Appendix K: Assessment of SWMFs and LIDs to Reduce Phosphorous Discharges Technical Memorandum

TATHAM ENGINEERING

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Drainage Master Plan

ASSESSMENT OF STORMWATER MANAGEMENT FACILITIES, BEST MANAGEMENT PRACTICES AND LID MEASURES TO REDUCE PHOSPHOROUS DISCHARGES

City of Barrie

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1 Introduction

Tatham Engineering Limited (Tatham) has completed this technical memorandum to accompany the Drainage Master Plan (DMP) document to identify and assess best management practices (BMP's), specifically stormwater management facility (SWMF) retrofit opportunities and low impact development (LID) measures, being considered as part of the DMP with the primary intent of reducing phosphorus discharge to Lake Simcoe. Alternative solutions are being developed as part of the DMP to address the drainage deficiencies identified across the City. This report has been prepared to provide information from a water quality and phosphorus loading perspective to allow for the evaluation of each alternative solution, and the individual projects included in each solution.

1.1 STUDY AREA

The study area for the Drainage Master Plan includes the entire City of Barrie excluding the Sophia Creek watershed, Mulcaster drainage area and Annexation Lands. The Study Area is illustrated on Figure 1: Study Area Location Plan provided in Appendix A.

The Sophia Creek watershed and Mulcaster drainage area are excluded from the study as a similar Municipal Class Environmental Assessment was recently undertaken for these areas. A Drainage and Stormwater Management Master Plan (DSWMMP) has also recently been prepared for the Annexation Lands to satisfy the requirements of the Lake Simcoe Protection Plan, specifically Policy 4.5-SA.

For discussion purposes the Study Area is broken into three drainage study areas as follows:

- Barrie Creeks Drainage Study Area;
- NVCA Watershed Drainage Study Area; and
- Lovers Creek, Hewitts Creek and Sandy Cove Drainage Study Area.

The drainage study areas are further divided into watersheds and drainage areas as illustrated on Figure 2: Watershed/Drainage Area Delineation Plan provided in Appendix A.

1.2 BACKGROUND

The City owns, operates and maintains a variety of stormwater infrastructure, including stormwater management facilities (SWMF) and storm sewer systems.

There are approximately 160 public and private SWMF's throughout the City that provide varying degrees of water quantity and water quality control. The existing SWMF's are illustrated on Figure 5: Existing Stormwater Management Infrastructure Plan provided in Appendix A. A number of the existing SWMF's do not satisfy the current design standards set by the Ministry of the Environment, Conservation and Parks (MECP), local Conservation Authorities (Lake Simoce Region Conservation Authority and Nottawasaga Valley Conservation Authority), and the Lake Simcoe Protection Plan (LSPP) to protect Lake Simcoe and its tributaries. Reducing nutrient loadings and the discharge of pollutants into Lake Simcoe, the Nottawasaga River and their tributaries are prime objectives of these policies.

The City is committed to satisfying all of the requirements of the LSPP including determining the effectiveness of the existing drainage infrastructure at reducing the negative impacts of stormwater on the environment and identifying additional stormwater management retrofit opportunities or improvements to existing storm infrastructure that could improve stormwater treatment. Any retrofit opportunities would be implemented on a site specific basis with the improvements carried through to downstream areas.

The current preferred approach to treating stormwater is to treat it at the source and through a treatment train as it travels to traditional end-of-pipe stormwater management facilities (SWMF). At source and treatment train controls focus on Low Impact Development (LID) measures, particularly infiltration measures, to treat and infiltrate rainfall as close to the source as possible. These measures best imitate the natural hydrology of the area, recharge groundwater resources, and have been shown to treat stormwater more effectively than traditional stormwater measures. In this regard, it is the preferred approach of the local Conservation Authorities to retrofit existing SWMFs to include Low Impact Development measures over wetland and wet pond conversions.

As part of the Drainage Master Plan, alternative solutions have been developed to address the drainage deficiencies identified across the City including the following flow reduction/water quality improvement alternatives:

- Alternative 2A – Retrofit/New Stormwater Management Facilities for Quantity Control
- Alternative 2B – Retrofit/New Stormwater Management Facilities for Quality Control
- Alternative 2C – Lot Level Low Impact Development
- Alternative 2D – Linear Low Impact Development

- Alternative 2E – Centralized Low Impact Development

This report has been prepared to detail the impact of each flow reduction/water quality improvement alternative solution, and the individual projects included in each solution, from a water quality and phosphorus loading perspective.

1.3 OBJECTIVES

The objective of this technical memorandum is to establish the effectiveness of the City's existing storm infrastructure at reducing phosphorus loads in Lake Simcoe, the Nottawasaga River and their tributaries. It will assess each flow reduction/water quality improvement alternative solution, and the individual projects included in each solution, from a water quality and phosphorus loading perspective. The following has been considered as part of this technical memorandum:

- The current phosphorous removal efficiency of the City's existing SWMF's;
- The phosphorus removal efficiency from the proposed LIDs and SWMF's within each watershed;
- Benefits of retrofitting existing dry ponds with LIDs instead of converting them into wet ponds and or constructed wetlands; and
- The overall impact of the alternative drainage solutions being evaluated from a phosphorus loading perspective.

1.4 POLICIES AND GUIDELINES

This report was prepared recognizing provincial policies and guidelines on water resources and the environment, including the following publications:

- The City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines, (2009);
- The Credit Valley Conservation Authority (CVC) and the Toronto and Region Conservation Authority (TRCA) Low Impact Development SWM Planning and Design Guide, (2010);
- Lake Simcoe Region Conservation Authority Lake Simcoe Phosphorous Reduction Strategy, (2010);
- Lake Simcoe Region Conservation Authority Lake Simcoe Protection Plan, (2009);
- Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Solutions, (2016); and

- The Ministry of the Environment, Conservation and Parks (MECP) *Stormwater Management Practices Planning and Design Manual*, (2003).

1.5 PREVIOUS STUDIES

Three previous studies have been completed with respect to stormwater retrofit opportunities within the City with the specific objective of reducing phosphorus loads in Lake Simcoe. The previous studies are summarized in the following section.

Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (LSRCA, 2007)

In 2007, the LSRCA completed the Lake Simcoe Basin Stormwater Management and Retrofit Opportunities report which identified retrofit opportunities for all urban centres within the Lake Simcoe basin, including the City of Barrie. The assessment delineated urban stormwater catchments and identified the level of water quality treatment provided by existing stormwater management facilities. Phosphorus loading (kg/yr) was calculated for existing urban areas and removal rates were determined based on the existing stormwater management controls in place. The study identified 56 opportunities within the existing City boundaries under LSRCA jurisdiction, documented site level constraints, calculated the associated phosphorus reduction potential, and estimated construction costs. The study estimated that 39 of the retrofit opportunities, with the potential to manage a drainage area of 1,363 ha, which if fully implemented, could reduce the phosphorus load from the City by 1,862 kilograms per year, or about a 32% reduction.

Stormwater Management Facility Retrofit and Maintenance Program (City of Barrie, 2009)

The City reviewed retrofit opportunities identified by the LSRCA within Barrie's urban boundary and further screened these opportunities considering additional local constraints and general feasibility. The screened list consists of 27 retrofit opportunities which were scored on a selection of criteria and ranked. The evaluation criteria included land ownership, presence of an existing pond, phosphorus load reduction potential and adjacent land-use, as well as consideration of various local constraints and general feasibility. The City's assessment also included updated cost estimates for the opportunities identified as part of the Stormwater Retrofit Program.

Assessment of Stormwater Management Facilities to Reduce Phosphorous Discharges (Amec, 2013)

In 2013, Amec was retained by the City to update the Stormwater Retrofit Program as part of the Drainage and Stormwater Management Master Plan (DSWMMP). As part of their retrofit evaluation, 77 potential retrofits and new facilities at drainage

outfalls were identified within the City's intensified and annexed lands, including lands under NVCA jurisdiction. The 77 retrofit opportunities were screened based on a selection of criteria with respect to each opportunity's physical, natural, social and economic environment. The assessment provided a further evaluation of the screened opportunities with an expanded set of criteria by incorporating field reconnaissance data collected by a team of engineers, aquatic and terrestrial biologists. The screened list following the detailed evaluation consisted of 33 ranked retrofit opportunities complete with construction cost estimates for implementation.

1.6 METHODOLOGY

The MECP Phosphorus Budget Tool (P-Tool) was used to estimate phosphorus loading for the drainage areas across the City that are located in the LSRCA watershed. This includes the Barrie Creeks drainage area and the Lovers Creek and Hewitts Creek watersheds. Similarly, the NVCA P-Tool was used for the drainage areas across the City located within the NVCA watershed. This includes the NVCA drainage study area. The P-tool programs estimate the overall phosphorous loading using a number of phosphorous export coefficients based on specific land use types. The City of Barrie Zoning Bylaw maps were used to determine the existing land use for each drainage study area. The existing land uses are illustrated on Figure 4: Existing Land Use Plan provided in Appendix A.

Each conservation authority's P-Tool program was then used to determine the potential phosphorus reductions resulting from the implementation of the flow reduction/water quality improvement alternative solutions, specifically the SWMF retrofit and Low Impact Development measures for each watershed. The results from the P-Tool analysis forecasts the effectiveness of the BMP's to reduce phosphorus loads within each watershed and drainage study area.

2 Flow Reduction/Water Quality Improvement Options Pre-Screening

Opportunities exist in the study area to implement SWM measures to improve water quality and reduce nutrient loads in Lake Simcoe. These opportunities include retrofitting, expanding and creating SWMF's and implementing Low Impact Development (LID) measures. The water quality/flow reduction improvement options screened as part of this study are described in the following sections.

2.1 SWMF RETROFIT/EXPANSION/CREATION

As part of the *Storm Water Management Facilities (SWMF) Asset Management Plan* and *Assessment of Stormwater Management Facilities to Reduce Phosphorus Discharges Technical Memorandum*, SWMF retrofit, expansion and creation opportunities were evaluated, recommended and prioritized. Similarly, the previously completed Master Drainage Plans also included recommendations for SWMF retrofit, expansion and creation. As part of this Drainage Master Plan, the previous studies and evaluations were reviewed and alternative SWMF retrofits, expansions and creations were considered.

From our review of the available background documents, an initial list of potential retrofit, expansion and creation opportunities was developed. The list was expanded to include SWMF's downstream of existing storm sewer outfalls where constructing a SWMF is feasible, beneficial and appropriate. A pre-screening evaluation was then completed for the SWMF's listed to establish those suitable to move forward as an alternative drainage solution.

The pre-screening evaluation included a review of each stormwater management facility (SWMF) retrofit/expansion/creation opportunities impact on natural heritage features and natural hazards. The SWMF retrofit/expansion/creation opportunities were also pre-screened based on their impacts on water quality, phosphorus removal, flooding, erosion, safety and costs. The SWMF's were then pre-screened and where determined appropriate eliminated from further evaluation due to natural heritage constraints, steep slopes, erosion, limited drainage areas, potential flood impacts, property acquisition, and safety concerns. The SWMF's included as part of the pre-screening evaluation are illustrated on Figure 8: SWMF Retrofit/Creation Opportunities (Pre-Screening Evaluation) provided in Appendix A.

The remaining SWMF retrofit/creation opportunities that were not eliminated are recommended for further evaluation as an alternative drainage solution and are being carried forward in this study. A list of the SWMF's recommended for further evaluation as an alternative drainage solution is provided in the following table. The SWMF's recommended for further evaluation are illustrated on Figure 9: SWMF Retrofit/Creation Opportunities (To Be Evaluated) provided in Appendix A.

Table 1: SWMF's Recommended for Further Evaluation Summary

Existing SWMF ID (Retrofit No.)					
WK01 (25)	LV03 (31)	LV05 (45)	GR01 (75)	BR13 (69)	LT01 (77)
GR04 (76)	LT05 (89)	LTGM (83)	LT04 (91)	KD05 (18)	BK03 (10)
BR14 (90)	BR05 (62)	LV16 (86)	LV17 (87)	LV07 (65)	LV12 (32)
LV10 (37)	HR03 (85)	HT13 (48)	LV02 (30)	WK05 (92)	LV01 (68)
KD03 (13)	HT06 (3)	KD06 (11)	DY02 (15)	HR01 (28)	DY01 (79)
WK04 (20)	BR08 (61)				

Creation No.	Watershed	Location
44	Hotchkiss Creek	Between Morrow Rd. and Highway 400 north of Essa Rd.
17	Kidd's Creek	Southwest of Bayfield St. between Coulter St. and Highway 400, in southeast corner of Sunnidale Park
26	Whiskey Creek	North of Big Bay Point Rd. and between Huronia Rd. and Pickett Crescent1229
42	Whiskey Creek	Southeast corner of Montserrand St. and Beacon Rd.
40	Whiskey Creek	Northeast corner of Chieftan Crescent
78	Dyments Creek	North of Dunlop Street West and west of Ferndale Industrial Drive
27	Hewitts Creek	Southeast corner of Walnut Crescent
94	Bunkers Creek	Highway 400 and Dunlop Street East
81	Hotchkiss Creek	Upstream of Wood Street and BCRY tracks (50 Wood St.)
96	Hotchkiss Creek	Between Wood St. and BCRY tracks (50 Wood St.)
72	Bunkers Creek	Highway 400 and Dunlop St. W.

Note: * Retrofit Opportunity Number assigned from previous reports

2.2 LOW IMPACT DEVELOPMENT (LID) MEASURES

From a review of the available background reports, specifically the *Evaluation of Low Impact Development Stormwater Technologies for the Uncontrolled Urban Areas in the Lake Simcoe Region* (Ryerson University, March 2010), the implementation of a

number of Low Impact Development (LID) measures is feasible in the study area, including infiltration trenches, perforated pipe systems, bioretention facilities, rain water harvesting and porous pavement. The implementation of wide scale and extensive LID measures within the City is limited by the existing groundwater and soil conditions in the study area and known wellhead protection areas, intake protection zones and groundwater recharge areas.

For this study, the implementation of LID measures involving infiltration was not recommended in wellhead protection areas A (WHPA-A) and B (WHPA-B). This is consistent with the recommendations of the *Low Impact Development Stormwater Management Planning and Design Guide* (2010). However, implementing infiltration LID measures throughout the remainder of the study area was considered. Within WHPA-A and WHPA-B, perforated pipe systems wrapped in an impervious liner to prevent infiltration was considered. The wrapped perforated pipe systems will intercept runoff and provide peak flow attenuation, however there is reduced water quality and no water balance benefits. Opportunities exist to construct LID measures as follows:

1. Underground within existing parkland and other City owned properties (centralized LIDs);
2. As part of road reconstruction/renewal projects (linear LIDs);
3. Future development; and
4. Lot level LIDs (rainwater harvesting and soakaway pits).

The implementation of linear LIDs within the municipal road allowance is recommended for local roads only. This is consistent with the recommendations of the *Low Impact Development Stormwater Management Planning and Design Guide* (2010).

For centralized LIDs, all of the parks and public space within the City was considered. The list of parks was reduced through an initial review of the background data based on the parks location, programs, land availability, drainage area, etc. through consultation with the City. After the initial review, a list of parks was created for further consideration as part of our pre-screening evaluation.

As part of the pre-screening evaluation of the centralized LIDs, the elevation of the bottom of the underground infiltration chamber system proposed in each park was determined based on available record drawings for the storm sewer that could be directed to the parks. The parks that require underground infiltration chamber system bottoms to be installed at great depths (i.e. greater than 6 m below existing grade) were eliminated from further evaluation.

For the remaining parks, the available soils information and groundwater levels were reviewed to determine if the bottom of the proposed underground infiltration chamber system is above the estimated groundwater levels. The parks with underground infiltration chamber system bottoms below the estimated groundwater level were eliminated from further evaluation. Following the pre-screening evaluation a list of the 22 parks suitable for LID implementation are recommended for further evaluation as an alternative drainage solution is provided in the following table. The parks included in the pre-screening evaluation and recommended for further evaluation are illustrated on Figure 13: Centralized LID Opportunities (Pre-Screening Evaluation) provided in Appendix A.

Table 2: Centralized LIDs Recommended for Further Evaluation

Park		
Carter Park	Madelaine Park	Shoreview Park
Kuzmich Park	Greenfield Park	Sandringham Park
Assikinack Park	Queensway/Hyde Park	Montserrand Park
Cartwright Park	Harvie Park	Mapleton Park
Sunnidale Park	Gibbon Park	Cloughley Park
Allandale Heights Park	Bear Creek Park	Golden Meadow Park
Wessenger Park	Lougheed Park	Starbane Park
Dunsmore Park		

3 Phosphorous Reductions from Existing SWMF's

To quantify the increased phosphorus removal efficiency resulting from the proposed SWMF retrofit/expansion/creation opportunities, we first have to establish the phosphorus removal efficiencies of the existing SWMF's throughout the City of Barrie. As such, a baseline scenario has been developed using the MECP Phosphorous Budget Tool (P-tool) and the NVCA P-tool to evaluate the phosphorous removal efficiency of the City's existing SWMF's. The baseline scenario development and results are summarized in the following sections.

3.1 EXISTING SWMF INVENTORY & CLASSIFICATION

The existing SWMF's in the City were identified by Tatham as part of the Barrie City Wide Minor and Major Drainage Systems Model Development project. Each SWMF was classified as a wet pond, dry pond or constructed wetland based on the available background information, design reports and/or field observations. The existing SWMF's included in the baseline scenario are identified in a table included in Appendix C for reference.

The MECP P-tool and NVCA P-tool assign median removal efficiencies to each type of SWMF. The SWMF phosphorus removal efficiencies are summarized in the following table:

Table 3: Best Management Practices (BMP) Removal Efficiencies

BMP	Removal Efficiency
Constructed Wetland	77%
Dry Detention Pond	10%
Wet Detention Pond	63%
Soakaway Pits / Infiltration Trenches	60%
Perforated Pipe Infiltration / Exfiltration Systems	87%

3.2 EXISTING PHOSPHOROUS REDUCTIONS

3.2.1 Barrie Creeks Drainage Study Area

The MECP P-Tool quantified the City's phosphorus loading rate from the Barrie Creeks drainage study area to Lake Simcoe as 4,955 kg/year ignoring the existing SWM measures in place. The existing SWMF's reduce the loading rate to 4,164 kg/year indicating that the existing SWMF's in the Barrie Creeks drainage study area are approximately 16% effective in reducing phosphorus loads to Lake Simcoe. The MECP P-Tool results summary for the Barrie Creeks drainage study area is provided in Appendix C for reference.

3.2.2 Lovers Creeks Watershed

The MECP P-Tool quantified the City's phosphorus loading rate from the Lovers Creek watershed to Lake Simcoe as 2,163 kg/year ignoring the existing SWM measures in place. The existing SWMF's reduce the loading rate to 1,600 kg/year indicating that the existing SWMF's in the Lovers Creek watershed are approximately 26% effective in reducing phosphorus loads to Lake Simcoe. The MECP P-Tool results summary for the Lovers Creek watershed is provided in Appendix C for reference.

3.2.3 Hewitt's Creek Watershed

The MECP P-Tool quantified the City's phosphorus loading rate from the Hewitt's Creeks watershed to Lake Simcoe as 515 kg/year ignoring the existing SWM measures in place. The existing SWMF's reduce the loading rate to 313 kg/year indicating that the existing SWMF's in the Hewitts Creek watershed are approximately 39% effective in reducing phosphorus to Lake Simcoe. The MECP P-Tool results summary for the Hewitts Creek watershed is provided in Appendix C for reference.

3.2.4 NVCA Watershed Drainage Study Area

The NVCA P-Tool quantified the City's phosphorus loading rate from the NVCA watershed drainage study area to the Nottawasaga River and its tributaries as 3,073 kg/year ignoring the existing SWM measures in place. The existing SWMF's reduce the loading rate to 2,517 kg/year indicating that the existing SWMF's are approximately 18% effective in reducing phosphorus loads from the NVCA watershed drainage study area to the Nottawasaga River and its tributaries. The NVCA P-Tool results summary for the NVCA watershed drainage study area is provided in Appendix C for reference.

3.2.5 Overall Study Area

Overall, the existing SWMF's across the City reduce the phosphorus loading rate to Lake Simcoe, the Nottawasaga River and their tributaries by 20%. The phosphorus loading rate is reduced from 10,706 kg/year to 8,594 kg/year by the existing SWMF's.

4 Phosphorus Reduction from Proposed SWMF Improvement Opportunities

To quantify the increased phosphorus removal efficiency resulting from the proposed SWMF retrofit/expansion/creation opportunities, the baseline scenario described in Section 4 was updated. The baseline scenario was updated to include the proposed SWMF retrofit/expansion/creation opportunities proposed in the study area. The potential phosphorus reductions associated with each alternative solution and the individual projects included in each alternative solution are presented in the following sections.

4.1 ALTERNATIVE 2A – STORMWATER MANAGEMENT FACILITIES FOR QUANTITY CONTROL

An opportunity exists to retrofit existing stormwater management facilities and construct new stormwater management facilities within the City to improve water quantity control, attenuate peak flows and reduce downstream flooding. After evaluation, 10 existing and new SWMF's were identified as viable improvement opportunities under this alternative. The retrofit projects identified in this study will increase the available storage and decrease release rates into the downstream creeks and drainage systems. Similarly, end-of-pipe SWMF's may be constructed at locations absent of any water quantity controls. The SWMF retrofits and new SWMF's can be designed to improve watershed water quality, promote infiltration and improve the water balance consistent with Alternative 2B.

The MECP and NVCA P-Tools were updated to include the SWMF retrofits proposed for water quantity control. The SWMF retrofits proposed for quantity control and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix D for reference.

Table 4: Water Quality Treatment/Phosphorus Reduction Summary – Alternative 2A

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
BK03 (10)	< 60%	80%	5.0	35.4	+30.4
RO#26 (WK)	N/A	80%	0.0	30.1	+30.1
HT13 (48)	N/A	< 60%	0.0	0.0	0.0
LT01 (77)	< 60%	80%	12.2	77.0	64.8
RO#78 (DY)	N/A	60%	0.0	0.0	0.0
DY01 (79)	< 60%	70%	184.1	0.0	-184.1
RO#81 (HT)	N/A	60%	0.0	0.0	0.0
RO#96 (HT)	N/A	< 60%	0.0	0.0	0.0
HR03 (85)	< 60%	80%	1.2	7.8	+6.6
RO#94 (BK)	N/A	60%	0.0	8.3	+8.3
				Total	**-43.9**

The P-Tool analysis demonstrates that the proposed SWMF's considered under Alternative 2A result in a phosphorus increase of 43.9 kg/year. The phosphorus loading rate is increased from 8,594 kg/year to 8,638 kg/year through the implementation of the proposed water quantity SWMF improvements.

It is noted that the proposed improvement to SWMF DY01 results in a decrease in phosphorus removal of 184.1 kg/year. However, SWMF DY01 does not have sufficient permanent pool or extended detention volume to satisfy the MECP basic level of treatment (60% TSS removal). The permanent pool volume in SWMF DY01 is unknown. However, it is estimated to be approximately 50% of the required volume to achieve basic level treatment and 10% of the required volume for enhanced level treatment. Although SWMF DY01 is classified as a wet pond, the level of treatment or removal efficiency of the SWMF is far less than prescribed in the P-Tool. Adjusting the removal efficiency for SWMF DY01 to a more representative value (10%) reduces the existing Phosphorus reduction of the pond to 29.2 kg/year. This results in a total phosphorus reduction of 111.0 kg/year from the proposed SWMF's considered under Alternative 2A.

4.1.1 Barrie Creeks Drainage Study Area

Implementation of Alternative 2A reduces the phosphorus loading rate from the Barrie Creeks drainage study area from 4,164 kg/year to 4,118 kg/year, resulting in

a reduction of 46 kg/year. The SWMF retrofits proposed for quantity control and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix D for reference.

Table 5: Barrie Creeks Drainage Study Area Phosphorus Reduction Summary – Alternative 2A

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
BK03 (10)	< 60%	80%	5.0	35.4	+30.4
RO#26 (WK)	N/A	80%	0.0	30.1	+30.1
HT13 (48)	N/A	< 60%	0.0	0.0	0.0
RO#78 (DY)	N/A	60%	0.0	0.0	0.0
DY01 (79)	< 60%	0%	29.2	0.0	-29.2
RO#81 (HT)	N/A	60%	0.0	0.0	0.0
RO#96 (HT)	N/A	< 60%	0.0	0.0	0.0
HR03 (85)	< 60%	80%	1.2	7.8	+6.6
RO#94 (BK)	N/A	60%	0.0	8.3	+8.3
				Total	**46.2**

4.2 LOVERS CREEK WATERSHED

No SWMF retrofits for water quantity control are proposed under Alternative 2A in the Lovers Creek watershed.

4.2.1 Hewitt's Creek Watershed

No SWMF retrofits for water quantity control are proposed under Alternative 2A in the Hewitt's Creek watershed.

4.2.2 NVCA Watershed Drainage Study Area

Implementation of Alternative 2A reduces the phosphorus loading rate from the NVCA watershed drainage study area from 2,517 kg/year to 2,452 kg/year, resulting in a reduction of 65 kg/year. The SWMF retrofits proposed for quantity control and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix D for reference.

Table 6: NVCA Watershed Phosphorus Reduction Summary – Alternative 2A

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
LT01 (77)	< 60%	80%	12.2	77.0	64.8
				Total	**64.8**

4.3 ALTERNATIVE 2B – STORMWATER MANAGEMENT FACILITIES FOR QUALITY CONTROL

An opportunity exists to retrofit existing stormwater management facilities and construct new stormwater management facilities within the City to improve watershed water quality, promote infiltration and improve the water balance. This includes retrofitting existing dry ponds to include an LID component where feasible or convert the dry ponds to constructed wetlands or wet ponds with a permanent pool component for enhanced treatment and improved phosphorus removal. Similarly, end-of-pipe SWMF's can be constructed at locations absent of any water quality controls upstream of the existing creeks. After evaluation, 33 existing and new SWMF's were identified as viable improvement opportunities under this alternative.

The MECP and NVCA P-Tools were updated to include the SWMF retrofits proposed for water quality control. The SWMF retrofits proposed for water quality control and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix E for reference.

Table 7: Water Quality Treatment/Phosphorus Reduction Summary – Alternative 2B

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
HT06 (03)	60%	80%	4.4	38.4	+34.0
KD03 (13)	< 60%	80%	4.0	34.4	+30.8
DY02 (15)	60%	80%	2.5	21.6	+19.1
RO#17 (KD)	N/A	80%	0.0	100.5	+100.5
KD05 (18)	60%	80%	3.1	26.5	+23.4
WK04 (20)	80%	80%	12.8	12.8	0.0
WK01 (25)	< 60%	80%	10.1	17.4	+7.3
RO#27 (HW)	N/A	80%	0.0	29.2	+29.2
HR01 (28)	60%	70%	4.0	25.0	+21.0
LV02 (30)	< 60%	60%	26.9	169.3	+142.4
LV03 (31)	60%	80%	1.4	8.6	+7.2
LV12 (32)	<60%	80%	4.0	34.9	+30.9
LV10 (37)	60%	80%	2.5	21.5	+19.0
LV05 (45)	< 60%	60%	11.1	11.1	0.0
BR08b (61)	< 60%	80%	7.5	47.4	+39.9
BR05 (62)	< 60%	70%	3.7	23.1	+19.4
LV07 (65)	60%	80%	11.7	101.8	+90.1
LV01 (68)	60%	80%	62.7	62.7	0.0
BR13 (69)	< 60%	80%	5.3	33.4	+28.1
GR01 (75)	< 60%	60%	6.7	42.3	+35.6
GR04 (76)	< 60%	70%	14.2	89.3	+75.1
LTGM (83)	80%	80%	37.0	37.0	0.0
LV16 (86)	60%	80%	0.5	3.7	+3.2
LV17 (87)	60%	80%	4.0	30.9	+26.9
LT05 (89)	< 60%	80%	25.3	25.3	0.0
BR14 (90)	60%	80%	54.8	54.8	0.0
LT04 (91)	60%	80%	66.1	66.1	0.0
WK05 (92)	60%	80%	88.5	133.8	+45.3
BK04 (95)	< 60%	< 60%	31.3	31.3	0.0

Table 7: Water Quality Treatment/Phosphorus Reduction Summary – Alternative 2B (continued)

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
KD06 (11)	< 60%	80%	7.8	67.7	+59.9
RO#40	N/A	80%	0.0	33.6	+33.6
RO#42	N/A	80%	0.0	21.4	+21.4
RO#44	N/A	80%	0.0	69.8	+69.8
				Total	**1013.1**

The P-Tool analysis demonstrates that the proposed SWMF's considered under Alternative 2B result in a phosphorus reduction of 1,013 kg/year. The phosphorus loading rate is reduced from 8,594 kg/year to 7,581 kg/year through the implementation of the proposed water quality SWMF improvements.

4.3.1 Barrie Creeks Drainage Study Area

Implementation of Alternative 2B reduces the phosphorus loading rate from the Barrie Creeks drainage study area from 4,164 kg/year to 3,883 kg/year, resulting in a reduction of 281 kg/year. The SWMF retrofits proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix E for reference.

Table 8: Barrie Creeks Drainage Study Area Phosphorus Reduction Summary – Alternative 2B

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
HT06 (03)	60%	80%	4.4	38.3	+33.9
KD03 (13)	< 60%	80%	4.0	34.4	+30.4
DY02 (15)	60%	80%	2.5	21.6	+19.1
RO#17 (KD)	N/A	80%	0.0	100.5	+100.5
KD05 (18)	60%	80%	3.1	26.5	+23.4
WK04 (20)	80%	80%	12.8	12.8	0.0
WK01 (25)	< 60%	80%	10.1	17.4	+7.3
HR01 (28)	60%	70%	4.0	25.0	+21.0
WK05 (92)	60%	80%	88.5	133.8	+45.3
				Total	**280.9**

4.3.2 Lovers Creek Watershed

Implementation of Alternative 2B reduces the phosphorus loading rate from the Lovers Creek watershed from 1,600 kg/year to 1,222 kg/year, resulting in a reduction of 378 kg/year. The SWMF retrofits proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix E for reference.

Table 9: Lovers Creek Watershed Phosphorus Reduction Summary – Alternative 2B

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
LV02 (30)	< 60%	60%	26.9	169.3	+142.4
LV03 (31)	60%	80%	1.4	8.6	+7.2
LV12 (32)	<60%	80%	4.0	34.9	+30.9
LV10 (37)	60%	80%	2.5	21.5	+19.0
LV05 (45)	<60%	60%	11.1	69.6	+58.5
LV07 (68)	60%	80%	11.7	101.8	+90.1
LV01 (68)	60%	80%	62.7	62.7	0.0
LV16 (86)	60%	80%	0.5	3.7	+3.2
LV17 (87)	60%	80%	4.0	30.9	+26.9
				Total	**378.2**

4.3.3 Hewitt's Creek Watershed

Implementation of Alternative 2B reduces the phosphorus loading rate from Hewitt's Creek watershed from 313 kg/year to 284 kg/year, resulting in a reduction of 29 kg/year. The SWMF retrofits proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix E for reference.

Table 10: Hewitt's Creek Watershed Phosphorus Reduction Summary – Alternative 2B

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
RO#27 (HW)	N/A	80%	0.0	29.2	+29.2
				Total	**29.2**

4.3.4 NVCA Watershed Drainage Study Area

Implementation of Alternative 2B reduces the phosphorus loading rate from the NVCA watershed drainage study area from 2,517 kg/year to 2,319 kg/year, resulting in a reduction of 198 kg/year. The SWMF retrofits proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix E for reference.

Table 11: NVCA Watershed Phosphorus Reduction Summary – Alternative 2B

SWMF ID (Retrofit No.)	Level of Treatment		Phosphorus Reduction (kg/year)		
	Existing	Proposed	Existing	Proposed	Δ
BR08b (61)	<60%	80%	7.5	47.4	+39.9
BR05 (62)	< 60%	70%	3.7	23.1	+19.4
BR13 (69)	< 60%	80%	5.3	33.4	+28.1
GR01 (75)	< 60%	60%	6.7	42.3	+35.6
GR04 (76)	< 60%	70%	14.2	89.3	+75.1
LTGM (83)	80%	80%	37.0	37.0	0.0
LT05 (89)	< 60%	80%	25.3	25.3	0.0
BR14 (90)	60%	80%	54.8	54.8	0.0
LT04 (91)	60%	80%	66.1	66.1	0.0
				Total	**198.1**

5 Phosphorus Reduction from Low Impact Development Improvements

To quantify the phosphorus removal efficiency resulting from the proposed Low Impact Development measures, the baseline scenario was updated. The baseline scenario was updated to included the proposed lot level, linear and centralized Low Impact Development measures proposed in the study area. The potential phosphorus reductions associated with each alternative solution and the individual projects included in each alternative solution are presented in the following sections.

5.1 ALTERNATIVE 2C – LOT LEVEL LOW IMPACT DEVELOPMENT

An opportunity exists to promote the use of lot level Low Impact Development (LID) measures on private property across the City to improve the water balance and watershed water quality. The use of rain barrels and implementation of soakaway pits by residents and property owners in the City will be encouraged to promote infiltration, improve the water balance and watershed water quality. As this option relies on residents and property owners to participate, we have used a conservative utilization rate to estimate the removal efficiency of phosphorus from this alternative. For initial estimate purposes we used a rate that assumed 25% of homes would participate and 25% of the roof area of these homes would drain to lot level LIDs.

Overall the phosphorus reductions provided by lot level LID measures as quantified by the MECP and NVCA P-Tools reduce the phosphorus loading rates from the existing conditions scenario from 8,594 kg/year to 8,577 kg/year. With the assumption of 25% uptake of private lot level LIDs, phosphorus loading in the City is reduced by approximately 17 kg/year which is less than 1% reduction. The results from the P-Tool analysis are included in Appendix F for reference.

5.2 ALTERNATIVE 2D – LINEAR LOW IMPACT DEVELOPMENT

An opportunity exists to implement linear Low Impact Development (LID) measures such as perforated pipe systems or infiltration trenches as part of local road reconstruction projects and intensification in the City. The linear LIDs will be implemented to attenuate peak flows, promote infiltration, improve the water balance and watershed water quality throughout the City.

Overall the phosphorus reductions provided by the linear LID measures proposed under this alternative is 577 kg/year. The phosphorus loading rate is reduced from 8,594 kg/year to 8,017 kg/year or an 7% reduction through the implementation of linear LIDs on local roads throughout the City. The results from the P-Tool analysis are included in Appendix G for reference.

Implementation of Alternative 2D reduces the phosphorus loading rate from each drainage study area and watershed in the City. The phosphorus loading rate reductions for each drainage study area and watershed are summarized in the following table. The results from the P-Tool analysis are included in Appendix G for reference.

Table 12: Phosphorus Reduction Summary – Alternative 2D

Drainage Area / Watershed	Existing Loading Rate (kg/year)	Proposed Loading Rate (kg/year)	Phosphorus Reduction	
			Rate (kg/year)	%
Barrie Creeks	4,164	3,800	364	9
Lovers Creek	1,600	1,505	95	6
Hewitt's Creek	313	262	51	16
NVCA	2,517	2,450	67	6

5.3 ALTERNATIVE 2E – CENTRALIZED LOW IMPACT DEVELOPMENT

An opportunity exists to implement centralized Low Impact Development (LID) measures in parks throughout the City to attenuate peak flows, promote infiltration, improve the water balance and watershed water quality. Opportunities exist to implement bio-retention facilities and infiltration galleries within existing parkland and at locations absent of any water quantity or quality controls in the City of Barrie.

The MECP and NVCA P-Tools were updated to include the 22 centralized park LIDs listed in Section 2. The centralized LIDs proposed and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix H for reference.

Table 13: Phosphorus Reduction Summary – Alternative 2E

Park	Drainage Area (ha)	Runoff Volume Captured (mm)	Phosphorus Reduction (kg/year)
Carter Park	4.6	7	6.0
Kuzmich Park	0.7	9	0.9
Assikinack Park	7.3	20	8.6
Cartwright Park	3.1	7	5.4
Sunnidale Park	7.7	5	9.7
Allandale Heights Park	2.5	13	3.2
Wessenger Park	9.3	12	15.0
Dunsmore Park	16.1	16	14.7
Madelaine Park	5.6	9	7.0
Greenfield Park	23.6	5	26.8
Queensway/Hyde Park	42.3	5	21.7
Harvie Park	2.5	22	2.7
Gibbon Park	4.3	5	4.9
Bear Creek Park	72.9	6	115.1
Lougheed Park	14.6	22	25.0
Shoreview Park	21.2	17	29.1
Sandringham Park	79.4	3	33.7
Montserrand Park	10.0	8	12.0
Mapleton Park	2.1	23	2.3
Cloughley Park	1.5	24	1.7
Golden Meadow Park	32.7	7	41.4
Starbane Park	4.9	14	8.4
		Total	**395.2**

The P-Tool analysis demonstrates that the proposed centralized LIDs considered under Alternative 2E result in a phosphorus reduction of 395 kg/year. The phosphorus loading rate is reduced from 8,594 kg/year to 8,199 kg/year through the implementation of the proposed centralized LIDs. This is a 5% reduction in phosphorus.

5.3.1 Barrie Creeks Drainage Study Area

Implementation of Alternative 2E reduces the phosphorus loading rate from Barrie Creeks drainage study area from 4,164 kg/year to 4,063 kg/year, resulting in a reduction of 101 kg/year. The implementation of centralized LIDs in select parks in the Barrie Creeks drainage study area results in a 2% reduction in phosphorus from the Barrie Creeks drainage study area to Lake Simcoe. The centralized LIDs proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix H for reference.

Table 14: Barrie Creeks Drainage Study Area Phosphorus Reduction Summary – Alternative 2E

Park	Drainage Area (ha)	Runoff Volume Captured (mm)	Phosphorus Reduction (kg/year)
Assikinack Park	7.3	20	8.6
Sunnidale Park	7.7	5	9.7
Allandale Heights Park	2.5	13	3.2
Greenfield Park	23.6	5	26.8
Gibbon Park	4.3	5	4.9
Montserrand Park	10.0	8	12.0
Mapleton Park	2.1	23	2.3
Cloughley Park	1.5	24	1.7
Shoreview Park	21.2	17	29.1
Harvie Park	2.5	22	2.7
		Total	**101.0**

5.3.2 Lovers Creek Watershed

Implementation of Alternative 2E reduces the phosphorus loading rate from the Lovers Creek watershed from 1,600 kg/year to 1,545 kg/year, resulting in a reduction of 55 kg/year. The implementation of centralized LIDs in select parks in the Lovers Creek watershed results in a 4% reduction in phosphorus from the Lovers Creek watershed to Lake Simcoe. The centralized LIDs proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix H for reference.

Table 15: Lovers Creek Watershed Phosphorus Reduction Summary – Alternative 2E

Park	Drainage Area (ha)	Runoff Volume Captured (mm)	Phosphorus Reduction (kg/year)
Carter Park	4.6	7	6.0
Madelaine Park	5.6	9	7.0
Golden Meadow Park	32.7	7	41.4
Kuzmich Park	0.7	9	0.9
		Total	**55.3**

5.3.3 Hewitt's Creek Watershed

Implementation of Alternative 2E reduces the phosphorus loading rate from the Hewitt's Creek watershed from 313 kg/year to 258 kg/year, resulting in a reduction of 55 kg/year. The implementation of centralized LIDs in select parks in the Hewitt's Creek watershed results in a 18% reduction in phosphorus from the Hewitt's Creek watershed to Lake Simcoe. The centralized LIDs proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix H for reference.

Table 16: Hewitt's Creek Watershed Phosphorus Reduction Summary – Alternative 2E

Park	Drainage Area (ha)	Runoff Volume Captured (mm)	Phosphorus Reduction (kg/year)
Queensway/Hyde Park	42.3	5	21.7
Sandringham Park	79.4	3	33.7
		Total	**55.4**

5.3.4 NVCA Watershed Drainage Study Area

Implementation of Alternative 2E reduces the phosphorus loading rate from the NVCA watershed drainage study area from 2,517 kg/year to 2,333 kg/year, resulting in a reduction of 184 kg/year. The implementation of centralized LIDs in select parks in the NVCA watershed drainage study area results in an 7% reduction in phosphorus from the NVCA watershed to the Nottawasaga River and its tributaries. The centralized LIDs proposed for quality control under this alternative and their corresponding phosphorus loading rate reductions are summarized in the following table. The results from the P-Tool analysis are included in Appendix H for reference.

Table 17: NVCA Watershed Phosphorus Reduction Summary – Alternative 2E

Park	Drainage Area (ha)	Runoff Volume Captured (mm)	Phosphorus Reduction (kg/year)
Lougheed Park	14.6	22	25.0
Bear Creek Park	72.9	6	115.1
Wessenger Park	9.3	12	15.0
Cartwright Park	3.1	7	5.4
Dunsmore Park	16.1	16	14.7
Strabane Park	4.9	14	8.4
		Total	**183.6**

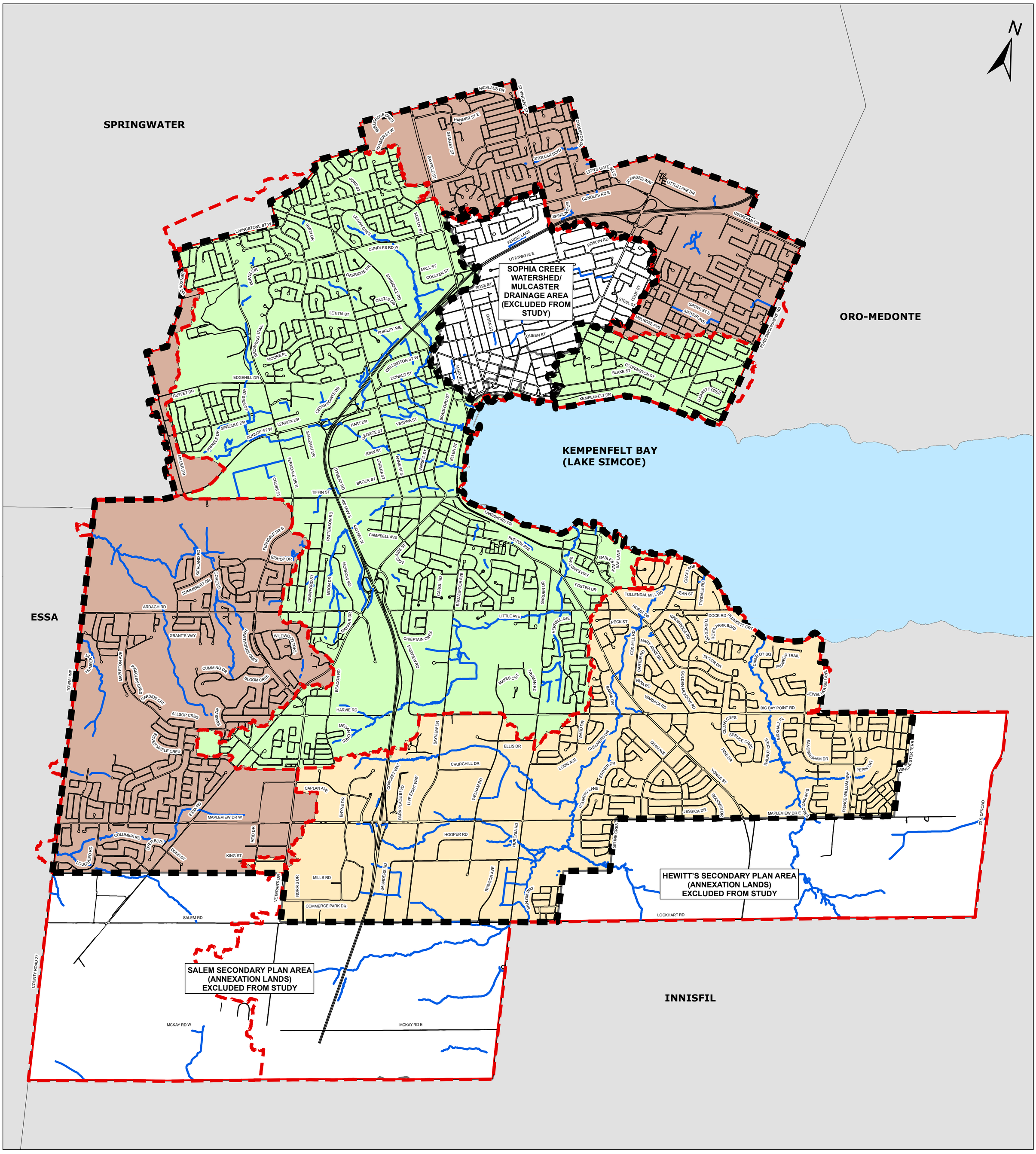
6 Conclusions

Overall, the existing SWMF's evaluated across the City reduce the phosphorus loading rate to Lake Simcoe, the Nottawasaga River and their tributaries by 20%. The phosphorus loading rate is reduce from 10,706 kg/year to 8,594 kg/year by the existing SWMF's. The SWMF retrofit/creation opportunities evaluated have the potential to reduce phosphorus loads by 1,124 kg/year, or 13%. Lot level LIDs implemented b y residents and property owners will not significantly reduce phosphorus loads to Lake Simcoe, the Nottawasaga River or its tributaries. Linear LIDs implemented on local roads throughout the City have the potential to reduce phosphorus loads by 577 kg/year, or 7%. Also Centralized LIDs implemented in select parks (suitable for infiltration) have the potential to reduce phosphorus loads by 395 kg/year, or 5%. The potential phosphorus removal efficiency of the proposed SWMF retrofit/expansion/creation and Low Impact Development opportunities are as follows:

Table 18: Phosphorus Reduction Summary

Alternative	Existing Loading Rate (kg/year)	Proposed Loading Rate (kg/year)	Phosphorus Reduction	
			Rate (kg/year)	%
2A	8,594	8,483	111	1
2B	8,594	7,581	1,013	12
2C	8,594	8,577	17	0
2D	8,594	8,017	577	7
2E	8,594	8,199	395	5

Appendix A: Figures



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LEGEND

- ROADS
- WATERCOURSES
- DRAINAGE STUDY AREA BOUNDARY
- OVERALL STUDY AREA
- SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA (EXCLUDED FROM STUDY)
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- NVCA WATERSHED DRAINAGE STUDY AREA
- BARRIE CREEKS DRAINAGE STUDY AREA
- LOVERS CREEK AND HEWITTS CREEK DRAINAGE STUDY AREA
- MUNICIPAL BORDER

TATHAM ENGINEERING

Barrie

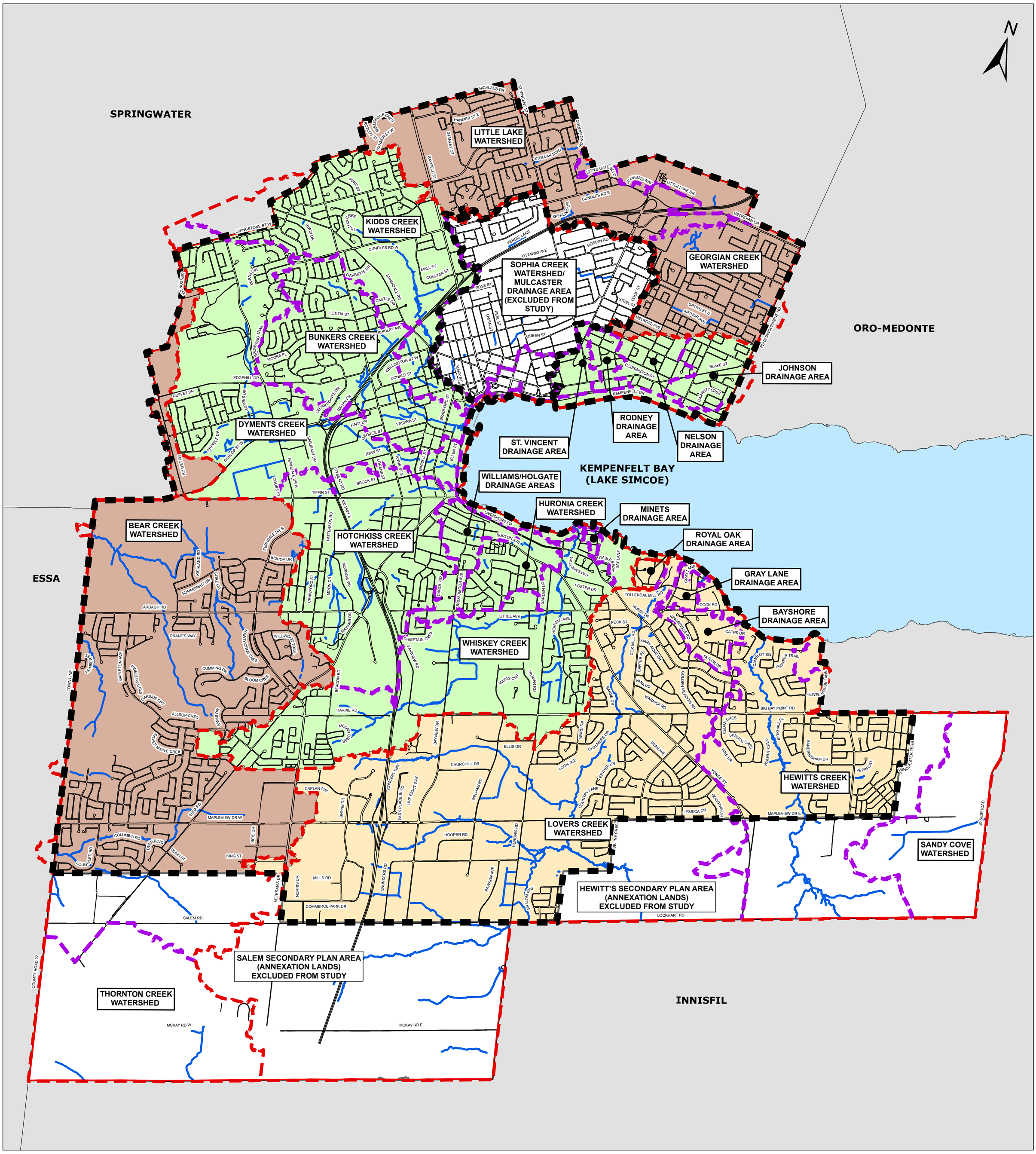
SCALE = 1:24,000

0 310 620 1,240 1,860 2,480 Meters

DRAINAGE MASTER PLAN

FIGURE 1 - STUDY AREA LOCATION PLAN

DATE: MARCH 2019



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LEGEND

- ROADS
- WATERCOURSES
- DRAINAGE STUDY AREA BOUNDARY
- WATERSHED BOUNDARY
- OVERALL STUDY AREA
- SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA (EXCLUDED FROM STUDY)
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- NVCA WATERSHED DRAINAGE STUDY AREA
- BARRIE CREEKS DRAINAGE STUDY AREA
- LOVERS CREEK AND HEWITTS CREEK DRAINAGE STUDY AREA
- MUNICIPAL BORDER

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Barrie

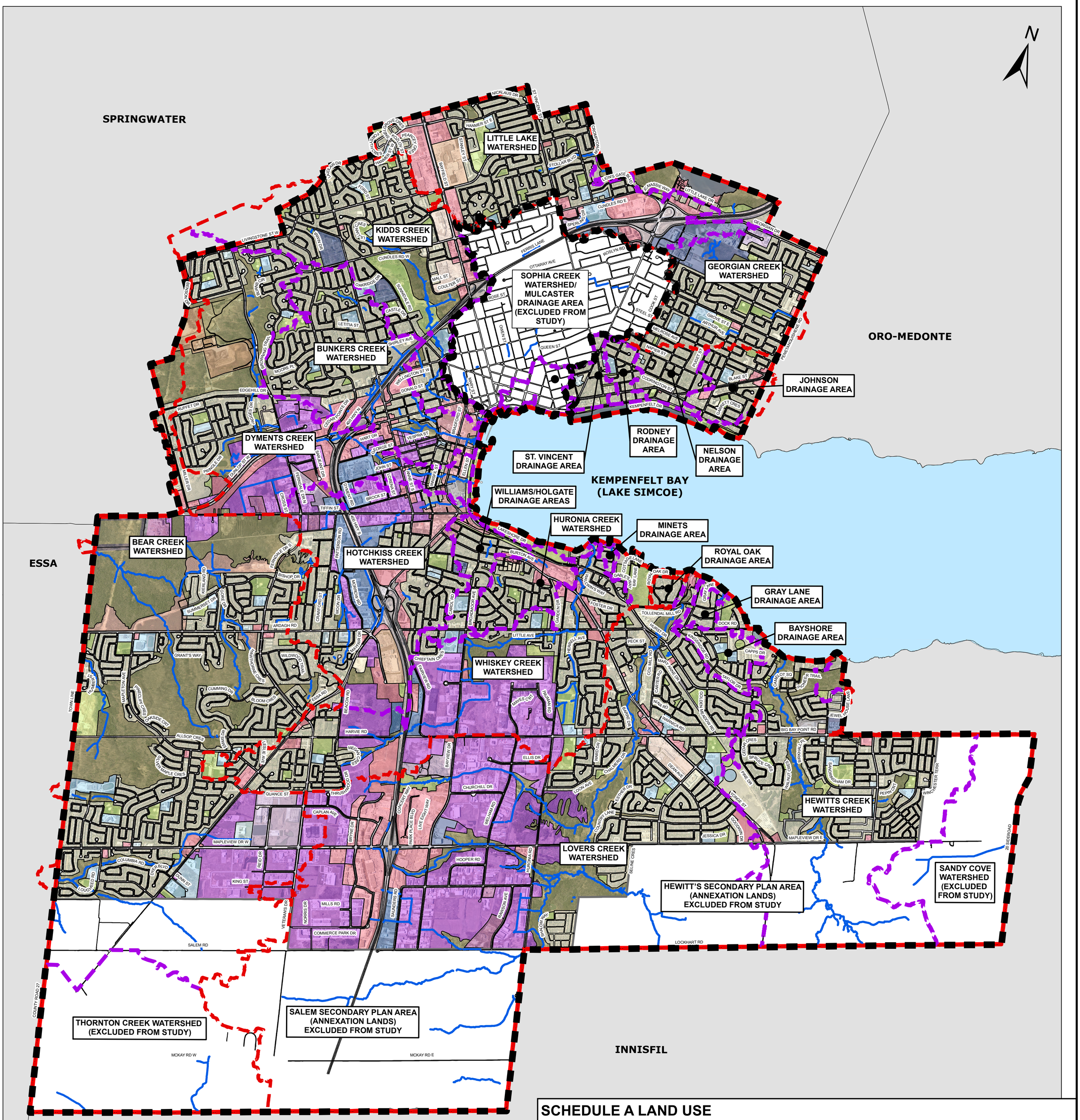
SCALE = 1:24,000

0 310 620 1,240 1,860 2,480 Meters

DRAINAGE MASTER PLAN

FIGURE 2 - WATERSHED/DRAINAGE AREA DELINEATION PLAN

DATE: MARCH 2019



SCHEDULE A LAND USE

- RESIDENTIAL
- CITY CENTRE
- GENERAL COMMERCIAL
- MIXED USE NODES AND CORRIDORS
- COMMUNITY CENTRE COMMERCIAL
- REGIONAL CENTRE COMMERCIAL
- BUSINESS PARK
- GENERAL INDUSTRIAL
- HIGHWAY 400 INDUSTRIAL
- RESTRICTED INDUSTRIAL
- INSTITUTIONAL
- EDUCATIONAL INSTITUTIONAL
- MAJOR INSTITUTIONAL
- OPEN SPACE
- ENVIRONMENTAL PROTECTION AREA
- SPECIAL RURAL AREA
- WATER TREATMENT CENTRE
- WASTE MANAGEMENTS FACILITY
- FUTURE URBAN
- APPLICATION BEFORE THE ONTARIO MUNICIPAL BOARD (OMB)

REFERENCES

The City of Barrie Official Plan - Schedule A Land Use.

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LEGEND

- ROADS
- WATERCOURSES
- WATERSHED BOUNDARY
- DRAINAGE STUDY AREA BOUNDARY
- SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA (EXCLUDED FROM STUDY)
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- OVERALL STUDY AREA
- MUNICIPAL BORDER

TATHAM ENGINEERING

Barrie

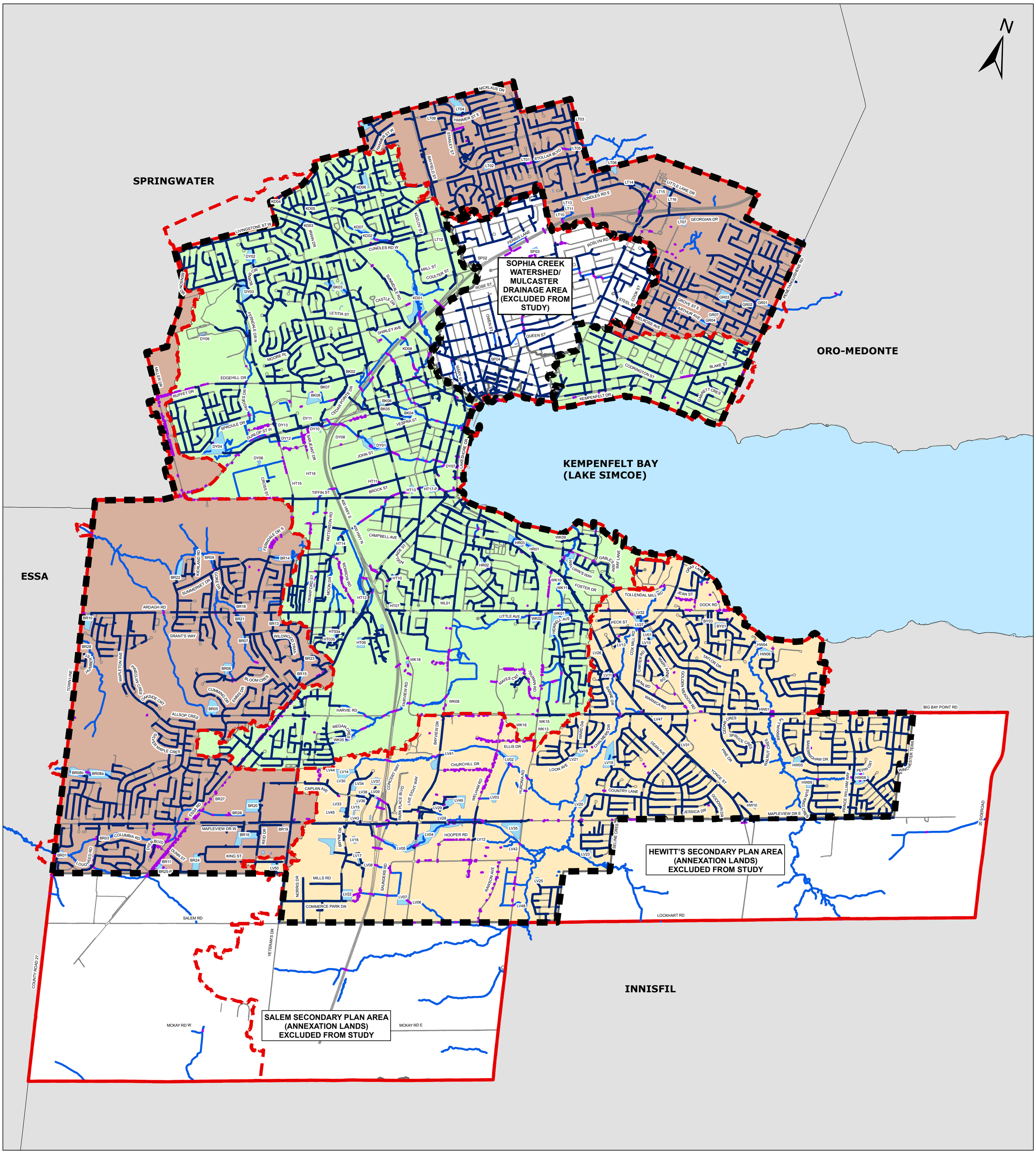
SCALE = 1:24,000

0 310 620 1,240 1,860 2,480 Meters

DRAINAGE MASTER PLAN

FIGURE 4 - EXISTING LAND USE PLAN

DATE: MARCH 2019



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LEGEND

- CULVERTS
- EXISTING STORM SEWER
- ROADS
- WATERCOURSES
- OVERALL STUDY AREA
- DRAINAGE STUDY AREA BOUNDARY
- STORMWATER MANAGEMENT FACILITY (SWMF), ROOFTOP STORAGE, MECHANICAL DEVICES
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- SOPHIA CREEK AND MULCASTER DRAINAGE AREAS (EXCLUDED FROM STUDY)
- NVCA WATERSHED DRAINAGE STUDY AREA
- BARRIE CREEKS DRAINAGE STUDY AREA
- LOVERS CREEK AND HEWITTS CREEK DRAINAGE STUDY AREA
- MUNICIPAL BORDER

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Barrie

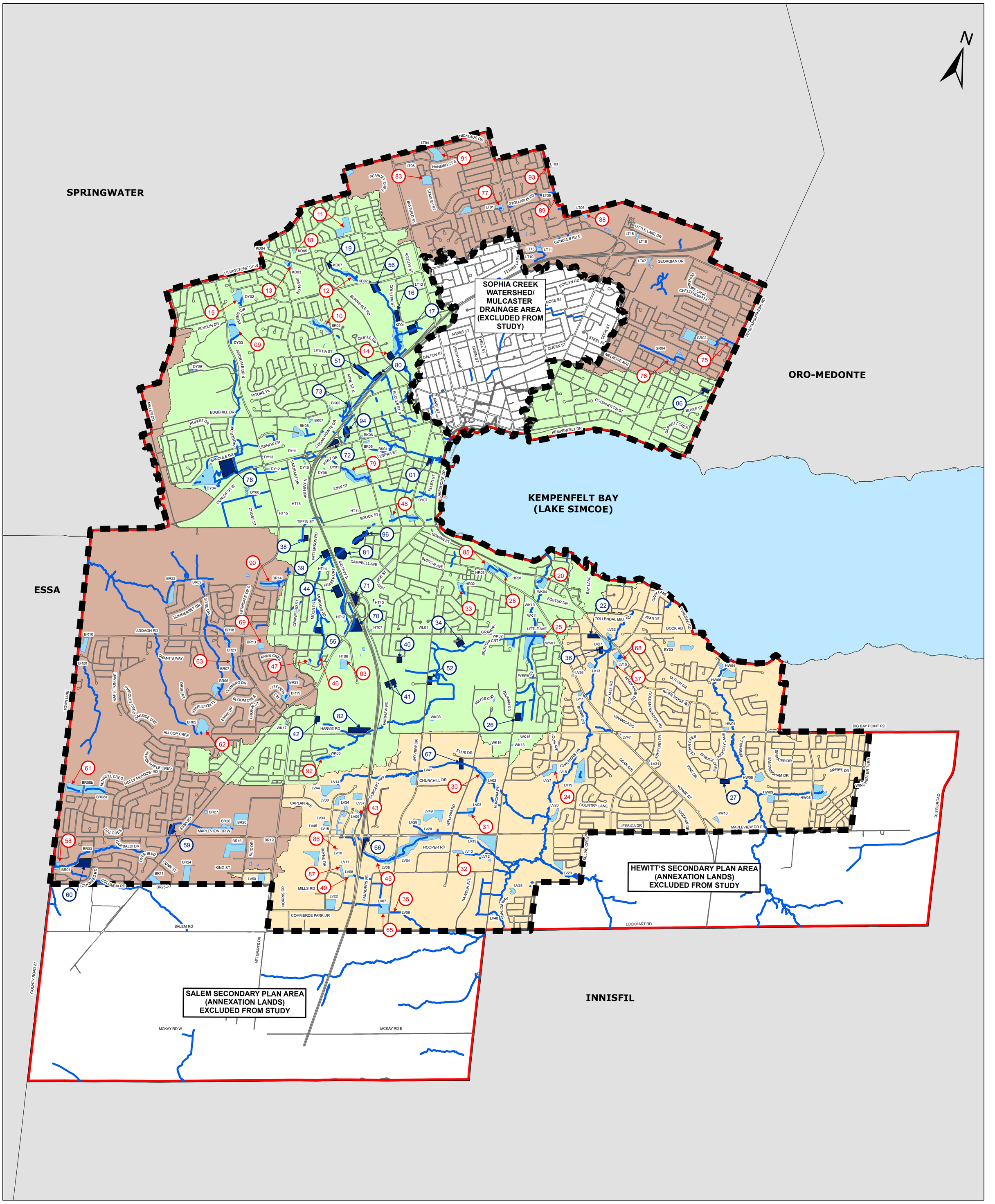
SCALE = 1:24,000

0 305 610 1,220 1,830 2,440 Meters

DRAINAGE MASTER PLAN

FIGURE 5 - EXISTING STORMWATER MANAGEMENT INFRASTRUCTURE PLAN

DATE: MARCH 2019



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LEGEND

- 30 — EXISTING SWMF RETROFIT OPPORTUNITY (OPPORTUNITY ID)
- 67 — PROPOSED SWMF (OPPORTUNITY ID)
- ROADS
- WATERCOURSE
- OVERALL STUDY AREA
- PROPOSED SWMF
- EXISTING SWMF
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA (EXCLUDED FROM STUDY)
- NVCA WATERSHED DRAINAGE STUDY AREA
- BARRIE CREEKS DRAINAGE STUDY AREA
- LOVERS CREEK AND HEWITTS CREEK DRAINAGE STUDY AREA
- MUNICIPAL BORDER

TATHAM ENGINEERING

Barrie

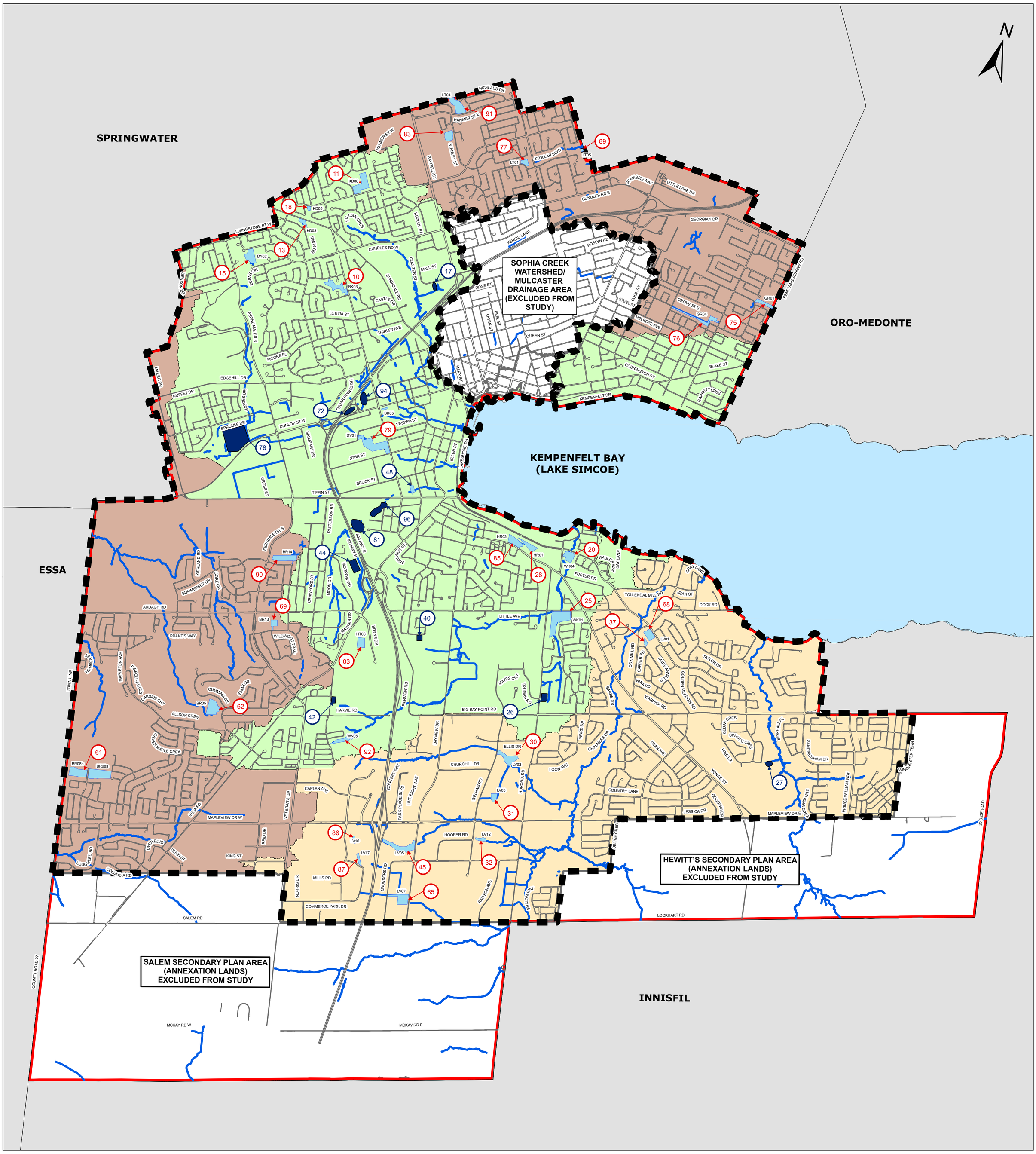
SCALE = 1:24,000

0 310 620 1,240 1,860 2,480 Meters

DRAINAGE MASTER PLAN

FIGURE 8 - SWMF RETROFIT/CREATION OPPORTUNITIES (PRE-SCREENING EVALUATION)

DATE: MARCH 2019



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LEGEND

- (30) EXISTING SWMF RETROFIT OPPORTUNITY (OPPORTUNITY ID)
- (67) PROPOSED SWMF CREATION OPPORTUNITY (OPPORTUNITY ID)
- ROADS
- WATERCOURSE
- OVERALL STUDY AREA
- PROPOSED SWMF
- EXISTING SWMF
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA (EXCLUDED FROM STUDY)
- NVCA WATERSHED DRAINAGE STUDY AREA
- BARRIE CREEKS DRAINAGE STUDY AREA
- LOVERS CREEK AND HEWITTS CREEK DRAINAGE STUDY AREA
- MUNICIPAL BORDER

TATHAM ENGINEERING

Barrie

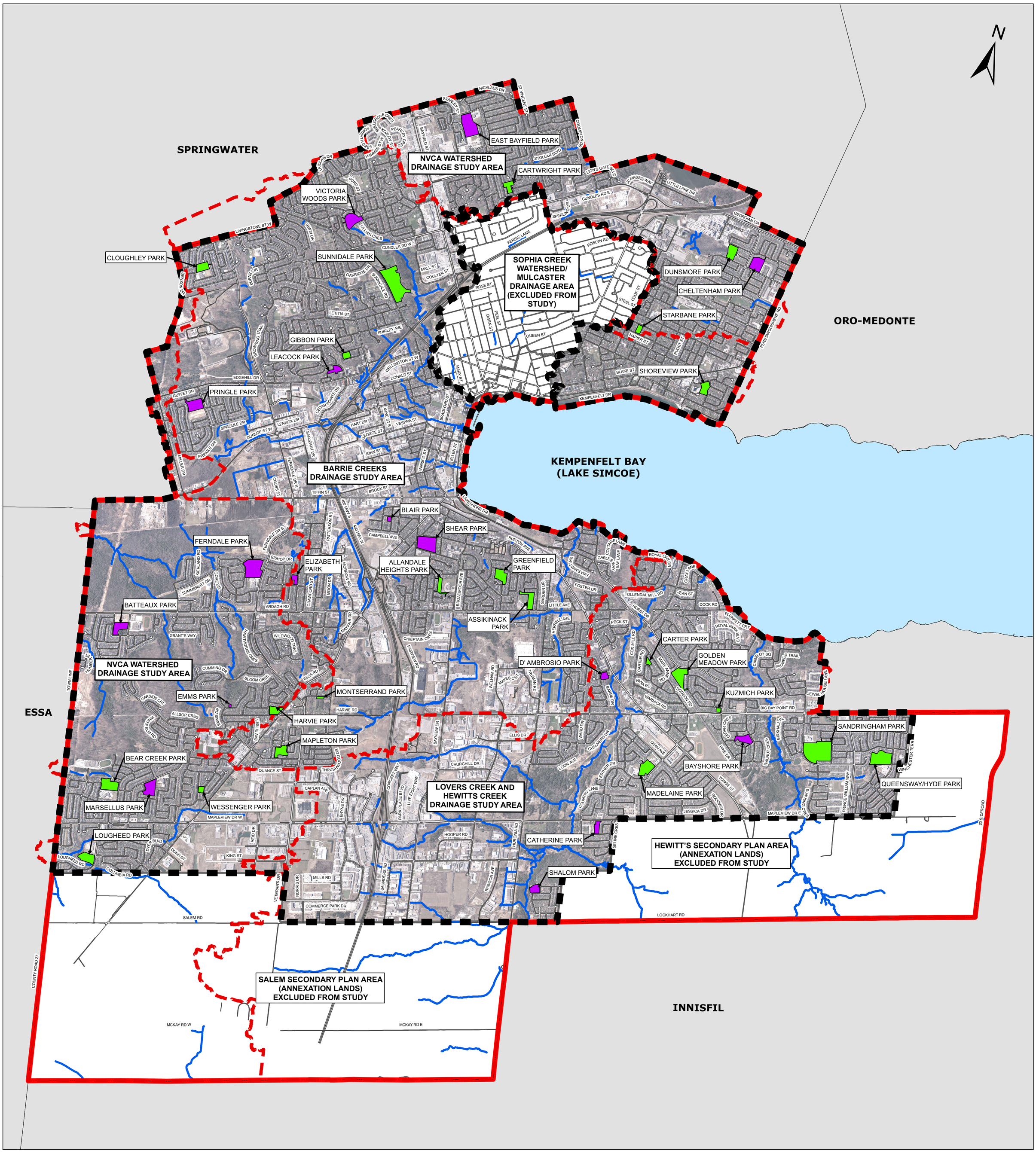
SCALE = 1:24,000

0 310 620 1,240 1,860 2,480 Meters

DRAINAGE MASTER PLAN

FIGURE 9 - SWMF RETROFIT/CREATION OPPORTUNITIES (TO BE EVALUATED)

DATE: MARCH 2019



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LEGEND

- WATERCOURSE
- ROADS
- DRAINAGE STUDY AREA BOUNDARY
- OVERALL STUDY AREA
- PARKLAND CONSIDERED FOR CENTRALIZED LID AND RECOMMENDED FOR FURTHER CONSIDERATION
- PARKLAND CONSIDERED FOR CENTRALIZED LID AND ELIMINATED FOR FURTHER CONSIDERATION
- ANNEXATION LANDS (EXCLUDED FROM STUDY)
- SOPHIA CREEK WATERSHED AND MULCASTER DRAINAGE AREA (EXCLUDED FROM STUDY)
- MUNICIPAL BORDER

TATHAM ENGINEERING

Barrie

SCALE = 1:24,000

0 310 620 1,240 1,860 2,480 Meters

DRAINAGE MASTER PLAN

FIGURE 13 - CENTRALIZED LID OPPORTUNITIES (PRE-SCREENING EVALUATION)

DATE: MARCH 2019

Appendix B:
Preliminary Evaluation Criteria

Preliminary Evaluation, Criteria Weighting and Ranking of SWMF's

The SWMF retrofit/expansion/creation opportunities were evaluated based on a number of factors including their phosphorus reduction potential using the methodology developed as part of the *Assessment of Stormwater Management Facilities to Reduce Phosphorous Discharges.* The preliminary evaluation, criteria weighting and ranking of the SWMF's is presented in the following sections.

Preliminary Evaluation

The criteria selected for the preliminary evaluation process are critical to determine the phosphorous load removal potential for each SWMF retrofit opportunity. The preliminary evaluation criteria are also designed to identify SWMF retrofits with significant constraints that may implicate the feasibility of any retrofit works. The preliminary evaluation has been completed at a desktop review level, and each criterion has been assigned an appropriate weighting to establish its significance in the context of determining each opportunity's ability to reduce phosphorous.

The criteria weighting and ranking system from the previous study has been adopted to perform the preliminary evaluation of the identified SWMF retrofit opportunities.

The following sections provides a summary of the scoring logic assigned to each criterion. Detailed explanations for each criterion have been provided in Appendix A for reference.

Physical Environment

Physical environment criteria include whether there is an existing SWMF present, the land ownership of the identified retrofit site, the opportunity for phosphorous removal and whether the retrofit opportunity is online or offline. The values used to assess SWMF retrofit options under these criteria and the corresponding scoring logic for their calculation are summarized in the following table.

Table 1: Physical Environment Criteria

Criteria	Retrofit Opportunity Value	Corresponding Score	Relative Significance
Is there an existing SWM facility?	Yes	1	High
	No	0	
Land Ownership	City	2	High
	Other Public Body	1	
	Private	0	
Potential Phosphorous Removal	>= 12 kg	5	Fundamental
	<12 kg to >= 7 kg	4	
	<7 kg to >= 4 kg	3	
	<4 kg to >= 3 kg	2	
	<3 kg to >= 2 kg	1	
	<2 kg	0	
Online vs. Offline	Offline	1	High
	Online	0	

Natural Environment

Natural environment criteria include:

- Natural feature adjacency;
- Impact to existing trees;
- Linkage of non-sensitive natural features;
- Potential thermal impacts to downstream watercourses; and
- Potential fisheries impacts.

The values used to assess SWMF retrofit options under these criteria and the corresponding scoring logic for their calculation are summarized in the following table.

Table 2: Natural Environment Criteria

Criteria	Retrofit Opportunity Value	Corresponding Score	Relative Significance
Natural Feature Adjacency	Non-sensitive nature features within 50 m of retrofit site boundary	1	Low
	Sensitive nature features within 50 m of retrofit site boundary	0	
	Any natural feature within retrofit site boundary	0	
Impact to Existing Trees	None (0% tree cover)	3	Moderate
	Minor (0 to 25% tree cover)	2	
	Moderate (25 to 60% tree cover)	1	
	Significant (>60% tree cover)	0	
Linkage Opportunity	Retrofit would create a linkage of 2 non-sensitive natural features	1	Low
	Otherwise	0	
Thermal Impacts to Downstream Watercourses	Warm water	1	High
	Cold water	0	
Potential Fisheries Impact	Ponds with some distance or a barrier to the watercourse	3	High
	Ponds with creeks nearby	2	
	Warmwater stream online opportunities	1	
	Presence of SAR fish or mussels	0	
	Online coldwater stream opportunities	0	

Social Environment

Social environment criteria include adjacent land uses and loss of parkland uses. The values used to assess SWMF retrofit options under these criteria and the corresponding scoring logic for their calculation are summarized in the following table.

Table 3: Social Environment Criteria

Criteria	Retrofit Opportunity Value	Corresponding Score	Relative Significance
Adjacent Land Use	Industrial / commercial	3	High
	Park / open space / institutional	2	
	Residential, existing SWM facility	1	
	Residential, no existing SWM facility	0	
Loss of Parkland	No	1	Moderate
	Yes	0	

Economic Environment

The economic environment criteria consist of the approximate capital cost to implement the proposed retrofit. The values used to assess SWMF retrofit options under this criterion and the corresponding scoring logic for their calculation are summarized in the following table.

Table 4: Economic Criterion

Criteria	Retrofit Opportunity Value	Corresponding Score	Relative Significance
Capital Cost	< $80,000 / kg	3	High
	>= $80,000 / kg to < $120,000 / kg	2	
	>= $120,000 / kg to < $180,000 / kg	1	
	>= $180,000 / kg	0	

Criteria Weighting

Each evaluation criterion noted above has been assigned a weighting according to its relative significance. This weighting allows for each criterion to be considered according to its relative importance with respect to reducing phosphorous discharges and with consideration to the potential impacts of each retrofit opportunity to the physical, natural, social and economic environments. The criteria weightings have been summarized in the following table.

Table 5: Criteria Weighting

Relative Significance	Definition	Weighting
Fundamental	These criteria are fundamental to the goals of the study. Assigned to *Phosphorous Removal Potential* only	5
High	These criteria represent a significant potential impact to the physical, natural, social or economic environment and dictate the feasibility of a given retrofit opportunity	3
Moderate	These criteria have a moderate potential for impact to the physical, natural, social or economic environment but can generally be mitigated with design considerations	2
Low	These criteria are used to differentiate between otherwise equal retrofit opportunities	1

Evaluation Ranking

As per the methodology outlined in the *Assessment of Stormwater Management Facilities to Reduce Phosphorous Discharges*, the scores assigned to a given retrofit opportunity for each criterion were normalized so that the maximum score was equal to one. The weighting factors were then applied to the normalized criterion scores and summed for each retrofit opportunity to provide a total score. For example, if a retrofit opportunity scored a 3 for phosphorous reduction, the maximum score is 5, so the normalized score would be equal to 0.6. The criteria weighting (5 in this case) would then be applied to the normalized score to equal 3, which would be summed with the other criteria scores.

The preliminary evaluation and associated criteria, criteria scores and total score have been populated in the following table. The SWMF retrofit opportunities have then been ranked based on their respective score and a list of SWMF's recommended for retrofit from a phosphorus reduction perspective is provided in the following table.

3.0 PRELIMINARY EVALUATION AND RANKING

As noted, the criteria selected for the preliminary evaluation process represent those critical to the technical goals of this assessment (i.e. phosphorus load removal potential) or represent significant constraints that may dictate the feasibility of a particular stormwater management retrofit opportunity (i.e. significant presence of mature trees). In order to keep the assessment balanced, an effort has been made to select at least one criterion from each of the technical, natural, social and economic environments. All criteria considered at the preliminary stage have been evaluated at a desktop review level and have been assigned a criteria weighting to reflect the relative significance of the criteria in determining the retrofit opportunity's feasibility and ability to meet the goals of the study. Each stormwater management retrofit opportunity has been assigned a score for each criterion based on the scoring logic outlined in Sections 3.1 to 3.4 and an overall score for each stormwater management retrofit opportunity has been calculated as a weighted sum. The stormwater management retrofit opportunities with higher scores represent the preferred opportunities or those with a higher feasibility as defined by the criteria considered in this study and have been ranked accordingly and advanced to the next stage (Detailed Evaluation).

The following section summarizes the physical, natural, social and economic evaluation criteria that have been considered for the preliminary stormwater management retrofit opportunity evaluation. Each criteria has been defined, its evaluation methodology outlined along with any assumptions made and its scoring system and relative weight explained.

3.1 Physical Environment

Existing Stormwater Management Facility

Existing stormwater quantity ponds, or dry ponds, are generally preferred stormwater management retrofit opportunities as the land, connecting storm infrastructure, and access are already in place, which can reduce the ultimate cost and increase feasibility. Furthermore, the neighbouring landowners are likely to put forward less resistance to modifying an existing pond versus building a new one, especially if the adjacent land use is residential. Notwithstanding, conversion from dry to wet would still require communication to local landowners on function and utility during the detailed design stage. Considering the above, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

The following defines the values used to assess the stormwater management retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Is there an existing SWM facility?	Score
Yes	1
No	0

Land Ownership

Since the City will be the proponent for all stormwater management retrofit opportunities, it is considered highly preferable that the City already owns the subject lands. Stormwater retrofits by nature are in existing development lands, so purchasing land has the potential to greatly increase the capital cost of a stormwater management retrofit opportunity, potentially by a factor of 2 or greater depending on adjacent land uses, proximity to downtown, presence of any hazard regulations, and other factors. Considering the above, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

The following defines the values used to assess the stormwater management retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Retrofit Opportunity Value	Score
City	2
Other Public Body	1
Private	0

Ownership by other Public Sector agencies (like the MTO) has been assessed as preferable to private ownership as transfer of land ownership may not be necessary and these Public Partners are deemed potentially motivated partners.

Phosphorus Removal Opportunity

Removal of phosphorus in stormwater runoff is the primary objective of this study and its associated recommendations. Calculation of the phosphorus removal potential for any given stormwater management retrofit opportunity is dependent upon the local phosphorus load and the efficiency of the system which can be constructed to remove it.

Phosphorus Load

The total phosphorus load is dependent on four factors including phosphorus loading rate, drainage area, land use, and level of existing upstream water quality treatment, if any.

- *Drainage area* to a stormwater management retrofit opportunity has been determined from LSRCA urban catchment mapping / data in combination with City storm sewer mapping and topography and updated by this assessment where appropriate.
- *Phosphorus loading rates* (kilograms per hectare per year) used in the CANWET modelling have been applied for the current study (High intensity urban development including residential, institutional, commercial and industrial land uses = 0.3 kg P/ha/yr, ref. DSWMMP, AMEC, October 2013). It is noted that monitoring data for City of Barrie subwatersheds has recorded in-stream phosphorus concentrations that may indicated higher urban phosphorus loading rates than that applied herein, thus the assessment herein may be considered conservative. Detailed design of a given retrofit opportunity should consider the most current and subwatershed specific phosphorus loading data available.

- *Land use* has been determined from review of aerial photography and classified as either residential, industrial/commercial, or open space. No phosphorus loading has been applied to open space land use; this is considered a conservative assumption and could be reconsidered at detailed design.
- *Existing upstream water quality treatment* has been determined from review of the City of Barrie stormwater pond inventory and mapping developed by the LSRCA indicating the treatment level of existing facilities. If a portion of the drainage area contributing to a stormwater management retrofit opportunity is currently receiving water quality treatment, the area has not been used in calculation of the phosphorus load. It is recognized that there exists a retrofit treatment opportunity for the residual phosphorus load associated with upstream ponds, since it is accepted that stormwater water quality treatment does not achieve 100% treatment of any pollutant. However for the purpose of this study, the number of instances of this occurrence and the associated residual phosphorus load has been considered insignificant. If the retrofit opportunity itself is an existing water quality pond designed to lower standards (e.g., MOE Basic level), the phosphorus removal opportunity has been adjusted accordingly to consider the existing formal water quality treatment. Lot-scale application of Best Management Practices (e.g. Oil/grit separators, Enhanced Grass Swales, etc) has not been considered in the current evaluation. It is noted that these are conservative assumptions which could be re-evaluated at detailed design.

Phosphorus Removal Rate

For the purpose of this study, it has been assumed all retrofits would be designed as a wet pond facility, as this type of facility is generally accepted to be the most efficient overall end-of-pipe water quality treatment technology considering for footprint area (relative to wetlands).

Phosphorus is present in stormwater in two forms: dissolved and particulate-bound. Removal of phosphorus from stormwater therefore depends on two separate processes. For wet ponds and wetlands dissolved phosphorus is removed by adsorption (phosphorus binding to metals) whereas particulate-bound phosphorus is removed by settling (out of the water column) and filtration (through the media at the base of the facility, or vegetation). Literature on phosphorus removal efficiency (measured by comparing influent and effluent of a stormwater facility during and after a storm event) generally reports total phosphorus, which is a combination of dissolved and particulate bound phosphorus. The removal efficiency achieved for phosphorus by wet pond stormwater management facilities (i.e. the preferred retrofit BMP) varies significantly in the literature from approximately 40% to 80%, depending on the study, setting, and the design standard (i.e. MOE Enhanced, Normal or Basic) of the facility. The MOE has applied a phosphorus removal efficiency of 63% for wet pond facilities in the Phosphorus Budget Tool (Hutchison Environmental Services Ltd., March, 2012). This value is understood to represent the phosphorus removal efficiency for wet ponds designed to meet the Enhanced water quality treatment levels. It is also understood that phosphorus removal efficiency generally increases as the volume of the permanent pool increases (all other factors equal). Therefore, it follows that a wet pond design for Enhanced level treatment would have a greater phosphorus removal efficiency than a Basic level wet pond (all other factors equal). A range of phosphorus removal rates are considered necessary for assessing stormwater retrofit opportunities since these facilities are designed to maximize treatment level within the available footprint and are not held

to a specific MOE treatment level as other development in the Lake Simcoe Watershed would be (i.e. all new development in the Lake Simcoe Watershed is required to meet Enhanced level water quality control). Therefore, for the purpose of comparing the phosphorus removal efficacy of the stormwater retrofit opportunities identified for the current study, the following phosphorus removal rates have been applied:

- The phosphorus removal rate of 63% (i.e. MOE Phosphorus Budget Tool and consistent with CANWET modelling) has been applied for retrofits which meet MOE Enhanced level volumetric requirements [i.e. Stormwater Management Planning and Design Manual, MOE, 2003];
- Phosphorus removal rates for retrofits meeting Normal and Basic level volumetric requirements have been assigned phosphorus removal rates reduced by 10% increments from the Enhanced rate (63%) based on the incremental difference in total suspended solids (TSS) removal assigned by MOE in the Stormwater Management Planning and Design Manual (MOE, 2003, i.e. 10% reduction in TSS removal between Enhanced and Normal, and Normal and Basic); therefore 53% and 43%, respectively; and,
- Retrofit opportunities achieving storage volumes below MOE's Basic level have been categorized as Constrained and a generic phosphorus removal rate of 33% has been applied (in keeping with a 10% incremental reduction, and the low-end efficiencies reported in the literature). Actual phosphorus removal efficiency for these facilities would be estimated at detailed design.

Phosphorus Removal Opportunity

The opportunity to remove the phosphorus load to a given stormwater management retrofit opportunity is dependent on the feasible phosphorus removal rate or treatment level, which is ultimately limited by the available footprint (and associated volume). To determine the feasible treatment level, the required footprint area for a given treatment level (which is dependent on required water quality volume), has been compared to the available land area for each retrofit opportunity. The phosphorus removal opportunity has been calculated as follows (ref. to Appendix B for sample calculation):

1. Calculate the required water quality volume for each level of water quality treatment:

The *required water quality volume* (permanent pool and extended detention) has been determined using MOE storage rates for wet ponds (ref. Table 3.2 Stormwater Management Planning and Design Manual, MOE, 2003), which are required to achieve a specific treatment level for a given imperviousness.

- *Enhanced*: residential (45% impervious) = 165 m^3/ha;
  Industrial/commercial (85% impervious) = 250 m^3/ha
- *Normal*: residential (45% impervious) = 100 m^3/ha;
  Industrial/commercial (85% impervious) = 150 m^3/ha
- *Basic*: residential (45% impervious) = 67.5 m^3/ha;
  Industrial/commercial (85% impervious) = 95 m^3/ha
- *Constrained*: Any opportunity not meeting the storage requirements of Basic level treatment has been categorized as Constrained

2. Calculate the required footprint area for each level of water quality treatment:

The required footprint area for a given treatment level is a function of the required water quality volume for that level and design depth. It has been assumed that wet ponds would be the most commonly applied stormwater management retrofit design given they require less footprint area than wetlands and available footprint area is generally constrained for retrofits. The following assumptions have been made to minimize the required pond footprint and remain within the design guidelines as outlined by MOE in the SWMP Manual for wet ponds:

- Total water quality depth (permanent pool plus extended detention) = 3 m
- Side slopes = 4:1 (average between minimum 5:1 on either side of the permanent pool elevation and 3:1 elsewhere)
- Length to width ratio = 3:1

It is noted that if the retrofit opportunity involves modification of an existing quantity control facility, all quantity control functions (flooding and erosion, if any) must be maintained as per the original design and Certificate of Approval (now called Environmental Compliance Approval). For the purpose of the current study, it has been assumed that any retrofit water quality volume would be generated by either expanding the existing footprint, if space is available, or otherwise lowering the existing stormwater management facility invert. It is noted that the assumptions herein could be modified at detailed design (i.e. steeper slopes) on a site-by-site basis to increase storage volume, and by extension treatment level.

Using the above assumptions, and through analysis of various pond geometries, the following empirical function has been developed to provide a preliminary estimate of the required footprint:

$$\mathbf{A_{Req} = [(V_{Req} / 2 / D)^{1/2} + 2*4D]^2 * C1 * C2}$$

A_{Req} = Footprint area required (m^2)
V_{Req} = water quality volume required (m^3, refer to 1 above)
D = depth, assumed 3 m
C1 = areal factor accounting for footprint area required for access and appurtenances, assumed 1.2 (i.e. 20% of the storage footprint area)
C2 = Factor of safety, assumed to be 1.2

Development of the empirical formula is included in Appendix B.

3. Compare required footprint area to available footprint area:

The feasible treatment level (i.e. Enhanced, Normal, Basic or Constrained) has been specified by comparing the required footprint area to the available footprint area, which has been measured conservatively from available base mapping considering constraints including existing quantity facility limits, property fabric and other natural and built constraints. The available footprint, and by extension the potential water quality volume, would be confirmed at detailed design.

The phosphorus removal potential (kg P/yr) has then been calculated as the product of the phosphorus load (kg P/yr) and the feasible treatment level (% P removal).

The phosphorus removal potential for all stormwater management retrofit opportunities considered in this assessment ranges from 1 to 26 kg/yr. The scoring logic has been set to favour opportunities with a greater phosphorus removal potential. A sample calculation for phosphorus removal potential is included in Appendix B.

The following defines the values used to describe each retrofit opportunity for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Potential Phosphorus Removal (kg)	Score
>= 12 kg	5
< 12 kg, >=7 kg	4
< 7 kg, >=4 kg	3
< 4 kg, >= 3 kg	2
< 3 kg, >= 2 kg	1
< 2 kg	0

Phosphorus removal is a primary goal of the Lake Simcoe Protection Plan and the objective of this study, as such this criterion has been assigned a relative significance of *fundamental* (ref. Section 3.5). It is noted that retrofits located within the Nottawasaga River Watershed would not directly address the phosphorus reduction mandates of the Lake Simcoe Protection Plan and as such these opportunities are ranked separately in Matrix 1.

It is noted that the phosphorus removal potential is based on several assumptions (summarized herein) related to available footprint, grading, removal efficiency and may not consider site specific constraints that may affect the water quality volume that can be generated, and as such should be confirmed at detailed design.

Online Versus Offline

An online stormwater management facility typically has an outlet control structure in line with an open watercourse and often uses natural valley storage to achieve its water quantity objectives, and may have a permanent pool if it serves a water quality function. An online facility necessarily conveys all upstream drainage area. An offline facility drains to its receiver without conveying the receiver's upstream drainage.

Traditional online facilities potentially introduce impacts to stream morphology (sediment starving) aquatic habitat and fish passage (thermal and barriers) as well as terrestrial resources typically associated with valley systems. They may also introduce additional design considerations as they are often in the floodplain; for these reasons online facilities are generally less preferable particularly for water quality management. Many of these impacts can be mitigated by using offline storage (potentially within valleys) that draws flow off an open watercourse (which flows freely through the facility) during elevated flow conditions. Online facilities offer advantages such as naturally available valley storage, the ability to treat large upstream drainage areas and are often the only available land in developed urban areas. It is

understood that LSRCA does not generally support online water quality treatment for the reasons discussed, and as such all online opportunities have been screened with the exception of those that have minimal low quality (i.e. straightened, poor riparian vegetation, etc) reach length upstream. For the simplicity of their design, in addition to less potential for other ecosystem impacts, offline facilities have been scored higher than online facilities. Considering the above, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

The following defines the values used to describe each retrofit opportunity for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Facility Type	Value Score
Offline	1
Online	0

3.2 Natural Environment

Natural Feature Adjacency

Natural features, such as forests, woodlands, thickets and meadows provide a variety of ecological values and functions. Adjacency of natural features to stormwater management facilities can be beneficial if the natural area primarily influences the facility. However, adjacency of natural features to storm ponds can also be detrimental if the facility primarily influences the natural feature.

The degree to which ponds and natural areas influence one another may be affected by a variety of factors, such as:

- separation distance;
- vegetation connectivity;
- surface water and groundwater connectivity; and,
- presence of physical or ecological barriers.

The adjacency of natural features to retrofit opportunities has been assessed at a preliminary level by review of orthophotography and Ecological Land Classification (ELC) mapping. Retrofit opportunities that contain any portion of a natural feature, or that are within 50 m of a sensitive natural feature have been considered to have a reduced priority as a retrofit opportunity. The designation of a sensitive natural feature can be more appropriately assessed at the Detailed Evaluation stage. For the purposes of the preliminary assessment the sensitive natural feature designation included only wetlands. During the Detailed Evaluation the sensitive natural feature designation may include for example: Provincially Significant Wetlands (PSW's), provincially rare vegetation community types, and areas where there are known occurrences of provincially or federally listed Species at Risk (SAR). A non-sensitive natural feature is any natural feature that is not considered sensitive and may include ELC communities such as forest, cultural woodland, cultural thicket, and any wetland type, but do not include cultural meadow. Considering the above, this criterion has been assigned a relative significance of *low* (ref. Section 3.5).

Detailed field review of the highly ranking retrofit opportunities has been completed by a qualified biologist to adequately determine which retrofit opportunities would benefit from adjacency to natural features and which have the potential to negatively impact nearby natural features.

The following defines the values used to describe each retrofit opportunity for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Adjacency of Natural Features	Score
Non-sensitive natural feature within 50m of SWM boundary	1
Sensitive natural feature (wetland) within 50m of SWM boundary OR Any natural feature (or portion) within SWM boundary	0

Impact to Existing Trees

Mature trees can be valuable natural resources due to their species, diameter, health, wildlife habitat function, and interactions with soil water and air. To the public at large, all mature trees are seen as having aesthetic, recreational and environmental value. Loss of mature trees associated with a retrofit opportunity is considered to reduce the priority of that opportunity. The relative impact to mature trees has been determined by review of orthophotography and may require an assessment of species, size and health by qualified biologists at the detailed design stage. Considering the above, this criterion has been assigned a relative significance of *moderate* (ref. Section 3.5).

The following defines the values used to describe each retrofit opportunity for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Impact to Existing Trees	Score
None (0 % tree cover)	3
Minor (0 – 25% tree cover)	2
Moderate (25 – 60% tree cover)	1
Significant (>60% tree cover)	0

Linkage Opportunity

Stormwater management facilities can provide ecological linkage functions. A facility that provides a linkage to adjacent natural areas via vegetation connectivity can be valuable habitat by functioning as a wildlife movement corridor. The opportunity for a retrofit to create a terrestrial linkage between two non-sensitive natural features is considered to increase the priority of that opportunity. A retrofit without linkage opportunities is considered a lower priority, as are retrofits where a linkage would be created with a sensitive natural feature (due to the potential of the retrofit to influence the sensitive feature [i.e. wetland]). Considering the above, this criterion has been assigned a relative significance of *low* (ref. Section 3.5).

The following defines the values used to describe each retrofit opportunity for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Linkage Opportunity	Score
Retrofit would create a linkage of 2 non-sensitive natural features	1
Otherwise	0

Potential for Thermal Impacts to Downstream (Receiving) Watercourses

Stormwater management facilities have been reported in literature to cause thermal impacts on receiving watercourses. Stormwater runoff stored in a pond is often warmed by the sun before being released downstream and in turn warms in-stream flow through thermal energy enrichment. The survival of sensitive cold water fish and other aquatic species can be impacted by the increase in water temperature. As such, it is preferred that retrofits drain to less sensitive warm water habitat.

There are several design considerations which can be incorporated into the design of a stormwater management retrofit to mitigate some of the associated thermal impacts, including bottom draw outlet structures and shading of the permanent pool and outlet channel. These should be evaluated at the detailed design stage. It is also noted that most of the watercourses in the City of Barrie are cold water habitat, and it follows that most of the identified retrofit opportunities will discharge to cold water habitat, therefore this criterion does not appreciably differentiate retrofit opportunities. Nevertheless, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

The following defines the values used to assess retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Retrofit Opportunity Value	Value Score
Warm water	1
Cold water	0

Potential Fisheries Impact

The potential for a retrofit opportunity to impact fish habitat and fisheries was based on the presence of potential aquatic habitat as determined from review of the available background data. Generally, the potential fisheries impact associated with the construction of a retrofit increases with the proximity to the watercourse. Online opportunities therefore represent the highest potential impact. The potential impact also increases for creeks classified as coldwater habitat. Impact to aquatic habitat is an important consideration, however in most cases can be addressed by restoration and compensatory measures. The specific impact/opportunity of a given retrofit opportunity has also been assessed at the Detailed Evaluation stage. Considering the above, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

The following defines the values used to assess retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Potential Fisheries Impact	Value Score
Ponds with some distance or a barrier to the watercourse	3
Ponds with creeks nearby	2
Warmwater stream online opportunities	1
Presence of SAR fish and mussels or online coldwater stream opportunities	0

3.3 Social Environment

Adjacent Land Use

It has been assumed that existing neighbouring residential land owners would be more resistant to construction of new stormwater management facilities adjacent to their homes, than would commercial and industrial land owners (assuming that land is not expropriated from commercial/private owners). It has been further assumed that residential land-owners with an existing quantity control facility adjacent to their property would be less resistant than those with no facility present at all. Park, open space and institutional (taken as schools only) land uses have been considered more desirable than residential land uses but less desirable than industrial/commercial land uses. Considering the above, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

The following defines the values used to assess retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Adjacent Land Use Classification	Value Score
Industrial/commercial	3
Park/Open Space/Institutional	2
Residential, existing quantity control pond	1
Residential, no existing pond	0

Loss of Parkland Uses

Parkland and its associated uses in existing development areas is highly valued by the local community, and depending on the size and significance of the park, the community of Barrie as a whole. Any retrofit opportunity in an existing park, or to a lesser extent an open space area, would have to be carefully designed to complement existing park use and landscaping as best as possible. Generally a retrofit opportunity in a park is considered to be of a lower priority. Considering the above, this criterion has been assigned a relative significance of *moderate* (ref. Section 3.5).

The following defines the values used to assess retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Loss of Parkland	Value Score
No	1
Yes	0

3.4 Economic Environment

Capital Cost

A significant consideration of a stormwater retrofit program relates to the approximate capital cost to implement. Several stakeholders may have an interest in the capital cost including developers if retrofits are funded by Development Charges, and the municipality if budgeted through other sources. As such, an effort must be made to select the most economical retrofit opportunities. In order to equalize the comparison of capital cost between all retrofit opportunities and score them accordingly, capital cost has been normalized as dollars per kilogram of phosphorus removed ($/kg P). Considering the above, this criterion has been assigned a relative significance of *high* (ref. Section 3.5).

Through review of various relevant and recent construction costs for stormwater management facilities (ref. Appendix B) the construction cost per unit volume of storage ($/$m^3$) has been conservatively estimated to be $120/$m^3$. This cost has been assumed to be constant based on the variable presence of an existing pond, since it is expected that any existing pond site would be required to be fully re-graded.

Land acquisition has been considered separately as it is not common to all retrofit opportunities and represents a significant and measurable cost. Land valuation in the City of Barrie for residential, industrial and commercial land uses is estimated at $315,000/acre, $250,000/acre and $440,000/acre, respectively, based on 2008 data received from City of Barrie Real Estate staff through Watson & Associates. Land valuation estimates have been applied to the available footprint area (ref. Section 3.1.1, Phosphorus Removal Potential) determined for each retrofit opportunity to determine the land acquisition cost if the land is privately owned.

Online facilities have been assumed to add cost due to the requirement to mitigate potential impacts to the natural environment as well for additional design considerations. This amount has been incorporated as an assumed 20% premium on the total capital cost.

Capital cost estimates do not consider site specific constraints that may require specialized design/construction considerations and have the potential to increase the capital cost. Site specific constraints include, but are not limited to: high groundwater, the presence of bedrock, or contaminated soils requiring mitigation. These variables would be determined by detailed site investigations (boreholes, soil testing, etc) prior to implementation and may affect the priority of a given retrofit opportunity.

Based on the above, two (2) equations have been developed and applied for calculation of the preliminary capital cost estimates:

City Owned Land:

- ***Capital Cost = Excavation Volume (m^3) * \$120/m^3* 1.2*** *(if online)*

Privately Owned Land:

- ***Capital Cost = [Excavation Volume (m^3) * \$120/m^3 + Land acquisition (m^2) * \$$X_{Land\ use}$/$m^2$] * 1.2*** *(if online)*

The following defines the values used to assess retrofit opportunities for this criteria and the scoring logic applied for the Stormwater Management Retrofit Opportunity Evaluation Matrix:

Capital Cost	Score
< \$80,000 / kg	3
>= \$80,000 / kg, <\$120,000 / kg	2
>= \$120,000 / kg, <\$180,000 / kg	1
>= \$180,000 / kg	0

3.5 Criteria Weighting and Evaluation Ranking

Each evaluation criterion discussed in Section 3.1 to 3.4 has been assigned a weighting according to its relative importance with respect to the goals of this study and the potential impact to the physical, natural, social and economic environments. The weighting system has been defined in Table 3.1 and the weighting for each evaluation criterion is summarized in Table 3.2.

Table 3.1: Criteria Weighting

Weight	Definition	Weighting Factor
Fundamental	These criteria are fundamental to the goals of the study. Assigned to *Phosphorus Removal Potential* only.	5
High	These criteria represent a significant potential impact to the physical, natural, social or economic environment and dictate the feasibility of a given retrofit opportunity.	3
Moderate	These criteria have a moderate potential for impact to the physical, natural, social or economic environment but can generally be mitigated with design considerations.	2
Low	These criteria are used to differentiate between otherwise equal retrofit opportunities.	1

Table 3.2: Preliminary Evaluation Criteria Weighting		
Environment	**Criteria**	**Weight**
Physical	Existing Pond	3
	Land Ownership	3
	Phosphorous Removal Opportunity	5
	Online Versus Offline	3
Natural	Natural Feature Adjacency	1
	Impact to Existing Trees	2
	Linkage Opportunity	1
	Thermal Impacts to Receiving Watercourse	3
	Potential Impact on Fisheries	3
Social	Adjacent Land Use	3
	Loss of Parkland	2
Economic	Capital Cost	3

The scores assigned to a given retrofit opportunity for each criterion have been normalized so that the maximum score equals one (1). For example, the maximum score for Phosphorus Reduction Potential is five (5), therefore all scores under this criterion have been divided by five (5). The weighting factors have been applied to the normalized criterion scores and summed for each retrofit opportunity to provide a total score.

The preliminary evaluation and associated criteria, criteria scores, and total score have populated the *Stormwater Management Retrofit Opportunity Evaluation Matrix* (ref. Matrix 1). Site Location Plans for all retrofit opportunities have been produced for the preliminary evaluation and are included in Appendix C; ref. Figure 3.1 (page 24) for a sample Site Location Plan.

Seventy-four (74) preliminary retrofit sites have been identified within the urban boundary, of which forty-one (41) have been screened due to site specific constraints (i.e. proposed development on the site, environmental constraints, etc), or the opportunity covers the same or similar drainage area to a more preferable opportunity (notwithstanding should the preferred sites prove infeasible these sites could be reconsidered). The remaining thirty-three (33) retrofit opportunities have been ranked. Matrix 1 summarizes the stormwater management retrofit opportunities, as ranked according to the criteria, scoring logic, and weighting factors outlined in the Preliminary Evaluation. Retrofit opportunities within the Lake Simcoe Watershed (28) and the Nottawasaga River Watershed (5) have been ranked separately on Matrix 1. The thirty-three (33) remaining retrofit opportunities have been advanced to the Detailed Evaluation which has included field reconnaissance (ref. Section 4.0). It is noted that all feasible retrofit opportunities have been advanced to the final City of Barrie Stormwater Retrofit Program.

The total phosphorous removal potential for the thirty-three (33) ranked retrofit opportunities is approximately 186 kg +/- at an estimated cost of approximately $19.2 million and an average cost of approximately $110,000 per kilogram of phosphorus.

It is noted that the Preliminary Evaluation and ranking was originally presented to the public at the March 6, 2013 Public Information Centre. The Preliminary Evaluation was subsequently updated with public, agency and City comments and the final version is presented herein (ref. Matrix 1).

Assessment of Stormwater Management Facilities to Reduce Phosphorous Discharges
Stormwater Management Retrofit Opportunity Screening

LEGEND
Text in **Bold** = Retrofit Opportunities Identified by CCTA
Red Text = Previously Screened Alternatives

Scored and used in ranking

Retrofit Opportunity No.	City of Barrie Pond No.	Watershed	Subwatershed	LSRCA Catchment No.	Drainage Area (ha)	Location	Description	Comments	Advanced by City	City of Barrie Comments	LSRCA Constraints	Construction/ Maintenance Access	Relation to Other RO	Alternate to RO#	Available Space (m²)	Feasible Treatment Level (Enhanced, Normal, Basic, Constrained)	¹Water Quality Volume (m³)	¹Footprint Required (m²)	EVALUATION CRITERIA																			
																			Physical Environment								Natural Environment						Social Environment			
																			Existing SWM Facility		Land Ownership		Online/Offline		Phosphorous Removal Opportunity		Regulated Area	Impact to Existing Trees	Natural Feature Adjacency	Linkage Opportunity	Potential Fisheries Impact	Potential for Thermal Impacts		Loss of Parkland Uses	Existing Land Use	Adjacent Land Use	
																			Yes/No	Score	City/MTO/Private	Score	Online/ Offline	Score	kg	Score	-	Score	Score	Score	Score	Cold/ Warm	Score	Describe		Res/Com/Ind/ Ins	Score
Evaluation Criteria Maximum Score ²																			-	1	-	2	-	1	-	5	-	3	1	1	3	-	1	1	-	-	3
Criteria Weight ²																			-	3	-	3	-	3	-	5	-	2	1	1	3	-	3	2	-	-	3
BARRIE CREEKS STUDY AREA OPPORTUNITIES																																			
8	SP3	LS	Sophia Creek	BAR-NE34 BAR-NE35 BAR-NE36 BAR-NE37 BAR-NE38	81.9	Southeast of Highway 400 and north of Ottaway Ave.			Yes	City Property	Possible fisheries concerns as it was once headwaters. Property belongs to?		Downstream of RO7, Upstream of RO4		3300	Constrained	4432	3300	Yes	1	City	2	Offline	1	8.1	4	General	3	1	0	2	Warm	1	1	IND	HWY, IND, RES	1
13	KD3	LS	Kidds Creek	BAR-NW2	30.4	South of Sunnidale Rd. and northeast of Irwin Dr.	Existing dry pond	Hwy 400 widening may impact	Alt	Feasible but no enough room and Alt. Sl. # 11 covers more D/A	Some tree removal				2000	Constrained	1579	2000	Yes	1	City	2	Offline	1	3.0	2	None	2	1	0	3	Cold	0	1	OS	RES & INS	1
3	HT6	LS	Hotchkiss Creek		31.7	West of Bryne Dr, South of Ardagh	Existing dry pond					Bryne St Easement			4500	Enhanced	4850	3959	Yes	1	City	2	Offline	1	3.7	2	Slope, meander	2	0	0	2	Cold	0	1	COM	COM	3
11	KD6	LS	Kidds Creek	BAR-NW17	62.4	North corner of Livingstone St. W. and Ford St.		City has completed EA recommending retrofit	Yes	Feasible but Alt. Sl. #11 covers more D/A	Encroach slightly on recreational facilities.		Upstream of RO12		4800	Normal	5000	4800	Yes	1	City	2	Offline	1	8.0	4	None	2	1	0	1	Cold	0	0	OS	INS & RES	1
15	DY2	LS	Dyments Creek	BAR-NW3 BAR-NW4	19.4	Northwest of McVeigh Dr. and south of Cundles Rd. W.			Yes	Parkland, City of Barrie	Next to baseball diamond		Upstream of RO9	9	3200	Enhanced	3193	3190	Yes	1	City	2	Offline	1	3.7	2	None	2	1	1	3	Cold	0	0	EP	RES & OS & INS	1
28	HR1	LS	Huronia Creek	BAR-SE46	65.0	West of Minet's Point Rd, between Burton Ave. and Lakeshore Dr.	Existing dry pond		Yes	Feasible (Alt. to Sl. # 50)	None	Commercial land to east off Burton Av	Downstream of RO33		4500	Basic	4605	4500	Yes	1	Private	0	Offline	1	8.4	4	Meander	2	1	1	0	Cold	0	1	COM	COM	3
25	WK1	LS	Whiskey Creek	BAR-SE32 BAR-SE33	18.2	Northwest corner of Herrell Ave. and Firman Dr.	Northeast corner of Willowby Park		No	Park - Willowby / On- line	None. This alternative does not interfere with drainage channel therefore avoiding fisheries concerns.	Willowby Park			4300	Enhanced	2998	3094	Yes	1	City	2	Offline	1	3.4	2	General	2	1	0	2	Cold	0	0	OS	COM & RES	1
53	WK1	LS	Whiskey Creek	BAR-SE35 BAR-SE36 BAR-SE44 BAR-SE52 BAR-SE60 BAR-SE32 BAR-SE33 BAR-SE34 BAR-SE41	117.2	Firman Dr and Little Ave.	North end of Willoughby Park, open space, few trees, opportunity to bypass online		No	Feasible, parkland (Alt. to Sl. # 46-48)	Fisheries concerns		Downstream of RO54		15000	Enhanced	23405	10764	Yes	1	City	2	Online	0	22.1	5	Floodplain, meander	2	1	0	0	Cold	0	0	OS	OS & RES	1
20	WK4	LS	Whiskey Creek	BAR-SE18	12.3	South of Tollendal Mill Rd. and west of Wallwin's Way	Existing Basic wetpond control facility, adjacent to small treed lot and Whiskey Creek watercourse	Existing Basic control, therefore minimal phosphorus removal potential , screened	Yes	Feasible	None				2200	Normal	1230	2200	Yes	1	City	2	Offline	1	2.0	0	Floodplain	1	0	0	2	Cold	0	1	EP	OS & RES	1
4	SP1	LS	Sophia Creek	BAR-NE15	129.0	Southwest of St.Vincent St. and north of Grove St. E.	In MacMoorison Park		Yes	MacMoorisson Park	Flow splitter will need to be installed under St. Vincent St. Site can not handle upstream contributions.		Downstream of RO7 & RO8		5500	Constrained	8625	5500	No	0	City	2	Online	0	12.8	5	General	2	1	0	1	Warm	1	0	OS	RES	0
44		LS	Hotchkiss Creek	BAR-SW19 BAR-SW4	16.0	Between Morrow Rd. and Highway 400 north of Essa Rd.	Divert Morrow Rd Ditch	Need to keep local drainage separate from upstream	Yes	Private Property	Property ownership (?)				12000	Enhanced	3813	3487	No	0	Private	0	Offline	1	2.9	1	General	3	1	0	2	Cold	0	1	IND	IND & OS	3
17		LS	Kidds Creek	BAR-NW33 BAR-NW34	38.2	Southwest of Bayfield St. between Coulter St. and Highway 400	South East corner of Sunnidale park		No	City owned, parkland, dolra	None				7200	Enhanced	9560	5883	No	0	City	2	Offline	1	7.2	4	Floodplain	1	0	0	0	Cold	0	0	EP	OS & COM	2
39		LS	Hotchkiss Creek	BAR-SW2	14.2	Between Patterson Rd. and Highway 400 east of Philips St.	Could be online facility to capture larger drainage area		Yes	Private Property	Property ownership (?)				3500	Enhanced	3543	3359	No	0	Private	0	Offline	1	2.7	1	General	2	1	0	2	Cold	0	1	IND	RES	3
14	KD1	LS	Kidds Creek	BAR-NW24	16.7	North corner of Highway 400 and Sunnidale Rd.	Adjacent Sunnidale Park online facility, could utilize existing topography	(The opportunity is not intended to be online)	No	Sunnidale Park /Quantity Pond, On-line	Some tree removal				3000	Enhanced	2756	2972	No	0	City	2	Offline	1	3.2	2	Floodplain	0	0	0	0	Cold	0	1	OS	RES & EP	1
26		LS	Whiskey Creek	BAR-SE36	15.1	North of Big Bay Point Rd. and between Huronia Rd. and Pickett Crescent	Open area between school and fields		No	School Property, Soccer Field, parkland	Property ownership (?)	Huronia North School	Upstream of RO54		2200	Basic	1019	2200	No	0	City	2	Offline	1	1.9	0	Meander	1	0	0	1	Cold	0	0	OS	IND & INS	2
42		LS	Whiskey Creek	BAR-SW28	19.5	Southeast corner of Montserrand St. and Beacon Rd.	Pond WK17 upstream	Recommended in Whiskey Creek MDP 2009	Yes		None	Fairview Road			5000	Enhanced	3218	3202	No	0	Private	0	Offline	1	3.7	2	Slope, meander	1	0	0	2	Cold	0	1	IND	RES & IND	2
38		LS	Hotchkiss Creek	BAR-SW1	8.0	West of Patterson Rd. between Tiffin St. and Phillips St.			Yes	Private Property	Property ownership (?)				2600	Enhanced	1327	2176	No	0	Private	0	Offline	1	1.5	0	None	2	1	0	2	Cold	0	1	IND	RES	3
55		LS	Hotchkiss Creek	BAR-SW16 BAR-SW17 BAR-SW46 BAR-SW47	10.0	North of Ardagh Rd.	Tree lot, small offline, or larger online opportunity	Option to move pond to street and acquire land	Yes	Tree removal, City Property (Alt. to Sl. # 26-27)	Some tree removal				3000	Enhanced	1650	2372	No	0	City	2	Offline	1	1.9	0	Meander	0	0	0	2	Cold	0	1	OS	IND & RES INS	0
40		LS	Whiskey Creek	BAR-SW20	9.7	Northeast corner of Chieftan Crescent	Proposed curling club will require SWM, opportunity to expand PP for BAR-SW20		No	Future Development SWM Pond / Private Property (Proposed Curling Club).	None	Fairview Road			5000	Enhanced	1597	2341	No	0	Private	0	Offline	1	1.8	0	None	3	1	0	2	Cold	0	1	IND	RES & IND	0
78		LS	Dyments Creek		212.6	North of Dunlop Street West and west of Ferndale Industrial Drive	Area available along Dyments Creek (online pond), identified in MDP												No	0	Private	0	Online	0		0	General	2								
79	DY1	LS	Dyments Creek		>500	Upstream of Victoria Street & upstream of Anne Street/John Street Intersection	Online natural storage areas												Yes	1		0		0		0										
80		LS	Bunkers Creek		75.8	South of Shirley Ave. in HWY 400 ROW	Area available on vacant land for online pond along northeast branch												No	0		0		0		0										
81		LS	Hotchkiss Creek		267.8	Upstream of Wood Street and BCR tracks	Area available on private land foronline pond, identified in MDP												No	0		0		0		0										
82		LS	Whiskey Creek		190.8	Upstream of Highway 400	New pond area identified for main tributary (online pond) & for new industrial/commercial development per												No	0		0		0		0										

Assessment of Stormwater Management Facilities to Reduce Phosphorous Discharges
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LEGEND
Text in **Bold** = Retrofit Opportunities Identified by CCTA
Red Text = Previously Screened Alternatives

Scored and used in ranking

Retrofit Opportunity No.	City of Barrie Pond No.	Watershed	Subwatershed	LSRCA Catchment No.	Drainage Area (ha)	Location	Description	Comments	Advanced by City	City of Barrie Comments	LSRCA Constraints	Construction/ Maintenance Access	Relation to Other RO	Alternate to RO#	Available Space (m²)	Feasible Treatment Level (Enhanced, Normal, Basic, Constrained)	¹Water Quality Volume (m³)	²Footprint Required (m²)	EVALUATION CRITERIA																			
																			Physical Environment								Natural Environment						Social Environment			
																			Existing SWM Facility		Land Ownership		Online/Offline		Phosphorous Removal Opportunity		Regulated Area	Impact to Existing Trees	Natural Feature Adjacency	Linkage Opportunity	Potential Fisheries Impact	Potential for Thermal Impacts		Loss of Parkland Uses	Existing Land Use	Adjacent Land Use	
																			Yes/No	Score	City/MTO/Private	Score	Online/ Offline	Score	kg	Score	-	Score	Score	Score	Score	Cold/ Warm	Score	Describe		Res/Com/Ind/ Ins	Score
Evaluation Criteria Maximum Score ²																			-	1	-	2	-	1	-	5	-	3	1	1	3	-	1	1	-	-	3
Criteria Weight ²																			-	3	-	3	-	3	-	5	-	2	1	1	3	-	3	2	-	-	3
10	**BK3**	**LS**	**Bunkers Creek**	**BAR-NW11 BAR-NW13**	**34.2**	**West of Anne St. N. and North of Shelley Lane**	**Open watercourse, treed area behind residential**	**Impact to trees and steep slopes considered non-starter. Screen.**	**No**	**On-line, A lot of tree removal, residential, City owned**	**Removal of trees**				**4000**	**Normal**	**3419**	**4000**	**No**	**0**	**City**	**2**	**Online**	**0**	**5.4**	**3**	**General**	**0**	**0**	**0**	**1**	**Cold**	**0**	**1**	**OS**	**RES**	**0**
BARRIE CREEKS STUDY AREA OPPORTUNITIES (CONTINUED)																																			
34		**LS**	**Whiskey Creek**	**BAR-SE58**	**1.3**	**Southeast of Wilson Crt.**	**Very steep slopes, screened**		**No**	**City of Barrie/Steep Slope, EP Area, Lackie's Bush.**	**Tree removal**				**5000**	**Enhanced**	**233**	**1316**	**No**	**0**	**City**	**2**	**Offline**	**1**	**0.3**	**0**	**Floodplain, slope meander**	**0**	**0**	**0**	**2**	**Cold**	**0**	**1**	**OS**	**RES**	**0**
29		LS	Whiskey Creek	BAR-SE50	2.2	Southeast corner of Little Ave. and McConkey Place	Parkette between residential rear yards and railway.	Screened, drainage area too small	No	Parkland (Topo Park ??), City owned.	None	Easement off McConkey Place			2700	Enhanced	363	1454	No	0	City	2	Offline	1	0.4	0	Floodplain	1	1	0	2	Cold	0	0	OS	RES	0
1		LS	Bunkers Creek	BAR-C14	0.9	Northeast corner of Vespra St. and Ellen St.	Previous study into SWM determined not preferable	Screened per previous study recommendation	No	Property owned by Public on both sides, Eco-park.	None				2000	Enhanced	235	1319	No	0	Private	0	Offline	1	0.2	0	Floodplain	3	1	0	2	Warm	1	0	COM	OS	3
2		LS	Hotchkiss Creek	BAR-C29	1.8	End of Sanford St, north of Tiffin St.	Small drainage area. Recent channel works for main channel	Water quality treatment previously proposed, rejected by LSRCA	No	City owned	None	Bradford St			2000	Enhanced	297	1387	No	0	City	2	Offline	1	0.3	0	Floodplain	2	1	0	1	Cold	0	1	COM	RES	0
6	JH1	LS	Johnson Drainage Area	BAR-NE2	4.3	Southeast corner of Corinhall St. and Buchanan St.	Pond decommissioned and built over	Pond decommissioned and built over, opportunity no longer exists	No	Decommissioned and Built Residential	None				0	Constrained	0	0	No	0	Private	0	Offline	1	0.4	0		-	-	-	3	Cold	0	1	RES	RES &COM	0
9	DY3	LS	Dyments Creek	BAR-NW1 BAR-NW5 BAR-NW6 BAR-NW3 BAR-NW4	85.0	East of Ferndale Drive	Existing dry facility, berm creates storage in natural valley		No	Parkland (Alt. to Sl. # 12)	Some tree removal		Downstream of RO15		3500	Constrained	4623	3500	Yes	1	City	2	Offline	1	8.4	4	General	1	1	1	2	Cold	0	1	EP	EP	3
12	KD2	LS	Kidds Creek	BAR-NW18 BAR-NW19	153.0	North of Cundles Rd. W. and Southwest of Lillian Crescent	Park, online and natural area, highly constrained, screened	Screened due to steep slopes	No	On-line Pond and steep slope	None		Downstream of RO11, 13, 18, 19		6000	Constrained	10034	6000	Yes	1	City	2	Online	0	15.1	5	Slopes, floodplain	1	0	0	0	Cold	0	0	EP	RES	1
16		LS	Kidds Creek	BAR-NW32	11.4	West of Coulter St. and northeast of Highway 400	East side of Sunnidale Park	Steep embankment, screened	No	Too Steep, city owned, a lot of tree removal, parkland	Removal of trees				0	Constrained	0	0	No	0	City	2	Offline	1	1.1	0	Slopes	0	0	0	2	Cold	0	1	EP	RES & COM	0
18	KD5	LS	Kidds Creek	BAR-NW8	17.3	South of Livingstone St. W. and east of Etherington Crescent	Open lot in residential area	Screened by City, covered over subsurface impacts to adjacent residential	Alt	Feasible but no enough room and Alt. Sl. # 11 covers more D/A	None				500	Constrained	281	500	Yes	1	City	2	Offline	1	1.7	0	None	3	1	0	3	Cold	0	0	OS	RES	1
19		LS	Kidds Creek	BAR-NW9	52.6	Lillian Crescent southeast of Sinclair Crt.	Victoria Woods Park	Could use valley lands pending input from LSRCA	No	Victoria Wood Parkland, No Soccer Field, City Owned (Alt. of Sl. # 6-8)	May be soccer field in footprint. Some tree removal.		Downstream of RO11, 13, 18		4700	Normal	5258	4700	No	0	City	2	Offline	1	8.4	4	General	3	1	0	2	Cold	0	0	OS	RES	0
33	HR2	LS	Huronia Creek	BAR-SE57	38.6	West of Wood crest Rd. and Greenfield Ave.	Existing dry pond in open space	Screened as alternative	Yes	Feasible but Alt. Sl. #51 covers more D/A	None	Kelly Place or Greenfield Ave	Upstream of RO28	28	2500	Constrained	2249	2500	Yes	1	Private	0	Offline	1	3.8	2	None	2	1	1	3	Cold	0	1	RES	RES & OS	1
41		LS	Whiskey Creek	BAR-SW24	17.9	South of Chieftan Crescent and northeast of Fairview Rd.	Appears to be minimal development upstream	Only Hwy 400 in drainage area, no other development, screened	No	Private Property (Proposed Curling Club)	Potential fisheries concerns				4000	Enhanced	2958	3074	No	0	Private	0	Offline	1	3.4	2	Meander	3	1	0	2	Cold	0	1	IND	HWY & IND	3
46	HT3a	LS	Hotchkiss Creek	BAR-SW46	5.0	Between Mayfair Rd. and Quail Crescent, west of Essa Rd.	Existing dry pond, small drainage area.	Drainage are too small to support wet facility. Consider OGS of other technology. Screened	No	Parkland, on-line	None	Loggers Run			1500	Basic	358	1500	Yes	1	City	2	Offline	1	0.7	0	None	0	0	0	2	Cold	0	1	RES	OS & RES	1
48		LS	Hotchkiss Creek	BAR-SW5	51.1	Between Highway 400 and Campbell Ave.	Open field, opportunity for offline bypass	Significant upstream watercourse, screened	No	Private property	None	Campbell Ave	Downstream of RO69, RO39		10000	Enhanced	12773	7084	No	0	Private	0	Online	0	9.7	4	Floodplain	2	0	0	1	Cold	0	1	IND	RES & COM	1
51		LS	Bunkers Creek	BAR-NW11 BAR-NW13 BAR-NW15 BAR-NW25 BAR-NW27	93.5	Between Vine Cres. And Shirley Ave.	Treed, steep slopes	Steep slopes, screened	No	City and privately owned. Room for extension, steep slope, Parkland (Alt. to Sl. # 14)	Removal of trees				5000	Basic	6308	5000	No	0	City	2	Online	0	12.1	5	Slopes	0	0	0	1	Warm	1	1	RES	RES	0
52		LS	Whiskey Creek	BAR-SW20 BAR-SW21 BAR-SW24 BAR-SW26	60.5	East of Bayview Dr.	Treed, private property	Constrained by area, steep slopes, online, screened	No	City Owned, adjacent to the Lackie's Bush (Alt. to Sl. # 29-30)	Tree removal. Potential fisheries concerns.	Bayview Dr.	Downstream of RO40 and 42		2000	Constrained	2580	2000	No	0	Private	0	Online	0	6.0	3	Floodplain, slopes, meander	1	0	0	1	Cold	0	1	COM	OS & IND	3
54		LS	Whiskey Creek	BAR-SE35 BAR-SE36 BAR-SE44 BAR-SE52 BAR-SE60	85.1	Herrell Ave and Leggott Ave.	North end of Huronia North Park, small woodlot, potential to make offline (19.7 ha res),or bypass online	Potential online constraint. Watercourse upstream straightened. City expects lack of	Yes	Parkland, City owned. Feasible but Alt. Sl. #49 covers more D/A	Property ownership(?), fisheries concerns, tree removal.		Upstream of RO53		8000	Normal	10931	8000	No	0	City	2	Online	0	13.5	5	Meander	0	0	0	1	Cold	0	0	OS	RES	0
56		LS	Kidds Creek	BAR-NW17 BAR-NW18 BAR-NW19 BAR-NW2 BAR-NW21 BAR-NW31 BAR-NW8 BAR-NW9	216.7	South of Cundles Rd. W.	Treed, steep slopes. Also option for 2 offline ponds adjacent watercourse	Several natural environment constraints, screened	No	EP Land but room to extend (Alt. to Sl. # 6- 10)	Some tree removal		Immediately DS to RO12,		10000	Basic	14626	10000	No	0	City	2	Online	0	28.0	5	None	1	0	0	1	Cold	0	0	EP	OS	2
70		LS	Hotchkiss Creek	BAR-SW19	21.6	South of Essa Road at Highway 400	Interchange	Partially developed and proposed on ramp, screened				Essa Road	Upstream of RO44		6500	Enhanced	5400	4199	No	0	MTO	1	Offline	1	4.1	3	None	2	1	0	2	Cold	0	1	COM	COM & IND	3
71		LS	Hotchkiss Creek	BAR-SW5	37.7	North corner of Essa Road and Highway 400 Interchange	Inside NE ramp loop	Land planned for development as MTO commuter lot				Ramp	Upstream of RO48		5000	Enhanced	4950	4003	No	0	MTO	1	Offline	1	5.7	3	None	3	1	0	2	Cold	0	1	COM	COM & IND	3
73		LS	Bunkers Creek	BAR-NW12	54.5	Southwest corner of Anne St. and Edgehill Dr	Existing open ditch, within intersection right-of-way	Anne Street planned widening, 5 to 7 lanes, may require steep slopes. Evaluate opportunity during Anne St				Edgehill Dr			2500	Constrained	2686	2500	No	0	City	2	Offline	1	5.4	3	None	2	0	0	2	Warm	1	1	RES	COM & INS	3
72		LS	Bunkers Creek	BAR-C1	107.0	Highway 400 and Dunlop St. W.	Inside NE ramp loop	MTO planned Hwy 400 widening. Also Dunlop St Widening. Evaluate opportunity at design. Screened as				Ramp	Downstream of RO3		5500	Basic	7883	5500	No	0	MTO	1	Offline	1	13.8	5	None	1	0	0	2	Warm	1	1	COM	COM	3
74		LS	Sophia Creek	BAR-NE13	59.2	SW corner of Highview Rd and Howard Cr	Open watercourse in easement	Screened as alternative				Highview Rd		4	1200	Constrained	1342	1200	No	0	City	2	Offline	1	5.9	3	Floodplain	2	0	0	3	Warm	1	0	RES	RES	0
5		LS	Sophia Creek	BAR-NE16	15.6	Southeast of Rose St. and west of Blue Mound Dr.	West side of fields at Maple Grove Public School	Screened as alternative	No	Soccer Field, Elementary School	Soccer field?	Rose St.	Upstream of RO4	4	2500	Normal	1564	2500	No	0	City	2	Offline	1	2.5	1	None	3	1	0	1	Warm	1	0	OS	RES & INS	0
47	HT3b	LS	Hotchkiss Creek	BAR-SW47	7.2	Northwest corner of Logger's Run and Evergreen Crt.		Screened as alternative	No	Private Pond, no room	None			55	1000	Constrained	320	1000	Yes	1	Private	0	Offline	1	0.7	0	None	2	1	0	3	Cold	0	1	RES	RES	1
BARRIE CREEKS STUDY AREA OPPORTUNITIES (CONTINUED)																																			
7		LS	Sophia Creek	BAR-NE33	7.0	West corner of Highway 400 and St.Vincent St.	Open space behind commercial parking lots	Possible impact by Hwy 400 widening. Screened as alternative	Yes	Private Property /Highway widening	None		Upstream of RO8	8	1500	Constrained	457	1500	No	0	Private	0	Offline	1	0.7	0	None	2	1	0	1	Warm	1	1	COM	HWY	3
LOVERS CREEK & HEWITTS CREEK STUDY AREA OPPORTUNITIES																																			
68	**LV1**	**LS**	**Lovers Creek**	**BAR-SE6 BAR-SE9**	**74.0**	**South corner of Cox Mill Road and Hurst Drive**	**Existing quantity pond. Permanent pool present, may not be part of design.**					**Hurst Drive**			**5100**	**Normal**	**7400**	**5100**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**11.8**	**4**	**None**	**2**	**1**	**0**	**2**	**Cold**	**0**	**1**	**OS**	**COM & RES**	**1**
24	**LV18**	**LS**	**Lovers Creek**	**BAR-SE23**	**21.9**	**Southeast corner of Chalmers Dr. and Loon Ave.**	**Existing dry pond, may require seepage consideration due to adjacent slopes**		**Yes**	**Feasible**	**None**				**2500**	**Basic**	**1475**	**2500**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**2.8**	**1**	**None**	**3**	**1**	**1**	**2**	**Cold**	**0**	**1**	**OS**	**RES & EP**	**1**
31	**LV3**	**LS**	**Lovers Creek**	**BAR-SE55**	**10.6**	**East of Welham Dr. and north of Mapleview Dr.**	**Existing dry pond behind industrial development, adjacent rail line**		**Yes**	**On-line, Allandale community**	**None**	**Easement of Welham Dr.**	**Upstream of RO30**		**3000**	**Enhanced**	**2658**	**2922**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**2.0**	**1**	**None**	**2**	**1**	**0**	**3**	**Cold**	**0**	**1**	**IND**	**IND & EP**	**3**
32	**LV12**	**LS**	**Lovers Creek**	**BAR-SE56**	**11.8**	**East of Welham Rd. and north of Saunders Rd.**	**Existing dry pond in large open lot**		**Yes**	**Feasible / City Property.**	**None**	**Welham Road**			**4200**	**Enhanced**	**4174**	**3654**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**3.2**	**2**	**None**	**2**	**1**	**0**	**2**	**Cold**	**0**	**1**	**IND**	**IND & EP**	**3**
37	**LV10**	**LS**	**Lovers Creek**	**BAR-SE9**	**23.1**	**Northeast corner of Cox Mill Rd. and Mary Anne Dr.**	**Existing quantity control facility**		**Yes**	**Feasible**	**Space constraints, pond would need to exceed 1m depth.**				**1000**	**Constrained**	**672**	**1000**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**2.3**	**1**	**None**	**2**	**1**	**0**	**3**	**Cold**	**0**	**1**	**RES**	**RES & OS**	**1**
65	**LV7**	**LS**	**Lovers Creek**	**efmt6**	**182.2**	**West of Bayview Dr., North of Salem Road**	**Very large dry pond. Beaver dam has created permanent pool**					**Bayview Dr.**	**Downstream of RO 49. Same DA as RO35, but**		**7200**	**Basic**	**8550**	**7200**	**Yes**	**1**	**City**	**2**	**Online**	**0**	**11.6**	**4**	**Meander**	**3**	**1**	**0**	**1**	**Cold**	**0**	**1**	**IND**	**IND**	**3**

Assessment of Stormwater Management Facilities to Reduce Phosphorous Discharges
Stormwater Management Retrofit Opportunity Screening

LEGEND
Text in **Bold** = Retrofit Opportunities Identified by CCTA
Red Text = Previously Screened Alternatives

Scored and used in ranking

Retrofit Opportunity No.	City of Barrie Pond No.	Watershed	Subwatershed	LSRCA Catchment No.	Drainage Area (ha)	Location	Description	Comments	Advanced by City	City of Barrie Comments	LSRCA Constraints	Construction/ Maintenance Access	Relation to Other RO	Alternate to RO#	Available Space (m^2)	Feasible Treatment Level (Enhanced, Normal, Basic, Constrained)	[1] Water Quality Volume (m^3)	[1] Footprint Required (m^2)	EVALUATION CRITERIA																	
																			Physical Environment								Natural Environment						Social Environment			
																			Existing SWM Facility		Land Ownership		Online/Offline		Phosphorous Removal Opportunity		Regulated Area	Impact to Existing Trees	Natural Feature Adjacency	Linkage Opportunity	Potential Fisheries Impact	Potential for Thermal Impacts		Loss of Parkland Uses	Existing Land Use	Adjacent Land Use	
																			Yes/No	Score	City/MTO/Private	Score	Online/ Offline	Score	kg	Score	-	Score	Score	Score	Score	Cold/ Warm	Score	Describe		Res/Com/Ind/ Ins	Score
Evaluation Criteria Maximum Score [2]																			-	1	-	2	-	1	-	5	-	3	1	1	3	-	1	1	-	-	3
Criteria Weight [2]																			-	3	-	3	-	3	-	5	-	2	1	1	3	-	3	2	-	-	3
67		**LS**	**Lovers Creek**	**BAR-SE54 Partial**	**39.7**	**Drainage easement south of Ellis Drive**	**Open watercourse draining industrial property**	**Constrained by space, consider purchasing part of adjacent property**				**Ellis Road**	**Upstream of RO30**		**850**	**Constrained**	**642**	**850**	**No**	**0**	**City**	**2**	**Offline**	**1**	**2.0**	**0**	**None**	**2**	**1**	**0**	**3**	**Cold**	**0**	**1**	**IND**	**IND**	**3**
21	**LV13**	**LS**	**Lovers Creek**	**BAR-SE19**	**10.2**	**Northeast corner of Macmillan Crescent and Tomlin Crt.**	**Existing dry pond, adjacent Brunton Park**	**Small drainage area, consider OGS or other technology**	**Yes**	**Feasible**	**None**				**1600**	**Constrained**	**637**	**1600**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**1.0**	**0**	**Meander**	**1**	**0**	**1**	**1**	**Cold**	**0**	**1**	**EP**	**OS & RES**	**1**
45	**LV5**	**LS**	**Lovers Creek**	**BAR-SW41**	**45.3**	**West of Bayview Dr. and north of Saunders Rd.**	**Online, natural watercourse, some trees**	**Several natural environment constraints, screened**	**No**	**OGS in place, On-line**	**Potential fisheries concerns. Some tree removal.**	**Bayview Dr.**	**Downstream of RO50**		**4400**	**Basic**	**4304**	**4400**	**Yes**	**1**	**City**	**2**	**Online**	**0**	**5.8**	**3**	**Slope, meander**	**0**	**0**	**0**	**1**	**Cold**	**0**	**1**	**EP**	**COM & IND**	**3**
27		**LS**	**Hewitts Creek**	**BAR-SE4 BAR-SE5**	**35.2**	**Southeast corner of Walnut Crescent**	**Storm outfall into natural area**	**OGS upstream**	**Yes**	**The u/s areas are under septic systems. EP Area, Privately owned.**	**Tree removal**				**8000**	**Enhanced**	**5813**	**4376**	**No**	**0**	**City**	**2**	**Offline**	**1**	**6.7**	**3**	**Floodplain, Wetland**	**0**	**0**	**0**	**2**	**Cold**	**0**	**1**	**EP**	**RES**	**0**
22		LS	Lovers Creek	BAR-SE20	3.8	West of Maclaren Ave. and South of Little Ave.	DA proposed for development, therefore not a retrofit opportunity		Yes	Just d/s has a quality pond (LV27), Private land, Area for future development + possible new SWMF at	None				0	Constrained	0	0	No	0	Private	0	Offline	1	0.4	0	None	-	-	-	3	Cold	0	1	RES	RES	0
30	LV2	LS	Lovers Creek	BAR-SE54	63.6	South of Ellis Dr. and east of Welham Rd.	Online dry pond. Aerial indicates some permanent ponding.		No	Fisheries concern? and On-line, city owned	Online pond. Flow from SW49 and natural drainage pass through.	Creek easement from Welham Road			13000	Enhanced	15904	8205	Yes	1	City	2	Online	0	12.0	5	Floodplain, meander	2	0	0	0	Cold	0	1	EP	IND	3
35	LV6	LS	Lovers Creek	BAR-SE68	69.3	East of Bayview Dr. and north of Lockhart Rd.	Pond LV22 upstream, treats to Level 1	Minimal watercourse upstream. Screened as alternative.	Yes	Current Pond Configuration = LV22 - >LV7 -> LV6, on-line but room for extension (Alt. to Sl. # 37)	None, this facility would also handle the flow from catchment SW42 which is already treated as level 1, therefore it was not used in the calculations.		Downstream of RO49	65	10000	Enhanced	17325	8702	Yes	1	City	2	Online	0	13.1	5	None	2	1	0	1	Cold	0	1	IND	IND & EP	3
36		LS	Lovers Creek	BAR-SE83	3.0	Between Peck St. and Cox Mill Rd.	Natural area behind residential	Drainage are too small to support wet facility. Consider OGS of other technology. Screened	Yes	Private Property, EP Area	None	No existing access			1700	Enhanced	494	1575	No	0	City	2	Offline	1	0.6	0	Floodplain, meander	2	1	1	2	Cold	0	1	EP	RES	0
43	LV9	LS	Lovers Creek	BAR-SW38	6.3	Between Barrie View Dr. and Highway 400 north of Mapleview Dr.	OGS treating area	Pond has been redeveloped as parking area	No	Private Pond and OGS in place	None				4500	Enhanced	1572	2325	Yes	1	Private	0	Offline	1	1.2	0	None	3	1	0	2	Cold	0	1	COM	IND	3
49	LV8	LS	Lovers Creek	BAR-SW50	16.9	Northeast corner of Commerce Park Dr.	Ponds LV16 and 17 may be in series upstream	Screened as alternative	Yes	Feasible, OGS in Place	None			65	2000	Constrained	1369	2000	Yes	1	Private	0	Offline	1	1.7	0	None	3	1	0	3	Cold	0	1	COM	OS & IND	3
50	LV40	LS	Lovers Creek	BAR-SW52	21.7	Northeast corner of Mapleview Dr. and Bryne Dr.	OGS treating area	Recent development may have constrained opportunity	No	OGS in place, Private Pond, room available	None	Mapleview Dr. W.	Upstream of RO45		2500	Constrained	1979	2500	Yes	1	Private	0	Offline	1	2.1	1	Meander	3	1	0	3	Cold	0	1	COM	IND & COM	3
66		LS	Lovers Creek	BAR-SW41 BAR-SW52	36.6	Highway 400 and Mapleview Dr. W	Inside SE ramp loop	MTO proposed widening of off ramp and Hwy 400 will constrain opportunity				Ramp	Downstream of RO50, Upstream of RO45		4500	Normal	5490	4500	No	0	MTO	1	Offline	1	5.8	3	None	3	1	0	2	Cold	0	1	COM	COM	3
NOTTAWASAGA VALLEY CONSERVATION AUTHORITY STUDY AREA OPPORTUNITIES																																				
75	**GR1**	**NR**	**Georgian Creek**	**NVCA**	**134.0**	**West of Penetanguishene Road, North of Rosenfeld Dr**	**Existing dry pond.**					**Penetanguishene Rd**			**3000**	**Constrained**	**4774**	**3000**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**13.3**	**5**	**None**	**2**	**1**	**0**	**2**	**Cold**	**0**	**1**	**OS**	**RES & COM**	**1**
69	**BR13**	**NR**	**Bear Creek**	**BAR-SW22 BAR-SW23 BAR-SW15**	**53.4**	**North of Wildwood Trail at Grouse Glen**	**Existing dry pond**					**Easement of Wildwood Trail**	**Downstream of dry pond BR15**		**4700**	**Normal**	**5337**	**4700**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**8.5**	**4**	**Meander**	**1**	**1**	**0**	**1**	**Cold**	**0**	**1**	**OS**	**RES & COM**	**1**
77	**LT1**	**NR**	**Little Lake**	**NVCA**	**96.5**	**Northeast of Cardinal St, west of St. Vincent St.**	**Existing storm easement. May require bypass sewer for DA to Pond LT2**	**Class EA underway by City**				**Cardinal St**			**2600**	**Constrained**	**2939**	**2600**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**6.0**	**3**	**None**	**3**	**1**	**0**	**0**	**Cold**	**0**	**1**	**OS**	**RES**	**1**
60		**NR**	**Bear Creek**	**NVCA**	**18.0**	**North side of Lougheed Park, east of Bear Creek**	**Natural draw between Lougheed Park and YMCA, opportunity to redirect storm sewer.**								**3300**	**Enhanced**	**2970**	**3080**	**No**	**0**	**City**	**2**	**Offline**	**1**	**3.4**	**2**		**3**	**1**	**0**	**2**	**Cold**	**0**	**0**	**OS**	**EP & INS & OP**	**2**
61	**BR8**	**NR**	**Bear Creek**	**NVCA**	**136.9**	**Up and downstream of Redoak Drive, south of Bear Creek Secondary School**	**Two dry ponds in series separated by a road embankment. Adjacent trees.**								**14000**	**Enhanced**	**22589**	**10492**	**Yes**	**1**	**City**	**2**	**Online**	**0**	**25.9**	**5**		**1**	**0**	**0**	**0**	**Cold**	**0**	**1**	**EP**	**INS & RES**	**1**
83		**NR**	**Little Lake**	**NVCA**	**40.4**	**Downstream of Georgian Mall**	**Potential for expansion of existing pond**												**Yes**	**1**	**Private**	**0**	**Offline**	**1**			**None**	**3**	**1**	**0**	**3**	**Warm**	**1**	**1**	**COM**	**RES & COM**	**1**
76	**GR4**	**NR**	**Georgian Creek**	**NVCA**	**55.4**	**West of Douglas Drive**	**Southeast corner of Eastview Park, existing dry pond**	**Screened as alternative**				**Douglas Dr**	**Upstream of RO75**	**75**	**3500**	**Basic**	**3740**	**3500**	**Yes**	**1**	**City**	**2**	**Offline**	**1**	**7.1**	**4**	**None**	**2**	**1**	**0**	**3**	**Cold**	**0**	**0**	**OS**	**RES & INS**	**0**
58	BR1	NR	Bear Creek	NVCA	223.0	Upstream of Lougheed Rd, South of Mapleview Dr W	Lougheed Rd embankment designed as dam for online quantity control using natural valley storage. Online check dams	Several natural environment constraints, screened				Easement of Garibaldi Drive			6500	Constrained	11507	6500	Yes	1	City	2	Online	0	15.3	5	Slope, floodplain, wetland	1	0	0	1	Cold	0	0	EP	RES	0
59		NR	Bear Creek	NVCA	45.0	Southern end of Girdwood Drive	Storm outfall to municipal easement. Will require watercourse realignment to stay offline	Site proposed for development					Part of DA contributing to #1		1500	Constrained	1463	1500	No	0	Private	0	Offline	1	4.5	3	Floodplain	2	1	0	1	Cold	0	1	COM	RES & INS	0
62	BR5	NR	Bear Creek	NVCA	17.0	Western end of Harvie Road	Quality control pond with forebay. Adjacent stand of mature trees	Screened, quality treatment exists							5500	Enhanced	2805	2997	Yes	1	City	2	Offline	1	3.2	2	Slope	1	0	0	1	Cold	0	1	EP	RES	1
63	BR7	NR	Bear Creek	NVCA	12.5	West of Hawthorn Crescent, south of Ardagh Rd	Quantity control pond, may have upstream oil/grit separators. Adjacent trees	Drains to BR21 with quality control component, screened							4000	Enhanced	2063	2606	Yes	1	City	2	Offline	1	2.4	1	Slope, floodplain	0	0	0	2	Cold	0	1	EP	RES	1

Appendix C: Existing Condition Phosphorous Calculations

Table B1: Best Management Practices (BMP) Removal Efficiencies

BMP	Removal Efficiency
Constructed Wetland	77%
Dry Detention Ponds	10%
Wet Detention Ponds	63%
Soakaways – Infiltration Trenches	60%
Perforated Pipe Infiltration/Exfiltration Systems	87%

Table B2: MOECC Phosphorus Export Coefficients

Land Use	Phosphorus Export Coefficient (kg/ha/year)
Cropland	0.16
Forest	0.06
Low Intensity Residential	0.07
High Intensity Development (Residential)	1.32
High Intensity Development (Commercial)	1.82

Table B3: NVCA Phosphorus Export Coefficients

Land Use	Phosphorus Export Coefficient (kg/ha/year)
Cropland	Varies
Natural Heritage – Forest	0.06
Natural Heritage – Low Intensity Residential	0.13
Urban – Residential	1.34
Urban – Commercial	0.77
Urban – Industrial	1.34
Urban – Transportation	4.03

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

BARRIE CREEKS STUDY AREA - EXISTING CONDITIONS

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	3.26	0.19
Forest	214.23	0.05
Low Intensity Development	167.55	0.13
High Intensity Development (Residential)	1253.59	1.32
High Intensity Development (Commercial/Industrial)	1795.17	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Underground Storage (25% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	0.00	1.64	-	1.62	0.00
Forest	0.09	105.43	-	100.21	8.50
Low Intensity Development	0.39	103.08	-	23.51	40.58
High Intensity Development (Residential)	6.35	619.38	-	160.34	467.52
High Intensity Development (Commercial/Industrial)	4.50	972.44	-	330.27	487.97

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **4164.31 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

HEWITTS CREEK STUDY AREA - EXISTING CONDITIONS

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	28.98	0.19
Forest	75.76	0.05
Low Intensity Development	24.19	0.13
High Intensity Development (Residential)	213.65	1.32
High Intensity Development (Commercial/Industrial)	121.21	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Underground Storage (25% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	-	-	-	4.20	24.78
Forest	-	-	-	9.39	66.37
Low Intensity Development	-	-	-	14.93	9.26
High Intensity Development (Residential)	-	-	-	126.01	87.64
High Intensity Development (Commercial/Industrial)	-	-	-	83.27	37.94

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **312.77 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

LOVERS CREEK STUDY AREA - EXISTING CONDITIONS

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	12.24	0.16
Forest	190.86	0.06
Low Intensity Development	49.35	0.07
High Intensity Development (Residential)	354.80	1.32
High Intensity Development (Commercial/Industrial)	921.87	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Underground Storage (25% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	0.00	0.09	-	0.10	12.05
Forest	0.34	10.27	-	16.59	163.66
Low Intensity Development	4.44	12.08	-	15.81	17.02
High Intensity Development (Residential)	10.02	31.41	-	194.74	118.63
High Intensity Development (Commercial/Industrial)	34.68	364.10	-	235.72	287.37

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **1599.85 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

NVCA WATERSHED STUDY AREA - EXISTING CONDITIONS

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	16.60	Varies
Natural Heritage - Forest	518.11	0.06
Natural Heritage - Low Intensity Residential	79.22	0.13
Urban - Residential	714.51	1.34
Urban - Commercial	299.33	0.77
Urban - Industrial	140.19	1.34
Urban - Transportation	371.06	4.03

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Underground Storage (25% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	-	1.62	-	6.68	8.30
Natural Heritage - Forest	-	36.09	-	68.78	413.24
Natural Heritage - Low Intensity Residential	-	26.42	-	32.60	20.20
Urban - Residential	-	335.14	-	196.38	182.99
Urban - Commercial	-	53.99	-	128.26	117.08
Urban - Industrial	-	17.72	-	87.72	34.75
Urban - Transportation	-	142.58	-	111.12	117.36

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **2517.35 kg/year**

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
2 - Wetland
3 - Hybrid Wetland / Wet Pond
4 - Wet Pond
5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Existing Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
BK03	5	36.74	42.99	3.73	111	-	4,078	5,144	-	0	Basic
BK04	4	313.23	40.47	3.54	153	35,238	12,529	31,323	Unknown	0	Basic
BK08	4	61.14	40.47	3.24	153	6,878	2,446	6,114	Sufficient	8,220	Enhanced
DY01	4	420.34	32.46	7.96	133	38,882	33,459	56,746	Unknown	0	Basic
DY02	5	17.85	44.15	6.39	117	-	2,089	1,428	-	3,130	Basic
DY03	5	129.14	30.74	4.11	77	-	9,962	11,623	-	10,910	Basic
DY04(1)	4	101.71	32.60	4.05	133	9,408	4,119	10,680	19,960	34,150	Enhanced
DY04(2)	5	104.96	31.75	3.04	80	-	8,367	11,021	-	34,170	Basic
DY07	4	575.76	34.68	6.08	138	56,137	35,006	46,061	Unknown	0	Basic
DY09	4	2.72	36.40	7.60	143	279	207	435	268	1,710	Normal
DY10	4	3.62	81.57	18.32	243	736	663	380	218	1,016	Basic
HR01	5	76.45	38.83	15.00	99	-	11,468	10,703	-	17,630	Basic
HR02	5	37.80	36.61	4.71	93	-	3,515	4,158	-	9,370	Basic
HR03	5	57.83	37.02	4.76	96	-	5,552	6,940	-	0	Basic
HT03A	4	6.95	40.91	2.98	153	782	278	521	113	603	Basic
HT03B	5	2.23	49.51	6.61	132	-	294	290	-	850	Basic
HT06	5	27.60	31.23	5.18	80	-	2,200	2,484	-	11,930	Basic
KD01	5	423.35	33.42	4.65	85	-	359,524	55,036	-	114,110	Basic
KD03	5	27.77	48.69	6.34	129	-	3,582	3,888	-	2,630	Basic

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
2 - Wetland
3 - Hybrid Wetland / Wet Pond
4 - Wet Pond
5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Existing Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
KD05	5	26.67	28.48	8.06	72	-	2,150	2,000	-	2,210	Basic
KD06	5	60.05	42.79	6.59	111	-	6,666	7,506	-	0	Basic
WK01	5	584.22	32.64	5.31	82	-	48,073	75,949	-	0	Basic
WK02	5	465.80	31.37	4.25	80	-	37,131	81,515	-	0	Basic
WK04	2	11.34	37.35	5.82	83	482	660	1,758	750	4,690	Enhanced
WK05A	4	110.22	41.70	6.61	155	12,675	7,285	15,430	2,957	7,894	Basic
WK05B	5	110.22	41.70	6.65	108	-	11,903	15,430	-	55,640	Enhanced
WK08	4	2.29	58.98	8.11	197	360	186	401	278	184	Normal
WK16	5	1.35	73.77	15.75	208	-	281	405	-	422	Basic
WK18	5	7.27	49.64	11.10	132	-	960	1,272	-	277	Basic
HW01	4	9.29	53.44	9.89	185	1,347	919	1,765	2,063	3,979	Enhanced
HW04	4	9.32	40.92	6.87	153	1,048	640	1,164	1,280	1,850	Enhanced
HW05	4	86.52	45.55	4.76	165	10,815	4,118	14,708	7,468	6,910	Normal
HW06	4	34.41	42.92	7.00	158	4,043	2,408	5,333	4,647	2,725	Enhanced
HW08	4	150.72	33.77	6.90	135	14,318	10,400	19,593	14,325	13,290	Enhanced
HW09	2	21.28	44.34	7.57	91	1,091	1,611	3,405	2,815	2,418	Enhanced
HW10	4	8.37	32.89	7.34	133	775	615	1,340	1,346	1,596	Enhanced
BY01	2	14.24	46.25	4.61	94	765	656	1,637	Sufficient	2,094	Enhanced
BY03	2	33.22	36.87	4.24	81	1,370	1,408	3,654	Sufficient	2,090	Enhanced

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
2 - Wetland
3 - Hybrid Wetland / Wet Pond
4 - Wet Pond
5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Existing Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
LV01	2	72.20	43.16	6.91	90	3,610	4,989	9,026	Sufficient	7,029	Basic
LV02	4	211.74	47.30	8.41	170	27,526	8,470	38,113	Unknown	46,730	Basic
LV03	5	7.53	48.00	9.68	129	-	972	1,356	-	1,460	Basic
LV04	5	102.11	46.28	7.94	123	-	12,560	18,380	-	5,805	Basic
LV05	5	80.68	49.73	8.34	132	-	10,650	15,329	-	4,485	Basic
LV06	5	5.25	70.10	16.57	200	-	1,050	1,155	-	0	Basic
LV07	5	161.22	55.57	8.25	150	-	24,183	35,468	-	10,020	Basic
LV08	5	5.80	77.86	1.07	219	-	1,267	1,449	-	2,480	Basic
LV09	5	13.02	71.10	13.05	203	-	2,640	3,256	-	3,100	Basic
LV10	5	18.15	31.69	5.40	80	-	1,446	2,177	-	2,461	Basic
LV11	4	12.65	44.46	0.38	163	1,550	506	2,025	Sufficient	2,140	Enhanced
LV12	5	17.15	63.46	12.02	177	-	3,029	3,601	-	0	Basic

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
2 - Wetland
3 - Hybrid Wetland / Wet Pond
4 - Wet Pond
5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Existing Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
LV13	5	12.38	38.17	6.30	99	-	1,225	1,733	-	492	Basic
LV14	4	30.00	57.72	427.00	195	4,639	128,083	6,149	91	95	Enhanced
LV15	5	17.38	58.32	11.62	160	-	2,781	3,650	-	2,700	Basic
LV16	5	2.63	74.03	14.35	211	-	555	632	-	2,820	Basic
LV17	5	15.74	50.83	9.91	135	-	2,124	2,832	-	3,930	Basic
LV18	2	19.53	46.84	7.58	94	1,050	1,481	3,125	Sufficient	603	Enhanced
LV19	3	160.68	35.66	5.66	110	11,248	9,095	20,889	15,670	15,700	Enhanced
LV20	2	36.12	50.12	7.98	99	2,122	2,882	5,779	4,800	7,760	Enhanced
LV21	2	19.51	39.97	6.56	85	878	1,280	2,536	2,600	6,306	Enhanced
LV22	4	64.32	41.69	8.19	155	7,396	5,268	11,577	8,214	8,604	Enhanced
LV23	2	26.76	31.74	5.53	75	936	1,480	3,345	2,200	3,000	Enhanced
LV25	4	20.46	40.57	3.38	153	2,302	819	2,763	3,020	1,465	Enhanced
LV26	5	0.41	14.15	0.24	36	-	15	17	-	12	Basic
LV27	4	2.51	42.05	9.56	158	295	240	477	425	470	Enhanced
LV30	2	0.69	87.86	16.33	90	35	113	173	Sufficient	95	Normal
LV32	4	1.82	32.58	5.27	133	168	96	191	Sufficient	1,717	Enhanced
LV37(1)	5	1.30	87.69	13.92	312	-	312	136	-	1,250	Basic
LV37(2)	5	3.21	76.54	15.85	693	-	693	337	-	2,037	Basic

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
2 - Wetland
3 - Hybrid Wetland / Wet Pond
4 - Wet Pond
5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Existing Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
LV41	5	4.32	81.18	15.53	229	-	991	1,080	-	204	Basic
LV48	1	0.17	79.52	18.07	38	7	30	58	-	11	Enhanced
LV49	4	33.55	66.32	12.94	216	5,894	4,341	8,052	Sufficient	9,725	Enhanced
LV50	4	9.53	20.04	4.45	103	596	424	1,144	3,290	2,394	Enhanced
LVBVCH	4	6.97	60.56	11.35	202	1,127	791	1,394	Unknown	2,192	Enhanced
BR01	5	526.13	22.91	1.54	57	-	29,764	-	-	0	Basic
BR03	5	217.95	36.46	2.38	93	-	20,269	-	-	0	Basic
BR05	5	18.47	45.16	6.50	120	-	2,216	2,309	-	1,381	Basic
BR06	4	23.14	35.59	4.40	140	2,314	1,018	2,314	2,800	2,495	Enhanced
BR07	5	19.69	34.32	4.43	87	-	1,722	2,166	-	4,279	Basic
BR08A	4	93.34	46.48	5.76	168	11,900	5,376	11,667	2,200	41,724	Enhanced
BR08B	4	137.62	45.66	5.74	165	17,202	7,899	17,890	2,649	18,336	Enhanced
BR09	4	39.64	45.93	4.26	165	4,955	1,689	5,153	6,513	5,340	Enhanced
BR10	4	90.18	30.56	4.10	128	7,891	3,698	10,371	8,410	6,880	Enhanced
BR11	4	107.13	6.72	4.18	68	2,946	4,478	5,357	4,850	4,210	Enhanced
BR13	5	78.76	36.22	4.60	93	-	7,324	9,451	-	0	Basic
BR14	4	128.22	37.99	4.94	145	13,463	6,334	15,386	4,190	5,750	Basic
BR15	5	31.72	42.81	5.30	111	-	3,520	3,964	-	4,800	Basic
BR16	4	38.83	44.26	8.09	163	4,757	3,142	6,796	16,134	8,460	Enhanced
BR20	3	74.72	34.22	6.42	108	5,081	4,797	9,341	6,400	12,650	Enhanced

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
2 - Wetland
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5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Existing Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
BR22	4	75.89	33.14	3.49	135	7209..4	3,036	8,348	9,002	5,653	Enhanced
BR23	5	12.48	42.88	6.57	111	-	1,385	1,747	-	0	Basic
BR24	4	23.49	18.00	3.40	95	1,292	940	1,645	8,192	13,805	Enhanced
GR01	5	134.78	42.54	5.43	111	-	14,961	18,195	-	0	Basic
GR03	5	34.44	45.38	4.21	120	-	4,133	4,477	-	0	Basic
GR04	5	79.70	40.74	4.71	105	-	8,369	10,760	-	0	Basic
LT01	5	106.80	50.45	7.75	135	-	14,418	14,952	-	6,060	Basic
LT02	4	40.87	56.66	7.85	192	6,227	3,208	6,539	4,980	3,980	Normal
LT03	4	36.27	46.26	0.22	168	4,624	1,451	4,896	Unknown	827	Enhanced
LT04	4	114.63	61.77	8.99	204	18,799	10,305	20,633	7,925	15,900	Basic
LT05	4	20.32	46.79	6.43	168	2,591	1,307	2,642	Unknown	364	Enhanced
LT06	4	56.47	46.98	6.06	168	7,200	3,422	9,035	1,840	733	Normal
LT07	4	4.50	57.53	11.82	195	696	532	1,665	Sufficient	1,900	Enhanced
LT08	5	1.57	71.90	12.46	203	-	319	370	-	2,850	Basic
LTCND	4	24.28	38.42	26.52	148	2,610	6,439	4,006	Sufficient	3,660	Enhanced
LTKOZ	4	14.30	50.45	0.66	178	1,966	572	2,216	Sufficient	24,190	Enhanced
LTXX	5	0.68	49.12	6.76	132	-	90	102	-	84	Basic
LTGM	4	7.71	77.77	8.37	237	1,516	661	1,349	3,217	983	Enhanced

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
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5 -Dry Pond

Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Proposed Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
BK03 (RO#10)	1	26.68	47.75	4.16	28	747	1,110	37,335	750	750	Enhanced
DY01 (RO#79)	4	402.85	32.46	4.72	87	18,934	19,015	54,385	23,401	19,608	Normal
DY02 (RO#15)	1	17.85	44.15	7.96	27	486	1,421	1,428	490	3,130	Enhanced
RO#78	5	236.43	22.11	3.21	57	-	13,375	23,643	-	-	Basic
HR01 (RO#28)	4	25.51	48.26	5.46	103	1,607	1,393	4,082	2,151	17,630	Normal
HR03 (RO#85)	4	57.83	37.02	5.16	145	6,072	2,984	6,940	6,094	6,513	Enhanced
HT06 (RO#3)	1	27.84	40.34	5.79	26	732	1,612	3,341	-	-	Enhanced
RO#44(A)	2	52.67	35.48	7.08	80	2,107	3,729	8,427	2,433	2,610	Enhanced
RO#44(B)	1	52.67	35.48	7.08	25	1,317	3,729	8,427	2,433	2,610	Enhanced
RO#48	5	386.52	43.51	4.86	114	-	44,063	46,382	-	-	Basic
RO#81	5	258.53	31.10	4.39	99	-	25,595	28,439	-	-	Basic
RO#96	5	286.41	37.56	5.55	96	-	27,495	31,505	-	-	Basic
KD03 (RO#13)	1	27.77	48.69	6.34	28	785	1,761	3,888	785	3,890	Enhanced
KD05 (RO#18)	1	26.67	28.48	3.65	23	620	1,067	2,000	620	2,830	Enhanced
KD06 (RO#11)	1	60.04	42.79	5.85	27	1,606	3,513	7,505	1,607	1,607	Enhanced
RO#17	4	35.60	73.85	13.28	230	6,764	4,728	8,544	7,260	9,452	Enhanced
WK01/RO25(1)	2	14.66	43.77	5.66	90	733	830	1,906	750	0	Enhanced
WK01/RO25(2)	2	14.76	43.67	-	90	738	591	2,362	-	-	Enhanced
WK04 (RO#20)	2	11.33	37.37	7.59	83	482	660	1,758	750	4,690	Enhanced

TATHAM ENGINEERING

SWM Facility Type
1 - Infiltration
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Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Proposed Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
WK05A/RO92A	4	106.26	41.99	6.77	65	2,603	7,194	7,970	2,957	7,894	Basic
WK05B/RO92B	4	106.26	41.99	6.64	20	2,125	4,250	1,725	2,125	55,640	Basic
RO#40	4	6.90	47.83	3.65	28	193	992	4,135	3,150	4,687	Enhanced
RO#42(A)	1	22.75	37.80	6.02	26	580	1,370	3,639	604	4,004	Enhanced
RO#42(B)	4	22.75	37.80	6.02	145	2,388	1,370	3,639	2,450	4,004	Enhanced
RO#26(A)	4	36.53	43.30	7.75	160	4,384	2,831	5,845	4,600	3,803	Enhanced
RO#26(B)	1	36.53	43.30	7.75	27	986	2,831	5,845	987	3,803	Enhanced
HW05	1	86.52	45.55	4.75	28	3,461	4,110	14,708	2,454	5,734	Enhanced
RO#27	4	34.63	31.13	6.07	130	3,117	2,102	3,983	3,117	2,102	Enhanced
LV01 (RO#68)	4	72.20	41.00	7.54	96	4,043	5,444	9,026	6,659	12,958	Enhanced
LV02 (RO#30)	4	174.68	47.30	9.07	69	5,066	15,844	31,442	8,212	64,520	Basic
LV03 (RO#31)	4	7.53	48.00	9.20	173	998	693	1,356	2,093	1,460	Enhanced
LV05 (RO#45)	4	80.68	49.73	8.34	71	2,461	6,729	15,329	1,800	4,485	Basic
LV07 (RO#65)	1	96.90	55.57	8.25	30	2,907	7,994	21,318	3,000	10,020	Enhanced
LV10 (RO#37)	1	18.15	31.69	5.40	24	436	980	2,268	445	2,461	Enhanced
LV12 (RO#32)	1	17.15	63.48	12.02	33	560	2,061	3,858	566	-	Enhanced
LV16	2	2.63	74.03	13.89	125	224	366	632	339	1,923	Enhanced
LV17	2	17.84	52.21	10.41	101	1,093	1,857	3,211	925	3,930	Enhanced
BR05 (RO#62)	4	18.47	45.19	8.61	100	1,108	1,590	2,771	1,604	2,652	Normal

TATHAM ENGINEERING

SWM Facility Type
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Project:	Barrie Drainage Master Plan	Prepared By:	ARO
File No.:	117076	Reviewed By:	DRT
Revision:	1	Date:	January 2019
Description:	SWMF Water Quality Requirements - Proposed Conditions		

SWMF ID / Retrofit No.	SWMF Type	Drainage Area (ha)	Percent Impervious	25 mm Storm Runoff Volume (mm)	Water Quality Storage Requirement (m^3/ha)	Permanent Pool / Infiltration Volume Required (m^3)	Extended Detention Volume Required (m^3)	Erosion Control Volume Required (m^3)	Permanent Pool / Infiltration Volume Provided (m^3)	Extended Detention/Erosion Control Volume Provided (m^3)	Level of Treatment Provided
BR08A(1)	1	72.98	49.82	-	-	2,080	-	-	-	4,384	Enhanced
BR08A(2)	4	20.35	34.49	4.51	138	1,984	918	2,239	2,200	41,724	Enhanced
BR08B/RO61	4	44.29	43.92	5.90	160	5,314	2,613	5,757	6,875	18,336	Enhanced
BR13	4	78.76	36.22	4.62	143	8,072	3,639	9,451	8,264	10,648	Enhanced
BR14(1)	4	49.46	40.89	4.98	153	5,564	2,463	6,430	5,675	5,750	Enhanced
BR14(2)	4	128.22	37.99	4.98	62	2,757	6,385	16,669	5,675	5,750	Basic
GR01/RO75	4	134.78	42.55	5.59	65	3,403	7,540	18,195	1,970	-	Basic
GR04/RO76	4	62.46	38.98	7.00	93	3,310	4,370	8,432	3,358	0	Normal
LT01/RO77	1	65.97	46.57	6.87	28	1,246	4,532	9,896	1,846	-	Enhanced
LT01(2)	4	65.97	46.57	4.98	68	3,109	3,285	8,576	3,550	0	Basic
LT01(3)	4	65.97	46.57	6.87	68	4,503	4,532	9,896	729	-	Basic
LT03	4	36.27	46.26	5.87	168	4,624	2,129	4,896	-	-	Enhanced
LT04/RO91	4	66.57	48.20	9.43	173	8,820	6,277	11,982	9,075	15,900	Enhanced
LT04(2)/RO91	4	114.63	61.77	9.43	204	18,799	10,810	20,633	18,970	-	Enhanced
T05/RO89/RO9	4	20.31	46.85	6.58	168	2,590	1,336	3,047	2,688	1,392	Enhanced
LT06	4	20.37	50.15	6.07	178	2,801	1,237	3,259	2,809	2,118	Enhanced
LTGM/RO84	4	48.86	80.59	13.27	242	-	6,484	11,726	-	7,021	Enhanced
RO84	4	48.86	80.59	8.35	242	9,853	4,080	11,726	3,217	983	Enhanced

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Existing Conditions
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**3434**	Total Pre-Development Phosphorus Load (kg/yr):	**4955.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	3.26	0.19	0.62
Forest	214.2	0.05	10.71
High Intensity - Comm/Industria	1795	1.82	3267.21
High Intensity - Residential	1254	1.32	1654.74
Low Intensity Development	167.6	0.13	21.78

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Existing Conditions
Subwatershed: Barrie Creeks

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	1.64	0.19	Dry Detention Ponds	10%	0.28
Cropland	1.62	0.19	Wet Detention Ponds	63%	0.11
Forest	100.21	0.05	Wet Detention Ponds	63%	1.85
Forest	0.09	0.05	Constructed Wetlands	77%	0.00
Forest	105.42	0.05	Dry Detention Ponds	10%	4.74
Forest	8.51	0.05	NONE	0%	0.43
High Intensity - Comm/Industrial	487.96	1.82	NONE	0%	888.09
High Intensity - Comm/Industrial	330.27	1.82	Wet Detention Ponds	63%	222.40
High Intensity - Comm/Industrial	972.44	1.82	Dry Detention Ponds	10%	1592.86
High Intensity - Comm/Industrial	4.5	1.82	Constructed Wetlands	77%	1.88
High Intensity - Residential	160.34	1.32	Wet Detention Ponds	63%	78.31
High Intensity - Residential	6.35	1.32	Constructed Wetlands	77%	1.93
High Intensity - Residential	619.38	1.32	Dry Detention Ponds	10%	735.82
High Intensity - Residential	467.52	1.32	NONE	0%	617.13
Low Intensity Development	40.58	0.13	NONE	0%	5.28
Low Intensity Development	23.51	0.13	Wet Detention Ponds	63%	1.13
Low Intensity Development	0.39	0.13	Constructed Wetlands	77%	0.01

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Existing Conditions

Subwatershed: Barrie Creeks

Low Intensity Development	103.07	0.13	Dry Detention Ponds	10%	12.06

Post-Development Area Altered: **3433.80**

Total Pre-Development Area: **3433.80**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**4955.06**
Post-Development:	**4955.06**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**4164.31**
Change (Pre - Post):	**790.75**
16% Net Reduction in Load	

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**4955.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**4164.31**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**790.75**
Conclusion:	**16% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Existing Conditions
Subwatershed: Hewitts Creek

Total Pre-Development Area (ha):	**463.78**	Total Pre-Development Phosphorus Load (kg/yr):	**515.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	28.97	0.19	5.50
Forest	75.76	0.05	3.79
High Intensity - Comm/Industria	121.21	1.82	220.60
High Intensity - Residential	213.65	1.32	282.02
Low Intensity Development	24.19	0.13	3.14

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Existing Conditions
Subwatershed: Hewitts Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	24.77	0.19	NONE	0%	4.71
Cropland	4.2	0.19	Wet Detention Ponds	63%	0.30
Forest	66.37	0.05	NONE	0%	3.32
Forest	9.39	0.05	Wet Detention Ponds	63%	0.17
High Intensity - Comm/Industrial	37.94	1.82	NONE	0%	69.05
High Intensity - Comm/Industrial	83.27	1.82	Wet Detention Ponds	63%	56.07
High Intensity - Residential	87.64	1.32	NONE	0%	115.68
High Intensity - Residential	126.01	1.32	Wet Detention Ponds	63%	61.54
Low Intensity Development	9.26	0.13	NONE	0%	1.20
Low Intensity Development	14.93	0.13	Wet Detention Ponds	63%	0.72

Post-Development Area Altered: **463.78**

Total Pre-Development Area: **463.78**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**515.06**
Post-Development:	**515.06**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**312.77**
Change (Pre - Post):	**202.29**
39% Net Reduction in Load	

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Existing Conditions
Subwatershed: Hewitts Creek

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**515.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**312.77**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**202.29**
Conclusion:	**39% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Existing Conditions
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1529.1**	Total Pre-Development Phosphorus Load (kg/yr):	**2163.00**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	12.24	0.16	1.96
Forest	190.87	0.06	11.45
High Intensity - Comm/Industria	921.87	1.82	1677.80
High Intensity - Residential	354.8	1.32	468.34
Low Intensity Development	49.35	0.07	3.45

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Existing Conditions
Subwatershed: Lovers Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.09	0.16	Dry Detention Ponds	10%	0.01
Cropland	12.05	0.16	NONE	0%	1.93
Cropland	0.1	0.16	Wet Detention Ponds	63%	0.01
Forest	16.6	0.06	Wet Detention Ponds	63%	0.37
Forest	0.34	0.06	Constructed Wetlands	77%	0.00
Forest	10.27	0.06	Dry Detention Ponds	10%	0.55
Forest	163.66	0.06	NONE	0%	9.82
High Intensity - Comm/Industrial	287.37	1.82	NONE	0%	523.01
High Intensity - Comm/Industrial	235.72	1.82	Wet Detention Ponds	63%	158.73
High Intensity - Comm/Industrial	364.1	1.82	Dry Detention Ponds	10%	596.40
High Intensity - Comm/Industrial	34.68	1.82	Constructed Wetlands	77%	14.52
High Intensity - Residential	194.74	1.32	Wet Detention Ponds	63%	95.11
High Intensity - Residential	10.02	1.32	Constructed Wetlands	77%	3.04
High Intensity - Residential	31.41	1.32	Dry Detention Ponds	10%	37.32
High Intensity - Residential	118.63	1.32	NONE	0%	156.59
Low Intensity Development	17.02	0.07	NONE	0%	1.19
Low Intensity Development	15.81	0.07	Wet Detention Ponds	63%	0.41

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Existing Conditions

Subwatershed: Lovers Creek

Low Intensity Development	4.44	0.07	Constructed Wetlands	77%	0.07
Low Intensity Development	12.08	0.07	Dry Detention Ponds	10%	0.76

Post-Development Area Altered: **1529.13**

Total Pre-Development Area: **1529.13**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**2163.00**
Post-Development:	**2163.00**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**1599.85**
Change (Pre - Post):	**563.16**
	26% Net Reduction in Load

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2163.00**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1599.85**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**563.16**
Conclusion:	**26% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Development Export Summary

Development :City of Barrie MDP Update - NVCA Watersheds - Existing Conditions

Updated : Sept 2014

Pre-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Existing Conditions

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.26**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	229.46
Industrial		140.19	0.41	187.31
Residential		714.51	0.41	958.96
Transportation		371.06	0.50	1,495.74
	Urban Land use Class Total :	**1,525.09**		**2,871.47**
	Development Total :	**2,139.01**		**2,921.12**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Existing Conditions

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.19**
Phosphorus load (kg/yr) :	**8.26**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Existing Conditions

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.27**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	230.48
Industrial		140.19	0.41	187.85
Residential		714.51	0.41	957.44
Transportation		371.06	0.50	185.53
	Urban Land use Class Total :	**1,525.09**		**1,561.30**
	Development Total :	**2,139.01**		**1,610.96**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Existing Conditions

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.19**
Phosphorus load (kg/yr) :	**8.27**

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Cropland					
0.05	100	0.36	10 %		BR114
Dry Detention Ponds					
Cropland					
0.23	100	0.26	10 %	0.01	BR119
Dry Detention Ponds					
Cropland					
0.00	100	0.23	10 %		BR141
Dry Detention Ponds					
Cropland					
0.70	100	0.60	10 %	0.04	BR164
Dry Detention Ponds					
Cropland					
0.31	100	2.77	10 %	0.09	BR166
Dry Detention Ponds					
Cropland					
0.12	100	0.48	63 %	0.04	BR181
Wet Detention Ponds					
Cropland					
0.00	100	0.41	63 %		BR191
Wet Detention Ponds					
Cropland					
0.21	100	1.24	63 %	0.16	BR195
Wet Detention Ponds					

Cropland					
0.23	100	0.28	63 %	0.04	LT111
Wet Detention Ponds					
Cropland					
0.60	100	0.32	63 %	0.12	LT112
Wet Detention Ponds					
Cropland					
0.23	100	0.51	63 %	0.07	LT113
Wet Detention Ponds					
Cropland					
0.11	100	0.67	63 %	0.05	LT114
Wet Detention Ponds					
Cropland					
0.03	100	0.46	63 %	0.01	BR154
Wet Detention Ponds					
Cropland					
1.24	100	0.31	63 %	0.24	BR182
Wet Detention Ponds					
Cropland					
2.65	100	0.52	63 %	0.87	BR186
Wet Detention Ponds					
Cropland					
0.57	100	0.83	63 %	0.30	BR187
Wet Detention Ponds					
Cropland					
0.21	100	0.72	63 %	0.09	BR188
Wet Detention Ponds					
Cropland					
0.10	100	0.67	10 %	0.01	BR165
Dry Detention Ponds					

Cropland					
0.72	100	0.36	63 %	0.16	BR189
Wet Detention Ponds					
Commercial					
128.26	100	0.77	63 %	62.22	
Wet Detention Ponds					
Commercial					
53.99	100	0.77	10 %	4.16	
Dry Detention Ponds					
Forest					
68.78	100	0.06	63 %	2.60	
Wet Detention Ponds					
Forest					
36.09	100	0.06	10 %	0.22	
Dry Detention Ponds					
Industrial					
87.72	100	1.34	63 %	74.06	
Wet Detention Ponds					
Industrial					
17.72	100	1.34	10 %	2.37	
Dry Detention Ponds					
Low Intensity Residential					
32.60	100	0.13	63 %	2.67	
Wet Detention Ponds					
Low Intensity Residential					
26.42	100	0.13	10 %	0.34	
Dry Detention Ponds					
Residential					
196.38	100	1.34	63 %	165.79	
Wet Detention Ponds					

Residential				
335.14	100	1.34	10 %	44.91
Dry Detention Ponds				

Transportation				
111.12	100	0.50	63 %	35.00
Wet Detention Ponds				

Transportation				
142.58	100	0.50	10 %	7.13
Dry Detention Ponds				

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2,139.01
PreDevelopment Area excluding Wetlands (ha):	2,139.01
Total PostDevelopment Area (ha):	2,139.01
Total Area treated by BMP's (ha):	1,245.12
Treated Area total:	1,245.12
Total PreDevelopment Load (kg/yr):	2,921.12
Total PostDevelopment Load (kg/yr):	1,610.96
Total P Load Reduction with BMP's (kg/yr):	403.77
Minimum P Load Reduction Required:	-1,310.17
Total PostDevelopment Load with BMP's (kg/yr)	1,207.19

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction

Appendix D: Alternative 2A Phosphorous Calculations

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

ALTERNATIVE 2A - SWMF FOR QUANTITY CONTROL RETROFIT SUMMARY

Pond	Drainage Area (ha)	Existing Best Management Practice	Removal Efficiency (%)	Existing Phosphorus Reduction (kg/year)	Retrofit Best Management Practice	Removal Efficiency (%)	Retrofit Phosphorus Reduction (kg/year)	Increase in Phosphorus Load Reduction from Retrofit (kg/year)
BK03 (RO #10)	36.71	Dry Pond	10%	4.97	Infiltration + Dry Pond (Treatment Train)	88%	35.38	30.41
KD06 (RO#11)	60.00	Dry Pond	10%	7.78	Infiltration	87%	67.71	59.92
RO #26	35.16	None	0%	0.00	Wet Pond	63%	30.09	30.09
RO #40	22.73	None	0%	0.00	Infiltration	87%	33.56	33.56
RO #42 - Alternative 1	22.27	None	0%	0.00	Infiltration + Dry Pond (Treatment Train)	88%	29.95	29.95
RO #42 - Alternative 2	22.27	None	0%	0.00	Wet Pond	88%	21.37	21.37
RO #44 - Alternative 1	52.67	None	0%	0.00	Wetland	77%	69.80	69.80
RO #44 - Alternative 2	52.67	None	0%	0.00	Bioretention	87%	78.87	78.87
LT01 (RO #77) - Alternative 1	65.89	Dry Pond	10%	12.22	Infiltration	87%	106.30	94.08
LT01 (RO #77) - Alternative 2	65.89	Dry Pond	10%	12.22	Wet Pond	63%	76.98	64.76
DY01 (RO #79) - Alternative 1	172.46	Wet Pond	63%	184.13	Wet Pond	63%	184.13	0.00
DY01 (RO #79) - Alternative 2	172.46	Wet Pond	63%	184.13	Peak Flow Control Facility	0%	0.00	-184.13
HR03 (RO#85)	9.29	Dry Pond	10%	1.24	Wet Pond	63%	7.84	6.60
RO #94	56.09	None	0%	0.00	Dry Pond	10%	8.31	8.31

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**2771**	Total Pre-Development Phosphorus Load (kg/yr):	**3989.16**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	3.19	0.19	0.61
Forest	146.9	0.05	7.34
High Intensity - Comm/Industria	1410	1.82	2566.09
High Intensity - Residential	1057	1.32	1395.03
Low Intensity Development	154.6	0.13	20.09

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	1.62	0.19	Other	67%	0.10
			Dry Pond + Wet Pond (Treatment Train)		
Cropland	1.48	0.19	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.04
Cropland	0.09	0.19	Bioretention Systems	**88%**	0.00
			Dry Pond + Infiltration (Treatment Train)		
			NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)		
Forest	1.57	0.05	Constructed Wetlands	77%	0.02
Forest	28.64	0.05	Dry Detention Ponds	10%	1.29
Forest	0.02	0.05	Treatment Train Approach	79%	0.00
			Wetland + Dry Pond (Treatment Train)		
Forest	47.28	0.05	Wet Detention Ponds	63%	0.87
Forest	3.81	0.05	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.02
Forest	57.04	0.05	Other	67%	0.94
			Dry Pond + Wet Pond (Treatment Train)		
Forest	8.5	0.05	NONE	0%	0.43
High Intensity - Comm/Industrial	487.97	1.82	NONE	0%	888.11
High Intensity - Comm/Industrial	367.77	1.82	Dry Detention Ponds	10%	602.41
High Intensity - Comm/Industrial	20.2	1.82	Bioretention Systems	**88%**	4.41
			Dry Pond + Infiltration (Treatment Train)		
			NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)		
High Intensity - Comm/Industrial	35.56	1.82	Other	67%	21.36
			Dry Pond + Wet Pond (Treatment Train)		
High Intensity - Comm/Industrial	81.57	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	19.30
High Intensity - Comm/Industrial	351.81	1.82	Wet Detention Ponds	63%	236.91

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

High Intensity - Comm/Industrial	4.11	1.82	Treatment Train Approach	79%	1.57
			Wetland + Dry Pond (Treatmnet Train)		
High Intensity - Comm/Industrial	60.95	1.82	Constructed Wetlands	77%	25.51
High Intensity - Residential	288.3	1.32	Dry Detention Ponds	10%	342.50
High Intensity - Residential	467.51	1.32	NONE	0%	617.11
High Intensity - Residential	19.63	1.32	Constructed Wetlands	77%	5.96
High Intensity - Residential	2.2	1.32	Treatment Train Approach	79%	0.61
			Wetland + Dry Pond (Treatment Train)		
High Intensity - Residential	164.57	1.32	Wet Detention Ponds	63%	80.38
High Intensity - Residential	79.65	1.32	Perforated Pipe Infiltration/Exfiltration Systems	87%	13.67
High Intensity - Residential	7.88	1.32	Other	67%	3.43
			Dry Pond + Wet Pond (Treatment Train)		
High Intensity - Residential	27.1	1.32	Bioretention Systems	**88%**	4.29
			Dry Pond + Infiltration (Treatment Train)		
NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)					
Low Intensity Development	40.58	0.13	NONE	0%	5.28
Low Intensity Development	2.39	0.13	Other	67%	0.10
			Dry Pond + Wet Pond (Treatment Train)		
Low Intensity Development	9.67	0.13	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.16
Low Intensity Development	57.88	0.13	Wet Detention Ponds	63%	2.78
Low Intensity Development	0.27	0.13	Treatment Train Approach	79%	0.01
			Wetland + Dry Pond (Treatment Train)		
Low Intensity Development	1.8	0.13	Constructed Wetlands	77%	0.05
Low Intensity Development	40.45	0.13	Dry Detention Ponds	10%	4.73
Low Intensity Development	1.53	0.13	Bioretention Systems	**88%**	0.02
			Dry Pond + Infiltration (Treatment Train)		
NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)					

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

		P Load (kg/yr)
Post-Development Area Altered:	**2771.40**	
Total Pre-Development Area:	**2771.40**	
Unaffected Area:	**0**	
Pre-Development:		**3989.16**
Post-Development:		**3989.16**
Change (Pre - Post):		**0.00**
		0% Net Increase in Load
Post-Development (with BMPs):		**2884.38**
Change (Pre - Post):		**1104.78**
		28% Net Reduction in Load

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**3989.16**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**2884.38**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**1104.78**
Conclusion:	**28% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Lovers, Hewitts and Sandy Cove Study Area
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1993**	Total Pre-Development Phosphorus Load (kg/yr):	**2676.50**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	41.22	0.16	6.60
Forest	266.6	0.06	16.00
High Intensity - Comm/Industria	1043	1.82	1898.41
High Intensity - Residential	568.5	1.32	750.35
Low Intensity Development	73.54	0.07	5.15

DEVELOPMENT: City of Barrie MDP Update - Lovers, Hewitts and Sandy Cove Study Area
Subwatershed: Lovers Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.09	0.16	Dry Detention Ponds	10%	0.01
Cropland	36.83	0.16	NONE	0%	5.89
Cropland	4.3	0.16	Wet Detention Ponds	63%	0.25
Forest	32.69	0.06	Wet Detention Ponds	63%	0.73
Forest	0.34	0.06	Constructed Wetlands	77%	0.00
Forest	3.56	0.06	Dry Detention Ponds	10%	0.19
Forest	230.04	0.06	NONE	0%	13.80
High Intensity - Comm/Industrial	325.31	1.82	NONE	0%	592.06
High Intensity - Comm/Industrial	72.31	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	17.11
High Intensity - Comm/Industrial	473.56	1.82	Wet Detention Ponds	63%	318.90
High Intensity - Comm/Industrial	112.56	1.82	Dry Detention Ponds	10%	184.37
High Intensity - Comm/Industrial	59.34	1.82	Constructed Wetlands	77%	24.84
High Intensity - Residential	320.82	1.32	Wet Detention Ponds	63%	156.69
High Intensity - Residential	10.02	1.32	Constructed Wetlands	77%	3.04
High Intensity - Residential	31.34	1.32	Dry Detention Ponds	10%	37.23
High Intensity - Residential	206.27	1.32	NONE	0%	272.28
Low Intensity Development	26.29	0.07	NONE	0%	1.84

DEVELOPMENT: City of Barrie MDP Update - Lovers, Hewitts and Sandy Cove Study Area
Subwatershed: Lovers Creek

Low Intensity Development	1.57	0.07	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.01
Low Intensity Development	39.75	0.07	Wet Detention Ponds	63%	1.03
Low Intensity Development	4.44	0.07	Constructed Wetlands	77%	0.07
Low Intensity Development	1.49	0.07	Dry Detention Ponds	10%	0.09

Post-Development Area Altered: **1992.92**

Total Pre-Development Area: **1992.92**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**2676.50**
Post-Development:	**2676.50**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**1630.45**
Change (Pre - Post):	**1046.05**
	39% Net Reduction in Load

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2676.50**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1630.45**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**1046.05**
Conclusion:	**39% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Development Export Summary

Development :Barrie MDP - NVCA Watershed - Ponds

Updated : Sept 2014

Pre-Development Phosphorus Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.20
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.11
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.61
	Agricultural Land use Class Total :	**16.59**		**8.87**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	229.46
Industrial		140.19	0.41	187.31
Residential		714.51	0.41	958.96
Transportation		371.06	0.50	1,495.74
	Urban Land use Class Total :	**1,525.09**		**2,871.47**
	Development Total :	**2,139.01**		**2,921.73**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.49
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.78
		Phosphorus export (kg/ha/yr)	0.44
		Phosphorus load (kg/yr)	0.11

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.49
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	3.61

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.49
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.94
		Phosphorus export (kg/ha/yr)	0.95
		Phosphorus load (kg/yr)	0.20

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.51**
Phosphorus load (kg/yr) :	**8.87**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.20
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.11
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.61
	Agricultural Land use Class Total :	**16.59**		**8.87**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	230.48
Industrial		140.19	0.41	187.85
Residential		714.51	0.41	957.44
Transportation		371.06	0.50	185.53
	Urban Land use Class Total :	**1,525.09**		**1,561.30**
	Development Total :	**2,139.01**		**1,611.56**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.49
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.78
		Phosphorus export (kg/ha/yr)	0.44
		Phosphorus load (kg/yr)	0.11

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.49
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	3.61

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.49
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.94
		Phosphorus export (kg/ha/yr)	0.95
		Phosphorus load (kg/yr)	0.20

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.51**
Phosphorus load (kg/yr) :	**8.87**

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Commercial					
186.05	100	0.77	63 %	90.25	
Wet Detention Ponds					
Forest					
77.13	100	0.06	63 %	2.92	
Wet Detention Ponds					
Industrial					
87.72	100	1.34	63 %	74.05	
Wet Detention Ponds					
Low Intensity Residential					
46.85	100	0.13	63 %	3.84	
Wet Detention Ponds					
Residential					
322.93	100	1.34	63 %	272.62	
Wet Detention Ponds					
Transportation					
164.72	100	0.50	63 %	51.89	
Wet Detention Ponds					
Commercial					
38.27	100	0.77	10 %	2.95	
Dry Detention Ponds					
Forest					
27.74	100	0.06	10 %	0.17	
Dry Detention Ponds					

Industrial				
17.72	100	1.34	10 %	2.37
Dry Detention Ponds				

Low Intensity Residential				
15.63	100	0.13	10 %	0.20
Dry Detention Ponds				

Residential				
218.05	100	1.34	10 %	29.22
Dry Detention Ponds				

Transportation				
97.11	100	0.50	10 %	4.86
Dry Detention Ponds				

Commercial				
7.22	100	0.77	87 %	4.84
Perforated Pipe Infiltration/Exfiltration Systems				

Low Intensity Residential				
3.50	100	0.13	87 %	0.40
Perforated Pipe Infiltration/Exfiltration Systems				

Residential				
39.48	100	1.34	87 %	46.03
Perforated Pipe Infiltration/Exfiltration Systems				

Transportation				
15.70	100	4.03	87 %	55.05
Perforated Pipe Infiltration/Exfiltration Systems				

Cropland				
0.05	100	2.77	10 %	0.01
Dry Detention Ponds				

Cropland				
0.23	100	2.77	10 %	0.06
Dry Detention Ponds				

Cropland				
0.03	100	2.77	63 %	0.05
Wet Detention Ponds				

Cropland				
0.70	100	2.77	10 %	0.19
Dry Detention Ponds				

Cropland				
0.10	100	2.77	10 %	0.03
Dry Detention Ponds				

Cropland				
0.31	100	2.77	63 %	0.54
Wet Detention Ponds				

Cropland				
0.12	100	2.77	63 %	0.21
Wet Detention Ponds				

Cropland				
1.24	100	2.77	63 %	2.16
Wet Detention Ponds				

Cropland				
2.65	100	2.77	63 %	4.62
Wet Detention Ponds				

Cropland				
0.57	100	2.77	63 %	0.99
Wet Detention Ponds				

Cropland				
0.21	100	2.77	63 %	0.37
Wet Detention Ponds				

Cropland				
0.72	100	2.77	63 %	1.26
Wet Detention Ponds				

Cropland				
0.21	100	2.77	63 %	0.37
Wet Detention Ponds				

Cropland				
0.23	100	2.77	63 %	0.40
Wet Detention Ponds				

Cropland				
0.60	100	2.77	63 %	1.05
Wet Detention Ponds				

Cropland				
0.11	100	2.77	63 %	0.19
Wet Detention Ponds				

Cropland				
0.23	100	2.77	10 %	0.06
Dry Detention Ponds				

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2,139.01
PreDevelopment Area excluding Wetlands (ha):	2,139.01
Total PostDevelopment Area (ha):	2,139.01
Total Area treated by BMP's (ha):	1,374.13
Treated Area total:	1,374.13
Total PreDevelopment Load (kg/yr):	2,921.73
Total PostDevelopment Load (kg/yr):	1,611.56
Total P Load Reduction with BMP's (kg/yr):	654.22
Minimum P Load Reduction Required:	-1,310.17
Total PostDevelopment Load with BMP's (kg/yr)	957.34

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction

Appendix E: Alternative 2B Phosphorous Calculations

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

ALTERNATIVE 2B - SWMF FOR QUALITY CONTROL RETROFIT SUMMARY

Pond	Drainage Area (ha)	Existing Best Management Practice	Removal Efficiency (%)	Existing Phosphorus Reduction (kg/year)	Retrofit Best Management Practice	Removal Efficiency (%)	Retrofit Phosphorus Reduction (kg/year)	Increase in Phosphorus Load Reduction from Retrofit (kg/year)
KD03 (RO#13)	27.76	Dry Pond	10%	3.95	Infiltration	87%	34.41	30.45
DY02 (RO #15)	17.48	Dry Pond	10%	2.48	Infiltration	87%	21.56	19.08
RO#17	155.48	None	0%	0.00	Wet Pond	63%	100.48	100.48
KD05 (RO#18)	20.40	Dry Pond	10%	3.05	Infiltration	87%	26.53	23.48
WK01 (RO#25)	82.01	Dry Pond	10%	10.13	Wetland + Dry Pond (Treatment Train)	79%	17.35	7.22
WK04 (RO#20)	11.33	Wetland	77%	12.80	Wetland + OGS	77%	12.80	0.00
WK05 (RO#92)	106.20	Wet Pond	63%	88.53	Wet Pond + Infiltration (Treatment Train)	95%	133.77	45.23
HT06	27.82	Dry Pond	10%	4.41	Infiltration	87%	38.37	33.96
HR01 (RO#28)	25.49	Dry Pond	10%	3.97	Wet Pond	63%	24.98	21.02
RO #27	34.60	None	0%	0.00	Wet Pond	63%	29.22	29.22
LV02 (RO #30)	162.83	Dry Pond	10%	26.88	Wet Pond	63%	169.32	142.45
LV03 (RO #31)	7.53	Dry Pond	10%	1.37	Wet Pond	63%	8.62	7.25
LV12 (RO #32)	17.14	Dry Pond	10%	4.01	Infiltration	87%	34.88	30.87
LV10 (RO #37)	17.14	Dry Pond	10%	2.47	Infiltration	87%	21.51	19.04
LV05 (RO #45)	63.27	Dry Pond	10%	11.05	Dry Pond	10%	11.05	0.00
LV07 (RO #65)	39.61	Dry Pond	10%	11.70	Infiltration	87%	101.77	90.07
LV01 (RO #68)	72.15	Wet Pond	63%	62.71	Wet Pond	63%	62.71	0.00
LV16 (RO #86)	2.63	Dry Pond	10%	0.48	Wetland	77%	3.69	3.21
LV17 (RO #87)	22.03	Dry Pond	10%	4.01	Wetland	77%	30.87	26.86
BR08B (RO #61)	44.26	Dry Pond	10%	7.52	Wet Pond	63%	47.40	39.88
BR05 (RO #62)	18.46	Dry Pond	10%	3.67	Wet Pond	63%	23.11	19.44
BR13 (RO #69)	34.54	Dry Pond	10%	5.29	Wet Pond	63%	33.36	28.06
GR01 (RO #75)	34.57	Dry Pond	10%	6.72	Wet Pond	63%	42.34	35.62
GR04 (RO #76)	80.16	Dry Pond	10%	14.17	Wet Pond	63%	89.27	75.10
LTGM (RO #83)	48.85	Wet Pond	63%	37.02	Wet Pond	63%	37.02	0.00
LT05 (RO #89)	19.63	Wet Pond	63%	25.30	Wet Pond	63%	25.30	0.00
BR14 (RO #90)	49.43	Wetland	77%	67.00	Wet Pond	63%	54.82	-12.18
LT04 (RO #91)	65.95	Wet Pond	63%	66.05	Wet Pond	63%	66.05	0.00
BK04 (RO #95)	211.38	Dry Pond	10%	31.25	Dry Pond	10%	31.25	0.00

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**2771**	Total Pre-Development Phosphorus Load (kg/yr):	**3989.16**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	3.19	0.19	0.61
Forest	146.9	0.05	7.34
High Intensity - Comm/Industria	1410	1.82	2566.09
High Intensity - Residential	1057	1.32	1395.03
Low Intensity Development	154.6	0.13	20.09

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	1.62	0.19	Other	67%	0.10
			Dry Pond + Wet Pond (Treatment Train)		
Cropland	1.48	0.19	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.04
Cropland	0.09	0.19	Bioretention Systems	**88%**	0.00
			Dry Pond + Infiltration (Treatment Train)		
			NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)		
Forest	1.57	0.05	Constructed Wetlands	77%	0.02
Forest	28.64	0.05	Dry Detention Ponds	10%	1.29
Forest	0.02	0.05	Treatment Train Approach	79%	0.00
			Wetland + Dry Pond (Treatment Train)		
Forest	47.28	0.05	Wet Detention Ponds	63%	0.87
Forest	3.81	0.05	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.02
Forest	57.04	0.05	Other	67%	0.94
			Dry Pond + Wet Pond (Treatment Train)		
Forest	8.5	0.05	NONE	0%	0.43
High Intensity - Comm/Industrial	487.97	1.82	NONE	0%	888.11
High Intensity - Comm/Industrial	367.77	1.82	Dry Detention Ponds	10%	602.41
High Intensity - Comm/Industrial	20.2	1.82	Bioretention Systems	**88%**	4.41
			Dry Pond + Infiltration (Treatment Train)		
			NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)		
High Intensity - Comm/Industrial	35.56	1.82	Other	67%	21.36
			Dry Pond + Wet Pond (Treatment Train)		
High Intensity - Comm/Industrial	81.57	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	19.30
High Intensity - Comm/Industrial	351.81	1.82	Wet Detention Ponds	63%	236.91

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

High Intensity - Comm/Industrial	4.11	1.82	Treatment Train Approach	79%	1.57
			Wetland + Dry Pond (Treatmnet Train)		
High Intensity - Comm/Industrial	60.95	1.82	Constructed Wetlands	77%	25.51
High Intensity - Residential	288.3	1.32	Dry Detention Ponds	10%	342.50
High Intensity - Residential	467.51	1.32	NONE	0%	617.11
High Intensity - Residential	19.63	1.32	Constructed Wetlands	77%	5.96
High Intensity - Residential	2.2	1.32	Treatment Train Approach	79%	0.61
			Wetland + Dry Pond (Treatment Train)		
High Intensity - Residential	164.57	1.32	Wet Detention Ponds	63%	80.38
High Intensity - Residential	79.65	1.32	Perforated Pipe Infiltration/Exfiltration Systems	87%	13.67
High Intensity - Residential	7.88	1.32	Other	67%	3.43
			Dry Pond + Wet Pond (Treatment Train)		
High Intensity - Residential	27.1	1.32	Bioretention Systems	**88%**	4.29
			Dry Pond + Infiltration (Treatment Train)		
NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)					
Low Intensity Development	40.58	0.13	NONE	0%	5.28
Low Intensity Development	2.39	0.13	Other	67%	0.10
			Dry Pond + Wet Pond (Treatment Train)		
Low Intensity Development	9.67	0.13	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.16
Low Intensity Development	57.88	0.13	Wet Detention Ponds	63%	2.78
Low Intensity Development	0.27	0.13	Treatment Train Approach	79%	0.01
			Wetland + Dry Pond (Treatment Train)		
Low Intensity Development	1.8	0.13	Constructed Wetlands	77%	0.05
Low Intensity Development	40.45	0.13	Dry Detention Ponds	10%	4.73
Low Intensity Development	1.53	0.13	Bioretention Systems	**88%**	0.02
			Dry Pond + Infiltration (Treatment Train)		
NOTE: BMP efficiency has been adjusted from the reference provided value by 88% (from 0% to 88%)					

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Pond Retrofits
Subwatershed: Barrie Creeks

		P Load (kg/yr)
Post-Development Area Altered:	**2771.40**	
Total Pre-Development Area:	**2771.40**	
Unaffected Area:	**0**	
Pre-Development:		**3989.16**
Post-Development:		**3989.16**
Change (Pre - Post):		**0.00**
		0% Net Increase in Load
Post-Development (with BMPs):		**2884.38**
Change (Pre - Post):		**1104.78**
		28% Net Reduction in Load

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**3989.16**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**2884.38**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**1104.78**
Conclusion:	**28% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Lovers, Hewitts and Sandy Cove Study Area
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1993**	Total Pre-Development Phosphorus Load (kg/yr):	**2676.50**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	41.22	0.16	6.60
Forest	266.6	0.06	16.00
High Intensity - Comm/Industria	1043	1.82	1898.41
High Intensity - Residential	568.5	1.32	750.35
Low Intensity Development	73.54	0.07	5.15

DEVELOPMENT: City of Barrie MDP Update - Lovers, Hewitts and Sandy Cove Study Area
Subwatershed: Lovers Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.09	0.16	Dry Detention Ponds	10%	0.01
Cropland	36.83	0.16	NONE	0%	5.89
Cropland	4.3	0.16	Wet Detention Ponds	63%	0.25
Forest	32.69	0.06	Wet Detention Ponds	63%	0.73
Forest	0.34	0.06	Constructed Wetlands	77%	0.00
Forest	3.56	0.06	Dry Detention Ponds	10%	0.19
Forest	230.04	0.06	NONE	0%	13.80
High Intensity - Comm/Industrial	325.31	1.82	NONE	0%	592.06
High Intensity - Comm/Industrial	72.31	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	17.11
High Intensity - Comm/Industrial	473.56	1.82	Wet Detention Ponds	63%	318.90
High Intensity - Comm/Industrial	112.56	1.82	Dry Detention Ponds	10%	184.37
High Intensity - Comm/Industrial	59.34	1.82	Constructed Wetlands	77%	24.84
High Intensity - Residential	320.82	1.32	Wet Detention Ponds	63%	156.69
High Intensity - Residential	10.02	1.32	Constructed Wetlands	77%	3.04
High Intensity - Residential	31.34	1.32	Dry Detention Ponds	10%	37.23
High Intensity - Residential	206.27	1.32	NONE	0%	272.28
Low Intensity Development	26.29	0.07	NONE	0%	1.84

DEVELOPMENT: City of Barrie MDP Update - Lovers, Hewitts and Sandy Cove Study Area
Subwatershed: Lovers Creek

Low Intensity Development	1.57	0.07	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.01
Low Intensity Development	39.75	0.07	Wet Detention Ponds	63%	1.03
Low Intensity Development	4.44	0.07	Constructed Wetlands	77%	0.07
Low Intensity Development	1.49	0.07	Dry Detention Ponds	10%	0.09

Post-Development Area Altered: **1992.92**

Total Pre-Development Area: **1992.92**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**2676.50**
Post-Development:	**2676.50**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**1630.45**
Change (Pre - Post):	**1046.05**
	39% Net Reduction in Load

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2676.50**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1630.45**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**1046.05**
Conclusion:	**39% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Development Export Summary

Development :Barrie MDP - NVCA Watershed - Ponds

Updated : Sept 2014

Pre-Development Phosphorus Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.20
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.11
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.61
	Agricultural Land use Class Total :	**16.59**		**8.87**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	229.46
Industrial		140.19	0.41	187.31
Residential		714.51	0.41	958.96
Transportation		371.06	0.50	1,495.74
	Urban Land use Class Total :	**1,525.09**		**2,871.47**
	Development Total :	**2,139.01**		**2,921.73**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.49
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.78
		Phosphorus export (kg/ha/yr)	0.44
		Phosphorus load (kg/yr)	0.11

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.49
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	3.61

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.49
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.94
		Phosphorus export (kg/ha/yr)	0.95
		Phosphorus load (kg/yr)	0.20

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.51**
Phosphorus load (kg/yr) :	**8.87**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.20
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.11
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.61
	Agricultural Land use Class Total :	**16.59**		**8.87**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	230.48
Industrial		140.19	0.41	187.85
Residential		714.51	0.41	957.44
Transportation		371.06	0.50	185.53
	Urban Land use Class Total :	**1,525.09**		**1,561.30**
	Development Total :	**2,139.01**		**1,611.56**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : Barrie MDP - NVCA Watershed - Ponds

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.49
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.78
		Phosphorus export (kg/ha/yr)	0.44
		Phosphorus load (kg/yr)	0.11

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.49
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	3.61

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.49
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.94
		Phosphorus export (kg/ha/yr)	0.95
		Phosphorus load (kg/yr)	0.20

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.51**
Phosphorus load (kg/yr) :	**8.87**

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Commercial					
186.05	100	0.77	63 %	90.25	
Wet Detention Ponds					
Forest					
77.13	100	0.06	63 %	2.92	
Wet Detention Ponds					
Industrial					
87.72	100	1.34	63 %	74.05	
Wet Detention Ponds					
Low Intensity Residential					
46.85	100	0.13	63 %	3.84	
Wet Detention Ponds					
Residential					
322.93	100	1.34	63 %	272.62	
Wet Detention Ponds					
Transportation					
164.72	100	0.50	63 %	51.89	
Wet Detention Ponds					
Commercial					
38.27	100	0.77	10 %	2.95	
Dry Detention Ponds					
Forest					
27.74	100	0.06	10 %	0.17	
Dry Detention Ponds					

Industrial				
17.72	100	1.34	10 %	2.37
Dry Detention Ponds				

Low Intensity Residential				
15.63	100	0.13	10 %	0.20
Dry Detention Ponds				

Residential				
218.05	100	1.34	10 %	29.22
Dry Detention Ponds				

Transportation				
97.11	100	0.50	10 %	4.86
Dry Detention Ponds				

Commercial				
7.22	100	0.77	87 %	4.84
Perforated Pipe Infiltration/Exfiltration Systems				

Low Intensity Residential				
3.50	100	0.13	87 %	0.40
Perforated Pipe Infiltration/Exfiltration Systems				

Residential				
39.48	100	1.34	87 %	46.03
Perforated Pipe Infiltration/Exfiltration Systems				

Transportation				
15.70	100	4.03	87 %	55.05
Perforated Pipe Infiltration/Exfiltration Systems				

Cropland				
0.05	100	2.77	10 %	0.01
Dry Detention Ponds				

Cropland				
0.23	100	2.77	10 %	0.06
Dry Detention Ponds				

Cropland				
0.03	100	2.77	63 %	0.05
Wet Detention Ponds				

Cropland				
0.70	100	2.77	10 %	0.19
Dry Detention Ponds				

Cropland				
0.10	100	2.77	10 %	0.03
Dry Detention Ponds				

Cropland				
0.31	100	2.77	63 %	0.54
Wet Detention Ponds				

Cropland				
0.12	100	2.77	63 %	0.21
Wet Detention Ponds				

Cropland				
1.24	100	2.77	63 %	2.16
Wet Detention Ponds				

Cropland				
2.65	100	2.77	63 %	4.62
Wet Detention Ponds				

Cropland				
0.57	100	2.77	63 %	0.99
Wet Detention Ponds				

Cropland				
0.21	100	2.77	63 %	0.37
Wet Detention Ponds				

Cropland				
0.72	100	2.77	63 %	1.26
Wet Detention Ponds				

Cropland				
0.21	100	2.77	63 %	0.37
Wet Detention Ponds				

Cropland				
0.23	100	2.77	63 %	0.40
Wet Detention Ponds				

Cropland				
0.60	100	2.77	63 %	1.05
Wet Detention Ponds				

Cropland				
0.11	100	2.77	63 %	0.19
Wet Detention Ponds				

Cropland				
0.23	100	2.77	10 %	0.06
Dry Detention Ponds				

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2,139.01
PreDevelopment Area excluding Wetlands (ha):	2,139.01
Total PostDevelopment Area (ha):	2,139.01
Total Area treated by BMP's (ha):	1,374.13
Treated Area total:	1,374.13
Total PreDevelopment Load (kg/yr):	2,921.73
Total PostDevelopment Load (kg/yr):	1,611.56
Total P Load Reduction with BMP's (kg/yr):	654.22
Minimum P Load Reduction Required:	-1,310.17
Total PostDevelopment Load with BMP's (kg/yr)	957.34

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction

Appendix F: Alternative 2C Phosphorous Calculations

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

BARRIE CREEKS STUDY AREA - ALTERNATIVE 2C - LOT LEVEL LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	3.26	0.19
Forest	214.23	0.05
Low Intensity Development	167.55	0.13
High Intensity Development (Residential)	1253.59	1.32
High Intensity Development (Commercial/Industrial)	1795.17	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Soakaways - Infiltration Trenches (Minimum 60% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	0.00	1.64	-	1.62	0.00
Forest	0.09	105.43	-	100.21	8.50
Low Intensity Development	0.39	103.08	-	23.51	40.58
High Intensity Development (Residential)	5.97	608.40	18.36	159.51	461.35
High Intensity Development (Commercial/Industrial)	4.50	972.44	-	330.27	487.97

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **4164.31 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2C **4152.20 kg/year**

TOTAL PHOSPHORUS REDUCTION **12.11 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

HEWITTS CREEK STUDY AREA - ALTERNATIVE 2C - LOT LEVEL LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	28.98	0.19
Forest	75.76	0.05
Low Intensity Development	24.19	0.13
High Intensity Development (Residential)	213.65	1.32
High Intensity Development (Commercial/Industrial)	121.21	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Soakaways - Infiltration Trenches (Minimum 60% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	-	-	-	4.20	24.78
Forest	-	-	-	9.39	66.37
Low Intensity Development	-	-	-	14.93	9.26
High Intensity Development (Residential)	-	-	3.50	123.27	86.87
High Intensity Development (Commercial/Industrial)	-	-	-	83.27	37.94

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **312.77 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2C **311.36 kg/year**

TOTAL PHOSPHORUS REDUCTION **1.41 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

LOVERS CREEK STUDY AREA - ALTERNATIVE 2C - LOT LEVEL LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	12.24	0.16
Forest	190.86	0.06
Low Intensity Development	49.35	0.07
High Intensity Development (Residential)	354.80	1.32
High Intensity Development (Commercial/Industrial)	921.87	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Soakaways - Infiltration Trenches (Minimum 60% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	0.00	0.09	-	0.10	12.05
Forest	0.34	10.27	-	16.59	163.66
Low Intensity Development	4.44	12.08	-	15.81	17.02
High Intensity Development (Residential)	9.82	30.99	6.01	190.78	117.20
High Intensity Development (Commercial/Industrial)	34.68	364.10	-	235.72	287.37

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **1599.85 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2C **1597.28 kg/year**

TOTAL PHOSPHORUS REDUCTION **2.57 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

NVCA WATERSHED STUDY AREA - ALTERNATIVE 2C - LOT LEVEL LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	16.60	Varies
Natural Heritage - Forest	518.11	0.06
Natural Heritage - Low Intensity Residential	79.22	0.13
Urban - Residential	714.51	1.34
Urban - Commercial	299.33	0.77
Urban - Industrial	140.19	1.34
Urban - Transportation	371.06	4.03

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Soakaways - Infiltration Trenches (Minimum 60% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	-	1.62	-	6.68	8.30
Natural Heritage - Forest	-	36.09	-	68.78	413.24
Natural Heritage - Low Intensity Residential	-	26.42	-	32.60	20.20
Urban - Residential	-	333.93	2.54	195.62	182.42
Urban - Commercial	-	53.99	-	128.26	117.08
Urban - Industrial	-	17.72	-	87.72	34.75
Urban - Transportation	-	142.58	-	111.12	117.36

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **2517.35 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2D **2515.91 kg/year**

TOTAL PHOSPHORUS REDUCTION **1.44 kg/year**

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**3434**	Total Pre-Development Phosphorus Load (kg/yr):	**4955.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	3.26	0.19	0.62
Forest	214.2	0.05	10.71
High Intensity - Comm/Industria	1795	1.82	3267.21
High Intensity - Residential	1254	1.32	1654.74
Low Intensity Development	167.6	0.13	21.78

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Barrie Creeks

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	1.64	0.19	Dry Detention Ponds	10%	0.28
Cropland	1.62	0.19	Wet Detention Ponds	63%	0.11
Forest	100.21	0.05	Wet Detention Ponds	63%	1.85
Forest	0.09	0.05	Constructed Wetlands	77%	0.00
Forest	105.42	0.05	Dry Detention Ponds	10%	4.74
Forest	8.51	0.05	NONE	0%	0.43
High Intensity - Comm/Industrial	487.96	1.82	NONE	0%	888.09
High Intensity - Comm/Industrial	330.27	1.82	Wet Detention Ponds	63%	222.40
High Intensity - Comm/Industrial	4.5	1.82	Constructed Wetlands	77%	1.88
High Intensity - Comm/Industrial	972.44	1.82	Dry Detention Ponds	10%	1592.86
High Intensity - Residential	6.18	1.32	Soakaways - Infiltration trenches	60%	3.26
High Intensity - Residential	159.51	1.32	Wet Detention Ponds	63%	77.90
High Intensity - Residential	0.82	1.32	Treatment Train Approach	1%	1.07
			Soakaway + Wet Pond		
High Intensity - Residential	5.97	1.32	Constructed Wetlands	77%	1.81
High Intensity - Residential	608.4	1.32	Dry Detention Ponds	10%	722.78
High Intensity - Residential	461.35	1.32	NONE	0%	608.98
High Intensity - Residential	0.38	1.32	Hydrodynamic devices	**91%**	0.05
			Soakaway + Wetland		

NOTE: BMP efficiency has been adjusted from the reference provided value by 91% (from 0% to 91%)

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2C - Lot Level Low Impact Development

Subwatershed: Barrie Creeks

High Intensity - Residential	10.98	1.32	Other	64%	5.22
			Soakaway + Dry Pond		
Low Intensity Development	40.58	0.13	NONE	0%	5.28
Low Intensity Development	23.51	0.13	Wet Detention Ponds	63%	1.13
Low Intensity Development	0.39	0.13	Constructed Wetlands	77%	0.01
Low Intensity Development	103.07	0.13	Dry Detention Ponds	10%	12.06

Post-Development Area Altered: **3433.80**

Total Pre-Development Area: **3433.80**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**4955.06**
Post-Development:	**4955.06**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**4152.20**
Change (Pre - Post):	**802.86**
16% Net Reduction in Load	

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**4955.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**4152.20**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**802.86**
Conclusion:	**16% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

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Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Hewitts Creek

Total Pre-Development Area (ha):	**463.8**	Total Pre-Development Phosphorus Load (kg/yr):	**515.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	28.97	0.19	5.50
Forest	75.76	0.05	3.79
High Intensity - Comm/Industria	121.2	1.82	220.60
High Intensity - Residential	213.7	1.32	282.02
Low Intensity Development	24.19	0.13	3.14

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Hewitts Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	24.77	0.19	NONE	0%	4.71
Cropland	4.2	0.19	Wet Detention Ponds	63%	0.30
Forest	66.37	0.05	NONE	0%	3.32
Forest	9.39	0.05	Wet Detention Ponds	63%	0.17
High Intensity - Comm/Industrial	37.94	1.82	NONE	0%	69.05
High Intensity - Comm/Industrial	83.27	1.82	Wet Detention Ponds	63%	56.07
High Intensity - Residential	86.87	1.32	NONE	0%	114.67
High Intensity - Residential	2.74	1.32	Treatment Train Approach	85%	0.54
					Soakaway + Wet Pond
High Intensity - Residential	123.27	1.32	Wet Detention Ponds	63%	60.21
High Intensity - Residential	0.77	1.32	Soakaways - Infiltration trenches	60%	0.41
					Soakaway
Low Intensity Development	9.26	0.13	NONE	0%	1.20
Low Intensity Development	14.93	0.13	Wet Detention Ponds	63%	0.72

		P Load (kg/yr)
Post-Development Area Altered:	**463.78**	
Total Pre-Development Area:	**463.78**	
Unaffected Area:	**0**	
Pre-Development:		**515.06**
Post-Development:		**515.06**
Change (Pre - Post):		**0.00**
		0% Net Reduction in Load
Post-Development (with BMPs):		**311.36**
Change (Pre - Post):		**203.69**
		40% Net Reduction in Load

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Hewitts Creek

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**515.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**311.36**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**203.69**
Conclusion:	**40% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1529**	Total Pre-Development Phosphorus Load (kg/yr):	**2163.00**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	12.24	0.16	1.96
Forest	190.9	0.06	11.45
High Intensity - Comm/Industria	921.9	1.82	1677.80
High Intensity - Residential	354.8	1.32	468.34
Low Intensity Development	49.35	0.07	3.45

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Lovers Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.093	0.16	Dry Detention Ponds	10%	0.01
Cropland	12.05	0.16	NONE	0%	1.93
Cropland	0.1	0.16	Wet Detention Ponds	63%	0.01
Forest	16.6	0.06	Wet Detention Ponds	63%	0.37
Forest	0.34	0.06	Constructed Wetlands	77%	0.00
Forest	10.27	0.06	Dry Detention Ponds	10%	0.55
Forest	163.66	0.06	NONE	0%	9.82
High Intensity - Comm/Industrial	287.37	1.82	NONE	0%	523.01
High Intensity - Comm/Industrial	235.72	1.82	Wet Detention Ponds	63%	158.73
High Intensity - Comm/Industrial	34.68	1.82	Constructed Wetlands	77%	14.52
High Intensity - Comm/Industrial	364.1	1.82	Dry Detention Ponds	10%	596.40
High Intensity - Residential	1.43	1.32	Soakaways - Infiltration trenches	60%	0.76
					Soakaway
High Intensity - Residential	190.78	1.32	Wet Detention Ponds	63%	93.18
High Intensity - Residential	3.96	1.32	Treatment Train Approach	84%	0.84
					Soakaway + Wet Pond
High Intensity - Residential	9.82	1.32	Constructed Wetlands	77%	2.98
High Intensity - Residential	31	1.32	Dry Detention Ponds	10%	36.83
High Intensity - Residential	117.19	1.32	NONE	0%	154.69

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Lovers Creek

High Intensity - Residential	0.2	1.32	Hydrodynamic devices	**91%**	0.02
					Soakaway + Wetland

NOTE: BMP efficiency has been adjusted from the reference provided value by 91% (from 0% to 91%)

High Intensity - Residential	0.42	1.32	Other	64%	0.20
					Soakaway + Dry Pond
Low Intensity Development	17.02	0.07	NONE	0%	1.19
Low Intensity Development	15.81	0.07	Wet Detention Ponds	63%	0.41
Low Intensity Development	4.44	0.07	Constructed Wetlands	77%	0.07
Low Intensity Development	12.08	0.07	Dry Detention Ponds	10%	0.76

Post-Development Area Altered: **1529.13**

Total Pre-Development Area: **1529.13**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**2163.00**
Post-Development:	**2163.00**
Change (Pre - Post):	**0.00**
0% Net Increase in Load	
Post-Development (with BMPs):	**1597.28**
Change (Pre - Post):	**565.72**
26% Net Reduction in Load	

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2C - Lot Level Low Impact Development
Subwatershed: Lovers Creek

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2163.00**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1597.28**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**565.72**
Conclusion:	**26% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Development Export Summary

Development :City of Barrie MDP Update - NVCA Watersheds - Alternative 2C

Updated : Sept 2014

Pre-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2C

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.04
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.22**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	229.46
Industrial		140.19	0.41	187.31
Residential		714.51	0.41	958.96
Transportation		371.06	0.50	1,495.74
	Urban Land use Class Total :	**1,525.09**		**2,871.47**
	Development Total :	**2,139.01**		**2,921.08**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2C

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.09
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.00
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.04

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**12.83**
Phosphorus load (kg/yr) :	**8.22**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2C

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.26**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	230.48
Industrial		140.19	0.41	187.85
Residential		714.51	0.41	957.44
Transportation		371.06	0.50	185.53
	Urban Land use Class Total :	**1,525.09**		**1,561.30**
	Development Total :	**2,139.01**		**1,610.95**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2C

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.19**
Phosphorus load (kg/yr) :	**8.26**

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Commercial					
128.26	100	0.77	63 %	62.22	
Wet Detention Ponds					
Commercial					
53.99	100	0.77	10 %	4.16	
Dry Detention Ponds					
Forest					
68.78	100	0.06	63 %	2.60	
Wet Detention Ponds					
Forest					
36.09	100	0.06	10 %	0.22	
Dry Detention Ponds					
Industrial					
87.72	100	1.34	63 %	74.06	
Wet Detention Ponds					
Industrial					
17.72	100	1.34	10 %	2.37	
Dry Detention Ponds					
Low Intensity Residential					
32.60	100	0.13	63 %	2.67	
Wet Detention Ponds					
Low Intensity Residential					
26.42	100	0.13	10 %	0.34	
Dry Detention Ponds					

Residential					
0.77	100	1.34	84 %	0.87	Soakaway + Wet Pond
User Entry					

Residential					
1.21	100	1.34	64 %	1.04	Soakaway + Dry Pond
User Entry					

Residential					
0.56	100	1.34	60 %	0.45	Soakaway
Soakaways - Infiltration Trenches					

Cropland					
0.05	100	0.36	10 %		BR114
Dry Detention Ponds					

Cropland					
0.23	100	0.26	10 %	0.01	BR119
Dry Detention Ponds					

Cropland					
0.03	100	0.46	63 %	0.01	BR154
Wet Detention Ponds					

Cropland					
0.70	100	0.60	10 %	0.04	BR164
Dry Detention Ponds					

Cropland					
0.10	100	0.67	10 %	0.01	BR165
Dry Detention Ponds					

Cropland					
0.31	100	2.77	10 %	0.09	BR166
Dry Detention Ponds					

Cropland					
0.12	100	0.48	63 %	0.04	BR181
Wet Detention Ponds					

Cropland					
1.24	100	0.31	63 %	0.24	BR182
Wet Detention Ponds					

Cropland					
2.65	100	0.52	63 %	0.87	BR186
Wet Detention Ponds					

Cropland					
0.57	100	0.83	63 %	0.30	BR187
Wet Detention Ponds					

Cropland					
0.21	100	0.72	63 %	0.09	BR188
Wet Detention Ponds					

Cropland					
0.72	100	0.36	63 %	0.16	BR189
Wet Detention Ponds					

Cropland					
0.21	100	0.77	63 %	0.10	BR195
Wet Detention Ponds					

Cropland					
0.23	100	0.28	63 %	0.04	LT111
Wet Detention Ponds					

Cropland					
0.60	100	0.32	63 %	0.12	LT112
Wet Detention Ponds					

Cropland					
0.23	100	0.51	10 %	0.01	LT113
Dry Detention Ponds					

Cropland					
0.11	100	0.67	63 %	0.05	LT114
Wet Detention Ponds					

Residential				
195.62	100	1.34	63 %	165.14
Wet Detention Ponds				
Residential				
333.93	100	1.34	10 %	44.75
Dry Detention Ponds				
Transportation				
111.12	100	0.50	63 %	35.00
Wet Detention Ponds				
Transportation				
142.58	100	0.50	10 %	7.13
Dry Detention Ponds				

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Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2,139.01
PreDevelopment Area excluding Wetlands (ha):	2,139.01
Total PostDevelopment Area (ha):	2,139.01
Total Area treated by BMP's (ha):	1,245.67
Treated Area total:	1,245.67
Total PreDevelopment Load (kg/yr):	2,921.08
Total PostDevelopment Load (kg/yr):	1,610.95
Total P Load Reduction with BMP's (kg/yr):	405.20
Minimum P Load Reduction Required:	-1,310.13
Total PostDevelopment Load with BMP's (kg/yr)	1,205.75

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction

Appendix G: Alternative 2D Phosphorous Calculations

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

BARRIE CREEKS STUDY AREA - ALTERNATIVE 2D - LINEAR LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	3.26	0.19
Forest	214.23	0.05
Low Intensity Development	167.55	0.13
High Intensity Development (Residential)	1253.59	1.32
High Intensity Development (Commercial/Industrial)	1795.17	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Perforated Pipe Infiltration/Exfiltration Systems (Minimum 87% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	0.00	1.64	-	1.62	0.00
Forest	0.09	105.43	-	100.21	8.50
Low Intensity Development	0.39	103.08	-	23.51	40.58
High Intensity Development (Residential)	6.35	619.38	-	160.34	467.52
High Intensity Development (Commercial/Industrial)	2.61	812.96	255.61	318.08	405.91

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **4164.31 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2D **3800.21 kg/year**

TOTAL PHOSPHORUS REDUCTION **364.10 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

HEWITTS CREEK STUDY AREA - ALTERNATIVE 2D - LINEAR LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	28.98	0.19
Forest	75.76	0.05
Low Intensity Development	24.19	0.13
High Intensity Development (Residential)	213.65	1.32
High Intensity Development (Commercial/Industrial)	121.21	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Perforated Pipe Infiltration/Exfiltration Systems (Minimum 87% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	-	-	-	4.20	24.78
Forest	-	-	-	9.39	66.37
Low Intensity Development	-	-	-	14.93	9.26
High Intensity Development (Residential)	-	-	-	126.01	87.64
High Intensity Development (Commercial/Industrial)	-	-	57.19	43.73	20.28

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **312.77 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2D **261.79 kg/year**

TOTAL PHOSPHORUS REDUCTION **50.98 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

LOVERS CREEK STUDY AREA - ALTERNATIVE 2D - LINEAR LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	12.24	0.16
Forest	190.86	0.06
Low Intensity Development	49.35	0.07
High Intensity Development (Residential)	354.80	1.32
High Intensity Development (Commercial/Industrial)	921.87	1.82

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Perforated Pipe Infiltration/Exfiltration Systems (Minimum 87% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	0.00	0.09	-	0.10	12.05
Forest	0.34	10.27	-	16.59	163.66
Low Intensity Development	4.44	12.08	-	15.81	17.02
High Intensity Development (Residential)	10.02	31.41	-	194.74	118.63
High Intensity Development (Commercial/Industrial)	29.79	350.56	99.11	128.28	314.13

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **1599.85 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2D **1504.59 kg/year**

TOTAL PHOSPHORUS REDUCTION **95.26 kg/year**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

NVCA WATERSHED STUDY AREA - ALTERNATIVE 2D - LINEAR LID

Land Use	Area (ha)	Phosphorous Export Coefficient (kg/ha/year)
Cropland	16.60	Varies
Natural Heritage - Forest	518.11	0.06
Natural Heritage - Low Intensity Residential	79.22	0.13
Urban - Residential	714.51	1.34
Urban - Commercial	299.33	0.77
Urban - Industrial	140.19	1.34
Urban - Transportation	371.06	4.03

Land Use	Area (ha)				
	Constructed Wetland (77% Removal)	Dry Detention Pond (10% Removal)	Perforated Pipe Infiltration/Exfiltration Systems (Minimum 87% Removal)	Wet Detention Pond (63% Removal)	Uncontrolled (0% Removal)
Cropland	-	1.62	-	6.68	8.30
Natural Heritage - Forest	-	36.09	-	68.78	413.24
Natural Heritage - Low Intensity Residential	-	26.42	-	32.60	20.20
Urban - Residential	-	335.14	-	196.38	182.99
Urban - Commercial	-	53.99	-	128.26	117.08
Urban - Industrial	-	17.72	-	87.72	34.75
Urban - Transportation	-	42.06	202.37	50.57	76.06

TOTAL PHOSPHOROUS LOADING UNDER EXISTING CONDITIONS **2517.35 kg/year**
TOTAL PHOSPHOROUS LOADING UNDER ALTERNATIVE 2D **2450.39 kg/year**

TOTAL PHOSPHORUS REDUCTION **66.96 kg/year**

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2D - Linear Low Impact Development
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**3434**	Total Pre-Development Phosphorus Load (kg/yr):	**4955.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	3.26	0.19	0.62
Forest	214.2	0.05	10.71
High Intensity - Comm/Industria	1795	1.82	3267.21
High Intensity - Residential	1254	1.32	1654.74
Low Intensity Development	167.6	0.13	21.78

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2D - Linear Low Impact Development
Subwatershed: Barrie Creeks

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	1.64	0.19	Dry Detention Ponds	10%	0.28
Cropland	1.62	0.19	Wet Detention Ponds	63%	0.11
Forest	100.21	0.05	Wet Detention Ponds	63%	1.85
Forest	0.09	0.05	Constructed Wetlands	77%	0.00
Forest	105.42	0.05	Dry Detention Ponds	10%	4.74
Forest	8.51	0.05	NONE	0%	0.43
High Intensity - Comm/Industrial	812.97	1.82	Dry Detention Ponds	10%	1331.64
High Intensity - Comm/Industrial	159.48	1.82	Other	88%	34.83
			Perforated Pipe + Dry Pond		
High Intensity - Comm/Industrial	82.06	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	19.42
			Perforated Pipe		
High Intensity - Comm/Industrial	318.08	1.82	Wet Detention Ponds	63%	214.20
High Intensity - Comm/Industrial	2.61	1.82	Constructed Wetlands	77%	1.09
High Intensity - Comm/Industrial	405.9	1.82	NONE	0%	738.74
High Intensity - Comm/Industrial	1.89	1.82	Hydrodynamic devices	**97%**	0.10
			Perforated Pipe + Wetland		
NOTE: BMP efficiency has been adjusted from the reference provided value by 97% (from 0% to 97%)					
High Intensity - Comm/Industrial	12.18	1.82	Treatment Train Approach	95%	1.11
			Perforated Pipe + Wet Pond		
High Intensity - Residential	160.34	1.32	Wet Detention Ponds	63%	78.31
High Intensity - Residential	6.35	1.32	Constructed Wetlands	77%	1.93
High Intensity - Residential	619.38	1.32	Dry Detention Ponds	10%	735.82

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2D - Linear Low Impact Development
Subwatershed: Barrie Creeks

High Intensity - Residential	467.52	1.32	NONE	0%	617.13
Low Intensity Development	40.58	0.13	NONE	0%	5.28
Low Intensity Development	23.51	0.13	Wet Detention Ponds	63%	1.13
Low Intensity Development	0.39	0.13	Constructed Wetlands	77%	0.01
Low Intensity Development	103.07	0.13	Dry Detention Ponds	10%	12.06

Post-Development Area Altered: **3433.80**

Total Pre-Development Area: **3433.80**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**4955.06**
Post-Development:	**4955.06**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**3800.21**
Change (Pre - Post):	**1154.85**
23% Net Reduction in Load	

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**4955.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**3800.21**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**1154.85**
Conclusion:	**23% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Hewitts Creek

Total Pre-Development Area (ha):	**463.78**	Total Pre-Development Phosphorus Load (kg/yr):	**515.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	28.97	0.19	5.50
Forest	75.76	0.05	3.79
High Intensity - Comm/Industria	121.21	1.82	220.60
High Intensity - Residential	213.65	1.32	282.02
Low Intensity Development	24.19	0.13	3.14

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Hewitts Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	24.77	0.19	NONE	0%	4.71
Cropland	4.2	0.19	Wet Detention Ponds	63%	0.30
Forest	66.37	0.05	NONE	0%	3.32
Forest	9.39	0.05	Wet Detention Ponds	63%	0.17
High Intensity - Comm/Industrial	20.29	1.82	NONE	0%	36.93
High Intensity - Comm/Industrial	39.539	1.82	Treatment Train Approach	95%	3.60
			Perforated Pipe + Wet Pond		
High Intensity - Comm/Industrial	43.73	1.82	Wet Detention Ponds	63%	29.45
High Intensity - Comm/Industrial	17.653	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	4.18
			Perforated Pipe		
High Intensity - Residential	87.64	1.32	NONE	0%	115.68
High Intensity - Residential	126.01	1.32	Wet Detention Ponds	63%	61.54
Low Intensity Development	9.26	0.13	NONE	0%	1.20
Low Intensity Development	14.93	0.13	Wet Detention Ponds	63%	0.72

Post-Development Area Altered: **463.78**

Total Pre-Development Area: **463.78**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**515.06**
Post-Development:	**515.06**
Change (Pre - Post):	**0.00**
0% Net Increase in Load	
Post-Development (with BMPs):	**261.79**
Change (Pre - Post):	**253.26**
49% Net Reduction in Load	

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Hewitts Creek

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**515.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**261.79**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**253.26**
Conclusion:	**49% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1529**	Total Pre-Development Phosphorus Load (kg/yr):	**2163.00**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	12.24	0.16	1.96
Forest	190.9	0.06	11.45
High Intensity - Comm/Industria	921.9	1.82	1677.80
High Intensity - Residential	354.8	1.32	468.34
Low Intensity Development	49.35	0.07	3.45

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Lovers Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.09	0.16	Dry Detention Ponds	10%	0.01
Cropland	12.05	0.16	NONE	0%	1.93
Cropland	0.1	0.16	Wet Detention Ponds	63%	0.01
Forest	16.6	0.06	Wet Detention Ponds	63%	0.37
Forest	0.34	0.06	Constructed Wetlands	77%	0.00
Forest	10.27	0.06	Dry Detention Ponds	10%	0.55
Forest	163.66	0.06	NONE	0%	9.82
High Intensity - Comm/Industrial	350.56	1.82	Dry Detention Ponds	10%	574.22
High Intensity - Comm/Industrial	18.54	1.82	Other	88%	4.05
			Perforated Pipe + Dry Pond		
High Intensity - Comm/Industrial	27.24	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	6.44
			Perforated Pipe		
High Intensity - Comm/Industrial	182.28	1.82	Wet Detention Ponds	63%	122.75
High Intensity - Comm/Industrial	29.79	1.82	Constructed Wetlands	77%	12.47
High Intensity - Comm/Industrial	260.13	1.82	NONE	0%	473.44
High Intensity - Comm/Industrial	4.89	1.82	Hydrodynamic devices	**97%**	0.27
			Perforated Pipe + Wetland		
NOTE: BMP efficiency has been adjusted from the reference provided value by 97% (from 0% to 97%)					
High Intensity - Comm/Industrial	48.44	1.82	Treatment Train Approach	95%	4.41
			Perforated Pipe + Wet Pond		
High Intensity - Residential	194.74	1.32	Wet Detention Ponds	63%	95.11
High Intensity - Residential	10.02	1.32	Constructed Wetlands	77%	3.04

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Lovers Creek

High Intensity - Residential	31.41	1.32	Dry Detention Ponds	10%	37.32
High Intensity - Residential	118.63	1.32	NONE	0%	156.59
Low Intensity Development	17.02	0.07	NONE	0%	1.19
Low Intensity Development	15.81	0.07	Wet Detention Ponds	63%	0.41
Low Intensity Development	4.44	0.07	Constructed Wetlands	77%	0.07
Low Intensity Development	12.08	0.07	Dry Detention Ponds	10%	0.76

Post-Development Area Altered: **1529.13**

Total Pre-Development Area: **1529.13**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**2163.00**
Post-Development:	**2163.00**
Change (Pre - Post):	**0.00**
0% Net Increase in Load	
Post-Development (with BMPs):	**1505.23**
Change (Pre - Post):	**657.78**
30% Net Reduction in Load	

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2D - Linear Low Impact Development
Subwatershed: Lovers Creek

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2163.00**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1505.23**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**657.78**
Conclusion:	**30% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Development Export Summary

Development :City of Barrie MDP Update - NVCA Watersheds - Alternative 2D

Updated : Sept 2014

Pre-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2D

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR195	0.21		0.06
Cropland	BR188	0.21		0.15
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.11
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.10**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	229.46
Industrial		140.19	0.41	187.31
Residential		714.51	0.41	958.96
Transportation		371.06	0.50	1,495.74
	Urban Land use Class Total :	**1,525.09**		**2,871.47**
	Development Total :	**2,139.01**		**2,920.96**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2D

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.09
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.91
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.06

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.09
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.38
		Phosphorus export (kg/ha/yr)	0.22
		Phosphorus load (kg/yr)	0.11

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**12.59**
Phosphorus load (kg/yr) :	**8.10**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2D

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.26**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	230.48
Industrial		140.19	0.41	187.85
Residential		714.51	0.41	957.44
Transportation		371.06	0.50	185.53
	Urban Land use Class Total :	**1,525.09**		**1,561.30**
	Development Total :	**2,139.01**		**1,610.95**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2D

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.19**
Phosphorus load (kg/yr) :	**8.26**

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Commercial					
128.26	100	0.77	63 %	62.22	
Wet Detention Ponds					
Forest					
68.78	100	0.06	63 %	2.60	
Wet Detention Ponds					
Industrial					
87.72	100	1.34	63 %	74.05	
Wet Detention Ponds					
Low Intensity Residential					
32.60	100	0.13	63 %	2.67	
Wet Detention Ponds					
Residential					
196.38	100	1.34	63 %	165.78	
Wet Detention Ponds					
Transportation					
60.55	100	0.50	95 %	28.76	Perforated Pipe + Wet Pond
User Entry					
Commercial					
53.99	100	0.77	10 %	4.16	
Dry Detention Ponds					
Forest					
36.09	100	0.06	10 %	0.22	
Dry Detention Ponds					

Industrial					
17.72	100	1.34	10 %	2.37	
Dry Detention Ponds					
Low Intensity Residential					
26.42	100	0.13	10 %	0.34	
Dry Detention Ponds					
Transportation					
100.52	100	0.50	88 %	44.23	Perforated Pipe + Dry Pond
User Entry					
Cropland					
0.05	100	0.36	10 %		BR114
Dry Detention Ponds					
Cropland					
0.23	100	0.26	10 %	0.01	BR119
Dry Detention Ponds					
Cropland					
0.03	100	0.46	63 %	0.01	BR154
Wet Detention Ponds					
Cropland					
0.70	100	0.60	63 %	0.27	BR164
Wet Detention Ponds					
Cropland					
0.10	100	0.67	10 %	0.01	BR165
Dry Detention Ponds					
Cropland					
0.31	100	2.77	10 %	0.09	BR166
Dry Detention Ponds					
Cropland					
0.12	100	0.48	63 %	0.04	BR181
Wet Detention Ponds					

Cropland					
1.24	100	0.31	63 %	0.24	BR182
Wet Detention Ponds					

Cropland					
2.65	100	0.52	63 %	0.87	BR186
Wet Detention Ponds					

Cropland					
0.57	100	0.83	63 %	0.30	BR187
Wet Detention Ponds					

Cropland					
0.21	100	0.72	63 %	0.09	BR188
Wet Detention Ponds					

Cropland					
0.72	100	0.36	63 %	0.16	BR189
Wet Detention Ponds					

Cropland					
0.21	100	0.77	63 %	0.10	BR195
Wet Detention Ponds					

Cropland					
0.23	100	0.28	63 %	0.04	LT111
Wet Detention Ponds					

Cropland					
0.60	100	0.32	63 %	0.12	LT112
Wet Detention Ponds					

Cropland					
0.23	100	0.51	10 %	0.01	LT113
Dry Detention Ponds					

Cropland					
0.11	100	0.67	63 %	0.05	LT114
Wet Detention Ponds					

Transportation					
41.30	100	0.50	87 %	17.97	Perforated Pipe
Perforated Pipe Infiltration/Exfiltration Systems					

Residential				
335.14	100	1.34	10 %	44.91
Dry Detention Ponds				

Transportation				
50.57	100	0.50	63 %	15.93
Wet Detention Ponds				

Transportation				
42.06	100	0.50	10 %	2.10
Dry Detention Ponds				

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2,139.01
PreDevelopment Area excluding Wetlands (ha):	2,139.01
Total PostDevelopment Area (ha):	2,139.01
Total Area treated by BMP's (ha):	1,286.40
Treated Area total:	1,286.40
Total PreDevelopment Load (kg/yr):	2,920.96
Total PostDevelopment Load (kg/yr):	1,610.95
Total P Load Reduction with BMP's (kg/yr):	470.72
Minimum P Load Reduction Required:	-1,310.01
Total PostDevelopment Load with BMP's (kg/yr)	1,140.23

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction

Appendix H: Alternative 2E Phosphorous Calculations

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

CENTRALIZED LIDS

Park	Land Use	Area (ha)	Phosphorus Coefficient (kg/ha)	Best Management Practice	Removal Efficiency (%)	Phosphorus Load Reduction (kg/year)	Increase in Phosphorus Load Reduction From LID (kg/year)
BARRIE CREEKS PARKS							
Allandale Park	Cropland	0.00	0.19	-	-	0.00	0.00
	Forest	0.00	0.05	-	-	0.00	0.00
	Low Intensity Development	0.00	0.13	Centralized LID	0.87	0.00	0.00
	High Intensity Development (Residential)	1.93	1.32	Centralized LID	0.87	2.22	2.22
	High Intensity Development (Commercial)	0.60	1.82	Centralized LID	0.87	0.95	0.95
				Phosphorus Reduction From Allandale Park LID =		**3.17**	**3.17**
Assickinack Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.00	0.07	-	-	0.00	0.00
	High Intensity Development (Residential)	4.58	1.32	Centralized LID + Dry Pond	0.88	5.32	4.72
	High Intensity Development (Commercial)	2.74	1.82	Centralized LID + Dry Pond	0.88	4.39	3.89
				Phosphorus Reduction From Assickinack Park LID =		**9.71**	**8.61**
Cloughley Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.01	0.06	Centralized LID + Dry Pond	0.88	0.00	0.00
	Low Intensity Development	0.00	0.07	-	-	0.00	0.00
	High Intensity Development (Residential)	1.06	1.32	Centralized LID + Dry Pond	0.88	1.23	1.09
	High Intensity Development (Commercial)	0.44	1.82	Centralized LID + Dry Pond	0.88	0.70	0.62
				Phosphorus Reduction From Choughley Park LID =		**1.94**	**1.72**
Gibbon Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.00	0.07	-	-	0.00	0.00
	High Intensity Development (Residential)	3.03	1.32	Centralized LID + Dry Pond	0.88	3.52	3.12
	High Intensity Development (Commercial)	1.28	1.82	Centralized LID + Dry Pond	0.88	2.05	1.82
				Phosphorus Reduction From Gibbon Park LID =		**5.57**	**4.94**
Greenfield Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.11	0.07	Centralized LID + Dry Pond	0.88	0.01	0.01
	High Intensity Development (Residential)	16.54	1.32	Centralized LID + Dry Pond	0.88	19.21	17.03
	High Intensity Development (Commercial)	6.90	1.82	Centralized LID + Dry Pond	0.88	11.05	9.80
				Phosphorus Reduction From Greenfield Park LID =		**30.27**	**26.83**
Harvie Park	Cropland	0.00	0.16	Centralized LID + Dry Pond	0.88	0.00	0.00
	Forest	0.01	0.06	Centralized LID + Dry Pond	0.88	0.00	0.00
	Low Intensity Development	0.48	0.07	Centralized LID + Dry Pond	0.88	0.03	0.03
	High Intensity Development (Residential)	0.55	1.32	Centralized LID + Dry Pond	0.88	0.64	0.57
	High Intensity Development (Commercial)	1.49	1.82	Centralized LID + Dry Pond	0.88	2.39	2.12
				Phosphorus Reduction From Harvie Park LID =		**3.06**	**2.71**
Mapleton Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.12	0.07	Centralized LID + Dry Pond	0.88	0.01	0.01
	High Intensity Development (Residential)	1.21	1.32	Centralized LID + Dry Pond	0.88	1.41	1.25
	High Intensity Development (Commercial)	0.75	1.82	Centralized LID + Dry Pond	0.88	1.20	1.06
				Phosphorus Reduction From Mapleton Park LID =		**2.61**	**2.32**
Montserrand Park	Cropland	0.09	0.16	Centralized LID + Dry Pond	0.88	0.01	0.01
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.48	0.07	Centralized LID + Dry Pond	0.88	0.03	0.03
	High Intensity Development (Residential)	3.83	1.32	Centralized LID + Dry Pond	0.88	4.45	3.94
	High Intensity Development (Commercial)	5.63	1.82	Centralized LID + Dry Pond	0.88	9.02	7.99
				Phosphorus Reduction From Montserrand Park LID =		**13.51**	**11.97**
Shoreview Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.16	0.07	Centralized LID	0.87	0.01	0.01
	High Intensity Development (Residential)	9.91	1.32	Centralized LID	0.87	11.38	11.38
	High Intensity Development (Commercial)	11.17	1.82	Centralized LID	0.87	17.69	17.69
				Phosphorus Reduction From Shoreview Park LID =		**29.08**	**29.08**
Sunnidale Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.97	0.07	Centralized LID + Dry Pond	0.88	0.06	0.05
	High Intensity Development (Residential)	0.01	1.32	Centralized LID + Dry Pond	0.88	0.01	0.01
	High Intensity Development (Commercial)	6.75	1.82	Centralized LID + Dry Pond	0.88	10.81	9.58
				Phosphorus Reduction From Sunnidale Park LID =		**10.88**	**9.65**
						TOTAL ADDITIONAL REDUCTION FROM BARRIE CREEKS PARKS =	**100.98**
HEWITTS CREEK PARKS							
Sandringham Park	Cropland	0.96	0.19	Centralized LID + Wet Pond	0.95	0.17	0.06
	Forest	0.00	0.05	-	-	0.00	0.00
	Low Intensity Development	9.21	0.13	Centralized LID + Wet Pond	0.95	1.14	0.38
	High Intensity Development (Residential)	44.06	1.32	Centralized LID + Wet Pond	0.95	55.25	18.61
	High Intensity Development (Commercial)	25.15	1.82	Centralized LID + Wet Pond	0.95	43.48	14.65
				Phosphorus Reduction From Sandringham Park LID =		**100.05**	**33.70**
Hyde/Queensway Park	Cropland	0.00	0.19	-	-	0.00	0.00
	Forest	0.00	0.05	-	-	0.00	0.00
	Low Intensity Development	0.33	0.13	Centralized LID + Wet Pond	0.95	0.04	0.01
	High Intensity Development (Residential)	16.82	1.32	Centralized LID + Wet Pond	0.95	21.09	7.10
	High Intensity Development (Commercial)	25.10	1.82	Centralized LID + Wet Pond	0.95	43.40	14.62
				Phosphorus Reduction From Hyde/Queensway Park LID =		**64.53**	**21.74**
						TOTAL ADDITIONAL REDUCTION FROM HEWITTS CREEKS PARKS =	**55.44**

BARRIE DRAINAGE MASTER PLAN
PHOSPHOROUS ASSESSMENT
FEBRUARY, 2018

CENTRALIZED LIDS

Park	Land Use	Area (ha)	Phosphorus Coefficient (kg/ha)	Best Management Practice	Removal Efficiency (%)	Phosphorus Load Reduction (kg/year)	Increase in Phosphorus Load Reduction From LID (kg/year)
LOVERS CREEK PARKS							
Carter Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.03	0.07	Centralized LID	0.87	0.00	0.00
	High Intensity Development (Residential)	3.05	1.32	Centralized LID	0.87	3.50	3.50
	High Intensity Development (Commercial)	1.55	1.82	Centralized LID	0.87	2.45	2.45
				Phosphorus Reduction From Carter Park LID =		**5.96**	**5.96**
Kuzmich Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.00	0.07	-	-	0.00	0.00
	High Intensity Development (Residential)	0.40	1.32	Centralized LID	0.87	0.46	0.46
	High Intensity Development (Commercial/Indust	0.27	1.82	Centralized LID	0.87	0.43	0.43
				Phosphorus Reduction From Kuzmich Park LID =		**0.89**	**0.89**
Golden Meadow Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.22	0.07	Centralized LID	0.87	0.01	0.01
	High Intensity Development (Residential)	23.16	1.32	Centralized LID	0.87	26.60	26.60
	High Intensity Development (Commercial)	9.35	1.82	Centralized LID	0.87	14.80	14.80
				Phosphorus Reduction From Golden Meadow Park LID =		**41.42**	**41.42**
Madelaine Park	Cropland	0.00	0.16	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.04	0.07	Centralized LID	0.87	0.00	0.00
	High Intensity Development (Residential)	4.13	1.32	Centralized LID	0.87	4.74	4.74
	High Intensity Development (Commercial)	1.44	1.82	Centralized LID	0.87	2.28	2.28
				Phosphorus Reduction From Madelaine Park LID =		**7.03**	**7.03**
						TOTAL ADDITIONAL REDUCTION FROM LOVERS CREEK PARKS =	**55.29**
NVCA PARKS							
Bear Creek Park	Cropland	0.00	0.45	-	-	0.00	0.00
	Forest	0.02	0.06	Centralized LID + Dry Pond	0.88	0.00	0.00
	Low Intensity Development	2.72	0.13	Centralized LID + Dry Pond	0.88	0.31	0.28
	High Intensity Development (Residential)	45.80	1.34	Centralized LID + Dry Pond	0.88	54.01	47.87
	High Intensity Development (Commercial)	3.85	0.77	Centralized LID + Dry Pond	0.88	2.61	2.31
	High Intensity Development (Industrial)	0.00	1.34	Centralized LID + Dry Pond	0.88	0.00	0.00
	High Intensity Development (Transportation)	20.55	4.03	Centralized LID + Dry Pond	0.88	72.88	64.60
				Phosphorus Reduction From Bear Creek Park LID =		**129.81**	**115.06**
Cartwright Park	Cropland	0.00	0.45	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.04	0.13	Centralized LID + Dry Pond	0.88	0.00	0.00
	High Intensity Development (Residential)	2.04	1.34	Centralized LID + Dry Pond	0.88	2.41	2.13
	High Intensity Development (Commercial)	0.00	0.77	-	-	0.00	0.00
	High Intensity Development (Industrial)	0.00	1.34	-	-	0.00	0.00
	High Intensity Development (Transportation)	1.03	4.03	Centralized LID + Dry Pond	0.88	3.65	3.24
				Phosphorus Reduction From Cartwright Park LID =		**6.06**	**5.37**
Dunsmore Park	Cropland	0.00	0.45	-	-	0.00	0.00
	Forest	0.03	0.06	Centralized LID	0.87	0.00	0.00
	Low Intensity Development	0.02	0.13	Centralized LID	0.87	0.00	0.00
	High Intensity Development (Residential)	2.78	1.34	Centralized LID	0.87	3.24	3.24
	High Intensity Development (Commercial)	12.36	0.77	Centralized LID	0.87	8.28	8.28
	High Intensity Development (Industrial)	0.00	1.34	-	-	0.00	0.00
	High Intensity Development (Transportation)	0.90	4.03	Centralized LID	0.87	3.16	3.16
				Phosphorus Reduction From Dunsmore Park LID =		**14.68**	**14.68**
Lougheed Park	Cropland	0.00	0.45	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.00	0.13	-	-	0.00	0.00
	High Intensity Development (Residential)	9.99	1.34	Centralized LID + Dry Pond	0.88	11.78	10.44
	High Intensity Development (Commercial)	0.00	0.77	-	-	0.00	0.00
	High Intensity Development (Industrial)	0.00	1.34	-	-	0.00	0.00
	High Intensity Development (Transportation)	4.62	4.03	Centralized LID + Dry Pond	0.88	16.38	14.52
				Phosphorus Reduction From Lougheed Park LID =		**28.16**	**24.96**
Strabane Park	Cropland	0.00	0.45	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.10	0.13	Centralized LID	0.87	0.01	0.01
	High Intensity Development (Residential)	3.55	1.34	Centralized LID	0.87	4.14	4.14
	High Intensity Development (Commercial)	0.00	0.77	-	-	0.00	0.00
	High Intensity Development (Industrial)	0.00	1.34	-	-	0.00	0.00
	High Intensity Development (Transportation)	1.21	4.03	Centralized LID	0.87	4.24	4.24
				Phosphorus Reduction From Strabane Park LID =		**8.39**	**8.39**
Wessenger Park	Cropland	0.00	0.45	-	-	0.00	0.00
	Forest	0.00	0.06	-	-	0.00	0.00
	Low Intensity Development	0.00	0.13	-	-	0.00	0.00
	High Intensity Development (Residential)	6.49	1.34	Centralized LID + Dry Pond	0.88	7.65	6.78
	High Intensity Development (Commercial)	0.24	0.77	Centralized LID + Dry Pond	0.88	0.16	0.14
	High Intensity Development (Industrial)	0.00	1.34	-	-	0.00	0.00
	High Intensity Development (Transportation)	2.58	4.03	Centralized LID + Dry Pond	0.88	9.15	8.11
				Phosphorus Reduction From Wessenger Park LID =		**16.97**	**15.04**
						TOTAL ADDITIONAL REDUCTION FROM NVCA PARKS =	**183.50**

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MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2E - Centralized LID
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**3434**	Total Pre-Development Phosphorus Load (kg/yr):	**4955.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	3.26	0.19	0.62
Forest	214.2	0.05	10.71
High Intensity - Comm/Industria	1795	1.82	3267.21
High Intensity - Residential	1254	1.32	1654.74
Low Intensity Development	167.6	0.13	21.78

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2E - Centralized LID
Subwatershed: Barrie Creeks

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.09	0.19	Treatment Train Approach	88%	0.00
			Perforated Pipe Underground System + Dry Pond		
Cropland	1.55	0.19	Dry Detention Ponds	10%	0.27
Cropland	1.62	0.19	Wet Detention Ponds	63%	0.11
Forest	100.21	0.05	Wet Detention Ponds	63%	1.85
Forest	0.09	0.05	Constructed Wetlands	77%	0.00
Forest	105.43	0.05	Dry Detention Ponds	10%	4.74
Forest	8.5	0.05	NONE	0%	0.43
High Intensity - Comm/Industrial	476.2	1.82	NONE	0%	866.68
High Intensity - Comm/Industrial	0.75	1.82	Hydrodynamic devices	**95%**	0.07
			Perforated Pipe Underground System + Wet Pond		
NOTE: BMP efficiency has been adjusted from the reference provided value by 95% (from 0% to 95%)					
High Intensity - Comm/Industrial	11.76	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	2.78
High Intensity - Comm/Industrial	329.52	1.82	Wet Detention Ponds	63%	221.90
High Intensity - Comm/Industrial	25.22	1.82	Treatment Train Approach	88%	5.51
			Perforated Pipe Underground System + Dry Pond		
High Intensity - Comm/Industrial	4.5	1.82	Constructed Wetlands	77%	1.88
High Intensity - Comm/Industrial	947.22	1.82	Dry Detention Ponds	10%	1551.55
High Intensity - Residential	159.13	1.32	Wet Detention Ponds	63%	77.72
High Intensity - Residential	1.21	1.32	Hydrodynamic devices	**95%**	0.08
			Perforated Pipe Underground System + Wet Pond		
NOTE: BMP efficiency has been adjusted from the reference provided value by 95% (from 0% to 95%)					

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2E - Centralized LID
Subwatershed: Barrie Creeks

High Intensity - Residential	29.05	1.32	Treatment Train Approach	88%	4.60
			Perforated Pipe Underground System + Dry Pond		
High Intensity - Residential	6.35	1.32	Constructed Wetlands	77%	1.93
High Intensity - Residential	590.33	1.32	Dry Detention Ponds	10%	701.31
High Intensity - Residential	455.68	1.32	NONE	0%	601.50
High Intensity - Residential	11.84	1.32	Perforated Pipe Infiltration/Exfiltration Systems	87%	2.03
Low Intensity Development	0.16	0.13	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.00
Low Intensity Development	23.39	0.13	Wet Detention Ponds	63%	1.13
Low Intensity Development	1.57	0.13	Treatment Train Approach	88%	0.02
			Perforated Pipe Underground System + Dry Pond		
Low Intensity Development	0.39	0.13	Constructed Wetlands	77%	0.01
Low Intensity Development	101.51	0.13	Dry Detention Ponds	10%	11.88
Low Intensity Development	40.42	0.13	NONE	0%	5.25
Low Intensity Development	0.11	0.13	Hydrodynamic devices	**95%**	0.00
			Perforated Pipe Underground System + Wet Pond		

NOTE: BMP efficiency has been adjusted from the reference provided value by 95% (from 0% to 95%)

Post-Development Area Altered: **3433.80**

Total Pre-Development Area: **3433.80**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**4955.06**
Post-Development:	**4955.06**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**4065.24**
Change (Pre - Post):	**889.82**
18% Net Reduction in Load	

DEVELOPMENT: City of Barrie MDP Update - Barrie Creeks - Alternative 2E - Centralized LID
Subwatershed: Barrie Creeks

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**4955.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**4065.24**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**889.82**
Conclusion:	**18% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

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MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2E - Centralized LID
Subwatershed: Hewitts Creek

Total Pre-Development Area (ha):	**463.78**	Total Pre-Development Phosphorus Load (kg/yr):	**515.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	28.97	0.19	5.50
Forest	75.76	0.05	3.79
High Intensity - Comm/Industria	121.21	1.82	220.60
High Intensity - Residential	213.65	1.32	282.02
Low Intensity Development	24.19	0.13	3.14

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2E - Centralized LID
Subwatershed: Hewitts Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.96	0.19	Treatment Train Approach	95%	0.01
			Perforated Pipe Underground System + Wet Pond		
Cropland	24.77	0.19	NONE	0%	4.71
Cropland	3.24	0.19	Wet Detention Ponds	63%	0.23
Forest	66.37	0.05	NONE	0%	3.32
Forest	9.39	0.05	Wet Detention Ponds	63%	0.17
High Intensity - Comm/Industrial	37.94	1.82	NONE	0%	69.05
High Intensity - Comm/Industrial	50.25	1.82	Treatment Train Approach	95%	4.57
			Perforated Pipe Underground System + Wet Pond		
High Intensity - Comm/Industrial	33.02	1.82	Wet Detention Ponds	63%	22.24
High Intensity - Residential	87.63	1.32	NONE	0%	115.67
High Intensity - Residential	60.89	1.32	Treatment Train Approach	95%	4.02
			Perforated Pipe Underground System + Wet Pond		
High Intensity - Residential	65.13	1.32	Wet Detention Ponds	63%	31.81
Low Intensity Development	9.26	0.13	NONE	0%	1.20
Low Intensity Development	9.54	0.13	Treatment Train Approach	95%	0.06
			Perforated Pipe Underground System + Wet Pond		
Low Intensity Development	5.39	0.13	Wet Detention Ponds	63%	0.26

DEVELOPMENT: City of Barrie MDP Update - Hewitts Creek - Alternative 2E - Centralized LID
Subwatershed: Hewitts Creek

Post-Development Area Altered:	**463.78**
Total Pre-Development Area:	**463.78**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**515.06**
Post-Development:	**515.06**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**257.32**
Change (Pre - Post):	**257.74**
50% Net Reduction in Load	

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**515.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**257.32**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**257.74**
Conclusion:	**50% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2E - Centralized LID
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1529.1**	Total Pre-Development Phosphorus Load (kg/yr):	**2163.00**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	12.24	0.16	1.96
Forest	190.87	0.06	11.45
High Intensity - Comm/Industria	921.87	1.82	1677.80
High Intensity - Residential	354.8	1.32	468.34
Low Intensity Development	49.35	0.07	3.45

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2E - Centralized LID
Subwatershed: Lovers Creek

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
Cropland	0.1	0.16	Wet Detention Ponds	63%	0.01
Cropland	0.09	0.16	Dry Detention Ponds	10%	0.01
Cropland	12.05	0.16	NONE	0%	1.93
Forest	163.66	0.06	NONE	0%	9.82
Forest	16.6	0.06	Wet Detention Ponds	63%	0.37
Forest	10.27	0.06	Dry Detention Ponds	10%	0.55
Forest	0.34	0.06	Constructed Wetlands	77%	0.00
High Intensity - Comm/Industrial	34.68	1.82	Constructed Wetlands	77%	14.52
High Intensity - Comm/Industrial	235.72	1.82	Wet Detention Ponds	63%	158.73
High Intensity - Comm/Industrial	274.77	1.82	NONE	0%	500.08
High Intensity - Comm/Industrial	364.1	1.82	Dry Detention Ponds	10%	596.40
High Intensity - Comm/Industrial	12.6	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	2.98
High Intensity - Residential	87.89	1.32	NONE	0%	116.01
High Intensity - Residential	30.74	1.32	Perforated Pipe Infiltration/Exfiltration Systems	87%	5.27
High Intensity - Residential	10.02	1.32	Constructed Wetlands	77%	3.04
High Intensity - Residential	31.41	1.32	Dry Detention Ponds	10%	37.32
High Intensity - Residential	194.74	1.32	Wet Detention Ponds	63%	95.11

DEVELOPMENT: City of Barrie MDP Update - Lovers Creek - Alternative 2E - Centralized LID

Subwatershed: Lovers Creek

Low Intensity Development	0.29	0.07	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.00
Low Intensity Development	15.81	0.07	Wet Detention Ponds	63%	0.41
Low Intensity Development	16.73	0.07	NONE	0%	1.17
Low Intensity Development	12.08	0.07	Dry Detention Ponds	10%	0.76
Low Intensity Development	4.44	0.07	Constructed Wetlands	77%	0.07

Post-Development Area Altered: **1529.13**

Total Pre-Development Area: **1529.13**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**2163.00**
Post-Development:	**2163.00**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**1544.58**
Change (Pre - Post):	**618.43**
	29% Net Reduction in Load

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2163.00**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1544.58**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**618.43**
Conclusion:	**29% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Development Export Summary

Development : City of Barrie MDP Update - NVCA Watersheds - Alternative 2E

Updated : Sept 2014

Pre-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2E

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.27**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	229.46
Industrial		140.19	0.41	187.31
Residential		714.51	0.41	958.96
Transportation		371.06	0.50	1,495.74
	Urban Land use Class Total :	**1,525.09**		**2,871.47**
	Development Total :	**2,139.01**		**2,921.13**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2E

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.19**
Phosphorus load (kg/yr) :	**8.27**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2E

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	BR154	0.03		0.01
Cropland	BR114	0.05		0.02
Cropland	BR160	0.06		0.04
Cropland	BR165	0.10		0.07
Cropland	LT114	0.11		0.07
Cropland	BR181	0.12		0.06
Cropland	BR188	0.21		0.15
Cropland	BR195	0.21		0.16
Cropland	LT111	0.23		0.06
Cropland	BR119	0.23		0.06
Cropland	LT113	0.23		0.12
Cropland	BR157	0.24		0.09
Cropland	BR166	0.31		0.86
Cropland	BR151	0.38		0.15
Cropland	GR103	0.48		0.17
Cropland	BR187	0.57		0.47
Cropland	LT112	0.60		0.19
Cropland	BR164	0.70		0.42
Cropland	BR189	0.72		0.26
Cropland	BR182	1.24		0.39
Cropland	BR186	2.65		1.38
Cropland	BR159	7.14		3.06
	Agricultural Land use Class Total :	**16.59**		**8.27**
Natural Heritage				
Forest		518.11	0.06	31.09
Low Intensity Residential		79.22	0.13	10.30
	Natural Heritage Land use Class Total :	**597.33**		**41.39**
Urban				
Commercial		299.33	0.20	230.48
Industrial		140.19	0.41	187.85
Residential		714.51	0.41	957.44
Transportation		371.06	0.50	185.53
	Urban Land use Class Total :	**1,525.09**		**1,561.30**
	Development Total :	**2,139.01**		**1,610.96**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : City of Barrie MDP Update - NVCA Watersheds - Alternative 2E

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : BR114

Slope Area (ha)	0.05	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.19	K (soil errodability factor)	0.16
Length of Slope (m)	635.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.35
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.27
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.02

SubArea : BR119

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.54	K (soil errodability factor)	0.16
Length of Slope (m)	450.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.17
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.60
		Phosphorus export (kg/ha/yr)	0.26
		Phosphorus load (kg/yr)	0.06

SubArea : BR151

Slope Area (ha)	0.38	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.55	K (soil errodability factor)	0.09
Length of Slope (m)	1,150.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.48
		Phosphorus export (kg/ha/yr)	0.40
		Phosphorus load (kg/yr)	0.15

SubArea : BR154

Slope Area (ha)	0.03	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.77	K (soil errodability factor)	0.09
Length of Slope (m)	2,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.94
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.90
		Phosphorus export (kg/ha/yr)	0.46
		Phosphorus load (kg/yr)	0.01

SubArea : BR157

Slope Area (ha)	0.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.21	K (soil errodability factor)	0.38
Length of Slope (m)	1,030.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.16
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.38
		Phosphorus export (kg/ha/yr)	0.38
		Phosphorus load (kg/yr)	0.09

SubArea : BR159

Slope Area (ha)	7.14	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.47	K (soil errodability factor)	0.38
Length of Slope (m)	1,220.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.20
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.68
		Phosphorus export (kg/ha/yr)	0.43
		Phosphorus load (kg/yr)	3.06

SubArea : BR160

Slope Area (ha)	0.06	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.80	K (soil errodability factor)	0.09
Length of Slope (m)	1,355.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.73
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.50
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.04

SubArea : BR164

Slope Area (ha)	0.70	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.16	K (soil errodability factor)	0.29
Length of Slope (m)	1,210.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.42
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.75
		Phosphorus export (kg/ha/yr)	0.60
		Phosphorus load (kg/yr)	0.42

SubArea : BR165

Slope Area (ha)	0.10	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.87	K (soil errodability factor)	0.29
Length of Slope (m)	700.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.19
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR166

Slope Area (ha)	0.31	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	7.69	K (soil errodability factor)	0.29
Length of Slope (m)	215.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	16.33
		Phosphorus export (kg/ha/yr)	2.77
		Phosphorus load (kg/yr)	0.86

SubArea : BR181

Slope Area (ha)	0.12	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	3.64	K (soil errodability factor)	0.09
Length of Slope (m)	380.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.99
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.01
		Phosphorus export (kg/ha/yr)	0.48
		Phosphorus load (kg/yr)	0.06

SubArea : BR182

Slope Area (ha)	1.24	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.44	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.48
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.97
		Phosphorus export (kg/ha/yr)	0.31
		Phosphorus load (kg/yr)	0.39

SubArea : BR186

Slope Area (ha)	2.65	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	4.34	K (soil errodability factor)	0.09
Length of Slope (m)	315.00	NN (determined by slope)	0.40
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.12
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.26
		Phosphorus export (kg/ha/yr)	0.52
		Phosphorus load (kg/yr)	1.38

SubArea : BR187

Slope Area (ha)	0.57	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.59	K (soil errodability factor)	0.09
Length of Slope (m)	340.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	2.06
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	4.16
		Phosphorus export (kg/ha/yr)	0.83
		Phosphorus load (kg/yr)	0.47

SubArea : BR188

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	5.25	K (soil errodability factor)	0.09
Length of Slope (m)	285.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.74
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.52
		Phosphorus export (kg/ha/yr)	0.72
		Phosphorus load (kg/yr)	0.15

SubArea : BR195

Slope Area (ha)	0.21	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.39	K (soil errodability factor)	0.38
Length of Slope (m)	1,040.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.45
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.83
		Phosphorus export (kg/ha/yr)	0.77
		Phosphorus load (kg/yr)	0.16

SubArea : GR103

Slope Area (ha)	0.48	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	0.34	K (soil errodability factor)	0.29
Length of Slope (m)	1,530.00	NN (determined by slope)	0.20
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.19
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.17

SubArea : LT111

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.97	K (soil errodability factor)	0.09
Length of Slope (m)	240.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.37
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	0.75
		Phosphorus export (kg/ha/yr)	0.28
		Phosphorus load (kg/yr)	0.06

SubArea : LT112

Slope Area (ha)	0.60	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.60	K (soil errodability factor)	0.09
Length of Slope (m)	305.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.50
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.01
		Phosphorus export (kg/ha/yr)	0.32
		Phosphorus load (kg/yr)	0.19

SubArea : LT113

Slope Area (ha)	0.23	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	8.99	K (soil errodability factor)	0.09
Length of Slope (m)	25.00	NN (determined by slope)	0.50
Cropt Type Factor)	0.50	LS (slope length gradient factor)	1.07
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	2.16
		Phosphorus export (kg/ha/yr)	0.51
		Phosphorus load (kg/yr)	0.12

SubArea : LT114

Slope Area (ha)	0.11	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	1.92	K (soil errodability factor)	0.29
Length of Slope (m)	675.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.49
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	3.22
		Phosphorus export (kg/ha/yr)	0.67
		Phosphorus load (kg/yr)	0.07

SubArea : BR189

Slope Area (ha)	0.72	R (rainfall / runoff for Lake Simcoe)	90.00
Surface Slope Gradient (%)	2.73	K (soil errodability factor)	0.09
Length of Slope (m)	510.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.50	LS (slope length gradient factor)	0.61
Tillage Type Factor	1.00	C (crop management factor)	0.50
		P (prevention + capture)	0.50
		Soil Loss (kg/year)	1.24
		Phosphorus export (kg/ha/yr)	0.36
		Phosphorus load (kg/yr)	0.26

PRE Developed Area (ha) :	**16.59**
Phosphorus export (kg/ha/yr) :	**13.19**
Phosphorus load (kg/yr) :	**8.27**

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Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Low Intensity Residential					
32.60	100	0.13	63 %	2.67	
Wet Detention Ponds					
Residential					
196.38	100	1.34	63 %	165.78	
Wet Detention Ponds					
Industrial					
87.72	100	1.34	63 %	74.05	
Wet Detention Ponds					
Commercial					
128.26	100	0.77	63 %	62.22	
Wet Detention Ponds					
Forest					
68.78	100	0.06	63 %	2.60	
Wet Detention Ponds					
Transportation					
111.12	100	0.50	63 %	35.00	
Wet Detention Ponds					
Low Intensity Residential					
23.65	100	0.13	10 %	0.31	
Dry Detention Ponds					
Residential					
270.82	100	1.34	10 %	36.29	
Dry Detention Ponds					

Commercial					
49.90	100	0.77	10 %	3.84	
Dry Detention Ponds					

Forest					
36.08	100	0.06	10 %	0.22	
Dry Detention Ponds					

Transportation					
113.81	100	0.50	10 %	5.69	
Dry Detention Ponds					

Low Intensity Residential					
2.77	100	0.13	88 %	0.32	Centralized LID + Dry Pond
User Entry					

Residential					
64.32	100	1.34	88 %	75.85	Centralized LID + Dry Pond
User Entry					

Commercial					
4.09	100	0.77	88 %	2.77	Centralized LID + Dry Pond
User Entry					

Forest					
0.02	100	0.06	88 %		Centralized LID + Dry Pond
User Entry					

Transportation					
28.77	100	4.03	88 %	102.03	Centralized LID + Dry Pond
User Entry					

Low Intensity Residential					
0.12	100	0.13	87 %	0.01	
Perforated Pipe Infiltration/Exfiltration Systems					

Residential					
6.33	100	1.34	87 %	7.38	
Perforated Pipe Infiltration/Exfiltration Systems					

Commercial					
12.36	100	0.77	87 %	8.28	
Perforated Pipe Infiltration/Exfiltration Systems					

Forest					
0.03	100	0.06	87 %		
Perforated Pipe Infiltration/Exfiltration Systems					

Transportation					
2.11	100	4.03	87 %	7.40	
Perforated Pipe Infiltration/Exfiltration Systems					

Cropland					
0.05	100	2.77	10 %	0.01	BR114
Dry Detention Ponds					

Cropland					
0.23	100	2.77	10 %	0.06	BR119
Dry Detention Ponds					

Cropland					
0.03	100	2.77	63 %	0.05	BR154
Wet Detention Ponds					

Cropland					
0.70	100	2.77	10 %	0.19	BR164
Dry Detention Ponds					

Cropland					
0.10	100	2.77	10 %	0.03	BR165
Dry Detention Ponds					

Cropland					
0.31	100	2.77	10 %	0.09	BR166
Dry Detention Ponds					

Cropland					
0.12	100	2.77	63 %	0.21	BR181
Wet Detention Ponds					

Cropland					
1.24	100	2.77	63 %	2.16	BR182
Wet Detention Ponds					

Cropland					
2.65	100	2.77	63 %	4.62	BR186
Wet Detention Ponds					

Cropland					
0.57	100	2.77	63 %	0.99	BR187
Wet Detention Ponds					

Cropland					
0.21	100	2.77	63 %	0.37	BR188
Wet Detention Ponds					

Cropland					
0.72	100	2.77	63 %	1.26	BR189
Wet Detention Ponds					

Cropland					
0.21	100	2.77	63 %	0.37	BR195
Wet Detention Ponds					

Cropland					
0.23	100	2.77	63 %	0.40	LT111
Wet Detention Ponds					

Cropland					
0.60	100	2.77	63 %	1.05	LT112
Wet Detention Ponds					

Cropland					
0.23	100	2.77	10 %	0.06	LT113
Dry Detention Ponds					

Cropland					
0.11	100	2.77	63 %	0.19	LT114
Wet Detention Ponds					

Industrial				
17.72	100	1.34	10 %	2.37
Dry Detention Ponds				

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2,139.01
PreDevelopment Area excluding Wetlands (ha):	2,139.01
Total PostDevelopment Area (ha):	2,139.01
Total Area treated by BMP's (ha):	1,266.07
Treated Area total:	1,266.07
Total PreDevelopment Load (kg/yr):	2,921.13
Total PostDevelopment Load (kg/yr):	1,610.96
Total P Load Reduction with BMP's (kg/yr):	607.19
Minimum P Load Reduction Required:	-1,310.17
Total PostDevelopment Load with BMP's (kg/yr)	1,003.77

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction