HALIFAX REGIONAL MUNICIPALITY
P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Regional Watershed Advisory Board
October 9, 2013

TO: Chair and Members of Regional Watershed Advisory Committee

Original Signed

SUBMITTED BY: ______________________________
Peter Stickings, Acting Director Planning and Infrastructure

DATE: September 20, 2013

SUBJECT: **Shubenacadie Lakes Sub-watershed Study Report**

ORIGIN

At the November 16, 2010, Regional Council, a motion was approved to under take a watershed study for Port Wallace this year and allow Port Wallace to move to the Secondary Planning Process as soon as the watershed study is completed.

LEGISLATIVE AUTHORITY

Section 229 (1)(g) of the Halifax Charter enables a Municipal Planning Strategy to require studies to be carried out prior to undertaking specified developments or developments in specified areas. This Study was initiated pursuant to Policy E-17 of the Regional Plan.

RECOMMENDATION

It is recommended that the Regional Watershed Advisory Board recommend to the Harbour East Community Council, that Shubenacadie Lakes Sub-watershed Study Report (AECOM) be accepted as background for future community planning.

BACKGROUND

AECOM was awarded the contract to prepare the Shubenacadie Lakes Sub-watershed Study (Attachment 1). An excerpt of the RFP outlining the study objectives and tasks is presented as Attachment 2.

This watershed study has been undertaken to provide background information for future community planning in Port Wallace. This Study is required pursuant to Policy E-17 of the Regional Plan. Policy E-17 requires the preparation of these studies to determine the carrying capacity of the watershed as background for future secondary planning processes.

DISCUSSION

The Shubenacadie Lakes Sub-watershed Study Report has been reviewed by the HRM and HW Steering Committee and deemed to have met the terms of reference of RFP for the Shubenacadie Lakes Sub-watershed Study.

The main findings and recommendations are summarized in the executive summary of the study, which is reproduced as Attachment 3. The full report can be found at: http://www.halifax.ca/planhrm/index.html (under project updates)

It is recommended that this study be recommended to the Harbour East Community Council as a background study for future community planning.

FINANCIAL IMPLICATIONS

There are no direct financial implications arising from this report. The Study has been prepared as background information for future community planning.

COMMUNITY ENGAGEMENT

The draft RFP was presented by staff to former Dartmouth and Halifax Watershed Advisory Boards (the WABs), as well as the Shubenacadie Watershed Environmental Protection Society (SWEPS). These committees were also invited to attend a public meeting held on November 14, 2011, at which AECOM presented the preliminary report with recommended water quality objectives. A submission received from the Halifax WAB in response to the report is as Attachment D.

The draft final report was also submitted to the WABs for comment. No submissions were received.

ENVIRONMENTAL IMPLICATIONS

This Study is required to determine the impact of development on the Shubenacadie Lakes Sub-watershed as background for the preparation of the Port Wallace Secondary Municipal Planning Strategy. Matters concerning the environment will be assessed during the process to prepare the Secondary Plan.

ALTERNATIVES

The Committee could recommend that more analysis be undertaken before the study is considered complete. This is not recommended as HRM is already proceeding with a Land Suitability and concept plan analysis, which can address additional issues which may be raised by the committee.

ATTACHMENTS

Attachment 1:	Study Area
Attachment 2:	Study Objectives and Tasks from the RFP for the
Attachment 3:	Executive Summary of Port Wallace Watershed Servicing Study Report
Attachment 4:	Halifax Watershed Advisory Board Review of draft Shubenacadie Lakes Subwatershed Study – Preliminary Report

---

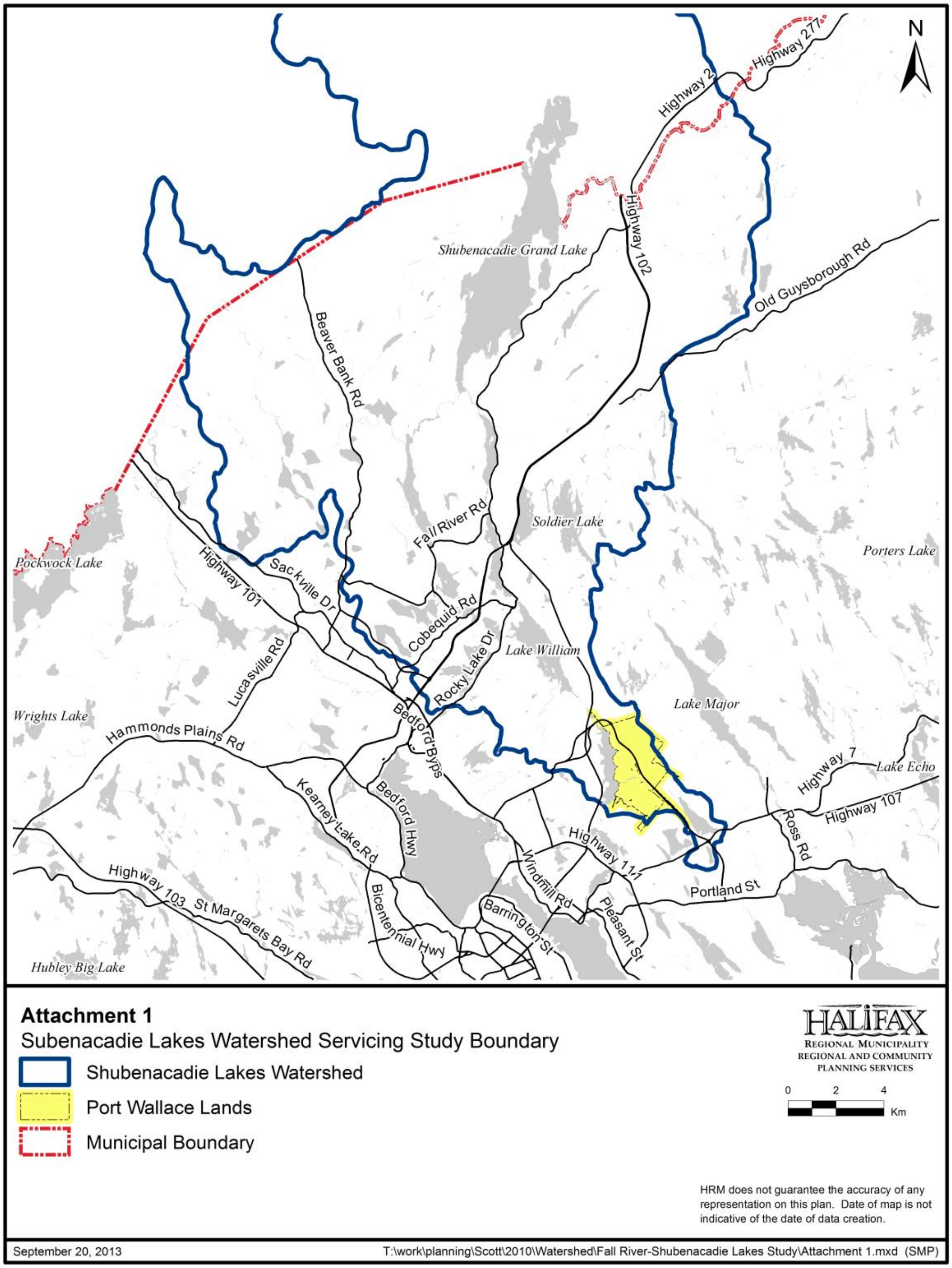
A copy of this report can be obtained online at http://www.halifax.ca/commcoun/cc.html then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 490-4210, or Fax 490-4208.

Report Prepared by: Paul Morgan, Senior Planner, Planning and Infrastructure, 490-4482

Original Signed

Report Approved by: Austin French, Manager, Planning and Infrastructure, 490-6717

Attachment 1 – Study Area



Attachment 2 - Study Objectives and Tasks from the RFP for the Shubenacadie Lakes Sub-watershed Study

3.0 STUDY SCOPE AND REQUIREMENTS

3.1 Background

Regional Council of the Municipality has directed that watershed studies be undertaken in response to requests to initiate planning for new serviced communities through secondary planning processes. One of the requests is identified by the Regional Planning Strategy as "Highway 102 West Corridor adjacent to Blue Mountain – Birch Cove Lakes Park" and the other as "Port Wallace".

The Regional Planning Strategy requires that watershed studies be undertaken as a prerequisite to more detailed secondary planning. The study objectives, as established by policy E-17, are set out as follows:

Watershed or sub-watershed studies concerning natural watercourses shall be carried out as part of comprehensive secondary planning processes. These studies shall determine the carrying capacity of the watersheds to meet the water quality objectives which shall be adopted following the completion of the studies. The studies, where appropriate, shall be designed to:

(a) recommend measures to protect and manage quantity and quality of groundwater resources;

(b) recommend water quality objectives for key receiving watercourses in the study area;

(c) determine the amount of development and maximum inputs that receiving lakes and rivers can assimilate without exceeding the water quality objectives recommended for the lakes and rivers within the watershed;

(d) determine the parameters to be attained or retained to achieve marine water quality objectives;

(e) identify sources of contamination within the watershed;

(f) identify remedial measures to improve fresh and marine water quality;

(g) recommend strategies to adapt HRM's stormwater management guidelines to achieve the water quality objectives set out under the watershed study;

(h) recommend methods to reduce and mitigate loss of permeable surfaces, native plants and native soils, groundwater recharge areas, and other important environmental functions within the watershed and create methods to reduce cut and fill and overall grading of development sites;

(i) identify and recommend measures to protect and manage natural corridors and critical habitats for terrestrial and aquatic species, including species at risk;

(j) identify appropriate riparian buffers for the watershed;

(k) identify areas that are suitable and not suitable for development within the watershed;

(l) recommend potential regulatory controls and management strategies to achieve the desired objectives; and

(m) recommend a monitoring plan to assess if the specific water quality objectives for the watershed are being met.

The Highway 102 West Corridor lands are within the Birch Cove Lakes Watershed (see Map 1) and the Port Wallace lands are within a sub-watershed of the Shubenacadie Lakes system (Maps 2a and 2b). As Lake Charles also flows towards Lake Micmac and Lake Banook, these lakes shall also be included in the study.

Watershed studies have previously been undertaken for each of these areas (see Appendix A: Resource Materials).

3.2 Study Scope and Tasks:

The study scope is to address the matters identified in Policy E-17 of the Regional Planning Strategy. In association with requirements of Policy E-17, the following specific tasks are to be undertaken:

A. Meet with the Shubenacadie Canal Commission, the Shubenacadie Watershed Environmental Protection Society and the Dartmouth Lakes Advisory Board in a joint meeting and the Bedford Watershed Advisory Board in a separate meeting to explain the work to be undertaken and to hear any concerns or issues arising.

B. Prepare a draft preliminary report for each study area with recommended water quality objectives for key receiving watercourses. Each report is to explain the criteria for the recommendations and will be presented at a public meeting and at a meeting of Regional Council for an endorsement of the recommendations. A separate public meeting will be scheduled for each watershed study and it should be assumed that separate presentations to Council will be required. Following each presentation at the public meeting, the Proponent will be expected to respond to questions arising and consider revisions based on the comments received which are to be incorporated into the final preliminary report to Council.

C. Review existing water quality data available and undertake a sampling program needed to establish a reliable and accurate baseline of the water quality in key receiving water courses.

D. Review and update the modeling previously undertaken for each watershed study and identify any deficiencies or changes to assumptions to be made. Any changes or deficiencies are to be reported to the project steering committee before proceeding with updating the models. The modeling for the Birch Cove Lakes watershed should assume that the proposed Highway 113 will be developed.

E. Undertake spatial modeling utilizing HRM LiDAR data for each watershed. The Proponent will use the data to develop an ArcGIS 9.3 Digital Surface Model (DSM) of each watershed. Further modeling will include the following tasks: watershed delineation including identification of vernal ponds, wetlands and intermittent streams; pre and post development analysis of impervious surface effects; and pre and post development watercourse sediment loads. Stormwater modeling is to take into account the anticipated effects of climate change (increased frequency and intensity of storm events).

F. Evaluate the potential for existing control structures within each watershed to affect water Quantity and quality in downstream watercourses. The evaluation is to provide a quantitative assessment of the impact on water quality measures and a qualitative assessment of the sophistication of management needed to be effective.

G. Liaise with provincial and federal representatives to determine if any regulations or guidelines affect the study outcome.

H. Prepare a draft final report for each study area which addresses the applicable matters identified under Policy E-17 for presentation at a public meeting (one for each watershed. Again, the Proponent will be expected to respond to questions and will consider revisions to the final report which is then to be presented to Regional Council.

Attachment 3 - Executive Summary from AECOM
Shubenacadie Lakes Sub-watershed Study Report

A copy of the main conclusions and recommendations from the Executive Summary of the Study is presented below. A full copy of the Final Report may be reviewed on-line at http://www.halifax.ca/planhrm/index.html

Executive Summary

The 2006 Halifax Regional Municipal Planning Strategy requires that watershed studies are undertaken before a Community Vision exercise and in advance of community design work undertaken through the secondary planning process. In response to requests by property owners of the "Port Wallace Lands" to begin planning for a new serviced community, Regional Council has requested the completion of a watershed study for the Shubenacadie Lakes subwatershed.

AECOM was contracted by HRM in August 2011 to complete the Shubenacadie Lakes Subwatershed Study in two phases:

1. present recommended water quality objectives for key receiving water bodies within the subwatershed in a Preliminary Report; and,
2. address the remaining objectives of Regional Plan Policy E-17 in a Final Report.

This Final Report identifies areas that are suitable and not suitable for development, determines the amount of development that can be accommodated while maintaining the recommended water quality objectives, recommends measures to protect and manage quantity and quality of surface and groundwater and suggests regulatory options and management strategies to achieve the desired water quality objectives.

The Shubenacadie Lakes subwatershed is located largely within the Eastern Ecoregion, with a small portion of the subwatershed (northeast of Grand Lake) located in the Valley and Central Lowlands Ecoregion. The subwatershed has a surface area of approximately 388 km^2. In general, surface water flows through the subwatershed from south to north. Lake Charles is the headwater lake of the Shubenacadie Lakes subwatershed but discharges both north and south due to the presence of the Shubenacadie Canal control structures at its north and south ends.

The subwatershed hosts a range of land uses from urban and commercial developments in the south to more rural settlements and open space / natural environments further north. Historical residential development in much of the subwatershed is associated with the numerous lakes which characterise this area. Fall River is designed under HRM planning documents as a Rural Commuter Centre, with the goal of focusing low and medium-density development around a hub along Highway 102. Residences range from older homes and cottages to modern suburban homes and low rise apartment buildings.

Existing Water Quality

In order to establish water quality objectives and prevent further deterioration in water quality, water quality data collected in the past six years were used to assess current conditions, prior to any further development in the subwatershed. Pre-2006 historical data were used for comparison purposes, when appropriate. The year 2006 was selected as starting year since this is the first year of the ongoing, comprehensive data set collected by or on behalf of HRM. In addition, AECOM completed limited additional water quality sampling at four locations on a quarterly basis over the course of this project.

Overall, the current water quality of the lakes in the Shubenacadie subwatershed is good. For the most part, the lakes are mesotrophic systems, characterized by relatively low concentrations of nutrients and chlorophyll α. Most of the lakes in the subwatershed also have low concentrations of total suspended solids (TSS), nitrate, chloride and *E. coli*.

However, several of the lakes are meso-eutrophic to eutrophic systems. This is likely due to their small size, proximity to highly developed areas, and nutrient inputs from both non-point and point sources. Point source inputs are primarily private and public waste water treatment plant discharges, sanitary sewer overflows and waste water treatment plant by-passes. Non-point sources of total phosphorus in urban areas include failing septic systems, yard and golf course fertilizers, agricultural activities such as riding stables, and pet and waterfowl droppings. Chloride concentrations are above the Canadian Water Quality Guidelines for the protection of aquatic life in three lakes (First, Banook and Micmac) and this is likely due to street and parking lot runoff containing dissolved winter road salt. Impervious surfaces, such as paved streets, parking lots and sidewalks tend to increase road runoff, which in turn increases chloride concentrations in nearby waterbodies relative to undeveloped areas. These results indicate that water quality has already been degraded in some of the smaller lakes that are in close proximity to highly developed areas (e.g., Lisle Lake, Duck Lake and Beaver Pond). Future development must be planned in recognition that urbanization may have a significant impact on the water quality of downstream waterbodies.

Water Quality Objectives

The water quality objectives are based upon a scientific understanding of the Shubenacadie Lakes subwatershed and widely accepted standards of water quality. These recommended water quality objectives will be used by HRM to establish the acceptable standards that HRM and the public agree will achieve the long term management goals for the Shubenacadie Lakes subwatershed.

The parameters most likely to be negatively influenced as a result of land use changes are total phosphorus, nitrate, ammonia, total suspended solids, chloride and E. coli. Given their sensitivity to development, these parameters were selected as “indicators” upon which the water quality objectives were based.

All indicator parameters, with the exception of total phosphorus, have definitive Canadian Water Quality Guideline (CWQG) protection of aquatic life (PAL) limits. Because the CWQGs for the protection of aquatic life are set to protect the most sensitive species, and because water quality in the Shubenacadie Lakes subwatershed is currently better than these objectives, this report recommends that the CWQGs PAL for nitrate, un-ionized ammonia, total suspended solids

(TSS), and chloride be adopted for the Shubenacadie Lakes subwatershed. HRM currently uses the guideline of 200 CFU/100 mL for E. coli for body contact recreation, which is the value recommended by Health Canada. AECOM suggests this value is appropriate for the E. coli parameter. With respect to phosphorus, Environment Canada provides a classification of trophic status for lakes and rivers. For the Shubenacadie Lakes subwatershed AECOM recommends building on this classification with each water body categorized into one trophic state based on existing conditions either measured or predicted by model results. As a result, the management objective would be to meet or maintain the trophic status of a water body so the water quality objective for total phosphorus becomes the upper limit of the total phosphorus (TP) range indicated in the table below for each trophic state. This approach is consistent with the objectives of the 2006 Halifax Regional Municipal Planning Strategy, which seeks "to maintain the existing trophic status of our lakes and waterways to the extent possible." Phosphorus water

Lake	Trophic State Objective	Numerical Objective	Early Warning	Evaluation
Grand, Lewis	Oligotrophic	< 10 μg/L	9 μg/L	Based on 3 year running average
Charles, Micmac, Banook, First, Second, Third, Thomas, Fletcher, Tucker, Kinsac, Barrett, and Powder Mill	Mesotrophic	< 20 μg/L	15 μg/L	
Loon, William, Rocky, Springfield	Mesotrophic	< 20 μg/L	18 μg/L	
Cranberry	Mesotrophic	< 20 μg/L	20 μg/L	
Fenerty	Meso-Eutrophic	22 μg/L	22 μg/L	Fenerty should be maintained at its current average phosphorus concentration of 22 μg/L.
Duck and Lisle	Both Duck (43 μg/L) and Lisle (50 μg/L) are eutrophic lakes. Water quality should not be allowed to deteriorate further and should be improved where feasible.			
Miller, Beaverbank, Fish and Beaver Pond	Insufficient data exist. More sampling is required to set WQO for these lakes.			

quality objectives by lake are summarized in the table below. **Water Quality Objectives, Early Warning Alert Values and Proposed Evaluation Methodology for Alert Values for Total Phosphorus (μg/L) in Shubenacadie Lakes Subwatershed.**

<u>Development Scenarios</u>

The potential effects of future land use changes on the trophic state and phosphorus concentrations in the lakes are assessed using a Lake Capacity Model (LCM) that has been employed previously in the Halifax region. The LCM estimates phosphorus loading to each lake and predicts lake response (i.e., changes in the trophic state) from these phosphorus loadings. This study also uses a stormwater management model (SWMM) to assess changes to hydrology and sediment loading from development and predict the resulting phosphorus loading in each subwatershed. In order to compare the SWMM and LCM results, the SWMM base development case assumes no stormwater management facilities will be used in future developments.

In reality, all future development within the watershed should be required to implement stormwater management facilities to control runoff water quantity and maintain its quality. In this study, future stormwater management facility designs were not available. Consequently, a simplified approach was taken to estimate the improvements to water quality based on the use of advanced stormwater management within all new developments. Removal rates of 80% or higher for TSS and 50% for TP were used as a standard applied to stormwater discharges in each subwatershed. These removal rates are used as an indication of what might be expected through the rigorous application of stormwater management measures.

For both models, the results are presented for three modeling scenarios:

1. Modeling Scenario 1: Existing Conditions;
2. Modeling Scenario 2: HRM Authorized Subdivision Agreements; and,
3. Modeling Scenario 3: Scenario 2 plus fully developed and serviced Port Wallace Lands.

Because the models operate from totally different principals, agreement between them is a good indication of the reliability of the results. These models together not only predict the likely future responses of the lakes to development pressures but can also be used to evaluate the benefit from development-specific mitigation measures that would permit the lakes to meet the proposed water quality objectives following development.

Modelling Results

Change between current conditions and the three development scenarios are illustrated in the table below for the two models (LCM = Lake Capacity Model; SWMM = Stormwater Management Model). The agreement between the predicted results from the two models is very good and the differences can generally be explained in the way in which the models respond to different land use characteristics or the impact of changing land uses.

Lake	Measured µg/L Average concentration ± standard deviation (number of samples)	Scenario 1: Existing Conditions (LCM/SWMM) µg/L	Scenario 2: HRM Authorised Subdivisions (LCM/SWMM) µg/L	Scenario 3: Scenario 2 + Fully Developed Port Wallace (LCM/SWMM) µg/L
Cranberry	20±13(17)	17/24	17/24	17/24
Loon	15±12(15)	14/15	14/15	1415
Charles	10±8(21)	10/15	**11/11**	**14/13**
Micmac	10±12(17)	10/NM	10/NM	**11/**NM
Banook	10±11(17)	10/NM	10/NM	**11/**NM
First	11±10(17)	12/10	**12/11**	**12/11**
Rocky	16±12(17)	16/24	**18/26**	**18/26**
Second	12±14(16)	13/12	**16/15**	**16/15**
Third	10±11(17)	11/11	**14/14**	**14/14**
Powder Mill	10±11(17)	11/18	**12/20**	**12/20**
William	9±7(20)	9/12	**12/13**	**12/14**
Soldier	n/a(0)	11/5	11/5	11/5
Miller	11±4(3)	12/10	**13/11**	**13/11**
Thomas	11±14(32)	13/11	**15/12**	**15/12**
Fletcher	10±9(20)	10/10	**11/**10	**11/**10
Grand	8±13(19)	9/7	**11/8**	**11/8**
Fish	18±1(2)	14/17	**15/18**	**15/18**
Springfield	14±10(16)	14/14	**17/17**	**17/17**
Lisle	50±26(8)	51/44	**54/45**	**54/45**
Fenerty	22±9(16)	18/7	**21/9**	**21/9**
Lewis	8±2(3)	9/7	**12/10**	**12/10**
Hamilton	n/a(0)	12/3	**13/**3	**13/**3
Tucker	10±7(17)	10/12	**15/17**	**15/17**
Beaverbank	11±1(2)	11/5	**12/**5	**12/**5
Barrett	11±6(17)	11/10	**16/15**	**16/15**
Duck	43±39(16)	44/42	**62/60**	**62/60**
Beaver Pond	23(1)	29/11	**34/13**	**34/13**
Kinsac	12±8(17)	14/6	**16/8**	**16/8**

Measured and Modeled Ice-Free Lake Phosphorus Concentrations

Under development Scenario 2, predicted phosphorus concentrations and thus trophic state in Cranberry, Loon, Micmac, Banook, First, Powder Mill and Soldier lakes are expected to remain unchanged. This is because there is little development planned in the catchments of these lakes.

Predicted phosphorus concentrations in all other lakes will increase under this modeling scenario. For the most part, concentrations are expected to increase by 1 to 4 /g/L, with an average increase of 2 /g/L across the entire subwatershed. This modeled increase was found with both the LCM and the SWMM.

Note: NM = not modeled. Note: Bold values indicate changes; that is, modeled values differing for Scenario 2 from Scenario 1 or for

Scenario 3 from either Scenario 1 or 2. To the extent possible, the lakes are listed from south to north and from upstream to downstream.

Phosphorus concentrations in Duck, Tucker and Barrett lakes are predicted to increase the most: by 19, 5 and 5 /g/L, respectively for both the LCM and 17, 7 and 4 /g/L, respectively for the SWMM under Scenario 2. The relatively low increase in phosphorus concentrations in most other lakes is due to the small scale of development in the subwatershed compared to the size of the subwatershed. Although many lakes are expected to show increases in phosphorus concentrations under Scenario 2, the magnitude is low (within confidence limits of measured concentrations); nevertheless, trophic state changes will occur due to slight increases in phosphorus concentrations for Lake William (predicted only by the LCM as the SWMM already indicated a mesotrophic state for existing conditions) and for Lewis and Grand lakes based only on the prediction of the LCM. These lakes may therefore exceed the proposed water quality objective of “no change to the trophic state” as a result of the development already authorized by HRM. The small magnitude of the phosphorus concentration increase, the natural variability of phosphorus concentrations in these lakes and the general proximity of the modeled concentrations to the trophic state boundary demonstrate the need for continued monitoring and the implementation of available measures to reduce loadings through mitigation.

The low density residential development modeled with Scenario 2 does not result in a significant increase on the mean TSS concentration as given by Table 5-5 of the Halifax Regional Municipality Stormwater Management Guidelines (Dillon 2006). The mean TSS concentration is expected to increase from 19.0 mg/L for a forest or wetland area to 22.1 mg/L for a low density residential area. Scenario 3 however; is expected to have a more significant impact on the water quality of Lake Charles because development would result in mean TSS concentrations increasing from 19.0 mg/L for forested to 47.7 mg/L for high density residential.

The most significant impact to TSS concentrations is expected to occur in Lake Charles as a result of the Scenario 3 development. Note that the model has considered the base case situation for the Port Wallace lands without stormwater management as well as with advanced stormwater management for the reduction of TSS and associated TP loadings (80% or higher removal of TSS and 50% for TP). A minor increase in TSS may also be observed in Grand Lake as a result of the cumulative impacts of the subwatershed development.

With regard to cumulative annual loadings, the impacts of development would have the most significant impact on Grand Lake, as it is located the furthest downstream in the subwatershed. Scenario 2 would see an increase predominately in Grand Lake, with the total mass of TSS increasing by 24%. However, this absolute increase is still relatively small due to the very low average TSS concentration in Grand Lake (3 ± 2 mg TSS/litre based on 22 samples). Scenario 3 results in an increased TSS load of 40% for Lake Charles. With the use of SWM techniques within the Port Wallace Lands, the increase of TSS may be reduced by 80% depending on the facility performance for an absolute load of approximately 197,072 Kg/year compared to the existing estimated load of 182,474 Kg/yr.

<u>Summary</u>

For each model type and model scenario, the predicted ice-free total phosphorus concentration for each lake is summarized as a trophic state below. In general, trophic state is only predicted to increase in either of the models as a result of the scenarios for Cranberry, Rocky, Grand and Lewis Lakes.

Predicted Trophic States using Modified LCM and SWMM

Lake	Measured	Scenario 1: Existing Conditions		Scenario 2: HRM Authorised Subdivisions		Scenario 3: Scenario 2 + Fully Developed Port Wallace	
		LCM	SWMM	LCM	SWMM	LCM	SWMM
Cranberry	mesotrophic	mesotrophic	meso-eutrophic	mesotrophic	meso-eutrophic	mesotrophic	meso-eutrophic
Loon, Charles, First, Second, Third, Miller, Thomas, Fletcher, Fish, Springfield, Tucker, Barrett, Powder Mill	mesotrophic	mesotrophic		mesotrophic		mesotrophic	
William	oligotrophic	oligotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic
Micmac, Banook	mesotrophic	mesotrophic	n/a	mesotrophic	n/a	mesotrophic	n/a
Rocky	mesotrophic	mesotrophic	meso-eutrophic	mesotrophic	meso-eutrophic	mesotrophic	meso-eutrophic
Soldier	n/a	mesotrophic	oligotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic
Grand	oligotrophic	oligotrophic	oligotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic
Lisle, Duck	eutrophic	eutrophic	eutrophic	eutrophic	eutrophic	eutrophic	eutrophic
Fenerty	meso-eutrophic	meso-eutrophic	oligotrophic	meso-eutrophic	oligotrophic	meso-eutrophic	oligotrophic
Lewis	oligotrophic	oligotrophic	oligotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic
Hamilton	n/a	mesotrophic	oligotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic
Beaverbank	mesotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic
Beaver Pond	meso-eutrophic	meso-eutrophic	mesotrophic	meso-eutrophic	mesotrophic	meso-eutrophic	mesotrophic
Kinsac	mesotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic	mesotrophic	oligotrophic

Many different stormwater management techniques can be applied to meet water quality objectives. Stormwater management at the individual development level should be designed to achieve “no net increase” in sediment and phosphorus load and peak flows. If this cannot be achieved, then the impact on water quality has to be factored into the development plan and water quality protection plan for the entire watershed.

Development-specific stormwater management proposals should be assessed relative to their ability to achieve the no net increase target. If a specific development cannot demonstrate that it will have no net increase, then HRM can consider alternatives to the development as proposed or reassessment of other mitigation measures within the subwatershed. New development applications in the watershed may incorporate the measures detailed within HRM’s Stormwater Management Guidelines to reduce or eliminate the impacts to water quality and quantity from development through the application of a subwatershed-specific or development-specific SWMM. The benefit of these measures can be evaluated by using the SWMM on a development scale and integrating it into the watershed scale SWMM developed here so that existing conditions and post-development conditions can be assessed relative to the water quality management objectives for the watershed.

Water Quality and Quantity Monitoring

A simplified water quality monitoring program is presented that addresses the fundamentals of watershed management. This approach includes the essential elements of monitoring and represents the minimum sampling effort required for water quality and quantity assessment and management. The program is summarized in the table below.

Minimum Water Sampling Program Recommended for Birch Cove Lakes Subwatershed

Lake	General Location	Access	Sample Timing	Other
Highest Priority				
"A" Lake (Fall River)	Outflow from lake	shore	Spring, summer, fall	No water quality data currently, shoreline developed with more development planned for subwatershed
Beaver Pond	Outflow from lake	shore	Spring, summer, fall	Only one water quality sample to date showing lake is eutrophic with further development planned in subwatershed
Rocky Lake	Outflow from lake	shore	Spring, summer, fall	Existing conditions indicate mesotrophic with some effect from development
Second Lake	Outflow from lake	shore	Spring, summer, fall	Existing conditions indicate mesotrophic with some effect from development, local industry may also be a concern
Fenerty Lake	Outflow from lake	shore	Spring, summer, fall	Existing conditions indicate mesotrophic with some effect from development
Grand Lake	Outflow from lake	shore	Spring, summer, fall	Routine monitoring, co-locate quality and quantity stations with level and temperature loggers, lake is too large to allow deterioration so early warning is essential
Second Priority				
Charles, Kinsac, Fletchers Lakes	Outflow from lake	shore	summer	Future pressure due to ongoing development, co-locate quality and quantity stations with level and temperature loggers
Third Priority				
Barrett, Beaverbank, Loon, Cranberry, First, Fish, William, Powder Mill, Springfield, Third, Tucker, Thomas, Lewis Lakes	Outflow from lake	shore	summer	Routine monitoring to evaluate lake trophic state and other water quality objectives
Banook, Micmac Lakes	Mid-lake sampling	boat	summer	Routine monitoring to evaluate lake trophic state and other water quality objectives
Miller Lake	Outflow from lake	shore	summer	Routine Monitoring with a special investigation of high ammonia concentrations to identify sources

At each station, water samples should be collected and analysed at a minimum for: total phosphorus (low level), total suspended solids (low level), chloride and chlorophyll α. In field measurements of pH, conductivity, temperature, dissolved oxygen, and air temperature should also be collected.

For establishing baseline conditions and evaluating the effects of specific developments on lake water quality, additional monitoring is required. However, this is not the purpose of the monitoring program outlined here; development-specific monitoring should be considered complimentary to this program.

Further refinement of the calibration curves for measuring flow and predicting development effects on these flows is integral to the water quality program and modeling. We strongly recommend the maintenance of the four flow monitoring sites within the subwatershed throughout the duration of the development as this information will be essential to verifying the model and adapting it to actual measurements which will be necessary to protect the lakes through adaptive environmental management practices including confirming the need for additional mitigation.

Distribution of Lake Charles Flow

Lake Charles is the headwater lake of the Shubenacadie Lakes subwatershed but discharges both north and south due to the presence of the Shubenacadie Canal control structures at its north and south ends. Historical reports suggest that approximately 60% of its discharge flows north to William and on to Lakes Thomas, Fletcher and Grand. The remaining 40% of the discharge from Lake Charles flows south to Lakes Micmac and Banook and ultimately to Dartmouth Cove in Halifax Harbour. As part of this project, the lock structures downstream and their elevations were surveyed and these were used in the model along with other surveyed points. Based on this, the SWMM model indicates that during storm events the outlet to Micmac and Banook lakes conveys approximately 90% of the flow while the outlet to Lake William conveys the remaining 10% of the flow. Due to safety considerations, no flow measurements could be made in the field to verify this apparent result. These results should be confirmed though a field assessment.

Attachment 4 - Halifax Watershed Advisory Board Review of draft Shubenacadie Lakes Subwatershed Study – Preliminary Report

On Wednesday, 18th July, 2012. Halifax Watershed Advisory Board reviewed the draft Shubenacadie lakes Subwatershed Study, Preliminary Report. Paul Morgan, Senior Planner, was in attendance to provide some background and to answer questions.
A summary of the Board's comments is provided below. The comments highlighted in **bold** represent the ones that seemed to be the most significant..

1. **Water Quality Objectives:**

- **biological indicators (fish/plants species) can be useful as early warning indicators for pollution problems.**

- **metals should be included in parameters and reviewed**. The report does note that metals are usually associated with the transport of suspended solids so the management of suspended sediment will also help reduce metals. However, dissolved metals, as a result of increased traffic and blasting (particularly pyritic slates), would not be indicated by increased suspended solids.

- **the Tables show "early warning levels". Before these levels are reached, trends should be noted and monitored**

- **remediation measures should be suggested**.

- **acid rain should be considered**

- setting water quality objectives is necessarily subjective because of the diversity between watersheds - phosphorus is widely considered as a significant parameter.

2. **Scope of Study**

- **in order to include the entire watershed, Hants county should be involved in this study**

- **Millar Lake should be included in Table 9, Ammonia concentrations. Ammonia levels in this lake, possibly associated with the airport via Soldier Lake, are alarming. The source of the ammonia should be found.**

- **Wilson Lake is part of the system and should be included**

- **the Lake Charles River flows into Sawmill River. Could this be diverted? Water control structures should be examined.**

- **the Sawmill River Watershed should be included.**

3. **Water Quality Monitoring**

- **the HRM Lakes Water Quality Sampling Program should be reinstated.** This program provided much of the background data for this study and is needed for water quality monitoring in the future.

- If there is no public sampling system, monitoring should be paid for by developers (tested by HRM personnel, results to local Watershed Advisory Boards)

- is monitoring for each development being considered?

- **A permanent water quality monitoring system could be installed for $50,000**

- a future step could be to undertake receiving water studies, including total receivable inputs

4. **Water Quantity /Flows**

- **flows should be monitored**

- the volume of water needs to be measured. Flushing could cause pollutants to accumulate or dilute them.

- permanent stream gauging devices are needed to monitor flows

- flow data is needed for modelling purposes.

- the inflow to lakes downstream of development should be monitored

- **by not undertaking flood plain mapping, an opportunity has been missed**

5. **Storm Water**

- Storm water runoff must be controlled. Engineering limits (White Book) must be made more stringent.

- Storm water should be treated to maintain quality.

- Specific measures to help achieve 100% on-site storm water retention should be suggested

- Multiple jurisdictions involved in storm water management is recognized as a problem

- in open space developments, road-building is not controlled which could lead to erosion, sedimentation, etc.

6. Waste Water

- **HRM should require regular pumping of septic tanks**. In clustered systems, water use would have to be monitored for each household – to decide when pumping necessary and who is putting how much water into the system.

- **the establishment of Wastewater Management Districts should be promoted**. Within the districts, residents could club together to pay for pumping the tanks of those who cannot afford it.

- **wastewater cluster systems with STPs should be encouraged in place of individual septic systems. In time, HRM should take these over and run them.**

7. Blasting/Slates

- Blasting (and the associated dust) could represent a problem as there are slates in this area

- blasting of pyritic slates releases dissolved metals to ground water and surface water. This significantly lowers pH, elevates ammonia (which converts to nitrates) and depletes oxygen.

- slate disposal should be monitored.