BRAS D'OR LAKES DEVELOPMENT STANDARDS

Final Report

EDM
ENVIRONMENTAL DESIGN AND MANAGEMENT LIMITED

Prepared for:
Bras d'Or Lakes Collaborative Environmental Planning Initiative

Prepared by:
EDM • Environmental Design and Management Limited

March 2008

BRAS D'OR LAKES DEVELOPMENT STANDARDS
Final Report

March 2008

Prepared for:
Bras d'Or Lakes Collaborative Environmental Planning Initiative

Prepared by:
EDM • Environmental Design and Management Ltd.

EDM
ENVIRONMENTAL DESIGN
AND MANAGEMENT LIMITED

EXECUTIVE SUMMARY

Introduction

The Bras d'Or Lakes Collaborative Environmental Planning Initiative (CEPI) is developing a watershed management plan for the Bras d'Or Lakes. CEPI is an alliance of federal, provincial, municipal, and First Nations governments and other interests. As part of this watershed plan, they are seeking to create guidelines for comprehensive development standards.

Background Research

The Bras d'Or Lakes are a unique series of estuarine bodies linked together to form an irreplaceable coastal ecosystem in the middle of Cape Breton Island. The unique combination of natural and cultural assets in the watershed has won world renown. *National Geographic Traveler* magazine has rated Cape Breton Island its Number 2 worldwide destination for sustainable tourism, along with New Zealand's South Island and Torres del Paine in Chile, following the Norwegian fjords.

Although water quality in the Bras d'Or Lakes is generally good, a study by CEPI/Unama'ki found that nearly 55 per cent of subwatersheds feeding the lakes have recently experienced some measure of decline in water quality. Several key factors influence the natural state of the water, such as the restricted exchange with the ocean, the wind, and the freshwater input sources.

Chemical composition and sediment quality throughout the lakes are very good with the exception of Whycocomagh Bay, which has anoxic water and sediments at low depths. PCB and PAH concentrations are low in all areas of the Bras d'Or Lakes, as are heavy metal concentrations in biota and sediments. Higher levels of zinc were found in Denys Basin and higher levels of lead were found just off Eskasoni. The potential and future effects of sedimentation in the various parts of the Bras d'Or Lakes are difficult to measure. Denys Basin and Whycocomagh Bay are probably more sensitive to sedimentation effects because of the large rivers that drain into them and the low flushing rates characteristic of both water bodies.

As with many areas of public concern in Canada, responsibility for the management of water resources is divided between the Federal and Provincial governments. In addition, provinces also delegate responsibilities to municipal governments within their boundaries. In particular, provinces normally delegate substantial responsibilities for land use planning and regulation to local government. Municipalities are also normally responsible for a variety of services that may impact, influence, or improve water quality, such as sewage collection and disposal, water supply, and stormwater management.

In Nova Scotia, the framework for municipal planning is set out in Part VIII of the *Municipal Government Act*, a comprehensive act that covers all aspects of municipal operations and responsibilities. Under the Act, which is commonly referred to as the MGA, municipal plans are officially called "municipal planning strategies" (MPS). The normal focus of a MPS is to declare the intentions of the specific municipality with respect to regulation of land use through a "land use bylaw" (LUB) and zoning map.

Watershed Protection

The focus of study for this assignment was non-structural BMPs, which are institutional and regulatory measures that do not generally involve construction of infrastructure. Such BMPs include municipal planning controls, strategic planning and institutional controls, pollution prevention procedures, education and participation programs, and regulatory controls. Typical non-structural BMPs include watercourse buffers, animal and pesticide controls, and varied public education programs. These measures are intended to limit contaminants in runoff and reduce the prospect of contaminants entering sensitive receiving waters.

Our investigations dealt with BMPs in four major categories: Suitability of Lands for Development, Watercourse Buffers, Wastewater Management Districts, and Low Impact Design.

GIS Assessment and Visualization

To assess the influence of potential best practice measures appropriate for the Bras d'Or Watershed, EDM assembled a customized GIS. Consideration of physical and land development characteristics within the watershed provided a clear understanding of the context in which best practices may be applied locally. These map layers allowed us to determine potential challenges and facilitating factors associated with implementation of leading best practices in the Bras d'Or. These GIS analyses took into account local soils, topography, forest cover, watershed boundaries, anticipated climate change impacts, and known water quality issues.

EDM applied GIS models employing suitability analysis methods as described in the preceding section to assess Suitability of Lands for Development, Watercourse Buffers, and Wastewater Management Districts. A standard Stormwater Management Model (SWMM) was applied to evaluate the impact of reducing impervious surfaces and implementing mitigation measures for remaining impervious surfaces. The model assessed the subsequent changes in runoff generated when comparing conventional development versus Low Impact Development strategies for reducing impervious surfaces and increasing infiltration.

Development Standards

Recommendations following from our analyses identify objectives, approaches (i.e., leading BMPs), and recommendations related to these categories as follows:

- *Objectives*: The stated objectives of responsible development practices.

- *Best Management Practices*: The best management practices outlined in this document provide guidance on how those objectives might be achieved. These BMPs are based on scientific research and are methods by which we feel local governments, developers, and other stakeholders can best achieve the desired objectives.

- *Recommendations*: Recommendations for action are provided with suggested policies and regulations for their implementation.

The key components of these recommendations are further summarized in the Bras D'Or Lakes Development Standards Handbook contained in **Appendix C**, which is intended to be separated from this report for use by planners to implement these measures.

Leading water resource BMPs are presented in relation to the four broad categories of investigation used throughout the study. Additional measures address approaches that can support and supplement these leading recommendations. They include amended and additional bylaws, public education, enhanced municipal practice, and continued intergovernmental cooperation. It is also important to recognize that CEPI has undertaken this study as a key step toward the creation of an Integrated Watershed Management Plan that will comprehensively address water resource protection objectives throughout the Bras d'Or Lakes Watershed.

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 PROJECT BACKGROUND 1
1.2 PROJECT PROCESS 3
1.3 REPORT ORGANIZATION 4

2.0 BACKGROUND RESEARCH 6
2.1 BRAS D'OR LAKE VALUES 6
2.2 WATERSHED DESCRIPTION 7
2.3 DEVELOPMENT IMPACTS ON WATERSHEDS 10
2.4 IDENTIFIED WATER RESOURCE ISSUES IN THE BRAS D'OR 12
2.5 MUNICIPAL MEASURES FOR WATER RESOURCE PROTECTION 18
2.5.1 Planning for Water in Nova Scotia 19
2.5.2 Planning for Water in the Bras d'Or Lakes 24

3.0 WATERSHED PROTECTION 28
3.1 ENVIRONMENTAL OBJECTIVES 28
3.2 BEST MANAGEMENT PRACTICES 29
3.2.1 Suitability of Lands for Development 31
3.2.2 Watercourse Buffers 32
3.2.3 Wastewater Management Districts 34
3.2.4 Low Impact Development 34
3.3 MUNICIPAL IMPLEMENTATION OF BMPS 39
3.4 STRATEGIC INTERVIEWING PROCESS 41
3.4.1 Critical BMPs for Water Resources 42
3.4.2 Structural v. Non-structural BMPs 43
3.4.3 Burden of BMP Implementation 43
3.4.4 Implementation at the Local Government Level 44
3.4.5 Cost Savings 46
3.4.6 Monitoring 46
3.4.7 Key Changes to Water Resource BMPs 48
3.4.8 Functional Responsibility 49

4.0 GIS ASSESSMENT AND VISUALIZATION 51
4.1 GIS DEVELOPMENT AND ANALYSIS 51
4.2 SUITABILITY ANALYSIS 54
4.2.1 Suitability of Lands for Development 55
4.2.2 Watercourse Buffers 58
4.2.3 Wastewater Management Districts 63
4.2.4 Low Impact Design 65

4.3 FUTURE STUDIES 66

5.0 DEVELOPMENT STANDARDS 68

5.1 WATER RESOURCE BMPS 68
5.1.1 Suitability of Lands for Development 68
5.1.2 Watercourse Buffers 71
5.1.3 Wastewater Management Districts 78
5.1.4 Low Impact Design 81
5.2 ADDITIONAL MEASURES 88
5.2.1 Amended and Additional Bylaws 89
5.2.2 Public Education 91
5.2.3 Municipal Practice 92
5.2.4 Intergovernmental Cooperation 93
5.3 INTEGRATED WATERSHED MANAGEMENT PLAN 94

Tables and Figures:

Table 1.1: Benefits of Environmental Planning to Local Government and Developers ... 3
Figure 2.1: Overview of the Bras d'Or Lakes Showing Twelve Subwatersheds 7
Table 2.1: Common Land Use and Development Impacts on Water Resources 12
Table 2.2: Identified Bras d'Or Environmental Issues 14
Table 2.3: Atlantic Canada Climate Change Adaptation Studies 16
Table 3.1: Examples of Structural and Non-Structural BMPs 31
Table 3.2: Recommended Widths for Vegetative Buffers in Relation to Buffer Function 33
Table 3.3: Low Impact Development Practices 35
Figure 3.1: Development Impacts on Infiltration 36
Figure 3.2: Low Impact Development Site Design Example 37
Table 3.4: Land Use Control Examples for Water Resource Protection 40
Table 4.1: GIS Map Layers 52
Figure 4.1: Sample Suitability Analysis for Water Quality Protection 53
Table 4.2: Suitability Analysis Model Characteristics 54
Figure 4.2: Most Suitable Lands for Residential Development, Bras d'Or Lakes Watershed 56
Figure 4.3: Percentage of Watershed Lands by Residential Suitability Category by County 57
Figure 4.4: Percentage of Watershed Land by Sedimentation Risk Category by County 59
Figure 4.5: Percentage of Watershed Lands by County Impacted by Climate Change .. 60
Figure 4.6: Percentage of County Lands (Watershed Portion) Covered by Buffer and High Risk Sedimentation Zones 61

Figure 4.7: Watercourse Buffers and Areas Most Likely to Contribute to Sedimentation 62
Figure 4.8: Watercourse Buffers with Storm Surge and Sea Level Rise Impacts..... 62
Figure 4.9: Percentage of Sea Level Rise +Strom Surge Outside 20 and 75-metre Buffer Zones 63
Figure 4.10: Percentage of Watershed Lands by County by Probability of Onsite Failure 64
Figure 4.11: Estimated Run-off, 3-hour Storm, Alternative Development Approaches.. 66
Table 5.1: Use of Indicators Throughout the Watershed Planning and Implementation Process 96

APPENDIX A: INTERVIEW OUTLINE

APPENDIX B: GIS ANALYSIS MAPS

APPENDIX C: BRAS D'OR LAKES DEVELOPMENT STANDARDS HANDBOOK

1.0 INTRODUCTION

> *I have traveled the globe. I have seen the Canadian and American Rockies, the Andes and the Alps and the highlands of Scotland, but for simple beauty, Cape Breton outrivals them all.*
>
> – Alexander Graham Bell

1.1 PROJECT BACKGROUND

The Bras d'Or Lakes system is renowned worldwide for the pristine beauty that Alexander Graham Bell lauded. While available water quality data indicate that the lake remains generally healthy, its protection is key to maintaining the tourism sector and the quality of life on Cape Breton Island.

In light of these important issues, the Bras d'Or Lakes Collaborative Environmental Planning Initiative (CEPI) is developing a watershed management plan for the Bras d'Or Lakes. CEPI is an alliance of federal, provincial, municipal, and First Nations governments and other interests. As part of this watershed plan, they are seeking to create guidelines for comprehensive development standards.

This effort should assist and coordinate the actions of municipal governments and related agencies to preserve the watershed. The required standards should be sensitive to the local context, sufficiently flexible to address variations in the priorities and capabilities of the implementing organizations, and practical and manageable on a day-to-day basis. Recommended standards and practices are primarily for application by municipal government, particularly through land use planning. Planning mechanisms are particularly favoured because they can often be implemented at relatively modest cost. Many planning measures, as discussed below, can be very effective while raising public awareness of the importance of water resource protection.

In this respect, the Development Standards Handbook recommended through this study is based on best management practices (BMPs) identified and evaluated by the consulting team in the context of the Bras d'Or Lakes Watershed. Additional consideration has been given to the structure created for planning and environmental protection practice in Nova Scotia under the *Municipal Government Act* and other legislation. **Chapter 5** provides recommendations for the Bras d'Or Lakes Watershed based on identified best practices. Recommendations are categorized in key groups described and analyzed in preceding chapters, and supplemented by additional more general recommendations. This structure has been carried into the Handbook.

Environmental planning that uses BMPs can require additional time and money – but the investment will pay for itself in a better quality of life, savings in

infrastructure and liability costs, and returns from increased property values. It provides many benefits to local governments, developers, and the community as a whole. **Table 1.1** details key benefits to local governments and developers that incorporate development BMPs into their planning.[1]

Benefit	Description
BENEFITS FOR LOCAL GOVERNMENTS	
Free Ecosystem Services	**Natural ecosystems** provide a range of free 'ecosystem services' (e.g., water and air purification, management of erosion and sediment runoff, and pest control) that would otherwise have to be paid for by local governments and taxpayers.
Community Improvement	Enhanced property values associated with **green space retention** can contribute to greater property tax revenues and therefore the ability to provide enhanced municipal services. Community green spaces are an important part of the viewscapes that make a community attractive to tourists, businesses, and potential residents.
New Businesses	Businesses are attracted by communities that offer a high quality of life for their employees. **Green space**, environmental protection, and **recreational opportunities** are often an important part of that choice. Eco-tourism is a rapidly growing industry for which the protection of the natural environment is vital.
Lower Costs, Higher Revenues	**Densification of one part of a site** to enable protection of another part results in proportionately lower costs for roads and servicing. This means lower long-term costs of maintaining these roads and services. There are savings in mowing and maintenance costs when lands are managed as a natural buffer rather than manicured lawn. The net property tax benefit of open space is greater than for developed lands. Agricultural land and open space pays significantly more in taxes than it requires in servicing from local governments. Although developed land contributes more in property taxes, there are higher servicing costs for such things as roads, libraries, and schools.
Avoidance of Future Costs	**Good planning** prevents development on hazard lands and other sites that are unsuitable for development. This may prevent expensive and time-consuming lawsuits if problems arise. There can be substantial costs of NOT protecting the environment. For example, increased impervious services and the removal of riparian buffer vegetation can result in significant flood damage.
Environmental Planning: A Tool for Decision Making	Assists local and senior governments with park **acquisition** decisions. Assists with **siting** developments, including transportation and utility corridors, in places with least impact on sensitive habitats. Helps to define zoning, bylaws, and the configuration of future urban growth areas and urban containment boundaries. Identifies the location of greenways and wildlife movement corridors, especially where they are not associated with stream corridors. Connectivity is important in maintaining genetic diversity (as it allows interbreeding between different populations) and in maintaining species diversity (as it allows the species to move between habitats).

[1] Adapted from *Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia, BC Ministry of Environment,* March 2006.

Benefit	Description
BENEFITS FOR THE DEVELOPMENT COMMUNITY	
Greater Certainty	Developers benefit from greater certainty if they know in advance that part of a development site has environmentally valuable resources. They can then account for this in site **development plans** and avoid wasted time and expense in disputes over proposed development of this land. Developers can identify unconstrained or lightly constrained development areas, so that phased developments have the potential to start and recover monies on areas with lower overhead first. Developers can use the community-level environmental information to help direct the site-level inventory.
Faster Approvals	Where new developments fit into the **community environmental plan**, the development is likely to move more quickly through the approvals process and encounter less community resistance. This translates into time and cost savings for the developer.
Reduced Costs	Per unit development costs are lower for higher density developments. If housing units are **clustered** on one portion of a site in order to protect environmentally valuable resources, there are cost savings because there is less area to be cleared and less infrastructure (e.g., roads and sewers). Cluster development can reduce the capital cost of subdivision development, primarily by reducing the length of infrastructure needed to service the development.
Increased Sale Values	Property values are higher next to **green space**. Trees and landscaping increase property values by 5–20% (International Society of Arboriculture 2003). Lots with remaining natural habitat (other than a cleared area for the house site and access) often sell faster and for higher prices.
Increased Marketability	The ability to incorporate special environmental features into the community plans provides unique neighbourhoods based on the local features. Planting trees increases the marketability of new developments.

Table 1.1: Benefits of Environmental Planning to Local Government and Developers

To facilitate implementation, model text is presented in a "how to" format outlining considerations pertinent to the Bras d'Or Lakes. Where beneficial, reference has also been made to the potential application of supporting tools and approaches such as geographic information systems (GIS), public consultation, a phased implementation, and pilot studies.

1.2 PROJECT PROCESS

In our proposal for this assignment, EDM developed a three-phase Project Plan to address the Scope of Work specified in the Request for Proposals. The three phases were identified as follows:

- PHASE I – Best Practices Review
- PHASE II – Assessment and Visualization
- PHASE III – Setting the Direction

In the first project phase, the consulting team initiated the project through a meeting in Sydney with representatives of CEPI and CBRM. Subsequently, consulting team members reviewed relevant background material and 'best practices' literature to

determine leading standards and guidelines that may be applicable within the Bras d'Or Lakes Watershed. We have also reviewed relevant legislation, physical and socio-economic characteristics, and studies applicable to the watershed to ensure a clear understanding of the context in which Cape Breton municipalities may apply best practices.

During Phase II, EDM consolidated information in a customized GIS database, and undertook targeted analyses to determine potential challenges and facilitating factors associated with implementation of best practices identified at the conclusion of this report. We conducted several targeted interviews with agencies involved in the development, implementation, and monitoring of BMPs within environments similar to the Bras d'Or Watershed.

Phase III made use of the research completed in Phase I and the watershed analyses completed in Phase II as the basis for creating policies, standards, and guidelines to fit within the legislative and physical context of communities in the Bras d'Or Lakes Watershed. These so-called development standards are drafted for incorporation in existing or new planning documents but with the expectation that they will form the foundation and a primary component of the content of an Integrated Watershed Management Plan for the Bras d'Or. They have also been summarized in a "Handbook" incorporated as an appendix to this document but also intended to stand alone as a guide to implementation for the municipalities and other stakeholders involved in protection of the Bras d'Or Watershed.

1.3 REPORT ORGANIZATION

Following this introductory chapter, this report is divided into four chapters. The first following chapter (**Chapter 2**) summarizes primary and secondary research completed to gain a comprehensive understanding of the current land use context within the Bras d'Or Lakes Watershed and the health of the Bras d'Or Lakes. It also outlines typical municipal measures for water resource protection.

Chapter 3 provides an overview of BMPs related to water resources across Canada, particularly those developed from a watershed perspective. It discusses how low impact development strategies and principles contribute to both natural resource protection and cost savings. This chapter discusses the many ways that municipalities may implement BMPs through such measures as buffer zones, subdivision specifications, and appropriate land use zoning. Several contacts from regulatory agencies across Canada and the United States were interviewed regarding the effectiveness of implemented BMPs. Results of these interviews are also provided in this chapter. The interview outline is provided in **Appendix A**.

We completed several targeted GIS analyses to determine potential challenges and facilitating factors associated with implementation of specified best practices within the Bras d'Or Lakes Watershed. **Chapter 4** discusses these analyses in detail, along with their results. **Appendix B** depicts maps related to each completed GIS analysis.

Chapter 5 outlines specific initiatives to protect the Bras d'Or Lakes Watershed. The chapter provides recommendations for management of water resources, including recommended policies for implementation of initiatives directly related to our GIS analyses as well as additional initiatives that are not directly related to land use regulation but support the objectives of water resource protection. Specific policy changes and related implementation members are summarized in the Bras D'or Lakes Development Standards Handbook, which is incorporated as **Appendix C**.

2.0 BACKGROUND RESEARCH

2.1 BRAS D'OR LAKE VALUES

The Bras d'Or Lakes are a unique series of estuarine bodies linked together to form an irreplaceable coastal ecosystem in the middle of Cape Breton Island. The Bras d'Or Lakes formed from 6,350 to 10,000 years ago, when rising sea levels crossed the land boundary and connected the small meltwater lake in the glacially formed basin to the ocean. The natural history of the Bras d'Or Lakes is elegantly summarized in a recent study:

> The waterscape of the Bras d'Or Lakes is unique to say the least. It was conceived on both sides of an ancient ocean, forged in the tropics within a supercontinent; all the while being weathered by the aggressive alliance of fire, ice and water for some 600 million years. This sculptured a rugged waterscape combining lakes, canyons, river valleys, foothills and plains that now form a series of four islands surrounding an inland sea, in turn surrounded by the North Atlantic and Gulf of St. Lawrence.[2]

Today, two narrow natural channels and a man-made canal connect the nearly 1,100-square kilometre lake to the Atlantic Ocean. The two channels allow freshwater and saltwater to merge continuously within the waterbody to produce a moderate salinity and two tier patterns of water currents and productivity.[3] The lake is generally sheltered from storm and wave activity of the open ocean, although significant wave energy is commonly generated by winds blowing across the lake.

The Bras d'Or Lakes provide many natural values. The shoreline of the lake system constitutes approximately 18 per cent of the total shoreline of Nova Scotia. The lakes are important for both terrestrial and aquatic/marine wildlife, and the lengthy coastline provides ample areas for nesting and foraging. Estuaries, like the Bras d'Or Lakes, are some of the most productive marine environments because the freshwater and seawater mixing brings nutrients to the surface, contributing to increased algal productivity. Estuaries frequently have warmer water than nearby coastal areas, and are used as nursery areas by many marine species.

The Bras d'Or Lakes Watershed also has many valued socio-economic features including:

---

[2] ADI Limited, *Bras d'Or Lakes State of the Environment Report*, Fresh Water Resources, Report (24) 5810-001.1, 2006.

[3] See: Great Canadian Lakes, "Bras d'Or Lake: A Unique Inland Sea – Freshwater Lake or Saltwater Sea," http://www.greatcanadianlakes.com/nova_scotia/brasdor/species-home.html, accessed February 26, 2008.

- Commercial value for fish and shellfish, aquaculture, marinas,
- Permitting and harvesting fees for plants and animals (for furs, food, and medicines);
- Cultural significance, especially for the five neighbouring First Nations;
- Recreation, education, aesthetic values; and
- Green infrastructure values such as flood protection, water purification, groundwater recharge, shoreline stabilization, storm surge protection, atmospheric gas regulation (carbon sink).

The combination of natural and cultural assets has won world renown. *National Geographic Traveler* magazine has rated Cape Breton Island its Number 2 worldwide destination for sustainable tourism, along with New Zealand's South Island and Torres del Paine in Chile, following the Norwegian fjords.[4] The magazine has also rated Cape Breton among the world's top ten islands and Cape Breton Highlands National Park as one of the leading parks in North America. Underlying these ratings are consistent references to the relatively unspoiled environment. A comment from one member of the panel that rated Cape Breton against other world islands is however particularly telling:

> [Cape Breton] Island is in good shape environmentally, but [the] Bras d'Or Lakes [are] undergoing environmental pollution from development and marine traffic.[5]

2.2 WATERSHED DESCRIPTION

The Bras d'Or Watershed covers terrestrial, freshwater, and marine features over an area of 3,589 square kilometres, based on calculations by EDM. Approximately 70 per cent (2,498.67 square kilometres) of the watershed consists of land and freshwater features, and the remaining 30 per cent (1,089.96 square kilometres) is the Bras d'Or Lakes themselves. The watershed covers approximately one-third of Cape Breton Island and includes land and freshwater based portions of four counties as follows:

- Victoria – 39.4 per cent of the watershed (984.83 square kilometres)
- Inverness – 27.9 per cent (696.20 square kilometres)
- Cape Breton – 21.2 per cent (529.20 square kilometres)

---

4 See: Jonathan B. Tourtellot, "Destination Scorecard: 115 Places Rated," *National Geographic Traveler*, March 2004, pp. 60-67.

5 National Geographic Center for Sustainable Destinations, "Island Destinations Rated: North America," www.nationalgeographic.co.uk/traveler/features/islandsrated0711/islands_northamerica.html#22, accessed March 11, 2008.

- Richmond – 11.5 per cent (288.44 square kilometres).

Figure 2.1 provides an overview of the Bras d'Or Lakes showing approximate boundaries of the twelve major subwatersheds and ten bay-scale areas.

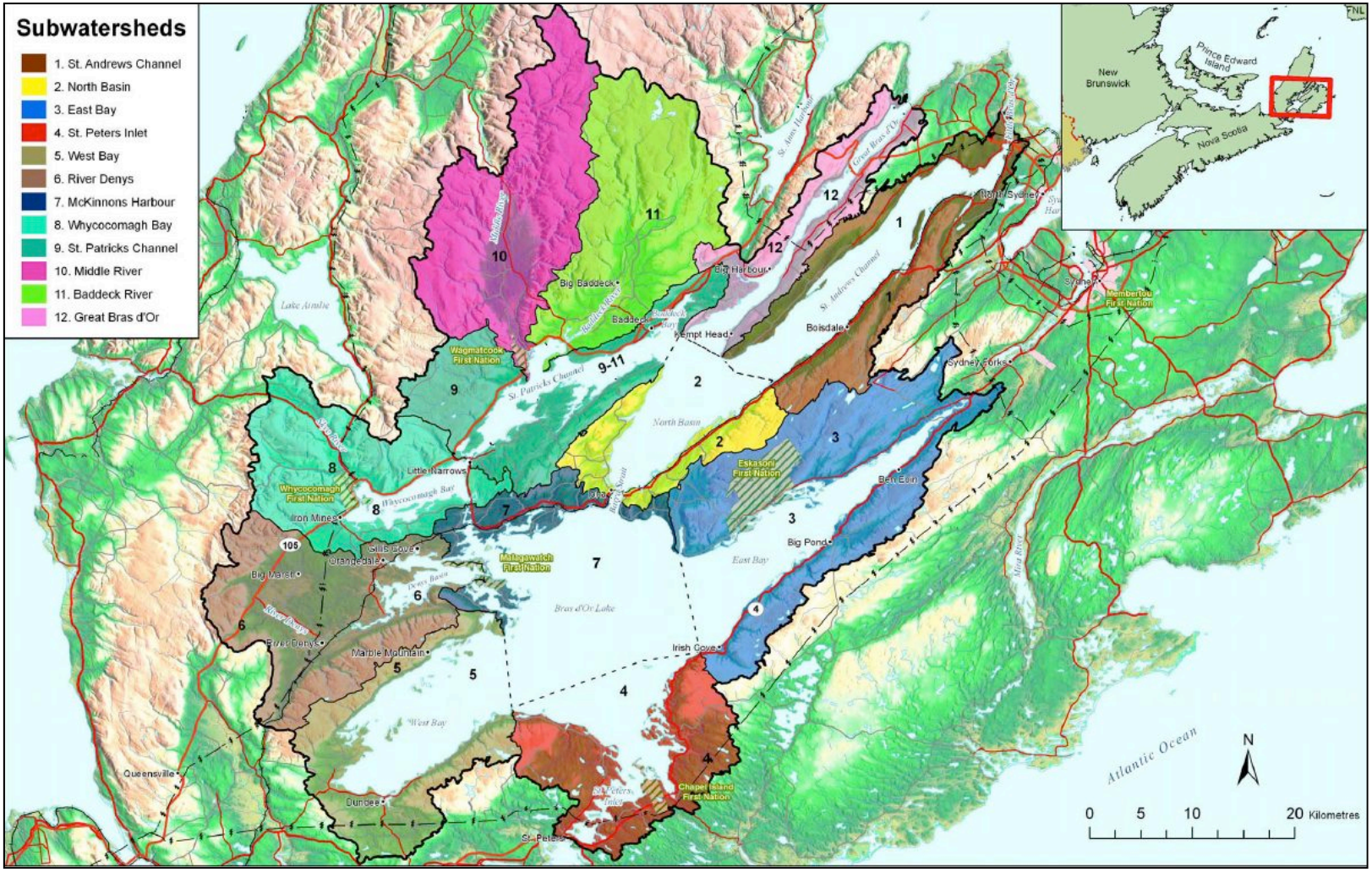
Approximately 22,000 people live in the many small communities throughout the watershed, most of which are on the lakeshores. Five First Nations reserves are located within the Bras d'Or Watershed: Eskasoni (2006 population, 2,952), Whycocomagh (2006 population, 623), Wagmatcook (2006 population, 408), Chapel Island (2006 population, 444), and Malagawatch (population not available). Together these reserves account for slightly more than half of the Indian Reserve population in Nova Scotia. Other larger communities in the watershed include Baddeck (2006 population, 873) and St. Peter's (population not available).[6]

Land use information for the four counties within the Bras d'Or Watershed shows 23,674 land parcels in 2008. Of these properties, 15,903 were classified as water, roads, or vacant, while 7,771 were occupied (**Map 1** in **Appendix B**). The majority of lands within the watershed are privately owned (62 per cent) with 33 per cent owned by the Province. Federal, municipal, and First Nations governments own most of the remainder of watershed lands. Three-quarters of developed properties in the watershed employ onsite sewer systems as opposed to central sewer systems.[7]

Agriculture, forestry, and mining are the main resource industries in the watershed. Agricultural activity in the Bras d'Or Watershed is variable, with a focus on beef and dairy production on the western side of the lakes, and horticulture predominant on the northern side. Lands to the east and south of the lakes have very little agricultural activity. Mining is also a long-standing industry in the Bras d'Or Watershed. The historical focuses have been gypsum and limestone. Today, gypsum and marble mining are ongoing.

[6] Populations for Baddeck from Statistics Canada, "2006 Census - Population and dwelling counts > Designated places (DPLs)," http://www12.statcan.ca/english/census06/data/popdwell/Table.cfm?T=1302&PR=12&S=0&O=A&RPP=25. Population for aboriginal communities from Nova Scotia Department of Finance, *2006 Census of Canada Nova Scotia Perspective*, Release # 5 – Aboriginal Peoples, January 2008.

[7] CBRM Planning Department, with information from the Nova Scotia Geomatics Centre.



Source: M. Parker, M. Westhead, P. Doherty, and J. Naug. 2007, *Ecosystem Overview and Assessment Report for the Bras d'Or Lakes, Nova Scotia*, 2007

Figure 2.1: Overview of the Bras d'Or Lakes Showing Twelve Subwatersheds

Forestry is practiced throughout the Bras d'Or Watershed. The most active forestry operations are in Inverness County and the least active are in Richmond County. The Nova Scotia Department of Natural Resources (NSDNR) has overall responsibility for forest management and forestry impacts. Nova Scotia's *Wildlife Habitat and Watercourses Protection Regulations* mandate a 20-metre minimum "special management" buffer zone on forestry lands along each side of streams and rivers wider than 50 centimetres, and along all lakes and marshes with permanent open water. In addition, connectivity management zones are required between ecologically significant areas. Various measures aimed at protecting water quality and ecological integrity are embedded within the environmental management systems and sustainable forest management standards of the largest commercial forestry operation in the watershed, NewPage Corporation (formerly Stora Enso Port Hawkesbury Limited). However, private property comprises 62 per cent of the watershed,[8] and the majority of these lands are not subject to these special management systems and standards.

While fishing also has a long history in the area, it is now restricted to oyster farming and lobster fishing due to the ban on bottom trawling and the collapse of the local herring fishery. Oyster farming, for good measure, is in crisis due to over-harvesting, degradation of habitats, Malpeque Disease, and the MSX parasite. Available commercial permits are now very limited.[9]

2.3 DEVELOPMENT IMPACTS ON WATERSHEDS

A watershed is an area of land that drains water, sediments, and dissolved materials to a common receiving body or outlet. A watershed is not restricted to surface water runoff; it includes interactions with subsurface water.

Activities that occur within the watershed, such as excavating and clearing associated with urban development and new construction, are major sources of siltation and sediment. The process of urban development also affects wetlands, drinking water, and groundwater, as well as habitat for plants and animals. Once established, urban settlements can create additional problems for nearby waterbodies by increasing the quantity of runoff. Urban stormwater, furthermore, can transport pollutants such as automobile fluids, lawn care products, pet waste, and trash.

---

[8] M. Parker, M. Westhead, P. Doherty and J. Naug, *Ecosystem Overview and Assessment Report for the Bras d'Or Lakes, Nova Scotia*, Canadian Manuscript Report of Fisheries and Aquatic Sciences 2789, Department of Fisheries and Oceans, 2007, p. 146.

[9] M. Parker, et al., *op cit.*, p. 163. (Confirmed through conversation with Allison MacIsaac, Unama'ki Institute)

Table 2.1 outlines existing and potential impacts from various types of land development within the Bras d'Or Lakes Watershed. Each impact is associated with its most likely source (urbanization, agriculture, forestry, mining, non-point source pollution, removal of riparian vegetation, invasive species, and climate change). This is not intended to be an exhaustive list, but rather to provide the reader with the breadth of ways in which water resources are impacted by common land uses. Some of these impacts have been identified in the Bras d'Or Lakes and are discussed further in **Section 2.4**.

Source	Impact or Impacting Land Use
Urbanization	Excessive nutrients from failing septic tanks, sewage treatment plants, and stormwater runoff (can lead to eutrophication and algal blooms which have effects throughout the food chain and reduces recreation and aesthetic value)
	Pathogens – sewage, urban runoff, medical waste, boat/marina waste, and pets/wildlife waste
	Toxic substance concentrations such as heavy metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides
	Wildlife behaviour impacts
	Loss of plant and animal habitat
Non-Point Source Pollution and Contaminants *(contaminants that enter the environment as a result of every day activities from numerous small sources)*	Nutrients and pathogenic bacteria (sewage from poorly maintained septic systems, agriculture runoff)
	Toxic metals and trace elements (pesticides from golf courses, urban lawns, and agricultural fields)
	Oil from automobile traffic, roads, parking lots, marinas, marine vessel activities
	Sediment (dust and siltation from erosion during construction, forestry, and agricultural activities)
	Salt (from ice control on roads and snow dumping)
	Suspended solids
	Oxygen demanding substances
	Leaching from landfills and old dump sites
	Golf courses
Agriculture	Excessive nutrients from fertilization (can lead to eutrophication and algal blooms which have effects throughout the food chain and reduces recreation and aesthetic value)
	Pathogens from sewage input, farm runoff, and animal waste
	Toxic substance concentrations such as pesticides
	Wildlife impacts
	Soil compaction and erosion from livestock impacts
	Clearing of riparian vegetation results in increased stream temperatures
Forestry	Sedimentation due to erosion
	Decreased infiltration due to compacted soils
	Local flooding and water pollution
	Acidification
	Nutrient enrichment

Source	Impact or Impacting Land Use
	Increased solar radiation
Mining	Water quality (sedimentation)
	Acid rock drainage
Removal of Riparian Vegetation	Decreased shoreline stability
	Decreased wildlife habitat
	Increased sedimentation and pollution impacts
Invasive Species	Effects on food chain
	Altered food, nutrient, or solar availability
Climate Change Impacts	Sea level rise
	Coastal erosion
	Increased storm surge
	Invasive non-native species
	Declining low season river flows and lake levels and higher water temperatures (potentially serious implications for water supplies, allocation, hydro-power production, waste assimilation/pollution concentrations, and freshwater ecosystems)
	Groundwater levels and quality are likely to be under greater stress with levels declining in populated southern regions
	Greater frequency of high intensity rainfalls that may increase soil erosion, flash floods and storm sewer overflow
	Average annual flood peaks expected to decrease in most regions, but occasional very large floods are likely to occur in vulnerable river systems, (*e.g.* Fraser, St. Lawrence tributaries)
	Sea level rise, combined with more severe winter storms, poses major flood and erosion risks in coastal areas, particularly in Atlantic Canada (Bay of Fundy, Northumberland Strait)

Table 2.1: Common Land Use and Development Impacts on Water Resources

2.4 IDENTIFIED WATER RESOURCE ISSUES IN THE BRAS D'OR

A local hydrogeologist who has conducted substantial research in the Bras d'Or Lakes region,[10] discussed the impacts of the Windsor/Mabou Hydrostratigraphic Unit that constitutes the majority of the land underlying and adjacent to the Bras d'Or Lakes. This hydrostratigraphic unit exhibits extensive deposits of salt gypsum and potash as well as shales, mudstones, siltstones, and active surface karst landscapes. Karst areas impact groundwater chemistry and commonly result in low yields of non-potable, very hard, salty water. The lakeshore soils are a result of the Windsor/Mabou unit, and are therefore largely comprised of clay and silt, which are not ideal for onsite septic systems. In addition, these types of soil result in extensive sedimentation problems as they are more inherently erodible, and typical approaches to sedimentation mitigation are not designed for fine particles.

[10] Fred Baechler, Chief Hydrogeologist, ADI Ltd., *pers comm.*, March 20, 2008.

A recent comprehensive study by CEPI in collaboration with the Unama'ki Institute assessed marine water quality in the lakes by compiling and reviewing all available studies relating to water quality in the Bras d'Or and by analyzing bacteriological, chemical, and sedimentation factors.[11] The study concluded that the lakes are relatively clean. Bacterial contamination from sewage is the primary source of pollution, with 3 per cent of the lakes classified as Conditionally Open or Closed to shellfish harvesting.

It is well known that the Bras d'Or Lakes experience variations in salinity, tidal range, and flushing times. Bathymetry is one of the most significant features of the Lakes, with many shallow sills ranging from 1 to 16 metres in depth affecting the chemical and biological character of water and its movement within the lakes. These sills divide the lake and its basins by effectively restricting exchange and flow, and have been shown to impact eutrophication, isolate chemical properties in deep areas, impact marine nitrate supply, and limit the entry of saline marine waters.[12] These variations, combined with uneven population distribution along the lakeshores, impact each bay to a varying degree and make them more or less susceptible to development and land use impacts.

Contamination from sewage in some portions of the Bras d'Or Lakes is of concern primarily because of its potential impacts on the oyster fishery, which has already slipped significantly. Sewage pollution comes from malfunctioning or undersized sewage storage or treatment systems, residential septic tanks and fields, and outhouses. Sewage contamination also comes from farms, where in some cases, livestock have direct access to water bodies or areas where buffering is insufficient to filter out contaminants before they reach a waterbody. Sewage is also sometimes discharged from marine vessels, a practice that was legal until July 2006, when the Bras d'Or Lakes were designated a Non-Discharge Zone under the *Canada Shipping Act*.

Despite the finding that water quality in the Bras d'Or Lakes is generally good, the CEPI/Unama'ki study found that nearly 55 per cent of subwatersheds feeding the lakes have recently experienced some measure of decline in water quality. Several key factors influence the natural state of the water, such as the restricted exchange with the ocean, the wind, and the freshwater input sources.

---

[11] Bras d'Or Lakes Collaborative Environmental Planning Initiative and Unama'ki Institute for Natural Resources, *State of the Bras d'Or Marine Environmental Water Quality, Background Report*, 2007 (Report # S0701).

[12] M. Parker, et al., *op cit.*, p. 11.

Chemical composition and sediment quality throughout the lakes are very good with the exception of Whycocomagh Bay, which has anoxic water and sediments at low depths. PCB and PAH concentrations are low in all areas of the Bras d'Or Lakes, as are heavy metal concentrations in biota and sediments. Higher levels of zinc were found in Denys Basin and higher levels of lead were found just off Eskasoni. The potential and future effects of sedimentation in the various parts of the Bras d'Or Lakes are difficult to measure. Denys Basin and Whycocomagh Bay are probably more sensitive to sedimentation effects because of the large rivers that drain into them and the low flushing rates characteristic of both water bodies.

Table 2.2 has been developed[13] to arrange and highlight relationships among key environmental issues. These issues are listed as primary, second, third, and forth order depending on the pathway of effect. This table is not intended to cover all possible causes of an issue. Longstanding issues that can be addressed through municipal regulations include sewage contamination and land use effects.

Primary Issue	2nd Order Effect	3rd Order Effect	4th Order Effect
Sewage (Malfunctioning or absent onsite systems, faulty central treatment systems, boats, direct discharge pipes)	Bacterial contamination, Excess nutrients	Water quality impacts	Impacts to fish habitat, human health, recreation
Land Use (Mining/gravel, extraction, agriculture, shoreline development, ATV use, landfills/ dumpsites, roads)	Erosion, siltation, habitat destruction, contaminants	Water quality impacts, Terrestrial habitat impacts	Impacts to fish habitat, wildlife and wildlife habitat, human health
Forestry (Clear-cutting, logging roads)	Erosion, siltation, habitat destruction	Water quality impacts, Terrestrial habitat impacts	Impacts to fish habitat and fish, wildlife and wildlife habitat
Invasive Marine Species (MSX, Green Crab, Tunicates)	Competition and predation on endemic species	Impacts to aquatic species	Ecosystem disruption, Financial impacts
Declining Fish stocks (Oysters, Lobster, Herring)	Ecosystem disruptions	Loss of fishery	Financial impacts

Table 2.2: Identified Bras d'Or Environmental Issues

Another issue that poses an additional threat is global climate change, evidenced by rising global temperatures, increasing extremes within the hydrologic cycle, and rising sea levels. Changing temperatures and extreme weather events can result in systemic changes and ecosystem shifts in some terrestrial and marine environments. Sea level rise is not expected to be globally uniform or linear, and some regions can

[13] Jason Naug, *Developing An Environmental Management Plan for the Bras d'Or Lakes Watershed: An Analysis of Its Scope and Approach for Addressing Issues*, Halifax, Dalhousie University, 2007.

be expected to become more or less substantially inundated than the global average. Sea level rise has implications for coastal infrastructure such as roads, structures, bridges, and seawalls. Groundwater characteristics may also be altered by sea level rise, as higher water tables can compromise wastewater treatment systems. Sea level rise combined with increases in the frequency and intensity of storms can lead to increased damage from storm surge—for both the built and natural environments.

In a presentation at the 2007 Ocean Connections Conference, Kyle MacKenzie of the Climate Change Section of Environment Canada in Dartmouth highlighted several adaptation studies that have been completed within the Maritimes. Study characteristics and findings are outlined in **Table 2.3**.

Study	Location	Responsible Agency	Key Findings
Climate Change Adaptations for Land Use Planners	Atlantic Canada	Birch Hill GeoSolutions, New Brunswick Climate Change Hub, Clean Nova Scotia, Town of Annapolis Royal, Municipality of the County of Kings, NSEL, Nova Scotia Department of Energy	Developed a toolkit for Land Use Planners to assist in assessing potential climate change impacts and alternative land use adaptation scenarios, and in implementing climate change adaptation planning techniques. Recommendations to incorporate climate change adaptation best practices into municipal public works practices, subdivision bylaws, and engineering designs. This may include best practices for greener stormwater management, flood-proofing, increasing wind resistance, using energy efficient building to help adapt to more extreme high and low temperatures, and decreasing the "ecological footprint" in many ways to help adapt to climate change, such as channeling runoff to infiltration basins, using permeable, frost resistant paving, leaving a natural buffer along watercourses, basin design and maintenance, new infrastructure design and location, etc.
Temperature & Precipitation Changes	Nova Scotia	Meteorological Service of Canada, Atlantic	Daily maximum/minimum temperature to increase 3.2°C/2.7°C by 2050; daily precipitation amount to change 12 per cent by 2050
Storm Surge Mapping	Annapolis Royal, Nova Scotia	Clean Annapolis River Project, through Natural Resources Canada's Climate Impacts and Adaptation Research Network (C-CIARN) program	Discovered that a tidal surge during a severe storm was a rare but real threat to coastal zones in their region, particularly if it occurred concurrently with an unusually high tide (the latter happens several times each year). Adaptive planning measures include proper dyke maintenance, measures to reduce potential economic loss and human harm, relocating much of the Fire Department's rescue equipment to deal more effectively with areas that could become isolated during a flood.

Study	Location	Responsible Agency	Key Findings
Climate-SMART (Sustainable Mitigation & Adaptation Risk Toolkits)	Halifax, Nova Scotia	Dillon Consulting	Developed an emissions management plan; climate change hazard mapping; and tools and strategies to facilitate adaptation to climate change
Storm Surge Model	Prince Edward Island	Natural Resources Canada, Environment Canada, Dalhousie University, Centre of Geographic Sciences of the Nova Scotia Community College, City of Charlottetown and other partners	Mid-range value of 4.70m flooding results in risks to: $190 million in property values, 41 municipally designated heritage properties valued at $10.5 million, and $46 million in infrastructure. Also noted value of erosion impacts, sea level rise impacts, storm surges, high level winds, and waves. Determined feasible and effective adaptation measures that might be adopted to minimize the impacts of these changes.
Sea Level Rise Study	Southeastern New Brunswick	Environment Canada, Fisheries and Oceans Canada, Natural Resources Canada, Parks Canada Agency, New Brunswick Department of Environment, New Brunswick Department of Natural Resources	Studied impact of sea level rise and climate change on the southeastern New Brunswick coast. Sea level rise around NB estimated at 10 to 98 cm. The median change is 50 cm, and that, coupled with the 20 cm the earth is expected to sink over the next 100 years, means tides could be a lot higher than they used to be within this generation's lifetime. Recommends shoreline development take into account erosion rates and elevation.
Storm and Wind Impacts on Transportation	Southwestern Newfoundland	Environment Canada, Memorial University	Sea level is currently rising at Port aux Basques at ca. 3.3 mm/a. Rising sea level will allow successive storm surges to rise higher and penetrate further inland. Coastal erosion is occurring along dune-backed sandy shorelines.

Table 2.3: Atlantic Canada Climate Change Adaptation Studies

John Shaw, a research scientist with Natural Resources Canada, noted in a video discussion[14] on sea level rise in Atlantic Canada with television science personality Jay Ingram that:

> … predictions for future climate change indicate that the sea level is going to increase by about 50 cm over the next century, mainly because the temperature of the ocean is going to increase. And in an area like Atlantic Canada, that 50-centimetre increase has to be added on to a good part of the sea level rise that we already have. In other words, sea level in this marsh could rise by 70 centimetres over the next century.

The additional factor to which Shaw referred is local sea level rise attributable to subsidence of the land in reaction to past glacial processes. This means that the

[14] See: Government of Canada, "Science.gc.ca - Science and Technology for Canadians," http://www.science.gc.ca/default.asp?Lang=En&n=419DB84C-1, accessed February 26, 2008.

region is already experiencing a relative increase in sea level and will be even more susceptible to global changes in sea level since the global sea level rise will be added to the current rate of local subsidence. This is well explained in a recent document for Natural Resources Canada:

> The vulnerability of coastal areas is a combination of global sea-level and local dynamics of the earth's crust. The entire Maritimes was covered by ice during the last glaciation and the load of the ice depressed the earth's crust. As the ice melted approximately 12,000 years ago, the crust rebounded. Even though the ice melted a long time ago the effects of the load on the earth's crust is not expected to end until another 2000 years. This rebound is not uniform across the region, and the effects are still being felt today. The areas where the ice was thickest were depressed the most and peripheral regions where actually uplifted, termed the 'peripheral bulge'. The ice was thickest over Hudson Bay and today this area is still rebounding from the load of the ice and is being uplifted. The Maritimes represent part of the peripheral bulge and the crust in the regions of southern New Brunswick and Nova Scotia are subsiding. Subsidence rates vary across the region with Nova Scotia sinking at a rate of 20 cm per century. The subsidence of the crust is important for coastal communities in that it compounds the problem of local sea-level rise and must be considered when projecting future flood risk.[15]

A key study by Natural Resources Canada, *Adaptation to Rising Sea Level in the Bras d'Or Lakes, Canada's Largest Inland Sea*, recently addressed mitigation of climate change impacts specifically for the Bras d'Or Lakes. The 2006 study, which was completed under the auspices of the Geoscience for Ocean Management Program with additional funding from the Climate Impacts and Adaptation Research Network (C-CIARN) program, defined past, present, and future trends in water level increases in the lakes. It also mapped the coastal environment to assess the lake's evolution and potential impacts of climate change. The study applied the method for predicting sea level rise developed by the International Panel on Climate Change's 2001 to estimate that the level of the Bras d'Or Lakes may rise by 0.36 metres to 0.76 metres by 2100, taking into account both global and local sea level rise estimates.

The study proposed several key guidelines for the Bras d'Or Lakes including:

- Do not armour the coast unless important community infrastructure such as highways, bridges, and institutions, which are not easily moved, are threatened by shoreline erosion;
- Armouring such as harbour breakwaters may also be required to provide safety for people working in the coastal zone;

[15] Birch Hill Geo Solutions, *Climate Change Adaptations for Land Use Planners*, p. 20. (See: http://adaptation.nrcan.gc.ca/projdb/178_e.php)

- Before selecting a building location for a residence on or back of shore cliffs, learn and take into account past and predicted rates of cliff retreat at that site;
- Do not develop infrastructure on coastal barriers; and
- Allow the coast to function close to the natural state where possible.

In creating development standards appropriate for the communities in the Bras d'Or watershed, it is important to consider potential storm surge generation in the Bras d'Or in addition to potential sea level rise impacts. Storm surge often accompanies very intense winter storms, hurricanes, or high winds resulting in the onshore pileup of ocean or lake water. It is generally the result of onshore winds and a low pressure storm that causes the ocean to rise up in response as it "pushes" the water into the continental shelf and onto the coastline. We asked several noted researchers with the Department of Fisheries and Oceans, Natural Resources Canada, and the Department of Oceanography at Dalhousie University to inform us of any storm surge modeling or forecasting completed for the Bras d'Or Lakes.

John Shaw of Natural Resources Canada stated:

> … rather than surges of the type we see on outer coasts, the lakes are susceptible to longer-term departures of water level associated with pressure variations. A magnitude of about 0.5 m is, I think, typical ...

Brian Petrie, a researcher with the Department of Fisheries and Oceans stated that the lack of fetch in the Bras d'Or Lakes will limit wave and classical storm surge development, but acknowledged the coupling impact of waves and surges acting together.

2.5 MUNICIPAL MEASURES FOR WATER RESOURCE PROTECTION

As with many areas of public concern in Canada, responsibility for the management of water resources is divided between the Federal and Provincial governments. In broad terms and focusing on water resources, the Government of Canada is responsible for fisheries, while provincial governments are responsible for water resources within their boundaries. As in many other areas, the Federal government takes an interest in promoting water quality as part of its broad interest in the environment, as do most provinces.

In addition, provinces also delegate responsibilities to municipal governments within their boundaries. In particular, provinces normally delegate substantial responsibilities for land use planning and regulation to local government. Municipalities are also normally responsible for a variety of services that may

impact, influence, or improve water quality, such as sewage collection and disposal, water supply, and stormwater management.

2.5.1 Planning for Water in Nova Scotia

The primary mechanisms for land use control throughout Canada are municipal plans and zoning bylaws. In Nova Scotia, the framework for municipal planning is set out in Part VIII of the *Municipal Government Act*, a comprehensive act that covers all aspects of municipal operations and responsibilities. Under the Act, which is commonly referred to as the MGA, municipal plans are officially called "municipal planning strategies."

The Province specifies under Section 213 of Part VIII of the MGA that the purpose of a MPS is to provide:

> (a) policies which address problems and opportunities concerning the development of land and the effects of the development;
> (b) policies to provide a framework for the environmental, social and economic development within a municipality;
> (c) policies that are reasonably consistent with the intent of statements of provincial interest; and
> (d) specify programs and actions necessary for implementing the municipal planning strategy.

Section 214 of the Act follows with an extensive list of subjects that policy statements may address including the following that are particularly relevant to water resources:

> (c) the protection, use and development of lands within the municipality, including the identification, protection, use and development of lands subject to flooding, steep slopes, lands susceptible to subsidence, erosion or other geological hazards, swamps, marshes or other environmentally sensitive areas;
> (d) stormwater management and erosion control;
> (e) in connection with a development, the excavation or filling in of land, the placement of fill or the removal of soil, unless these matters are subject to another enactment of the Province;
> (f) in connection with a development, retention of trees and vegetation for the purposes of landscaping, buffering, sedimentation or erosion control;

(g) studies to be carried out prior to undertaking specified developments or developments in specified areas;
(h) the staging of development;
(i) the provision of municipal services and facilities
…
(m) the use and conservation of energy, including the height and siting of developments;
…
(q) any other matter relating to the physical, social or economic environment of the municipality.

Acknowledging the importance of the foregoing, the normal focus of a MPS is to declare the intentions of the specific municipality with respect to regulation of land use through a "land use bylaw" (LUB) and zoning map. A typical MPS will have policy sets corresponding to specific land use types (i.e., residential, commercial, industrial, conservation, etc.). Policies in each set will set out general objectives for the land use category with thrusts such as "the creation of stable neighbourhoods," "enhancement of a strong commercial core," or "preservation of the natural environment." Policies will also define different types of land uses and outline the broad features that characterize each type. When dealing with residential development, for example, most Nova Scotia communities identify single unit, two-unit, and multiple-unit types, sometimes distinguishing high-rise from low-rise multiple-unit developments. Policies of this type provide the foundation for zones that define and regulate these land uses; for example, an R-1 Zone for single unit homes, an R-2 Zone for duplex and semi-detached dwellings, and an R-3 Zone for multiple-unit development.

The Province, though the MGA, has given municipalities considerable latitude to formulate plans. Provincial oversight of plan content is largely focused on Statements of Provincial Interest of which there are current five dealing with:

- Drinking Water Supply
- Flood Risk Areas
- Agricultural Land
- Infrastructure
- Housing

Interestingly, the first two deal directly with water issues, while the statement concerning Infrastructure has aspects that are also relevant. The statement concerning Drinking Water Supply requires municipalities to regulate land use in watersheds feeding surface water supplies from which municipal drinking water is

drawn and aquifers from which groundwater is drawn for the same purposes. The Statement specifies the following potential measures to protect these areas:

- Restricting permitted uses to those that do not pose a threat to drinking water quality;
- Balancing the expansion of existing uses against the risks posed to drinking water quality;
- Limiting the number of lots. Too many lots may result in development which cumulatively affects drinking water quality. The minimum size of lots and density of development should be balanced against the risks posed to the quality of drinking water;
- Setting out separation distances between new development and watercourses to provide protection from runoff;
- Establishing measures to reduce erosion, sedimentation, runoff and vegetation removal associated with development.

The statement recognizes that "[e]xisting land use and the location, size and soil conditions of a municipal water supply watershed will determine the land-use controls that should be applied."[16]

The statement concerning Flood Risk Areas requires stringent limitations in five specific areas that have been mapped under the Canada-Nova Scotia Flood Damage Reduction Program, all of which are in Mainland Nova Scotia. The Statement indicates further, however, that in areas "where local knowledge or information concerning these floodplains is available, planning documents should reflect this information" and similar limitations should be applied. These include:

- Within the Floodway
  - development must be restricted to uses such as roads, open space uses, utility and service corridors, parking lots and temporary uses
  - the placement of off-site fill must be prohibited

- Within the Floodway Fringe
  - development, provided it is floodproofed, may be permitted, except for residential institutions

[16] See: http://www.gov.ns.ca/snsmr/muns/plan/provint/drnkintr.asp

such as hospitals, senior citizen homes, homes for special care and similar facilities where flooding could pose a significant threat to the safety of residents if evacuation became necessary, and any use associated with the warehousing or the production of hazardous materials
- the placement of off-site fill must be limited to that required for floodproofing or flood risk management
- expansion of existing uses must be balanced against risks to human safety, property and increased upstream and downstream flooding.[17]

The statement concerning infrastructure requires municipalities to, "make efficient use of community infrastructure … particularly municipal water and wastewater facilities." Recommended approaches to achieving this include:

- promote cost effective use of existing infrastructure through:
  - infill
  - more appropriate density

- support rational extension of infrastructure through:
  - clustering
  - directing of development to areas that can be serviced efficiently

- deter urban sprawl and development that leapfrogs over serviced areas through:
  - establishing density standards more appropriate to rural areas[18]

The remaining Statements of Provincial Interest deal with preservation of agricultural land and provision of varied and affordable housing both of which have implications for water resources. Of particular note is the recommendation of the Statement of Provincial Interest on Housing that municipalities "provide for flexible residential land development standards such as … higher density, smaller lots sizes,

[17] See: http://www.gov.ns.ca/snsmr/muns/plan/provint/fld_intr.asp

[18] See: http://www.gov.ns.ca/snsmr/muns/plan/provint/infr_int.asp

and reduced yard requirements." With respect to rural areas, the Statement enjoins municipalities to "deter urban sprawl and development that leapfrogs over serviced areas through … establishing density standards more appropriate to rural areas."[19] Given the emphasis on flexibility in the Statement, this final clause can be interpreted as supporting either smaller lots in properly managed cluster developments, or larger lots that minimize the potential impact of failure of conventional onsite systems.

Statements of Provincial Interest are taken into account in the Provincial approval process for planning documents and amendments to planning documents. If planning staff with the Province's Department of Service Nova Scotia and Municipal Relations deem a MPS or an amendment to a MPS not to be "reasonably consistent" with a Statement, the Minister may reject the plan or amendment, or request its modification. The Province may also develop additional Statements of Provincial Interest to address such areas a climate change or an expanded drinking water policy, which is currently under development by Nova Scotia Environment and Labour (NSEL).

In addition to typical land use categories (i.e., different levels of residential, commercial, industrial, and institutional development), most municipal plans in Nova Scotia also identify land use categories or overlays that specifically address water resource concerns as required by the Statements of Provincial Interest on Drinking Water Supply and Flood Risk Areas. Typically, groundwater recharge areas are subject to restrictions on development that are increasingly stringent as proximity to the wellhead or wellfield decreases. LUB provisions implementing such policies often permit no development except for uses related to water extraction in the immediate vicinity of a wellhead. More intense land uses are normally allowed with increasing distance, with the strongest restrictions on land uses – notably industrial uses and service stations – that are most likely to involve the handling of large quantities of hydrocarbons or other hazardous materials. Very similar regulations are applied to watercourses used as surface water supplies with the strongest restrictions applied on the banks of streams and lakes, and a broadening array of land uses permitted with increasing distance. As with groundwater, land uses such as industrial operations and service stations are most likely to be prohibited.

Policies to address flooding concerns generate similar regulations. Most follow the structure set out in the Statement of Provincial Interest by identifying a Floodway (normally subject to 1 in 20 year flooding) and a Floodway Fringe (the 1 in 100 year flood zone). As suggested in the Statement, restrictions on building in the Floodway are normally absolute. Construction in the Fringe is usually permitted with

[19] See: http://www.gov.ns.ca/snsmr/muns/plan/provint/hsg_intr.asp

floodproofing (i.e., with fill, with watertight foundations, etc.) except for land uses that may place less mobile individuals at risk or involve the handling of hazardous materials that may be released into the watercourse in a flooding event.

A positive aspect of these policies is that the related regulations often overlay each other. Restrictions on construction in floodways, for example, also tend to preserve natural vegetation and landforms that protect the watercourse.

Other requirements, on the other hand, may have to be balanced. The Statement on Drinking Water Supply Areas, for instance, suggests that development density should be kept low, whereas the Statements on Infrastructure and Housing both require consideration of high density development and clustering of land uses. These approaches are not necessarily in conflict but do require planners to consider techniques that will account for the objectives of all the Provincial statements. An example in this respect would be the encouragement of open space subdivision, which several Nova Scotia municipalities have recently endorsed. Under this approach, houses and related development are clustered together on the most advantageous portion of a property to minimize the length of required roadways and service networks, and avoid environmentally sensitive lands such as steep slopes and the banks of watercourses.

No Statement of Provincial Interest directly addresses climate change. The consequences of potential sea level rise caused by climate change are, however, attracting the interest of planners. HRM's 2006 Regional MPS includes Policy E-16 prohibiting residential development "within a 2.5 metre elevation above the ordinary high water mark" in areas of the municipality outside Halifax Harbour and Sheet Harbour. We understand HRM is the first municipality in Canada to adopt this type of standard. It is likely, however, that others will follow this lead. HRM, furthermore, intends to study the issue further through a so-called "functional planning" process intended to support more detailed protective measures.[20]

2.5.2 Planning for Water in the Bras d'Or Lakes

The Bras d'Or Lakes Watershed, as noted above, is divided among four municipal units that cover all of Cape Breton Island except the Town of Port Hawkesbury. CBRM contains the only substantial urban concentration other than Port Hawkesbury on the island but also covers extensive rural and wilderness areas, including its portion of the Bras d'Or Watershed. The other three counties are all largely rural. They are generally lightly settled, including their portions of the watershed. Eskasoni, Whycocomagh, Wagmatcook, Chapel Island, and Malagawatch are all First Nations reserves separately administered by their respective bands. The

[20] John Charles, Parks Planner, HRM, *pers. comm.*, March 2008.

communities of Baddeck and St. Peter's are administered by Village Commissions as well as their respective counties of Victoria and Richmond. Both Village Commissions are primarily concerned with the management of water and sewage facilities but also have planning advisory committees that interpret their planning strategies and land use bylaws prepared for each community by the Eastern District Planning Commission (EDPC).

CBRM has its own Planning and Development Department. Since its amalgamation in 1995, the municipality has developed a comprehensive MPS covering all of its territory. The MPS focuses on land use and economic development issues in the urban core but also addresses water resources, notably in Part 9 dealing with Environmental Issues. Policies of specific interest to this study include Policy 5 dealing with rural Lot Sizes and Onsite Sewer and Water Services, and Policy 6 supporting erosion Setbacks from Major Bodies of Water. Both policies promote investigation and collaboration with other levels of government but neither is implemented by regulations in the LUB or any other bylaw of the municipality.

The plan also makes limited reference to the Bras d'Or Lakes. It recognizes the attractiveness of the lakeshores for residential development. The plan also notes the absence of public access to beaches along extensive stretches of the Bras d'Or shoreline. Policy 6 in Part 3 of the MPS commits CBRM Council to protect existing public beaches on the Bras d'Or as well as on the coastline of the municipality. The plan also recognizes that the extent of the Bras d'Or Lakes Watershed necessitates inter-municipal cooperation. Policy 5 of Part 8 commits CBRM to develop "an intermunicipal plan for the Bras D'Or Lake focused on its environmental remediation" in cooperation with senior governments and First Nations communities.

The plan also recognizes the potential of wastewater management districts (WMDs) to address rural sewage collection and treatment, albeit in the context of watersheds from which public drinking water is withdrawn. Notwithstanding that the Bras d'Or Lakes are saline and are, therefore, not a source of drinking water, the objectives set out in the CBRM MPS concerning the establishment of WMDs are instructive:

> Once [drainage basins of water bodies used as a source of public drinking water supplied by the CBRM] are identified, the CBRM will progressively attempt to establish a wastewater management district for each of these areas. The purpose of a wastewater management district will be to:
>
> - educate the constituents in each community, neighbourhood, or subdivision identified as to how

onsite wells and wastewater systems function properly;
- explain the protection a management program provides;
- determine the type of solution that could be implemented (*e.g. cluster system or a maintenance program on the existing onsite sewage disposal systems*);
- determine the extent to which the CBRM would be responsible; and
- establish property charges (*if necessary*) to pay for the cost of any system.

While the MPS appears to recommend this approach for its clear and direct benefits in protecting human health, the objectives are equally applicable to the preservation of the natural environment in the Bras d'Or Lakes.

The other three Cape Breton counties are served by the EDPC, which is located in Port Hawkesbury. The Commission is jointly funded by the three counties and the Town of Port Hawkesbury on Cape Breton Island, as well as the County of Antigonish on the mainland. The Commission has developed a dozen adopted plans applicable to areas within the three counties. The following incorporate areas within the Bras d'Or Watershed:

- Whycocomagh, Inverness County
- Shannon Lake, Richmond County
- St. Peter's, Richmond County
- Sporting Mountain, Richmond County
- Baddeck, Victoria County

All of these plans recognize the importance of considering the impact on watercourses[21] of developments approved through rezoning and development agreement. Only the St. Peter's MPS, however, contains policy implementing a specific restriction intended to protect waterways from potential sources of pollution[22]:

[21] "Watercourses" are defined by the Nova Scotia *Environment Act* as "any creek, brook, stream, river, lake, pond, spring, lagoon or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually any water in it or not). It also includes all groundwater."

[22] The Sporting Mountain MPS contains several policies that recognize the importance of protecting watercourses but none that specifically references buffers or any other measure to accomplish this goal. The Sporting Mountain LUB, nonetheless, implements a watercourse buffer that restricts "Medium Intensity Industrial Uses" from locating within 325 feet of the Bras d'Or Lakes and requires them to maintain a 20-foot treed buffer "adjacent to [any] watercourse." The more general policies in the Sporting Mountain

Policy G-4 It shall be the policy of Council to establish a 50-foot setback from the high water mark of the Bras d'Or Lakes and St. Peter's Bay, with the exception of properties located on the north side of Highway 4 between the St. Peter's canal and Corbett's Cove Road. No new structures will be permitted within this setback, with the exception of wharves and boathouses, and the exception of properties located on the north side of Highway 4 between the St. Peter's canal and Corbett's Cove Road.

In 2001, CBRM, the three counties, and the Town of Port Hawkesbury, joined in the *Pitu'paq* partnership with the Province of Nova Scotia and the five First Nations Reserves on the island to tackle the pollution problems of Bras d'Or Lakes. Participants in the society work collaboratively to protect and preserve the Bras d'Or Watershed. The organization is facilitated by NSEL through the Bras d'Or Lake Coordinator. Member organizations are working together to address onsite sewage, sewage treatment plant issues, and boating sewage. The commitment of CBRM to the society is recognized in Policy 5 in Part 8 of the CBRM MPS.

MPS could presumably support the extension of watercourse buffers to other land uses and/or the implementation of other measures to protect watercourses potentially influenced by lands in the plan area.

3.0 WATERSHED PROTECTION

3.1 ENVIRONMENTAL OBJECTIVES

To maintain the ecological integrity of riparian and aquatic ecosystems within the Bras d'Or Watershed, it is important to maintain their ecological features and functions. These features are many and varied and include the:

- Forest and ground cover adjacent to watercourses and waterbodies;
- Organic debris that falls into the watercourses, waterbodies, or riparian areas;
    - Exchange of nutrients between terrestrial and aquatic systems;
    - Side channels, intermittent streams, seasonally wetted adjoining areas and floodplains;
- Natural sources of streambed materials;
- Areas for lateral channel migration (active floodplains);
- Subsurface flows that allow riparian vegetation to be maintained in permanently or seasonally dry gullies; and
- Permeable surfaces.

These environmentally valuable resources can be protected during land development if appropriate measures are taken. Local governments and the development community in the Bras d'Or Lakes Watershed should aim to meet the following environmental objectives during land development process:

- Minimize pollution threats;
- Minimize soil erosion;
- Minimize vegetation loss;
- Enhance and protect riparian corridors;
- Reduce storm water runoff volumes and velocities where appropriate;
- Increase stream stabilization; and
- Provide a greater emphasis on planning and preparedness for groundwater droughts and severe floods/weather.

Local governments should address these objectives within their plans and land use regulations. Developers should be able to demonstrate to local governments and the public how they are addressing these objectives and incorporating them into all stages (design, construction, and occupation) of their development.

3.2 BEST MANAGEMENT PRACTICES

Many federal, provincial, and municipal laws and regulations govern land development around environmentally valuable resources. However, these do not always capture the 'best practices' of the day. Best Management Practices (BMPs) are approaches that have been applied with success in one or more areas that may have benefits for others. With the expansion of the Internet, the dissemination of BMPs has been greatly enhanced. More and more studies are available reporting on the refinement and implementation of BMPs and the monitoring of their consequences.

In the field of watercourse protection, it is beneficial to distinguish between structural and non-structural BMPs. The distinction is well illustrated by stormwater management techniques. Structural stormwater management BMPs are either engineered or constructed systems that directly improve the quality and/or control the quantity of stormwater runoff. These can be incorporated into municipal and private development practices. They may include measures such as pervious pavement, vegetated swales, green roofs, infiltration basins or trenches, or biofiltration (i.e., vegetative practices such as filter strips, grassed swales, riparian areas, etc.).

Non-structural BMPs for stormwater management are institutional and regulatory measures that do not generally involve construction of infrastructure. Such BMPs include municipal planning controls, strategic planning and institutional controls, pollution prevention procedures, education and participation programs, and regulatory controls. Typical non-structural BMPs include watercourse buffers, animal and pesticide controls, and varied public education programs. These measures are intended to limit contaminants in runoff and reduce the prospect of contaminants entering sensitive receiving waters.

Table 3.1 provides examples of structural and non-structural BMPs for the planning, design, and construction of development in urban and rural settings. Because of the difficulties in enforcement by local government, some practices like yard maintenance and boating may be better suited to education campaigns than regulation through municipal bylaws.

Focus	Example Best Practices
Urban Runoff	- Use vegetation extensively to filter runoff. - Divert runoff around sites where pollutants could be picked up. - Require collection/removal of pet waste from curbsides, yards, parks, and other areas where the waste can be washed directly into receiving waters. - Connect drains from vehicle washing areas to the sanitary sewer system to prevent discharge of wash water into surface water.

Focus	Example Best Practices
Stormwater Management and Reduced Impervious Areas	Use Low Impact Development strategies such as: - Design runoff management systems to incorporate natural drainage features and follow existing topography wherever possible - Use conservation design principles such as cluster development, open space preservation, reduced pavement widths, reduced driveway lengths etc. - Increase use of infiltration practices such as infiltration basins and trenches, porous pavement, disconnected downspouts, rain gardens, etc. - Use runoff storage and conveyance practices such as eliminating curbs and gutters, rain barrels, depressional storage, green roofs, grassed swales and grass-lined channels, creating longer flow paths over landscaped areas, etc.
Road Salting and Snow Dumping	- Inform salt applicators of sensitive areas. - Store disposed snow near flowing surface waters, but at least 8 metres from the high water mark of surface waters or the coast. - Place snow storage areas 25 metres or more from any private water supply wells, 60 metres from community water supply wells, and 120 metres from municipal wells.
Road Construction and Maintenance	- Avoid paving in the rain. - Maintain vegetation, minimize pesticide and fertilizer use, and implement an integrated pest management regime along rights of way wherever possible. - Stabilize a site with seeding, mulching, silt fence, hay bales, etc. as soon as possible during and after construction. - Minimize the length of road per unit area and the number of watercourse crossings, especially in sensitive areas.
Bridge Maintenance	- Degrease moving bridge parts on a routine basis, manually remove excess grease and dispose it without any deposition into waterbodies. - Mitigate paint and abrasive entry to watercourses during bridge cleaning by using ground covers to capture falling debris and vertical drapes to improve containment performance.
Sanitary Waste Management	- Install sanitary sewers where appropriate and feasible. - Inspect septic tank systems regularly and require regular pump-out. - Remove and ban connection to sewer systems to prevent overflow events and require holding facilities where appropriate.
Construction Design	- Construct and stabilize runoff management systems at the beginning of site disturbance and construction activities. - Ensure that a sediment and erosion control plan includes planting appropriate native plant species of a size that will quickly re-establish riparian cover.
Landscaping Best Management Practice	- Minimize disturbance to plants and trees. - Select and save trees to gain time in landscaping later. - Maintain a buffer zone of natural vegetation along the shoreline.
Site Excavation and Development	- Prevent erosion by mulching or providing other cover where possible. - Minimize slope lengths and provide immediate erosion control measures. - Monitor the effectiveness of mitigation and adjust, maintain, and repair periodically and after every storm.
Septic Systems	- Conduct an education and awareness campaign for residents with septic systems—local requirements, maintenance, upgrades, inspection, water conservation, appropriate and inappropriate inputs to drains and toilets (e.g., cleaners, chemicals, pet wastes, detergents)

Focus	Example Best Practices
Chemical and Petroleum Collection and Storage	- Collect and recycle community hazardous waste at designated centres. - Keep an up-to date material inventory of items on commercial and industrial sites that contribute to stormwater pollution when exposed to the weather. - Store containers in areas that will contain leaks.
Buffer zones, Setbacks, and Easements	Use buffers, setbacks, and easements adjacent to stream systems and coastal areas to: - Reduce and filter runoff. - Stabilize stream banks. - Restore/maintain chemical, physical, biological integrity of water resources. - Provide physical and visual separation of heavy use activities. - Allow accumulation and entry of organic matter into the aquatic ecosystem. - Provide riparian wildlife habitat.
Recreational Waterfront	- Keep shoreline in its natural state. - Avoid burning on the beach (remaining ash is highly alkaline and may change the pH of the lake, and increase the growth of undesirable plants). - Use a diving platform or raft instead of developing a beach for swimming.
Docks, Moorings and Marinas	- Use phosphate-free detergents and treat wash water before it is discharged - Install containment booms at fueling stations and install catch basins around boat launches to prevent pollutants from entering the water - Provide pump-out facilities to eliminate potential discharges into waterbodies
Yard Maintenance	- Conduct an education and awareness campaign—site and climate specific plants, appropriate pesticide, fertilizer, and herbicide timing and application, water conservation, composting, landscaping techniques to increase infiltration
Boating	- Conduct an education and awareness campaign—proper trash disposal, appropriate and inappropriate cleaners, prevent fuel and lubricant leaks, recycle used oils and leftover paints, consider use of 4-stroke engines over 2-stroke engines, conduct major maintenance on land

Table 3.1: Examples of Structural and Non-Structural BMPs

The focus of this study, in any case, is on non-structural approaches that can be implemented through municipal planning measures. The array of non-structural BMPs is extensive. Following are summaries of four common and distinct categories of non-structural measures that are particularly pertinent for the Bras d'Or Lakes due to identified water resource issues.

3.2.1 Suitability of Lands for Development

Identification of the suitability of lands for development is fundamental to land use planning. The criteria for determining suitability may however vary among communities and regions. In intensively developed urban areas, suitability usually depends on access to key municipal infrastructure such as roads, and water and sewer networks, although considerations such as the cost of construction in relation to topography and soil cover may also enter into the equation.

In the Bras d'Or Watershed, existing infrastructure is limited and many areas are potentially attractive for development, particularly lands on the lakeshores. Establishing lands suitable for development in this case should take into account not only existing communities with developed road networks, and water and sewer services, but also lesser developed or greenfield areas. In the Bras d'Or Watershed the key criterion should be the potential detrimental effect of development on watercourses.

3.2.2 Watercourse Buffers

Reservation of riverbanks and shorelines is probably the most common measure for watercourse protection applied in North America. Watercourse buffers provide a barrier and filter that mitigates the worst impacts of agricultural and urban runoff. Lands along the banks of streams, rivers, and lakes, furthermore, tend to support more intensive tree and vegetative cover that is essential to stabilizing banks and preventing erosion, as well as enhancing wildlife habitat. In addition to providing an area to filter runoff, buffers also reduce the prospect of deleterious activities in close proximity to watercourses.

The benefits of watercourse buffers are in fact myriad and inter-related:

> Greenbelts [i.e., buffers] along watercourses both preserve fish population and prevent damage due to flooding. Streambank vegetation in the form of overhanging shrubs, … deadfall, or roots of undercut trees and shrubs provide important escape cover for stream-resident fishes, both directly through terrestrial insects which fall into the stream from over-hanging bushes and indirectly by supplying food to aquatic invertebrates in the form of leaves and twigs which fall into the stream. Trees, bush and grasses on the streambanks stabilize the soil along the shore, inhibiting erosion during high discharge periods. The vegetation also acts as a filter ot runoff water, both slowing its rate and removing some of the suspended sediment. Shade from streamside vegetation has been demonstrated to have an important moderating effect on stream temperature.[23]

Watercourse buffers are discussed in the CBRM MPS, and implemented in the LUBs prepared by the EDPC for St. Peter's and Sporting Mountain. They are becoming an increasingly common feature of planning strategies and land use bylaws across Nova Scotia. Determining appropriate buffer setbacks in relation to the key characteristics of the lands that affect receiving waters is a key objective of the current study.

[23] Canada Fisheries and Oceans, *Urban Development Guidelines for Protection of Fish Habitat in Insular Newfoundland*, St. John's, Newfoundland, March, 1983, Appendix 2.

Examination of standards adopted in other jurisdictions shows a very wide range as suggested by data in **Table 3.2** taken from a document prepared by the District of Muskoka. The Muskoka report suggests that "[t]he effectiveness of buffer widths in maintaining water quality … generally increases with buffer width." It also states that "there appears to be a consensus that 30-metres achieves a broad range of desired outcomes" but then suggests that a 30-metre buffer may not be adequate to ensure appropriate nutrient levels to meet drinking water standards. The report also notes that slopes may influence the effectiveness of buffers given higher levels of erodibility.[24]

Function	Recommended Buffer Width
Bank Stability	• Minimum 20-30 m
Maintenance of Benthic Communities	• 30 m
Reduce Fecal Coliforms	• 30 m • 23-92 m
Nutrient Reduction	• 10-36 m
Sediment Removal	• 30 m • 3 m (sand), 15 m (silt) 122 m (clay) • 75% removal in 30-38 m • 50% deposition within 88 m
Wildlife Habitat	• 30 m • 75-200 m (birds, small & large mammals) • 30-100 m (beaver)

Source: District of Muskoka Planning and Economic Development Department

Table 3.2: Recommended Widths for Vegetative Buffers in Relation to Buffer Function

The Muskoka document, many other studies on watercourse buffers, and many adopted regulations, furthermore, recommend a sequence of buffer layers to which different regulations should be applied. These divisions, very generally, may include the following:

- The watercourse itself in which boating activities, particularly motorized boating, may be regulated if not prohibited;
- The immediate banks of the watercourse in which building is usually severely restricted and the maintenance of natural vegetation is encouraged if not required;
- A secondary area abutting the banks in which managed activities such as forestry operations may be permitted or, in more urban situations, in which specific buildings may be permitted.

[24] District of Muskoka Planning and Economic Development Department, *Shoreline Vegetative Buffers*, October 2003, pp. 4-6. The original table from which **Table 3.2** is derived includes references for the buffer widths cited.

The last area may extend to the entire watershed, particularly if the water body in question is used as a drinking water supply.

On the Bras d'Or Lakes, sea level rise and storm surge are a supplementary reason to reserve land on lakeshores. As noted, HRM has recently adopted a base level elevation for residential development outside its key harbour areas. Watercourse buffers adopted primarily to filter sediments and hazardous materials before they reach a watercourse will most certainly overlap areas that may be inundated by future sea level rise. Sea level rise, however, is an unwanted interaction between water and land, whereas watercourse buffers address undesirable impacts of land on water. The interaction of both factors was an important consideration in our assessment of buffers.

3.2.3 Wastewater Management Districts

Section 342 of the *Municipal Government Act* empowers municipal governments to create wastewater management districts (WMDs). According to the Service Nova Scotia and Municipal Relations (SNSMR) summary on WMDs in the *Local Government Resource Handbook*:

> Wastewater management districts (WMD) are areas established by a municipality (similar to a sewer district, but) within which it has the power to manage all wastewater disposal systems both public and private (ie individual, onsite sewage disposal systems). This means that in a WMD a municipality has the power to enter onto private property for purposes of inspecting, repairing, upgrading or replacing wastewater systems (usually septic tanks &/or soil absorption systems). It also has the power to establish charges, in a manner similar to those in a sewer district, to carry out the above noted duties.[25]

WMDs may be required in areas where the density of development combined with local soil characteristics has resulted in the failure of septic systems. In the Bras d'Or Watershed the approach may also be beneficial to address areas of denser development where sewage is directly discharged to watercourses and alternative collection methods are desirable. Lastly, they offer a potential mechanism to manage new methods of communal servicing associated with Low Impact Development.

3.2.4 Low Impact Development

Low Impact Development (LID) is a strategy that uses structural and non-structural practices to meet the technical requirements of stormwater management regulations and protect water resources. The goal of LID is to maintain the pre-development

[25] SNSMR, *Local Government Resource Handbook*, March 2003, Section 5.1- "Wastewater Management Districts - An Alternative for Sewage Disposal in Small Communities," p.2.

hydrologic regime by designing a functionally equivalent hydrologic site design. **Table 3.3** lists a range of practices employed to help meet LID goals.

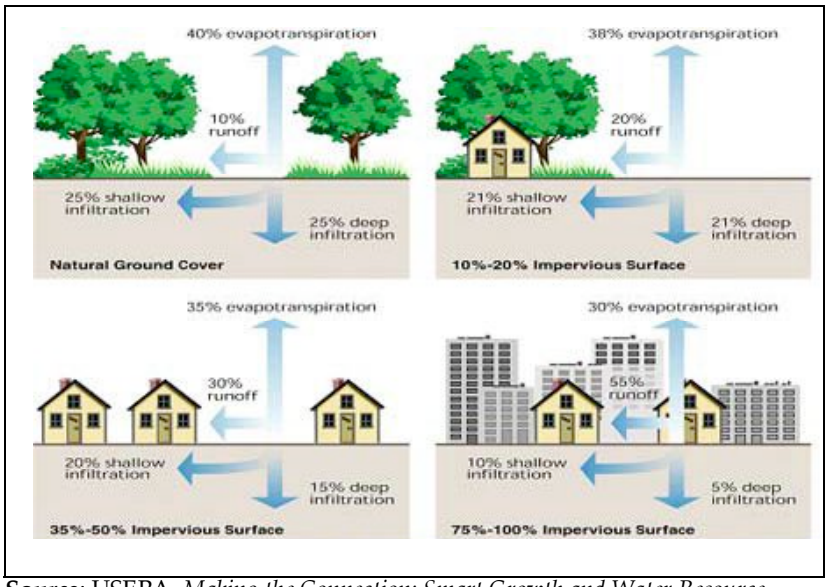
Practices	Examples
Open Space Design	Cluster development
	Open space preservation
	Reduced pavement widths (streets, sidewalks)
	Shared driveways
	Reduced setbacks (shorter driveways)
	Site fingerprinting during construction
Infiltration	Infiltration basins and trenches
	Porous pavement
	Disconnected downspouts
	Rain gardens and other vegetated treatment systems
Runoff Storage	Parking lot, street, and sidewalk storage
	Rain barrels and cisterns
	Storage in landscape islands and in tree, shrub, or turf depressions
	Green roofs
Runoff Conveyance	Eliminate curbs and gutters
	Create grassed swales and grass-lined channels
	Roughen surfaces
	Create long flow paths over landscaped areas
	Install smaller culverts, pipes, and inlets
	Create terraces and check dams
Filtration	Bioretention/rain gardens
	Vegetated swales
	Vegetated filter strips/buffers
Low Impact Landscaping	Plant native, drought tolerant plants
	Convert turf areas to shrubs and trees
	Reforest
	Encourage longer grass length
	Plant wildflower meadows rather than turf (medians & open space)
	Amend soil to improve infiltration

Table 3.3: Low Impact Development Practices

As **Figure 3.1** illustrates, development increases the volume and rate of runoff from a site, and reduces groundwater recharge and evapotranspiration. In response, LID uses hydrologic functions (i.e., storage, infiltration and evaporation, transpiration, and groundwater recharge, as shown in **Figure 3.2**) to control the volume and frequency of discharge through integrated and distributed micro-scale stormwater practices.

Conventional development strategies treat stormwater as a secondary component of site design, usually managed with "pipe-and-pond" systems that collect rainwater and discharge it off site. In contrast, LID embraces hydrology as an integrating

framework for site design rather than a secondary consideration. Existing conditions influence the location of roadways, buildings, and parking areas, as well as the stormwater management approach. Designers select from a range of customized small-scale source controls to reduce runoff volume. The resulting preservation of flow paths minimizes infrastructure requirements.



Source: USEPA, *Making the Connection: Smart Growth and Water Resource Protection. Growth and Water Resources*

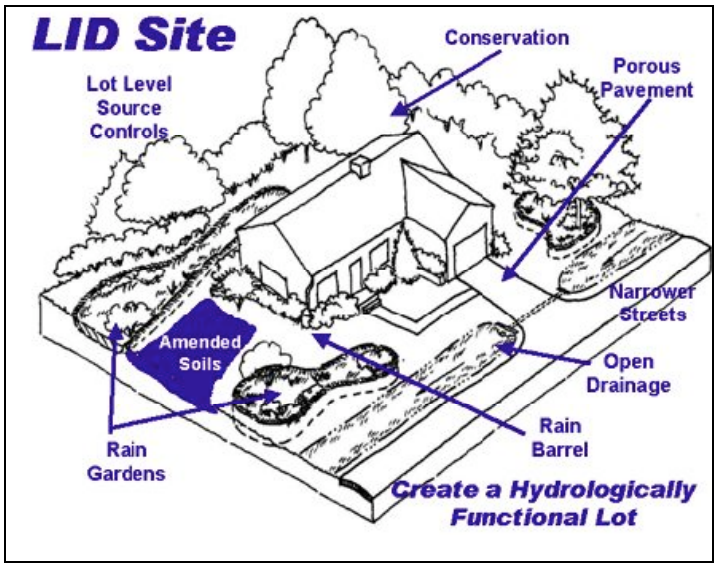
Figure 3.1: Development Impacts on Infiltration

Designers can also address LID objectives through broader, non-structural approaches that cluster development. This approach, which is often labeled "open space development," seeks to reduce surface permeability by shrinking the footprint of development.

Simply put, rather than building 10 houses on lots of one acre or more as is typically required for homes with onsite sewage disposal in rural Nova Scotia, 10 houses can be accommodated very reasonably on 2 to 5 acres of a 10-acre site, assuming an acceptable sewage disposal and treatment system can be provided. Clustering housing units reduces the required length of access roadways, driveways, and related surfaces. If buildings are developed in two or three stories rather than one, or attached as in a townhouses or apartments, roof area can also be reduced. The residual 5 or more acres created by concentrating buildings on less area, as in our example can, furthermore, be used for sewage disposal and treatment, and groundwater extraction, and/or conserved in its natural state. Where the property is adjacent to a watercourse, it is normally beneficial to reserve lands closest to the watercourse to provide a buffer and to allow residents to share the benefits of waterfront access.

Some LID site designs that seek to cluster development and reduce lot coverage may conflict with local land use regulations or public perceptions of attractive and

desirable development. Many people may consider attached and multi-story buildings as incompatible with "rural character." These individuals and others may also be influenced by the accurate perception that sufficient lot area is required to ensure effective location of onsite septic systems and to mitigate the effects of failure should it occur. Amendments to Nova Scotia's *Provincial Subdivision Regulations*, which govern development in much of the province's rural area, no longer set a minimum required lot size, but NSEL continues require at least 2,700 m^2 and generally requires more area pursuant to its testing of individual lots by NSEL.[26]



Source: USEPA

Figure 3.2: Low Impact Development Site Design Example

In clustered development, new approaches to sewage treatment such as recirculating sandbed filters, solar aquatic systems, or managed onsite systems often must be applied. Both the public and regulatory authorities need to be educated about these approaches and all concerned must gain experience in their application. Effective application of these techniques, however, should facilitate more compact development that is more affordable for homebuyers and less costly for local governments.

A major argument for both structural and non-structural LID measures is, in fact, their economy. Many valuation studies have estimated the cost savings of implementing 'green infrastructure' BMPs. The Centre for Landscape Research at the University of British Columbia, for one, has conducted extensive in-depth research. For example, they have determined that grassy swales provide significant costs savings:

[26] Prior to amendments in 1997, the *Provincial Subdivision Regulations* required all lots to be at least 1 acre (4,047 m^2). The Regulations no longer set a minimum. NSEL's current minimum is equal to two-thirds of an acre. Larger lots are required as required by soil permeability.

> Using grassy swales rather than conventional curb, gutter, and pipe design results in savings of about $8,000 per housing unit.
>
> Grassy swales cost about $70 per metre, compared to $185 per metre for conventional storm drains.

They also estimate that "green roads" using narrow widths, and attractive ditch and culvert systems to manage stormwater cost $118 per metre in BC versus $330 per metre for conventional roads with curb and gutter.[27] The reduction of road networks through clustering has similar, if not more obvious, benefits.

The United States Environmental Protection Agency (USEPA) recently completed an assessment of seventeen case studies that used LID strategies and practices to reduce stormwater management costs. They found:

> … LID practices can reduce project costs and improve environmental performance. In most cases, the case studies indicate that the use of LID practices can be both fiscally and environmentally beneficial to communities. As with almost all such projects, site-specific factors influence project outcomes, but in general, for projects where open space was preserved and cluster development designs were employed, infrastructure costs were lower. In some cases, initial costs might be higher because of the cost of green roofs, increased site preparation costs, or more expensive landscaping practices and plant species. However, in the vast majority of cases, significant savings were realized during the development and construction phases of the projects due to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping. Total capital cost savings ranged from 15 to 80 percent when LID methods were used, with a few exceptions in which LID project costs were higher than conventional stormwater management costs.[28]

The University of New Hampshire's Stormwater Centre has tested several LID stormwater systems over a diverse range of seasonal conditions.[29] These stormwater systems included bio-retention systems, tree filters, porous asphalt parking lots, sand filters, and gravel wetlands. These tests have disproven the notion that LIDs do not fair well in harsher winters experienced in cold climate regions like Nova Scotia. In

---

27 Centre for Landscape Research, *An Economic Rationale for Integrated Stormwater Management*, 2005, Part 3.0, pp. 1 and 3-4.

28 USEPA, *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, December 2007.

29 University of New Hampshire Stormwater Centre, *2007 Annual Report*, pp. 12-21.

fact, all of the tested LID stormwater approaches exhibited excellent water quality treatment and peak flow reduction year round.

3.3 MUNICIPAL IMPLEMENTATION OF BMPS

Land use planning provides powerful yet cost-effective options for dealing with development and its impact on water resources. As discussed in **Subsection 2.5.1**, above, plans can comprehensively address a wide variety of issues set out in Section 214 of the MGA, including most of the approaches to water resource protection outlined in this Chapter.

Watercourse buffers, for example, can be addressed through policy permitted under Section 214(1)(c) of the MGA for "the protection, use and development of lands … subject to flooding, steep slopes, … erosion or other geological hazards, swamps, marshes or other environmentally sensitive areas." Buffers, furthermore, are well-suited to incorporation in LUBs either as conservation zones or as overlays applicable to specific portions of properties (i.e., along riverbanks and shorelines) in which development is restricted. Bylaws may also implement more complex procedures such as site plan approvals or development agreements that allow the municipal Council in question to consider developments in the context of provisions that usually combine quantitative restrictions (e.g., prescribed setbacks or coverage limits) with consideration of policy concerns (e.g., impacts on adjacent properties and/or on the environment).

Other approaches may be implemented directly from policy that encourages specific municipal action, as, for example, the CBRM MPS encourages CBRM Council to adopt WMDs for developed areas within water supply watersheds. Initiatives for public investment and/or public education may also be encouraged by policy, although such policies do not, in practice, guarantee implementation.

Finally, Council may implement MPS Policy and other municipal intentions through other bylaws. Subdivision bylaws are particularly important for water resource protection because they set standards for development of infrastructure required to support land development. Subdivision standards, for example, are probably at least as relevant as LUB requirements to the implementation of LID. Other bylaws that may be useful to protect water bodies include bylaws pertaining to building codes, lot grading, topsoil removal, animal control, and application of pesticides. These bylaws may be developed pursuant to or independent of MPS policies. All Cape Breton municipal units have building and subdivision bylaws, and several have other relevant bylaws that contribute to the protection of water resources or could do so. **Table 3.4** below summarizes common land use controls and other municipal options for water resource protection.

Type of Land Use Control	Examples
Direct policy implementation (MPS)	- Adoption of Wastewater Management Districts for developed areas within water supply watersheds - Encourage initiatives for public investment and/or public education
Land Use Bylaw (LUB) Regulations	- Zones for specific land uses or land restrictions - Watercourse buffers - Site plan approvals and development agreements
Subdivision Bylaw	- Set standards for development of infrastructure required to support land development, such as facilitating or requiring low impact development through specification roadway, parking area, and driveway standards
Other Bylaws and Regulations	- Building Codes - Lot Grading - Topsoil Removal - Wastewater Management District - Animal Control - Pesticide Application

Table 3.4: Land Use Control Examples for Water Resource Protection

Many municipal units in Nova Scotia have adopted land use controls to protect water resources. Truro and Antigonish, which are prone to serious flooding from watercourses listed in the Statement of Provincial Interest on Flood Risk Areas, have implemented Floodway and Floodway Fringe Zones. Many municipalities, including CBRM and several of the municipal units under the jurisdiction of the EDPC, have adopted wellfield protection zones and regulations to limit development in surface water supply areas. Some have developed "single purpose planning strategies" for rural areas specifically to address wellfields or surface water supply areas. Watercourse buffers have also become commonplace in LUBs. Some municipal units have also begun to implement measures in planning strategies and subdivision bylaws to encourage LID, notably through open space subdivision (see: **Subsection 2.5.1**, above).

Certain Nova Scotia municipal units have also adopted Lot Grading and Topsoil Removal Bylaws, which directly regulate land development practices that may influence stormwater generation and soil transport to watercourses. Others also have animal control and pesticide application bylaws, which among other concerns attempt to reduce the potential of deleterious materials reaching watercourses (e.g., chemicals and animal feces). Only three municipal units in Nova Scotia have adopted Wastewater Management District Bylaws to date and, although all Nova Scotia municipalities have building codes, there is little evidence that any have significantly altered code requirements to address watercourse protection.

3.4 STRATEGIC INTERVIEWING PROCESS

While there is a vast array of available development BMPs, not all are appropriate for application in every situation. While our customized GIS analysis assisted us in developing our initial list of model BMPs specifically appropriate to the Bras d'Or Watershed, we also interviewed key staff at various levels of government in Canada and the United States concerning the development, implementation, monitoring, and effectiveness of BMPs for water resource protection within their respective jurisdictions. These interviews helped EDM to identify BMPs that have yielded the best results, as well as common challenges to the implementation or effectiveness of BMPs.

We interviewed twelve individuals from the ten key regulatory agencies and interest groups, as listed in **Table 3.5**. EDM developed a loose interview outline, provided in **Appendix A**, to guide these inquiries. Interviews generally took 15 to 30 minutes each and were conducted by telephone. Two key individuals interviewed work in the development and implementation of BMPs within an estuary-focused watershed similar to the Bras d'Or Lakes, and have been monitoring the effectiveness of BMPs for many years. EDM staff also conducted additional, less formal interviews with planners employed by the Province of Nova Scotia and HRM, as well as with the planners with CBRM and EDPC on the Steering Committee for this assignment.

Contact	Organization	Interview Completion
William Hart	Centre for Water Resources Studies, Dalhousie University	Full
Tony Blouin	Manager of Environmental Policy, Environmental Management Services, HRM	Full
Derrick Hammond	Director of Planning Services, District of Muskoka Planning and Economic Development Department, Ontario	Full
Michael Lott	Planner, Environmental Planning and Wetlands, Stafford County, Virginia	Full
Daniel Savard	NSEL, Integrated Planning Section	Partial
Jonathon Burtt	Water Planning Section, Province of New Brunswick	Full
Brook Harker	Watershed Evaluation of BMPs Manager, Agriculture Canada	Full
Paula Estornell	Environmental Protection Agency, Water Protection Division (Chesapeake Bay), Stormwater Protection Manager	Full
Stephen Venezia	Environmental Protection Agency, Water Protection Division, Stormwater Protection Manager	Full
Margarita Chatterton	Rhode Island Department of Environmental Management. Office of Water Resources, Permitting Section (Naragansett Bay)	Partial
Rob Roseen	University of New Hampshire Center for Stormwater Technology Evaluation and Verification (CSTEV)	Partial
Thelma Murphy	Environmental Protection Agency, Water Protection Division, Stormwater Protection Manager	Partial

Table 3.5: Interview Contacts

Interview responses are summarized below. The purpose is not to list each comment verbatim, but rather to delineate the dominant themes of concern and support regarding BMPs for water resource protection.

3.4.1 Critical BMPs for Water Resources

Given the wide breadth of BMPs available for protecting water resources, most interviewees were unable to list specific BMPs that they felt were the most important. However, low impact development strategies, vegetated watercourse buffers, erosion control, and urban stormwater were all highlighted as very important considerations, particularly in terms of nutrient management. One interviewee provided a lengthy commentary on subdivision requirements that took into account open space development. Generally, respondents advocated a proactive approach through source prevention over clean-up options. Furthermore, most indicated that the synergies created by a combination of several BMPs addressing different development or land use activities will provide the best protection of water resources. Several interviewees noted that BMPs must be measurable in some way.

As each situation has unique features, local conditions should dictate the options available to the designer. For example, there are some concerns about outdoor engineered wetlands in cold climates, and porous concrete can usually only absorb up to about 1.5 inches of rain, so heavier wet weather events will result in runoff to storm drains. One interviewee noted a favored approach for implementing BMPs in a specified sequence:

- *Conserve* – implement as many BMPs as possible that will reduce or prevent runoff from development areas for your project
- *Minimize runoff* – reduce imperviousness of the subject site
- *Slow runoff* – apply BMPs that slow runoff (keep post-development time of runoff as close to the predevelopment time as possible)
- *Store runoff* – employ as many BMPs as possible for storing the runoff
- *Prevent pollution* – inform people in the area regarding pollution prevention and maintenance of BMPs in support of an overall Low Impact Design (LID) approach.

The Government of Ontario and the USEPA provide an abundance of specific information on how to apply BMPs in different climates.[30]

[30] See for example: Ontario Ministry of the Environment, *Stormwater Management and Planning Manual,* March 2003 and USEPA, *Using Smart Growth Techniques for Stormwater Best Management Practices*, December 2005.

3.4.2 Structural v. Non-structural BMPs

Nearly all interviewees supported balanced application of both structural and non-structural BMPs. Several interviewees, nevertheless, expanded on the relative strengths and weaknesses of BMPs in each category. Several noted that structural BMP's are easier to implement as they can be more readily included in the conditions of a development approval or permit and do not require the same degree of oversight. For example, a riparian buffer, implemented as part of a subdivision development plan, is permanent and easy to audit, whereas a BMP such as contour terracing of steeply graded agricultural land requires a shift in a farmer's land use practice that may not occur in the absence of inspection and enforcement mechanisms.

Other interviewees noted the benefit of so called "Green Infrastructure" measures such as green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips, reforestation, and protection and enhancement of riparian buffers and floodplains through supplementary planting. These landscape and planting approaches tend to cost less to build and maintain than traditional hardscape collection, conveyance, and storage structures because they generally require less earth moving and construction. On the other hand, effective Green Infrastructure often requires designers with detailed plant and soil knowledge.

3.4.3 Burden of BMP Implementation

Again, a balanced approach is often appropriate with responsibility for BMP implementation, monitoring, and maintenance being shared between both municipalities and developers. Many Nova Scotia municipalities place the burden of structural BMPs on developers through development agreements and bylaw provisions. Infrastructure charges, which are common in Ontario and Western Canada, and being used by HRM in Nova Scotia, are usually applied on a per acre basis to recover the costs of shared infrastructure. These fees generally relieve municipalities of major capital costs, although local governments still have to maintain infrastructure in the long-term.

The administration of non-structural BMPs normally falls entirely on municipal government but the costs are usually modest. For the most part, both implementation and administration of these measures is subsumed in the overall processes of municipal planning and land use regulation, and, to a lesser extent, municipal engineering. The primary challenge is that enforcement of all planning requirements tends to focus on the development phase. At other times, enforcement is largely complaint driven. Proactive enforcement is probably beyond the capacity of most local governments.

Some interviewees maintained that structural BMPs are more the developer's responsibility, such as provision of green space for stormwater control or even educating homeowners in a new development about appropriate maintenance of onsite sewage systems. Others, however, acknowledged that municipalities are more effective administrators and promoters in the long-run. Many Nova Scotia municipalities, for example, provide educational information in municipal offices concerning onsite system maintenance and similar matters, or mail reminder notices or advice with utility or tax bills. Local governments can require that land on which stormwater infrastructure is built be deeded to them for their management and maintenance. Municipalities can also establish WMDs through which their staff can oversee the management and maintenance of individual septic systems for a fee collected through user charges or area rates.

3.4.4 Implementation at the Local Government Level

Ontario's District of Muskoka is similar to the Bras d'Or Lakes region in terms of its population and the distribution of development through many serviced and unserviced waterfront communities. The District has implemented watercourse buffers, septic system monitoring policies, and subdivision requirements that support open space development. Despite the scope of recent regulations, which are components of Muskoka's Lake System Health Program, the Director of Development Services noted that no substantial challenges were encountered incorporating these policies into Muskoka's Official Community Plan, site plan approvals, zoning provisions, or development permits. Planners with HRM also stated that they did not meet substantial resistance to measures to buffer watercourses and to limit building in areas potentially subject to sea level rise.

On the other hand, a planner at Stafford County, Virginia, referred to his state as "developer friendly … with a strong development industry," and correlated this with sometimes high levels of opposition against environmental regulation. Stafford County, which is similar to the Bras d'Or Lakes area in terms of its interrelationship with an extensive estuary with significant clay and silt soils. Virginia's *Chesapeake Bay Preservation Act* mandates 100-foot buffers on all perennial streams and wetlands or floodplains associated with perennial streams. Stafford County is proposing additional buffer requirements of 100 feet on all intermittent streams and slopes greater than 15 per cent in portions of the county close to the bay. In addition, Stafford County is proposing an additional 35-foot setback between the buffer and building structures to allow yard space for activities other than passive recreation, which is permitted in buffer areas.

The *Chesapeake Bay Preservation Act* also mandates that onsite septic systems have a backup system capable of handling similar amount of flow should the primary system fail. While the State of Virginia approves onsite systems, the municipal

government can regulate placement of the system on site (i.e., outside of the 100-foot riparian or shoreline buffer). In addition, Stafford County mandates that all properties must employ LID approaches, unless the developer demonstrates that LID is not suitable on the site for biophysical reasons.

While it helps that the state supports the County's water resource regulations, the Stafford County planner consulted noted that it is generally a struggle to pass regulations. He added that education is key to reduce opposition to environmental protection on private property. While most education occurs at the state level, Stafford County is active in providing educational brochures and public presentations concerning new environmental regulations.

Administration of measures of this type is still limited. Many jurisdictions have had watercourse buffers or flood plain controls in some form for a decade or more. Few have had restrictions to address sea level rise. In form, all of these types of regulation are similar to typical zoning regulations for different land use types. In most cases subject areas are identified on a municipal zoning map and often on supporting mapping of environmental features and constraints. Restrictions normally exclude specific land uses as would any zone regulating land use, such as an R-1 zone for single-unit housing. The range of excluded land uses is normally much broader, however, frequently restricting nearly all structures. Nevertheless, such strict limitation on land use has long-term precedents in Holding and Conservation zones, which have been a common feature of bylaws in Nova Scotia and elsewhere since at least the 1970s.

Where watercourse and coastal zone restrictions may differ from zoning standards for built land uses is that they are linear and frequently overlay only portions of properties. Buffers, also, often attempt to maintain watercourse and coastal lands in their natural state by prohibiting the removal of vegetation. Challenges have been raised in some areas to the universal application of uniform buffers where slope and soil type vary. Farmers sometimes raise objections to restrictions on the basis that they reduce the economic value of land, particularly the potential to cultivate fertile riparian areas. Other property owners may object where buffers restrict the area available on their property for construction and variance procedures may be necessary to accommodate this.

Local government planning, development, and building departments are usually effective in regulating the location and form of buildings in relation to regulations, and in overseeing construction processes. They generally do not have the staff to regulate activities effectively after the construction period. Fortunately, Provincial legislation in Nova Scotia, as discussed above, is very supportive of buffer measures encouraging the requisite municipal policy measures and providing additional

legislative protection, particularly with respect to tree cutting. Other provinces and states provide similar support, which is probably essential to effective enforcement of day-to-day conservation requirements. Several of the municipal planning staff interviewed argued that staff resources must be increased as new ordinances are put into place, as there will inevitably be more need to oversee the new regulations, provide education, and enforce them.

3.4.5 Cost Savings

Green infrastructure and LID activities are often promoted as cost savers, an assertion backed by many studies consulted for this assignment. As noted above, Green Infrastructure generally requires less earth moving, material inputs, and construction requirements. In addition, appropriate use of BMPs should avoid costs of remediating problems that may develop later.

One interviewee, however, noted that education is essential to support innovative techniques. If, for example, a new development is serviced through onsite systems but landowners are not informed about appropriate use and maintenance, systems may fail and landowners may end up paying more to replace or repair their systems than to maintain it properly. One solution to this that has been successfully implemented in some municipalities in Oregon and California is the establishment of regular septic system maintenance by the local municipality. As the homeowner should pay every few years for maintenance already, collection of a tax by the local government can ensure that maintenance is performed as required for the mutual protection of all property owners. This approach is well suited to implementation through WMDs in Nova Scotia.

One interviewee maintained that private landowners should not be charged to implement BMPs. He noted that the Province of New Brunswick requires a trust fund to cover costs while only asking for owner permission.

The Chesapeake Bay watershed covers five states and is one of the largest watersheds in the United States. A recent study concluded that developed lands within the Chesapeake Bay Watershed contribute less than one-third of the pollution loading in the Bay, but would require approximately two-thirds of the overall restoration costs. The most cost-effective approach to reverse the trend of increasing pollutant loads from new development is by forming strong partnerships with communities to encourage them to adopt and implement more environmentally sensitive development techniques.

3.4.6 Monitoring

Interviewees made several points regarding appropriate monitoring of BMPs, such as:

- The importance of monitoring the environment wherever possible before development takes place or before BMPs are implemented, or that as much baseline information is collected as possible. The challenge following development, otherwise, is to determine how much change was a direct result of the development or attributable to other factors. Appropriate BMP implementation requires specific education and funding, combined with deployment of approaches suited to each situation. BMPs have sometimes been improperly employed especially when funding dries up.

- BMPs need regulatory punch, such as permits, wherever possible to ensure they are used – and used appropriately. HRM, for example, has required developers subject to development agreements to monitor stormwater flows both before and after development.

- Maintenance is an issue with structural BMPs if it is not clear who carries the maintenance costs after they are built. Some interviewees maintained that developers should implement BMPs and put money up front for their maintenance or create a maintenance fund for municipalities to use down the road.

- Fiscal constraint is an issue and while regulations may exist, they are of limited use if no data is being gathered, and monitoring data is not being collected and assessed.

- It is important to ensure that standards are realistic so that they can be met and have more support to implement them.

- BMPs must be in place for at least 7 to 8 years before scientific proof can be obtained, and proof is often needed to continue with studies.

- Different indicators for BMP success can be water quality, benthic invertebrates, phosphorous, nitrogen, etc. A positive measurement in one indicator does not necessarily indicate success because BMPs may have negatively affected another indicator. Choices must be made up front about the criteria and priorities of a healthy environment.

- The Virginia Department of Environmental Quality is responsible for extensive water quality sampling, and uses the Total Maximum Daily Load (TMDL) method of calculating the maximum amount of

a pollutant that a waterbody can receive and still meet water quality standards, and allocates certain amounts to different pollutant sources.

- It is difficult to test BMPs outside the lab, in a natural environment, where there are many influencing factors.

Interviewees provided many reasons for some BMPs not meeting all expectations:

- If an effective BMP is applied to too small an area or in an improper location (e.g., to reduce phosphorous loading to a lake, areas in close proximity will have a bigger impact than sites farther away).

- If a BMP is not appropriately suited to the physical features of the landscape such as slope, vegetation, distance to water, soils, or plant composition of the buffer strip itself.

- If there is incomplete understanding or testing of a BMP in various locations. For example, a buffer strip is often an area of very high density plant material that if allowed to decay, as it often does, can become a source of damaging soluble phosphorus.

- If a BMP is tested on small parcels of land rather than within a larger watershed, or modelling is insufficient to assess its performance in an extensive area.

3.4.7 Key Changes to Water Resource BMPs

Many interviewees noted the marked increase in public awareness of environmental issues over the last decade. As a result, BMP's are now more readily accepted and implemented by landowners, municipalities, and developers. Indeed, BMP's are constantly being "tweaked" to adapt to changing climate, advancing scientific knowledge, and public concerns. Watercourse buffers, for one example, have become increasingly widespread and have expanded in some cases, but have also become more refined (i.e., account for considerations such as slope and soil erodibility). They are also now being considered to address growing concerns with climate change.

Interviewees also noted the shift from structural to non-structural BMPs over the past 20 years. As noted, non-structural approaches are perceived to be relatively low cost and, besides, work well in concert with structural practices. In some respects, non-structural techniques are "catching up" with significant assistance from organizations such the as USEPA, which recently launched a Green Infrastructure Action Strategy and has for seven years maintained a "National Menu of BMPs"

addressing non-structural stormwater management techniques under the following headings:

- *Public Education* - BMPs for MS4s [municipal separate storm sewer systems] to inform individuals and households about ways to reduce stormwater pollution.
- *Public Involvement* - BMPs for MS4s to involve the public in the development, implementation, and review of an MS4's stormwater management program.
- *Illicit Discharge Detection & Elimination* - BMPs for identifying and eliminating illicit discharges and spills to storm drain systems.
- *Construction* - BMPs for MS4s and construction site operators to address stormwater runoff from active construction sites.
- *Post-construction* - BMPs for MS4s, developers, and property owners to address stormwater runoff after construction activities have completed.
- *Pollution Prevention/Good Housekeeping*- BMPs for MS4s to address stormwater runoff from their own facilities and activities.[31]

3.4.8 Functional Responsibility

Implementation of BMP's can involve all three levels of government, the private sector, and the public. As discussed above, the Province implements BMPs through legislation applicable to municipalities and the public. It also directs its own actions through policy and operational guidelines applicable to its staff. The Provincial Department of Transportation and Infrastructure Renewal, for example, adopted an "environmental policy" in 2000 that committed, among other things, to "[e]ncourage participation by all departmental employees in using best management practices and protecting and promoting environmental responsibility."[32] The Federal Government similarly encourages good practice by its departments and by junior governments, often through funding support.

---

31 USEPA, "National Menu of Stormwater Best Management Practices," http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm accessed February 28, 2008.

32 Nova Scotia Transportation and Public Works, *Generic Environmental Protection Plan (EPP) for the Construction of 100 Series Highways*, July 2007, p. I-1.

Within municipalities, engineering and planning are the primary line functions that influence the use of water resource BMPs. Engineering departments have a particularly strong role in defining and implementing structural BMPs as designers, managers, and overseers of municipal stormwater infrastructure. They also have a key role to play in the current trend from hard infrastructure to Green Infrastructure, since development engineering staff are generally responsible for approving stormwater management techniques specified by developers.

Planning staff also influence this trend through their control over municipal planning policy, which can encourage or even require innovative structural approaches. The more direct role of planners, however, is in the development of land use oriented non-structural measures, which are likewise initiated in policy documents but are normally implemented in LUBs or through development approval processes such as development agreements or site plan approvals.

Ultimately, responsibility for encouragement and implementation of BMPs is widespread at all levels of government. All departments that own and develop land and infrastructure have an obvious and direct role. In addition to engineering and public works functions, parks and recreation departments can have considerable influence through appropriate construction practice sand through the role of parks and open spaces in buffering watercourses. Other departments and agencies may have similar if smaller parts to play as role models, and in the dissemination of information on good practice.

4.0 GIS ASSESSMENT AND VISUALIZATION

Many North American jurisdictions have developed and successfully applied guidelines and regulations to protect water resources. A review of these best practices has been helpful in determining leading standards and guidelines. While general best practice recommendations are easy to find, a clear danger lies in directly applying BMPs developed for one jurisdiction to another. For example, the best practice chosen to increase infiltration and therefore reduce runoff in an area with highly pervious soils (e.g., high sand content) may be to create retention ponds or rain gardens. However, this could be ineffective in a location with less permeable soils (e.g., high clay content). In the second instance, a more appropriate BMP may be to build storage ponds that can filter and then release captured water into the receiving waters at a quantity that is equivalent to the natural hydrological system.

4.1 GIS DEVELOPMENT AND ANALYSIS

To assess the influence of potential best practice measures appropriate for the Bras d'Or Watershed, EDM assembled a customized GIS. Consideration of physical and land development characteristics within the watershed provided a clear understanding of the context in which best practices may be applied locally. **Table 4.1** describes the many data sets incorporated in our GIS. These map layers allowed us to determine potential challenges and facilitating factors associated with implementation of leading best practices in the Bras d'Or. These GIS analyses took into account local soils, topography, forest cover, watershed boundaries, anticipated climate change impacts, and known water quality issues.

GIS-based suitability analysis was the core assessment tool applied. Suitability analysis is a method of finding the best areas in a landscape to support a specific land use or group of land uses. It is also useful for determining areas at risk from factors such as sea level rise or wastewater problems. For example, it is possible to determine how much of the watershed portion of a county would be affected by specific buffer recommendations, as well as what proportion of an area at risk from sedimentation or climate change impacts would be mitigated by implementation of a specific buffer. We can also overlap several recommended buffers identified for different reasons (e.g., erosion control and mitigation of sea level rise or storm surge) and to determine a comprehensive buffer width or boundary to capture an appropriate percentage of land covered by all of the recommended buffers.

To do this, layers of spatial data are modeled or ranked to produce a map showing the most or least suitable locations in relation to the attribute being considered. **Figure 4.1** illustrates this process for a sample water protection model written by EDM and published by Environment Canada in 1996 (joint copyright, EDM •

Environmental Design and Management Ltd. and the Government of Newfoundland and Labrador).

Data Layer	Description
Base Map	The base map was prepared from a digital topographic base. It includes streams, lakes, rivers, wetlands, vegetated areas, and infrastructure such as roads, buildings, and rail lines.
Property Boundaries and Ownership	Supplied by Service Nova Scotia and Municipal Relations (SNSMR). The information was used to assess the configuration of lots in the onsite septic system failure model.
Watersheds	Provided by SNSMR. The information was used to weight watersheds that drain to sensitive bays in residential suitability model.
Wetlands	Obtained from Nova Scotia Department of Natural Resources (NSDNR). The information was used to determine proximities to water resources.
Watercourses and Waterbodies	1:10,000 watercourses and waterbodies provided from SNSMR. The data was used to determine proximities to water resources.
Soils	Soils of Nova Scotia are mapped by Agriculture Canada. The study area's soils are mapped and described in a report for the Cape Breton region that includes descriptions of the drainage, slope category, depth of soils, and parent material. This information was used in relation to erodibility, wastewater, and stormwater analyses.
Topography	Slopes were calculated using data provided by SNSMR. This DEM was also used to calculate detailed contours for the site and provide insights relating to erodibility, wastewater, and stormwater analyses.
Forest Inventory	Forest cover data was provided by NSDNR. The information was used to help identify preferred areas for development in the residential suitability model.

Table 4.1: GIS Map Layers

The basic methodology involves combining GIS data with multi-criteria decision-making techniques. Scores are assigned to the individual criterion or data layer being considered and then weights are applied. For this project, the following formula was at the core of the spatial analysis:

*((Layer1 * (weighting factor)) + (Layer2 * (weighting)) + (Layer3 * (weighting)) = OVERALL SCORE*

In other words, when considering areas most likely to contribute to sedimentation or siltation of watercourses, the formula rated areas of land based on their erosion potential and proximity to watercourses and water bodies. The formula looked like this:

*((Precipitation + Soils + Slope Length) * (weighting factor of 0.8, 0.5, or 0.1)) = OVERALL SCORE OF CELL*

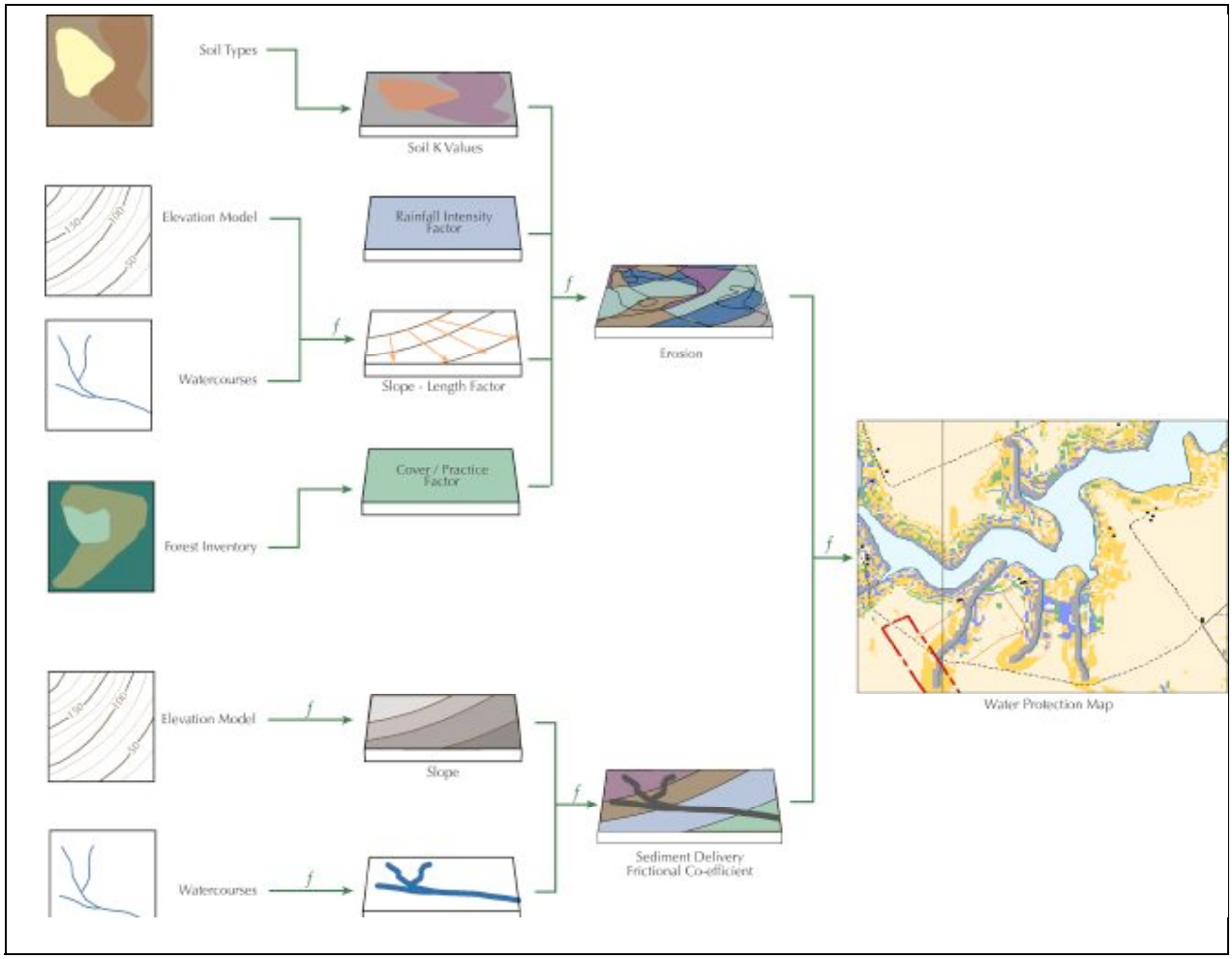


Figure 4.1: Sample Suitability Analysis for Water Quality Protection

Specific criteria and their respective weights were developed and refined throughout the analysis as needed through a literature review and discussions between team members (**Table 4.2**).

Model	Factors	Rating (Low Score Best)	Weight Applied
USLE	Precipitation	2100	N/A
	Soils (K factor)	K Factor	N/A
	Length of Slope	Metres	N/A
Sedimentation	USLE	Unmodified	- If Within 100 metres, Watercourse Buffer = 0.8 - If Greater Than 5% Slope and within 200 metres, Watercourse Buffer = 0.5 - Water Features Beyond 200 metres = 0.1
Residential Suitability	Drainage	1-10 (based on soils)	N/A
	Proximity to Roads	0-5	N/A
	Watershed that drains to a sensitive bay	0, 5	N/A
	Slope	1-4	N/A
	Sedimentation	1-10	N/A
	Vegetation Cover	1-3	N/A
	Slope Direction	1-3	N/A
	Till Thickness	1-10	N/A
Onsite Sewage Failure	Lots within 210 feet of another (based on width/proximity)	1-10	N/A
	Drainage	0, 5	N/A
	Till Thickness	0, 5	N/A
	Slope	0, 5	N/A
	Proximity to Water	Unmodified	- If within 100 metres, Watercourse Buffer = 0.8 - If greater than 5% slope and within 200 metres, Watercourse Buffer = 0.5 - Water features beyond 200 metres = 0.1

Table 4.2: Suitability Analysis Model Characteristics

4.2 SUITABILITY ANALYSIS

EDM assessed four leading potential initiatives for watercourse protection outlined in **Section 3.2**, above:

- Suitability of Lands for Development
- Watercourse Buffers
- Wastewater Management Districts
- Low Impact Design

These four initiatives were chosen for GIS analysis as a direct result of research that identified water resource issues in the Bras d'Or Lakes Watershed (**Section 2.4**). EDM applied GIS models employing suitability analysis methods as described in the preceding section to assess the first three methods. A standard Stormwater Management Model (SWMM) was applied to evaluate the impact of reducing impervious surfaces and implementing mitigation measures for remaining impervious surfaces. The model assessed the subsequent changes in runoff generated when comparing conventional development versus Low Impact Development strategies for reducing impervious surfaces and increasing infiltration.

4.2.1 Suitability of Lands for Development

Land suitability assessment as just described is the ideal technique to identify locations that are most readily developed within the watershed and whose development is likely to have the least impact on watercourses. Within our GIS, we assessed lands based on both development criteria (e.g., access to roads, south facing slopes) and environmental features such as drainage, slope, soil erodibility, the proximity of erodible soils to watercourses and wetlands, the presence of wetlands, and the sensitivity of receiving waters.

We made several assumptions when choosing the factors that went into the model and their subsequent relative importance to the model. We assumed that:

- Access to roads makes land more suitable for development because there is less requirement for infrastructure development and/or improvement;
- Lands that drain into known sensitive bays are less suitable for development given their potential for increased detrimental impact on already stressed water resources;
- The greater the slope of the land, the less suitable land is for development due to increased cost of grading and increased chance of erosion and subsequent sedimentation of water resources;
- Increased till thickness makes land more suitable for development due to better onsite sewage system performance and better drainage (resulting in less runoff to surface waters), as well as lower construction costs;
- Southern, southeastern, or southwestern slopes make land more desirable for residential development due to better lighting of structures and solar energy gains; and
- Hardwood or mixed forest cover makes land more desirable for residential development due to its aesthetic value and, in some cases, their associated improved soil drainage characteristics.

The results of GIS modeling are presented in **Map 2** in **Appendix B**. Areas most suitable for residential development within the watershed are indicated by the darkest green colour on the map. Less suitable areas are represented in shades of brown with the darkest brown suggesting the least suitable areas.

Figure 4.2 shows only areas in the two highest categories of residential suitability. The model takes into account some measures of desirability and marketability so it is not surprising to find that the areas of highest suitability are generally close to the lakes. The most extensive tracts of this higher rated land are on the northeast and eastern shores of Great Bras d'Or and on the shores of West Bay on Bras d'Or Lake, as well as in the area around Iona and Christmas Island. The most notable centres of population in areas rated less suitable are the Villages of Baddeck and Whycocomagh, which are less suitable areas for onsite development. Baddeck, however, has its own central water and sewer system.

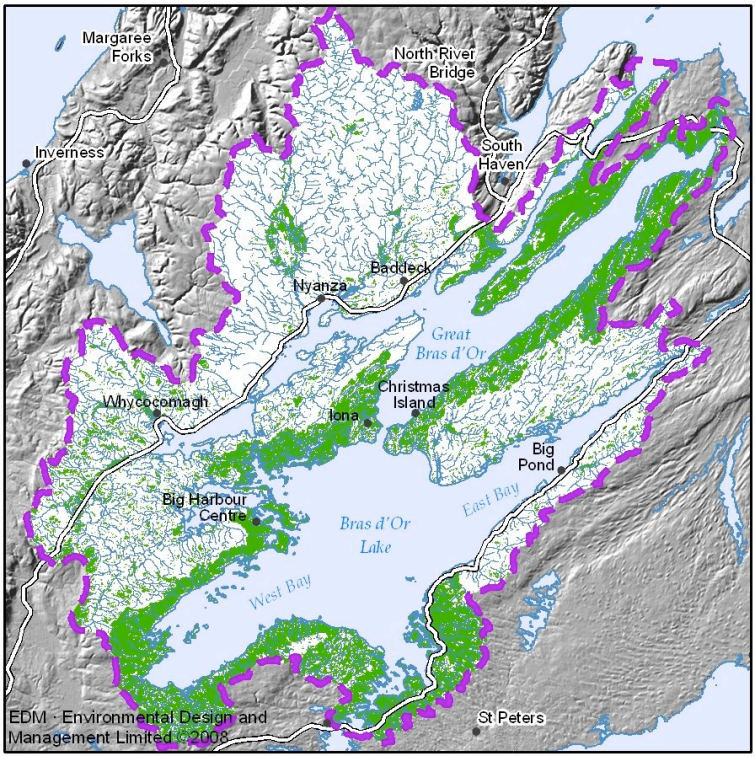


Figure 4.2: Most Suitable Lands for Residential Development, Bras d'Or Lakes Watershed

Lands identified as less suitable for development are the north side of the Great Bras d'Or Channel; the highland areas flanking the Baddeck River and its various tributaries north of Baddeck; the lands flanking Whycocomagh and the peninsula on the south side of Whycocomagh Bay, as well as lands along the north and south shores of East Bay. These are generally areas of steeper slope, are less accessible via the current road network, and/or are lands located on known sensitive bays. The highland areas are also frequently characterized by wetlands. Upstream of Baddeck, most of this land is owned by the Crown. The Province is, in fact, the predominant owner of upland areas throughout the Bras d'Or Watershed.

Figure 4.3 provides percentages of land rated at varying levels of suitability to development, and hence their impacts on water quality. Percentages are based on terrestrial and freshwater portions of Counties located within the watershed.

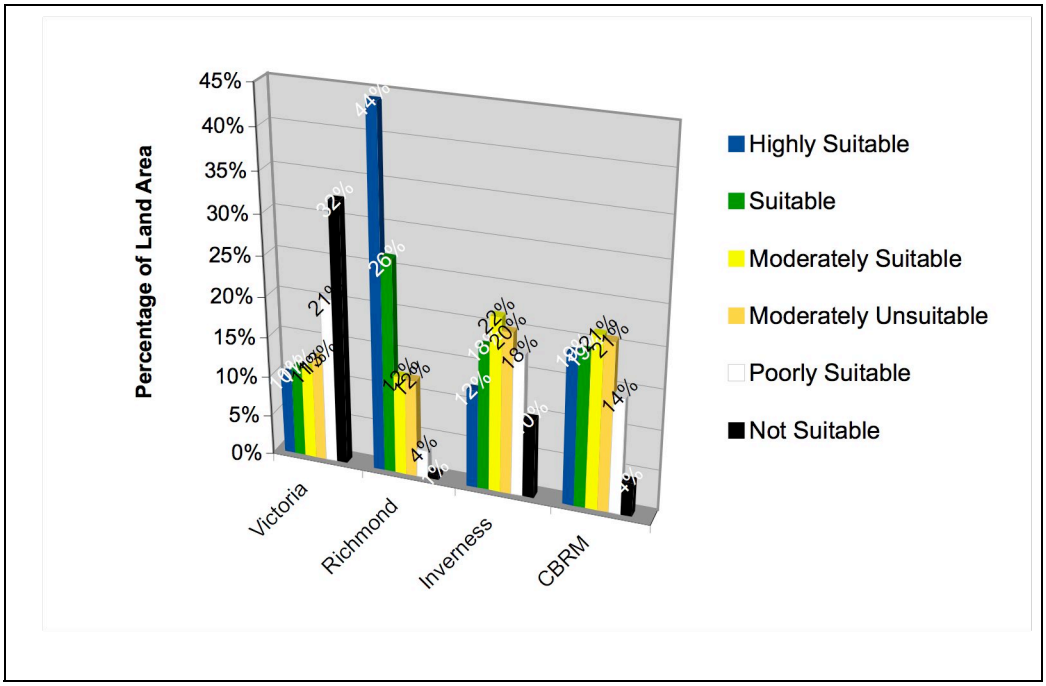


Figure 4.3: Percentage of Watershed Lands by Residential Suitability Category by County

An important component of the residential suitability model was the incorporation of the state of receiving waters to which these areas drain. For example, highly rated areas that drain to sensitive receiving waters clearly cannot be regarded as equally suitable. Locations draining to bays with notably low flushing rates or which are already suffering impacts from inadequately managed development may require corrective action or additional mitigation measures before development should be considered.

A recent Department of Fisheries and Oceans report on the Bras d'Or identified the following bays as particularly sensitive:

- Baddeck Bay
- Nyanza Bay
- Whycocomagh
- Denys Basin
- East Bay

All of these waterbodies, according to the report, "exhibit signs of, heavy metal and organic contaminants … " They are also characterized as having minimal "flushing and water movement."[33] All, furthermore, contain shellfish closure areas, although there are many closed areas in other parts of the lake system as well.

In summary, most of the less suitable areas for development in the watershed have not attracted significant development to date and are not readily available for development in any case because of Provincial ownership. Suitable areas for development correspond reasonably well to the existing settlement pattern, with two of the primary centres, Baddeck and St. Peters, in less suitable locations already converted to municipal networks. Areas rated less suitable for development most certainly include pockets of land that are suitable for onsite development on their own merits. Development of these sites should however be undertaken with caution recognizing that surrounding lands are unlikely to be able to support substantial populations without resorting to piped systems, and will likely remain well separated from established communities in which schools, medical services, and other public facilities are concentrated.

4.2.2 Watercourse Buffers

Our assessment of watercourse buffer widths took into account standard buffers to address such issues as sediment and pollutant filtration, as well as the requirements to mitigate the potential effects of climate change. Our modeling, therefore, overlaid potential watercourse buffers for the lakes and their tributary streams, along with areas identified at risk for sedimentation risk or climate change impacts.

Assessing Sedimentation Risk

Map 3 in **Appendix B** shows the results of the soil erodibility and transport model that assessed the sensitivity of lands to erosion and their ability to transport eroded material to adjacent watercourses. First, the sensitivity of lands to erosion was determined by modeling factors such as precipitation, soils, and slope. Next, buffers of 100 metres were placed around watercourses and assigned a weighting. Slopes greater than 5 per cent beyond 100 metres were identified to a distance of 200 metres and assigned another weighting of less value due to the decreased likelihood of transmission. Lastly, land areas were assigned the appropriate weighting depending on their location within the 100 or 200-meter buffer and their slope. We assumed that sedimentation risk is automatically high within 20 metres of the shoreline, for all soil types.

[33] M. Parker, et al., *op cit.*, p. 46.

Figure 4.4 provides percentages of land rated at varying levels of contribution to sedimentation and increased impacts on water quality. Percentages are based on terrestrial and freshwater portions of the counties containing portions of the watershed.

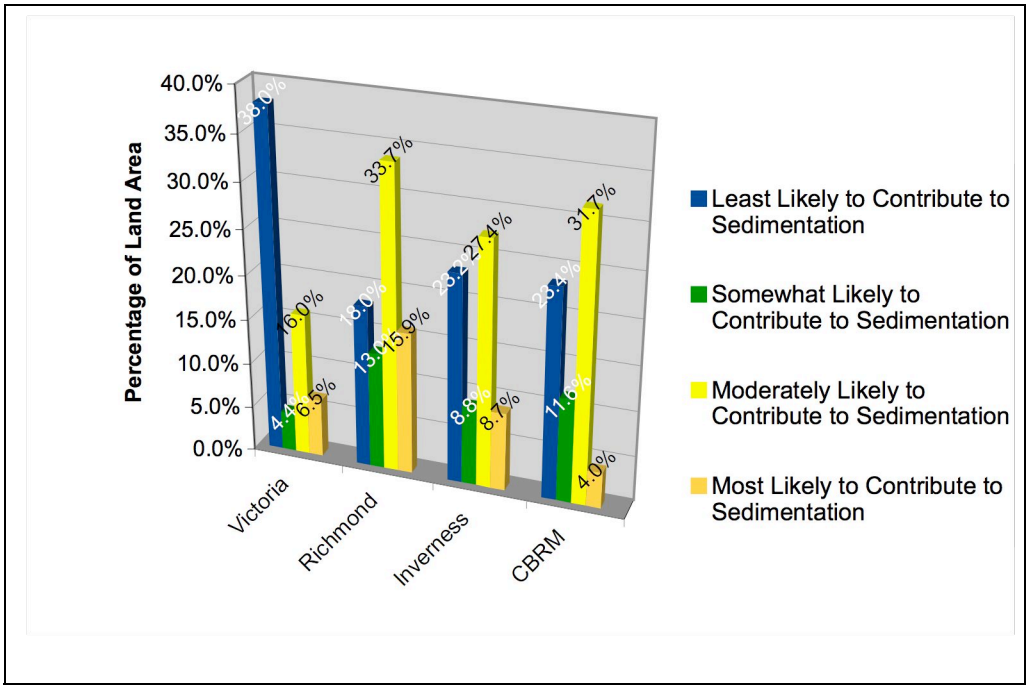


Figure 4.4: Percentage of Watershed Land by Sedimentation Risk Category by County

Assessing Climate Change Impacts

Two considerations are key for accurate and detailed sea level rise prediction. The first is good science to provide site-specific estimates. The second is a high-resolution digital elevation model (DEM). While sound scientific estimates of sea level rise and related storm surge are available for the Bras d'Or Lakes, high-resolution DEM is lacking. Industry standard for this type of application is a LIDAR survey based DEM with resolution in centimetres. In its place, EDM constructed a DEM with a 10-meter cell to model the entire watershed. This provides useful insight into the potential effects of sea level rise and storm surge at the watershed scale; however, local effects should be further studied using a high resolution DEM.[34]

[34] The completed climate change analysis (sea level rise and storm surge) is appropriate on a regional scale. It is appropriate to assess potential impacts from these factors but should not be used to assess a given parcel of land. More detailed, LIDAR-based analysis is required for detailed planning decisions dealing with specific land parcels. Sea level rise and storm surge estimates were taken from recent studies on the Bras d'Or Lakes discussed in **Section 2.4**, above. Storm surge in this case refers to low pressure resulting in higher water levels rather than increased wave action.

To assess sea level rise we assumed an elevation of up to 0.75 metres to which we added current storm surge of 0.50 metres to represent a potential cumulative effect of 1.25 vertical metres. **Figure 4.5** provides percentages of land identified as potentially impacted by storm surge, sea level rise, or the combination of the two. Percentages are based on terrestrial and freshwater portions of the counties located within the watershed. Areas that would be underwater or impacted by storm surge are shown on **Map 4** in **Appendix B** in relation to 20 and 75-metre buffer zones. The proportions of each county impacted are small, with Richmond leading the way at just 1.5 per cent. Nevertheless, all of this land is lakefront property. It includes, therefore, the most intensively developed portions of the watershed and much of its most highly valued land.

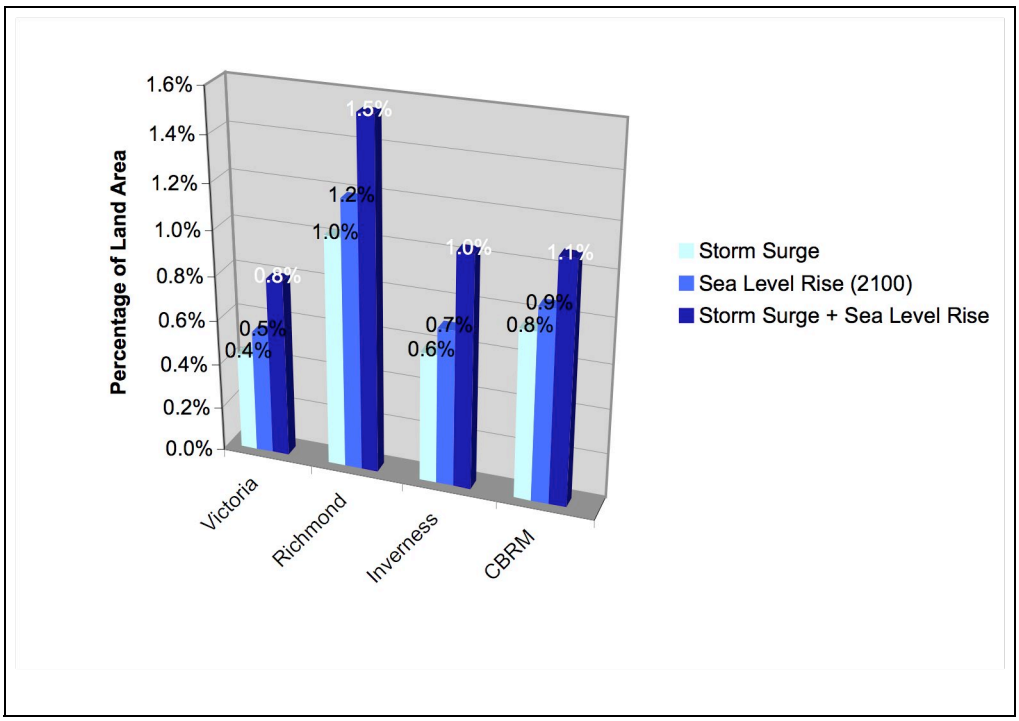


Figure 4.5: Percentage of Watershed Lands by County Impacted by Climate Change

Assessing Appropriate Buffers

Map 5 in **Appendix B** delineates buffers of 20 metres corresponding to the common minimum buffer distance established in Atlantic Canada[35] and the higher standard of 75 metres applied to all designated water supply watercourses in New Brunswick.

35 See: "Riparian Buffers in Atlantic Canada," NPA Fact Sheet, Canada's National Programme of Action for the Protection of the Marine Environment from Land-Based Activities, www.npa-pan.ca/en/publications/factsheets/riparian.cfm, accessed March 18, 2008.

The map also portrays a critical sediment transport area within 200 metres of every watercourse that varies in relation to soil erodibilty and factors that influence the ease of transport to adjacent waterbodies, hereafter called the High Risk Sedimentation Zone.

Figure 4.6 provides percentages of land affected by the 20 and 75-metre buffers and the High Risk Sedimentation Zone. Percentages are based on terrestrial and freshwater portions of Counties located within the watershed.

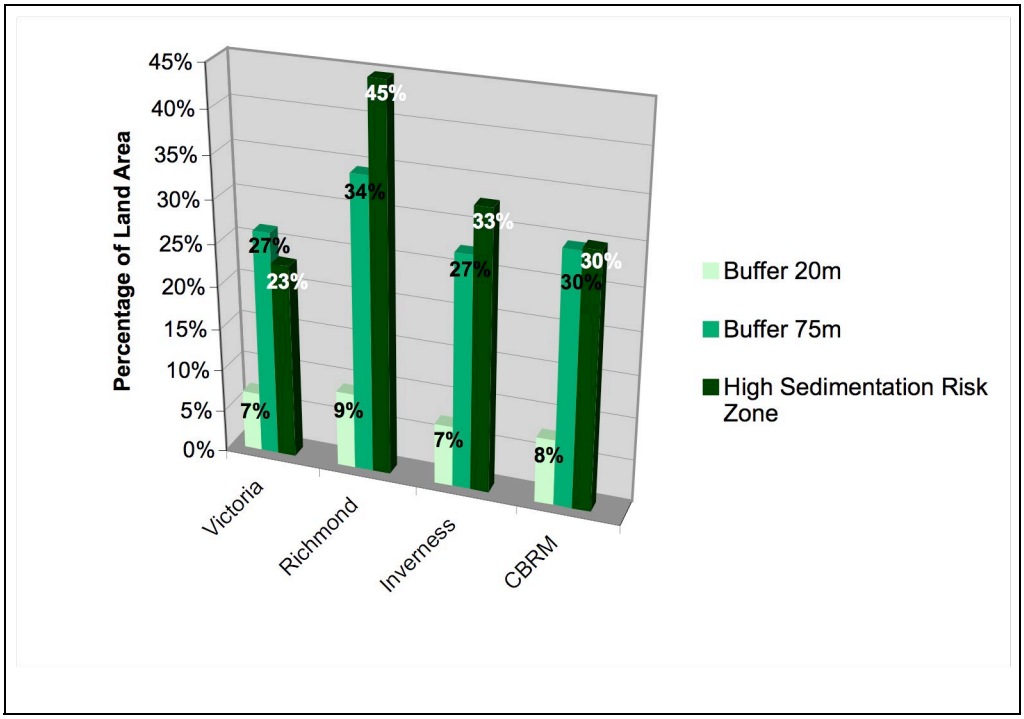


Figure 4.6: Percentage of County Lands (Watershed Portion) Covered by Buffer and High Risk Sedimentation Zones

Comparison of the 20 and 75-metre buffers to each identified risk area (areas of high sedimentation risk and climate change impacts) provides a measure of the relative suitability of narrow and wider buffers throughout the watershed.

Figure 4.7 illustrates the extent of areas of highly erodible and transportable soils in relation to these buffers around Whycocomagh. Along the watercourses in Whycocomagh are sections of both highly erodible soils and areas in which erodible soils extend well beyond the 75-metre buffer. **Figure 4.8** provides the same detailed view of Whycocomagh Bay showing the extents of current storm surge, estimated sea level rise, and the cumulative effects of future sea level rise and storm surge. Based on the figure, storm surge, sea level rise, and the combined effect of sea level rise are

substantially overlapped by the 20-metre buffer. The estimated reach of projected sea level rise extends farther, however, in salt marsh areas and other low lying areas, as well as many islands.[36] This is generally evident throughout the lake system from close inspection of **Map 4** in **Appendix B**.

While our GIS analysis indicates that roughly 50 per cent of the combined effect of sea level rise plus storm surge will be contained within the 20-metre buffer areas that we have delineated and 90 to 98 per cent will be encompassed by 75-metre buffers (**Figure 4.9**), several complications suggest that it will be more effective to address sea level rise separately from watercourse protection. First, the purposes to be addressed in each case are fundamentally different: buffers mitigate the impacts of land and hazardous materials that may be transported to the water, while the concern with sea level rise and storm surge is the potential of water to invade the land. Second, while the majority of sea level rise and storm surge impacts will be addressed by a 20-metre

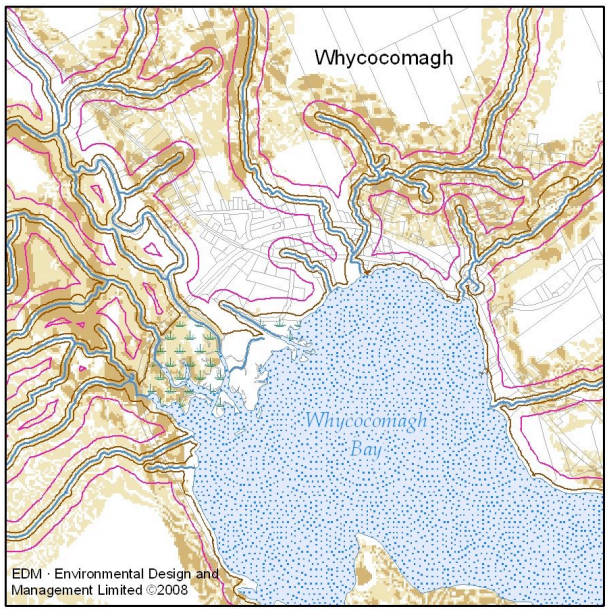


Figure 4.7: Watercourse Buffers and Areas Most Likely to Contribute to Sedimentation

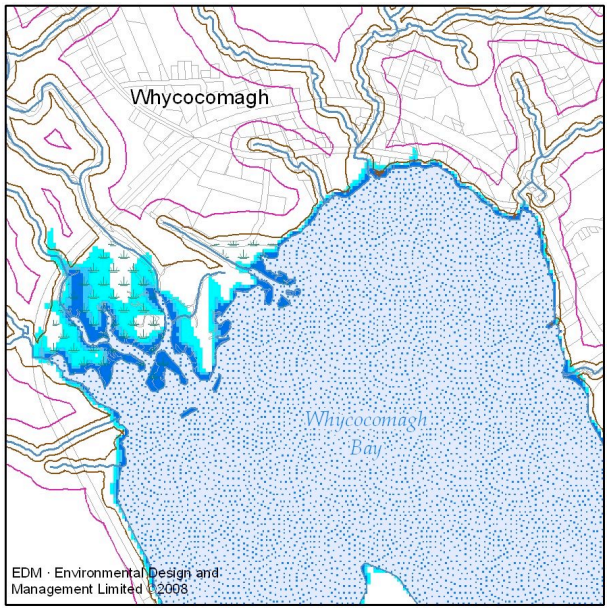


Figure 4.8: Watercourse Buffers with Storm Surge and Sea Level Rise Impacts

[36] Readers examining **Figure 4.8** should be aware that buffers have been drawn to take into account wetlands as well as running watercourses. Wetlands are particularly significant in the lower reaches of watercourses emptying to the bay.

buffer, a substantial portion will extend outside these buffer areas. Third, although 75-metre buffer areas will cover nearly all sea level rise and storm surge impacts, many areas not impacted would be unduly restricted, if such a standard was applied

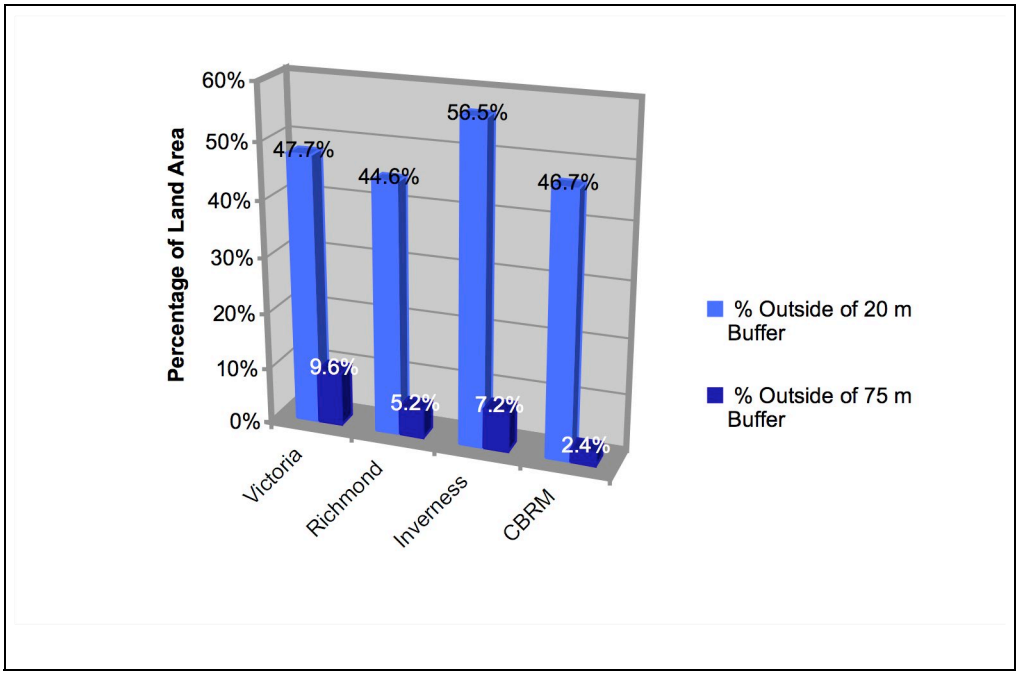


Figure 4.9: Percentage of Sea Level Rise +Strom Surge Outside 20 and 75-metre Buffer Zones

A regulation based on elevation rather than distance, as has been implemented in HRM, will therefore be far more precise. It will ensure not only that all areas potentially impacted by sea level rise and associated storm surge will be encompassed by the proposed regulation but also that those areas that will not be so affected will not be unnecessarily restricted.

4.2.3 Wastewater Management Districts

Wastewater management districts or WMDs have to date been applied on an "as needed" basis in Nova Scotia. The few instances where they have been adopted or are under consideration are areas in which onsite systems are under stress and failing. EDM has developed and applied an onsite servicing suitability model that incorporates the major factors that influence the success of onsite systems. Specifically, the model takes into account most of the physical considerations incorporated in our residential land suitability model discussed in **Subsection 4.2.1**. These factors include drainage, slope, soil cover type and thickness, and sedimentation risk. The model also incorporates development density in terms of lot proximity and width. We assumed that:

- Better drained soils make land more suitable for on site sewage system development;
- Thicker till increases suitability for on site sewage systems by promoting better drainage;
- Moderate slopes land more suitable for on site sewage system development as they result in better drainage;
- Lots need to be a minimum of 210 square feet wide to provide enough space for a properly functioning on site septic system; and
- Lands within 100 metres of surface water are less suitable for on site septic systems than lands more than 200 metres away.

Potential problem areas are discernible by properties coloured red and orange on **Map 6** in **Appendix**. Many of these properties are in areas displayed as highly suitable for residential development, particularly on either side of East Bay. Clusters of these properties are most apparent where lots are smaller and, therefore, residential density is highest. WMDs may eventually be required to resolve sewage management concerns in one or more of these areas but inquiries with CBRM and EDPC staff indicated that Staney Brae Subdivision on George's River, which empties into the south side of the St. Andrews Channel, is the only location within the watershed in which substantial problems of this type have been identified.

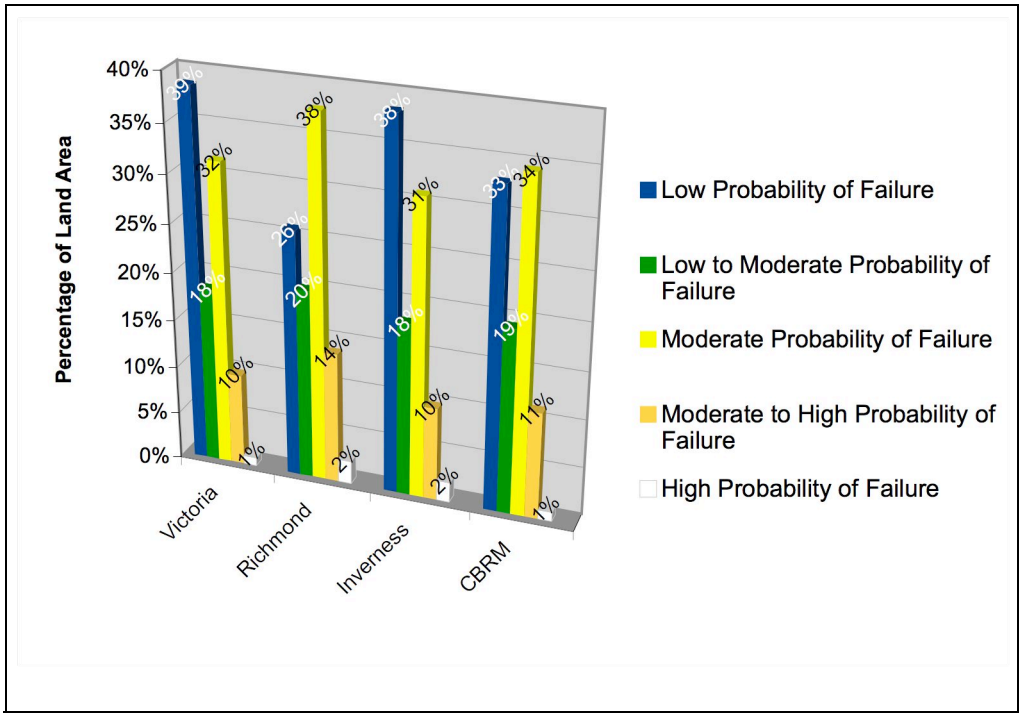


Figure 4.10: Percentage of Watershed Lands by County by Probability of Onsite Failure

Figure 4.10 provides percentages of land associated with each category of onsite failure probability. Percentages are based on terrestrial and freshwater portions of the counties located within the watershed. It indicates that the majority of land in all four counties is well-suited to onsite servicing, although roughly 10 to 15 per cent is generally rated as prone to failure.

4.2.4 Low Impact Design

Low Impact Design or LID, as discussed **Subsection 3.2.4**, above, involves a variety of techniques aimed at maintaining the pre-development hydrological regime in terms of infiltration and runoff quantities. Given that LID is a combination of techniques, some of which have small-scale influences, it is not as well suited to analysis in GIS as preceding initiatives. EDM therefore applied USEPA's Stormwater Management Model (SWMM) to compare the hypothetical permeability of surfaces as found in conventional and LID (i.e., clustered) residential development patterns.

Conventional development was modeled assuming homes with an average 1,200-square foot roof area and 600 square feet of driveway space, based on the average building footprint size in CBRM. For the LID approach we assumed a 50 per cent decrease in impervious surface impacts based on reduced driveway length, reduced roof area (achieved through use of two and three-storey building plans and/or employment of green roof technology), and mitigation measures such as cisterns, rain barrels, infiltration basins, and grassed swales.[37]

All modeling assumed localized storm information derived from a typical one in five year storm in Halifax, generally a high volume storm. The model shows how reducing impervious surfaces leads to decreased generation of run-off. Whereas an undeveloped 1-acre lot will transmit just 0.1421 m^3 of water off site, development of a typical single unit house on the same acre will generate 5.77 m^3 or an increase of nearly 4,000 per cent. On the other hand, reduction of the impervious surface combined with measures to mitigate impervious surface cover will prospectively decrease runoff by nearly 50 per cent, from 5.77 cubic metres to 2.88 cubic metres (**Figure 4.11**).

[37] The assumption of 50 per cent reduction is based on findings from the University of New Hampshire's Stormwater Centre, where conventional and LID approaches are regularly analyzed and compared.

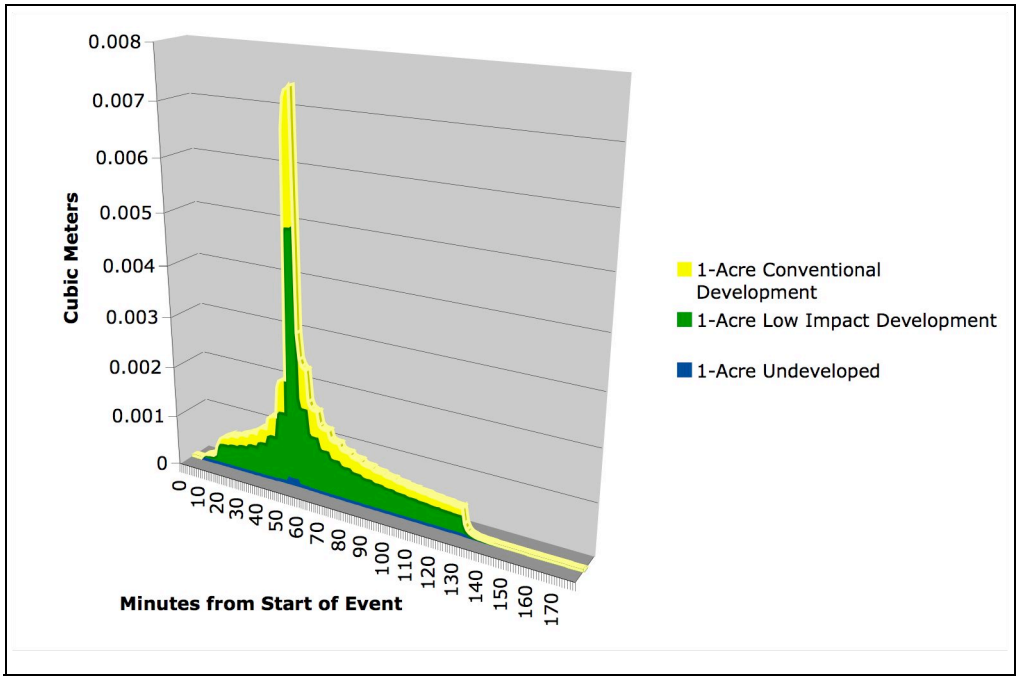


Figure 4.11: Estimated Run-off, 3-hour Storm, Alternative Development Approaches

4.3 FUTURE STUDIES

Data available for this study was sufficient for analysis at the regional or watershed scale. The provincial digital elevation model used had a contour interval of 5 metres. Almost all data sets were 1:10,000 scale, with the exception of the Agriculture Canada soils data, which was at 1:50,000 scale. The soils layer had some data gaps, but these were primarily in areas of less interest with minimal arable soil cover.

Several additional studies should be completed at a bay or county (watershed portion) scale to further inform development practices that protect water quality and quantity in the Bras d'Or Lakes. Many of these studies are dependent on securing the data necessary to support the appropriate analysis. Recommended localized studies and their associated data include:

- *Analysis of Shore Types*: Shore types (e.g., rock cliff, beach, vegetated, riverine) could be analyzed to determine the effects of sea level and storm surge on different bays of the lake and their corresponding shore type.

- *Storm Surge Modeling in the Bras d'Or Lakes*: While storm surge is mitigated by the relative shelter of the Bras d'Or Lakes, increased wave action may result from extreme storms, particularly when

waves, wind, and tidal impacts coincide and couple their effect.

- *Detailed Sea Level Rise:* More detailed study and long term monitoring of sea level rise in the Bras d'Or Lakes is essential to monitor predictions of sea level rise. A high resolution LIDAR digital elevation model created from LIDAR imagery would be particularly useful to provide a clearer estimate of on shore impacts from rising water levels.

- *Water Quality*: While the Canadian Sanitary Shellfish Program provides data on fecal, bacterial, and salinity levels of receiving waters, important information on septic tank failures, contamination of wells, and sedimentation is lacking.

- *High Resolution Bathymetry:* Acquiring detailed bathymetric data for the Bras d'Or Lakes would better define potential water quality risk areas and sensitive bays, based on the depth of bays and presence of sills. A previous study assessed this type of data at the lake scale.

- *Detailed Suitability Analysis:* The use of high resolution LIDAR digital elevation model created from LIDAR imagery would provide further detail and accuracy for future suitability analyses conducted at the sub-regional scale.

5.0 DEVELOPMENT STANDARDS

This chapter outlines recommended approaches, related measures, and procedures for implementation. The following sections address broad categories of watercourse protection measures studied and evaluated by EDM. Each section identifies objectives, approaches (i.e., leading BMPs), and recommendations related to these categories as follows:

- *Objectives*: The stated objectives of responsible development practices.
- *Best Management Practices*: The best management practices outlined in this document provide guidance on how those objectives might be achieved. These BMPs are based on scientific research and are methods by which we feel local governments, developers, and other stakeholders can best achieve the desired objectives.
- *Recommendations*: Recommendations for action are provided with suggested policies and regulations for their implementation.

The key components of these recommendations are further summarized in the Bras D'Or Lakes Development Standards Handbook contained in **Appendix C**, which is intended to be separated from this report for use by planners to implement these measures.

5.1 WATER RESOURCE BMPS

In our opinion, the suggested BMPs proposed below, can be undertaken within the context of existing Federal and Nova Scotia legislation. Our discussions of approaches, in fact, provide examples of implementation in Nova Scotia.

Those who undertake urban and rural land development bear a special responsibility to ensure that the choices they make benefit the current and future generations of people, plants, and animals on Cape Breton Island. Based on the research completed in Phase I, and the watershed analyses completed in Phase II, commonly accepted guidelines and standards have been customized to fit within the legislative, physical, and socio-economic context of Bras d'Or Lakes Watershed.

5.1.1 Suitability of Lands for Development

Land suitability assessment, as discussed above, refers to the identification of lands most suitable for development based on a combination of factors reflecting cost, technical feasibility, marketability, and environmental impact.

Objectives

To identify marketable lands for development that minimize government and societal costs, and impacts on valued environmental features.

Approaches

Any municipality contains areas that are more or less suitable for development. This is especially pertinent in Nova Scotia with its rugged landforms, inconsistent soil cover, numerous watercourses, and extensive coastline. Identifying areas that are more suitable for development can protect unique environmental features, and reduce private and public sector costs.

GIS-based land suitability assessment is the most effective method for identifying areas that are highly suitable for development. GIS is also well suited to identifying areas in which development should be limited or that should be conserved in their natural state. GIS assessment of the physical qualities of land and its relationships to existing infrastructure and environmental features may be supplemented, in many cases, by engineering and financial studies. Such studies can detail not only the benefits of accessing existing infrastructure and avoiding environmentally sensitive features, they can also define the costs of new infrastructure and measures to mitigate environmental effects.

The former City of Halifax and Halifax Regional Municipality, into which it was absorbed in 1996, have used this approach successively to assess lands and direct development. The Land Development Distribution Strategy, a City report prepared in the 1970s, provided a basis for identifying the Mainland North area as a preferred area for development in the 1978 City of Halifax Municipal Development Plan. The development of Mainland North as the primary area for new residential development was further prioritized through the 1983 Mainland North Servicing Strategy,[38] which was based on an early form of GIS-based land suitability analysis and set priorities for sequencing development within a Comprehensive Development District (CDD), largely based on the most efficient approach to extending water and sewer networks. A Holding Zone was simultaneously applied to the Mainland South area to control its development while the City dealt with infrastructure deficiencies, and to conserve environmentally sensitive areas.

Many other municipalities have followed suit. Kings, West Hants, and East Hants, for example, have all identified "Growth Centres" within their boundaries that they have deemed to be particularly well-suited to future development. In the case of East Hants, priorities were directly founded on a comprehensive land suitability

[38] The DPA Group Inc., *Mainland North Servicing Strategy*, 1983.

assessment prepared by EDM in 1998.[39] HRM has done similar analyses to arrive at the designation of Morris-Russell Lake and Bedford West as the two primary areas for "greenfield" residential development designated in the Halifax Regional Municipal Planning Strategy of 2006.

The identification of areas for comprehensive growth management is probably not appropriate for the Bras d'Or Watershed given its relatively slow rate of development. Strategic concentration of development, however, can have considerable benefit for the environment. Emphasis on development in and around centres that have piped water and sewer services with appropriate sewage treatment will facilitate conservation of natural areas as well as reducing municipal costs. Assessment of new subdivision and multiple-unit development using increasingly sophisticated land suitability assessment tools should also be beneficial to identify measures that will mitigate potential environmental impacts.

Recommendations

Municipal priorities for development can be established through either restriction or encouragement, or a combination of the two. Zoning gives municipalities a very effective tool for both. Areas that present obvious challenges for development can be limited through the application of a Holding Zone or, if they include valued environment features, a Conservation Zone. Zoning, by the same token, can be applied to facilitate development of areas that appear particularly desirable. The most common zoning technique to achieve this in Nova Scotia is the Comprehensive Development District or CDD, which normally establishes a framework for comprehensive planning of a subject area. Smaller scale development can be managed through Site Plan Approval or Development Agreement.

The municipal plans and LUBs applicable in the Bras d'Or Lakes Watershed make very limited use of these zoning tools at present. There are no Holding or Conservation Zones, or CDDs. To support the application of land suitability assessment in any planning area, the applicable MPS will have to be amended, preferably after careful study of the lands to be rezoned taking into account the full range of suitability factors.

Proposed Policies

Policy should encourage all municipalities with jurisdiction in the Bras d'Or Lakes Watershed to assess comprehensively watershed lands within their boundaries. This assessment should give specific regard to the potential impact of such development on watercourses.

[39] EDM • Environmental Design and Management Limited, *East Hants Land Suitability Assessment*, 1998.

Serviced Centres
It shall be a policy of Council to encourage development to locate in areas within the Bras d'Or Watershed that are connected to or can feasibly be connected to existing water and sewer networks.

Residential Land Suitability Assessment
For subdivisions or development proposals of more than five lots, it shall be a policy of Council to assess the potential impact of the proposed development on the Bras d'Or Watershed taking into account such considerations as:

(a) topography,
(b) soil type and thickness,
(c) proximity to existing water, sewer, and road networks,
(d) proximity to other services necessary to support and protect residential development such as police, fire, schools, libraries, parks, and recreation facilities,
(e) the existence of water and sewer concerns, and
(f) the impact of land development and occupation on the surrounding environment, particularly on the Bras d'Or Lakes and their tributary watercourses.

Additional Considerations

Implementation of the second policy will require CBRM and EDPC to employ GIS databases to study medium to large-scale development proposals. The most essential data have been assembled for this study. CBRM and EDPC may wish to cooperate to develop a single model for this purpose using similar if not uniform data. Cooperation should be more economical for all participants and would increase consistency of approach across the watershed.

The residential suitability analysis prepared for this study is a very substantial start in this direction. More in depth consideration of municipal and other government services supporting development, including consideration of public sector costs would be essential. It would also be vital to give more detailed consideration to the current condition and ultimate capacity of receiving waters, which would benefit from the collection or assembly of water quality data.

5.1.2 Watercourse Buffers

Watercourse buffers establish areas of no development or limited development intended to filter sediment and other hazardous materials from stormwater before it reaches receiving waters. Under this heading also, we have discussed building restrictions adjacent to watercourses subject to sea level rise and related storm surge.

Objective

To limit land use, and preserve natural features and vegetation in areas immediately abutting watercourses so as to maintain the natural filtering qualities of these lands, shade water edges, preserve aesthetic qualities, and protect against the effects of sea level rise, while facilitating controlled public access.

Approaches

Watercourse buffers are arguably the most widely adopted non-structural measure to protect water resources. Their fundamental purpose is to maintain a natural area abutting watercourses to filter contaminants generated by human land use. As illustrated through our GIS analysis, they may also address the protection of land uses potentially threatened by sea level rise, storm surge, and flooding. The effectiveness of these buffers depends primarily on their width in relation to key physical features. Slope, soil cover, and erodibility, as well as the characteristics of receiving waters in terms of depth and flushing characteristics all influence the required width of buffer areas.

Watercourse buffer standards, in practice, vary considerably in dimensions and in their technical foundation. Where they are comprehensively applied, standards are usually simple. HRM has applied a 20-metre buffer to all watercourses in its jurisdiction through the following policy:

> E-10 HRM shall, through the applicable land use by-law, require the retention of a minimum 20 metre wide riparian buffer along all watercourses throughout HRM to protect the chemical, physical and biological functions of marine and freshwater resources. The by-law shall generally prohibit all development within the riparian buffer but provisions shall be made to permit board walks, walkways and trails of limited width, fences, public road crossings, driveway crossings, wastewater, storm and water infrastructure, marine dependent uses, fisheries uses, boat ramps, wharfs, small-scale accessory buildings or structures and attached decks, conservation uses, parks on public lands and historical sites and monuments within the buffer. In addition, no alteration of land levels or the removal of vegetation in relation to development will be permitted.

According to HRM staff consulted by EDM, the 20-metre standard reflects and overlays the 20-metre forestry buffer established under the Provincial *Wildlife Habitat and Watercourses Protection Regulations*. It also, coincidentally, reflects the suggested

area for maintenance of vegetation within Watershed Zones applied to surface water supply watersheds.[40]

The Province of New Brunswick has a slightly more nuanced approach for 30 water supply watersheds it has designated for protection. The Province divides lands in all of these watersheds into three zones:

- Zone A – the watercourse
- Zone B – the 75-metre setback
- Zone C – the balance of the watershed.[41]

The associated regulations are stringent. Within the watercourse or Zone A, for example, motorized boating is permitted in only five of the 30 designated watersheds and is restricted to 4-stroke engines of less than 10 horsepower carrying no more than 25 litres of fuel in "firmly attached" tanks. In Zone B, regulations effectively prohibit new construction and, in Zone C, a variety of activities – including forestry, agriculture, road construction, and mining – are subject to restrictions of varied severity. While the Province of New Brunswick has provided a procedure for exempting properties from regulations where appropriate, its clear priority is to protect drinking water supplies.

Typically, land uses are severely restricted within buffer areas. Uses are normally limited to public utilities requiring direct access to a watercourse such as water treatment and wastewater treatment plants. Otherwise, most municipalities normally permit only passive recreation uses such as walking parks and trails. Exceptions may, however, be made for traditional uses such as docks and sheds associated with commercial fishing, and for marinas and related facilities required for recreational boating and similar activities.

If a standard buffer distance is to be maintained along all watercourses, the requirement can be established in policy and in the General Provisions of a LUB. More complex buffers that vary in relation to the features of abutting lands and/or

---

40 SNSMR, *Local Government Resource Handbook*, March 2003, Section 5.6- "Model Land Use Bylaw," p. 78. The section of the Handbook contains the following note:

This regulation is enabled under S. 220(5)(d) but it requires supporting policy in the strategy. Its purpose is to help prevent any sedimentation and erosion of the watercourse shore line when a development is to take place. The 20-metre distance is only a suggestion. Individual circumstances should be studied before any accurate distance can be determined.

41 Province of New Brunswick, "Surface Water Protection Program," http://www.gnb.ca/0009/0373/0001/0002-e.asp, accessed February 29, 2008.

receiving waters can be defined in terms of a specific formula (e.g., 10 metres where the abutting slope is 0 to 5 per cent; 20 metres where it is 5 to 10 per cent; and 30 metres over 10 per cent). Variable buffers are probably more easily assessed, however, through GIS analysis taking into account a wide range of factors including sea level rise caused by ongoing climate change. Planners can then use GIS information to delineate buffer areas on the municipal Zoning Map.

LUBs can enforce buffers in this context through separate zones in which land use is strictly limited or as overlays in which specific restrictions augment the regulations applicable to a specific zoning category. For example, with respect to the latter approach, an R-1 (Single Unit) Zone abutting a watercourse would have a prescribed frontage, lot area, and setbacks under the R-1 Zone but would also be subject to a no build area where it abutted the watercourse. Generally, this would coincide with the required rear yard setback but might be more or less than the rear yard requirement depending on prevailing municipal standards and/or local conditions.

Provisions might also be incorporated in the LUB to allow property owners to challenge the prescribed setback. If setbacks have been defined in relation to criteria assessed through generalized GIS data, a property owner may be able to demonstrate that the actual circumstances of their property differ sufficiently to justify alteration (but not elimination) of a buffer boundary applicable to them. Procedures for exercising such a right would have to be provided through MPS policy.

Buffers, as noted at several points above in this report, overlay areas likely to be affected by sea level rise and related storm surge. The issues are however fundamental opposites. Whereas the primary purpose of watercourse buffers is to reduce the quantity of detrimental materials transported to receiving waters from the land, sea level rise and storm surge reflect concerns with the potential of water to submerge land. For this reason, HRM expressed its "interim restriction" on residential development on its coastline as an elevation above sea level rather than a setback from the water's edge:

> E-16 HRM shall, through the applicable land use by-law, prohibit all residential development on the coast within a 2.5 metre elevation above the ordinary high water mark, except for lands designated Halifax Harbour on the Generalized Future Land Use Map (Map 2) and industrial lands within the port of Sheet Harbour. Provisions shall be made within the by-law to permit residential accessory structures, marine dependant uses, open space uses, parking lots and temporary uses within the 2.5 metre elevation.

This limit will apparently apply until completion of the Potential Hazards to Development Functional Plan, which will examine issues such as contaminated soils and the urban/wildlife interface, as well as the potential impacts of climate change. We would anticipate that the latter will include definition of lands that may be threatened by inundation using LIDAR imagery recently collected by HRM.

Recommendations

Each municipal unit in the Bras d'Or Watershed should introduce MPS policy to support the general implementation of buffers or similar measures to protect watercourses and address the potential impacts of sea level rise and related storm surge. At a minimum, a buffer of at least 20 metres should be established around all watercourses, recognizing that this standard already applies under Provincial legislation for forestry activity throughout Nova Scotia. Our analysis suggests that likely sea level rise and associated storm surge will be 68 to 82 per cent addressed within this area on most of the lakeshores.

Policy may also support the imposition of a wider buffer zone. Technical support is available to justify a buffer width of at least 30 metres, and many scientists and planners would argue for specific restrictions applicable to the entire watershed. Certainly, wider buffers could be justified in locations with significant slopes (e.g., greater than 15 per cent).

Municipalities could bring considerations such as slope and soil erodibility to bear through application of the GIS models applied for this study sufficient to map variable width buffers on zoning maps. Alternatively, municipalities could control the siting of land uses of particular concern within the watershed as has been done for medium-intensity industrial uses through the Sporting Mountain MPS and LUB, or exclude specific uses from the watershed altogether through zoning (e.g., no land is currently zoned heavy industrial anywhere in watershed).

The basic 20-metre buffer area and any areas where it may be extended beyond 20 metres should be represented as an overlay on zoning maps pertinent to the watershed. LUBs to which these zoning maps are related should strictly limit uses in these areas, restricting most if not all construction and limiting other uses to parks and open spaces, beaches, and trails. Areas from 20 to 75 metres may be allowed a broader range of uses including most residential and commercial construction. Limitations in these areas would focus on uses that involve the storage and handling of materials that could present a direct and serious threat to water quality.

To address sea level rise and related storm surge, municipalities in the watershed may wish to adopt an elevation below which construction will be prohibited along the shores of the Bras d'Or Lakes, as has been done as an interim measure by HRM

for its coastline. The appropriate elevation would be 1.25 metres corresponding to the rise in sea level predicted for 2100 combined with storm surge.

One final tool available to implement buffers is dedication of land through subdivision, which is permitted under Section 271 of Part 9 of the MGA, which deals with subdivision. The MGA permits municipalities to take 5 per cent of the land approved for subdivision or up to 10 per cent "if the requirement and the reasons for it are provided for in a municipal planning strategy." The Act, furthermore, states that "if the land being subdivided has frontage on the ocean, a river or a lake, the land transferred [may be required to] include land with frontage on the ocean, river or lake or land to provide public access to the ocean, river or lake." Only Inverness among the four municipalities within the Bras d'Or Watershed, however, requires the dedication of land for public purposes.

Use of these provisions, particularly the specific dedication of waterfront lands, would nevertheless give the municipalities in the Bras d'Or a very effective device to restrict building in watercourse buffer areas and to manage those buffer areas in the long term. At the same time, as the text of the MGA suggests, the land so acquired could be used to improve public access to the water. In CBRM, this would directly address the priority of Policy 6 in Part 5 of the CBRM MPS, which states:

> It shall be a policy of Council that the preservation for public use of beaches and shoreline along the shore of the Bras D'Or Lakes and Sydney Harbour, as well as prominent peninsulas along the shore of the Atlantic Ocean, be a recreational priority for the CBRM …

For other municipalities, it would provide a means to maximize the protection of watercourses adjacent to new development and allow them to likewise enhance public access to these highly valued areas. In areas that do not abut watercourses, furthermore, municipalities may take advantage of provisions to take cash-in-lieu of lands to create a fund to acquire additional lands of value to the public on the shores of the Bras d'Or and its tributary watercourses.

Proposed Policy

Policy is recommended to implement a 20-metre buffer applicable to all watercourses. Additional policy is further suggested to support the application of a more extensive buffer where justified by local circumstances, to ensure adequate separation of particular land uses that involve inherent risks to watercourses, and to address potential sea level rise and storm surge on lakeshores. A final policy recommendation calls for dedication of lands adjacent to watercourses through the subdivision process.

20-Metre Watercourse Buffers
It shall be a policy of Council to require the retention, through the land use bylaw, of a minimum 20-metre buffer area along all watercourses within the Bras d'Or Watershed to protect the chemical, physical and biological functions of marine and freshwater resources. The bylaw shall generally prohibit all development within the buffer but provisions shall be made to permit existing structures; decks attached to existing structures in the buffer or to legal structures abutting the buffer; boardwalks, walkways, and trails of limited width; fences, public road crossings, and driveway crossings; wastewater, storm and water infrastructure; marine dependent uses; fisheries uses; boat ramps; wharfs; conservation uses; parks on public lands; and historical sites and monuments within the buffer. In addition, no alteration of land levels or removal of vegetation in relation to development will be permitted.

Watercourse Buffers Up to 75 Metres
It shall be a policy of Council to consider the retention of additional watercourse buffer areas to a maximum of 75 metres in which the same or more limited restrictions on land use may be implemented through the land use bylaw, in consideration of the perceived sensitivity of receiving waters, potential for soil erosion, and/or potential inundation from flooding or sea level rise.

High Risk Land Uses
It shall be the policy of Council to include provisions in appropriate zones to ensure adequate separation from all watercourses of land uses in which there may be a reasonable expectation of the storage or handling of materials that may be detrimental to water quality if released to such watercourses such as services stations, specific industrial uses, manure storage facilities, and salt storage sheds.

Sea Level Elevation
It shall be a policy of Council to restrict, through the land use bylaw, all development on the shores of the Bras d'Or Lakes within a 1.25-metre elevation above the ordinary high water mark.

Dedication of Waterfront Lands
It shall be the policy of Council to require the dedication of up to 10 per cent of any lands approved for subdivision within the Bras d'Or Watershed for the protection of watercourses. Where any such subdivision may abut a watercourse, Council shall assume at least 20 metres immediately abutting the watercourse. Where lands more than 20 metres from a watercourse are deemed not to be of interest to protect the watercourse or to provide access to such watercourse, it shall be the policy of Council to accept cash-in-lieu to be accumulated in a municipal fund for the strategic acquisition of waterfront lands, particularly on the shores of the Bras d'Or Lakes.

Additional Measures

As directly stated in the foregoing proposed policies and described in the preceding description, watercourse buffers should be implemented through the appropriate LUB. Only uses permitted in the specific zone and not further restricted by the specifications of the buffer overlay would be permitted. For example, although it would be our intention to permit fisheries and boating related uses in watercourse buffer areas, such uses may nevertheless be restricted in, say, a residential zone.

Existing uses may also infringe on buffer areas, as where a home has been built next to or over the water, or a use like a service station is within less than 75 metres of a watercourse. As with all existing uses affected by LUB amendments, such buildings would, at the minimum, have the status of legal non-conforming structures. Under Sections 239 through 241 of the MGA, buildings with legal non-conforming status can be rebuilt if damaged, change use to other uses permitted in the applicable zone, and expand existing uses within the building envelope. Non-conforming residential structures may also be expanded provided their expansion does not impinge on an established restriction such as a watercourse buffer. Section 242 of the Act permits Council to relax restrictions through MPS policy to permit non-conforming uses to expand more freely, be reconstructed more readily, or otherwise function and, possibly, grow in spite of LUB restrictions.

We recommend the cautious employment of Section 242 provisions with respect to watercourse buffers. If a practical structure has been built on a property, there is no reason to permit its expansion at the expense of watercourse protection. On the other hand, some vacant lands may be configured such that it may be very difficult to accommodate a reasonable structure while observing buffer restrictions. In these situations, procedures are available in Section 235 of the MGA to allow the Development Officer to vary "the size or other requirements relating to yards."

These procedures must be implemented through MPS policy and LUB provisions. They should not be applied where the variance is in conflict with the intent of MPS policy or LUB provisions or to circumstances that are "general to properties in the area." Given that the existing lot pattern through most of the Bras d'Or Watershed reflects the Seigneurial pattern of deep lots extending from relatively narrow waterfrontage, situations in which the configuration of existing lots will preclude construction will almost certainly be atypical.

5.1.3 Wastewater Management Districts

Wastewater Management Districts or WMDs are a mechanism established by Provincial legislation to facilitate the management of communal water and sewer systems.

Objective

To establish a framework or frameworks to address pollution control challenges through the establishment of community-based approaches to managing onsite systems, or small-scale collection and treatment systems.

Approaches

WMDs have generally been applied in Nova Scotia to address existing wastewater problems. The mechanism is certainly available to address existing problem areas within the Bras d'Or Watershed. It should also be considered as a mechanism to support new approaches to residential development, most notably clustered or open space development approaches that advance LID objectives.

WMDs can be applied to identify areas that require conventional sewage treatment plants or special management of onsite systems. They are also an ideal framework for managing relatively innovative systems such as recirculating sandbed filters or solar aquatics systems. WMDs facilitate the collection of area rates to cover community costs. Alternatively, they can be created in conjunction with condominium corporations or community co-operatives that can operate separately from the municipality.

The WMD mechanism is available to any municipal unit under Section 3.4.2 of Part 14 of the MGA. It can be encouraged by policy of which the Central Richmond MPS, which was prepared by the EDPC for lands outside the Bras d'Or Watershed, contains a concise example:

> Policy 3.2 It shall be the policy of Council to explore and, where possible, encourage the implementation of Waste Water Management Districts as an alternative to centralized sewage treatment systems.

Policy 5b in Section 8 of the CBRM MPS, contemplates turning all of the Bras d'Or watershed into a WMD:

> 5.b It shall be a policy of Council to consider the drainage basin of the Bras D'Or Lake as a potential wastewater management district when developing a wastewater management strategy for the entire Regional Municipality.

Policy, however, is not essential. Under the MGA, a municipal unit wishing to establish one or more WMDs must establish a WMD Bylaw. This does not require a plebiscite or vote but SNSMR's *Local Government Resource Handbook* suggests that

"municipalities as a matter or course would likely solicit the views of the residents of an area where a WMD is being considered to ensure that they have their support."[42]

The handbook further specifies the following content for a WMD Bylaw:

- *Boundaries* - identify the boundaries of the WMD;
- *Wastewater system(s)* - identify the wastewater system(s) [e.g. type, location, extent] to be used in the district;
- *Municipal responsibilities* - specify the extent of municipal responsibilities for the repair, upgrading or replacement of private and public sewer systems; &
- *Method of charging* - specify the method of charging persons in the district.[43]

Recommendations

Adopt policy in appropriate municipal planning strategies to support the implementation of Wastewater Management District Bylaws to address sewage management problem areas where they arise and to support cluster developments or other development forms that may require the creation of small scale piped systems or other water and/or sewer management approaches that require communal management. Management approaches may include management by the municipal unit in question financed through an area rate, or by a condominium corporation or cooperative working with the municipal unit. The latter approaches can be implemented without a WMD but the absence of municipal oversight may entail risks for residents and adjacent waterbodies.

Proposed Policy

Policies are proposed to address both existing areas of development that may be experiencing sewage disposal and treatment challenges, and proposed development that is either more intense that the existing pattern of may intensify the existing pattern of development.

Wastewater Management Districts for Existing Development

Where conditions of sewage disposal in existing areas of development within the Bras d'Or Watershed may threaten the welfare of residents and/or the quality of water resources within the area, it shall be a policy of Council to consider the establishment of a Wastewater Management District to manage and monitor sewage collection and treatment facilities and, where necessary, establish charges for such management and monitoring.

---

42 SNSMR, *op cit.*, p. 2.
43 *Ibid.*, p. 5.

Wastewater Management Districts for Proposed Development
Where development of more than 20 residential units is contemplated through a single project or where a proposal involving 5 or more units will result in a density of development in excess of one unit per acre, it shall be a policy of Council to consider the establishment of a Wastewater Management District to manage and monitor sewage collection and treatment facilities and, where necessary, establish charges for such management and monitoring.

Additional Considerations

Implementation of WMDs will require the creation of a Wastewater Management District Bylaw in each case addressing the four considerations specified in the MGA. The Municipality of Barrington and the Municipal District of Guysborough have both posted WMD Bylaws on their respective Web sites that may serve as models for Cape Breton municipalities.[44] The documents are however detailed and tailored to the particular circumstances and systems of the communities in question.

5.1.4 Low Impact Design

Low Impact Design or LID refers to a collection of techniques that can be applied in land development and construction to control and manage stormwater runoff.

Objective

To establish policy and adjust regulations as necessary to permit and encourage approaches to land development, site planning, and building design that will manage stormwater runoff directed to watercourses and/or to enhance the quality of such runoff.

Approaches

Given that LID encompasses a wide range of potential measures, approaches to its implementation are also varied. Cluster or open space development, for example, can be addressed through MPS policy, LUB provisions, Subdivision Bylaw standards, and establishment of WMDs, among other initiatives.

MPS policy as explained in **Subsection 2.5.1**, above, is required to provide the foundation for LUB provisions. HRM's new Regional MPS, for example, contains an elaborate policy permitting Council to consider Open Space Development by Development Agreement:

[44] See: Municipality of Barrington, "Planning Documents," www.barringtonmunicipality.com/by-laws.html, for the WMD Bylaw for Woods Harbour, and Municipality of the District of Guysborough, "Municipal By-laws," www.municipality.guysborough.ns.ca/ for the WMD Bylaws for Little Dover and the community of Guysborough.

S-15 HRM shall permit the development of Open Space Design residential communities, as outlined in this Plan, within the Rural Commuter and Rural Resource designations and within the Harbour designation outside of the Urban Service Area, but not within the portions of the Beaver Bank and Hammonds Plains communities as identified in the Subdivision By-law under Policy S-25 and within the Rural Area Designation under the Eastern Passage/Cow Bay Plan Area. HRM will consider permitting the maximum density of such developments to one unit per hectare of gross site area. In considering approval of such development agreements, HRM shall consider the following:

(a) where the development is to be serviced by groundwater and as determined through a hydrogeological assessment conducted by a qualified professional, that there is an adequate supply of ground water to service the development and that the proposed development will not adversely affect groundwater supply in adjacent developments;
(b) that there is sufficient traffic capacity to service the development;
(c) the types of land uses to be included in the development which may include a mix of residential, associated public or privately-owned community facilities, home-based offices, day cares, small-scale bed and breakfasts, forestry and agricultural uses;
(d) whether soil conditions and other relevant criteria to support onsite sewage disposal systems can be met;
(e) the lot frontages and yards required to minimize the extent of road development, to cluster building sites on the parcel and provide for appropriate fire safety separations;
(f) that the building sites for the residential units, including all structures, driveways and private lawns, do not exceed approximately 20% of the lot area;
(g) approximately 80% of the lot is retained as a non-disturbance area (no alteration of grades, except for the placement of a well or onsite sewage disposal system in the non-disturbance area shall be permitted and provision shall be made for the selective cutting of vegetation to maintain the health of the forest);
(h) that the development is designed to retain the non-

disturbance areas and to maintain connectivity with any open space on adjacent parcels;

(i) connectivity of open space is given priority over road connections if the development can be sited on the parcel without jeopardizing safety standards;

(j) trails and natural networks, as generally shown on Map 3 or a future Open Space Functional Plan, are delineated on site and preserved;

(k) parks and natural corridors, as generally shown on Map 4 or a future Open Space Functional Plan, are delineated on site and preserved;

(l) that the proposed roads and building sites do not significantly impact upon any primary conservation area, including riparian buffers, wetlands, 1 in 100 year floodplains, rock outcroppings, slopes in excess of 30%, agricultural soils and archaeological sites;

(m) the proposed road and building sites do not encroach upon or are designed to retain features such as any significant habitat, scenic vistas, historic buildings, pastoral landscapes, military installations, mature forest, stone walls, and other design features that capture elements of rural character;

(n) that the roads are designed to appropriate standards as per Policy T-2;

(o) views of the open space elements are maximized throughout the development;

(p) opportunities to orient development to maximize the capture of solar energy;

(q) the proposed residential dwellings are a minimum of 800 metres away from any permanent extractive facility;

(r) the proposed development will not significantly impact any natural resource use and that there is sufficient buffering between any existing resource use and the proposed development to mitigate future community concerns; and

(s) consideration be given to any other matter relating to the impact of the development upon surrounding uses or upon the general community, as contained in Policy IM-15.

The detail reflected in the 19 points of the foregoing policy plus eleven additional points brought to bear by Policy IM-15, which is referenced in point (s), reflects the caution with which many authorities are approaching the open space concept. An overall density of one unit per hectare is most certainly not dense and the requirement that no more than 20 per cent of the land should be used for building

area seems limiting. Interestingly, however, the HRM policy makes no reference to protection of surface water.

The Open Space Model Ordinance posted by the Stormwater Manager's Resource Center (SMRC) provides a more liberal and flexible approach:

> The total number of residential units allowable within an open space development shall not exceed the number of units that would otherwise be allowed in the existing zoning district using conventional development. The total number of units allowed shall be determined using the following formula:
>
> $T = BDC[A - (U+R)]$
>
> Where:
>
> T = Total Units (dwelling units)
>
> BD = Base Density (dwelling units/acre)
>
> A = Total Site Area (acres)
>
> U = Unbuildable Land as defined in Section II (acres).
>
> R = Road and Utility Right of Way (acres)[45]

The foregoing formula essentially permits the same density as would result from a conventional subdivision design the proviso that lots cannot be less than 1/8 of an acre under any circumstance. The Model Ordinance also recommends provision of open space as follows:

> The total area of dedicated open space shall equal the amount by which all dwelling unit lots are reduced below the base zoning and shall meet the requirements outlined in Table 1.

Table 1. Open Space Required for Various Densities

Base Density (du/ac)	Open Space Required (% of buildable area)*
>1	35%
0.5<BD<1	40%
0.2<BD<0.5	45%
<0.2	50%

[45] The Stormwater Manager's Resource Center, "Open Space Design Zoning Controls," Model Ordnance, http://www.stormwatercenter.net/Model%20Ordinances/open_space_model_ordinance.htm accessed March 3, 2008.

> * *The amount of open space should increase with decreasing density, because of the feasibility of protecting open space in these areas. In rural open space designs, different techniques are typically used than in more suburban areas, clustering homes in small groups or "pods" that retain a rural character.*

The model ordinance does not explicitly require the preservation of areas around watercourses but buffers would clearly be encompassed by the following priorities:

> The following areas shall be high priorities for inclusion in designated open space
>
> 1. Resource buffers.
> 2. High quality forest resources
> 3. Individual trees
> 4. Critical habitat areas
> 5. High quality soil resources
>
> At least 75% of designated open space shall be contiguous, with no portion less than 100 feet wide.
>
> At least 50% of designated open space shall be … maintained in a natural, undisturbed condition.

This framework gives the subdivision designer considerable flexibility within a context that sets the priority on minimizing the bottom line consequences of excessive density, which is its impact on surface permeability. Additional issues such as provision of suitable sewage treatment and disposal are also addressed in the Model Ordinance.

Additional LID measures can be encouraged through MPS policy and either required or permitted through municipal bylaws. More flexible parking standards, for example, would normally be addressed in the LUB.[46] Roadway requirements are typically provided in the Subdivision Bylaw. WMDs, as noted, must be implemented through a WMD Bylaw.

Some measures may face challenges, however. A current example is green roofs. Green roofs raise structural concerns that should be addressed in municipal building codes. With relatively few green roof structures in place, the creation of building

[46] The Model Ordinance, for example, requires two parking spaces per residential unit but permits them to be located on the street as well as on individual properties.

standards is in its infancy in Canada. Municipalities interested in encouraging the green roof approach currently must look to a small number of foreign examples, most notably Germany, for guidance.[47]

Recommendations

Adopt policies in all municipal planning strategies supportive of design measures that encourage balanced stormwater flow. In particular, we recommend the adoption of policy to encourage open space design in appropriate locations within the Bras d'Or Watershed. Such policy should permit residential density at least equivalent to that achievable under the zone applicable to the area in question and should the location of roadways, other paved areas, and structures within a open space subdivision minimizes their impact on adjacent watercourses. The approval of open space proposals could be accomplished through either site plan approval, which is largely an administrative process involving staff approval provided specific guidelines are met, or development agreement, in which individual proposals are subject to public review pursuant to the MGA (i.e., public information meeting and public hearing leading to Council approval or refusal).

Encouragement of structural measures can be addressed through policy endorsing the thrust of these concepts and permitting the Development Officer on behalf of Council to consider their application. Through this means, municipal units may give consideration to measures such as landscaped berms in place of concrete curbing, the use of pervious paving surfaces rather than the asphalt, or the construction of buildings with green roofs. Some of these initiatives will no doubt be experimental and the municipality in question should ensure that the results of such innovations are monitored and evaluated to determine their appropriateness for general application.

Proposed Policy

Two policies are proposed: one to facilitate open space development and a second to support alternative stormwater control measures.

Open Space Development

It shall be the policy of Council to permit, by way of (site plan approval/a development agreement), the clustering of residential development within a property of five or more acres provided that through such clustering the number of dwelling units shall not exceed the number of units that would otherwise be allowed

[47] Goya Ngan, *Green Roof Policies: Tools for Encouraging Sustainable Design*, December 2004, p. 8 and pp. 44-45.

under the applicable zone using conventional development. In considering approval of such development agreements, Council shall consider the following:

(a) the lot frontages and yards required to minimize the extent of road development, to cluster building sites on the parcel and provide for appropriate fire safety separations;
(b) that the building sites for residential units, including all structures, driveways and private lawns, do not exceed approximately 50% of the lot area;
(c) that approximately 50% of the lot is retained as a non-disturbance area (no alteration of grades, except for the placement of a well or onsite sewage disposal system in the non-disturbance area shall be permitted and provision shall be made for the selective cutting of vegetation to maintain the health of the forest);
(d) where the development is to be serviced by groundwater, that there is an adequate supply of groundwater to service the development and that the proposed development will not adversely affect groundwater supply in adjacent developments, as determined through a hydrogeological assessment conducted by a qualified professional;
(e) whether soil conditions and other relevant criteria to support onsite sewage disposal systems can be met or that alternative systems for sewage collection and treatment acceptable to the municipality can be provided.;
(f) that the development is designed to retain the non-disturbance areas and to maintain connectivity with any open space on adjacent parcels;
(g) connectivity of open space is given priority over road connections if the development can be sited on the parcel without jeopardizing safety standards;
(h) existing parks, trails, natural networks, and natural corridors are delineated on site and preserved;
(i) that the proposed roads and building sites do not significantly impact on any primary conservation area, including riparian buffers, wetlands, 1 in 100 year floodplains, rock outcroppings, slopes in excess of 30%, agricultural soils and archaeological sites;
(j) that the proposed road and building sites do not encroach on or are designed to retain features such as any significant habitat, scenic vistas, historic buildings, pastoral landscapes, military installations, mature forest, stone walls, and other design features that capture elements of rural character;
(k) that views of the open space elements are maximized throughout the development;

(l) that opportunities to orient development to maximize the capture of solar energy;
(m) that the proposed development will not significantly impact any natural resource use and that there is sufficient buffering between any existing resource use and the proposed development to mitigate future community concerns; and
(n) that consideration be given to any other matter relating to the impact of the development on surrounding uses or on the general community.

Stormwater Control Measures
It shall be the policy of Council to encourage consideration of alternative methods to manage stormwater flows such as:

(a) the use vegetated swales, landscaping, and properly designed ditch and culvert systems;
(b) pervious surfacing of driveways, walkways; and
(c) employment of cisterns, rain barrels, and green roof technology.

5.2 ADDITIONAL MEASURES

The foregoing section addresses key measures suited to municipal implementation assessed for this study by EDM. While implementation of related recommendations will be a substantial step to protecting the Bras d'Or Lakes, we have noted and described in several locations above, the wide range of potential tools for protecting water resources. In **Section 5.1**, we have focused on land use planning tools – MPSs, LUBs, and Subdivision Bylaws – as the primary mechanisms for protecting water resources. A variety of other bylaws can however be employed to supplement and reinforce the foregoing techniques.

In addition, municipalities can achieve a good deal through less direct initiatives. Some of these are fairly simple measures such as educating the public about the value and sensitivity of water resources; others may involve operational changes by local governments themselves implemented through staff education and/or revised operational guidelines; still more may require the cooperation of senior governments with the technical skills, staff, and/or other resources either to assist municipalities or supplement the municipal role. The implementation of these types of measures may, furthermore, benefit from inter-municipal cooperation at the regional level, through the Provincial Government, and through municipal and non-profit organizations, as well as with support from the Federal Government.

5.2.1 Amended and Additional Bylaws

As noted, planning regulation is particularly effective in managing land development and construction. Many activities may however threaten water quality in undeveloped areas and in developed areas after construction. Of particular concern are activities involving the handling of hazardous materials and hydrocarbons; the management of animal and human wastes; and the cultivation or alteration of land as in gardening and farming.

Among measures worthy of consideration are the following:

- *Pesticide Control* – Many municipal governments in Canada have adopted pesticide control bylaws. Although these regulations have most often been pursued to protect individuals sensitive to pesticides, they may have benefits for watercourse protection to the extent that they manage pesticide application and require notification of surrounding property owners, or, in some cases severely limit or ban the use of pesticides. HRM adopted the first pesticide control bylaw in Nova Scotia in 2003. The bylaw permits the use of pesticides provided the area of application is adequately separated from individuals deemed sensitive to these materials and with properly signed. In other areas of Canada, most notably the Province of Quebec, some municipalities have gone so far as to ban the use of pesticides entirely.[48]

- *Animal Control* – Like pesticide bylaws, animal control bylaws are most often focused on issues other than water resource protection, such as licensing, public safety, and population control. Animal wastes can however be a serious threat to water quality and can be controlled through provisions of animal control or waste management bylaws.

  Appropriate bylaws normally require collection and removal of animal waste from curbsides, yards, parks, roadways, and other areas where the waste can be washed directly into receiving waters. Pet owners may be required to carry plastic leak proof bags while on walks so as to pick up feces. Bags should be sealed and deposited in trash cans for pick up by municipal solid waste services. At home, small amounts of pet wastes can be flushed down the toilet (if

[48] The Web site "Responsible Pest Management" provides a good overview of Canadian pest control bylaws adopted to date at www.pestinfo.ca/main/ns/8/doc/25/lang/EN, accessed March 31, 2008.

disposal is not to a septic tank) or buried in holes at least 20 cm deep, away from any waterway, well, or vegetable garden.

- *Lot Grading* – Once again, lot grading or topsoil removal bylaws are primarily adopted to protect against detrimental impacts other than effects on watercourses, most particularly to guard against alterations to lands that may direct stormwater to other properties. Alteration of stormwater flows or augmentation of stormwater flows with sediments exposed through topsoil removal and grading is a major threat to watercourses.

  In general, lot grading bylaws require application for a permit to remove or alter topsoil. In Halifax, applicants must identify their property and the extent of proposed works on a plan or aerial photograph. Among other items they are required to identify nearby watercourses, limit the removal of vegetative cover, and make provision to reinstate vegetation so as to minimize sedimentation.

Only the provisions of the MGA limit the overall scope of municipal regulation in Nova Scotia. Municipal bylaws may also regulate such concerns as the use, location, and type of fuel storage tanks; the timing and conduct of land development and construction (e.g., to avoid periods of extreme precipitation); and the removal of trees from public land.

Recommendations

All four municipalities with lands within the Bras d'Or Watershed have dog and/or animal bylaws. None of these bylaws, however, appears to contain any provisions concerning the handling of wastes. None of the four municipalities has a pesticide or a lot grading bylaw. Amendment of dog or animal bylaws to ensure proper collection and disposal of waste products, particularly dog feces, may be beneficial and would follow standards established in many other areas of Canada. The same could be said with respect to pesticide controls and lot grading regulations, although it should be noted in the context of this study that watercourse protection is at most a secondary objective of these regulations.

Proposed Policy

MPS Policy is not required to support initiatives of this type. MPS policy could however encourage Councils to consider amending or adopting bylaws to address these issues.

Amended and Additional Bylaws for Watercourse Protection
It shall be the policy of Council to consider the amendment or adoption of bylaws to improve the handling and disposal of animal waste; manage and control pesticide use; control the grading and removal of topsoil; or other measures that may be beneficial to the protection of watercourses and preservation of water quality.

5.2.2 Public Education

Governments have an implicit role in educating the public on many matters within their jurisdiction. In the environmental realm, governments have had a leading role in disseminating information on such matters as acid rain, climate change, water quality. In Nova Scotia, the province and its municipalities have been notably effective in teaching the public to recycle through an increasingly sophisticated solid waste management system.

Public education is equally important to implementation of water protection measures. For initiatives such as watercourse buffers to be effective, the public must be aware of the regulation and its objectives. Individuals who understand the purpose of regulations are much more likely to observe them and to assist municipal government with enforcement. Commitment to the objectives of water resource protection can furthermore extend good practice to areas that are difficult to regulate and/or enforce. Examples include handling of marine wastes, which is largely beyond the capacity of municipalities to oversee, and the management of individual septic systems.

The almost unlimited scope of public education initiatives can however tax municipal resources. Municipalities do however have a variety of low cost vehicles to communicate through, most notably their Web sites and standard municipal mailings (i.e., tax and utility bills). In their role as providers of recreational and cultural services municipalities may also sponsor events and courses that raise awareness of water quality issues and enhance technical understanding of the means to protect and enhance water resources. Examples might include adult education courses in septic system cleaning and management, and public beach or river cleanups.

Recommendation

Municipalities in Cape Breton should deploy available resources to raise awareness of the value of water resources and the importance of their preservation.

Proposed Policy

MPS policy is not required; however, the following may be considered to encourage Council action:

Environmental Education
It shall be the policy of Council to use all economical means at its disposal to raise public awareness of water quality issues and the means to preserve and protect water quality. To these ends, Council shall provide information and technical materials to the public, and sponsor events that inform the public of water resource issues and/or involve the public in activities intended to enhance water resources or the related environment.

5.2.3 Municipal Practice

A wide range of municipal activities may impact water resources. In addition to water and sewer systems, local governments typically own extensive facilities including municipal offices, parks and recreation facilities, fire halls, libraries, and other properties. Municipalities also own and manage extensive road networks.

Municipal facilities and infrastructure, like other public and privately owned facilities and infrastructure, may represent a threat to water resources if not properly managed. Municipalities can act as role models in their approach to the care and maintenance of their property and facilities. Many municipal pesticide bylaws, for example, apply a stepped approach to implementation beginning with restriction of the use of pesticides on municipal properties. Municipalities may also adopt guidelines for specific aspects of their operations that may threaten water resources such as storage and application of road salts. Although not encountered in our research, municipalities might also set an example by implementing LID approaches in developing and managing their buildings and lands.

Recommendation

Cape Breton municipal governments should ensure that their practices reflect advanced methods to protect and preserve water resources.

Proposed Policy

MPS policy is not required; however, the following may be considered to encourage Council action:

Municipal Guidelines
It shall be the policy of Council to encourage municipal staff to review all practices that may have a detrimental effect on water resources or may be improved in a manner that may enhance water resources or provide an example to the public of means to enhance water resources. Where appropriate, Council shall encourage staff to develop or revise operational guidelines to achieve these ends, with particular attention to road clearing and cleaning, management of municipal buildings and grounds, and handling of potentially hazardous materials by municipal staff.

5.2.4 Intergovernmental Cooperation

As the preceding subsection suggests, water protection programs must be broad-based to be effective. In this respect, cooperation among local governments with related interests, and/or with the provincial and federal governments will extend the reach and effectiveness of municipal initiatives. It is also effective to engage not for profit organizations and interested citizens in initiatives as has been done with this study in which CEPI is being strongly supported by CBRM and the EDPC.

Senior governments may require local governments to implement water resource protection measures as Nova Scotia does through its Provincial Interest Statements, but they also provide extensive support. SNSMR and NSEL are actively engaged in the implementation and oversight of piped and onsite sewage disposal systems, as well as in most aspects of groundwater and surface water protection. They provide inspection and evaluation services, as well as public education and technical assistance.

The Federal government also provides extensive supporting education programs as well as funding assistance. In the past, the Green Plan and Canada Infrastructure Works Programs (CIWP) have provided significant assistance to municipalities to address water and sewer challenges, although it would be fair to say that environmental considerations were not significantly weighted in prioritizing funded projects under CIWP. The Government of Canada through Indian and Northern Affairs Canada also provides extensive funding for aboriginal groups, which are a prominent component of the population in the Bras d'Or Watershed. The department's most prominent current initiative, the First Nations Infrastructure Fund, does not explicitly provide assistance with water or sewer projects but does support "planning and skills development" for bands.

Additional sources of support include the Union of Nova Scotia Municipalities and the Federation of Canadian Municipalities (FCM), and organizations such as the Una'maki Institute. These organizations most frequently offer administrative and technical support, although FCM has for several years sponsored the Green Municipal Fund, which provides grants to municipal governments worth up to 50 per cent of cost for development of Sustainable Community Plans and feasibility studies, and up to 80 per cent for capital projects.[49] The program is well-suited to innovative initiatives for watershed planning, and testing and implementation of LID techniques, among other initiatives.

[49] FCM.ca, "The Green Municipal Fund," www.sustainablecommunities.fcm.ca/GMF/.

Recommendation

Cape Breton municipal governments should ensure that their practices reflect advanced methods to protect and preserve water resources.

Proposed Policy

MPS policy is not required; however, the following may be considered to encourage Council action:

Intermunicipal Cooperation
It shall be the policy of Council to continue to cooperate with other municipal units in Cape Breton on the protection and preservation of water resources within the Bras d'Or Watershed.

Intergovernmental Cooperation
It shall be the policy of Council to coordinate efforts to protect and preserve water resources within the Bras d'Or Watershed with senior governments. To this end, Council shall encourage municipal staff to access technical support and funding from senior governments to support watershed planning, assess alternative approaches to water and wastewater management, and upgrade infrastructure relevant to the preservation and enhancement of water quality.

5.3 INTEGRATED WATERSHED MANAGEMENT PLAN

A watershed the size of the Bras d'Or Lakes ultimately demands integrated planning. While recommendations in the foregoing subsection of **Section 5.2**, can reinforce the commitment to cooperation reflected in the partnership for which this study has been prepared, the ultimate goal of CEPI, stated in the RFP for this study, is to develop "a watershed management plan for the Bras d'Or Lakes and [facilitate] its implementation."

The expectation that this will be an inter-municipal plan[50] developed in cooperation with key interest groups, First Nations, and senior governments is acknowledged by Policy 5a of the CBRM MPS:

> 5.a It shall be a policy of Council to continue to support the concept of an intermunicipal plan for the Bras D'Or Lake focused on its environmental remediation by continuing to

[50] Part 8 of the MGA treats inter-municipal planning strategies as equivalent to MPSs and other planning documents. The same standards for content, process, and approval apply except that the Council's involved may agree to hold a joint public hearing when considering approval or amendment of an inter-municipal planning strategy.

participate in:

- the joint planning endeavours of the three levels of government and the First Nations Reserves (*Pitupaq*); and
- the Bras D'Or Lakes Stewardship Society.

Integrated watershed management has a long and illustrious history, exemplified by such well-known initiatives as the Tennessee Valley Authority. An integrated approach is required in the Bras d'Or Lakes for several reasons:

- Only portions of the Bras d'Or Watershed are currently subject to municipal plans (i.e., all of the watershed within CBRM, Baddeck, Whycocomagh, Sporting Mountain, and St. Peter's);

- The relatively small municipal units in Cape Breton need to create the economies of scale to address the technical challenges of watershed management in the Bras d'Or Watershed; and

- The Bras d'Or Watershed is a natural ecological unit in which activities in one area of the watershed have clear and direct impacts on the environment in other areas, primarily through the medium of the lake waters.

Under the heading "Key Components of an IWM Plan," Infrastructure Canada's Web site lists the following process steps:

- characterizing the watershed (preliminary information gathering);
- setting goals and objectives;
- developing, evaluating, and selecting management alternatives;
- designing an implementation program (which includes writing the IWM plan);
- implementing the watershed plan;
- measuring progress and making adjustments.

In accordance with these steps, the site continues that "a Canadian IWM plan commonly contains the following components":

- a watershed inventory (relevant data regarding the watershed);
- issues affecting the watershed;
- planning objectives;
- analysis of management alternatives;

- plan of action (sometimes referred to as the Implementation Plan); and
- performance monitoring requirements.

This study has inventoried data and issues. It has also stepped beyond planning objectives to identify specific actions that can be incorporated in existing municipal planning documents or that may form the foundation of a more comprehensive plan for the Bras d'Or Lakes Watershed. The primary remaining requirements to develop an effective Management Plan now will be to detail initiatives such as public information programs and community action plans, and to establish a monitoring regime.

With respect to the latter requirement, **Table 5.1** taken from the USEPA's very comprehensive *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* provides a list of steps towards establishing a monitoring program.[51] The essential first step noted in the table is to develop a water environment baseline. This has yet to be done in the Bras d'Or owing to rudimentary water sampling. In any case, the USEPA recommends that indicators should be quantitative and should be selected in consultation with interested stakeholders.

Planning Step	Description of How Indicators are Used
Assess Current Conditions	Indicators are used to measure current environmental conditions (e.g., water quality, habitat, aquatic resources, land use patterns)
Develop Goals	Indicators are used to determine when the goal will be achieved (e.g., reducing nutrient loads to meet water quality standards)
Develop Pollution Load Reduction Targets	Indicators are used to measure the targets for load reductions (e.g., phosphorus concentration)
Select Management Strategies	Indicators are used to track the implementation of the management measures (e.g., number of management practices installed)
Develop Monitoring Program	The monitoring program measures the indicators that have been developed as part of the management strategies and information/education program
Implement Watershed Plan	Indicators are used to measure the implementation of the watershed plan, tracking dollars spent, resources expended, management practices implemented, and improvements in water quality

Source: USEPA, *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*

Table 5.1: Use of Indicators Throughout the Watershed Planning and Implementation Process

[51] USEPA, *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*, Draft, October 2005, p. 4-10.

The comprehensibility of measurement is key as stated in the Handbook:

> Keep in mind that indicators provide a powerful means of communicating to various audiences about the status of the watershed, as well as demonstrating the progress being made toward meeting goals. Select indicators that will help to communicate these concepts to nontechnical audiences. For example, using a 30-day geometric mean for *E. coli* bacteria to demonstrate reduction in pathogens to the waterbody won't mean much to most people. But using the number of shellfish beds that have been reopened because of the reduction of pathogen inputs is easier to understand. Or being able to count the number of failing septic systems that have been located and repaired shows people how the sources of pathogens are being reduced.[52]

Ultimately, the development of an Integrated Watershed Management Plan for the Bras d'Or is the responsibility of the residents of the watershed. Their engagement in the creation of policies, their observance of the specifications of regulations, and their commitment to practices and actions that will achieve the goals of a Watershed Management Plan are essential to effective water resource protection.

[52] *Ibid.*, p. 4-11.

APPENDIX A: INTERVIEW OUTLINE

1) What are the most important BMPs for water quality/quantity?
   a. Are they measurable?
   b. Are these appropriate to local conditions (four seasons, cold climate with heavy rainfall and snowfall)?

2) Do you see an advantage to a stormwater management program based on a balance between both structural and non structural BMPs, or do you favour one over the other?

3) In your experience, is one BMP type easier to implement than the other?

4) In your opinion, is it more appropriate to place the burden of BMPs on developers or is it the local government's role to implement them?

5) How have non-structural BMPs been implemented in your region (particularly if any relating to watercourse buffers, low impact development, wastewater management districts or policies relating to septic systems, sedimentation controls)?

6) What are the key challenges of implementing non-structural BMPs (particularly in relation to watercourse buffers, low impact development, wastewater management districts or policies relating to septic systems)?

7) Have you experienced or do you foresee any cost savings as a result of the BMPs (for municipalities and/or for developers)?

8) Has there been any effectiveness monitoring to assess the BMPs?
   a. If yes, please provide more information on monitoring program and results.
   b. If no, why not?

9) If a monitoring program is in place:
   a. What factors most impacted the success in meeting objectives?
   b. If monitoring determined the stated objectives were not met, was that due to the recommended BMPs being inadequate or inappropriate, not implemented, or not implemented correctly?

10) What changes to the BMPs are necessary to better achieve the stated objectives?

11) Have their been key changes to water resources related BMPs that you are aware of?
   a. The older regulations may provide more insight into administering/ implementing them. Can you speak to any lessons learned?

12) What staff resources do you have available to implement and monitor BMPs?

APPENDIX B: GIS ANALYSIS MAPS

APPENDIX C: BRAS D'OR LAKES DEVELOPMENT STANDARDS HANDBOOK

BRAS D'OR LAKES DEVELOPMENT STANDARDS
Handbook

March 2008

Prepared for:
Bras d'Or Lakes Collaborative Environmental Planning Initiative

Prepared by:
EDM • Environmental Design and Management Ltd.

ABOUT THIS HANDBOOK

EDM • Environmental Design and Management has prepared this handbook to summarize initiatives for water resource protection to be considered by the municipalities with jurisdiction over portions of the Bras d'Or Lakes Watershed. These initiatives are recommended in our report *Bras d'Or Lakes Development Standards* prepared for the Bras d'Or Lakes Collaborative Environmental Planning Initiative (CEPI). The report presents the results of our extensive study of Best Management Practices (BMPs) for water resource protection in the Bras d'Or Lakes.

The focus of our study was on approaches to protection of water resources that could be implemented at the local level through management and regulation of land development. The study concentrated on four key groups of initiatives:

- Suitability of Lands for Development (see p. 2, below)
- Watercourse Buffers (p. 3)
- Wastewater Management Districts (p. 6)
- Low Impact Development (p. 7).

The handbook summarizes recommendations related to each area. For each recommendation the handbook provides proposed municipal policy suitable for incorporation in a Municipal Planning Strategy (MPS) along with implementation approaches. MPS policy is most often implemented through a Land Use Bylaw (LUB) regulating land development and construction within a designated planning area.

Other devices and approaches are also available. Some policy initiatives can be implemented directly from policy; most notably, four additional categories discussed in our report:

- Amended and Additional Bylaws (p. 9)
- Public Education (p. 10)
- Municipal Practice (p. 11)
- Intergovernmental Cooperation. (p. 11).

Ultimately, water resource protection is in the hands of the community. The highest degree of success will be achieved when municipal employees, residents, businesses, and even visitors are aware of the importance of preserving and protecting watercourses, and fully committed to the achievement of water protection goals. The implementation of initiatives to protect water resources should therefore be as comprehensive as possible and supported by continuous efforts at public education.

With respect to the former requirement, it is important to note that only limited areas of the Bras d'Or Watershed are currently subject to a MPS. Within the watershed, all of Cape Breton Regional Municipality, Baddeck in Victoria County, Whycocomagh in Inverness County, and Sporting Mountain and St. Peter's in Richmond County are subject to municipal plans and land use bylaws. The policy and bylaw amendments recommended following have been drafted for incorporation in these existing documents, using similar language and formatting. The majority of the area within the watershed, however, is outside these established planning areas. Although all four municipal units have subdivision bylaws, which are also an important implementation tool, and these bylaws apply to the entire municipality in all cases, they cannot incorporate restrictions less stringent than the Provincial Subdivision Regulations except pursuant to MPS policy.

Ultimately, CEPI is seeking to create an Integrated Watershed Management Plan (IWMP) for the Bras d'Or. Ideally, the following recommendations will eventually form a major portion of the content of a comprehensive document. A comprehensive Watershed Management Plan should, however, go beyond just land use controls. The IWMP should cover initiatives beyond land use controls and building regulations. It should address public education, community animation, and ongoing monitoring. To these ends, it must be created in consultation with other levels of government and a full range of stakeholders.

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
Suitability of Lands for Development		**See**: *Bras d'Or Lakes Development Standards,* Section 5.1.1, pp. 68-71
To identify lands that are marketable for development that also minimize government and societal costs, and impacts on valued environmental features.	**Serviced Centres** It shall be a policy of Council to encourage development to locate in areas within the Bras d'Or Watershed that are connected to or can feasibly be connected to existing water and sewer networks.	Adopt additional policy in MPS documents applicable to serviced centres within the Watershed, identifying these areas as preferred growth centres. In these areas, permit higher density development and a wider variety of development types to encourage the creation of complete communities, and to enhance the financial viability of development. For the balance of the watershed, adopt policy to minimize the possible negative impacts of development and to preserve the rural character of those areas. This policy could be implemented in the LUB through requirements for restricted land use, larger lots,

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
	Residential Land Suitability Assessment For subdivisions or development proposals of more than five lots, it shall be a policy of Council to assess the potential impact of the proposed development on the Bras d'Or Watershed taking into account such considerations as: (a) topography, (b) soil type and thickness, (c) proximity to existing water, sewer, and road networks, (d) proximity to other services necessary to support and protect residential development such as police, fire, schools, libraries, parks, and recreation facilities, (e) the existence of water and sewer concerns, and (f) the impact of land development and occupation on the surrounding environment, particularly on the Bras d'Or Lakes and their tributary watercourses.	and higher yard and setback requirements. Prohibition of the construction of private roads except where associated with Open Space Design approaches (see below) would also assist toward this objective. Require developers through the Subdivision Bylaw to assess the probable impacts of larger proposals and identify measures to mitigate impacts.
Watercourse Buffers		**See**: *Bras d'Or Lakes Development Standards*, Section 5.1.2, pp. 71-78
To limit land use, and preserve natural features and vegetation in areas immediately abutting watercourses so as to maintain the natural filtering qualities of these lands, shade water edges, preserve aesthetic qualities, and protect against the effects of sea level rise, while facilitating controlled public	**20-Metre Watercourse Buffers** It shall be a policy of Council to require the retention, through the land use bylaw, of a minimum 20-metre buffer area along all watercourses within the Bras d'Or Watershed to protect the chemical, physical and biological functions of marine and freshwater resources. The bylaw shall generally prohibit all development within the buffer but provisions shall be made to permit existing structures; decks attached to existing structures in the buffer or to legal structures abutting the	Add the following in the General Provisions of the applicable LUB: Notwithstanding anything else in this Bylaw, all lots abutting a watercourse shall retain at least a 20-metre vegetated buffer next to such watercourse. Municipalities that have adopted this type of

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
access.	buffer; boardwalks, walkways, and trails of limited width; fences, public road crossings, and driveway crossings; wastewater, storm and water infrastructure; marine dependent uses; fisheries uses; boat ramps; wharfs; conservation uses; parks on public lands; and historical sites and monuments within the buffer. In addition, no alteration of land levels or removal of vegetation in relation to development will be permitted. **Watercourse Buffers Up to 75 Metres** It shall be a policy of Council to consider the retention of additional watercourse buffer areas to a maximum of 75 metres in which the same or more limited restrictions on land use may be implemented through the land use bylaw, in consideration of the perceived sensitivity of receiving waters, potential for soil erosion, and/or potential inundation from flooding or sea level rise.	comprehensive watercourse buffer in Nova Scotia have not illustrated the requirement on their zoning maps. The applicable LUB may be amended in several ways to accomplish this. An overlay zone is one option. A zone similar to a floodway zone might be adopted in which construction could be appropriately restricted. Pursuant to the policy outlined, this zone could be applied on the banks or shores of any watercourse up to a distance of 75 metres. Restrictions might vary from the standards applicable within the 20-metre buffer areas. For example, it may be possible to allow the removal of vegetation if appropriate construction practices are employed, or to allow development provided sites are filled above the level of potential sea level rise and related storm surge. As this type of restriction would be implemented as a zone overlay, as opposed to a LUBprovision, its application will have to be illustrated on the Zoning Map or Maps.

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
	High Risk Land Uses It shall be the policy of Council to include provisions in appropriate zones to ensure adequate separation from all watercourses of land uses in which there may be a reasonable expectation of the storage or handling of materials that may be detrimental to water quality if released to such watercourses such as services stations, specific industrial uses, manure storage facilities, and salt storage sheds.	Amend applicable sections of the LUB. The most likely amendments will be additional buffer distance in zones permitting land uses of concern. For example, a Highway Commercial Zone might be amended to require that services stations and automobile dealerships be located at least 75 metres from any watercourse.
	Sea Level Elevation It shall be a policy of Council to restrict, through the land use bylaw, all development on the shores of the Bras d'Or Lakes within a 1.25-metre elevation above the ordinary high water mark.	Add the following in the General Provisions of the applicable LUB: Notwithstanding anything else in this Bylaw, no building shall be constructed on the shores of the Bras d"Or Lakes within a 1.25-metre elevation above the ordinary high water mark. This provision does not have to be illustrated on the Zoning Map.
	Dedication of Waterfront Lands It shall be the policy of Council to require the dedication of up to 10 per cent of any lands approved for subdivision within the Bras d'Or Watershed for the protection of watercourses. Where any such subdivision may abut a watercourse, Council shall assume ownership of all lands within at least 20 metres immediately abutting the watercourse. Where lands more than 20 metres from a watercourse are deemed not to be of interest to protect the watercourse or to provide access to such watercourse, it shall be the policy of Council to accept cash-in-lieu to be accumulated in a municipal fund for the strategic	Add the following in the applicable Subdivision Bylaw: Before receiving approval of a final plan of subdivision, the subdivider of any property within the Bras d'Or Watershed having frontage on a watercourse shall provide a park dedication to the Municipality which: (a) if in the form of land, shall include all lands within the proposed subdivision within 20

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
	acquisition of waterfront lands, particularly on the shores of the Bras d'Or Lakes.	metres of the watercourse, provided such lands do not exceed 10 per cent of all newly created lots, including any proposed parkland, but excluding proposed public streets or highways, private roads, walkways and the remainder of land owned by the subdivider; and (b) if in the form of equivalent value, shall be equal to 10 per cent of the estimated assessed market value of all newly created lots, excluding public streets or highways, private roads, and walkways and the remainder of land owned by the subdivider.
Wastewater Management Districts		**See**: *Bras d'Or Lakes Development Standards*, Section 5.1.3, pp. 78-81
To establish a framework or frameworks to address pollution control challenges through the establishment of community-based approaches to managing onsite systems, or small-scale collection and treatment systems.	**Wastewater Management Districts for Existing Development** Where conditions of sewage disposal in existing areas of development within the Bras d'Or Watershed may threaten the welfare of residents and/or the quality of water resources within the area, it shall be a policy of Council to consider the establishment of a Wastewater Management District to manage and monitor sewage collection and treatment facilities and, where necessary, establish charges for such management and monitoring. **Wastewater Management Districts for Proposed Development** Where development of more than 20 residential units is contemplated through a single project or where a proposal involving 5 or more units will result in a density of development in excess of one unit per acre, it shall be a policy of Council to consider the establishment of a Wastewater	A Wastewater Management District Bylaw is required for each WMD established. Creation of a model WMD Bylaw would be beneficial but each bylaw must recognize the boundaries of the particular district, the waste disposal technology to be employed, the related management approach, and the specific regime for allocating WMD costs to users. See Wastewater Management Districts for Existing Development preceding

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
	Management District to manage and monitor sewage collection and treatment facilities and, where necessary, establish charges for such management and monitoring.	
Low Impact Design		**See**: *Bras d'Or Lakes Development Standards*, Section 5.1.4, pp. 81-88
To establish policy and adjust regulations as necessary to permit and encourage approaches to land development, site planning, and building design that will manage stormwater runoff directed to watercourses and/or to enhance the quality of such runoff.	**Open Space Development** It shall be the policy of Council to permit, by way of site plan approval and/or development agreement, the clustering of residential development within a property of five or more acres provided that through such clustering the number of dwelling units shall not exceed the number of units that would otherwise be allowed under the applicable zone using conventional development. In considering approval of such development agreements, Council shall consider the following: (a) the lot frontages and yards required to minimize the extent of road development, to cluster building sites on the parcel and provide for appropriate fire safety separations; (b) that the building sites for residential units, including all structures, driveways and private lawns, do not exceed approximately 50% of the lot area; (c) that approximately 50% of the land to be subdived is retained as a non-disturbance area (no alteration of grades, except for the placement of a well or onsite sewage disposal system in the non-disturbance area shall be permitted and provision shall be made for the selective cutting of vegetation to maintain the health of the forest); (d) where the development is to be serviced by groundwater, that there is an adequate supply of groundwater to service the development and that the proposed development will not adversely affect groundwater supply in adjacent	The municipality should decide which of site plan approval or the development agreement process suits its purposes. The decision should largely be based on the degree of control Council wishes to exercise, recognizing that additional control though a Development Agreement process, may discourage employment of the open space approach. Council may use both regulatory techniques, reserving development agreements for larger developments or for developments requiring adaptations beyond set guidelines. Site plan approval or development agreement procedures must be provided in zones in which Open Space Development will be considered. Normally, these will be rural residential zones in which standard development would require onsite services on larger lots. Specifications for Open Space Development in these zones should address lot size, frontage, and yard requirements, as well as the percentage of land required to be set aside for sewage disposal and treatment, water supply, and land conservation. They may provide latitude for consideration of other LID measures such as permeable paving surfaces,

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
	developments, as determined through a hydrogeological assessment conducted by a qualified professional; (e) whether soil conditions and other relevant criteria to support onsite sewage disposal systems can be met or that alternative systems for sewage collection and treatment acceptable to the municipality can be provided; (f) that the development is designed to retain the non-disturbance areas and to maintain connectivity with any open space on adjacent parcels; (g) connectivity of open space is given priority over road connections if the development can be sited on the parcel without jeopardizing safety standards; (h) existing parks, trails, natural networks, and natural corridors are delineated on site and preserved; (i) that the proposed roads and building sites do not significantly impact on any primary conservation area, including riparian buffers, wetlands, 1 in 100 year floodplains, rock outcroppings, slopes in excess of 30%, agricultural soils and archaeological sites; (j) that the proposed road and building sites do not encroach on or are designed to retain features such as any significant habitat, scenic vistas, historic buildings, pastoral landscapes, military installations, mature forest, stone walls, and other design features that capture elements of rural character; (k) that views of the open space elements are maximized throughout the development; (l) that opportunities are taken to orient development to maximize the capture of solar energy; (m) that the proposed development will not significantly impact any natural resource use and that there is sufficient	cisterns, or green roofs, which could justify reduction of the area of conserved land to the extent that they might reduce stormwater flow. Consideration of Open Space Development will probably raise a wider range of concerns for the public than the potential impact of such development on stormwater management, watercourses, and other aspects of the natural environment. Provisions (d) through (n) of the suggested policy address considerations of this type and would be taken into account by the Development Officer in the case of site plan approval, and by Council in the case of an appeal of a site plan approval decision or consideration of a Development Agreement application. These specifications would also be a primary guide for the Nova Scotia Utilities and Review Board when hearing an appeal of a Development Agreement decision by Council. Often, MPSs include "Implementation Policies" that provide further context for the consideration of LUB amendments and Development Agreements. These policies typically invoke consideration by Council of such matters as the adequacy of public infrastructure and the financial capacity of the municipality, and land use and environmental impacts (e.g., noise, traffic, views). These provisions will also bear on consideration of

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
	buffering between any existing resource use and the proposed development to mitigate future community concerns; (n) that private roads , and water, sewer and stormwater infrastructure required to service the development can be appropriately managed by future residents of the development; (o) that consideration be given to any other matter relating to the impact of the development on surrounding uses or on the general community. **Stormwater Control Measures** It shall be the policy of Council to encourage consideration of alternative methods to manage stormwater flows such as: (a) the use vegetated swales, landscaping, and properly designed ditch and culvert systems; (b) pervious surfacing of driveways, walkways; and (c) employment of cisterns, rain barrels, and green roof technology.	Open Space Subdivisions through Development Agreement. Where the combination of existing provisions is considered insufficient further amendment may be required. Additional bylaws or bylaw amendments may be required. For example, amendments may be required to the Subdivision Bylaw to permit alternative street standards, or a development requiring a shared sewage treatment system might require the creation of a WMD with an associated WMD Bylaw. Amend the Subdivision Bylaw and Building Bylaws as necessary to permit the use of alternative technologies.
Amended and Additional Bylaws		**See**: *Bras d'Or Lakes Development Standards*, Section 5.2.1, pp. 88-91
To explore additional regulatory measures that may have benefits in watercourse protection.	**Amended and Additional Bylaws for Watercourse Protection** It shall be the policy of Council to consider the amendment or adoption of bylaws to improve the handling and disposal of animal waste; manage and control pesticide use; control the grading and removal of topsoil; or other measures that may be beneficial to the protection of watercourses and preservation of water quality.	Consider adoption of one or more of the following: · Pesticide Control · Animal Control · Lot grading

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
		Any other potential bylaw, regulation, or guideline that may further the objective of protecting and enhancing water resources.
Public Education		**See**: *Bras d'Or Lakes Development Standards*, Section 5.2.2, pp. 91-92
To raise public awareness of water quality issues and the means to preserve and protect water quality.	**Environmental Education** It shall be the policy of Council to use all economical means at its disposal to raise public awareness of water quality issues and the means to preserve and protect water quality. To these ends, Council shall provide information and technical materials to the public, and sponsor events that inform the public of water resource issues and/or involve the public in activities intended to enhance water resources or the related environment.	Promote water resource awareness through all available, cost-effective means. Provide continuing education courses through recreation departments and organize events to involve the community in clean-up and other improvements. Add information on Water Resource protection to municipal Web sites. All of the municipal units on Cape Breton provide general information on a variety of matters. Information on water resource protection will simply augment this useful material. I t should be prominently accessible as, for example, a component of the Community Information pages of the CBRM site. Municipal Web sites should link to appropriate pages in other Web sites offering pertinent information such as Environment Canada, Nova Scotia Environment and Labour, the Un'amaki Institute, and CEPI. These agencies are also potential sources of printed information that may be distributed to the interested public.

MUNICIPAL WATER RESOURCE PROTECTION INITIATIVES		
Objectives	**Suggested Policy**	**Implementation Approaches**
Municipal Practice		**See**: *Bras d'Or Lakes Development Standards*, Section 5.2.3, p. 92
To ensure municipal operations are conducted with conscientious concern for the environment.	**Municipal Guidelines** It shall be the policy of Council to encourage municipal staff to review all practices that may have a detrimental effect on water resources or may be improved in a manner that may enhance water resources or provide an example to the public of means to enhance water resources. Where appropriate, Council shall encourage staff to develop or revise operational guidelines to achieve these ends, with particular attention to road clearing and cleaning, management of municipal buildings and grounds, and handling of potentially hazardous materials by municipal staff.	Prepare a municipal operations manual or amend existing operational guidelines in consideration of water resource protection priorities covering typical municipal functions such as buildings, parks, and grounds maintenance; road construction and maintenance, including salt application and storage; and fleet operation and maintenance.
Coordinated Action		**See**: *Bras d'Or Lakes Development Standards*, Section 5.2.4, pp. 93-92
To maximize cooperation among local governments, interested stakeholders and senior governments toward the protection of water resources.	**Intermunicipal Cooperation** It shall be the policy of Council to continue to cooperate with other municipal units in Cape Breton on the protection and preservation of water resources within the Bras d'Or Watershed.	All municipal units in the Bras d'Or Watershed should continue to cooperate with CEPI and other agencies committed to watershed protection and enhancement leading, ultimately, to the creation and mutual endorsement of an Intermunicipal Watershed Management Plan for the Bras d'Or.
	Intergovernmental Cooperation It shall be the policy of Council to coordinate efforts to protect and preserve water resources within the Bras d'Or Watershed with senior governments. To this end, Council shall encourage municipal staff to access technical support and funding from senior governments to support watershed planning, assess alternative approaches to water and wastewater management, and upgrade infrastructure relevant to the preservation and enhancement of water quality.	Local governments and associations should continue to work with Provincial and Federal authorities to protect water resources. Senior governments are a key source of funding support. They also provide information that local authorities can assist to disseminate and guidelines to which local authorities should attempt to conform. Where necessary local governments should encourage or even