, Nova Scotia Environment developed a 5-step process to planning and establishment of safe drinking water for all Nova Scotians. The scope of work for implementation of the 5-step strategy is as follows:

- Step 1 Form a Source Water Protection Advisory Committee
- Step 2 Delineate the Source Water Protection Area Boundary
- Step 3 Identify Potential Contaminants and Assess Risks
- Step 4 Develop and Adopt a Source Water Protection Plan
- Step 5 Monitor and Evaluate the Plan

In accordance with the requirements of the Approval to Operate, and in order to fulfill the general requirements of the Protected Water Area designation and the goals of the MPS and LUB, the Municipality of the County of Annapolis has undertaken to obtain and follow these guidelines. The remainder of this report describes the actions taken and presents the results.

1.4 The Need for Management

Provision of an adequate and safe water supply to consumers is the top priority for the Province of Nova Scotia and the Municipality of the County of Annapolis. This is achieved through a Multiple-Barrier Approach – that is a series of steps, which together, provide a multi-layer protection system to ensure that safe water is delivered to the consumer. In Nova Scotia, the barriers defined in the Drinking Water Strategy are as follows:

- Keeping it Clean - ensure the water source is protected from contamination
- Making it Safe - provide the required treatment
- Proving it Safe - continuous testing and monitoring

The Source Water Protection Plan is a general strategy and outline of management practices that form a program designed for use by community stakeholders. The program is developed and administered by the stakeholders, with the objective of providing high quality drinking water by maintaining a clean and adequate water supply source.

1.5 Source Water Protection Advisory Committee

The Source Water Protection Advisory Committee (the Committee), is tasked with developing a source water protection plan and providing the Municipality of the County of Annapolis with direction on land use issues, water quality, levels and flows within the catchment area. The mandate of the committee includes addressing issues such as the identification of stakeholders; water quantity and quality concerns; actual and potential sources of contamination; management strategies and the effectiveness of the Source Water Protection Plan. Terms of Reference, which define the Source Water Protection Committee's composition, roles and responsibilities of committee members, operations and reporting hierarchy, and, committee members' length of term, are provided in Appendix B. The Committee is also charged with preparing an annual report on the effectiveness of the Source Water Protection Plan, noting the stages of completeness of the Initiatives herein contained.

2.0 Water Quality Issues

Identification of potential sources of contamination and their associated risks is critical to the success of any source water protection plan. Point and non-point sources of potential contamination were identified. Point sources, as defined by Nova Scotia Environment, are sources of pollution that can be monitored and regulated; conversely, non-point sources are diffuse in nature and difficult to locate. Examples of point sources are fuel tanks, landfills and salt storage depots. Non-point source examples include land application materials, such as fertilizers (chemical and organic), road salting, and pesticide application.

2.1 Activities within the Source Water Supply Area

Land use within the Lake Cady Source Water Protection Area is primarily limited to residential and recreational usage. Approximately 79 percent of the area is forested, however only a few small-scale forestry operations are active. There is no commercial agriculture in the area.

Land use information for the Lake Cady area is divided into three categories:

i. **Number of Buildings/Structures**

There are approximately 22 occupied residences in the Lake Cady water supply area, most of which are seasonal cottages along the shore of Lake Cady.

ii. **Percentage of Land Use**

The land use is a combination of lakes, clear-cut forest, wooded forest, and residential area and the approximate breakdown is: 79% wooded forest, 14% clear cut forest, 1% partial cut forest, 5% water bodies and 1% non-forested land (including residential areas)

iii. **Land Ownership**

The Lake Cady Source Water Protection Area is approximately 2,260 hectares. The majority of this land (88 %) has identified private owners. 5% are parcels with unknown owners, smaller lakes owned by the Crown comprise 1 %, 2% are parcels owned by the Municipality, and 1 % is forest roads. The small (approximately 0.5 hectares) island in Lake Cady is owned by the NSDNR.

The Lake Cady watershed is unique in that the residents within the watershed are not provided service by municipal water-supply infrastructure. The three residences located on Virginia Road on the northern boundary of the watershed all are on individual water wells. The northern end of Lake Cady is host to several cottages which are seasonally inhabited. The residents draw their water from the lake via individual pumping and/or gravity feed systems. The locations of residences are shown on Figure 3.

2.2 Potential Sources of Contamination

Potential contaminants are divided into seven main categories, as defined by NSE:

- i. **Microbial**
Viruses and harmful bacteria; potential sources include sewage treatment plants, septic systems, agricultural livestock operations, or wildlife.
- ii. **Inorganic**
Salts and metals, which can occur naturally or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- iii. **Pesticides and herbicides**
May come from a variety of sources, such as agriculture, storm-water runoff, and residential uses.
- iv. **Organic chemical contaminants**
Synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production; they can also come from gas stations, urban storm water runoff, and septic systems.
- v. **Radioactive contaminants**
Naturally occurring or the result of oil and gas production and mining activities
- vi. **Sediment**
Weathering of soil and rock; human development can cause sedimentation, primarily through soil erosion.
- vii. **Nutrients**
Nitrogen and phosphorus can be generated by human activity, and cause eutrophication, whereby excessive plant growth depletes oxygen levels in water.

Keeping these categories in mind, potential contaminants within the Lake Cady Source Water Protection Area were identified by reviewing land use practices, forestry operations, recreational uses and residential practices. The Committee considered the likelihood of a release for each of the identified contaminant sources as well as the severity of the consequences should such a release occur in order to determine a general level of concern, as shown in Table 2.1.

Table 2.1 - Potential Contaminant Sources

Potential Contaminant	Description	Probability ¹	Severity ¹	Level of Concern
Septic systems	Residential systems (microbial pathogens)	2	1	Low
Fuel storage	Heating oil tanks	1	1	Low
NSPI Infrastructure	PCB-containing transformers	1	2	Low
	Utility pole treatments	2	2	Medium
Forest fires	Increased sedimentation	1	2	Low
	Contaminated run-off			
Transportation corridors	Road salt	1	1	Low
	Commercial fuel/oil spills	2	5	High
Sedimentation	Construction/Forestry (runoff to culverts/ditches)	3	1	Medium
	Forest fires (decreased canopy)	1	3	Medium
Herbicides/Pesticides	Forestry, NSPI	3	2	Medium
Recreation	Fuel spills (power boats)	1	1	Low
Wildlife and Vegetation	Sedimentation	1	1	Low
	Pollen	2	1	Low
	Plant Detritus	2	1	Low
	Animal Feces	2	1	Low
	Algae Growth	1	1	Low
¹Note: The Committee assigned lower numbers to indicate a lower probability or severity.				

2.3 Pathways of Contamination and Prioritization Based on Risk

After the potential contaminant sources were identified and the general level of concern assigned, the Committee undertook to identify the source activities and pathways that specific contaminants have in common. They then consolidated them in order to facilitate management and ranked them in order to optimize the allocation of resources. The rationale that the Committee used to rank each potential contaminant source is provided below. The results of the contaminant risk ranking process and rationale are summarized in Table 2.2.

Commercial Fuel Spills

- Three homes on Virginia Road have domestic heating oil tanks.
 - Tanks are filled approximately once per month, which necessitates the passage of commercial fuel trucks through the watershed on a regular basis.
 - Virginia Road runs along the northern tip of Lake Cady. If a truck were to overturn, fuel oil could potentially spill directly into Lake Cady.
- Other residences along Virginia Road, further from lake, are nevertheless within the Source Water Protection Area, and ditching along the road discharges into Lake Cady.
- Forestry-related fuel spills could reach streams or lakes within the Source Water Protection Area.
- Cottages that are not currently equipped or new residences that could be constructed within the Source Water Protection Area could add fuel storage tanks.

Sedimentation

- Ditching along Virginia Road drains into Lake Cady.
 - The road is owned and maintained by the province, which may include occasional salt application.
- Forestry operations result in cleared land, which reduces the forest canopy and increases runoff volumes.
 - This can increase the sediment load in watercourses throughout the watershed.
 - Logging roads cross the West Moose River.
- Development of additional lands in the watershed can reduce the permeable surface area and vegetative cover and thus increase runoff and erosion.
 - Examples include paving, decking, and landscaping.

Similar to logging and development, forest fires remove canopy and ground cover and can lead to increased erosion and consequent sedimentation.

Table 2.2 Rationale for Contaminant Risk Ranking

Priority	Potential Contaminant	Rationale	Rank
1	Commercial fuel spills	<ul style="list-style-type: none"> Trucks re-fuelling domestic tanks Proximity of a spill to source water <ul style="list-style-type: none"> Volume of a spill 	High
2	Sedimentation	<ul style="list-style-type: none"> Storm collection (culverts, ditches) Increased recreational activity Increased and/or new development Forestry and reduction of canopy 	Medium
3	Herbicides/Pesticides	<ul style="list-style-type: none"> NSPI, Public Works, NSTIR 	Medium
4	Recreation - fuel spills	<ul style="list-style-type: none"> Currently self-regulated Risk varies depending on the size of spill 	Medium
5	Residential Fuel Storage	<ul style="list-style-type: none"> Detection of leaks can be difficult Risk varies depending on proximity to source water and size of tank <ul style="list-style-type: none"> No spill mitigation provisions 	Low
6	Road salt	<ul style="list-style-type: none"> Increased salinity and hardness 	Low
7	Septic systems	<ul style="list-style-type: none"> Detection of leaks can be difficult Risk varies depending on proximity to source water Water treatment system can handle 	Low
8	Forest fires	<ul style="list-style-type: none"> Increased sedimentation Contaminated runoff 	Low
9	NSPI infrastructure	<ul style="list-style-type: none"> Possible PCBs Utility pole treatment <ul style="list-style-type: none"> Herbicides 	Low
10	Wildlife & Vegetation	<ul style="list-style-type: none"> Pollen and plant material Increased nutrient loadings from wildlife <ul style="list-style-type: none"> Algal growth 	Low

Herbicides/Pesticides

- Nova Scotia Power Infrastructure (NSPI) has a power distribution line along Virginia Road.
 - NSPI typically uses herbicides and/or pesticides to manage vegetation along the pole line.
 - NSPI policy is to “consult with GIS mapping to determine where any designated or municipal watershed interacts with infrastructure” when planning vegetation management, to prevent the treatment with herbicides or pesticides, any distribution line that crosses through a watershed.
- NSTIR is currently experimenting with herbicides to manage roadside growth.
- Forestry operations typically use pesticides/herbicides to manage pests and weeds.
- Residents have outbuildings for storing gardening and lawn maintenance chemicals, including fertilizers and pesticides, which could increase the potential for a spill.

Recreation

- Lake Cady and other surface water bodies in the proposed Source Water Protection Area are used for recreational boating and fishing. Power boats can present a significant risk through the release of fuels. Although it has been reported at Committee meetings that the current users of the lake do not use them, the users of the lake are currently self-regulating. Therefore, there is little to protect the water source, if the current practice should change in the future.
- Lead sinkers, often used when fishing on lakes, can also be a source of contamination.
- The watershed is used for snowmobiling and off-road vehicles; the use of recreational vehicles can be the source of oil and fuel spills.
- Recreational activities in and along watercourses can create additional sedimentation through riverbank erosion.
 - Recreational examples include all-terrain vehicles, fishing, hiking, etc.
- Recreational activities in and along watercourses can also create potential for pollution spills through littering.
- Re-designation of the Protected Water Area would bring an opportunity to draft regulations to prohibit the introduction of motorized recreation in the lakes and other surface water bodies in the Source Water Protection Area. The reduction of this threat might also be supported through changes to Municipal by-laws.

Road Salt

- NSTIR uses salt to manage snow and ice conditions on roads in the watershed.
 - Salt poses a threat to drinking water by increasing chloride concentrations.

Residential Fuel Storage

- Residents often have outbuildings for storing property maintenance chemicals such as gasoline and oil.
 - These are partly addressed in the current Land-Use By-Laws, but there are no offsets with respect to critical areas or prescribed spill prevention measures.
- Other chemicals are used for general household maintenance, such as anti-freeze (as many residences are seasonal).

Septic Systems

- All residences in the Lake Cady watershed use on-site septic systems, as there is no municipal service in the area. However, there is not much concern as long as density remains low. Land-Use By-Laws currently do not specify offsets from critical surface-water bodies.
 - Typical contaminants in household wastewater include nutrients (nitrogen and phosphorus) and pathogens (viruses and bacteria).
 - Although algal blooms may result from excess nutrient loading, the quantities introduced, due to low population density, would likely be a minor contributor to a bloom.
 - Although pathogens may survive in improperly maintained systems and be transported to the head pond, the treatment facility is well-equipped to address the situation.
 - A more pressing concern would be the use of septic systems for the disposal of hazardous materials.

Forest Fires

- In addition to the forest-fire consequence of increased sedimentation, the use of water-soluble fire suppressants poses a contamination risk to drinking water supplies.

NS Power Infrastructure

- Poles are treated mainly with pentachlorophenol (PCP) and less frequently chromated copper arsenate (CCA). NSPI has a minimum set-back of 15 and 5 meters from the high-water mark of any freshwater resource, for the application PCP and CCA, respectively.
- There are five pole-top transformers located within the watershed. Some of these may be PCB-containing, depending upon their ages. More recently installed transformers use mineral oil, but NSPI considers transformer manufactured prior to 1983 to be potentially contaminated with PCBs.
- Frequent inspection and maintenance may be expected to prevent leaks. NSPI was observed on Virginia Road in late August 2013, with a cherry picker, presumably engaged in inspection and maintenance. According to NSPI, there is a two-year inspection cycle.

- Maintenance has the potential to cause a spill, and NSPI trains and equips their service crews for immediate response, in the event of a spill. Cleanup is carried out to meet Atlantic RBCA Tier 1 guidelines, in the case of more serious spills that “trigger reporting” under the Nova Scotia Emergency Spill Regulations.

Wildlife and Vegetation

- Large amounts of pollen during the spring could contribute to sedimentation in lakes, but is not considered to be a significant water quality risk.
- Dead plant material falling into or near lakes could increase turbidity and sedimentation, but is not considered to be a significant water quality risk.
- Local wildlife may contaminate lakes with their waste, leading to increased nutrient levels.
- Algae growth, especially seasonal blooms can potentially affect water quality. The best way to decrease risk of algal blooms is to reduce the inflow of excess nutrients into water bodies.

3.0 Goal and Objectives

The overall objective of this Source Water Protection Plan is to manage land uses within the defined source water protection area to assure the continued supply of good quality water.

3.1 Goal and Objectives

The goal of the SWPP may be achieved through the accomplishment of specific objectives:

1. Establish multiple lines of protection, which will take the form of different initiatives for different types of contaminants. In order to reduce contaminant influx in a cost-effective manner, these initiatives will address vulnerable areas identified in earlier steps. They variously include: physical isolation from ongoing potential contaminant sources, changes in practice, changes in the Land-Use Bylaw and Water-Protection Area delineations and regulations, educating the public about responsible behaviour within the boundaries of a drinking-water supply watershed, and developing effective contingency plans to mitigate an incident, if one does occur.
2. Provide a plan that is flexible and can be adapted or augmented, if there are changes in contaminants (or activities that have the potential to introduce contaminants). It may be found that the current Land-Use Bylaw within the defined protection zone does not have sufficient provision to preclude activities that have the potential to impact water quality. Therefore, the management plan must address both existing and potential future land uses. It is important to incorporate ongoing public and key stakeholder input into the management plan, so as to design a well-integrated plan that builds upon existing programs and resources.
3. Provide a management plan that allows the potential sources of contamination to be easily and cost-effectively monitored. The degree of monitoring/management should depend on the locations of the potential contaminant sources and their proximity to the water source.

3.2 Risk Management Practices

As stated in Step 4 of the NSE 2009 guidelines, almost every activity on the land has the potential to affect the quality of water in a community. Management planning brings together the people within the source water protection area to address those activities. By working together, individuals within the source water protection area can design a coordinated management plan that builds upon the strengths of existing programs and resources, and addresses the water quality concerns in an integrated, cost-effective manner.

The guidelines require the assessment of alternative source-water protection management options. The following list of management options, with a general statement as to their

effectiveness, cost, usefulness, and acceptability, is provided for the use of Source Water Protection Advisory Committees:

a. Acquisition of Land

Typically the most expensive option, but also the most effective, as it gives the Municipality direct control over the land usage and development.

b. Best Management Practices (BMPs)

Methodologies used by residents and industry to define practical and effective means of protecting source water areas. In the case of the Water Utility and other institutions, such as NPSI and NSTIR, BMPs can be directly adopted and applied. For the public and private industry, adoption of BMPs may require education or even regulations.

c. By-laws

By-laws are enacted under Municipal Planning Strategies and allow the Municipality to restrict land usage and activities in sensitive areas.

d. Contingency Planning

Not all risks to a protected water area can be mitigated. Contingency Planning defines emergency response protocols, in case of a dangerous contamination occurrence within the source water protection area.

e. Designation

Regulations enacted under the *Nova Scotia Environment Act*, Section 106. The majority of the Lake Cady Source Water Protection Area is formally designated as Protected Water Area under this legislation. Regulations can be drafted that would enable the Municipality to define allowable activities within the protected area.

f. Education and Stewardship

The Municipality can work to develop and deliver educational materials to inform residents and land owners of the importance of protecting source waters, and to recommend practices for doing so.

The Source Water Protection Advisory Committee is responsible for evaluating the application of these various management options to the identified potential contaminants within the Source Water Protection Area, considering effectiveness, cost, maintenance, useful life, adverse effects, and public acceptability of each option, in order to develop suitable management recommendations.

4.0 Management Recommendations

For each potential contaminant in the SWP Area, the management options presented in the NSE guidelines were evaluated by the Committee for effectiveness, cost, maintenance, useful life, adverse effects, and public acceptability. Table 4.1 below provides a summary of the management options and indicates the expected effectiveness each option on the various potential contaminants, with an assignment of a “1” deemed to be the most effective.

Table 4.1 - Management Options

Potential Contaminant	Acquisition of Land	BMPs	By-laws	Contingency Plan	Designation	Education & Stewardship
Commercial fuel spills	5	2		1	4	3
Construction and forestry-related sedimentation		1	3		2	
Herbicides / pesticides	5	3	4		2	1
Recreation-related erosion, fuel spills, and contamination		3	4		1	2
Residential fuel storage spills		2		4	3	1
Road salt		1		2		
Septic systems		2				1
Forest fires		3		1		2
NSPI infrastructure		1				

Although certain management options are judged to be more effective than others for specific contaminant source activities, the Committee recognizes that the most effective initiatives would make use of two or more management options in a coordinated fashion. Rationale for the assigned priorities is presented in the sections that follow.

4.1 Acquisition of Land

The acquisition of land is the most expensive management option for potential contaminants. This is especially true in large watersheds, where the cost of purchasing extensive acreage of land may be prohibitive. Given the size of the Lake Cady Source Water Protection Area, only the purchase of the most vulnerable areas, such as high risk lands directly bordering surface water bodies, may be an option. Therefore, the majority of potential contaminants are best addressed using other management options, as described in the following sections. However, the acquisition of land was ranked as a management approach for potential commercial fuel spills and for herbicides and pesticides, but the effectiveness is expected to be limited. If other management options are not sufficient to manage these risks, the Municipality will have to initiate a program of purchasing land to create an effective buffer zone for potential contaminants. If the parcels are large, the vulnerable parts can be identified and the parcels subdivided so that only the part that is a concern can be purchased.

4.2 Best Management Practices

BMPs for potential contaminants in source water protection areas are established and well-defined, and are a good way to initiate change in individual land holder and business operational practices. BMPs are often cost effective solutions resulting from minor changes in day-to-day decision making. Additionally, government grants may be available to help attain these practices.

All of the identified potential contaminants in the Lake Cady Source Water Protection Area will be addressed, at least in part, by the implementation of BMPs. However, it is unreasonable to assume that all residents, visitors, and commercial interests will be aware of the BMPs and be willing to adopt them. Therefore, for potential sources of contamination other than municipal activities, BMPs cannot be a stand-alone initiative. For certain contaminants, BMPs were selected as the most effective management option (road salt, NSPI infrastructure, wildlife and vegetation, and sedimentation from construction- and forestry-related activities), or the second most effective option (commercial fuel spills and residential fuel storage). In some cases, BMPs are an essential third or fourth option behind education and stewardship programs and designation-related regulations, for contaminant sources made more likely by development (herbicides and pesticides and improperly-disposed hazardous materials). For recreation-related impacts, BMPs rank third, behind designation-related regulations and education. BMPs are also ranked as the third effective management for potential contamination from forest fires. Table 4.2 lists BMPs commonly applied to the potential contaminant source activities of concern that were identified by the Committee.

Table 4.2 - Best Management Practices

Potential Contaminant	Best Management Practices
Commercial Fuel Spills	<ul style="list-style-type: none"> • Immediately notify Municipality in the event of a fuel spill. • Place road signage to indicate protected water source area. • Spill kits are required on commercial fuel supply vehicles. • Reduced speed of commercial vehicles in source water protection area. • Design and install guardrails in higher-risk stretches of roadway within water protection area. • Immediately clean up any spills with proper equipment.
Sedimentation	<ul style="list-style-type: none"> • Notify the Municipality about any construction (or any other activity involving clearing the land of vegetation) proposed to take place in the Source Water Protection Area. • Review erosion and sedimentation control plans for all construction within proximity to watercourse. • During construction activity implement sedimentation controls such as check dams, filter barriers, surface stabilization, sediment ponds and proper grading. • Limit the length and steepness of the designed slopes to reduce runoff volumes and velocity. <ul style="list-style-type: none"> • Avoid clearing/cutting large portions of land, if possible. If clearing land is required expose the smallest practical area of land for the shortest possible time. • Keep exposed soil covered with temporary or permanent vegetation where possible to minimize surface runoff.
Herbicides & Pesticides	<ul style="list-style-type: none"> • Notify the Municipality two weeks in advance of any proposed application that is to take place in the Source Water Protection Area. <ul style="list-style-type: none"> • Make use of vegetated buffers to reduce herbicides/pesticides runoff. • Avoid herbicides/pesticides drift by applying during low/no wind conditions, keeping booms low and using nozzles that produce large droplet sizes. • Make use of natural, biological, or organic forms of pest and weed control where applicable. • If agricultural practices are to occur in the Source Water Protection Area, crops should be rotated to reduce pest cycle, and hooded /recirculating spray booms should be used to reduce drift. • When transporting herbicides/pesticides keep secured to prevent any spillage. <ul style="list-style-type: none"> • Don't recycle empty pesticide containers or reuse them for anything else. • Never dispose of any unwanted pesticide by flushing it down the drain or toilet.

Recreation	<ul style="list-style-type: none"> • Immediately notify Municipality in the event of a fuel spill. • Never pour over the water during fueling or boat maintenance; do not "top-off" fuel tanks; fuel the boat on the trailer whenever possible. <ul style="list-style-type: none"> • Install any fuel storage tanks far away from the waterfront. • Inspect fuel tanks regularly and perform regular maintenance on the watercraft. <ul style="list-style-type: none"> • Keep fuel spill kits onboard watercraft in case of fuel leak. • Reduce the potential for erosion caused by recreation by prohibiting the use of recreational motorized vehicles.
Residential Fuel Storage	<ul style="list-style-type: none"> • Immediately report fuel spills to the Municipality. • Consider an innovative home oil tank with a longer life cycle. <ul style="list-style-type: none"> • Oil tanks should be installed by a trained and experienced installer. • Ensure that your outdoor oil tank is properly supported, with the legs centered, to prevent it from shifting, settling or falling over. The support legs of an above-ground tank should be installed on a concrete pad or reinforced patio stones. • Do not locate an oil tank directly under house eaves where it may be subjected to falling snow and icicles or to increased external pitting from dripping water. • Ensure that the oil tank is not placed in contact with the building. Leaves and other organic matter can accumulate between the tank and the building, causing external corrosion. • Ensure that the oil tank is not in contact with plants or grass. Their moisture can lead to accelerated corrosion of the tank. • Use slabs, gravel, or equivalent ground treatments to preclude the growth of vegetation adjacent to tanks. • Provide the oil tank with adequate protection in areas exposed to vehicles. • Do not install a used or "refurbished" tank. Any tank that was removed from its original location was removed for a reason. Reuse is simply inviting problems and a likely leak. <ul style="list-style-type: none"> • Regularly inspect oil tanks for rust, damage, and corrosion. • Fuel storage tanks must be replaced regularly as per insurance provider's requirements.
Road Salt	<ul style="list-style-type: none"> • Maintain appropriate application rates, especially in vulnerable areas. • Salt Storage sites to be located indoors on impermeable pads. Load and unload salt indoors. • Ensure salt storage locations are designed to avoid any runoff or material loss on site. • Monitor and keep proper records on de-icing practices to determine optimal usage. <ul style="list-style-type: none"> • Consider using zero-velocity spreaders. • Make use of proper pre-wetting.

<p>Septic Systems</p>	<ul style="list-style-type: none"> • Report malfunctions to provincial authorities. • Inspect and pump septic systems regularly. • Ensure septic system is designed by a trained and experienced designer. <ul style="list-style-type: none"> • Do not dispose of hazardous materials through the septic system. • Don't plant trees, shrubs or other large plant near the septic system. <ul style="list-style-type: none"> • Don't drive or park vehicles on any part of the septic system. <ul style="list-style-type: none"> • Don't overload the system with water. • Don't operate the system outside of its design limits. • Keep roof drains, basement sump pump drains, and other rainwater or surface water drainage systems away from the drain field. Flooding the drain field with excess water slows down or stops treatment and can cause plumbing fixtures to back up.
<p>Forest Fires</p>	<ul style="list-style-type: none"> • Plan burning activity in order to take into account weather, time of year, and fuel conditions so that these help achieve the desired results and minimize effects on water quality. <ul style="list-style-type: none"> • Follow the provincial Department of Natural Resources Wildfire Risk Burning Season Restriction Program (March 15 to October 15 for all outdoor fire activities. • Following a fire provide temporary or permanent cover on the site as soon as possible after the fire is out to maintain erosion control measures. • All Class I or Class II equipment, as per NS Forest Fire Protection Regulations, requires a fire extinguisher and a round point shovel. Class II machines will also require a back tank pump unit. • All power saws being operated during fire season are to be equipped with an exhaust muffler in functional condition and a spark arresting device in functional condition. <ul style="list-style-type: none"> • Avoid smoking in and around dry brush during fire season.
<p>NSPI Infrastructure</p>	<ul style="list-style-type: none"> • Avoid using treated wooden poles if possible. • Avoid disturbing any wetland or tributary stream during installation or any utility pole or other infrastructure installation. <ul style="list-style-type: none"> • Phase out use of PCBs in pole-top transformers, as soon as possible

4.3 Municipal By-Laws

Land Use By-laws provide the Municipality with another barrier for protecting source water, by limiting the development of properties adjacent to water bodies to specific uses and reducing contaminant loading by requiring larger lot sizes. For the more sensitive areas, it may be possible to restrict specific land uses altogether. With respect to construction-related erosion and sedimentation, the current Land-Use By-Law appears to make adequate protection. The by-laws currently stipulate that erosion must be controlled during construction, and that altering land levels without approval is prohibited. Beyond sedimentation, the principal threat from development in an area that is served by individual subsurface wastewater treatment and disposal is nitrate loading to reservoirs, which causes eutrophication and consequently, increased sedimentation and anoxic conditions. The current zoning and minimum lot areas should suffice to protect the SWPA against this density-related threat.

In terms of forestry practises, temporary forestry operation structures are permitted in the LCR-2, LCR-3, and LCR-4 zones. As this is generally the limit of authority of a land use by-law to regulate forestry operations, it appears prudent to rely on the forestry industry's own BMPs and on environmental groups that watch the industry. To supplement this, assuring sediment control in sensitive areas is probably best accomplished with regulations attached to the Water Protection Area designation.

Another increasing density related threat would be an increase in the probability of discharging hazardous substances or the leakage from fuel storage tanks or spills during delivery. The Committee has determined this is best addressed through regulations attached to the Protected Water Area designation and through education and stewardship programs. The current land-use by-laws could provide more protection from accidental spills, especially with respect to residential fuel storage. Currently, the land use by-law only regulates minimum distances between the fuel storage tank and the main residence. In critical areas, such as those with steep slopes or proximity to surface water, by-law could require spill control or leak-detection measures, such as double-walled tanks, secondary containment, non-corrodible tanks (e.g. stainless steel, fiberglass, or composite) and regular municipal inspection. Consequently, the Committee ranked by-laws as the most effective management option with regard to residential fuel storage. Although the application of BMPs by residents is also essential to prevent contamination in areas where surface water is vulnerable and education and stewardship programs are probably necessary in order to gain voluntary cooperation, they would probably be less effective without by-laws to regulate the most critical locations.

In the case of herbicides/pesticides or recreational fuel spills the Committee ranked education and stewardship, designation, and BMPs (in this order) as most effective management option for herbicides/pesticides. For recreational fuel spills, designation and its related regulations, education/stewardship and BMPs was the chosen order.

4.4 Contingency Planning

Contingency planning is necessary where the risk of unintentional contamination exists, and this risk cannot be removed entirely from the Lake Cady Source Water Protection Area through the use of other management options. For example, in the event of a spill within the watershed of a hazardous substance, the Municipality must be prepared to react quickly and to ensure that authorities effectively remove the hazardous substance from the area, reducing long-term impacts. Contingency planning was ranked as the most effective management option for commercial fuel spills and forest fires, the second most effective option for road salt contamination (behind BMPs) and the fifth ranked option for potential contaminants from residential fuel storage.

4.5 Designation

By designating the Lake Cady watershed as a Protected Water Area under the *Nova Scotia Environment Act, Section 106*, the Municipality is able to define allowable activities within the watershed, beyond those that can be restricted by Municipal by-laws. Designation can also help when revising by-laws for areas with increased sensitivity. Designation was ranked as the most effective management option for recreation-related contamination (fuel spills, sediment), the second most effective management option for sediment influx and herbicides/pesticides, the fourth effective management option for residential fuel storage and commercial fuel spills.

4.6 Education and Stewardship

Education and stewardship was ranked as the most effective management option for the application of herbicides and pesticides, and an essential second or third option for commercial fuel spills, recreational fuel spills, existing residential fuel storage, existing septic systems, and forest fires, which all rely for protection on BMPs that need to be promoted and taught. Through developing educational programs for the residents, land owners, and those working or engaging in recreational activities within the Lake Cady Source Water Protection Area, the Municipality would be able to send a clear message about the importance of protecting source waters and the necessary actions to achieve this goal. Education is especially crucial in the case of this Source Water Protection Area, where the end users are not the same as the residents and landowners and who may not be aware of their responsibility to manage potential contaminants and protect the water for downstream users. The goal is to create a sense of ownership and encourage stewardship for people who live and work in the watershed, because they are in the best position to ensure and implement good practices.

5.0 Implementation Plan

In order to bring about the desired level of source water protection, this plan contains several initiatives; each one addressing one or more of the prioritised risks identified by the Committee (using one or more of the management options deemed most effective). These initiatives, including the individual actions they entail, estimated costs, and suggested implementation dates, are listed in Table 5.1. The Committee anticipates that the Municipality will elect to complete the majority of these initiatives with the assistance of an environmental consultant. The costs presented in Table 5.1 represent the estimated costs of that assistance. Where some of the recommended actions appear to be readily incorporated in to the tasks normally assigned to Water Utility staff, the cost reflects only the portion that would involve a consultant or outside contractor. A more detailed explanation of each recommended initiatives, and the actions that compose them, follow the table.

Table 5.1 Initiatives

INITIATIVE (The initiatives are not presented in order of priority.)	TIMELINE	COST	RESPONSIBLE PARTY
1. Repeal & Designation of the Lake Cady Protected Water Area			
\$19,400			
(1) Apply to repeal existing PWA Designation & initiate new PWAD process.	Year 1	\$2,000	Committee/Cons.
(2) Define boundaries of PWA for acceptable format submission	Year 2	\$3,500	Committee/Cons.
(3) Define boundaries of PWA for submission in acceptable format.	Year 2	\$5,000	Committee/Cons.
(4) Submit request for Designation & formalize the designation.	Year 3	\$3,000	Committee/Cons.
(5) Notify public & register designation.	Year 3	\$4,000	Committee/Cons.
(6) Post signs at the new boundaries of protected water area.	Year 4	\$1900	Committee/Cons.
2. Contingency Planning			
\$3,500			
(1) Review and update current municipal contingency plans in the event of a reduction in water quality.	Year 2	\$1,000	ACWU/Cons.
(2) Identify fuel providers and advise them of the presence of the SWPA, BMPs to reduce likelihood and impact of spills, and penalties for non-compliance.	Year 1	See Initiative 3.	ACWU/Cons.

(3) Identify likely fire responders and advise them of the presence of the SWPP, agree upon fire-fighting protocols.	Year 1	\$1,000	ACWU/Cons.
(4) Include spill-reporting procedures in education materials.	Year 1	See Initiative 3.	Committee/Cons.
(5) Establish action threshold for chloride in water supply to trigger use of alternative de-icers.	Year 1	\$1,500	ACWU/Cons.
(6) Review water quality monitoring plans with NSE	Year 1	\$250	Committee
3. Education and Stewardship \$19,500			
(1) Educate fuel providers about applicable restrictions / BMPs for water protection area.	Year 1/biennially	\$2,500	Committee/Cons.
(2) Identify available grants/other resources for implementing BMPs, such as for tank upgrades, etc.	Year 1	\$1,000	Committee/Cons.
(3) Determine best media channels for distributing Source Water Protection educational materials.	Year 1	\$1,000	Committee/Cons.
(4) Develop educational materials including water protection responsibilities, regulations, and BMPs.	Year 3	\$5,000	Committee/Cons.
(5) Distribute educational materials to all residents, property owners, and users through various media.	Year 1/annually	\$10,000	Committee/Cons.
4. Modify Municipal By-Laws for Greater Protection of the Lake Cady Water Supply \$8,500			
(1) Review provincial laws, delineate critical areas, recommend buffer distances, restrictions, mitigations to be included in modified and augmented by-laws.	Year 2	\$3,000	Committee/Cons.
(2) Formalize modifications into proposed new water supply protection by-laws, with revised zoning maps, if necessary.	Year 3	\$2,500	Committee/Cons.
(3) Submit proposed by-laws to Municipal Council and complete review process.	Year 3	\$3,000	Committee/Cons.
(4) Distribute by-laws online, in educational materials, and post pertinent information on signs in appropriate locations.	Year 4	See Initiative 3.	Committee/Cons.
5. Acquisition of Land \$3,500 +			
(1) Identify/rank vulnerability of properties in the protection area to potential contamination.	Year 1	\$2,000	Committee/Cons.
(2) Determine financial resources available for acquisition of land in the protection area.	Year 2/ongoing	\$1,500	Committee/Cons.
(3) If lands become available, are poorly managed, and/or funds are available, proceed to acquire land.	Ongoing	Varies with property	Committee/Cons.
6. Nova Scotia Power Infrastructure \$900 +			
(1) Inform NSPI of revised protection area & restrictions	Year 1	\$200	Committee/Cons.



to PCB-containing transformers and pesticide application.			
(2) Request special inspection of NSPI power infrastructure in protection area for PCBs and pole treatment, and discuss infrastructure upgrades to protect water supply.	Year 1	\$200	Committee/Cons.
(3) Maintain relationship with NSPI to monitor inventory status within and promote awareness of the SWPA.	Ongoing	\$500/annually	Committee/Cons.

ACWU = Annapolis County Water Utility, Cons. = Consultant

5.1 Re-Designation of the Lake Cady Protected Water Area

This initiative is to implement further protection / management options for the Lake Cady water supply area that the Municipal Planning Strategy and Land Use By-law cannot or do not regulate. Operationally, Municipal Council will apply to the Minister of the Department of Environment to repeal the existing Protected Water Area designation and request a new Lake Cady Protection Water Area designation that corresponds with the Source Water Protection Area shown on Figure 2. The initiative would also involve drafting regulations to reduce the incidence and impacts of potential contamination from commercial fuel spills, the recreational use of gasoline-powered vehicles and vessels, activities that increase sedimentation, the application of herbicides and pesticides, and residential fuel storage. The Hebb, Milipsigate and Minamkeak Lake Watershed Protected Water Area Regulations are examples that preclude or regulate the use of motorized vehicles, agriculture, pest-control products, and any activities that might cause erosion.

- (1) Notify stakeholders, including land owners, commercial fuel suppliers, logging companies, NSE, NSPI, NSTIR, and other persons doing business in the Lake Cady Source Water Protection Area that a modification of the current Protected Water Area is being proposed. Anticipated cost of \$2,000 for the consultant to complete these tasks.
- (2) Cooperate with NSE to determine acceptable formal boundary submission. Anticipated cost of \$3,500 for the consultant to complete, in conjunction with the Committee.
- (3) Based upon the BMPs presented in Table 5.2, and involving stakeholders, draft proposed regulations that would reduce the incidence of commercial and recreational fuel spills, the introduction of sediment and herbicides/pesticides to surface water bodies, and the leakage of fuel from residential fuel storage systems. The regulations would also require reporting any discharges of the contaminants of concern to the Municipality. Anticipated cost of \$5,000 for the consultant to complete.
- (4) Send the revised delineation, proposed regulations, and summary of the public consultation to NSE for review and comment. Anticipated cost of \$3,000 for the consultant to complete, in conjunction with the Committee.
- (5) Cooperate with NSE requests related to advancing the proposed changes toward designation. Anticipated cost of \$2,000 for the consultant to complete, in conjunction with the Committee.
- (6) After the designation formally takes effect, have it recorded in the Registry of Deeds and published in local newspapers. Anticipated cost of \$400 for newspaper/record fees and consultant time for submittal.
- (7) Post signs to clearly identify the boundary of the Protected Water Area and indicate that regulations are in effect for the designated drinking water supply. Anticipated cost of \$1,500 for signs, with installation coordinated by the Council.

5.2 Contingency Planning

This initiative is to review and modify current contingency planning to better mitigate incidents involving commercial fuel spills, residential fuel spills, and forest fires, and increases in raw-water chloride concentrations, resulting from road salting.

- (1) Review current municipal contingency planning, making certain that adequate provisions for ensuring the supply of potable water in the case of temporary reduction of water quality in the source area. Review current incident-response procedures in the Municipality and making use of the BMPs in Table 5.2 and other sources, draft additional procedures for source water protection during and following commercial fuel spills and forest fires. Anticipated cost of \$1,000 for the consultant to complete, in conjunction with the Utility.
- (2) Identify and contact commercial oil providers operating within the Source Water Protection Area and determine whether their delivery staff is aware that they are operating in a Protected Water Area, whether they have received training in spill prevention and mitigation and their vehicles are equipped with spill kits. Provide information on the Municipality's spill response planning and contact information and any pertinent instructions. Costs associated with the Education and Stewardship Initiative.
- (3) Identify and contact likely responding municipalities and the province in the case of a forest fire. Ensure that they know the boundaries of the Source Water Protection Area and are aware that certain fire suppressant chemicals may damage the potable water source for Cornwallis Park. Anticipated cost of \$1,000 for the consultant to complete, in conjunction with the Utility.
- (4) Make certain that education/stewardship materials related to residential fuel storage includes the importance of immediately reporting any overfills, spills, apparent loss of product, or the observation of sheen or floating product the surface water bodies within the Source Water Protection Area. Costs associated with the Education and Stewardship Initiative.
- (5) Prepare descriptive statistics for raw-water chloride concentrations to establish a normal seasonal variation baseline and set a conservatively low action threshold. Monitor chloride concentrations and prepare to implement non-chloride alternative de-icers, until levels are normal. Anticipated cost of \$1,500 for the consultant to complete, in conjunction with the Utility.

5.3 Education and Stewardship

This initiative is to develop educational programs for the residents, land owners, and users of the Lake Cady Source Water Protection Area, that will provide information on the importance of protecting source waters, create a sense of stewardship, educate them on the BMPs which should be used to reduce the risk of contamination, and inform them of the laws or regulations governing activities in the SWPP.

- (1) Identify and contact the commercial fuel vendors who service residents of the Source Water Protection Area. Provide them with information about proposed regulations and by-laws intended to reduce the possibility of commercial fuel spills and recommend pertinent BMPs from Table 5.2. Repeat this outreach regularly. Anticipated cost of \$2,500 for the consultant to complete, in conjunction with the Committee.
- (2) Identify any grants or government resources that may be available for teaching or encouraging BMPs, such as grants for upgrading residential fuel tanks or installing corrosion protection systems. Anticipated cost of \$1,000 for the consultant to complete, in conjunction with the Committee.
- (3) Determine the types of media that would be most effective for disseminating information about each potential contamination source and for each target audience. These might include seminars, broadcasted messages, social media, signs, telemarketing, flyers, dramatizations, presenting educational films, materials sent via mail, etc. Anticipated cost of \$1,000 for the consultant to complete the assessment and prepare the recommendation, in conjunction with the Committee.
- (4) Compile/develop a battery of educational materials for raising awareness of the risks of contamination and teaching (a) BMPs for the proper use of herbicides and pesticides, the prevention of forest fires and recreation-related fuel spills, the proper operation and maintenance of residential fuel-storage tanks and septic systems; (b) describing and relating enforcement timelines for any new regulations and by-laws changes; and (c) encouraging the stewardship role of residents, land owners, and others that make use of the resources within the Source Water Protection Area. Anticipated cost of \$5,000 for the consultant to complete, in conjunction with the Committee.
- (5) Post, broadcast, mail, and make use of social media to deliver educational materials to all property owners, residents, and other entities that do business within the Lake Cady Source Water Protection Area. Anticipated cost of \$10,000 for the consultant to complete, in conjunction with the Committee.

5.4 Review of Existing Lake Cady Water Supply Area MPS and LUB

This initiative is to modify the existing Lake Cady Water Supply Land Use By-law to better protect the Source Water Protection Area. The by-law would require the municipality to: identify critical areas with respect to residential fuel storage and specify restrictions and mitigation measures; and supporting, where possible, other initiatives intended to regulate the use of herbicides and pesticides and diminish the possibility of recreation-related fuel spills, within the Source Water Protection Area.

- (1) Gather recommended buffer distance research for various slopes and soil types to identify areas that are most critical from the perspective of hydrocarbon spills and of erosion and sediment transport. Review provincial laws with regard to the limits of municipal by-laws to regulate activities that might threaten water quality. Compile information and propose modifications to existing by-law. Anticipated cost \$3,000.
- (2) Formalize modifications and additions into the revised water supply protection by-law for the Source Water Protection Area. Anticipated cost of \$2,500 for the consultant to complete, in conjunction with the Committee.
- (3) Submit suggested changes to the Municipal Council, and complete the formal process required to modify existing. Revise the proposed by-laws as needed, and complete final amendment. Anticipated cost of \$3,000 for consultant to complete, in conjunction with the Committee.
- (4) Post revised by-law online, include in educational materials for residents / landowners, and post signs summarizing restrictions at boat ramps and other appropriate locations within the protected area. Costs associated with the Education and Stewardship Initiative.

5.5 Acquisition of Land

This initiative is proposed to acquire the properties that are most critical for the protection of the resource within the Lake Cady Source Water Protection Area, to allow the municipality to maintain direct control of their use. The Committee considers the acquisition of land to be the most effective management option for preventing commercial fuel spills and the introduction of herbicide/pesticide contamination into surface water, but it is expensive and should be reserved for the most vulnerable areas.

- (1) Identify vulnerable land in the Lake Cady Source Water Protection Area, such as buffer zones surrounding water bodies, intersection of roads and water bodies, tight curves on inclines, and other critical land. Rank the identified land by level of vulnerability, taking into account the effectiveness of other options for managing potential contamination resulting from herbicides / pesticides and commercial fuel spills. Anticipated cost of \$2,000 for the consultant to complete, in conjunction with the Committee.

- (2) Determine financial resources available for the acquisition of land, including yearly allotted amounts or one-time allotments. If possible, modify existing budgets to include allotments for land purchases. Anticipated cost of \$1,500 for the consultant to complete, in conjunction with the Committee.
- (3) Maintain information on the owners of the identified vulnerable land and any posting of these parcels for sale or changes in ownership, so that if other management options are determined insufficient, or financial resources become available, the process of acquiring these lands may begin promptly. Costs vary with the price of land.

5.6 Nova Scotia Power Infrastructure

This initiative is to establish a relationship with NSPI to determine: their management practices within the Source Water Protection Area, the types of pole treatment they employ and if the existing five pole-top transformers contain PCBs.

- (1) Contact NSPI and relate the revised delineation of the Lake Cady Source Water Protection Area. Discuss replacement plans/schedule should existing electrical transformers contain PCBs, discuss pole treatments that have the potential to leach into the drinking water supply, and ask for restriction on the application of herbicides. Anticipated cost of \$200 for the consultant to complete.
- (2) Formally request a special inspection of the NSPI power lines located in the Source Water Protection Area, to determine whether the five pole-top transformers contain PCBs, and what chemically-treated poles are located in the watershed. Discuss schedules for upgrades/replacement if needed, especially for infrastructure in close proximity to water bodies. Anticipated cost of \$200 for the consultant to complete.

NOTE: NSPI has a policy of inspecting feeder lines every two years. NSPI appeared to have been performing an inspection in August 2013. If this is correct, the next inventory may not be until August 2015. Consequently, a special inspection is recommended, primarily to let NSPI know that additional information (that may not normally be the subject of an inspection) is being requested.

- (3) Follow up with NSPI (optimally establish an official liaison officer) to ascertain any changes in procedure or policy regarding the management of their inventory in the Source Water Protection Area. Anticipated annual cost of \$500 for the consultant to complete, in conjunction with the Committee.

6.0 Monitoring Program

6.1 Purpose

The purpose of the Source Water Protection Monitoring Program is:

- to document and evaluate changes in the Source Water Protection Area
- to determine if the Source Water Protection Plan is effectively protecting water quality
- to identify necessary changes to improve water quality

The Annapolis County Water Utility is required to monitor the Water Supply System, as a condition of the approval to operate issued by Nova Scotia Environment.

6.2 Monitoring Parameters and Locations

The sampling parameters, listed in Table 6.1, were selected based on the identified potential contaminants, and include both direct and indirect indicators of contamination.

Table 6.1 Source Water Monitoring Program Sampling Parameters and Locations

PARAMETER	LOCATION		
	Outlet of Lake Cady (low-density residential area)†	Outlets of Potter Lake, Shell Camp Lake, and Mud Lake (undeveloped areas)†	Raw water before treatment
Turbidity	Quarterly	Semi-annual	Daily*
Conductivity	Quarterly	Annual	Annual**
pH	Quarterly	Semi-annual	Daily*
Total Coliform and E. coli	Semi-annual	Semi-annual	Weekly*
Nitrate	Semi-annual	Semi-annual	Annual**
Chloride	Semi-annual	Semi-annual	Semi-annual
TDS	Annual	Annual	Annual**
Pesticides	Annual	Annual	Annual
Polychlorinated Biphenyls (PCBs)	Annual	Annual	Annual
Volatile Organic Compounds (VOCs)	Annual	NA	Annual
Total Petroleum Hydrocarbons	Annual	NA	Annual

*requirement of the utility's approval to operate

**requirement of the Guidelines for Monitoring Public Drinking Water Supplies (GMPDWS)

† the sampling interval shown is for the second and following years. Several sampling events are required (quarterly), targeting a wide range of stream flow conditions.

The utility's existing raw water sampling program includes some of these parameters, including those required by the Guidelines for Monitoring Public Drinking Water Supplies (GMPDWS). Raw or untreated water samples, taken, as part of the utility's regular testing program, may be considered a composite of the water being produced by the Source Water Protection Area. Sources of contamination at one point in the Source Water Protection Area can affect the concentrations of contaminant downstream of that point, but unless the source is very close to the head pond, the concentration will be diluted by one or more streams, from other parts of the watershed, before entering the transmission main. A reduced set of monitoring parameters is suggested for areas that are undeveloped, and is subject to change, if development occurs. In addition to the sampling program, the water utility is to conduct annual inspections of the Source Water Protection Area, in the form of a walkthrough or drive-by, to identify any obvious changes in the protection area and early warning signs for potential water quality problems.

6.3 Sampling Procedures

Samples are to be processed by a laboratory at detection limits that do not exceed the maximum acceptable concentrations (MAC) or interim maximum acceptable concentration (IMAC) for substances listed in the most recent version of the Guidelines for Canadian Drinking Water Quality. The QA/QC sample results should be evaluated, and if QA/QC objectives have not been met, additional sampling should be performed.

6.4 Monitoring Schedule

According to the NSE Guidelines for developing a monitoring program as part of a Source Water Protection Plan, surface water sampling should be conducted at various times of the year "during periods of varying hydrological conditions (e.g. periods of low flow, after large rainfall events, during spring melt, etc.)."

This may be necessary in order to obtain an adequate baseline for all seasons and drought conditions, but this would be an expensive study, especially if several sampling locations and many water-quality parameters are involved. Further, it may be that not all hydrologic conditions will appear in any given year. However, we expect that a number of parameters will vary together and by comparing concentration ratios, it may be that biases due to hydrologic fluctuations can be reduced. That is, if the concentration of one parameter normally occurs in a certain proportion with respect to another, the ratio between the concentrations of the two parameters may not change as much as the concentrations at different stream flows. Consequently, a sudden deviation in the concentration ratio may be an indication of a sudden increase in the rate of introduction of one of the parameters. In addition, it might be most efficient to have several sampling events in the first year, trying to sample during as wide a variety of stream flow conditions as possible.

Thereafter, sampling one or two times a year (see Table 6.1), and checking to see whether observed relationships between parameters can be confirmed over time, should establish a serviceable baseline. After about three years, the baseline should be sufficiently well established that we would be able to detect long-term changes in water quality. If increasing trends are observed in the concentrations of any monitored contaminant the source water protection plan should be examined to determine whether it is working as planned and, if not, how it might be corrected. Changes in the protection area may warrant increased sampling frequency. For example, an increase in commercial forestry operations.

6.5 Contingency Monitoring

A measured increase in the concentration of a given contaminant may or may not have a known cause in the Source Water Protection Area. It may have resulted from a known incident, in which case, we may already know enough about it that we can predict how its concentration in the raw water will vary over time and how long it will take to flush it out of the system. Alternatively, the source could be an unknown (or unreported) spill or a non-point discharge. If that is the case, some forensic sampling may be needed in order to determine the size of the discharge and the pathway it is following to the head pond. In order to facilitate this, periodic monitoring of the various parts of the Source Water Protection Area is needed. This will allow the creation of a baseline for each contaminant in each section of the watershed. The most convenient sampling locations would be the outfalls of lakes or the nearest downstream road crossings. The baseline will represent the normal local range of variation for each contaminant of concern. In this way, we can be in a better position to make a timely response when we detect an excursion, after the fact.

Additional sampling and inspection should be completed, if a known contaminant has entered the system. If one or more of the identified contaminants are detected at elevated concentrations in the raw water supply, additional sampling should be completed in the Source Water Protection Area to identify the contaminant source. Sustained drought conditions may cause risk of contamination to increase, and therefore warrant more frequent sampling.

6.6 Monitoring Records and Reporting

The utility will maintain records of ongoing monitoring, analyze results, document trends and changes in water quality, and report findings to the Source Water Protection Advisory Committee and Nova Scotia Environment on an annual basis.